

11

SMOKE CONTROL

Ref.: BMC 23.10.045, IBC 909, NFPA 92A, 92B

11.01 Standards Established

11.01-1 **Scope.** The purpose of this standard is to clarify existing Code and City of Bellevue Fire Department requirements for the design, installation and acceptance testing of smoke control systems. This information is to supplement existing code requirements and does not cover all aspects. This section applies to active and/or passive smoke control systems, and includes shaft pressurization as well as zoned smoke control systems.

Design Approaches may include the Pressurization Method, Airflow Design Method, Exhaust Method, Passive Smoke Control and Performance Based Designs. All of these are defined in ICC standards. The objectives of such designs is to accomplish the following:

- (1) Contribute to the protection of life and to the reduction of property loss
- (2) Provide conditions outside the event zone that enable emergency response personnel to enter for rescue and fire-fighting operations
- (3) Maintain a tenable environment in smoke refuge areas and exit enclosures, and within the event zone when utilizing the exhaust method, for the required duration
- (4) Inhibit smoke from entering stairwells, smoke refuge areas, elevator shafts, or similar areas
- (5) Inhibit the migration of smoke from the event zone

11.01-2 **Smoke control (when required).** A smoke control system (including pressurization for smokeproof enclosures) meeting the requirements of Section 909 shall be provided in high rise buildings in accordance with IBC 403.13, and as required elsewhere in the IBC .

11.01-3 Smoke control and smoke management systems shall comply with the International Building Code, Section 909, and as determined by the Fire Department.

11.01-4 Generally accepted and well-established principles of engineering required by IBC Section 909.2 shall include NFPA 92A and 92B, Smoke Control Provisions of the 2003 IBC, an Interpretation and Applications Guide, Douglas H. Evans, P.E. and John H. Klote, D.Sc., P.E., 2005, International Code Council, Principles of Smoke Management, John H. Klote, D.Sc., P.E., and James A. Milke, Ph.D., P.E., 2002, American Society of Heating,

Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE) and Society of Fire Protection Engineers (SFPE) and Commissioning Smoke Control Systems, 1994, ASHRAE Guideline 5 – RA 2001, for design, installation, acceptance testing, periodic testing, and maintenance of engineered smoke control systems.

11.01-5 All smoke control system equipment shall be listed and labeled by Underwriters' Laboratories and/or approved by Factory Mutual or other listing agencies as approved by Fire Department Official. Interconnecting equipment that has not been listed for interconnection, or the creation of components or system into a nonstandard unit that is not normally available from the manufacturer is not acceptable.

11.01-6 All smoke control system equipment shall be installed in accordance with its listing and manufacturer's recommendations.

11.01-7 **Definitions**

End-to-End Verification. A self-testing method that provides positive confirmation that the desired result (e.g., airflow or damper position) has been achieved when a controlled device has been activated, such as during smoke control mode, testing, or manual override operations.

Pressurized Stairwells/Hoistways. A type of smoke-control approach in which stair shafts and elevator hoistways are mechanically pressurized, to establish prescribed pressure differentials with respect to the event zone, with outdoor air to keep smoke from contaminating them for a duration of at least 2hr.

Smoke-Control Mode. A predefined operational configuration of a system or device for the purpose of smoke control.

Smoke-Control System. An engineered system that utilizes a combination of passive barriers, mechanical equipment and automatic detection and/or suppression to inhibit smoke movement from the event zone to other smoke zones.

Dedicated Smoke-Control System. Smoke-control systems and components that are installed for the sole purpose of providing smoke control, and upon activation these systems operate specifically to perform the smoke-control function. They include components that do not function under normal building operating conditions, such as stair pressurization fans or smoke control dampers that operate specifically to perform the smoke control function upon smoke control system activation.

Nondedicated Smoke-Control Systems. Smoke-control systems and components that share components with some other system(s), such as the building HVAC system, and upon activation cause the HVAC system to change its mode of operation in order to achieve the smoke-control objectives.

Smoke-Control Zone. A space within a building enclosed by smoke barriers, including the top and bottom.

Zoned Smoke-Control System. A smoke-control system applying the Pressurization Method that includes a relative negative pressure for the event zone and a relative positive pressure for all contiguous smoke-control zones, in accordance with IBC 909.6.

Sandwich Method. A zoned smoke-control system that utilizes a combination of exhaust in the event zone and pressurization in contiguous smoke zones.

Event Zone. The smoke-control zone where the fire event is considered to originate.

Active Zone. A smoke-control zone that utilizes mechanical ventilation for smoke-control during smoke control mode to achieve design objectives.

Passive Zone. A smoke-control zone with no mechanical ventilation for smoke control.

Passive Sub-Zone. A space within an active smoke zone that is not provided with mechanical ventilation for smoke control. The passive sub-zone is not required to be separated by smoke barrier construction.

11.02 Design Approach

- 11.02-1 In buildings or occupancies that are required to be provided with smoke control, in accordance with IBC Section 106.3.4, BFD requires that the owner engage and designate design professionals to function as the architect of record, electrical engineer of record, and mechanical engineer of record for the building. Each of these individuals must be registered or licensed in their particular branch of engineering or architecture by the State of Washington in accordance with RCW 18.235, and will be responsible for the elements of the smoke control system in their area of responsibility. Appropriate certification must also be demonstrated by fire alarm and fire sprinkler system designers.
- 11.02-2 Where buildings include a smoke control system, a signed statement must be provided from each of the individuals identified in Section 11.02-1 stating that the designer has read the Detailed Design Report (*see Section 11.03-5*) and has incorporated it into their design, unless the design professional is the author of the report.
- 11.02-3 The statement described in Section 11.02-2 must be provided with designs submitted for approval that include systems serving smoke control functions, including initiation, control, monitoring, power, and equipment. Such design plans shall also bear the concise narrative description of the smoke control system for the building and any special requirements of the design, as described in Section 11.03-5.

- 11.02-4 Designs prepared in accordance with Section 11.02-3 must be reviewed by the author of the detailed design report and provided with a letter that the smoke control system design documents prepared by others comply with the smoke control design. This letter must be submitted for approval of the associated permit.
- 11.02-5 IBC 909.4.2 and 909.4.3 requires designs to incorporate the effect of outdoor temperature and wind. The detailed design report shall address the anticipated performance of the smoke control system under extreme climatic conditions and the presence of operable windows or doors. It is acceptable to utilize a computer model, such as the National Institute of Standards and Technology – Building and Fire Research Laboratory software program CONTAM for such analysis.
- 11.02-6 Control systems for mechanical smoke control systems shall include end-to-end verification, i.e. positive confirmation of actuation, testing, manual override and the presence of power downstream of all disconnects (See IBC 909.12). For smoke control fans, the override switch on the smoke control panel shall show a fault condition when the power disconnect switch for the fan is in the off position, and that a trouble condition must be sent to the fire alarm monitoring agency.
- 11.02-7 Automatic weekly self-tests shall be conducted and documented for smoke control systems (See IBC 909.12). Such testing must include positive confirmation of actuation. The fire alarm or smoke management panel shall exercise system components once per week and receive positive confirmation that the component operated properly. For fans, the self-test typically involves turning on the fan just long enough to bring them up to speed and receive positive confirmation of airflow. For dampers, the self-test typically involves cycling the damper into both the open and closed positions and receiving positive confirmation of each position via contact switches. The duration of the self-test shall be adequate to allow the system to detect a fault condition in the event an affected system component did not function properly. During the self-test, should any devices malfunction, a visible and audible signal shall be displayed at the Fire-fighter's smoke control panel, and a trouble signal shall be transmitted to the fire alarm monitoring agency. The self-test procedure and output shall be printed and maintained in the fire control room and accessible to inspection agencies.
- 11.02-8 Shaft pressurization shall be initiated upon activation of any monitored fire alarm device, including but not limited to manual pull stations, smoke/heat detection, sprinkler waterflow, etc.
- 11.02-9 Waterflow detection devices serving multiple smoke zones and manual pull stations may not be used to initiate smoke control systems (exception: shaft pressurization only) since the smoke zone of origin is unknown. Subsequent activation of an automatic fire alarm initiating device (i.e.

addressable smoke detector) within an active smoke control zone shall automatically configure the smoke control system appropriately.

- 11.02-10 The Fire-fighter's Smoke Control Panel (see Section 11.04) shall be the highest priority command such that all override switches are operational, whether or not the building fire alarm has been activated.
- 11.02-11 Smokeproof enclosure ventilation equipment, including shaft pressurization equipment, is required to be protected in accordance with IBC Section 909.20.6.1. This includes equipment power and control wiring as outlined in 11.07-1.
- 11.02-12 Smoke detectors used for activation of ventilating equipment in accordance with IBC Section 909.20.6 shall be located outside the smoke proof enclosure served. Where the conditions outside the smoke proof enclosure preclude the installation of a smoke detector, a smoke detector shall be located inside the smoke proof enclosure within 5 feet of each affected entrance.
- 11.02-13 Where mechanical garage ventilation occurs in a building with mechanical smoke control, the ventilation system shall operate at 100% in the event of an automatic fire alarm activation in the garage zone, unless the rational analysis requires a different action. When this ventilation system is not part of the building life safety system, emergency power is not required for this system, unless otherwise required (see Section 11.04-12.2).
- 11.02-14 Truck docks and similar facilities located in a building that is provided with smoke control may require special consideration. Such facilities are considered on a cases-by-case basis.
- 11.02-15 Loading docks. Smoke removal for the loading dock area within a building shall have a minimum exhaust volume of 10 air changes per hour and must be approved by the COB Fire Department. Fans for truck loading bays must be on emergency power.

11.03 Submittal Requirements

- 11.03-1 Submittal requirements shall be as described in this section, and the appropriate City of Bellevue description sheet (See Appendix):
Sheet 42A – Conceptual Smoke Control Submittal
Sheet 42B – Detailed Smoke Control Submittal
Sheet 42C – Smoke Control System Revisions
- 11.03-2 Where a rational analysis is required as described in IBC Section 909.4, it shall be prepared by a Professional Engineer competent in the design of smoke control systems. This includes providing support for the types of smoke control systems to be employed, their methods of operation, the systems supporting them and the methods of construction to be utilized.

- 11.03-3 A Conceptual Design Report must be submitted to provide a rational analysis, including general narrative description of the building and the smoke control methods and objectives that will be applied, as described in Sheet 42A. Calculations and computer modeling analysis need not be provided with the Conceptual Design Report.
- 11.03-4 A summary event matrix for the smoke control system shall be provided with the Conceptual Smoke Control Plans (42A).
- 11.03-5 The Conceptual Design Report and zone drawings shall be submitted in accordance with Sheet 42A and approved prior to issuance of the Building Permit (BB, BZ).
- 11.03-6 A Detailed Design Report shall be prepared as described in Sheet 42B or C. This report shall be based on the Conceptual Design Report and provide a rational analysis in accordance with IBC Sections 909.2 and 909.4. The report shall be provided as a bound document, independent of design plans.
- 11.03-7 The architect of record must prepare smoke zone plans, with an appropriate legend showing the locations of all required smoke barriers as outlined in the detailed design report and described in Sheet 42B or C. Such plans must be of microfilm quality.
- 11.03-8 The architect, engineer of record, author of the detailed design report, or special inspector shall prepare a Acceptance Test Procedure (ATP) in accordance with IBC Section 909.3 and Sheet 42B or C that will be submitted to the City of Bellevue for review and approval with the smoke control (FH) permit. The ATP shall be provided as a bound document, independent of the design plans and detailed design report.
- 11.03-9 A detailed event matrix that includes every fire alarm and smoke control initiating device down one column, and every fire alarm notification device (by zone), every smoke control device (i.e. fans, dampers, etc.), and every other event that must occur in order for proper operation of the smoke control system (i.e. HVAC shutdown, etc.) across the top. With prior approval, some devices may be combined.
- 11.03-10 The proposed layout of the Fire-fighter's Smoke Control Panel (FSCP) for smoke control override in accordance with IBC Section 909.16 must be included with fire alarm submittals that add, alter or replace a FSCP. A full-scale color representation of the FSCP must be submitted for final approval. See Section 11.04 for details.
- 11.03-11 Approved control diagrams must be kept accessible in the Fire Control Room for the life of the building and must be updated when changes are made to the building.

11.04 Fire-fighter's Smoke Control Panel (FSCP)

- 11.04-1 The Fire-fighter's Smoke Control Panel is a system that provides graphical monitoring and manual overriding capability over smoke-control systems and equipment at designated locations(s) within the building for the use of the fire department. This is also referred to as the Fire Fighters' Smoke-Control Station (FSCS) in NFPA 92A.
- 11.04-2 A FSCP is required for Fire Department emergency response purposes. The FSCP shall have the highest priority control over all smoke-control systems and equipment, whether or not the Automatic Fire Alarm System has been activated. The panel shall be designed to enable Fire Department personnel who may be unfamiliar with the specific system the ability to reconfigure the status of each smoke zone as deemed necessary during an emergency.
- 11.04-3 This panel shall be in accordance with IBC Sections 909.12 and 909.16, and incorporate BFD standards listed in this section.
- 11.04-4 The smoke control panel shall consist of a white background and generally depict significant smoke barriers (i.e. floors, shaft walls, exterior walls) by single black lines, appearing as a general section view of the building. The image shall sufficiently illustrate all smoke zones in the building without providing the level of detail common to architectural elevation or section views. Large smoke zones, such as atria or interconnected garage levels, shall be surrounded with a color-coded bold line. In general, garage zones shall be bounded by an orange line, atria by a purple line.
- 11.04-5 Devices, switches, indicators and the like shall bear plain English identification as to its function. All text shall be on contrasting background with a minimum size and stroke equivalent to 12-point bold Sans Serif font (such as Helvetica). Marking pens and self adhesive label makers are not accepted for identification.
- 11.04-6 Where pilot type lamp indicators are required, Light Emitting Diodes (LED's) may be used.
- 11.04-7 The general location of each smoke control system component, including fans, ducts and dampers, that is controlled or annunciated by the panel shall be depicted on the panel.
- 11.04-8 Where the smoke control system utilizes the pressurization method of IBC Section 909.6, to the extent practicable, the exhaust equipment shall be located on the left side of the building image and supply equipment located on the right side.
- 11.04-9 Fans, major ducts, dampers, stairwells, shafts and zoning within the building that are portions of the smoke control system shall be shown

connected to their respective ducts or dedicated fans with clear indication of direction of airflow. The indication and direction of air movement shall be shown with arrows of the following colors:

- (1) Smokeproof enclosure supply air: BLUE
- (2) Building exhaust shafts: RED
- (3) Building supply air: GREEN

- 11.04-10 Smoke control system indicator colors shall be provided in accordance with IBC Section 909.16.1 and as outlined below.
- 11.04-10.1 A single white indicator shall be provided and labeled "SYSTEM NORMAL," in accordance with Section 909.16.1-1. This indicator shall be illuminated at all times monitored equipment is in normal status and all switches are in the Auto position. Illumination of this lamp shall be in addition to the indication of the status of each component.
- 11.04-10.2 Indicators as required by IBC Sections 909.16.1-2 through 909.16.1-4 shall be individually provided for each monitored piece of equipment. Where specifically approved by the BFD, such indicators may be combined to represent the cumulative condition of monitored components within a zone.
- 11.04-11 Control capability provided in accordance with IBC Section 909.16.2 for each smoke zone utilizing the pressurization method of IBC Section 909.6 shall be via a single 4-position switch. Settings for this switch shall be in the following sequence: CLOSED / EXHAUST / AUTO / PRESSURE. When approved, superfluous positions may be eliminated if the smoke control system is not provided with such control in a zone.
- 11.04-11.1 The CLOSED position shall automatically close/shut-down the components within a zone, isolating that zone from all adjacent smoke zones.
- 11.04-11.2 The EXHAUST position shall automatically posture the components within that zone, to create a negative pressure within the zone.
- 11.04-11.3 The AUTO position shall be configured in accordance with IBC 909.16.3 (2).
- 11.04-11.4 The PRESSURE position shall automatically posture the components within that zone to create a positive pressure within the zone.
- 11.04-12 Garage Control. A single 3 position switch shall be provided to operate the garage fans, where provided. Settings for this switch shall be in the following sequence: GARAGE FANS ON / AUTO /OFF. Monitoring of

garage system status shall be provided only if components are provided with emergency power.

- 11.04-12.1 The GARAGE FANS ON position shall serve to automatically posture the components of both the supply and exhaust system fans to on.
 - 11.04-12.2 The AUTO position shall be the normal operating position of the components. If the fire alarm system in the garage zone is in alarm the system shall automatically posture the components of both the supply and exhaust system fans to on
 - 11.04-12.3 The OFF position shall serve to automatically posture the components of both the supply and exhaust system fans to off.
- 11.04-13 Where multiple fans intended to operate simultaneously in smoke control mode serve a single smoke zone, a single switch shall be provided for simultaneous control of all associated fans. However, indication of each individual fan unit is required (*see Section 11.04-10.2*).
- 11.04-13.1 Each zone shall be provided with a red smoke alarm indicator labeled AREA SMOKE (initiated by area smoke detection) and red waterflow alarm indicator labeled WATERFLOW (initiated by automatic sprinkler protection waterflow). The appropriate indicator shall be illuminated upon initiation of the respective alarm in the zone. Where multiple zones exist on a floor, the zone of alarm shall be clearly depicted on the panel. If required for clarity, such alarm zones shall be shown in a plan view of the floor on the smoke control panel.
 - 11.04-13.2 The duct detector and power disconnect for pressurization fans shall have it's indication located near the fan depiction. Power disconnect are to be yellow/amber. Smoke detection shall be red indicator.
 - 11.04-13.3 The panel shall be provided with a list in the upper right corner of the panel of all possible and potential initiating device categories as appropriate, including: AREA SMOKE, DUCT DETECTOR, WATERFLOW, SPECIAL SYSTEM, HEAT DETECTOR, MANUAL STATION, POWER DISCONNECT. Each category shall be provided with a red indicator. The respective indicator is to be illuminated upon such an alarm event in the building.
- 11.04-14 A single switch shall be provided on the panel to unlock all locking doors in accordance with IBC 403.12 and IBC Chapter 10. The switch shall be provided in the lower right corner of the panel.
- 11.04-15 Identification shall be provided to denote zones where standpipe connections are equipped with pressure-reducing valves (PRV).

11.05 Smoke Control Record Documents

11.05-1. The following items must be maintained current in the fire control room or other approved location for the life of the building: Items one and two must be submitted to and approved by BFD prior to the start of special inspections.

1. Plans showing the devices and equipment which make up the smoke control system. This should include all smoke barriers, applicable initiating devices, controllers, fire alarm control panel, fire-fighter's smoke control panel, facility temperature controls, control wiring or tubing, isolation valves, relays, doors, dampers, fans, all supervision devices.

2. Every device must have a distinct identifying address. For purposes of this requirement, the Fire Department will accept the detailed design drawings, provided all of the devices listed above are shown, and no extraneous equipment other than fire alarm devices.

3. A detailed event matrix (each device must be identified by individual address exactly as it is shown on the control diagram plans above);

4. Documents describing the proper operation and maintenance requirements of each component of the smoke control system, including fan curves for the smoke control fans in the building.

5. Maintenance logs and quarterly testing logs;

6. The approved smoke control report;

7. UUKL panel self-test printouts;

8. The final special inspection report.

11.05-2. Changes as a result of final installation, testing, or a change to the system design must be documented in the special inspection report, prepared in accordance with IBC Section 909.18.8.3. Record drawings shall include an accurate depiction of risers, raceway, conduit, all wire runs, cable identification, conduit size, location of junction boxes, terminal boxes, sources of power, devices, sensors, equipment, controlled equipment (motor starters, fans, pumps, valves, dampers, etc.).

11.06 Wiring

Ref.: IBC 909, NEC- 700, NFPA 110

11.06-1 Stairwell and elevator hoistway pressurization equipment, control and power wiring, etc. are considered part of the emergency system and must comply with Article 700 of the National Electrical Code (NFPA 70-05). This includes the related control devices, power supplies, power and control wiring, and all associated electrical equipment. In addition to the

requirements in the NEC, in particular 700.9 (C), all portions of the shaft pressurization system are required to comply with IBC Section 909, including 909.20.6.1. Rooftop penthouses are considered part of the building. Protection of wiring and control systems located inside the building must extend from the emergency source of power to the protected devices or equipment.

Bellevue Fire would deem the following designs to comply with the above integrity and survivability requirements. These are not the only methods of meeting the survivability requirements. The additional requirements of IBC 909 and NEC 700 must be complied with, including protecting the remaining equipment and ductwork by 2-hour fire-resistance-rated barriers.

1. **Concrete Cover:** Wiring shall be located within concrete slabs and walls when covered with a minimum of 2" of concrete.
2. **Dedicated Shaft/Enclosure Method:** Wiring shall be located in a separate, dedicated 2-hour fire-resistance-rated (FRR) enclosure.
3. **2hr. Wiring:** The use of 2hr FRR wiring in conduit protected by automatic sprinklers and against vandalism and other adverse effects including falling equipment or debris. This can typically be achieved by securing conduit tight to building structural elements.
4. **Electrical Room Separation Method:** When smokeproof enclosure pressurization/ventilation power and control wiring is located within a 2-hour FRR electrical room, the emergency power supply (panel and associated raceway or busway) shall be separated by a 2-hour FRR fire barrier from the other systems within the room, on all levels.
5. **Stairwell/Elevator Shaft Method:** Wiring shall be located within the 2hr FRR stairwell it is servicing, (or possibly elevator shafts if L&I will allow), when routed such that it is adequately protected against vandalism and other adverse effects including falling equipment or debris and in accordance with IBC Chapter 7. This can typically be achieved by securing conduit tight to building structural elements.
6. **Fire Alarm Controlled Method:** When smokeproof enclosure pressurization/ventilation equipment is controlled by the fire alarm system, the power wiring will be allowed to be located in the 2-hour FRR fire alarm shaft. Panels, cabinets, etc., are not allowed to be placed in the shaft, only conductors.

Design proposals that do not conform to one, or a combination of the above methods will require submittal of an alternate materials, design and methods proposal. Alternate materials, design and methods of construction and equipment may be presented for review and approval by the Fire Marshal and Building Official. Any such proposal that does not comply with the above design methods, must demonstrate compliance with the provisions of NEC 700.9 (C) and IBC 909.1.

- 11.06-2 The chosen method of conductor protection shall be depicted and described on associated electrical, architectural and fire alarm drawings.
- 11.06-3 All wiring shall be fully enclosed within continuous raceways. (IBC 909.12.1).
- 11.06-4 The emergency generator and transfer switches shall be in a separate room from the normal power transformers and switch gear. The rooms must feature 2hr fire resistance rated construction. (Ref. IBC 403.10, IBC 909.11, NFPA 110- 7.2).
- 11.06-5 Smoke Control wiring and pressurization system wiring may be commingled with other emergency circuits in accordance with Article 700 of the NEC. The survivability requirements outlined in 11.06-1 must be complied with.
- 11.06-6 All junction boxes and covers for the smoke control system shall be externally identifiable. Smoke control boxes are to be orange, covers are to be orange with yellow diagonal strip. Fire alarm boxes are to be red, covers are to be red also. (NEC 700.9 (A)).
- 11.06-7 All initiating and monitoring circuits devices shall be labeled.
- 11.06-8 The requirements for the primary power supply shall apply to all auxiliary panels and equipment. These shall include: A dedicated circuit, marked at the electric panels location and the smoke control panel or auxiliary panels locations. All primary power conductors shall be physically protected.
- 11.06-9 When the fire-fighter's smoke control panel is located in an area that is not continuously occupied a smoke detector shall be provided within 15 feet of the panel. (Measured horizontally) This applies to all auxiliary panels and equipment that may be located remote from the FSCS. When ambient conditions will not allow the use of smoke detectors a heat detector may be used.
- 11.06-10 Signaling Line Circuits or other data control circuits shall be arranged so that a short, ground or open within a smoke zone will not cause the loss of initiating devices, monitoring devices or building control devices in any other smoke zone of the protected premises. A zone shall indicate stairwells and shafts, a floor, or area of a floor designed as a smoke compartment.

11.07 Acceptance Testing

Ref.: IBC 909.18

- 11.07-1 Each smoke control system shall be inspected and tested in accordance with IFC 909.10 through 909.19, Chapter 8 of NFPA 92A and ASHRAE

Guideline 5. In particular, the following is a partial list of items that must be tested:

- Power systems shall automatically transfer to full standby power within 10 seconds of failure of the primary power per COB Ordinance.
- Smoke Barrier construction shall be evaluated in accordance with IBC Section 909.5 requirements.
- The pressure difference across door shall not exceed a 30-pound force to set the door in motion in accordance with IBC Section 1008.1.2.
- Each automatic initiation device shall be tested in accordance with IBC 909.18.7.
- Pressurized shafts shall have a positive pressure relative to the building, including where a shaft opening exists to a pressurized zone, measured with all stairway doors closed under maximum anticipated stack pressures.

11.07-2 Acceptance testing shall be performed in accordance with IBC Section 909.18, the Acceptance Test Procedure (ATP) and as described in this section.

11.07-3 A written Acceptance Test Procedure (ATP) to demonstrate and certify proper system operation shall be prepared by the SI/SIA and submitted to the Building and Fire Department for approval prior to the performance of the ATP. As a minimum, the ATP shall provide a detailed method of testing and documenting the following to demonstrate to the AHJ that the electrical components of the smoke control system functions as intended by the design.

11.07-4 The initial test shall be a preliminary test, which will be conducted by the contractor and witnessed by the S/I-SIA. The installer and a trained technician for the FSCP shall be present for all testing.

11.07-5 The City of Bellevue does not certify or list special inspection agencies (SIA) or special inspectors (S/I). In general, the qualifications for special inspector are described in Section 11.07-5.1-4.

11.07-5.1 The SIA must have the minimum qualifications required by IBC Section 909.18.8.2. This agency may be comprised of multiple parties, each with one or all of the stated qualifications.

11.07-5.2 The party serving as the S/I shall be a Professional Engineer (P.E.) with the qualifications of IBC Section 909.18.8.2, or a P.E. with smoke management commissioning experience may serve as the S/I to coordinate and verify all components of the smoke-control system within his or her area of expertise. The P.E. who prepared the rational analysis and Detailed Design Report may serve as the S/I.

- 11.07-5.3 The vender, or a technician certified by the vendor, shall design, supervise, program and commission the installed system controls. The installing contractors shall perform the testing of the system that they installed, which shall be witnessed by the special inspector. The vendor, technician, or installing contractor cannot serve as the S/I.
- 11.07-5.4 All flow and pressure testing must be done by an approved Associated Air Balance Council or National Environmental Balancing Bureau agency. If this company is hired by the installing contractor, the S/I must witness all required special inspection testing.
- 11.07-6 Ongoing records of inspection described in 1704.1.2 shall be maintained in the FCC or other approved location for review upon request by the City of Bellevue as described below:
- 11.07-6.1 Ongoing records shall minimally serve to document the date of each inspection, the focus of each inspection, and the results.
- 11.07-6.2 Elements of the smoke control system found to not conform to the detailed design report or testing program shall be clearly identified as to what the issue is, the date it is discovered, how it was resolved and the date it is resolved (if applicable).
- 11.07-7 The special inspection agency must be provided with the approved smoke control report, the ATP, the control diagrams (*see Section 11.06*), and the approved smoke control permit plans.

11.08 System Commissioning

Ref.: IBC 909.19

- 11.08-1 Commissioning acceptance testing shall be completed in accordance with Section 11.05 above.
- 11.08-2 Prior to system commissioning by the City of Bellevue, a report shall be provided as described in IFC Section 909.18.8.3.1. This report shall also identify any remaining system deficiencies.
- 11.08-3 The S/I-SIA will arrange for system commissioning by the Bellevue Fire Department, Fire Prevention Division, to include witnessing a final contractor executed operational and performance test of the system. An air balance contractor must be present to provide measurement of pressure differentials and airflow, as appropriate. The ATP shall be referenced with regard to methodology for testing selected system components and features. All testing shall be conducted in accordance with approved standards by appropriate party, and observed by Fire Inspector.

11.08-4 Pressurization Methods (IBC Sections 909.6, 909.6.3 or 909.20): For a smoke control system serving a typical high-rise tower, the testing must demonstrate proper system operation and performance in no fewer than 3 smoke zones and a minimum of 10% of the building's smoke zones. Smoke zones will be selected at the Fire Inspector's discretion, and are generally intended to evaluate conditions at or near the bottom, middle and top of a tower; every pressurized shaft shall be evaluated. Proper system function is demonstrated by achieving stated performance criteria. Smoke control system features to be evaluated during system commissioning include:

1. Visual observation of elements described in Sections 11.04 and 11.06 above, including proper annunciation of system normal status, except for deficiencies identified with Section 11.08-02 above, and system configuration upon testing of select smoke-control zones.
2. Visual observation of smoke barriers in select smoke-control zones for absence of obvious deficiencies.
3. Proper function of smoke control system in select smoke-control zones, including a minimum of 1 of each initiating device serving the zone (i.e. smoke detector, waterflow switch, manual station) and sequence of operation. Required pressure differentials across smoke barriers and maximum door opening forces must be demonstrated.
4. Manual control of smoke control system equipment serving select smoke-control zones shall be demonstrated.
5. Proper function of any smoke control fan equipment via automatic initiation and manual control if not observed during evaluation of select smoke-control zones.

11.08-5 Exhaust or Airflow Method (IFC 909.8 or 909.7): Atria or other spaces utilizing the exhaust and/or airflow method, the testing must demonstrate proper system operation and performance of 100% of the smoke control equipment. Smoke control system features to be evaluated during system commissioning include:

1. Visual observation of elements described in Sections 11.04 and 11.06 above, including proper annunciation of system normal status, except for deficiencies identified with Section 11.08-02 above, and system configuration upon testing of smoke-control zones.
2. Visual inspection of associated smoke barriers for absence of obvious deficiencies.
3. Proper function of smoke control system, including a minimum of 1 of each initiating device (i.e. smoke detector, waterflow switch, manual station) and sequence of operation. It shall be demonstrated that airflow toward the fire does not exceed 200 feet per minute, per IFC Sections 909.7.2 and 909.8.1.

4. Manual control of smoke control system equipment shall be demonstrated.

11.08-6 Other smoke control systems or features shall be evaluated as requested by the Fire Inspector based on the approved design and installed condition to demonstrate proper operation of the smoke control system and features.

11.08-7 Testing involving chemical smoke or a tracer gas may be required if a concern exists regarding the potential for smoke feedback into supply air, such as when an inlet is located near an exhaust outlet.

11.08-8 If any smoke control system deficiency not identified as described in Section 11.08-2 above is discovered during system commissioning, system commissioning may be ceased at the Fire Inspector's discretion until such time as testing in accordance with Section 11.05 above can be repeated as necessary to resolve the deficiency, and a revised report is submitted in accordance with Section 11.08-2 above.

11.09 Periodic Testing

Ref.: IFC 909.21

11.09-1 The routine maintenance and operational program described in IFC Section 909.21.1 shall be stored with the materials identified in Section 11.05-1. Periodic testing shall reference these materials. If required documents are not present, they shall be developed for approval in accordance with Information Sheet 42C.

11.09-2 The written record described in IFC Section 909.21.2 shall be maintained with the routine maintenance and operational program in reverse chronological order, beginning with the most recent completed report. The record shall minimally include copies of completed BFD Smoke Control System Confidence Test Report forms together with the associated Cover Sheet.

11.09-3 Periodic testing shall be performed by qualified service technicians who are familiar with the proper operation of the smoke control system and equipment. Periodic testing involves manipulation of FSCP manual override controls; care must be exercised to avoid creating conditions harmful to life or property. The intent of this testing is to ensure that the system will function as designed during an emergency, not to challenge the integrity of the system.

11.09-4 Operational testing associated with periodic testing need not include the measurement of pressure differentials or airflow quantities. Pressure differentials and airflow quantities shall be observed as required for Performance Testing. Performance Testing shall be performed in accordance with the ATP based on the Detailed Design Report. If these

documents are not present, they shall be developed by the S/I-SIA for approval in accordance with Information Sheet 42C.

- 11.09-5 City of Bellevue Fire Department standard Fire Protection System Confidence Test Report Cover Sheet and Test Report Form shall be completed and submitted for each Operational or Performance Test.
- 11.09-6 Operational Testing of smoke control systems for “each control sequence,” shall minimally include the following:
1. System activation by manual control via FSCP while the system is in normal status; may result in transmission of trouble signal to FACP.
 2. Trouble signal transmitted to FACP when FSCP manual control set to Off or Closed position while system is in normal status.
 3. System operation by automatic means via a minimum of 1 of each type of initiating device (i.e. smoke detector, waterflow switch, manual station) and sequence of operation serving each smoke-control zone.
 4. Manual control via FSCP when system is active to activate inactive system components and disable active system components. Manipulation of the system to achieve each possible combination of switch configurations need not be demonstrated. However, proper manual override capability shall be demonstrated for each switch.
 5. Return all override switches to their "Auto" position.
- 11.09-7 Where testing would result in the repeated start and stop of large fans, such fans may be disabled or bypassed provided that verification that the proper system output to the fans is transmitted during testing while the FSCP is constantly attended. Proper operation of disabled equipment shall be restored and demonstrated upon receipt of an actual alarm event, or at the conclusion of the testing period, whichever occurs first.
- 11.09-8 Performance Testing shall be conducted in accordance with applicable sections of the ATP and Section 11.05-8 by a qualified individual as described in Section 11.09-6 and witnessed by a S/I-SIA as described in 11.08.4. Periodic Performance Testing shall occur as follows:
1. For each building or tower with a pressurization system or pressurized shafts, conduct Performance Tests, including observations and measurements of all aspects of the smoke control system, as described in Section 11-08.4 Items 1 through 5, at a minimum of 3 locations: a smoke control zone in the lower third, a floor in the middle third and a floor in the upper third of the building and/or tower served by each shaft. Performance Tests in

subsequent years shall be conducted on previously untested floors, as is practical so that all floors ultimately are tested in a cycle.

2. For each exhaust or airflow system, conduct Performance Tests, including observations and measurements of all aspects of the smoke control system, as described in Section 11-08.5 Items 1 through 4.
3. For all other systems, conduct Performance Tests, observations and measurements of all aspects of the smoke control system at a minimum number of locations to demonstrate proper performance as approved by the Department and Fire Department. Each test shall attempt to involve as many different fan systems as practical. Performance tests in subsequent years shall be conducted on previously untested locations, as is practical so that all locations ultimately are tested.
4. For each sequence of operations, visually confirm that controlled components in associated active zones have assumed the correct operating condition for the type of alarm initiating device and the location of initiating device. Proper annunciation shall be confirmed also at the FSCP.
5. Manually override the operation of a sampling of fans and/or dampers during each test, taking care not to damage system components.
6. During at least one test, for buildings requiring elevator recall, confirm that the elevators return to the designated return floor and perform as required.
7. Return all override switches to their "Auto" position.
8. S/I-SIA shall immediately notify the City of Bellevue in writing and call 425-452-6872 weekdays (except holidays) from 8 am to 5 pm, or 911 outside these hours, whenever it is determined that a smoke control component or system is inoperable and is creating a life threatening situation.
9. The S/I-SIA shall give written notice to the owner of any deficient or non-complying smoke control system feature that is discovered is not corrected prior to the end of the day. All deficient or non-complying aspects shall be corrected.

11.09-9

S/I-SIA shall submit a Confidence Test Report to address the results of Performance Testing within 30 days of completion of the testing or date that a deficiency or non-complying condition, which has not been corrected, was discovered. The Confidence Test Report shall clearly identify any unresolved issues, and include:

1. Executive Summary of smoke control design methodology
2. Documents Reviewed
3. Passing Criteria

4. Testing Scenarios
5. Inspection and Testing Report
6. Statement of Compliance

- 11.09-10 Dampers controlled by the smoke control system, whether monitored by the FSCP or not, shall be visually inspected and maintained a minimum of every 4 years in accordance with NFPA 90A and the manufacturer's recommendation.
- 11.09-11 Fire alarm system testing may coincide with periodic testing, except that each dedicated smoke control system component shall be manually exercised at least semiannually.

CONCEPTUAL SMOKE CONTROL SUBMITTAL

07/11/07

The city may require additional information as needed. For preparation information, see description sheet # 1, *Standards for Plans and Drawings*. If you have any questions concerning your application, please visit or call Permit Processing (425-452-6800) between 8 a.m. and 4 p.m., Monday through Friday (Wednesday, 10 to 4). Assistance for the hearing impaired: dial 711 (Telecommunications Relay Service).

Because of the complexity of smoke control systems, it is important that design documents incorporate the conceptual smoke control approach as early as possible during the design process.

Locations that may require smoke control systems include (IBC 2006 reference):

- Pressurized Shafts/Smokeproof Enclosures(1020.1.7)
- Underground Buildings (405.5)
- Windowless Buildings (408.8)
- Covered Mall Buildings (402.9)
- High-rise Buildings (403.13)
- Building Atriums (404.4)
- Stages and Platforms (410.3.7.2)
- Assembly Seating (1025.6.2.1)

To apply for the building or TI permit where smoke control/shaft pressurization is provided, documentation consisting of the following is required: *Submit 1 set*

A Conceptual Design Report must be prepared by a Professional Engineer competent in the design of smoke control systems and accompanied by current architectural background drawings and Smoke Zone Plans. The report must include, where applicable:

1. A general narrative description of the building and smoke zones, with attention to height, area, layout, use, ambient conditions, and other fire protection systems.
2. Smoke Zone Plans at a legible scale (these may be part of the drawing set) identifying smoke zone boundaries and smoke barrier locations. Depict the smoke control approach for each space, such as active (indicate mechanical supply and/or exhaust capability), passive (indicate if vents are provided), or sub-zones (spaces not constructed as a smoke compartment and not provided with smoke control).
3. A corresponding description of each space identified on the Smoke Zone Plans, in sufficient detail to describe the smoke control method for each space and how it would be initiated.
4. System performance goals and design objectives, including general testing criteria.
5. Specific performance criteria to be evaluated for each zone.
6. Location of fire-fighter's smoke control panel.
7. Description of the 2-hour protection of pressurization fan wiring, equipment and ductwork.
8. Identification of spaces where computer modeling is planned.
9. Identified design constraints.
10. Design basis fire(s) and locations.
11. Tenability criteria.

Conceptual design documents need not include calculations or detailed control diagrams, but must generally identify every smoke zone in the building and the smoke control approach for each zone. Approved smoke control approaches are described in City of Bellevue Fire Department Development Standards (BFDDS), Chapter 11-Smoke Control.

Approval of the Conceptual Design Report **does not** constitute approval of the smoke control system. Where required, a smoke control permit must be obtained as described in City of Bellevue Submittal Requirements Guide 42b (formerly Guide 42).

Remodeling or tenant improvement (TI) projects that affect the performance of an **existing** smoke control system, or require the addition of a smoke control system, must satisfy the conditions described in this guide, 42a.

Where a **new** smoke control system is required, see Guide 42b (formerly Guide 42).

If **revisions to an existing** smoke control system are required, see Guide 42c (formerly Guide 42).

Detailed Smoke Control Submittal

07/11/07

The city may require additional information as needed. For preparation information, see description sheet # 1, *Standards for Plans and Drawings*. If you have any questions concerning your application, please visit or call Permit Processing (425-452-6800) between 8 a.m. and 4 p.m., Monday through Friday (Wednesday, 10 to 4). Assistance for the hearing impaired: dial 711 (Telecommunications Relay Service).

Because of the complexity of smoke control systems, it is important that the design documents clearly identify the expected performance of the system. These documents must also clearly identify the expected performance of *each component* in the smoke control system. Components include all passive and active elements that work together to provide smoke control in accordance with International Building Code (IBC) Section 909.

To more clearly identify the systems involved on design plans, the background systems and floor plans should be in light line weight, with the pertinent systems in heavy line weight. Smoke control system component drawings shall be submitted on current architectural backgrounds.

To obtain the smoke control permit, documentation containing the following details/ specifications is required: *Submit 1 set*

1. A Detailed Design Report, based on the Conceptual Design Report, including the smoke control system rational analysis, must be prepared by a Professional Engineer competent in the design of smoke control systems. This rational analysis must be stamped by the Professional Engineer. The Detailed Design Report must be a bound document, independent of design plans, and minimally address the following:
 - a. General narrative description of the building. This description will include identification of building uses and occupancies as well as passive and active fire protection features that will work together with the smoke control system.
 - b. Narrative description of each passive and active smoke zone. Every space in a building requiring smoke control must be identified as an active or passive smoke zone, with measurable performance criteria identified.
 - c. Description of which methods will be used for each active smoke-control zone, and supporting rational analysis in accordance with IBC Section 909.4. This description will include such items as minimum required fan size, expected fire loads, ceiling heights, computer modeling, calculations, locations of operable windows and/or doors, etc.
 - d. Specific discussion of how smoke control will be initiated in each zone and the associated system responses. Provide a simple and clear event matrix.
 - e. Calculations associated with the smoke control system design and fan capacities.
 - f. Identification of the anticipated system performance, especially with regard to pressurized stairwells/hoistways, during stack effect conditions. Provide calculations demonstrating minimum and maximum pressure differentials to be observed during and in the absence of any stack effect.
 - g. Description of smoke dampers and fire/smoke dampers, including which dampers will be supervised for damper position, the position of unsupervised dampers when smoke control system is active, damper positions upon loss of power, actuation temperature of fire and fire/smoke dampers.
 - h. Identification of coordinated zones for sprinkler and fire alarm systems with regard to smoke control zones.
 - i. Identification of where variable frequency drives are to be used for smoke control equipment and method of control.

- j. The piston effect of elevators.
 - k. Description of fire modeling or other performance-based analysis utilized in the design of the smoke control system. The purpose of the analysis as well as associated assumptions and conclusions must be clearly identified.
 - l. Any related material that supports the design of the smoke control system.
 - m. The signature and stamp of the professional engineer responsible for the rational analysis.
2. The author of the Detailed Design Report must create a concise narrative description of the smoke control system for the building and any special requirements of the design. This description will be required to be on every set of associated design plans and be shown on future tenant improvement drawings for the life of the building as described in Sheet 42c. This description must include a non-infringement statement that the engineers and architects preparing plans must sign stating that the designer has read and complied with the smoke control report prepared for that building (include author and date).
 3. A detailed event matrix that includes every fire alarm and smoke control initiating device by address down one column, and every fire alarm notification device (by zone), every smoke control device (i.e. fans, dampers, etc.), and every other event that must occur in order for proper operation of the smoke control system (i.e, HVAC shutdown, etc.) across the top; with prior approval, some devices may be combined.
 4. The following drawings must be included:
 - a. Smoke control zone drawings.
 - b. Drawings depicting the fire rating of associated smoke barriers.
 - c. Drawings demonstrating pressurization control and power wiring routing and protection.
 - d. Drawings demonstrating fire alarm wiring routing and protection.
 - e. Smoke control mechanical equipment and ductwork drawings.
 5. The submittal for each associated permit—including architectural, mechanical, electrical, fire alarm, and fire sprinkler plans—are not required to be submitted with the smoke control application. However, each of these associated permit applications must include the following:
 - a. Clear identification where passive zones and active zones are provided.
 - b. Identification of the smoke zone boundaries. These boundaries are required to be constructed as smoke barriers and must be appropriately identified in the architectural plan set.
 - c. The concise narrative description of the smoke control system for the building and any special requirements of the design.
 - d. A letter prepared by each designer stating that their design satisfies the requirements of the smoke control system.
 6. An Acceptance Testing Program (ATP) must be submitted with the smoke control permit in accordance with IBC Section 909.3, and as described in City of Bellevue Fire Department Development Standards, Chapter 11. The architect, engineer of record or special inspector must prepare the ATP as a bound document, independent of the design plans and smoke control report, and minimally address the following:
 - a. Qualifications of the special inspector and special inspection agency.
 - b. Summary of the testing to be performed, including a general description of each smoke control component and zone to be evaluated, and the applicable performance criteria as identified in the smoke control report and IBC Section 909.18.
 - c. If testing will occur in absence of stack effect (with similar interior and exterior temperatures) the ATP must identify the range of acceptable test pressures to ensure system pressures will be maintained in the presence of anticipated stack effect.
 - d. Method of testing of passive barriers, such as door fan testing. The special inspection program must include the random testing of an approved percentage or quantity and distribution of passive smoke zones. Where multiple passive zones exist on multiple floors, such as residential units, a minimum of 1 unit per floor and a maximum of 10 percent per floor must be evaluated, whichever is greater, unless otherwise approved.
 - e. Provide representative test forms and inspection reports that will be used.

f. Anticipated testing schedule, minimally addressing IBC Section 909.18.8.1.

To apply for permits for associated systems (mechanical, electrical, building, fire alarm, sprinkler), required documentation for those permits must also include the following details/specifications:

1. The Architect of Record, Mechanical and Electrical Engineers of Record, and fire alarm and sprinkler system designers for the project must sign the smoke control system design documents that they prepared. If the rational analysis was prepared by another party, each designer must provide written documentation that they have read and incorporated the rational analysis in their design, such as by a written statement on the record drawings.
2. The author of the Detailed Design Report must review design documents pertaining to the smoke control system when prepared by others and provide a letter identifying that the design complies with the smoke control system requirements.
3. Fire alarm and mechanical plans must include identification of the location and address of all devices that will initiate smoke control, components associated with the smoke control process (including actuators, control dampers, fire and smoke dampers, variable air volume controls, and fans), and associated system responses/configurations.
4. When applicable, design submittals must include the sequence of operations (including timing, if necessary, to provide for proper door operation or prevent duct implosion or explosion) and the positioning of each damper for every fire scenario.
5. Sprinkler plans must demonstrate that sprinkler zones are coordinated with smoke zones.
6. Mechanical plans must provide capacities of each smoke control fan—including applicable calculations for the number of belts and the operating exhaust temperature—and must identify equipment locations with inlet and outlets clearly identified and separated.
7. Control diagrams must be provided as referenced by IBC Section 909.15.
8. Provide seismic anchorage of critical systems and include the design with the associated design submittal, as appropriate (IBC Section 403.14).
9. Provide the location and design of the emergency generator and transfer switch rooms per IBC Section 909.11 on the architectural and electrical plans, and identify 2-hour fire-rated separation of power wiring to equipment serving smoke proof enclosures. The 2-hour fire-rated protection of wiring must also be shown on the Fire Alarm plans.
10. Electrical plans must provide generator sizing and minimum run time of the generator for evacuation purposes. Demonstrate 2-hour protection of wiring controlling/powering fans serving smoke proof enclosures.
11. Provide electrical loads of the individual equipment associated with the smoke control system and associated generator sizing with the electrical plans.
12. For final approval, Fire-fighter's Smoke Control Panel must be submitted in color at full-scale for Fire Department review with the fire alarm plans.

Requirements for Electrical Smoke Control Plans for New Installations:

This list is meant to be a guide to the information needed for an electrical smoke control plan review. All the information may not be needed for every job but should be customized to fit the particular job encountered. This may not be a complete list but is designed to help the submitter provide the information needed. The smoke control plans should be able to “stand on their own” and should not require the reviewer or inspector to refer to any other plans or information that may have been previously submitted.

1. Plans designated as “Smoke Control System” to differentiate them from any other plans for that job or project.

2. Panel schedule (industry standard type) for the emergency panel with connected and demand loads.
3. Schedule of smoke control components showing equipment, the load in amps or volt-amps, conduit type and size, conductor type and size, and breaker type and size.
4. Wiring methods for the fire alarm system.
5. All emergency system wiring methods pertaining to the smoke control.
6. Schedule of individual smoke control components starting loads that will start at the same time
7. Schedule of individual smoke control components running loads
8. The total combined loads of smoke control components for start up and run (start up and run shown separately).

Note: Approval of the smoke control system *does not* constitute approval of each component system. Separate fire alarm, sprinkler, building, mechanical, and electrical approvals are required.

Smoke Control System Revisions

07/11/07

The city may require additional information as needed. For preparation information, see description sheet # 1, *Standards for Plans and Drawings*. If you have any questions concerning your application, please visit or call Permit Processing (425- 452-6800) between 8 a.m. and 4 p.m., Monday through Friday (Wednesday, 10 to 4). Assistance for the hearing impaired: dial 711 (Telecommunications Relay Service).

Because of the complexity of smoke control systems, it is important that the design documents clearly identify the expected performance of the system. These documents must also clearly identify the expected performance of each component in the smoke control system. Components include all passive and active elements that work together to provide smoke control in accordance with International Building Code (IBC) Section 909.

Projects subject to this guide may include those involving:

- Additions or alterations to existing buildings affecting the use, occupancy, or leakage area of one or more smoke-control zones
- Adding, removing, or altering the location of smoke barriers or openings therein
- Adding, removing, or replacing equipment serving the smoke control system, including dedicated or non-dedicated fan equipment
- Adding, removing, replacing, or altering devices or systems that are capable of affecting the function of the smoke control system, including fire alarm detection devices

Where a new smoke control system is required by additions or alterations to an existing building, see Guide 42b.

To more clearly identify the systems involved, the background systems and floor plans should be in light line weight with the pertinent systems in heavy line weight.

To obtain the smoke control permit, documentation containing the following details/ specifications is required: *Submit 5 sets*

1. The detailed design report for the existing building condition must be referenced to identify the effects of the project on the smoke control system. In the absence of this information, the apparent smoke control approach for the entire building and the existing smoke control sequence of operation for the affected zones must be identified and described by a Professional Engineer competent in the design of smoke control systems.
2. Where a concise narrative description of the smoke control system has been prepared as described in Item 15 of Guide 42b, this narrative and any special requirements of the design must be noted on the plans. In the absence of such a narrative, the apparent smoke control approach and any special design requirements must be noted on the plans based on the information in Item 1.
3. When the project would result in deviation from the Detailed Design Report or concise narrative description, an updated smoke control system rational analysis must be performed in accordance with IBC Section 909.4 and must be prepared by a Professional Engineer (P.E.) competent in the design of smoke control systems. This analysis must be stamped by the P.E.

and address all modified and affected smoke zones, and update the detailed design report and concise narrative description.

4. The Architect of Record, Mechanical and Electrical Engineers of Record, and fire alarm and sprinkler system designers for the project must sign the smoke control system design documents that they prepared. If the rational analysis was prepared by another party, each designer must provide written documentation that they have read and incorporated the rational analysis in their design, such as by a written statement on the record drawings.
5. If the project resulted in deviation from the concise narrative description or detailed design report, the author of the updated detailed design report or concise narrative description must review design documents pertaining to the smoke control system when prepared by others and provide a letter identifying that the design complies with the smoke control system requirements.
6. Indicate on the design plans the location of all (new and existing) devices that will initiate smoke control, devices involved in the smoke control process (including actuators, control dampers, fire and smoke dampers, variable air volume controls, and fans), and identification of devices provided with emergency power.
7. Provide smoke-control zone drawings that clearly identify the existing configuration of affected active and passive smoke-control zones.
8. Provide smoke-control zone drawings that clearly identify the configuration of active and passive zones after completion of the project. Sprinkler zones must be coordinated with smoke zones.
9. Identify the smoke control method being used for each affected smoke-control zone, including applicable calculations (supporting analysis utilizing computational fluid dynamics (CFD) or a network flow analysis may be required), and identify unique or unusual fire loads.
10. Provide details of each new fan involved in smoke control, including its capacity, the number of belts and wiring for power, control, and monitoring. Where an existing fan is replaced, identify the existing fan operating capacity in smoke control mode.
11. Provide the sequence of operations (including sequence of operations, if necessary, to prevent duct implosion or explosion) and updated performance matrix with the positioning of each damper for every fire scenario in each affected smoke control zone.
12. Verify seismic anchorage of critical systems and include the design with the submittal (IBC Section 403.14).
13. Identify modifications to electrical loads of the individual equipment associated with the smoke control system and confirm adequate capacity of associated emergency generator.
14. Full-scale color illustration of Fire-fighter's Smoke Control Panel (FSCP), if revised or added.
15. Where the project work is limited to modifications within an existing smoke zone, operational testing only is required to demonstrate appropriate system responses based on alarm sequences initiated in affected zones, as well as system responses in the affected zones based on alarm sequences initiated in adjacent zones. Manual control of equipment in affected zones via the FSCP must also be verified.
16. When the project work adds, modifies, or replaces smoke control zones, barriers, or fan equipment, in addition to operational testing as described in Item 16, performance testing of the affected zones is required and an Acceptance Testing Program (ATP) to evaluate the affected areas of the smoke control system in accordance with City of Bellevue Fire Department Development Standards (BFDDS) Chapter 11. Performance tests shall minimally demonstrate satisfactory performance of the elements of the affected smoke-control zones. If variable frequency drive (VFD) settings are modified, tests must be performed as required in the

modified area, and in adjacent areas served by previous fan speed to confirm proper pressures.

To incorporate all of this information, the control diagrams will include portions of the automatic sprinkler design, fire alarm design, mechanical shop drawings, mechanical design documents, electrical design documents, and architectural drawings. Architectural drawings need to show wall and opening protection ratings, draft curtains, smoke barriers, and passive boundaries as applicable. This results in a comprehensive package of smoke-control design documents that requires careful thought in preparation and review by the contractors and special inspector.

Approved smoke control system features are described in BFDDS Chapter 11, Smoke Control.