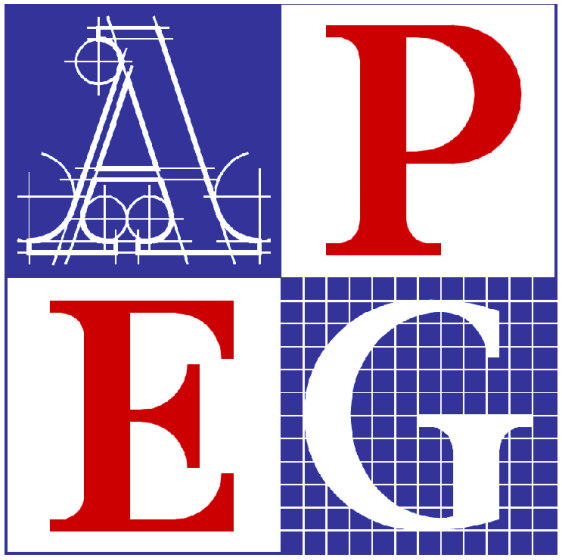
APEGBC



Professional Engineers
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Guidelines for Fire Protection Engineering Services for Building Projects

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1.0 DEFINITIONS

Act
Engineers and Geoscientists Act, R.S.B.C. 1996, c. 116, as amended.

Alternative Solutions
A design or solution which does not conform to the prescriptive requirements of the *Code* but provides the level of performance required by the *Code* (see Division C, Part 2, Section 2.3 Alternative Solutions, Clause 2.3.1.1).

Architect
A member in good standing of the Architectural Institute of British Columbia (MAIBC).

APEGBC
The Association of Professional Engineers and Geoscientists of the Province of British Columbia.

Authority Having Jurisdiction (AHJ)
The governmental body (often municipal) with the authority to administer and enforce the *Code* or the official or agency designated by that body to exercise such a function.

Basic Services
The services provided by the *FPER* as set out in Section 4.2.

Client
The party who engages the *FPE* to provide professional *Fire Protection Engineering* services.

Code
The *British Columbia Building Code (BCBC)*, the *Vancouver Building By-law (VBB)*, *National Building Code (NBC)*, or similar *Code* on which the construction or alterations of buildings is based.

Coordinating Registered Professional (CRP)
Often referred to as the "Prime Consultant", the *CRP* is the individual who is registered as a *Member* in good standing of the *APEGBC* or the Architectural Institute of British Columbia, and who has the responsibility to coordinate the design and *Field Review* of the various design professionals (such as electrical, structural, mechanical, fire protection, geotechnical, architectural) for the project.

Design Drawings
Included within the meaning of the term *Design Drawings* are those drawings that are produced for the following purposes:

- schematic designs, design development, tendering, contract drawings, those issued for submission for permitting purposes and those issued for construction. The professional engineer responsible for the design is required to seal, sign and date the final versions of all drawings prepared for the various submissions involved in tender documents, contract documents, permitting documents and for construction documents. The purpose of the document for these various phases of a project should be identified on the drawings.

Design Objective
A description of the performance benchmark against which the predicted performance of a design is evaluated.

Direct Supervision
Taking responsibility for the control and conduct of an assisting *Member*, a less experienced *Member*, an Engineer-in-Training (EIT) or a non member.

Electrical Engineer of Record (EER)
The *Member* with general responsibility for electrical integrity of the electrical systems as provided for in the *APEGBC Guidelines for Electrical Engineering Services for Building Projects*.

Field Review
Means review of the work

(a) at a project site of a development to which a building permit relates, and

(b) where applicable, at fabrication locations where building components are fabricated for use at the project site

that a *Member* in his/her professional discretion considers necessary to ascertain whether the work substantially complies in all material respects with the plans and supporting documents prepared by the *Member* for which the building permit is issued. Refer to the *APEGBC Quality Management Guidelines – Documented Field Reviews During Implementation or Construction.*

Final Design Drawings
Drawings which represent the *Final Design Drawings* following construction which reflect all updates to the *Design Drawings* due to design changes made during construction. It is intended that the *Final Design Drawings* incorporate all addenda, change orders, and other significant design changes but not necessarily site instructions used to make minor adjustments to the conditions reflected in the *Design Drawings*. If they are prepared, the *Final Design Drawings* must be sealed, signed and dated by the responsible professional engineer.

Fire Protection Engineer (FPE)
A *Member*, registered by the *APEGBC* as a Professional Engineer or the holder of a limited license, who specializes in the science of *Fire Protection Engineering* with the responsibility for completing any aspect of the *Fire Protection Engineering* as outlined in Part 4 of this guideline.

Fire Protection Engineering
The application of science and engineering principles to protect people and their environment from destructive fire and includes:

- analysis of fire hazards;
- mitigation of fire damage by proper design, construction, arrangement, and use of buildings, materials, structures, industrial processes, and transportation systems; and
- the design, installation and maintenance of fire detection and suppression and communication systems.

Fire Protection Engineer of Record (FPER)
The *Member*, registered by the *APEGBC* as a Professional Engineer, or the holder of a limited license who specializes in the science of *Fire Protection Engineering* with the responsibility for completing any aspect of the *Fire Protection Engineering* as outlined in Parts 4.1 or 4.2 of this guideline. In general, the *FPER* will be responsible for specific parts of the Schedules B, and C-B of the *Code* as well as the design of fire and life safety systems. Another *Member*, such as the *MER* may provide a performance based specification at the incipient stages of a project. This *Member* is not the *FPER* for the purposes of these guidelines.

General Contractor
The party who has a contract with the *Owner* or a party authorized by the *Owner* for the construction of all or a portion of the building. Depending on the contractual arrangements, a construction or project manager may fulfill many of the roles of a *General Contractor*.

Letters of Assurance:
Standard forms of the *BCBC* and the *VBB* informing the *AHJ* which aspects of a project design and *Field Reviews* are the responsibility of a particular *RPR*, which for the purposes of this guideline is the *FPER*. Where the work being performed by the *FPE* does not fit within a specific discipline outlined in the standard forms, a model supporting *Letter of Assurance* (Schedule S-B and S-C as provided in the *AIBC/APEGBC Practice Note 16: Professional Design and Field Review by Supporting Registered Professionals*) may be prepared by a *Supporting FPE* and submitted to the *RPR*.

Mechanical Engineer of Record (MER)
The *Member* with general responsibility for the mechanical integrity of the mechanical systems as provided for in the *APEGBC Guidelines for Mechanical Engineering Services for Building Projects*.

Member
A Professional Engineer, Professional Geoscientist, Licensee including Limited Licencees acting within their scope of practice and licensed to practice by *APEGBC* in accordance with the *Act.*

Owner
The party who owns a building or the party with the written authority to act on the *Owner*'s behalf.

Performance Based Design
An engineering approach to design based on (1) agreed upon goals and objectives, (2) deterministic and/or probabilistic analysis of various design scenarios, and (3) quantitative assessment of design alternative against the goals and objectives using accepted engineering tools, methodologies, and prescriptive criteria.

Prescriptive Based Design
A design that complies with prescriptive *Code* requirements also known as an acceptable solutions.

Record Drawings
Drawings prepared as a record to confirm what was constructed. They are generally developed as a result of the contractor's contractual obligations. The information

presented on the drawings may vary based on the nature of the works involved but can include such things as measurements, elevations, detailed dimensions and sizes of various elements of the constructed work. Typically these drawings are not signed and sealed by the *FPER* however if circumstances dictate such a requirement they can be sealed, with signature and date by a *RP* specifically engaged to provide that level of *Field Review*. Refer to Section 4.2.5.2(d) for further information on the sealing of *Record Drawings*.

Registered Professional (RP)

a) a person who is registered or licensed to practice as an *Architect* under the *Architects Act*, or

b) a person who is registered or licensed to practice as a professional engineer under the *Act.*

Registered Professional of Record (RPR)

Defined in the *Code* as a *RP* retained to undertake design work and *Field Reviews* pursuant to Clause 2.2.7.3 in Division C, Part 2 in the *Code*.

Review

The process by which a design or aspect of a design or construction is reviewed with the objective of providing a level of assurance that the work reviewed substantially conforms to the *Design Objective*s.

Shop Drawings

Drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are provided by the contractor to the engineer of record to illustrate details of a portion of work. For additional information refer to the *APEGBC Professional Practice Guidelines – Shop Drawings*.

Specialty FPE

A *FPE* who is responsible for specific aspect(s) of the fire and life safety concepts of a building project such as the development of an *Alternative Solution* which does not involve a broad overall project *Review*.

For *FPE's* designing speciality systems such as kitchen suppression systems, refer to the definition of *Supporting FPE*.

Structural Engineer of Record (SER)

The *Member* with general responsibility for the structural integrity of the primary structural system as provided for in the *APEGBC Guidelines for Professional Structural Engineering Services for Part 3 Building Projects*.

Sub-Contractor

The party who contracts with the *General Contractor* to construct certain aspects of the work.

Supporting Fire Protection Engineer (Supporting FPE)

A *Member* who designs and supervises the preparation of documents for specialty *Fire Protection Engineering* services while acting as a supporting *RP* providing supplementary supporting *Fire Protection Engineering* services to the *FPER*. Where supporting *Fire Protection Engineering* services are provided, it is recommended that appropriate assurances be obtained by the relevant *FPER* from the *Supporting FPE*. Schedules which enable the *Supporting FPE* to provide such assurances to the *FPER*

are the model supporting *Letters of Assurance* (model Schedules S-B and S-C) provided in the *AIBC/APEGBC Practice Note 16: Professional Design and Field Review by Supporting Registered Professionals*. Also *APEGBC Bulletin K: Letters of Assurance in the BC Building Code and Due Diligence* provides information on the role of the supporting engineer.

Sustainable Goals

Often referred to as high performance or Green' designs, the *Sustainable Goals* for a project should seek to strike a balance between economics, environmental issues and social issues for buildings and/or the built environment. Ideally goals should be set to progress towards a vision of the built environment as truly sustainable.

2.0 INTRODUCTION

2.1 PURPOSE OF GUIDELINES

The *Guidelines for Fire Protection Engineering Services for Building Projects* (Guidelines) has been prepared by a committee of *APEGBC* and has been adopted by the Council of the *APEGBC*.

The guidelines set out the scope of professional practice which *Members* should meet and follow in providing professional engineering services related to the professional activities identified in the guidelines. *APEGBC* and its Council are committed to improve the quality of the services *Members* provide to *Clients* and the public; these guidelines have been published for that purpose.

It is anticipated that variations in the application of these guidelines may be required. A *Member* must always exercise professional judgment in providing services. It is not intended that the guidelines be used as a legal document or for altering contracts between *Members* and *Clients*. However, *Members* may use the guidelines to assist in establishing the terms of their contracts with their *Clients*.

No variation, however, that detracts from the overall purpose of the guidelines should be made. The guidelines are intended to establish standards of practice which *Members* should meet to fulfil the *Member's* professional obligations, especially in regard to the primary duty to protect the safety, health and welfare of the public; to protect the environment; and to promote health and safety in the workplace as per the Code of Ethics. The Council of the *APEGBC* intends that failure to meet the intent of these guidelines may give rise to disciplinary proceedings.

APEGBC supports the proposition that *Members* should receive fair and adequate compensation for services rendered and that this principle applies to the services provided to comply with these guidelines. In no event will low fees be justification for services which do not meet the standards set out in these guidelines. *Members* may wish to discuss these guidelines with their *Clients* when receiving instructions for assignments and reaching agreements regarding compensation.

2.2 SCOPE OF GUIDELINES

These guidelines apply to the practice of *Fire Protection Engineering* for buildings governed by Part 3 of the *BCBC*, the *VBB*, or the *NBC*. Parts of these guidelines may also be applicable to other buildings and structures.

These guidelines also encompass the commitments which municipalities may require from *Members* as set out in the *Letters of Assurance* of the *BCBC* and the *VBB*.

These guidelines outline the professional services which should generally be provided by the *FPE* for a project carried out under the requirements of those portions of the *Code*s and regulatory requirements set out above.

These guidelines specify tasks which should be performed by the *FPE* to achieve designs which are in the best interest of the project, the public and the environment and which are properly coordinated with the work of other design and construction team participants. These guidelines should assist in maintaining the integrity of the overall and detailed designs. The *FPE* often works in conjunction with the *Architect*, *MER*, *EER*, *SER* and/or other design team members or contractors on certain projects;

these guidelines should assist in the delineation of responsibilities among these parties.

2.3 QUALIFICATION

Notwithstanding the purpose and scope of the guidelines, the decision of the *FPE* not to follow one or more of these guidelines does not mean that the *FPE* is legally negligent or unprofessional in the performance of professional services. Such a judgment or decision would depend upon a detailed analysis of the facts and circumstances to determine if other *FPE*s in similar circumstances would have conducted themselves similarly.

2.4 KNOWLEDGE AND EXPERIENCE OF THE *FPE*

A *FPE* is expected to have knowledge in an appropriate level of fire dynamics along with an understanding of architectural, mechanical, electrical, and structural systems that relate to fire protection. The *FPE* is also expected to have a thorough knowledge of the fire safety requirements of the *Code* and relevant standards (e.g. NFPA) in order to determine that the design concepts are compatible with the performance objectives of the *Code* and any relevant standards. An *FPE* is expected to be able to apply this knowledge to protect people and their environment. This knowledge may be obtained through experience, self study or formal education. A basic educational requirement for all *FPE*'s is an undergraduate degree in a relevant engineering discipline, such as Mechanical, Electrical, Civil or Chemical Engineering combined with appropriate experience and training in fire dynamics and risk analysis.

For complex systems requiring a sophisticated level of analysis knowledge of the subject is typically gained through formal education offered in advanced university courses.

While still meeting the basic requirements an *FPER* may have a more limited knowledge base provided it is sufficient to perform the more prescriptive design requirements of the aspects of the relevant *Code* and or standard(s) associated with the *FPER*'s services.

Typically a professional engineer with suitable experience would have three to five years of experience under the supervision of a senior professional engineer experienced in the relevant professional activities that the *FPE* or *FPER* would be involved in.

2.5 QUALITY MANAGEMENT AND CONCEPT REVIEW

2.5.1 Quality Management Bylaws

The *APEGBC* Quality Management Bylaw 14(b) requires that all Professional Engineers and licensees shall establish and maintain documented quality management processes for their practices which shall include as a minimum;

(1) retention of complete project documentation which may include, but is not limited to, correspondence, investigations, surveys, reports, data, background information, assessments, designs, specifications, *Field Reviews*, testing information, quality assurance documentation, and other engineering and geoscience documents for a minimum period of 10 years (see *APEGBC Quality Management Guidelines – Retention of Project Documentation)*;

(2) regular, documented checks of engineering and geoscience work using a written quality control process appropriate to the risk associated with the work (see *APEGBC Quality Management Guidelines – Documented Checks of Engineering and Geoscience Work)*;

(3) documented *Field Reviews* by, or under the direct supervision of, *Members* or licensees, of their domestic projects during implementation or construction (see *APEGBC Quality Management Guidelines – Documented Field Reviews During Implementation or Construction)*.

The timing and nature of the design check will depend on the design. Small or straightforward prescriptive or *Performance Based Designs* may be checked when the design is substantially complete. Large, complex or multi-stage designs should be checked at stages during the design. The *FPE* responsible for the design may also provide the check provided that the quality management process established provides for a procedure by which the *FPE* can check the design with respect to appropriate criteria. An example of a prescriptive design checklist for a sprinkler system is included in Appendix D. This sample is not intended to be comprehensive. Other checklists for other designs, such as fire alarm systems, would be required. Additional items not shown on the sample checklist may be required, particularly for specialized designs.

An independent concept review may be requested as part of a design. The decision to conduct an independent concept review is up to the stakeholders, and is more likely to occur for a significant or complex *Performance Based Design*. Where a *FPE* is responsible for a complex *Performance Based Design*, the *FPE* should, at an early stage in the design, obtain input of relevant stakeholders as described in Section 3 of these guidelines. Prior to acceptance by the *AHJ*, the independent concept review may be required. The terms of the independent concept review should be established and be acceptable to relevant stakeholders, prior to commencement of the review. In general, the independent concept review should be conducted in accordance with the Society of Fire Protection Engineers (SFPE) publication *Guidelines for Peer Review in the Fire Protection Design Process*, except where modified by agreement of the relevant stakeholders.

2.5.2 Use of Seal

In addition all *Members* must authenticate their professional documents in a manner which is consistent with the intent of the *APEGBC Quality Management Guidelines – Use of the APEGBC Seal*.

2.5.3 Delegation of Responsibility

The *Fire Protection Engineering* services described in Section 4 must be carried out by a *FPE* or a *Supporting FPE* with appropriate training or experience, or by an individual to whom the work is delegated (a delegatee). A delegatee can be an assisting *Member*, a less experienced *Member*, an EIT or a non-*member* but must be working under the *Direct Supervision* of the *Member* responsible. The *Act* (Section 1(1)) states that D*irect Supervision* means that the *Member* responsible takes full responsibility for the control and conduct of the work he/she delegates. Taking this responsibility is noted by the *Member* responsible signing, sealing and dating the work delegated.

The *Member* responsible should exercise his/her professional judgment and due diligence in determining what work should be delegated and how it is delegated. The *Member* responsible must determine that the delegated services meet the required standards.

Direct Supervision typically takes the form of specific instructions on what to do, check, confirm, test, observe, record and report back to the *Member* responsible, and how to carry out those tasks. Where the work is more extensive or where engineering decisions/judgments are required, the *Member* responsible should make those engineering decisions/judgments, or provide further direction/instruction to the delegatee.

When delegating work, the following should be considered:

- circumstances surrounding the project and whether it is appropriate to delegate;
- level, complexity or critical nature of work;
- level of training and experience of the degelatee;
- complexity of instruction required to be provided to the delegatee;
- level of engineering decisions/judgments that the delegatee will be required to make;
- level of detail required by the delegatee when reporting back to the *Member* responsible;
- ability of the *Member* responsible to confirm the results of the delegated work; and
- necessity for follow-up work by the *Member* responsible.

The delegation of a task such as the carrying out of *Field Reviews* is to be done in a manner which ensures that the *Field Reviews* meet the standard expected of a professional engineer. The responsible engineer or licensee directing a non-member or a subordinate *Member* with respect to undertaking *Field Review* tasks must ensure that such work is carried out in a fashion which meets the definition of *Direct Supervision*.

Meeting the intent of this definition includes having the responsible engineer or licensee exercise his/her professional judgement and due diligence in addressing the following matters with respect to the delegation of *Field Reviews*:

1. Considering all the circumstances surrounding the project and the above context, whether or not it is appropriate to delegate one or more of the *Field Reviews* to a non-member or a subordinate *Member*.
2. Consideration of the level, complexity or critical nature of the *Field Review* to be conducted, in order that the responsible engineer can be satisfied with the quality and accuracy of the observations being made by the assisting non-member or a subordinate *Member*.
3. Whether or not the assisting non-member or a subordinate *Member* that will be carrying out the *Field Reviews*, has the appropriate level of training and experience, taking into consideration the complexity of the project at hand.
4. The instruction required to be provided to the assisting non-member or a subordinate *Member* on the level of effort to be exercised in the *Field Review*, the level of detail required when reporting on the *Field Review* and the specific aspects of the construction activities, which are to be included in the *Field Review*.
5. Subsequent *Review* of the field reports by the responsible *Member* and follow up, as required.

2.5.4 Independent Peer Review

An independent peer review is an additional level of *Review* beyond the minimum requirements of Bylaw 14(b)(2) that may be undertaken for a variety of reasons (such as those listed above) by an independent *Member* not previously involved in the project. At the discretion of the *FPE* responsible for the preparation of the professional engineering documents that are being considered for an independent peer review, in consultation with the reviewer(s) involved in the regular checking/*Review* process outlined above, such an additional level of *Review* may be deemed appropriate. Alternatively, an *AHJ* may request an independent peer review to support project approval. An independent peer review may be undertaken by another *Member* within the same firm, or a *Member* external to the firm.

The independent peer review process should be more formal than the checking/*Review* process carried out under Bylaw 14(b)(2). An independent reviewer should submit a signed, sealed and dated letter or report, to be either included with the report or put on file, that includes the following:

- limitations and qualifications with regard to the *Review*; and
- results of the *Review*.

When an independent peer review is carried out, the *FPE* who sealed with signature and date the original professional engineering documents remains the engineer of record.

The independent peer review discussed above is not the same as an independent review or advisory service provided by a *Member* who is retained by the *Regulatory Authority*, or sometimes a *Client*.

2.6 ACKNOWLEDGEMENT

This edition of the *Guidelines for Fire Protection Engineering Services for Building Projects* has been prepared by the volunteer Fire Protection Engineering Subcommittee of the Building Codes Committee of *APEGBC*. The general format follows guidelines previously prepared by *APEGBC* for other disciplines. Portions of the text have been developed from references to the publications by the SFPE, including the *SFPE Engineering Guide to Performance-Based Fire Protection, 2nd Edition*, the publication *The Role of the Fire Protection Engineer in the Construction Process*, and the publication *The Engineer and The Technician: Designing Fire Protection Systems*.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

3.1 COMMON FORMS OF PROJECT ORGANIZATION

Project organizations vary according to the needs of the project and the parties. The *FPE* can be engaged by the *Owner*, but is often engaged by the *Owner*'s *CRP*, a design/build contractor, or other design professionals responsible for the delivery of part or all of the project.

3.1.1 *FPE's* Role

The role of the *FPE* and interaction with other members of the design and construction team depends on the contractual involvement of the *FPE*. The scenario in Appendix B illustrates how the *FPE* or *FPER* may participate in a building project and provides a guide for their actions.

3.1.1.1 If the initial *FPE* is changed and another *Member* or *Fire Protection Engineering* company is retained to carry out analyses and design and/or provide *Field Reviews* for some or all of the project, the *Member* providing the latest design and/or *Field Reviews* shall carry out such *Reviews*, investigations, and analyses as required to accept full responsibility for the fire protection aspects of the project, for which they are responsible. Where appropriate this will include the issuance of *Letters of Assurance*. Please refer to the *Guide to the Letters of Assurance* in the *Code* on how to document when there is a change in the *FPE* or *FPER* during design or construction.

3.1.1.2 The role of the *FPE* and interaction with other members of the design and construction team depends on the contractual involvement of the *FPE*. Appendices B and C represent only a few of the many possible types of involvement of an *FPE*, and are not intended to imply that these are the only or even the most common or preferred scenarios.

3.1.1.3 The *FPER* is a subcategory of the *FPE* which addresses specific design aspects of the *Code* as laid out in Schedule B. Their scope is usually limited to prescriptive requirements of the *Code* (possibly modified by other *FPE*'s) for fire suppression or fire alarm systems.

3.1.1.4 The *RP* signing the Schedule C-B should be the same *RP* signing the Schedule B. Only if the *RP* signing the Schedule B is no longer available to do the work should this provision be waived. In such circumstances, the *Guide to the Letters of Assurance* in the *Code* should be followed.

3.2 RESPONSIBILITIES OF ORGANIZATION

3.2.1 *Owner*

3.2.1.1 In order that the design and construction of the project may be carried out in a manner that meets appropriate standards of public safety, environmental legislation and the requirements of applicable building regulations, the *Owner* should:

(a) where required, retain or cause to be retained qualified professionals with responsibility for the design of all aspects of the project, including a *CRP*;

(b) cooperate with the *CRP* so that an adequate written description of the project is developed;

(c) cooperate with or direct the *CRP* or other appropriate and mutually acceptable party to cooperate with the *FPE* in setting out a written description of the scope of the *FPE*'s services as described in paragraph 3.2.4;

(d) before the commencement of the *FPE*'s services, complete or cause to be completed a written agreement with the *FPE* (directly with the *Owner* or with the *CRP* or with another appropriate and mutually acceptable party) confirming the scope of services and associated compensation;

(e) cooperate with the *CRP* and the *FPE* to establish a mutually agreed realistic schedule for the provision of the *FPE*'s services;

(f) authorize in writing any additional services that may be required beyond the scope of the *FPE*'s agreement or original scope of services;

(g) ensure that all required approvals, licenses and permits from the *AHJ* are obtained;

(h) provide the *FPE* with the right of entry onto the project site for exploration purposes;

(i) recognize that drawings, specifications, reports, and other documents prepared by the *FPE* are for the project and that such documents shall not be used or copied for other projects without the agreement of the *FPE* and without advice from a qualified design professional;

(j) recognize that, because *Code* interpretation by the *AHJ* may differ from the *FPE*, changes may be required;

(k) disclose fully and promptly any and all information that may affect the *FPE*'s performance, scheduling, design, or payment for services, including but not limited to any existing fire protection reports or data, any situations that may require special testing or equipment, and all known or anticipated potential uses;

(l) if other *FPE*'s are selected for specific aspects of the work, establish or shall cause to be established a clear delineation of the responsibilities of the various *FPE*s including, where appropriate, the provision for concept review of the impact of specialty work on the fire protection programme;

(m) provide for a *Field Review* program as recommended by the *FPE* and, as may be required by the *APEGBC* Bylaws, the *Code*, other relevant authorities and/or the project specifications;

(n) if the initial *FPE* is changed and another *Member* or *Fire Protection Engineering* company is retained to carry out analyses and design and/or provide *Field Reviews* for some or all of the project, assure or cause to be assured that the *Member* providing the latest design and/or *Field Reviews* accepts full responsibility for the fire protection aspects of the project including issuance of *Letters of Assurance*. The *Owner* should recognize that a change in the *FPE* may require additional time and investigation to permit the new *FPE* to satisfy himself/herself of the adequacy of the design and the status of the previous work prior to issuance of *Letters of Assurance*. Please refer to the *Guide to the Letters of Assurance* in the *Code* published by the BC Government's Building and Safety Standards Branch.

3.2.1.2 If the *Owner* fails or refuses to carry out the obligations as set out in paragraph 3.2.1.1., the *FPE* should:

(a) consider giving written notice to the *Owner*, advising the *Owner* of the *FPE*'s recommendations;

(b) consider whether to continue with the project since, in any event, the *FPE* is obligated to comply with the intent of these guidelines.

3.2.2 *Coordinating Registered Professional*

Large or complex projects with more than one *RP* will normally have a *CRP*. Where a *CRP* is involved, to enable the *FPE* to perform his/her duties properly, the *CRP* should:

3.2.2.1 Interpret the needs of the *Owner* and, in doing so, should develop a feasible design to suit the *Owner's* intended functions and needs. The *CRP* should identify or cause to be identified by other participants of the design team any special design criteria such as anticipated occupancies, uses, future constructions, and other performance requirements or additional fire protection services not normally part of the scope of such projects, and should advise the *FPE* accordingly. The *CRP* should develop and identify to the design team the *Sustainable Goals* for the project;

3.2.2.2 Outline the scope of assignment to each design professional (including to the *FPEs*, if any) for design, preparation of contract documents, *Review* of work during construction, and contract administration;

3.2.2.3 Provide timely information in sufficient detail as required to permit the *FPE* to adequately perform his/her duties;

3.2.2.4 Recognize that, because *Code* interpretation by the *AHJ* may differ from the *FPE*, changes may be required;

3.2.2.5 Disclose fully and promptly any and all information that may affect the *FPE*'s performance, scheduling, design, or payment for services, including but not limited to any existing fire protection reports or data, any situations that may require special testing;

3.2.2.6 Coordinate and *Review* the designs, drawings, and other contract documents produced by all the participants of the design team;

3.2.2.7 Coordinate communication of information between the *Owner*, the contractor, and the design professionals, including the *FPE*, so that the work proceeds in a manner which complies with applicable *Codes* and regulations and meets the *Owner's* needs;

3.2.2.8 Be familiar with and, where appropriate, apply the *APEGBC Sustainability Guidelines* to the work.

3.2.3 Other *Registered Professionals*

To enable the *FPE* to perform his/her duties properly on projects where other *RPs* are involved the following should occur:

3.2.3.1 The coordination of information is to occur in a timely fashion and in sufficient detail in order to permit the duties of the *FPE* and the other *RP(s)* to be adequately performed. This information will normally include *Design Drawings* and, depending on the project, may also include information such as specifications, proposed design changes, and certain change orders during construction;

3.2.3.2 Where proposed design changes affect the duties of the *FPE* those changes should be coordinated between the *FPE* and the other relevant *RP(s)*;

3.2.3.3 Where the *FPE* is involved in an *Alternative Solution* or a *Performance Based Design* which impacts systems provided by other *RP(s)*, the recommendations of the *FPE* must be coordinated with the designs provided by the other *RP(s)*.

3.2.4 *FPE* - Fire and Life Safety Concepts

The *FPE* for building fire and life safety concepts is responsible for the *Fire Protection Engineering* aspects of the design and the associated *Field Reviews*. If included in the scope of services, recommendations may also be provided for other aspects of a building project, such as accessibility and other aspects of the *Code*. The *FPE* also has a responsibility to provide designs that contribute toward the overall *Sustainable Goals* of the project.

3.2.4.1 The *FPE* for fire and life safety concepts together with the *Owner* or *CRP* is responsible for setting out a written description of the scope of the *FPE's* services sufficient to enable and permit the *FPE* to meet the design and *Field Reviews* requirements of these guidelines and applicable building regulations.

3.2.4.2 Every building project that involves fire protection systems must have a design professional taking overall responsibility for the coordination of the *Fire Protection Engineering* systems provided for the building. It is recommended that one *FPE* coordinate the *Fire Protection Engineering* aspects of a project when different *FPEs* undertake fire and life safety analysis for various aspects of the project.

3.2.4.3 In the preparation of recommendations and designs, the *FPE* shall be entitled to rely upon project information and special building design criteria or other performance requirements provided by the *Owner* and other design professionals including the *CRP* and the engineers of record. Changes in this information during or following fire protection investigations or design analyses may require additional investigations and/or changes to the design.

3.2.4.4 The *FPE* will normally be responsible for the preparation of *Fire Protection Engineering* recommendations and design concepts.

3.2.4.5 A *Specialty FPE* may be engaged for specific aspect(s) of the fire and life safety concepts of a building project such as the development of an *Alternative Solution* which does not involve a broad overall project *Review.*

3.2.4.6 Observations of *Fire Protection Engineering* aspects of construction should be performed under the direction of the *FPE* because the *FPE* is best qualified to recognize and deal with situations that require the *FPE*'s professional judgment and interpretation. The *FPE*'s observation of construction, interpretation of conditions, and formulation of recommendations or directions should be performed in close communication with the *CRP* and other appropriate members of the design team.

3.2.4.7 The *FPE*'s responsibilities during construction usually include conducting *Field Reviews* of *Fire Protection Engineering* systems for equivalent aspects of construction being installed by the contractor engaged by the *Owner*. The presence or observations of the *FPE* during construction shall not relieve the contractor of his/her responsibilities to construct the project in accordance with the contract documents and good practice, nor shall it relieve the contractor of his/her responsibilities to utilise

appropriate construction methods, techniques, sequences, procedures, safety precautions, and programs necessary for the safe and suitable completion of the project.

3.2.4.8 The *FPE* should provide ongoing observations, testing, advice, and recommendations to facilitate the successful completion of the *Fire Protection Engineering* related aspects of the building that are within the *FPE*'s scope of services. The *FPE* typically relies on others such as the *Owner*, the *CRP*, or the contractor to notify him/her of the progress of construction and when the fire protection elements of the project are ready for *Field Reviews*.

3.2.4.9 Concept review by the *FPE* of designs by *Specialty FPEs* may be provided to assess risks associated with proceeding with such specialty work. Despite such *Reviews* or observations, the *FPE* and the *Specialty FPE* are not responsible for the designs of others.

3.2.4.10 Be familiar with and, where appropriate, apply the *APEGBC Sustainability Guidelines* to the work.

3.2.5 *FPER* - Design Aspects

3.2.5.1 The *FPER* responsible for design is often engaged by the design build contractor but may be engaged by the *Owner*, a supplier or contractor, the *CRP*, a design/build contractor, or other entity responsible for the delivery of the project. For those items for which the *Supporting FPE* is engaged, the *Supporting FPE* shall be responsible for all aspects of investigation, design, and *Field Reviews. The Supporting FPE* should submit model Schedules S-B and S-C to the *FPER* (see *AIBC/APEGBC Practice Note 16: Professional Design and Field Review by Supporting Registered Professionals*).

3.2.5.2 Where a *Specialty FPE* is responsible for specific aspects of the fire and life safety concepts or analysis, the *FPER* should provide all relevant information to the *Specialty* FPE. This information should include all relevant performance criteria. This will allow the *Specialty FPE* to carry out a concept review of the impact that the *FPER's* designs have on the fire and life safety aspects of the project for which the *Specialty FPE* is responsible. Such concept reviews by the *Specialty FPE* are intended to achieve the objectives as set out in Section 3.2.4

3.2.5.3 The *FPER* has no responsibility for the designs prepared by the *Specialty FPE* or for the *Field Reviews* of the construction of the specialty work.

3.2.5.4 The *FPER* signs the Assurance of Professional Design and Commitment for *Field Reviews* regarding the *Fire Protection Engineering* aspects of the design which the *FPER* prepared.

3.2.5.5 Be familiar with and where appropriate apply the *APEGBC Sustainability Guidelines* to the work.

3.2.5.6 There may be another *Member* such as the *MER* or *EER* who provides a performance based specification in order to facilitate the building permit process. For the purposes of this guideline, the *FPER* is the *Member* performing the detailed design, not the *Member* providing the performance based specification. The *Member* providing the performance based specification is responsible for contractual related issues including protecting the *Owner*'s interests but is not responsible for the *Fire Protection*

Engineering design except for aspects of the design which were provided by the *Member*.

3.2.6 *Structural Engineer of Record*

The *SER* is responsible for the structural integrity of the primary structural system of the building project. The *SER* should:

3.2.6.1 Provide timely information in sufficient detail as required to permit the duties of the *FPE* to be adequately performed;

3.2.6.2 Provide sufficient information on structural *Design Drawings* to allow fire-resistance ratings of structural members and assemblies to be determined;

3.2.6.3 Inform the *FPE* of changes in the structural design where those changes may affect the duties of the *FPE*;

3.2.6.4 Where there are issues related to an *Alternative Solution* or a *Performance Based Design* involving the structural design, incorporate the recommendations of the *FPE* into the structural design.

3.2.7 *Mechanical Engineer of Record*

The *MER* is responsible for the mechanical integrity of the mechanical systems shown on contract documents prepared by the *MER*. The *MER* should:

3.2.7.1 Provide timely information in sufficient detail as required to permit the duties of the *FPE* to be adequately performed;

3.2.7.2 Identify any special mechanical design criteria or systems that may affect the duties of the *FPE* such as commercial cooking equipment, industrial processes, smoke venting or related pressurization systems, or other performance requirements;

3.2.7.3 Where the *MER* has provided a preliminary, *Performance Based Design* of *Fire Protection Engineering* systems with detailed design to be provided by the *FPER*, provide information related to locations and preliminary design criteria for fire protection equipment and systems. Guidelines for this required information are provided in the Appendix of the *BCBC* or *VBB*;

3.2.7.4 Inform the *FPE* of changes in mechanical system design where those changes may affect the duties of the *FPE*;

3.2.7.5 Where there are issues related to an *Alternative Solution* or a *Performance Based Design* involving mechanical systems, incorporate the recommendations of the *FPE* into the mechanical design.

3.2.8 *Electrical Engineer of Record*

The *EER* is responsible for the electrical systems shown on the contract documents prepared by the *EER*. The *EER* should:

3.2.8.1 Provide timely information in sufficient detail as required to permit the duties of the *FPE* to be adequately performed;

3.2.8.2 Identify any special electrical design criteria that may affect the duties of the *FPE*, such as oil-filled transformers, unsprinklered electrical rooms, protection of electrical conductors, fire alarm criteria, or other project requirements;

3.2.8.3 Where there are issues related to an *Alternative Solution* or a *Performance Based Design* involving electrical systems, incorporate the recommendations of the *FPE* into the electrical design;

3.2.8.4 Inform the *FPE* of changes to electrical systems that may affect the duties of the *FPE*.

3.2.9 *General Contractor*

3.2.9.1 The *General Contractor* has a contract with the *Owner*. This contract usually provides that the *General Contractor* is responsible for the labour, materials, and equipment for the work and that the *General Contractor* is responsible for the quality of construction, construction methods, techniques, sequences, procedures, safety precautions, and programs associated with the construction work, all as set out in the contract documents.

3.2.9.2 The *General Contractor* is responsible for coordinating the work of the *Sub-Contractors* and for checking the *Sub-Contractor's* work prior to *Field Reviews* by the *FPE*.

3.2.9.3 It is recommended that the *General Contractor* provide reasonable notice to the *Owner/FPE* or *CRP and/or FPE* when components are ready for *Field Reviews* by the *FPE*.

3.2.10 Design/Build Contractor

3.2.10.1 The design/build contractor assumes total design and construction responsibilities for a project, including all professional services, labour, materials, and equipment to produce completed construction in accordance with an agreed contract with the *Owner*.

3.2.10.2 In addition to the normal responsibilities of a contractor, the design/build contractor will take on many of the responsibilities of the *Owner*, as identified in Section 3.2.1, and may take on the responsibilities of the *CRP* [Section 3.2.2]. These responsibilities shall include retaining and providing coordination among the *FPE*(*s*) and other participants of the design/build team.

3.3 SELECTION OF CONSULTANTS

The recommended procedures for selecting a consultant are as described in the *Budget Guidelines for Consulting Engineering Services* published by the *APEGBC* and the Association of Consulting Engineering Companies of BC (ACEC-BC). Further information may also be found in the ACEC-BC brochure *Appointing Your Consulting Engineer Using Qualifications Based Selection*.

3.3.1. The following list include examples of various scopes of works that may require the services of a *FPE*:

(a) Preparation of *Alternative Solutions* based on *Performance Based Design* principles, often including fire dynamics analysis;

(b) Evaluation of fire hazards and risks resulting from fuel loads to assist in the design of fire protection systems as well as carry out timed egress analysis;

(c) The development of *Performance Based Design* specifications for a building;

(d) Hazard analysis using techniques such as computerized fire modelling programs in order to predict safe egress time, fire development, and smoke production rates for the design of smoke management system, activation times for sprinklers and/or detectors, and tenability conditions in buildings;

(e) Prediction or determination of fire resistance for wood, steel, and concrete construction assemblies as determined by fire growth and heat transfer models;

(f) *Review* of system *Design Drawings* and/or installations in order to provide recommendations and/or evaluation of fire protection systems. These *Reviews* may include fire alarm, fire detection, fire suppression, smoke management, smoke control, emergency voice communication, emergency egress routes, and water supply;

(g) *Field Review*, performance testing, and evaluation of *Fire Protection Engineering* systems;

(h) Development of smoke management system designs and test methods used to predict smoke production and movement within a building;

(i) Fire Suppression system design;

(j) Fire alarm and detection systems design.

The above list is not necessarily complete and is not intended to exclude other services.

4.0 GUIDELINES FOR PROFESSIONAL PRACTICE

The services which a *FPE* should consider as part of good practice are outlined below. This outline may assist in explaining the services of the *FPE* to a *Client*; it is not intended to be exhaustive and should not be interpreted to detract in any way from the previous provisions of these guidelines and what might be considered appropriate in the professional judgment of the *FPE* for the circumstances of a particular project.

The broad range of services provided by *FPE's* in building projects are covered under the following three categories. These are 1) design services (when acting as the *FPER*) and the following two types of *Code* related services, 2) fire and life safety *Fire Protection Engineering* services and 3) prescriptive design services. An *FPE* may provide one or more types of services on the same project. The design services may also be performed by an *MER* or *EER* and the information contained herein should in no way be construed as restricting their ability to perform such designs provided they are qualified to do so. Often, the *MER* may provide performance based specifications and sign *Letters of Assurance*. The *FPE* who provides the detailed design for the fire suppression system is the *FPER* for the purposes of this guideline.

A summary of the specific responsibilities a *Member* has under each of the fire suppression items identified on Schedule B of the *Letters of Assurance* are included in Appendix A.

4.1 SCOPE OF SERVICES - DESIGN

Fire protection design services may be provided by an *FPE*, the *FPER*, the *EER* (e.g. for the fire alarm system), the *MER* (e.g. for the sprinkler system, standpipe system, kitchen suppression system, dry chemical suppression systems, or gaseous agent suppression systems), or a combination of the design professionals of record and supporting engineers. Where the *MER* or *EER* are performing the designs, they should also refer to the appropriate guidelines, e.g. the *APEGBC Guidelines for Mechanical Engineering Services for Building Projects* or the *APEGBC Guidelines for Electrical Engineering Services for Building Projects*.

For existing buildings, the *FPE* may act as the *CRP* and be responsible for providing or coordinating most, if not all, *Fire Protection Engineering* design services on the project.

Before commencement of design services, the *FPE* should discuss with the *Client*:

4.1.1. The terms of reference and the scope of work for *Basic Services* and additional services;

4.1.2. Reach agreement on fees, payment schedule and professional liability insurance coverage;

4.1.3. Reach agreement on a contract. (Please refer to the Contract Language page on the ACEC-BC website. This website location includes Standard Form Agreements, a Contract Language Management Plan and Position Papers on Key Contractual Issues;

4.1.4. For a "fast-track" project, in addition to the above, the *FPE* should establish with the *Client* the terms and conditions under which preliminary or partially complete contract documents may be issued in advance and clearly define the requirements for partially complete contract documents;

4.1.5. For an existing building, the *FPE* should visit the site or obtain appropriate information about the building before discussing the scope of work;

4.1.6 Review the *Design Objectives*.

4.2 BASIC *FIRE PROTECTION ENGINEERING* SERVICES

The usual stages of the *Basic Services*, as discussed below, are generally organized in an agreement according to the sequential stages of a typical project. Each stage of the *Basic Services* generally contains those items which pertain most typically to the progress of work for that construction stage. Because of the requirements of a specific project, certain *Basic Services*/activities may be required to be performed out of the normal sequence or in different stages than indicated in the scope of services.

In many projects, the *FPER* is brought on as part of a design build contract. Many of the following steps therefore would not be required. Even for a designer active in earlier stages of the project, involvement in many of these steps may be minimal. For instance, reports on types of systems will generally not be required. In addition, the *FPER* may be responsible for only one of the disciplines potentially within the field of *Fire Protection Engineering*. Other engineers, such as the *MER*, the *EER*, or other *FPE*s, may be undertaking design for the other fields within the scope of *Fire Protection Engineering* design.

Similarly, many aspects of the following, including most of Sections 4.2.3 and 4.2.4, would not be applicable to an *FPE* engaging in fire and life safety analysis. While some aspects of other sections are relevant, research results may lead to only a few or possible one practical design alternative.

4.2.1 "Conceptual" or “Schematic" Design Stage

In the Conceptual or Schematic Stage, the *FPER* may:

4.2.1.1. Attend, as required, periodic meetings with the *Client* and design team to obtain the *Client's* instructions regarding the *Client's* functional, aesthetic, cost and scheduling requirements to prepare a preliminary design concept and to report on the *Fire Protection Engineering* systems which may include consideration of economy, performance, capital cost, sustainability, compatibility with other design elements and requirements of relevant *Codes* and authorities;

4.2.1.2. Assist the *CRP* or *Owner* in:

(a) Defining the need for any specialty consulting services which may be required for the project, e.g., *Alternative Solutions*, *Code*, and Certified Professional, life cycle assessment;

(b) Reviewing the project schedule including any milestone dates;

(c) Determining channels of communication;

(d) Determining drawing standards and specifications format;

(e) Determining the number and timing of project team meetings during each stage of the project;

4.2.1.3. Establish dates by which information affecting the fire protection design will be needed from other disciplines;

4.2.1.4. Conduct a site *Review* and review existing drawings where appropriate;

4.2.1.5. Establish criteria for the electrical, mechanical and other consultants as required;

4.2.1.6. Identify fire protection design criteria, prepare preliminary calculations for:

(a) sprinkler and standpipe design, establish basic hydraulic design criteria, water supply arrangements and characteristics, need for fire pump or unusual water supply, type of standpipe system,

(b) fire alarm design, basic fire alarm system requirements, special fire alarm system requirements such as high building measures and institutional needs,

(c) other fire protection system designs, basic system criteria required to provide the basis for the system design.

4.2.1.7. Consider developing with the *Client* and *CRP* and the design team's *Sustainable Goals* for the project.

4.2.1.8. Develop the fire protection scheme for the fire protection systems. Develop alternate schemes where appropriate. Consider materials and systems suitable to the project requirements. Consider the requirements of the other design professionals and provide the information they require;

4.2.1.9. Check applicable *Codes*, regulations and restrictions, insurance requirements and other factors affecting the design of the project;

4.2.1.10 Prepare a preliminary cost estimate or cooperate appropriately with others responsible for reporting the estimate;

4.2.1.11. Determine the allocation of suitable space for service rooms and other major fire protection installations;

4.2.1.12. Establish, where appropriate, comparative information to be used in selection of fire protection systems for the project;

4.2.1.13. Provide, if required, brief outline specifications for proposed materials;

4.2.1.14. Describe the major fire protection system(s) and each significant component and material;

4.2.1.15. Explain to the *Client* all new construction materials or new techniques proposed for use in the project and their alternatives, including the risks, advantages and disadvantages over both the short and long term, so that the *Client* can weigh the choices and make an informed decision before the *FPE* proceeds further;

4.2.1.16. Advise the *Client* of the recommended *Fire Protection Engineering* systems. Review the effect of these systems on the *Fire Protection Engineering* construction budget for the project;

4.2.1.17. A *Client* may assume responsibility for all or some of the foregoing conceptual or schematic design stage activities provided:

(a) the *FPE*'s ability to satisfy the requirements of the subsequent stages of these guidelines is unimpaired;

(b) the responsibility for such preliminary design activities is clearly defined in writing;

(c) the *Client* or *FPE*, in writing, waives the *FPE's* responsibility for such preliminary design activities and their effect on the selection of the *Fire Protection Engineering* systems. This waiver does not relieve the requirement for the *FPER* to comply with items included as signatory parts of Schedule B.

4.2.2 Design Development Stage

In the design development stage when the selected scheme is developed in sufficient detail to enable commencement of the final design and construction documents by all participants of the design team, the *FPER* may:

4.2.2.1. Attend, if required, meetings with the *Client* and design team;

4.2.2.2. Consider re-visiting the *Sustainable Goals* and strategies identified during the conceptual design stage of the project;

4.2.2.3. *Review* results of studies by appropriate specialist consultants;

4.2.2.4. Prepare preliminary *Fire Protection Engineering* analysis and design calculations for typical *Fire Protection Engineering* elements of the fire protection systems. Select appropriate equipment;

4.2.2.5. Prepare preliminary *Design Drawings* based on information coordinated with other consultants showing layouts of typical areas;

4.2.2.6. Prepare or edit the "Outline Specifications" for fire protection items, as required;

4.2.2.7. Coordinate *Fire Protection Engineering* design with space and servicing criteria to meet the requirements of the other design team participants. In particular, notify the *EER, MER*, and/or the *Architect* of all points of interface between the *Fire Protection Engineering* and the other disciplines and determine as soon as possible the electrical characteristics and electrical requirements of all *Fire Protection Engineering* loads and potential conflicts between the *Fire Protection Engineering*, mechanical, and electrical riser locations;

4.2.2.8. Coordinate the location of the fire hose and standpipe systems with other disciplines of the project team to ensure that the standpipe risers are properly protected without compromising the minimum clearance in the exiting stairs;

4.2.2.9. Specify the types of fire suppression systems used in areas subject to freezing and the development of appropriate design details or specifications. If heat tracing is provided, specify the minimum heating per unit area or per unit length of pipe, and the type and thickness of thermal insulation;

4.2.2.10. Submit design development documentation for *Review* and approval by the *Client*;

4.2.2.11 Review the documents prepared at the design development stage for consistency with the *Design Objectives*.

4.2.3 Contract Document Stage

In the contract document stage when the selected scheme is developed in sufficient detail to enable the preparation of contract documents, the *FPER* may:

4.2.3.1 General:

(a) Design the *Fire Protection Engineering* systems;

(b) Attend periodic coordination meetings, as required;

(c) Coordinate with the *AHJ* as required;

(d) Establish testing and *Field Review* requirements;

(e) Comply with fire resistance requirements as determined by the *CRP* or specialty consultants;

(f) Confirm that the *Fire Protection Engineering* systems meet the *Sustainable Goals* of the project and that the *Sustainable Goals* identified by the design team at the design development stage are met with respect to the responsibilities of the *FPER*;

(g) Seal documents per the *Act*;

(h) All designs must receive a design check as a standard procedure as per Bylaw 14(b)(2) of the *Act*. Refer to *APEGBC Quality Management Guidelines – Documented Checks of Engineering and Geoscience Work*;

(i) Coordinate fire protection design with space and servicing criteria to meet the requirements of the other design team participants. In particular, notify the *EER*, *MER*, and/or the *Architect* of all points of interface between the *Fire Protection Engineering* and the other disciplines and determine as soon as possible the electrical characteristics and electrical requirements of all *Fire Protection Engineering* loads and potential conflicts between the *Fire Protection Engineering* systems, mechanical, and electrical riser locations;

(j) *Review* the contract documents for consistency with the *Design Objectives*.

4.2.3.2. Fire Protection Calculations

The *FPER* must prepare *Fire Protection Engineering* calculations to support all *Fire Protection Engineering* designs. The *Fire Protection Engineering* calculations should be prepared legibly and presentably and filed by the *FPER* for record purposes. Hard copy of input and output of any computer analysis should be included as well as a description of the software used.

In general, *Fire Protection Engineering* calculations include but are not limited to:

(a) Design criteria:

- Discussion and description of design basis including assumptions;
- *Codes* and design standards used with edition dates;
- List of *Fire Protection Engineering* design parameters and provisions greater than *Code* requirements as requested by the *Client* or otherwise used by the *FPER*;

(b) Location diagrams for *Fire Protection Engineering* elements;

(c) Computer analysis and design results, if applicable;

(d) Special studies and analysis where required by *Code*.

4.2.3.3. *Fire Protection Engineering* Design

The *Fire Protection Engineering* designs are usually based on *Codes* and referenced standards (such as those prepared by NFPA and U.L.C.) Other design guides, such as ASHRAE, the electrical code, and indirectly referenced NFPA standards, should be used where appropriate. In addition, there may be designs based on criteria determined by other *FPE*'s.

4.2.3.4. *Fire Protection Engineering* Drawings

Prepare complete, contract drawings. The drawings should be made, where possible, to the same scale as that of the building layout drawings and should define the work:

(a) Where scale of drawings or complexity of work make drawing difficult to be read and interpreted, separate drawings should be provided for such areas of the work as *Fire Protection Engineering* and other related special systems;

(b) Schematics and diagrams should be provided as required for all major systems with notes to describe the function of control, flow and operation;

(c) Plot plans and/or site plans showing water supply arrangements and connections to public utility services as required, complete with elevations, should be included;

(d) For hydraulic calculations, node points with self explanatory interconnection between the drawings and hydraulic calculations;

(e) Floor plan layouts for all design systems such as sprinkler or fire alarm systems as appropriate should be provided. Complete pipe and/or conductor sizing should be shown on these documents. Pipe hanger, seismic restraint, and freeze protection details should be provided. Sizes, types, locations and temperature ratings of all sprinkler heads and hose connection outlets pressure regulating pressures and location of valves and types of fire alarm devices should be shown;

(f) To avoid conflicts, supplementary details should be provided for valve/pump or electrical rooms and congested areas;

(g) Where the *FPER* is also responsible for wiring, locations should be indicated where protection of conductors is mandated by *Code* (such as required for high buildings or fire pumps). Wiring locations are often not required otherwise and can be located by the contractor. However in renovations there may be a need to minimize the impact of wiring on existing architectural spaces. In such instances conduits and piping work can be shown in single line details. Where it is necessary to show arrangements and clearance for piping or duct work in ceiling spaces, shafts, header trenches, pipe chases and for tight or close-coupled equipment conduits and piping should be shown in double-line detail with appropriate valves, fittings and accessories;

(h) The *FPER* is to note on the drawing where the basis of the design criteria has been established by others;

(i) Schedules should be included to provide capacities and details of performance of compressors, pumps, etc. Alternatively, these schedules may be included in the specifications;

(j) All drawings as well as details, elevations and sections should be properly cross-referenced;

(k) Depending on the *FPER*'s scope of work, the drawings the *FPER* prepares for construction may include aspects of or all the *Fire Protection Engineering* related work on a project. These drawings normally should comply with the contract documents, the requirements for details to be incorporated in the design standard, recommendations contained in the *Fire Protection Engineering* reports prepared by the *FPER* or other *FPE's*, and sound engineering and construction practices. The *FPER's* review of other *FPE's* drawings shall be for general conformance with the contract documents and intent of the *Fire Protection Engineering* recommendations. They may also contain requirements that are required to be integrated into the design prepared by the *FPER*. This *Review* is not for the purpose of determining adequacy of elements and correctness of dimensions or quantities for which the *FPER* is responsible. The *Review* shall not constitute approval of the contractor's safety measures in or near the work site or methods of construction.

4.2.3.5. Specifications

(a) Where the documents form part of a tender package, prepare specifications using a format suitable for inclusion with the overall contract documents;

(b) The specifications should include information on:

- submittals required;
- standards, *Codes*, municipal by-laws governing work;
- quality control requirements;
- materials including material specification to meet the *Sustainable Goals* of the project;
- where applicable waste management for materials related to the installation of the *Fire Protection Engineering* systems;
- workmanship and fabrication;
- tolerances;
- information for temporary works and erection information where necessary to ensure the intent and integrity of the design;
- construction *Field Review* and testing;
- notification by the contractor before significant segments of the work are begun;
- warranties;
- performance criteria for design and detailing by *Supporting FPEs*.

(c) Where appropriate, the specifications may be abbreviated and become part of the drawings;

(d) The specifications generally set out that the *FPER*'s *Review* of submittals and *Field Review* of work as well as any testing by independent agencies reporting to the *Client* are undertaken to inform the *Client* of the quality of the contractor's performance and that this *Review* and testing are not for the benefit of the contractor. The contractor must provide his own independent quality control program.

4.2.4 Tendering Stage

4.2.4.1. Assist in the preparation of pre-qualification documents, if required;

4.2.4.2. Assist in reviewing bidder's qualifications, if required;

4.2.4.3. Assist the *Client* in obtaining required approvals, licences and permits. Prepare and supply *Letters of Assurance* and documents required by the *AHJ* or the *Code*;

4.2.4.4. Assist in analysis and evaluation of tenders submitted;

4.2.4.5. Provide assistance to the *Client* in answering queries raised by the bidding contractors and issue *Fire Protection Engineering* addenda and clarification of *Fire Protection Engineering* documents, as required;

4.2.4.6. Assist in the preparation of the contract, if required.

4.2.5 Construction Stage

It is essential that *Field Reviews* be provided for all systems for which the *FPER* is responsible to ascertain whether or not the work substantially complies with the *Fire Protection Engineering* contract or design documents.

It is preferable that the field services be provided by the *FPER*; however, where practical the *FPER* may delegate these duties to other qualified individuals.

Field Reviews including construction observation and testing to allow the design *FPER* to form a professional opinion about the *Fire Protection Engineering* aspects of the work undertaken by the contractor. The level of observation and testing required is at the discretion of the *FPER* based on what he/she feels is necessary in order for the *FPER* to complete the *Letters of Assurance* and submit to the appropriate *AHJ*.

Field services by the *FPER* should not be construed to relieve the contractor of the contractor's responsibility for building the project in accordance with the contract documents. The *FPER* does not have control of and thus is not responsible for: the quality of construction, construction means, methods, techniques or procedures; safety precautions and programs in connection with the construction work; the acts or omissions of the contractor, the *Sub-Contractors*, or any of the contractor's or *Sub-Contractors'* agents or employees or any other persons performing any of the construction work. In addition, the *FPER* is not responsible for the failure by the contractor or *Sub-Contractors* to carry out the construction work in accordance with the contract documents.

Construction observation or *Field Reviews* by the *FPER* does not relieve the contractor of responsibility for construction of the project, controlling progress, providing safe working conditions, and correcting any deviations from project requirements.

Some items reviewed by the *FPER* may also require *Review* by other members of the design team or by testing and inspection agencies. Such work may include proprietary products and *Fire Protection Engineering* elements designed by others.

4.2.5.1. Field Services During Construction

Field services should include, but not necessarily be limited to, the following and may vary depending on the complexity of the job:

(a) Attend construction meetings;

(b) Confirm communication channels and procedures;

(c) Assist in confirming, reporting and scheduling procedures for testing and *Field Reviews*;

(d) Assist in confirming procedures for *Shop Drawings* and other submittals;

(e) Confirm that the qualifications of manufacturers meet the specifications;

(f) Advise the contractor and the *CRP* on the interpretation of the *Fire Protection Engineering* drawings and specifications and issue supplementary details and instructions during the construction period as required;

(g) If requested, advise the *Client* on the validity of charges for additions to or deletions from the contract and on the issue of change orders;

(h) *Review* and comment on, if requested by the *Client*, the contractor's applications for progress payments. Estimate, if required, completed work and materials on site for payment according to the terms of the construction contract;

(i) *Review* reports from the testing and inspection agencies to determine if the agency has verified compliance of the reported item of work with the *Fire Protection Engineering* contract related documents. Initiate any necessary action;

(j) Coordinate *Field Reviews* of frost protection of concealed fire protection related piping in walls and ceilings with the *Architect*;

(k) Conduct substantial and total performance *Field Reviews* of the fire protection components of the project, note deficiencies and *Review* completed corrections;

(l) Submit, if required, *Letters of Assurance* and *Final Design Drawings* to the *CRP* or the *AHJ*; as appropriate;

(m) Attend the start-up of the *Fire Protection Engineering* systems and respond as required to any design-related operational difficulties. Arrange and perform a *Field Review* when the contractor has applied for substantial completion of the project; prepare a list of deficiencies (workmanship, completeness and function) and, when these have been rectified, issue the final report.

4.2.5.2. *Review* of Submittals

Submittals should be reviewed for general compliance with the *Fire Protection Engineering* related contract documents and do not include: checking dimensions or quantities or the *Review* of the contractor's safety measures or methods of construction.

(a) Review the *Shop Drawings* and other submittals for conformance with the contract documents and the intent of the design (refer to the *APEGBC Professional Practice Guidelines – Shop Drawings*);

(b) Confirm that the submittals have been reviewed by the *General Contractor* and relevant *Sub-Contractor* before review by the *FPER*;

(c) When appropriate and/or required, confirm that the relevant *Shop Drawings* bear the signature and professional seal of the *Supporting FPE* responsible for the design of such systems as pressure vessels and kitchen suppression systems. Responsibility for the detail design remains with the *Supporting FPE* whose seal and signature appears on the specialty drawings. To clarify responsibility, the *FPER* may qualify the extent of work which has been designed by the *Supporting FPE.* The *Supporting FPE* should submit model Schedules S-B and S-C to the

FPER (see *AIBC/APEGBC Practice Note 16: Professional Design and Field Review by Supporting Registered Professionals*);

(d) When required as per the contract documents *Review Record Drawings,* where provided, prepared and submitted by the contractor in electronic format or on white prints or mylar copies to reflect the constructed condition of the project as turned over to the *Client.* The *Client* shall be advised that these drawings are prepared by the contractor and have been reviewed only for general conformity to the drawing standards and the intent of the design and that the *FPER* cannot accept responsibility for the accuracy of the contractor supplied information. The *FPER* may seal *Record Drawings* if an appropriate declaration is provided on the *Record Drawings* (see Section 3.2.12.9 of the *APEGBC Quality Management Guidelines – Use of the APEGBC Seal*). *Record Drawings* may not be provided if there are no significant changes from the *Final Design Drawings* prepared and sealed by the *FPER*;

(e) Arrange for the contractor to submit and review the Operating and Maintenance Manual for the equipment/systems supplied on this project. The data submitted should include manufacturer's recommendations for maintenance of each piece of equipment and other such information which will enable the *Client* to assume operation of the building. In addition to regulatory or contractual requirements, the manual should explain special features of the system, such as filling antifreeze systems or pressure tanks, setting pressure regulating valves, or special hazards, such as the potential for explosions, if not properly detailed in manufacturers literature.

4.2.5.3. *Field Review*

(a) Visit the site at intervals appropriate to the stage of construction to determine the quality and the progress of the construction of those elements designed by the *FPER*. At the discretion of the *FPER*, proprietary products, connections and seismic restraint elements which have been designed by *Supporting FPE s* should be *Field Reviewed* by those *Supporting FPEs* at the appropriate stage of construction and reported in writing to the *FPER* (see *AIBC/APEGBC Practice Note 16: Professional Design and Field Review by Supporting Registered Professionals)*;

(b) Prepare site visit reports outlining observations and deficiencies in the work and bring them to the attention of the contractor's site representative;

(c) Distribute site visit reports to the contractor, *CRP* and other parties as appropriate. Where the *Owner* directly retains the services of the *FPER*, it is recommended that the *Owner* also be sent copies of the reports;

(d) Conduct a final project *Review* and advise the *Client* of continuing or newly-determined defects or deficiencies in the project;

(e) *Field Reviews* by the *FPER* are intended to confirm that the work or progress of the work substantially conforms to the design and the *Design Objectives* or intent.

4.2.5.4. Commissioning

While ongoing *Field Reviews* are usually required during a project, the demonstration of the efficacy of the *Fire Protection Engineering* systems at the completion of projects is essential for *Fire Protection Engineering* systems. The *FPER* should assure that testing has been performed by the contractor or *Sub-Contractors* such as:

(a) for fire alarm designers, following verification by the appropriate contractor
- spot checking fire alarm devices for alarm initiation and zoning
- checking audibility of the alarm devices
- confirming off-site monitoring, where provided

(b) for sprinkler designers
- checking the water supply with a flow test
- checking flow operation of the sprinkler system and associated alarm devices
- confirming that required sprinkler related fire alarm devices have been provided and the system has been verified

(c) for HVAC related designers
- review the balancing of the system for compliance with the *Design Objectives*
- review the interaction of the system with other design components (such as the fire alarm system) to check overall system performance

(d) for other designs
- provide functional tests to demonstrate the efficacy of the systems

The *FPER* is to ascertain that upon completion of the Contractor's Material and Test Certificates the following has been properly done:

- flushing of underground feed mains
- review of dry and preaction system trip times. Trip tests must be made to:

  (a) Ensure that the dry or preaction system will trip
  (b) Ensure that water will reach the site of the fire within a reasonable time period

- The review of full drain tests for irregularities that may indicate problems with the sprinkler system water supply.

It may not be feasible to conduct a full operational tests but the demonstration should test the interaction of as many components as practical.

4.3 BUILDING FIRE AND LIFE SAFETY ANALYSIS (*FPE*)

Building fire and life safety analysis comprises an overview of a building to establish the requirements for fire and life safety, identification of building features which do or do not provide the appropriate level of safety, and development of the appropriate remedies to achieve the required level of safety. The analysis may be based on the requirements of a prescriptive building *Code* or on an "objective - based" building *Code*, the latter approach requiring the application of *Fire Protection Engineering* principles to demonstrate that the required objectives will be achieved. For many building projects, the analysis may be a blend of the two approaches. That is, the prescriptive approach will be used to identify the fire and life safety requirements for the building. During this approach non-compliant building features will be identified. Where appropriate, an engineering analysis will be undertaken to identify cost effective alternatives for those features for which explicit compliance with a prescriptive requirement is not possible because of design or operational constraints.

4.3.1 Prescriptive Analysis

The following is a list of some of the services that the *FPE* may provide:

4.3.1.1. *Review* of schematic designs to identify building parameters which determine the building *Code* requirements applicable to the building;

4.3.1.2. Extract the applicable building *Code* fire and life safety requirements and determine how to apply those requirements to the building;

4.3.1.3. Prepare a building *Code* concepts report for the guidance of the design team;

4.3.1.4. Provide advice to the design team during the working drawing stage on how to achieve building *Code* compliance for particular issues. This will also include advising on compliance with standards referenced by the *Code*;

4.3.1.5. *Review* the working drawings at predetermined stages to check for general conformance to the applicable *Code* requirements;

4.3.1.6. Prepare a building *Code* analysis report for the assistance of the *AHJ* during the building permit application review;

4.3.1.7. Provide advice to the design team for the resolution of building *Code* compliance issues which arise during the construction stage;

4.3.1.8. Provide assistance to the design team during the commissioning of life safety systems;

4.3.1.9. Where requested by the *Owner* or the *CRP*, provide *Field Review* to identify and resolve *Code* compliance issues to facilitate the final occupancy *Field Review*.

4.3.2 Performance - Based Analysis

An objective based *Code* is a tool that can be used in developing a *Performance Based Design*. Some of services that could be provided include:

4.3.2.1. *Review* the conceptual plans of the building to identify the building parameters which determine the building *Code* objectives which influence the design of the building;

4.3.2.2. *Review* the building *Code* to identify the objectives which will have to be met in the building;

4.3.2.3. Meet with the *Owner* and the design team to determine if there are objectives or requirements in addition to the *Code* objectives;

4.3.2.4. Develop performance criteria which will establish that the objectives are met;

4.3.2.5. Identify relevant fire scenarios and develop design fires. Prepare a report for discussion with the design team and the *AHJ* to obtain agreement with the objectives, criteria, and design fires;

4.3.2.6. Develop and evaluate trial designs;

4.3.2.7. Where a trial design does not meet the performance criteria, modify and re-evaluate the design;

4.3.2.8. If design modification is not appropriate, *Review* the *Owner's* or other special objectives to determine if the objectives and associated performance criteria can be modified. If this is not possible, abandon the design;

4.3.2.9. In consultation with the *Owner* and/or the design team, finalize the selection of the design and prepare a performance - based design report;

4.3.2.10. *Review* the performance - based design report with the *AHJ* and other stakeholders to obtain comments and concurrence with the results of the analysis;

4.3.2.11. Finalize the performance - based design report;

4.3.2.12. Assist the design team in the preparation of construction documentation to establish that the documentation reflects the requirements of the design report;

4.3.2.13. Conduct *Field Reviews* to establish that any special features required by the design report are installed correctly;

4.3.2.14. Assist in the commissioning of fire and life safety systems in the building;

4.3.2.15. Assist in the preparation of operations and maintenance manuals and review those manuals to establish that they adequately describe the fire and life safety systems requirements and any other special building features that are required;

4.3.2.16. When satisfied the *Performance Based Design* has been adequately executed, provide a *Letter of Assurance* to the *AHJ*.

4.3.3 Mixed Analysis

A partial list of services which may be provided are:

4.3.3.1. For those features of the proposed design which cannot meet a prescriptive requirement explicitly, identify the intent of the particular prescriptive building requirement(s) which will not be met;

4.3.3.2. Establish the performance criteria which will be used to evaluate the acceptability of an *Alternative Solution*;

4.3.3.3. *Review* the intent of the prescriptive building *Code* requirement(s) and the proposed performance criteria with the design team and the *AHJ*;

4.3.3.4. Evaluate the alternatives and, in consultation with the design team, finalize the selection of the design;

4.3.3.5. Prepare a report on the analysis as a stand alone document or for incorporation in the building *Code* analysis report;

4.3.3.6. *Review* construction documentation to establish that the *Alternative Solution(s)* are adequately described;

4.3.3.7. Conduct *Field Reviews* to establish that the *Alternative Solution(s)* are being installed correctly;

4.3.3.8. Assist in the preparation of operations and maintenance manuals to establish that they contain the appropriate information with respect to the *Alternative Solution(s)*;

4.3.3.9. Witness commissioning tests of any special systems which are required by the *Alternative Solution(s)*;

4.3.3.10. Provide a *Letter of Assurance* to the *AHJ* when the engineer is satisfied that the *Alternative Solution(s)* have been correctly executed.

4.3.4 Specialty *Fire Protection Engineering* Analysis Services

In addition to *Fire Protection Engineering* design services and *Fire Protection Engineering* analysis for an entire project, a *FPE* may also be requested to provide services for only one or a small number of specific aspects of a building project. This may include activities such as development of *Alternative Solutions,* analysis of certain aspects of a building to assess *Code* compliance, or assistance to project designers or *Owners* with respect to determining the best method of meeting a *Code* requirement. For these specialty *Fire Protection Engineering* analysis services, the *FPE* should:

4.3.4.1. Develop a scope of services that clearly defines the *Specialty FPE*'s specialty analysis services and areas of involvement;

4.3.4.2. Establish clear lines of communication with respect to receiving direction as to the work required, and to reporting results, recommendations or observations;

4.3.4.3. *Review* applicable documents with respect to the area of analysis.

Fire Protection Engineering analysis services may include, but not be limited to:

4.3.4.4. *Review* of *Alternative Solution* designs, products or materials;

4.3.4.5. Programming of items such as *Owner's* equipment and fire and life safety systems, where investigation and analysis must determine user requirements for a statement of system requirements, materials, performance and reliability;

4.3.4.6. Conducting a risk and reliability analysis;

4.3.4.7. *Field review* and testing or commissioning of fire and life safety systems;

4.3.4.8. Surveys of existing fire and life safety systems and equipment;

4.3.4.9. Computer fire modelling;

4.3.4.10. Services as an expert witness in connection with any public hearing, arbitration, or court proceeding concerning the project, including attendant preparation;

4.3.4.11. Analysis of the fire-resistance rating of an existing or proposed structural member or assembly, or fire separation;

4.3.4.12. *Review* of special hazards such as industrial processes or storage regulated by the *British Columbia Fire Code,* the *Vancouver Fire By-Law* or other relevant municipal requirements;

4.3.4.13. Design of *Fire Protection Engineering* systems to protect special hazards;

4.3.4.14. Analysis of egress and exiting from a building or portion of a building;

4.3.4.15. Spatial separation analysis for a building or portion of the building;

4.3.4.16. *Field review* during construction for specific building features or systems;

4.3.4.17. *Review* of fire department access to a building;

4.3.4.18. Analysis of fire protection water supply for a building or development;

4.3.4.19. Analysis of combustible load in a building or portion of a building;

4.3.4.20. Development of *Alternative Solutions* or performance-based design aspects with respect to compliance with the intent of specific *Code* requirements.

Where the specialty analysis services include development of *Alternative Solutions* or performance-based approaches to meet the intent of *Code* requirements, the *FPE* should:

4.3.4.21. Identify the intent of the prescriptive *Code* requirement(s) that will not be met, and the criteria that will be used to evaluate the acceptability of an *Alternative Solution*;

4.3.4.22. Determine potential alternatives that meet the intent of the prescriptive requirement(s);

4.3.4.23. Evaluate the alternatives and, in consultation with appropriate members of the design team, finalize the selection of the design;

4.3.4.24. Prepare a report on the analysis as a stand alone document or for incorporation in a *Code* analysis report;

4.3.4.25. *Review*, as appropriate, the proposed *Alternative Solution(s)* with the *AHJ* and respond to questions or concerns that they may have regarding the proposed approach. This will normally include submittal of documentation, in a format acceptable to the authorities;

4.3.4.26. *Review* appropriate construction documentation to establish that the *Alternative Solution(s)* are adequately described;

4.3.4.27. Conduct *Field Reviews* where considered necessary to assess construction or installation of the *Alternative Solution(s)*;

4.3.4.28. Where applicable, assist in the preparation of operations and maintenance manuals to establish that they contain the appropriate information with respect to the *Alternative Solution(s)*;

4.3.4.29. Where applicable, witness commissioning tests of any special systems that are required by the *Alternative Solution(s)*;

4.3.4.30. Provide confirmation in writing to the *AHJ* when the *Alternative Solution(s)* have been satisfactorily constructed or installed.

4.4 ADDITIONAL *FIRE PROTECTION ENGINEERING* SERVICES

Services beyond those outlined under *Basic Services* are frequently required. These services are generally not considered part of the basic *Fire Protection Engineering* services. These services may be provided by the *FPE* or *FPER* under terms mutually agreed upon by the *Client* and the *FPE(R)*.

4.4.1. Additional Services

Special services are those which ordinarily cannot be foreseen when the scope of services is first developed or are not normally included as *Basic Services*. These may be included in *Specialty FPE* services outlined in 4.3.4, 4.3.5 and 4.3.6. The following includes some of the special services that may be provided:

4.4.1.1. Additional services due to changes in the scope, complexity, diversity, design, location, or magnitude of the project as described and agreed to under the basic service agreement;

4.4.1.2. Preparation of alternate fire and life safety system designs and related documentation after selection of the original system made during the conceptual or schematic design stages;

4.4.1.3. *Review*, design and documentation of *Alternative Solution* or substitute systems if requested by the *CRP*, the *Client*, or the contractor, for tendering to obtain competitive bids for items such as proprietary products;

4.4.1.4. Work connected with the preparation of documents for tendering segregated contracts, pre-tendered contracts, phased or fast-track construction, legal agreements or covenants required;

4.4.1.5. *Review* of *Alternative Solution* designs or products after completion of the contract documents;

4.4.1.6. Work resulting from changes necessary because of construction cost over-runs which is outside the control of the *FPE*;

4.4.1.7. Translation of contract documents into a second language, conversion to other units, special preparation of drawings for reduction;

4.4.1.8. Programming of such items as *Owner's* equipment and fire and life safety systems where investigation and analysis must determine user requirements for a statement of system requirements, materials, performance and reliability;

4.4.1.9. Analysis of long range plans as defined by the *CRP* and attendant preliminary sketches and reports (master planning);

4.4.1.10. Preparation of alternative building or system designs and attendant documentation when required by the *CRP* or *Client* either for *Review* or for competitive tender prices;

4.4.1.11. Construction, project management, coordination or negotiation services;

4.4.1.12. Conducting risk and reliability analysis and/or value engineering (life cycle costing) analysis including schematics where required by the *CRP*, *Client* or *AHJ*;

4.4.1.13. Preparation of analyses, designs, or other documentation for future implementation not included in construction contract;

4.4.1.14. Preparation of Bills of Material or Schedules of Material at any time during the project;

4.4.1.15. Resident engineering services during construction;

4.4.1.16. Preparation of analyses, drawings, specifications and change orders and administration of contract additions and/or deletions which are initiated by the *Client* but either have not been implemented or result in a reduction in the contract price;

4.4.1.17. Testing of building system components requiring confirmation of conformance with specifications and standards;

4.4.1.18. The preparation or detailed *Review* of operating or maintenance manuals;

4.4.1.19. Preparation of *Final Design Drawings* where requested (see Section 1.0);

4.4.1.20 Preparation of *Record Drawings* (see Sections 1.0 and 4.2.5.2 (d));

4.4.1.21. Providing services after expiry of the period of one (1) year following Certification of Substantial Performance or “occupancy” depending on services provided;

4.4.1.22. Complete or partial revision of design documents previously approved by the *Client* or in keeping with written instruction or drawings previously received from the *Client*;

4.4.1.23. Commissioning of building fire and life safety systems including: mechanical, electrical and other emergency systems;

4.4.1.24. Advisory services which include: testimony; consultation and advice; appraisals; valuations; research; other services leading to specialized conclusions and recommendations;

4.4.1.25. Surveys of existing fire and life safety systems/equipment;

4.4.1.26. *Review* of balancing of air and water/liquid systems where they directly impact on the *FPE*’s scope of work;

4.4.1.27. Modelling analysis, which involves the use of computer programs or other models/mockups to simulate a potential fire in a building;

4.4.1.28. Work beyond the extent of the project;

4.4.1.29. *Review* of seismic restraints designed by supporting engineers for fire and life safety systems;

4.4.1.30. Preparing or assisting with the preparation of cost estimates. The *FPE* should inform the *Client* of the variable inherent in the estimate and the expected degree of variation from the estimate. Where the degree of variation is critical, the *Owner* should have the estimate independently verified;

4.4.1.31. Filing or assisting in full or staged Building Permit application;

4.4.1.32. Preparation of demolition documents;

4.4.1.33. Tenant-improvement related design services;

4.4.1.34. Design or *Review* of the effects of the contractor's methods, procedures or construction equipment on the project;

4.4.1.35. Work resulting from corrections or revisions required because of errors or omissions not related to work under the responsibility, obligation or duty of the *FPE*;

4.4.1.36. Services required that are beyond or inconsistent with original instructions given by the *Client* or *Owner*, as a result of changes in *Codes*, laws or regulations, or change orders;

4.4.1.37. Services required as a result of errors, omissions, or poor workmanship by the contractor, *Sub-Contractors* or by other professionals on the project;

4.4.1.38. Services involved with regulatory meetings, public hearings or legal proceedings concerning the project including attendant preparation of same;

4.4.1.39. Services as an expert witness or fact witness in project related disputes;

4.4.1.40. *Review* and/or design of substitute systems;

4.4.1.41. Preparation of shop or fabrication drawings not part of the basic scope of work;

4.4.1.42. Extra services due to extended time schedules for design or construction;

4.4.1.43. Services resulting from damage as the result of fire, man-made disasters, or natural disasters;

4.4.1.44. Overtime work requiring premium pay when authorized;

4.4.1.45. Travelling time outside normal requirements;

4.4.1.46. Environmental impact comparison between various fire protection systems using a lifecycle assessment process.

APPENDIX A: *LETTERS OF ASSURANCE*

References: *British Columbia Building Code - Guide to the Letters of Assurance*

Vancouver Building By-law - Guide to Letters of Assurance

As stated in the above noted guidelines, *Letters of Assurance* are intended to clearly identify the responsibilities of key players in a construction project with respect to Building *Code* requirements. *Letters of Assurance* are intended to commit a project's *Owner* to engage the appropriate *RPs* in their corresponding disciplines to provide design and *Field Review* under the appropriate terms of reference, with signed and sealed assurances.

Guides related to *Letters of Assurance* are provided in both the *British Columbia Building Code* and the *Vancouver Building By-law*. These guides should be reviewed prior to completion of *Letters of Assurance*.

Definitions or descriptions of each of the various professional disciplines is defined in the appropriate Schedules B and C-B.

While the scope of the services provided by many design engineers such as the *FPER* is included in the Schedules B, and C-B's, many of the services provided by other *FPE*'s do not fit clearly within the items identified in the Schedules. The model Schedule S has been developed to provide a standard *Letter of Assurance* covering both the *FPE* and other supporting design professionals to provide an appropriate uniform *Letter of Assurance* (see *AIBC/APEGBC Practice Note 16: Professional Design and Field Review by Supporting Registered Professionals* for the model Schedules S-B and S-C). Examples where the model Schedules S would apply include kitchen hood fire suppression systems mandated by NFPA 96 under Part 6 of the *Code* (usually under the overall coordination of the kitchen hood *MER*), dry chemical systems (such as for a paint spray booth mandated by the *Fire Code*), and gaseous fire suppression systems (usually done to reduce damage and down time).

The Fire Suppression Schedules are generally associated with water based fire suppression systems as outlined in Subsection 3.2.5 of the *Code*. The design of sprinkler systems in accordance with NFPA 13D may not require professional design.

Scenario 1 - The responsibilities outlined below apply to both an *FPER* acting as the Prime Consultant as per Scenario 1 in Appendix A of Division C of the *Code* or as an Engineer responsible for the detailed design in conformance with a Performance Specification provided by the *MER* per Scenario 2 in Appendix A of Division C of the *Code*.

The items discussed below are numbered consistently with the numbers in Schedule B of the BCBC, and VBB, collectively referred to as the *Code*.

5.1 Suppression System Classification for Type of Occupancy

The *Fire Protection Engineer of Record (FPER)* is responsible for the determination of the hazard classification of the occupancy and the system type for the building.

The *Code* references NFPA 13, NFPA 13R, NFPA 14 and NFPA 20 as the standards to be used for the design and installation of fire suppression systems.

NFPA 13 contains tables of occupancies that are to be used in determining occupancy.

These are not consistent with occupancies listed in the *Code*. It is important when specifying and designing the sprinkler system that a precise understanding of the intended use of the building is acquired prior to system design. If this is not possible then one must specify the limits of the system design.

Definitions are not necessarily consistent between the *Code* and NFPA 13. The definitions used in NFPA 13 would apply to the application of the NFPA Standard.

5.2 Design Coverage, Including Concealed or Special Areas

The *FPER* is responsible for detailed design coverage for all areas, including concealed or special areas which are covered by the NFPA standards or are beyond the coverage of the NFPA standards. The special protection coverage in some areas may be the result of *Alternative Solution*s developed by the *Fire Protection Engineers*/*Code* consultants.

5.3 Compatibility and Location of Electrical Supervision, Ancillary Alarm and Control Devices

The *FPER* is responsible for:

- the design of the fire suppression system supervisory devices,
- confirmation that all fire suppression supervisory devices are properly located and connected to the fire alarm system,
- confirmation that all required freeze protection devices are installed and functional

The requirements for fire suppression system alarm and monitoring functions are contained in the *Code.* The primary responsibility for the fire alarm systems lies with the *RP* responsible for that system. However the *FPER* has a responsibility to coordinate their devices with the *RP* responsible for the fire alarm system.

In the case of a Part 9 Building with no fire alarm system, then more active design may be required by the *FPER* because an alarm system must be designed and provided.

5.4 Evaluation of the Capacity of Cities' (Municipal) water Supply Versus System Demands and Domestic Demand, Including Pumping Devices Where Necessary

The *FPER* is responsible for the comparison of the demands of the fire protection and domestic water systems relative to the water supply. NFPA 13R requires the domestic demand to be included in the sprinkler demand. Unless already designed by another design professional, the *FPER* is responsible for specifying the proper water connection size and the size of the water service lines. If a fire pump or fire pumps are required, the *FPER* is responsible for determining the fire pump capacities and the locations and the coordination of the power supply for the fire pump(s) with the *EER*.

Unless already designed by another design professional, if a water supply system is required to be designed and installed for the project, the *FPER* is responsible for the determination of the fire protection water flow demand and capacity, and the development of the specifications and drawings for the water supply system. The *FPER* must determine the appropriate standard in such applications. For sprinklered buildings, the relevant NFPA sprinkler standard is the appropriate standard. For unsprinklered buildings, coordination with the local Fire Department is essential and application of the appropriate standards should conform with the *Code*.

An investigation of the available water source and supply is necessary at the onset of any sprinkler system design. Major municipalities that provide normal static and peak demand supply information are the most convenient sources of reliable information in

respect to this issue. Where smaller municipalities, or private water sources are considered, it is important to rely not only on flow test information but one must apply a sufficient safety factor in order to allow for peak demand, low water level or other less than optimal conditions, or increased demand over time which results in reduced available water supply.

The *FPER* must be able to implicitly rely upon the information provided by the municipality subject to good engineering judgment.

For modifications to existing sprinkler systems the degree to which any particular requirements can be relaxed without affecting the existing level of safety of the *Code* requires judgment on the part of both the designer and the *AHJ*.

5.5 Qualification of Welder, Quality of Welds and Material

The *FPER* is responsible to ascertain that all welding is done by a welder having the appropriate trade qualifications.

5.6 *Review* of all Applicable *Shop Drawings*

The *FPER* is responsible for reviewing all applicable *Shop Drawings* to ensure suitable application to, and integration with, the overall design. See *APEGBC* document entitled *"Association Guidelines for Shop Drawings."*

5.7 Acceptance Testing for "Contractor's Material and Test Certificate" as per NFPA Standards

The *FPER* is responsible for ensuring that all tests as outlined in the Contractor's Material and Test Certificates (CMTC) for the fire suppression systems are completed properly by the contractor. This includes the underground services. Often, underground work is designed by a Civil Engineer, but regardless of who is responsible for the design, the *FPER* should be provided with a copy of the Underground CMTC.

There are a variety of CMTC formats depending on which NFPA standards apply to the specific suppression system installation.

5.8 Maintenance Program and Manual for Suppression Systems

The *FPER* is responsible for the specification of the content of the maintenance program and manual for the fire suppression system so that it complies with the appropriate *NFPA* standard. The *FPER* is also responsible to ascertain that the maintenance program and manual for the fire suppression systems is prepared in accordance with the specification and to direct that the maintenance program and manual for fire suppression systems be provided to the end user of the fire suppression systems.

5.9 Structural Capacity of Sprinkler Components, Including Anchorage and Seismic Restraint

The *FPER* is responsible for designing adequate support and seismic restraint of the primary elements of the sprinkler system piping and related components (i.e. fire pump, tanks, controllers, batteries, valves, valve manifolds, etc.) to assure that it meets the project design standards (e.g. NFPA 13). If complex seismic issues exceed the expertise of the *FPER*, the *FPER* is responsible for ensuring a qualified structural/seismic engineer is retained.

The *FPER* is responsible for the structural capacity of the support and fastening of the suppression system components but not the structural integrity of the fire suppression system components themselves.

5.10 For Partial Systems - Confirm Sprinklers are Installed in all Areas Where Required

Partial systems relate to instances where sprinklers are required to be installed, or are installed, in only a portion of a building or structure. The *FPER* is responsible for ensuring that sprinklers are provided for all relevant portions of whatever is driving the requirement for the sprinklers. (i.e.: if sprinklers are required for a spray booth, in an otherwise unsprinklered building, the *FPER* must confirm that all relevant ducts are provided with sprinkler protection).

5.11 Fire Department Connections and Hydrant Locations

The *FPER* is responsible for locating the fire department connection with respect to the hydrant locations. In the absence of an *MER* providing performance specification, the *FPER* is also responsible for coordination of these major system components with other disciplines of the project team.

The area between the hydrant and the fire department connection must be sufficiently free of obstructions to allow fire fighting personnel reasonable access to connect a hose.

5.12 Fire Hose and Standpipes

The *FPER* is responsible for designing the fire hose and standpipe systems and locating the fire hose connections and hose stations to conform to the requirements of NFPA14.

5.13 Freeze Protection Measures for Fire Suppression Systems

The *FPER* is to identify those portions of a sprinkler and standpipe system which require freeze protection measures and to confirm that all required freeze protection devices are installed and functional.

5.14 Functional Testing of Fire Suppression Systems and Devices

The *FPER* is responsible to assure that the functional testing of all fire suppression systems and devices has been carried out. This includes trip testing of dry and preaction sprinkler systems, flow testing of fire and booster pumps, etc.

Scenario 2 - The responsibilities outlined below apply to an *MER* providing performance specifications in accordance with Scenario 2 in Appendix A of Division C of the *Code.*

When an *MER* provides a Performance specification and signs for the Fire Suppression component of the Schedule B-2, the *MER* is undertaking the responsibility that the detailed fire suppression design will incorporate all elements in the specification. In general, under Scenario 2, the *FPER* should sign B1, B2 and C-B LOAs.

The *MER* does this by reviewing the detailed fire suppression design documents and by relying on the *FPER's* professional assurance. Consequently the *MER* will only have a coordinating role in items 5.2, 5.5, 5.9, 5.10, and 5.13 and to assure that items 5.2, 5.5, 5.9, 5.10 and 5.13 are addressed. In this coordinating capacity the *MER* meets his responsibilities with reliance placed on the *FPER* to addresses these items. If the *MER* observes issues of concern, they are to be coordinated with the *FPER*.

The other items as identified below should be directly addressed in the specifications and follow up *Reviews* by the *MER.* The *MER* may provide more detailed specifications in order to better protect the *Owner's* interests. The *MER's* responsibility for these other items is as follows:

5.1 Suppression System Classification for Type of Occupancy

As a minimum the *MER* is to determine and specify the appropriate sprinkler Standard (NFPA 13, 13R, or 13D and whether a standpipe system is required) per the *Code* or an *Alternative Solution*. The *MER* should include the necessary information on the type of occupancy in the detailed performance specifications and/or drawings.

5.2 Design Coverage, Including Concealed or Special Areas

MER to coordinate, see Section 5.2 of Scenario 1.

5.3 Compatibility and Location of Electrical Supervision, Ancillary Alarm and Control Devices

As a minimum interface with the electrical engineer as required in order to provide sufficient information for the electrical engineer to complete the design of the electrical aspects of the fire suppression system.

The *MER* should provide all of the electrical requirements for the fire suppression systems as part of the detailed performance specifications. The *FPER* should follow these requirements in the preparation of the *Final Design Drawings*; any discrepancies and/or changes should be brought to the attention of the *MER*, in writing.

5.4 Evaluation of the Capacity of Cities' (Municipal) Water Supply Versus System Demands and Domestic Demand, Including Pumping Devices Where Necessary

The *MER* should ascertain the capacity of the municipal water supply to meet the demands of the fire protection and domestic water systems and specify a fire pump only if the municipal water supply system cannot meet these demands. The need for an extraordinary water supply should be addressed if there is insufficient capacity or if there is an *Alternative Solution* which requires it.

The *MER* should coordinate the requirement for and capacity of the fire pump with the electrical engineer. This will be confirmed when the *FPER* completes their fire suppression system design.

The *MER* ensures that the appropriate design professional specifies the proper water connection size and the size of the water service line.

The *MER's* performance specifications will often require that the *FPER* reconfirm the municipality water supply and the water flows required for the fire suppression systems including modifications to tenant improvements.

For modifications to existing sprinkler systems the degree to which any particular requirements can be relaxed without affecting the existing level of safety of the *Code* requires judgment on the part of both the designer and the *AHJ*.

5.5 Qualification of Welder, Quality of Welds and Material

MER to coordinate, see Section 5.5 of Scenario 1.

5.6 *Review* of all Applicable *Shop Drawings*

The *MER* is responsible to review the *FPER's* drawings and appropriate *Shop Drawings* to ascertain that they substantially comply with the *MER's* performance specifications.

5.7 Acceptance Testing for "Contractor's Material and Test Certificate" as per NFPA Standards

The *MER* is responsible for reviewing the CMTC for the fire suppression systems to ensure the intent of the performance specifications are met.

5.8 Maintenance Program and Manual for Suppression Systems

As a minimum the *MER* should specify and review the manual for the fire suppression systems as part of their overall maintenance manual specifications.

The *FPER* may rely on the *MER* to ensure that the intent of the performance specifications have been met.

5.9 Structural Capacity of Sprinkler Components, Including Anchorage and Seismic Restraint

MER to coordinate, see Section 5.9 of Scenario 1.

5.10 For Partial Systems - Confirm Sprinklers are Installed in all Areas Where Required

MER to coordinate, see Section 5.10 of Scenario 1.

5.11 Fire Department Connections and Hydrant Locations

The *MER* should determine the location of nearby hydrants and locate the fire department connections for coordination with architectural features and conformance to the *Code*.

The area between the hydrant and the fire department connection must be sufficiently free of obstructions to allow fire fighting personnel reasonable access to connect a hose.

5.12 Fire Hose and Standpipes

The *MER* should determine the basic design criteria for a standpipe system and, if hose connections are required, the *MER* should show all the fire hoses and standpipes on the performance specification drawings; the layouts should be reviewed with the *FPER*.

5.13 Freeze Protection Measures for Fire Suppression Systems

The *MER* is to specify the requirements for heat tracing and insulation for freeze protection of all sprinkler and standpipe systems.

5.14 Functional testing of fire suppression systems and devices

MER to coordinate, see Section 5.14 of Scenario 1.

APPENDIX B: "*SUPPORTING FPE* - ASSURANCE OF PROFESSIONAL DESIGN AND *FIELD REVIEW*"

NOTE: Please refer to *AIBC/APEGBC Practice Note 16: Professional Design and Field Review by Supporting Registered Professionals* for the model Schedules S-B and S-C and *APEGBC Bulletin K: Letters of Assurance in the BC Building Code and Due Diligence.*

APPENDIX C: GUIDELINES FOR DESIGN BUILD FIRE SUPPRESSION SYSTEMS

Many sprinkler and standpipe systems involve a combined design by an *FPER* and a contractor's designer. A clarification of "prepared under *Direct Supervision*" is appropriate. Refer to the *APEGBC Quality Management Guidelines – Direct Supervision*.

If the tender documents include a pipe layout with detailed pipe sizing the engineer preparing that design should be the *FPER* and should support their design. If there is a more *Performance Based Design* or if the contractor elects to significantly modify the tender design in accordance with the tender documentation, then the *FPER* responsible for the final design should be involved in the following steps:

(i) Prior to any drawing or sizing of piping, the *FPER* reviews the structure and architectural arrangement to optimize the location of mains and branch lines.
(ii) The *FPER* reviews the water supply arrangements. The water supply characteristics also require review to determine an acceptable design supply curve.
(iii) The *FPER* determines the hazard level and basic design requirements.
(iv) The fire suppression system piping and sprinkler head arrangement is drawn.
(v) The *FPER* determines the hydraulic calculated area.
(vi) Ascertain whether seismic design is required and incorporating it into the design as appropriate.
(vii) The system is hydraulically calculated and sizing information transferred to the drawings. Economic considerations should be considered in pipe sizing. Details are added to the drawings as required.
(viii) The *FPER* reviews the entire design.
(ix) The *FPER* reviews the installation including before boarding, after boarding, hearing alarms, etc. where appropriate.

The above guidelines may be modified to suit different types of projects. While the involvement of the *FPER* may vary, only under unusual circumstances, such as the unavailability of the original *FPER*, should an *FPER* get involved only when the design is complete.

Similar guidelines can be developed for other *Fire Protection Engineering* systems.

APPENDIX D: SAMPLE CHECKLIST FOR SPRINKLER SYSTEMS

Project: _____ Date: _____

List prepared by: _____

- ❑ Name of Owner and Occupant:
- ❑ Location, including street address:
- ❑ Point of compass:
- ❑ Full height cross section, or schematic diagram, if required to clarify, including ceiling construction and method of protection for nonmetallic piping:
- ❑ Location of partitions:
- ❑ Location of firewalls:
- ❑ Occupancy class of each area or room:
- ❑ Location and size of concealed spaces, closets, attics and bathrooms:
- ❑ Any small enclosures in which no sprinklers are to be installed:
- ❑ Size of City main in street and whether dead-end or circulating. If dead-end, direction and distance to nearest circulating main. City main test results (the lowest possible summer pressure must be used) and system elevation relative to test hydrant:
- ❑ Make, type and nominal orifice size of sprinklers:
- ❑ Total number of sprinklers on each dry pipe system, preaction system, etc.
- ❑ Approximate capacity in gallons of each dry pipe system:
- ❑ Pipe type and schedule of wall thickness:
- ❑ Nominal pipe size and cutting length's of pipe (or centre to centre dimension):
- ❑ Location and size of riser nipples:
- ❑ All control valves, check valves, drain pipes and test connections:
- ❑ Kind and location of alarm valves:
- ❑ Underground pipe size, length, location, weight, material, point of connection to City main; the type of valves, meters, and valve pits; and the depth that top of the pipe is laid below grade:
- ❑ Piping provisions for flushing:
- ❑ For hydraulically designed systems, the information on the hydraulic data nameplate:
- ❑ A graphic representation of the scale used on all plans including the scale used on the graph sheet:
- ❑ Name and address of contractor:
- ❑ Hydraulic reference points shown on the plan shall correspond with comparable reference points on the hydraulic calculation sheets:

Information Relating To The Basis Of Design

A. Hydraulic Information Required

- ❑ Description of hazard.
- ❑ Design area of water application (Does the remote area appear correct?)
- ❑ Density
- ❑ Total water requirements as calculated including allowance for inside hose, outside hydrant, in rack sprinklers, and water curtain and exposure sprinklers (Is the water supply and pressure sufficient for the water demand?)
- ❑ Sprinkler description and discharge constant (K) (Is the K factor correct?).
- ❑ Number of sprinklers calculated for each section.

Sprinkler Checklist for: _____

B. Data Required for Review

- ❑ Has 30% increase for design area been added for each dry pipe system?
- ❑ Has area been adjusted for sloped ceiling?
- ❑ Has reduced design area been used for FR heads?
- ❑ Has larger area been used for storage hazards?
- ❑ Has the information for the hydraulic nameplate been supplied?
- ❑ Are pipe length's or plans the same size as on calculations?
- ❑ Are pipe sizes on plans the same as listed on calculations?
- ❑ Have all valves, fittings, T's, elbows, etc. been added to the calculations?
- ❑ Is the HWC-value for the pipe correct?
- ❑ Is the flow for the first sprinkler correct?
- ❑ Are all the reference points shown on the sprinkler plans?
- ❑ Is the spacing and coverage area per sprinkler correct?
- ❑ Are all the pipe sizes shown on the plan and do they correspond to the calculations?
- ❑ Are the pipe lengths, centre to centre of fittings shown on the plans and do they correspond to the calculations?
- ❑ Is the density from the design curve correct?

Calculation program result checking

- ❑ Are the equivalent pipe lengths for fittings and devices noted on the plan or calculations?
- ❑ Friction loss per metre of pipe?
- ❑ Total friction loss between reference points.
- ❑ Elevation head in kPa (or bars or psi) between reference points.
- ❑ Required pressure at each reference point.
- ❑ Location and elevation of static and residual test gauge with relation to the riser reference points.