



**Technical Audit
of
New Zealand Fire Service
Design Review Unit**

Report prepared by

Warrington Fire Research Australia

For

**New Zealand Fire Service
Engineering Unit
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EXECUTIVE SUMMARY

Warrington Fire Research Australia Pty Ltd (WFRA) has been commissioned by the New Zealand Fire Service (NZFS) to undertake a technical audit of a representative sample of work performed by the NZFS Design Review Unit in the discharge of their duties under the Building Act 2004.

The NZFS Design Review Unit (DRU) was formed in late April 2005 to review fire engineering designs submitted to the NZFS in accordance of Section 46 of the Building Act 2004. The DRU aims to provide a written memorandum to the Building Consent Authority (BCA) regarding the fire engineering designs of designated buildings with respect to the following matters:

- Provision of means of escape.
- The ability of the fire service to undertake fire fighting operations.

Designated buildings are identified in the NZ Gazette as those that utilise performance based fire engineering designs and require a NZFS approved evacuation scheme.

The technical audit undertaken was based on the following methodology:

- The full list of the building consents received and assessed by the DRU was submitted and a representative audit sample of 26 was selected by WFRA. The NZFS had no input into the selection process adopted by WFRA. The applicable fire engineering documentation relating to the selected 26 audit samples were then forwarded by the DRU for assessment.
- A technical review of the fire engineering design was undertaken to assess the submitted documentation against the relevant provisions of Building Act 2004 including relevant design standards. This technical review includes comments on the methodology and quality employed by the fire engineer designer, and the technical accuracy of the memorandum response provided by the DRU.

The technical review undertaken by WFRA in the scope of this report does not constitute a peer-review in accordance with the Institute of Professional Engineers New Zealand (IPENZ) guidelines. The review is limited to the scope identified above, as directed by the Engineering Unit of the New Zealand Fire Service.

The findings of this report are identified in 2 stages:

1. A summary of the quality and technical merit of the NZFS DRU memorandums and fire engineering reports; and
2. Recommendations for improvements with respect to the NZFS DRU process.

The results of the quality and technical review are provided in the following summaries:

| DRU MEMORANDUMS | Percentage of reports | | | | |
|------------------------|-----------------------|------------|------------|------|-----------|
| | Poor | Incomplete | Acceptable | Good | Very Good |
| Assessment Background | 41% | 0% | 59% | n/a | n/a |
| Well presented format | n/a | n/a | 100% | n/a | n/a |
| Technically accurate | 0% | 38% | 62% | n/a | n/a |
| Information actionable | 15% | 38% | 47% | n/a | n/a |

| ENGINEERING REPORTS | | Percentage of reports | | | | |
|--|--|-----------------------|------------|------------|------|-----------|
| | | Poor | Incomplete | Acceptable | Good | Very Good |
| Formal fire engineering design process | <i>Identified</i> | 4% | 8% | 83% | 4% | 0% |
| | <i>Followed</i> | 29% | 63% | 8% | 0% | 0% |
| Acceptance criteria | <i>Specified</i> | 13% | 21% | 42% | 17% | 8% |
| | <i>Comprehensive</i> | 21% | 38% | 42% | 0% | 0% |
| Engineering methods used | <i>Appropriate & Technically correct</i> | 17% | 75% | 8% | 0% | 0% |
| Conclusions | <i>Clear</i> | 4% | 19% | 50% | 19% | 8% |
| | <i>Substantiated</i> | 4% | 77% | 12% | 8% | 0% |

The results indicate that the DRU is effectively fulfilling their obligations under the Building Act Section 47 taking into account the quality and detail of the submissions.

Recommendations for improvements with respect to the NZFS DRU process have been separated into 2 categories:

1. Measures which can be managed by the NZFS Design Review Unit; and
2. Opportunities for improvement to the building industry process in which the NZFS Design Review Unit operate and which has an effect on the quality and technical ability of the DRU responses.

Findings in the Performance of the NZFS Design Review Unit

Finding 8-1

A review of the means of escape and fire fighting provisions within a fire engineered design should not be conducted in isolation to other measures of the proposed strategy.

Fire Engineering Design requires a holistic approach to an assessment; therefore, the review should also adopt this principle in associating aspects of a proposed fire engineering design to the provisions for the means of escape and fire fighting. NZFS Design Review Unit should adopt this principle in discharging their duties in accordance with Section 47 of the Building Act 2004.

Finding 8-3

The NZFS Design Review Unit response period of 10 working days should include a mechanism for the request of additional information. Similar to the BCA when considering Building Consent applications, this period should not include the time when additional information is requested from the BCA so that appropriate NZFS Design Review Unit comment can be made.

The NZFS Design Review Unit should request the Department of Building and Housing to provide interpretation of “working days” that is consistent with that provided to Building Consent Authorities in the consideration of building applications, as set out in the Building Act.

Finding 8-4

Adoption of principals in IPENZ Practice Note 2 – *Peer Review, reviewing the work of another Engineer* as the basis for the NZFS Design Review Unit role in undertaking the duties identified in Section 47 of the Building Act 2004.

These principals should be incorporated into an internal document, prepared to assist DRU reviewing engineers in discharging this duty in a consistent and transparent manner. This is to include clear guidance in undertaking a holistic review of a design in context with issues relating to means of escape and fire fighting provisions.

Finding 8-5

The NZFS Design Review Units should endeavour to participate in the Fire Engineering Brief process to enable technical input to the design/assessment and resolution of regulatory and technical issues at the early design stage of the project rather than upon building consent submission.

Finding 8-7

The quality of fire engineering submissions has been shown to significantly influence the quality of the NZFS Design Review Unit assessment. Minimum benchmarks should be set within the DRU to determine an appropriate quality of fire engineering submission that can be reasonably reviewed by them in discharging their duties under Section 47 of the Building Act 2004.

Opportunities for Improvement in undertaking Fire Engineering Assessments

Finding 8-2

The NZFS Design Review Unit should recommend to the Department of Building and Housing that 'Guidance Notes' be developed for fire engineering practitioners and Building Consent Authorities on the preferred format and minimum information contained within Fire Engineering submissions containing assessments for Alternative Solutions.

Finding 8-6

The NZFS Design Review Unit should recommend to the Department of Building and Housing that 'Guidance Notes' be developed for building practitioners (including Building Consent Authorities and fire engineering practitioners) on the expectation of the Department when designers use *reasonable practicable* as justification for variations to Compliance Documents and making submissions to NZFS Design Review Unit under Section 47 of the Building Act 2004.

Finding 9-1

Fire engineering practitioners should be required to adopt a holistic approach to the identification, formulation and assessment of performance based fire engineering designs. Appropriate fire engineering guidelines that set out acceptable practice methodologies are to be adopted, such as the International Fire Engineering Guidelines.

Recommendations should be made to the 'Department of Building and Housing' and IPENZ that an improvement in the general quality of fire engineering submissions is an opportunity for improvement of the building approval process.

Finding 9-2

The NZFS Design Review Unit should recommend to the Department of Building and Housing that “Guidance Notes” should be developed for the guidance of fire engineering practitioners in undertaking performance based fire engineering design. This is to include the minimum expectations to the competency of the designer relevant to the design proposed, form which a fire engineering assessment is provided for submission to BCA, reasonable justification of assessment and assumptions made and involvement of relevant stakeholders.

Suitable assistance in the development of these notes is provided in the International Fire Engineering Guidelines.

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PART ONE – BACKGROUND

1 INTRODUCTION

1.1 DESCRIPTION OF WORK

Warrington Fire Research Aust Pty Ltd has been appointed to conduct an audit of the NZFS Design Review Unit (DRU) based on a technical assessment of a selection of building consent applications submitted to the NZFS and the corresponding DRU memorandums issued to the Building Consent Authority.

1.2 SCOPE AND LIMITS OF REPORT

The scope of this report is a technical assessment of the memorandums issued by the DRU. A review of the fire engineering design documents submitted as part of the building consent process have also been assessed in order to establish the context in which the memorandums have been issued.

The purpose of this audit is to report on the quality and technical accuracy of the memorandums issued by the DRU and is not intended to incorporate a peer review of the selected fire engineering projects. The findings presented in this report should not be used to establish compliance with or approval from regulatory bodies or authorities having jurisdiction for any particular project.

The individuals and organisations involved in the selected projects, including the design company, fire engineer designer and DRU reviewers, have not been identified in the body of the report for privacy reasons. These details are of no consequence to the findings and have no impact on the technical validity of the projects reviewed.

The assessments conducted and reported in this document are the opinions of WFRA for the purposes of establishing the quality and technical understanding of the New Zealand Fire Service Design Review Unit.

2 NEW ZEALAND REGULATORY SYSTEM FOR BUILDING DESIGN

2.1 INTRODUCTION

The New Zealand building industry applies a performance based building code (The Building Code¹) regulated by the Building Regulations 1992² and the Building Act 2004³.

Through the rigor of a performance-based design, it can be demonstrated whether or not a building design is satisfactory and complies with the implicit or explicit intent of the applicable code requirement⁴.

While designing for performance is expected to increase innovation by freeing a design from prescriptive constraints⁵, the risk of variations in the determination of minimum performances, objectives and inconsistencies in the assessment of designs against these objectives is increased substantially unless the performance objectives are well defined⁶.

The New Zealand approval process identifies regulatory avenues in which a design may comply with the Building Code and hence the Building Regulations 1992 and the participants that are to be involved so far as to the design, approval and construction of a building.

2.2 REGULATORY FRAMEWORK

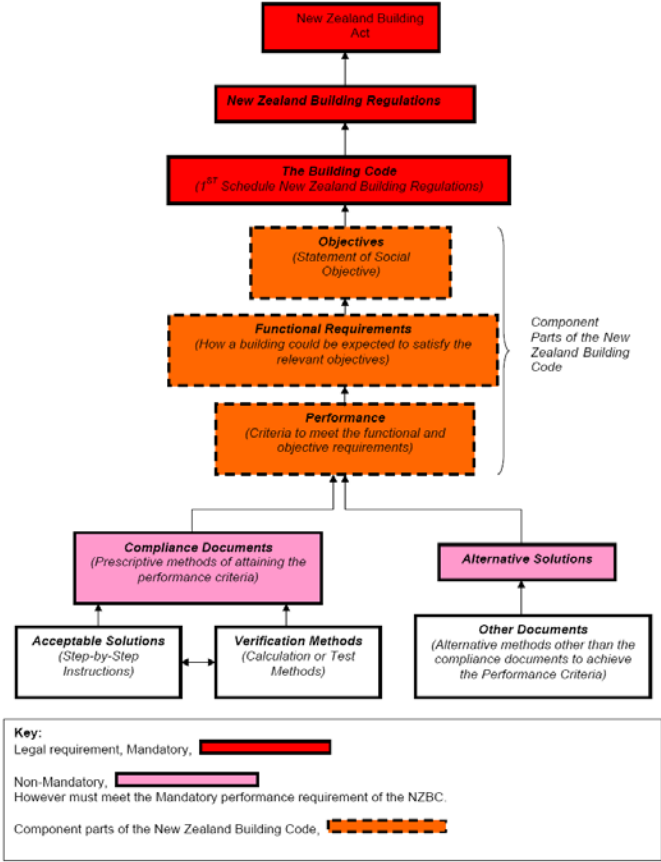


Figure 2-1 – Regulatory Framework⁷

The regulatory framework is shown in Figure 2-1 taken from the International Fire Engineering Guidelines⁸. As shown in this structure, there is a regulatory requirement for all designs to satisfy the Building Act 2004. In the majority of new and existing buildings, the design is to comply with the Performance criteria of the Building Code.

In order to demonstrate that a building design satisfies the Performance criteria of the Building Code, the Building Regulations 1992 allows the use of standard Acceptable Solutions and Verification Methods prepared by the Department of Building and Housing Compliance Documents⁹ or an Alternative Solution, as shown in Figure 2-2 from the International Fire Engineering Guidelines.

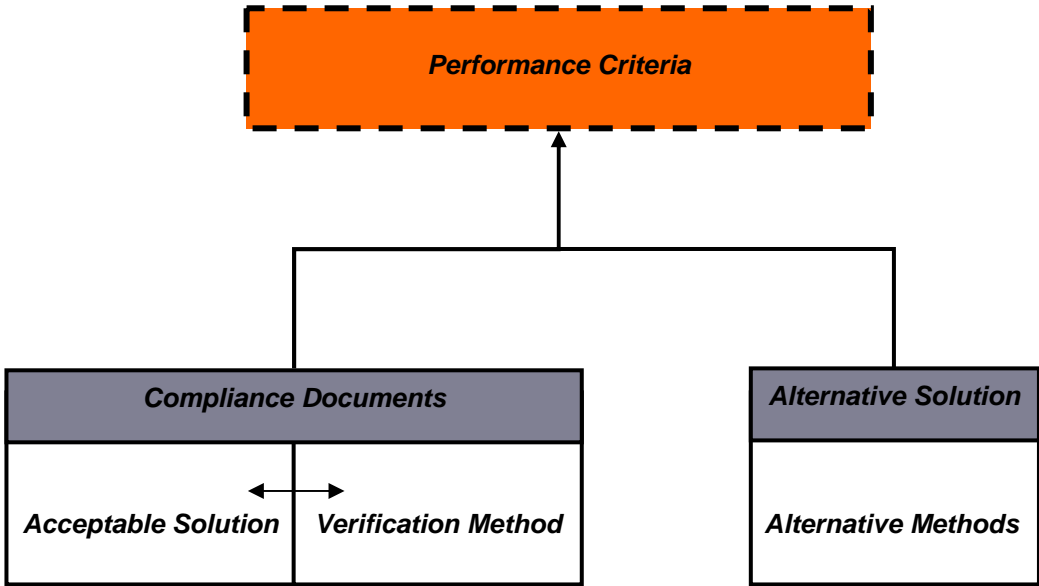


Figure 2-2 – Three avenues allowed by the Building Code for a design to comply with Performance criteria⁷.

The level of safety provided in the Building Code’s Performance criteria is not explicit or quantified such that this may lead to a varying range of interpretation of the performance requirements⁵.

2.3 PROCEDURE FOR DESIGN AND APPROVAL OF BUILDING DESIGNS RELATING TO FIRE SAFETY

The Building Act 2004 identifies the participation of certain groups in the building process at different stages. This includes groups such as the owner/agent, designers/consultants for the design, planning approval (i.e. Territorial Authority), code compliance and inspection (i.e. Building Consent Authority) and others.

An outline of this process, with consideration to both avenues of Building Code compliance, is provided in Figure 2-3.

When a building is designed in accordance with the Compliance Documents, the Building Consent Authority can not refuse Building Consent, such that the involvement of NZ Fire Services and the Fire Engineer is limited. However, if a design requires an evacuation scheme or it proposes to vary from the Compliance Documents then the proposal is to be submitted to the NZFS Commission for advice, in accordance with Section 46 of the Building Act 2004.

To ensure that engineering and non-engineering factors are adequately addressed in the design, it is important that the intent and objectives of the regulations are well understood. Relevant stakeholders and authorities having jurisdiction are to be active participants in the engineering analysis and design process¹⁰

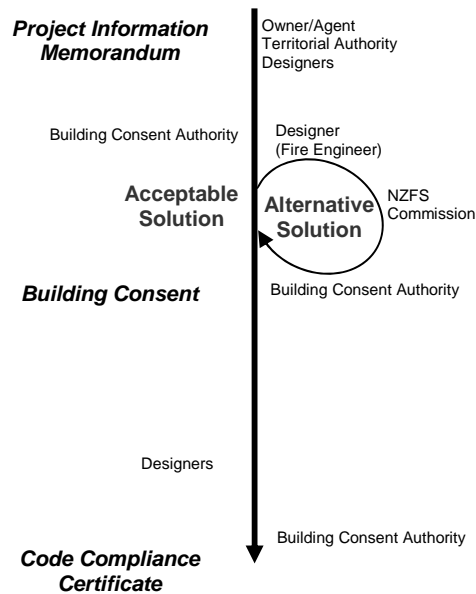


Figure 2-3 – Outline of the required participants in the NZ building approval process¹¹.

2.4 INVOLVEMENT OF NZFS IN BUILDING REGULATORY PROCESS

Section 46 of the Building Act 2004 allows involvement of the New Zealand Fire Services in the building approval process in specific instances with limitations to the type and extent of advice that can be given.

The NZFS may provide comment to the Building Consent Authority (BCA) of the design during the time the BCA processes the relevant building consent application. Designated buildings are identified in the NZ Gazette as those that require an evacuation scheme and are an alternative design to the Compliance Documents.

To facilitate this process, copies of the fire report will be sent from the BCA to the NZFS for comment, and the NZFS may within 10 working days pass comment by way of a memorandum back to the BCA on:

- a) The provisions for means of escape from fire.
- b) The needs of persons who are authorised by law to enter the building to undertake fire-fighting.

If the NZFS does not comment within ten working days then the BCA may proceed to determine the application without the memorandum from the NZFS; i.e. the NZFS forfeit their role for the purposes of the Act. Additional to this time constraint, the DRU may not offer advice that exceeds the Performance criteria of the Building Code.

2.5 ROLE OF THE DRU

As New Zealand has adopted a national approach in the building control process with the establishment of the Building Consent Authority position, the NZFS has also adopted a national approach in discharging the NZFS Commission's duties in performing an advisory role to the BCA under the Building Act 2004.

The NZFS established the Design Review Unit (DRU) in April 2004. The unit undertakes all performance based fire engineering reviews on behalf of the NZFS and enables a single department of the NZFS to liaise with the BCA to facilitate the building approval process.

Though the role of the DRU is advisory to the BCA in their consideration of the Building Consent application, Section 48 of the Building Act 2004 requires that the BCA must have regard for the memorandum issued by the NZFS Commission.

The technical accuracy of the DRU in undertaking this role is to be examined in this audit by way of a review of DRU Memorandums and the corresponding design submission provided by the BCA.

PART TWO – SURVEY METHODOLOGY

3 INTRODUCTION

This Technical Audit aims to provide an indication of the technical accuracy of the Memorandums issued by the NSWFS Design Review Unit (DRU). Projects selected for this Audit are intended to be representative number reflecting both a cross-section of designers and DRU reviewers.

In order to investigate the technical accuracy of advice provided by the DRU, a review of the fire engineering submission is also required. This is to assess the justification for advice prepared by the DRU reviewers. It also allows consideration of any aspect of the fire engineering submission which may have affected how the DRU was able to undertake their duties.

Audits of systems require that items be assessed against relevant benchmarks. In this instance, benchmarks are to be representative of critical components of the role of the DRU in undertaking their role in the regulatory environment described in Section 2.5.

4 PROJECT SELECTION METHODOLOGY

4.1 INTRODUCTION

The audit methodology adopted for this project was designed to obtain a sample of fire engineering designs which are characteristic of the total number of designs submitted to the DRU by designer and DRU reviewer. The audit sample of 26 was identified as part of the project scope and represents approximately 4.6% of the total pool of fire engineering designs submitted to the DRU since April 2005.

4.2 SAMPLING

The full list of building consents received and assessed by the DRU since April 2005 was provided and a representative audit sample of 26 was selected by WFRA. The NZFS had no input into the selection process adopted by WFRA. The applicable fire engineering documentation relating to these 26 audit samples were then provided by the DRU for assessment.

The selection process adopted by WFRA was developed to provide a representative sample of building designs and reviews within the limitations of the project scope. The number of designs submitted by each fire engineer designer and the number of consent reviews undertaken by each DRU reviewer were collated so that the percentages of individual fire engineers and reviewers to the total pool could be approximated in the sample audit. Where possible, each fire engineer and reviewer were represented in the sample audit, except as related to the limitations of the project scope and where individuals involved in only a small number of projects could not be incorporated. The projects were then selected randomly based on the above criteria.

This process was designed to avoid skewing the selected projects to any individual fire designer or reviewer. In addition, this process enabled any designers or reviewers forming a significant proportion of the total pool to be appropriately represented in the audit sample.

The project selection process was intended to achieve the following:

- a) A sample of typical projects reviewed by the DRU, both complex and relatively small scale projects.
- b) A fair selection of fire engineer designers which is intended to be representative of the fire engineers operating in New Zealand.
- c) A fair selection of DRU reviewers which is intended to be representative of the quality of the reviews undertaken by the NZFS.

The project selection process yielded the audit samples A to Z as identified in Table 4-1; i.e. project A was submitted by company A and assessed by DRU reviewer A, etc. Note that the initial list of projects from which the samples were selected did not identify the individual fire engineer involved in the submission but only listed the relevant company.

Table 4-1 – Summary of project selection process

| DRU Reviewer | A | B | C | D | E | F | G | H | I | total | designs as % of consents | designs as % of sample |
|------------------------------|-----|------|------|-----|------|------|------|------|------|-------|--------------------------|------------------------|
| Company | | | | | | | | | | | | |
| A | A | S | I | | F | R | | | | 5 | 23.1% | 19.2% |
| B | | B | | | | | | | | 1 | 0.5% | 3.8% |
| C | | | C | | | | H | | | 2 | 4.6% | 7.7% |
| D | | | | D | | | | Y | | 2 | 6.2% | 7.7% |
| E | | | E | | | | | | | 1 | 1.8% | 3.8% |
| F | | | | | | G | | | | 1 | 2.3% | 3.8% |
| G | | | | | J | | N+Z | | | 3 | 7.5% | 11.5% |
| H | | | | | V | | | K | | 2 | 5.3% | 7.7% |
| I | | | | | | | | | L | 1 | 2.5% | 3.8% |
| J | | | | | | M | | | | 1 | 3.4% | 3.8% |
| K | | | | | | | | | O | 1 | 0.2% | 3.8% |
| L | | P | | | | | | | | 1 | 2.0% | 3.8% |
| M | | | Q | | | | | | | 1 | 3.2% | 3.8% |
| N | | | | | | T | | | | 1 | 0.4% | 3.8% |
| O | | | | | | | | | U | 1 | 1.8% | 3.8% |
| P | | | | | W | | | | | 1 | 2.0% | 3.8% |
| Q | | | | | | | | X | | 1 | 0.7% | 3.8% |
| total | 1 | 3 | 4 | 1 | 4 | 4 | 3 | 3 | 3 | 26 | | |
| reviews as % consents | 1.4 | 11.7 | 15.5 | 1.4 | 23.6 | 15.7 | 7.6 | 11.9 | 11.0 | | | |
| reviews as % sample | 3.8 | 11.5 | 15.4 | 3.8 | 15.4 | 15.4 | 11.5 | 11.5 | 11.5 | | | |

The reference index identifying each Project, DRU reviewer and Fire Engineering Organisation are provided in Appendix C.

5 TECHNICAL AUDIT METHODOLOGY

The required outcomes of this technical audit are to provide comment on the following items:

- a) Report on the technical accuracy of the memorandums issued by the DRU, and
- b) Comment on the quality and the methodologies used in the fire engineering submissions.

The DRU memorandums were evaluated in the context of the specific project to establish appropriate comment to the advice provided. This required a detailed assessment of the fire engineering submission relevant to each DRU memorandum.

The technical audit methodology adopted for this review is shown Figure 5-1.

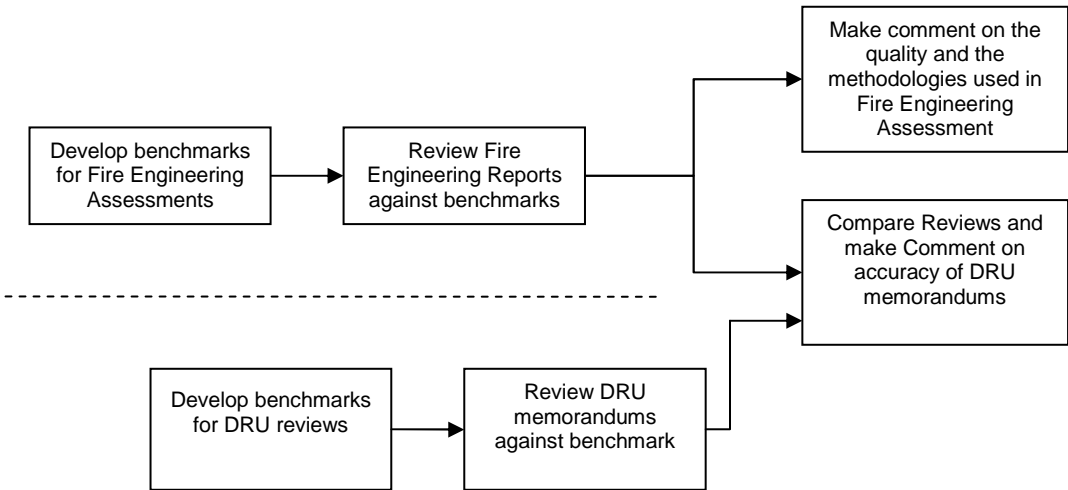


Figure 5-1 – Technical Audit Methodology

6 BASIS FOR DRU MEMORANDUM SURVEY

6.1 INTRODUCTION

Identification of the methodology and criteria to be assessed by the DRU is considered relevant to satisfying the NZFS obligations under the Act.

While the scope of DRU review is provided in the Building Act 2004, the methodology and the assessment requirements to which this is to be undertaken are not clearly identified in the regulations.

6.2 BUILDING ACT 2004

The role of the DRU in the approval process is detailed in Section 47 of the Building Act 2004:

47 New Zealand Fire Service Commission may give advice on applications under section 46

- (1) The New Zealand Fire Service Commission may, within 10 working days after receiving a copy of an application for a building consent under section 46, provide the building consent authority concerned with a memorandum that sets out advice on the following matters in respect of the building to which the application relates:
 - (a) provisions for means of escape from fire:
 - (b) the needs of persons who are authorised by law to enter the building to undertake fire-fighting.
- (2) The New Zealand Fire Service Commission must not, in the memorandum referred to in subsection (1), set out advice that provides for the building to meet performance criteria that exceed the requirements of the building code.
- (3) If the New Zealand Fire Service Commission does not provide a memorandum within the period specified in subsection (1), the building consent authority may proceed to determine the application without the memorandum.

Based on this Section of the Building Act 2004, the following components are considered to apply to the role of the DRU reviewer:

- a) Is the assessment for *means of escape from fire* satisfactory?
- b) Is the assessment for *the needs of persons who are authorized by law to enter the building to undertake fire-fighting* satisfactory?
- c) Are the recommendations made by DRU justifiable and meet (but do not exceed) the performance criteria specified within the requirement of the Building Code?

Section 47 of the Building Act 2004 sets out the advice that the DRU can provided on the review of an application for a building consent but does not provide guidance on the how is this to be interpreted or conducted. However a number of guideline documents can be used for reference.

6.3 IPENZ PRACTICE NOTE – PEER REVIEW

The Institution of Professional Engineers New Zealand have issued a practice note (Practice Note 2 – Peer Review, Reviewing the work of another Engineer)¹² to provide guidance to professional engineers on undertaking a peer-review of another person's design.

Though the Practice Notes do not represent a mandatory requirement they *offer guidance to practising engineers by exploring issues of importance to the profession and setting out good practice methodologies.*

Practice Note 2 identifies that Peer Review can include technical and ethical comments in regards to the following:

1. *Whether the completed work has met the objectives set out for it.*
2. *Other options that could have been included in the preliminary design.*
3. *Whether the evaluation of options is rigorous and fair*
4. *The validity of the assumptions.*
5. *The validity of the conclusions.*
6. *The process towards completion of the work.*
7. *The validity of the recommendations.*
8. *The objectives set out for the work.*
9. *Adherence to relevant regulations and codes of practice.*
10. *The fitness for purpose for the work.*

In undertaking the scope set out by Section 47 of the Building Act 2004, it is considered that the DRU reviewer must consider the items identified above with the exception of (2), (6), and (10).

Practice Note 2 identifies the roles of a peer reviewer for differing levels of review (i.e. technical or regulatory), appropriate competencies of the reviewer and possible areas of exposure to liability. It however offers no assistance in considering what is valid, rigorous or fair and how an overall design is to be considered.

The DRU does not currently consider their role as a peer-review and therefore do not utilise this Practice Note. However the roles are similar and the technical knowledge and competency of the DRU reviewer would be at least equivalent to a peer review.

6.4 FIRE ENGINEERING PRACTISE GUIDELINES

In varying provisions of the Compliance Documents for a proposed design, the variations or proposed mitigating systems may compromise the performance of other Acceptable Solution provisions to the design.

A performance based design is therefore required to identify the following:

- Particular Acceptable Solution provisions that the variation also impacts (not necessarily in the same Part of the Acceptable Solutions).
- The potential consequence of the variation and relevant impacted parts to a building's fire safety strategy.
- Proposal of mitigating systems and assessment of the overall fire safety design.

As a holistic approach is required in formulating and assessing a performance based solution, it is considered appropriate for the review by the DRU to also adopt such a holistic view in their assessment process. For example, reducing the Fire Resistance Ratings of structural elements could significantly impact on persons undertaking fire fighting activities.

Section 47 of the Building Act 2004 may be construed as limiting the extent of the DRU review to the provisions for means of escape from fire and fire fighting provisions only; however this is contrary to the holistic approach required technically of fire engineering.

To assist fire engineering practitioners in formulating, assessing and reviewing performance based designs the following documents are available:

- Fire Engineering Design Guide (FEDG)¹³, and
- International Fire Engineering Guidelines (IFEG)¹⁴.

The IFEG and FEDG both require the design and supporting documentation for Alternative Solutions and Acceptable Solutions to include an holistic assessment.

Additional to providing fire engineering techniques, methodologies and data for formulating and assessing a design, the International Fire Engineering Guidelines provides guidance to using a stakeholder design process and how fire safety systems (including active, passive and management systems, maintenance and fire brigade intervention) may interact with each other to provide the overall fire safety strategy for a building and its occupants.

The International Fire Engineering Guidelines was developed in collaboration with the New Zealand Department of Building and Housing, National Research Council of Canada, Australian Building Codes Board and the International Code Compliance, United States of America.

7 BASIS FOR FIRE ENGINEERING ASSESSMENT SURVEY

7.1 INTRODUCTION

Fire engineering has evolved to an internationally accepted discipline of engineering. It provides opportunity for building designs to be free from prescriptive design requirements, thus allowing for flexible functionality and design innovation for the building. By considering the overall fire safety strategy for a building and the performance and interaction of all the fire safety systems in the building, an appropriate level of life safety can be designed into a building.

The New Zealand regulatory framework accepts the use of a performance based approach for design for fire safety.

7.2 BUILDING ACT 2004

The Building Act 2004 requires that any building works be in accordance with the New Zealand Building Code, subject to Section 17, and that the building work is not required to achieve a performance additional to or more restrictive than the Building Code, Section 18.

17 All building work must comply with building code

All building work must comply with the building code to the extent required by this Act, whether or not a building consent is required in respect of that building work.

18 Building work not required to achieve performance criteria additional to or more restrictive than building code

- (1) A person who carries out any building work is not required by this Act to—
- (a) achieve performance criteria that are additional to, or more restrictive than, the performance criteria prescribed in the building code in relation to that building work; or
 - (b) take any action in respect of that building work if it complies with the building code.
- (2) Subsection (1) is subject to any express provision to the contrary in any Act.

The circumstance where the Building Code identifies that it may be unreasonable to fully comply with the building code is with respect to alterations and/or change of use of existing buildings. The extent of compliance is limited to Section 112 and Section 115 of the Building Act 2004.

112 Alterations to existing buildings

- (1) A building consent authority must not grant a building consent for the alteration of an existing building, or part of an existing building, unless the building consent authority is satisfied that, after the alteration, the building will—
 - (a) comply, as nearly as is reasonably practicable and to the same extent as if it were a new building, with the provisions of the building code that relate to—
 - (i) means of escape from fire; and
 - (ii) access and facilities for persons with disabilities (if this is a requirement in terms of section 118); and
 - (b) continue to comply with the other provisions of the building code to at least the same extent as before the alteration.
- (2) Despite subsection (1), a territorial authority may, by written notice to the owner of a building, allow the alteration of an existing building, or part of an existing building, without the building complying with provisions of the building code specified by the territorial authority if the territorial authority is satisfied that,—
 - (a) if the building were required to comply with the relevant provisions of the building code, the alteration would not take place; and
 - (b) the alteration will result in improvements to attributes of the building that relate to—
 - (i) means of escape from fire; or
 - (ii) access and facilities for persons with disabilities; and
 - (c) the improvements referred to in paragraph (b) outweigh any detriment that is likely to arise as a result of the building not complying with the relevant provisions of the building code.

115 Code compliance requirements: change of use

An owner of a building must not change the use of the building,—

- (a) in a case where the change involves the incorporation in the building of 1 or more household units where household units did not exist before, unless the territorial authority gives the owner written notice that the territorial authority is satisfied, on reasonable grounds, that the building, in its new use, will comply, as nearly as is reasonably practicable, with the building code in all respects; and
- (b) in any other case, unless the territorial authority gives the owner written notice that the territorial authority is satisfied, on reasonable grounds, that the building, in its new use, will—
 - (i) comply, as nearly as is reasonably practicable and to the same extent as if it were a new building, with the provisions of the building code that relate to—
 - (A) means of escape from fire, protection of other property, sanitary facilities, structural performance, and fire-rating performance; and
 - (B) access and facilities for persons with disabilities (if this is a requirement under section 118); and
 - (ii) continue to comply with the other provisions of the building code to at least the same extent as before the change of use.

The Building Act 2004 describes what aspects of a building design are to be considered with the Building Code and to what extent these aspects are to comply. A summary of these sections are provided in Table 7-1.

Table 7-1 – Scope and extent of building system compliance as stipulated in Building Act 2004.

| Building Application Extent | Full Compliance | Reasonably Practicable Compliance | Compliance to Existing Extent |
|-----------------------------|-----------------|---|-------------------------------|
| New Building (s.17) | Yes | No | N/A |
| Alteration (s.112) | No | Means of Escape Access and Facilities for Disabled Persons | Other Provisions |
| Change of Use (s.115) | No | Means of Escape Protection of Other Property Sanitary Facilities Structural Performance Fire Rating Performance Access and Facilities for Disabled Persons | Other Provisions |

The Building Code describes regulatory paths for which compliance with the Performance criteria can be achieved, as shown in Figure 2-2, but does not identify the objectives for what is reasonably practicable.



The Compliance Documents prepared by the Department of Building and Housing are Acceptable Solutions and Verification Methods that are considered to satisfy the Performance criteria, which represents the community's expectation with respect to an acceptable level of fire safety.

In undertaking a performance based design for a new building, Section 17 of the Building Act 2004 requires compliance with the Building Code. The objectives of the design are therefore to demonstrate a level of fire safety to that provided by the Performance criteria. However, when considering an existing building, the reference to a *reasonable practicable* level of compliance for some systems introduces ambiguity to the objective of a building design. It raises the following issues:

- a) Is *reasonable practicable* in reference to the Performance criteria, such that it offers an avenue for a existing building to be exempt from satisfying minimal levels of community expectation for life safety?
- b) If compliance with the Performance criteria is not *reasonable practicable*, then what level of life safety is reasonable?
- c) How is a design assessed against what is considered to be a *reasonable practicable* level of life safety shown to be satisfied?
- d) Which parties are to be involved in determining, assessing and approving designs which demonstrate *reasonable practicable* levels of life safety rather than compliance with Building Code?

Therefore, additional to the difficulties in the interpretation of Performance criteria, further difficulties can be expected with consideration to what is *reasonable practicable*.

Occupational Health and Safety terminology can be used to provide guidance on this issue, for example:

Reasonably practicable must be used in the context of:

- a) the likelihood of the hazard or risk concerned eventuating,
- b) the degree of harm that would result if the hazard or risk eventuated,
- c) what the person concerned knows, or ought reasonably to know, about the hazard or risk and any ways of eliminating or reducing the hazard or risk,
- d) the availability and suitability of ways to eliminate or reduce the hazard or risk, and
- e) the cost of eliminating or reducing the hazard or risk.

7.3 FIRE ENGINEERING GUIDELINES

The Building Act 2004 sets out what the objectives of the design should be but offers no guidance on how this can be demonstrated. Guidelines have been developed for the fire engineering discipline, as discussed in Section 6.4. They provide acceptable fire engineering assessment methodologies and data to which a design can be formulated and assessed against set objectives.

7.3.1 *Fire Engineering Design Guide*

The Fire Engineering Design Guide¹³ was a document that was developed by study groups of the New Zealand Structural Engineering Society and the New Zealand Fire Protection Association, in conjunction with the Centre for Advance Engineering and the Institution of Professional Engineers New Zealand. It was developed to *provide guidance to those wishing to carry out or review specific fire engineering designs to meet the requirements of the New Zealand Building Code and any additional requirements of the building owner.*

The Fire Engineering Design Guide identifies the following factors that are to be considered when determining the performance required from a specific fire engineering design:

- a) *Building geometry and intended use,*
- b) *Location of adjacent properties,*
- c) *Probability of a fire occurring,*
- d) *Fuel load and distribution,*
- e) *Number and location of occupants,*
- f) *Proximity and likely response of the Fire Services,*
- g) *Available water supply, and*
- h) *Building management practises that affect fire safety.*

It further states the following written items that are to be included in any fire engineering design which is to represent the overall design philosophy:

- a) *The performance requirements forming the basis of the design.*
- b) *The differences between those requirements and those of the Building Code.*
- c) *The overall strategy for meeting the performance requirements.*
- d) *An overview of the fire engineering analysis.*
- e) *A summary of the building design and fire protection features.*

In preparing the fire engineering design strategy, with respect to specific factors described above, the fire protection features within the building should be able to address the following issues:

- a) *To prevent fire,*
- b) *To control fire growth,*
- c) *To control smoke spread,*
- d) *To limit fire spread within the fire building,*
- e) *To prevent fire spread to other buildings,*
- f) *To allow rapid egress,*

- g) *To facilitate Fire Service operations, and*
- h) *To prevent structural collapse.*

The Fire Engineering Design Guide has subsequently been superseded by the International Fire Engineering Guidelines¹⁴, which provides further guidance on the stakeholder process in undertaking a performance based design and inter-relations of the different fire safety systems to create the overall fire safety strategy for a building.

7.3.2 *International Fire Engineering Guidelines*

In New Zealand, the International Fire Engineering Guidelines¹⁴ is published by the Chief Executive of the Department of Building and Housing as Guidance information under Section 175 of the Building Act 2004. The document identifies the process to be followed in fire engineering designs and the role of the fire safety engineer:

“The fire engineer should generally:

- a) Facilitate the Fire Engineering Brief process
- b) Develop and undertake evaluation of the alternative solution;
- c) Provide guidance on and technical justification for decisions made during the FEB process on matters such as acceptance criteria, design fires, design occupant groups and analysis strategy including the selection use and design parameters of any Computer based design tools;
- d) Provide design advice as part of the building team;
- e) Prepare the fire engineering report, based upon the IFEG guidance and using the format provided in Chapter 1.11 Preparing the Report, for assessment by the Building Consent Authorities.
- f) Identify any special commissioning, management in use and maintenance requirements of the alternative solution.
- g) Present recommendations for inspection, maintenance and reporting in respect to the compliance schedule.”

The IFEG describes the fire engineering design process to be adopted:

The variations (relating to) engineering judgement can be minimized if the process detailed in these guidelines in Section 1.2.11 is used and there is involvement of other stakeholders as described in the fire engineering brief process (Chapter 1.2).

Any evaluation to achieve the performance criteria may require the involvement of stakeholders. These stakeholders will have input into the fire-engineering brief, which forms the basis of the fire engineering strategy to meet the performance criteria for acceptance. The fire engineering brief described in Part 1 facilitates such involvement.

Throughout the Fire Engineering Brief (FEB) all relevant criteria stipulated under the performance criteria as laid down by the NZBC must be taken into consideration. The relevance of the requirements in the FEB needs to be addressed specifically to the building in question.

It is recommended that margins of safety or redundancies be included in a building fire safety system (see discussion of Trial Designs in Part 1.2.7). Such redundancies can be used to compensate for these uncertainties and deficiencies and these Guidelines recommend that redundancy be examined in the context of sensitivity studies (see Section 1.2.9.5).

The technical review undertaken by WFRA was based in part on the process specified within the IFEG to determine the adequacy of the consultative process and presentation of the relevant fire engineering issues to be assessed.

7.4 SFPE AND NFPA – INTRODUCTION TO PERFORMANCE-BASED FIRE SAFETY

The Society of Fire Protection Engineering and National Fire Protection Association jointly prepared guidance with the fire safety design process and documentation of the performance based analysis¹⁵.

The main parts identified for this process are the following:

- *Identify the project participants and their role and responsibilities.*
- *Identify the qualifications and competency of the participants.*
- *Identify the objectives of the analysis and design within the prescriptive, performance and code mandated requirements.*
- *Consideration of site information.*
- *Statement of goals, objectives, requirements and acceptance criteria.*
- *Consideration of fire scenarios, design fires, design alternatives, and engineering tools and methods.*

Emphasis in this process is ensuring that the relevant parties are involved in the design process. This early guidelines states the following:

To help ensure that that...factors are adequately addressed, and that the proposed design becomes accepted, it is important to ensure that the intent of the regulation and the fire safety goals and objectives are well understood by all participants in the analysis and design, that engineering methods and evaluation and design tools which have received broad acceptance are considered, and that the authorities having jurisdiction are active participants in the engineering analysis and design process.

7.5 COMPLIANCE DOCUMENT FOR NZBC CLAUSE C1, C2, C3, C4 – FIRE SAFETY.

A “Design Sequence” for design is recommended in Compliance Document for New Zealand Building Code Clauses C1, C2, C3, C4 - Fire Safety, C/AS1 1.3.1¹⁶.

As stated in Compliance Document for New Zealand Building Code Clauses C1, C2, C3, C4 - Fire Safety, the recommended design sequence *provides the user with a suggested design sequence for applying this acceptable solution to any type of building.* Though providing assistance in developing and identifying potential variations to the acceptable solutions, it is considered that it should not be the sole form of any fire engineering assessment, as it does not provide assistance in assessing the overall fire safety strategy.

The design sequence instead divides a fire safety system into the following parts without the designer requiring an understanding or consideration of the consequences a variation in one Part may have to the effectiveness of an acceptable solution for another Part:

Part 2 – Occupant Numbers and Purpose Group

Part 3 – Means of Escape

Part 4 – Requirements for Firecells

Part 5 – Fire Resistance Ratings

Part 6 – Control of Internal Fire and Smoke Spread

Part 7 – Control of External Fire Spread

Part 8 – Fire Fighting

Part 9 – Outbreak of Fire

These Parts address some of the factors that have been identified in Fire Engineering Design Guide but are silent on issues such as:

- The process of identification of hazards, frequency and consequence to determine fire scenarios to be addressed.
- Specific characteristics of the building (legibility, location) or occupants (social relationships, mental and physical abilities) that will be different for all buildings and localities.
- Proximity and likely response of the Fire Services (not just notification and available Fire Safety Precautions for their use).
- Building management practices that affect fire safety.
- The consequence and dependency of one Part has with another Part.

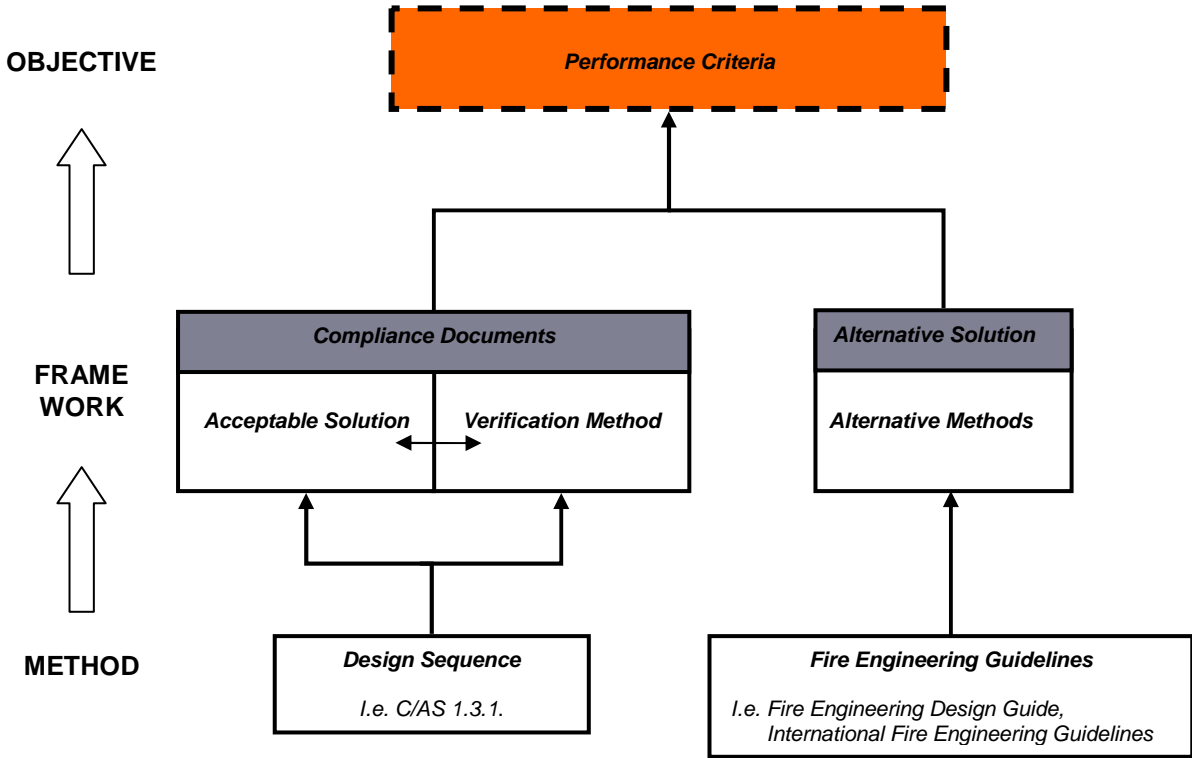


Figure 7-1 – Fire engineering process to satisfy fire safety objectives

7.6 CONCLUSION

Based on consideration to the form of reports available and recommendations of Compliance Document for New Zealand Building Code Clauses C1, C2, C3, C4 - Fire Safety, the following items were identified as being an appropriate benchmark for the review of fire engineering reports:

- a) Has the scope of the project and objectives been defined?
- b) Have variations to the Acceptable Solutions been explicitly identified?
- c) Has a Fire Engineering Brief been conducted and prepared and what involvement did the NZFS have?
- d) Does the Fire Engineering Report have the following items?
 - i. Unique Identification.
 - ii. Version or Issue Number.
 - iii. Date of Issue
 - iv. Numbered Pages
 - v. Contents

- vi. Identification of Authors and Signatures
 - vii. Indication that it has been reviewed by another person.
- e) Are there indications that the Fire Engineering Report has been issued to third party for review (other than NZFS) and comments incorporated in Fire Engineering Report before issued to NZFS for review in accordance with Section 47 of the Building Act 2004?
- f) If the design sequence in C/AS1 1.3.1 has been used to review proposed building works (not to assess variations), are they appropriately considered in relation to Parts of C/AS1 and Performance Requirements, as appropriate to relevant Sections of the Building Act 2004?
- g) If fire engineering analysis has been undertaken, are the following items been satisfactory considered?
- i. Is a trial design concept been nominated?
 - ii. Are the objectives for the analysis explicitly stated?
 - iii. Are potential hazards, frequency of incidents and consequences of fire events been considered in determining credible scenarios to be considered in the fire engineering analysis?
 - iv. Is the analysis method appropriate to the objective and justified?
 - v. Are acceptance criteria, factors of safety, and other analysis inputs appropriate to the scenarios considered and analysis method appropriate and justified?
 - vi. Have sensitivity to the trial concept design been provided?
 - vii. Have all the potential impacts of an Alternative Solution to other parts of the Acceptable Solutions, thereby demonstrating a holistic approach, been considered by the designer?
 - viii. Have procedural, maintenance or preventative measures been considered?
 - ix. Is there a direct assessment of the trial concept design against the relevant Performance Requirement?

PART THREE – TECHNICAL REVIEWS

8 REVIEW OF DRU MEMORANDUMS

8.1 INTRODUCTION

The memorandums prepared by the DRU for the selected sample projects were reviewed technically in accordance with the criteria identified in Section 6 so that the quality and adequacy of the DRU responses could be determined.

Details of each memorandum review are contained in Appendix B.

8.2 DRU EVALUATION

Limitations in the DRU assessment of each Fire Engineering submission and the accuracy of the advice given in their Memorandum, reflecting the adequacy of the initial assessment identifies trends as indicated in Table 8-1.

Table 8-1 – Summary of the assessment and accuracy of advice by the DRU assessed against the nominated benchmarks.

| Appropriate DRU Assessment | Accurate DRU Advice | Percentage of Projects Assessed |
|----------------------------|---------------------|---------------------------------|
| ✓ | ✓ | 47% |
| ✓ | ✗ | 23% |
| ✗ | ✓ | 15% |
| ✗ | ✗ | 15% |
| 59% | 62% | |

Based on the evaluation undertaken, the DRU is adequately assessing the submitted fire engineering assessments in 59% of submissions and provides accurate advice to the BCA in 62% of submissions.

The difference between the DRU assessment and the technical accuracy of the DRU advice arises as specific issues in the submission may not have been identified but the advice has broadly covered the issues generally. Additionally, some advice given in the memorandum may not have been justified sufficiently by the DRU reviewer such that it may be considered more excessive than the Building Code.

DRU assessment limitations for *means of escape from fire and the needs of persons who are authorised by law to enter the building to undertake fire-fighting* are shown in Figure 8-1 and Figure 8-2.



Figure 8-1 – Limitations of DRU assessment for Escape from Fire.

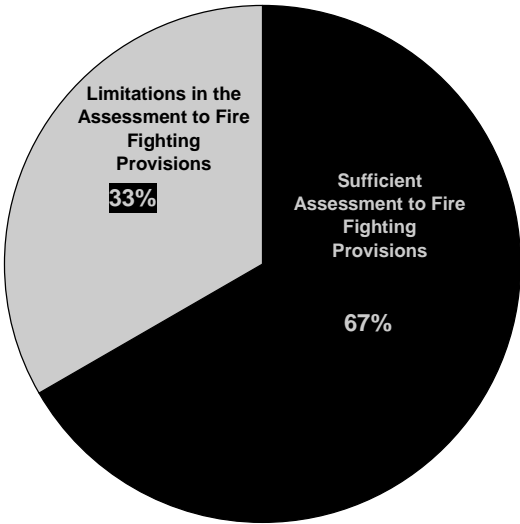


Figure 8-2 – Limitations of DRU assessment for Fire Fighting Provisions.

Note that the discrepancy between Figures 8-1/2 (50% appropriate) and Table 8-1 (59% appropriate) is the result of 2 projects which comprise verification solutions only, therefore were excluded from the data set of Figures 8-1/2.

8.2.1 *Provisions for Means of Escape from Fire*

Limitations in the assessment of *provisions for the means of escape from fire* have been summarised in Figure 8-3. In 50% of the Memorandums which were considered to be inappropriate, the DRU reviewer has failed to recognise the issue within the overall design, either by adopting a narrow approach or not considering the assessment methodology used.

In the instances where a holistic review of the design was not provided, the DRU reviewer has often failed to comment on the compromises that the identified variation has made to other parts of the overall fire safety strategy. In some instances, the DRU reviewer has been silent on the issue of *reasonable practicable* for a specific system, making no comment to the compromise of the overall fire safety strategy.

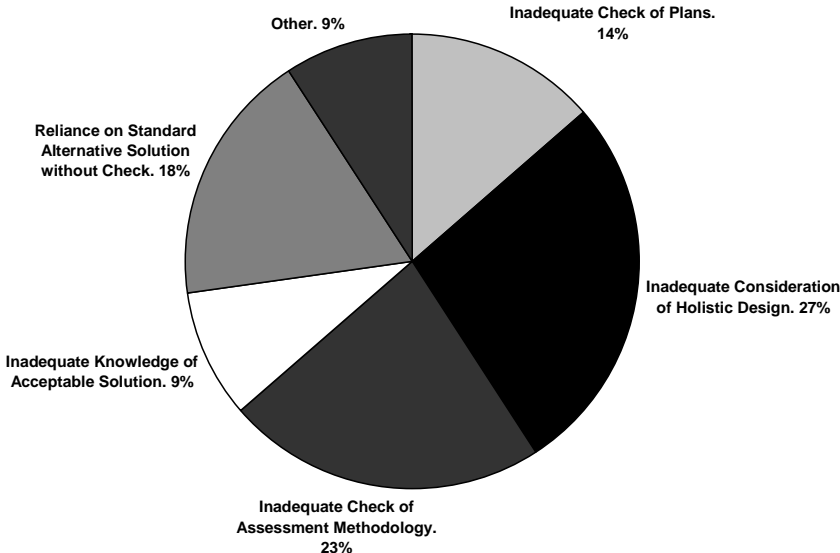


Figure 8-3 – Detail of the limitations of the DRU review for the *provisions for the means of escape from fire*

8.2.2 *Needs of persons who are authorised by law to enter the building to undertake fire-fighting*

A similar breakdown of the limitation of the DRU review of fire fighting provisions is provided in Figure 8-4.

In all instances, the DRU has identified a level of inadequate documentation within the submission. This was often for site and hydrant plans, architectural plans for existing parts of a building and water supply information.

The DRU response to the inadequate information was consistent throughout, which was for the BCA to consider these items. In 17 % of cases when this has occurred, the DRU have still accepted the design. In other instances, the DRU reviewer has noted that no comment can be made and it should be to the satisfaction of the BCA. This in effect means that in some instances where inadequate information has been provided there is no effective check by the NZFS unless the design is resubmitted.

It is possible that statements for the BCA to consider the matter are intended to avoid the potential for the process to exceed the 10 day mandatory assessment period.

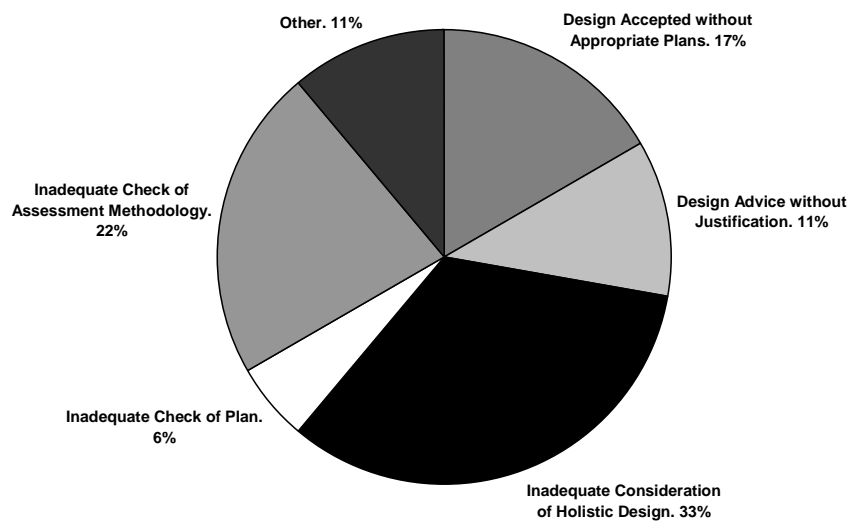


Figure 8-4 – Detail of the limitations of the DRU review for the *needs of persons who are authorised by law to enter a building to undertake fire-fighting*

The most frequent limitation (33%) of the DRU process has been the lack of a holistic approach in the review. This centres on the following two issues:

- The DRU reviewer has considered the specific variation proposed by the designer but has not evaluated where the variation may compromise other systems that could impact on the means of escape or fire fighting activities, and
- The DRU reviewer has considered that fire fighting provisions need not be considered because of *reasonable practicable* or believes that consideration by the Designer and the DRU reviewer to the provision is not required in accordance with Section 112 and Section 115.

8.3 OUTSTANDING ITEMS IN DRU REVIEW

Evaluation of the DRU issued memorandums relating to each building consent project forming part of the audit sample identified the following general issues:

- a) A holistic approach to evaluating the submissions was not evident.
- b) Insufficient documentation was cited as an issue in many memorandums.
- c) Participation in the FEB process as a relevant stakeholder was not evident.
- d) Technical quality of the DRU memorandums.

8.3.3 *The Holistic Approach*

The holistic approach necessary for fire engineering assessments has been identified previously. It is considered that the NZFS must also adopt a holistic approach as part of their assessments to enable the relevant issues associated with means of escape and fire fighting to be properly incorporated within the design solution and therefore the issued memorandums. This necessitates an evaluation of the total fire design solution to arrive at suitable recommendations within the memorandums.

Support of this process is provided through British Standards in a Draft for Development for Fire Safety Engineering, DD240: Part 1:1997. This states the following¹⁷:

The fire safety requirements need to be considered as a total system in which both the active and passive measures are incorporated and in which flexibility is allowed in their exchange when equivalence can be shown.

While it is acknowledged that the NZFS scope is limited by the regulatory framework of the Act, this should not be used to narrowly assess the building consent. A holistic approach can still be adopted to derive the memorandum recommendations and enable a thorough assessment of the means of escape and fire fighting provisions within the fire engineered design.

It is acknowledged that this recommendation may be perceived as extending the authority of the NZFS but it is simply an acceptance of the complex interactions of fire safety systems in the built environment.

An example of this interaction is provided below:

The proposed design is for a reduced fire rating of a floor element. Instead of a direct comment to this reduction, the DRU reviewer can review and make comment to this proposal as it may impact on the following:

- *The period that a path of egress on one floor is reasonably protected is reduced. It would therefore be reasonable to expect the designer to provide an assessment comparing the time that the path of egress becomes unusable with the period required for that path to be used as a evacuation route, and*

- *Floors are also used for fire brigade activities in undertaking search and rescue functions as well as fire fighting activities. Comparison between the structural adequacies of the floor with fire brigade intervention would therefore also be an assessment that the DRU could reasonably expect in a submission for this design.*

Finding 8-1

A review of the means of escape and fire fighting provisions within a fire engineered design should not be conducted in isolation to other measures of the proposed strategy.

Fire Engineering Design requires a holistic approach to an assessment; therefore, the review should also adopt this principle in associating aspects of a proposed fire engineering design to the provisions for the means of escape and fire fighting. NZFS Design Review Unit should adopt this principle in discharging their duties in accordance with Section 47 of the Building Act 2004.

8.3.4 *Insufficient Documentation*

A thorough review is only possible if sufficient and relevant information is provided. The majority of DRU reviewers indicated that insufficient documentation was received to adequately assess the project design and fulfil the NZFS requirements under Section 47 of the Act.

It is recommended that Guideline Notes be developed to nominate a preferred and consistent format and minimum information required in the building consent submissions. This would emphasise the holistic approach and identify to the fire designer the necessary information for the DRU memorandum to be issued within the 10 working day limit.

Alternatively, the NZFS may return building consents if they are submitted with insufficient documentation to make an informed decision but this could cause delays to construction programs and therefore a pre-assessment should be undertaken within 2 days of submission to identify major inadequacies.

Finding 8-2

The NZFS Design Review Unit should recommend to the Department of Building and Housing that 'Guidance Notes' be developed for fire engineering practitioners and Building Consent Authorities on the preferred format and minimum information contained within Fire Engineering submissions containing assessments for Alternative Solutions.

Finding 8-3

The NZFS Design Review Unit response period of 10 working days should include a mechanism for the request of additional information. Similar to the BCA when considering Building Consent applications, this period should not include the time when additional information is requested from the BCA so that appropriate NZFS Design Review Unit comment can be made.

The NZFS Design Review Unit should request the Department of Building and Housing to provide interpretation of “working days” that is consistent with that provided to Building Consent Authorities in the consideration of building applications, as set out in the Building Act.

8.3.5

FEB Participation

As identified previously, the Fire Engineering Brief (FEB) process is of primary importance to the fire engineering design particularly when complex or absolute performance design solutions are considered. The NZFS have included in their cover note to the memorandums that – “*The NZFS is restricted to providing advice to the BCA only during the design review process*” – which highlights the regulatory constraints in which they act. There would be some benefit to the community and other stakeholders if more advice could also be offered through participation in the FEB process.

Many of the DRU comments to the assessment methodology presented in the fire engineering submissions noted inappropriate or unjustified use of certain modelling techniques, input to models, manipulation of modelling results and other assumptions. These items could have been resolved at an earlier stage, rather than upon building consent submission.

No conflict of interest is considered to exist between a FEB participant and an authority having jurisdiction, as regulatory authority participation in the FEB is a fundamental part of the fire engineering process. The views of the BCA and NZFS can be incorporated in the FEB and the fire designer is therefore sufficiently informed to address the issues raised within the fire engineering assessment.

Finding 8-4

Adoption of principals in IPENZ Practice Note 2 – *Peer Review, reviewing the work of another Engineer* as the basis for the NZFS Design Review Unit role in undertaking the duties identified in Section 47 of the Building Act 2004.

These principals should be incorporated into an internal document, prepared to assist DRU reviewing engineers in discharging this duty in a consistent and transparent manner. This is to include clear guidance in undertaking a holistic review of a design in context with issues relating to means of escape and fire fighting provisions.

Finding 8-5

The NZFS Design Review Units should endeavour to participate in the Fire Engineering Brief process to enable technical input to the design/assessment and resolution of regulatory and technical issues at the early design stage of the project rather than upon building consent submission.

8.3.6 Technical Quality of the DRU Memorandums

The technical review of the DRU identifies that they have a significant role in the building approval process for building designs incorporating performance based fire engineering design.

It is considered that they perform the following roles:

- Representative of New Zealand Fire Service personnel who are a relevant stakeholder of the project and an end user of the building.
- Representative in maintaining an appropriate level of safety in building design to meeting community expectation.

Suitability for this role is provided by their knowledge of fire fighting requirements and competency in performance based fire engineering assessment methodologies.

The technical quality of DRU memorandums is generally better than the quality of the fire engineering submissions (refer section 9); however, the limitations identified in the previous Sections 8.3.3 to 0 are the primary omissions:

- a) Lack of FEB and FEB participation therefore impacting on the regulatory assessment and methodology adopted in the fire engineering report.
- b) Narrow focus on means of escape and fire fighting without considering broader holistic approaches.
- c) Inconsistent regulatory approach and assessment within the DRU. For example, the choice to review fire fighting provisions for Section 112 applications varied between DRU reviewers as well as what interpretation of *reasonable practicable* is used.
- d) The level of scrutiny when Designers use a standard Alternative Solution is reduced. The Ministry of Education is an example. The DRU should not accept solutions without evaluation and justification by the fire designer as to the suitability of application for the particular project. This can be achieved by the following:
 - i. Determine if the designer has initially identified the Acceptable Solutions requirements for the facility.
 - ii. Determine whether the designer has evaluated the suitability of the “standard Alternative Solution” for the particular project.

- iii. Confirm that the Alternative Solution has been assessed against the relevant performance requirements.
- e) In many cases, the memorandum recommendations were not clearly specified and compliance requirements of recommendations made were not defined. No projects indicated a further follow up report or inspection by the NZFS or indication that the BCA had incorporated the recommendations in any permit issuing process. A clearer statement of the recommendation may be used to avoid ambiguity, for example:

It is the opinion of the NZFS that the proposed design adequately addresses matters relating to Section 47 the Building Act 2004, subject to implementation of the following items in the fire design solution with compliance to be documented by the BCA:

Where the fire engineering assessment contains omissions in the technical assessment or requires a resubmission to the DRU due to insufficient documentation, the following may be used:

It is the opinion of the NZFS that the following items are insufficiently addressed in the proposed Alternative Solution as identified. In accordance with Section 47 of the Building Act 2004, the NZFS provides the following comments however; the fire design solution should be resubmitted to the DRU upon rectification of the following omissions:

Finding 8-6

The NZFS Design Review Unit should recommend to the Department of Building and Housing that 'Guidance Notes' be developed for building practitioners (including Building Consent Authorities and fire engineering practitioners) on the expectation of the Department when designers use *reasonable practicable* as justification for variations to Compliance Documents and making submissions to NZFS Design Review Unit under Section 47 of the Building Act 2004.

8.4 CONTEXT TO LIMITATIONS IN THE DRU ASSESSMENT

The technical quality of the DRU assessment and subsequent technical advice can not be audited in isolation. It is expected that the quality of the content and assessment in fire engineering submissions may affect the ability for the DRU to appropriately review the submission. Figure 8-5 to Figure 8-7 provides a relative performance of the DRU when specific limitations in the fire engineering submission are provided for context.

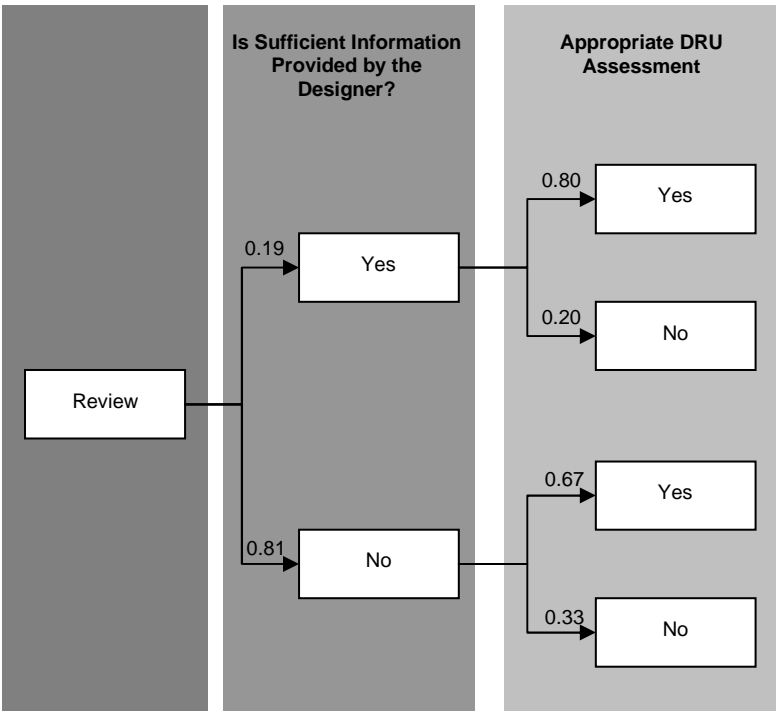


Figure 8-5 – Performance of the DRU in the context of limitations in the documentation provided in fire engineering submission.

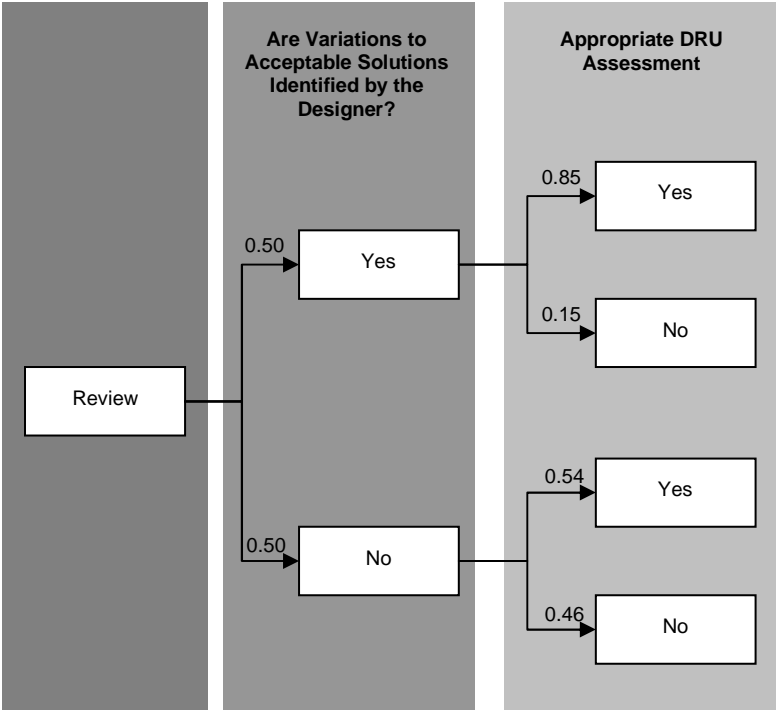


Figure 8-6 – Performance of the DRU in the context of limitations in identification of variations to Acceptable Solutions.

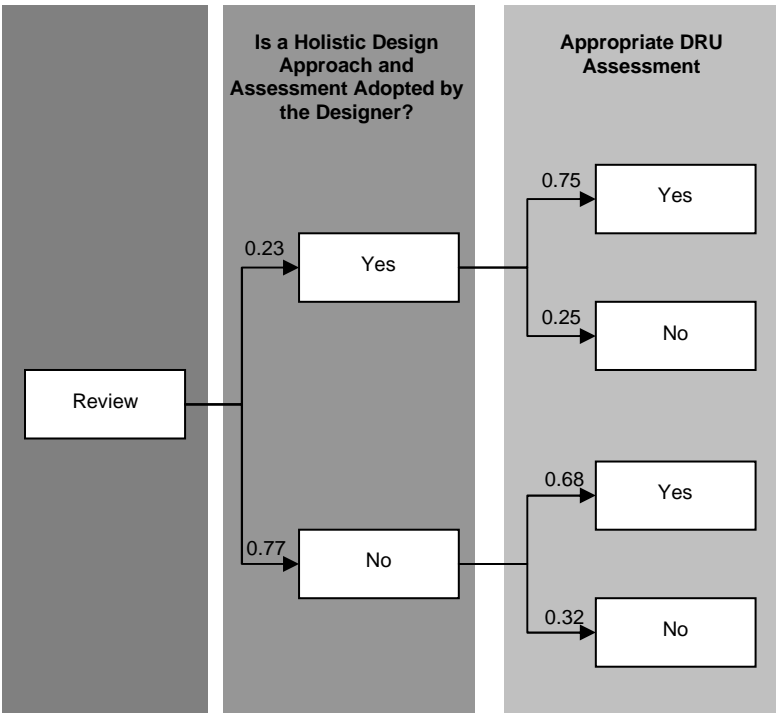


Figure 8-7 – Performance of the DRU in the context of limitations of the Designer utilising a holistic design approach.

In context, the above assessments identify that the performance of the DRU in assessing submission is satisfactory given the limitations of the design. For example, Figure 8-6 shows that where 50% of the fire engineering submissions explicitly identified the variations to be assessed, the technical assessment by the DRU was appropriate in 85% of these projects compared to only 54% of projects when no explicit variations were identified.

This indicates that the technical accuracy of the DRU assessment and advice may adversely affected by the quality of the fire engineering submissions. It is therefore considered that provisions to assist in removing potential limitations to the quality of fire engineering submission is also expected to improve the technical accuracy of DRU advice.

Finding 8-7
The quality of fire engineering submissions has been shown to significantly influence the quality of the NZFS Design Review Unit assessment. Minimum benchmarks should be set within the DRU to determine an appropriate quality of fire engineering submission that can be reasonably reviewed by them in discharging their duties under Section 47 of the Building Act 2004.

9 REVIEW OF FIRE ENGINEERING ASSESSMENTS

9.1 INTRODUCTION

The building consent audit samples were selected as identified in Section 4.2, and the documentation reviewed to enable the DRU memorandums to be assessed in context. The sample documentation for each project, typically comprising a fire engineering assessment report and relevant drawings, were assessed against the selected benchmarks as discussed in Section 7.

The details of each project are contained in Appendix A.

9.2 OUTSTANDING ITEMS IN FIRE ENGINEERING ASSESSMENT REVIEW

Assessment of the Fire Engineering Reports identified a number of deficiencies within the fire engineering analyses and methodologies used. As assessed in A.28, these are primarily:

- Regulatory assessment (limitations in 50% of Reports);
- Participation of relevant stakeholders (limitations in 96% of Reports);
- Understanding and implementation of fire engineering principals, including use of a holistic approach to design and assessment (limitations in 82% of Reports).

9.2.1 *Regulatory Assessment*

Regulatory assessment or interpretation of whether a proposed design achieves compliance is generally undertaken by the designers who identified what they consider as compliant with or variant from the Acceptable Solutions by interpretation and discussion.

There are significant variations in the determination of the relevant input design parameters, including an Acceptable Solution benchmark that determines the adequacy of the design towards achieving its intended objectives. As a consequence, building designs have a relatively high degree of variation in its inherent level of safety¹⁸. Therefore, the involvement of parties with a good understanding of the regulatory environment, Building Code requirements and the intent of the Building Code is important to ensure sufficient acceptance of the validity of the performance based design.

Many of the Fire Engineering Reports do not clearly distinguish in the design assessment between compliance with the Acceptable Solution or equivalence to the Acceptable Solution.

A typical example of this process is the design assessment relevant to the Acceptable Solution for selection of F Ratings. The following common issues were noted:

- Failure to note C/AS1 4.5.8 which states *No firecell, other than the top floor firecell, shall have a firecell rating (F Rating) of less than column 2 of Table 4.1 for that purpose group and FHC.* Designers often state F0 for ground floor levels of multi-storey buildings.
- Failure to note the corresponding Fire Hazard Classification in the selection of Fire Safety Precautions when using C/AS1 Table 4.1.
- C/AS1 5.6.6 provides a FRR reduction if sprinklers are provided (if not required by C/AS1 Table 4.1) by 50%. This does not necessarily equate to F Rating reduction by 50%.

The result of the process described above has resulted in the following general observations:

- a) Reports exhibited both elements of an Acceptable Solution compliance report and a fire engineering report. Variations to the Building Act 2004 were not explicitly stated to provide identification and effective assessment or review.
- b) Section 18 of the Building Code 2004 states that *building work is not required to achieve performance criteria additional to or more restrictive than building code.* Designers appear to also interpret this as *the building work is not required to achieve more than that required by an Acceptable Solution.* This has the net effect of designers adopting an approach where provisions more than an Acceptable Solution are not necessary. Therefore, fire engineering design proposals rarely nominate additional provisions to mitigate other variations to Acceptable Solutions.
- c) If the building work is an alteration to an existing building, Section 112 of the Building Act 2004 applies. This states that the building is to *comply as nearly as is reasonably practicable and to the same extent as if it were a new building with the provisions of the building code that relate to means of escape from fire and access and facilities for person with disabilities and continue to comply with the other provisions of the building code as before the alteration.* This has resulted in designers narrowing their assessment focus to C/AS1 Parts 2, 3 and 4 for the new part only. Because of the 'continue to comply' provision in Section 112, the potential impact of the existing part to the new part or vice versa have not been considered in the assessments.

- d) If the building work is a change of use, Section 115 of the Building Act 2004 applies. This states that the building is to *comply as nearly as is reasonably practicable and to the same extent as if it were a new building with the provisions of the building code that relate to means of escape from fire, protection of other property, sanitary facilities, structural performance and fire rating performance and access and facilities for person with disabilities and continue to comply with the other provisions of the building code as before the alteration.* This has resulted in designers narrowing their assessment focus to C/AS1 Parts 2, 3, 4, 5 and 7 to the specific building part only. Because of the ‘continue to comply’ provision in Section 115, the potential impact of the existing part to the change of use part or vice versa have not been considered in the assessments.

While it is not considered the role of the DRU to assess these regulatory issues and provide comment in the memorandum, consideration could be given to extending the role of the Fire Brigade.

Finding 9-1

Fire engineering practitioners should be required to adopt a holistic approach to the identification, formulation and assessment of performance based fire engineering designs. Appropriate fire engineering guidelines that set out acceptable practice methodologies are to be adopted, such as the International Fire Engineering Guidelines.

Recommendations should be made to the ‘Department of Building and Housing’ and IPENZ that an improvement in the general quality of fire engineering submissions is an opportunity for improvement of the building approval process.

9.2.2 Stakeholder Participation

A fundamental process of fire engineering designs is a stakeholder approach to identify design objectives. The FEB forms the basis for a fire engineering assessment so that project objectives and the methodology necessary to meet those objectives are clearly stated before detail analysis is undertaken. The FEB aims to achieve the following:

- a) Identification and involvement of relevant stakeholders and authorities having jurisdiction to identify the relevant objectives to be considered. This should include the NZFS.
- b) Development of a trial concept design in conjunction with stakeholders.
- c) Assessment to the extent that the proposed trial concept designs satisfies the Acceptable Solutions, with advice sought from the BCA. This will clearly identify particular variations to the Acceptable Solutions.
- d) Formulation of proposed Alternative Solutions. The relevant regulatory objectives that the proposed Alternative Solutions are to be assessed against are to be advised by the BCA (i.e. relevant Building Code Performance Criteria).
- e) The selection of assessment methodologies and input parameters to be used in the fire engineering analysis, proposed by the Fire Engineer.

- f) Preparation of a Fire Engineering Brief detailing all the above information. This will form the basis for the assessment of the fire engineering analysis, subject to consensus by the relevant stakeholders, BCA and authorities having jurisdiction.

The FEB process is considered to have the potential to resolve many of the issues identified in Section 9.2.1 with respect to the scope of the regulatory assessment and nominated fire engineering issues.

No FEB were supplied as part of the documentation, therefore stakeholder input and participation is assumed to be minimal in the projects reviewed. In addition, FEB are often marked revision A or 1 indicating no amendments or comments from other parties has been incorporated in the reports, which also indicates a lack of stakeholder participation and input.

9.2.3 *Fire Engineering Assessment*

Following typical examples of where the fire design documentation for Alternative Solutions failed to demonstrate accepted fire engineering principles as identified in section 3.3:

- a) A number of fire engineering assessments are conducted by comparative assessment with the particular C/AS1 provision that is varied, without consideration of the consequence to other Acceptable Solutions. For example, where the installation of sprinklers in lieu of smoke detection was used, the benefit in managing fire severity was identified but the effects of a reduction in early warning were not evaluated.
- b) Other benchmarks used in comparative assessments appear to be determined solely by the Fire Engineer. Justification as to the suitability of the benchmark is not provided.
- c) A number of the fire engineering assessments conducted used an absolute assessment methodology; however, the corresponding performance requirement is not identified nor is it used to establish the parameters for assessment. It is common for the design scenario, acceptance criteria, modelling tools and assessment parameters to be stipulated solely by the Fire Engineer.
- d) In a number of projects, the designer specified “standard Alternative Solutions” based on either experimental results or departmental guidelines. The designer has not included an evaluation of the suitability of the standard Alternative Solution for the project specific building and occupant characteristics.
- e) An appropriate evaluation of potential hazards, their frequency, mitigating factors and potential consequences are not being undertaken by fire designers as the basis for determining appropriate assessment scenarios.
- f) The use of the term *reasonably practicable* is often relied upon by fire designers for justification of existing buildings. A general lack of technical assessment and consideration of the following issues were provided within the fire engineering report:

- i. An audit of the existing building to determine the extent that an existing system *reasonably practicably* complies with the Acceptable Solution including justification for the expected performance level achieved. This could be an existing system report, testing, maintenance records, etc.
- ii. The fire designer evaluates the reason why it is not *reasonably practicable* to make an existing system comply with the Acceptable Solution; i.e. the practicality of upgrading to current standards.
- iii. The fire design evaluation includes an assessment that the level of life safety is not compromised by the existing provision, or that the reduced level of performance is mitigated by some other measure. This may include assessment of the potential impact that the variation or expected reduction in the performance of the system may have on new or other existing systems.

Finding 9-2

The NZFS Design Review Unit should recommend to the Department of Building and Housing that “Guidance Notes” should be developed for the guidance of fire engineering practitioners in undertaking performance based fire engineering design. This is to include the minimum expectations to the competency of the designer relevant to the design proposed, form which a fire engineering assessment is provided for submission to BCA, reasonable justification of assessment and assumptions made and involvement of relevant stakeholders.

Suitable assistance in the development of these notes is provided in the International Fire Engineering Guidelines.

PART FOUR – FIRE SAFETY DESIGN AND APPROVAL
PRINCIPALS

10 CONCLUSIONS

In the opinion of WFRA, the following conclusions can be derived from the audit review process undertaken. The conclusions are limited to the quality and technical merits of the DRU memorandums and reviewers:

- a) Considering that in most instances inadequate documentation was provided to the DRU for review, DRU reviewers provided an appropriate assessment and response to a building consent submission to the relevant BCA in 47% of the projects reviewed. Where sufficient information was provided in the submission, the DRU reviewers provided an appropriate assessment in 80% of the projects reviewed.
- b) Technical advice provided by the DRU was reasonable in 62% of projects reviewed. Limitations in the holistic approach adopted by the reviewer were identified as the primary reason for technical deficiencies in the memorandums.
- c) The lack of a consistent approach to the term *reasonably practicable* is evident, particularly when used as the extent of compliance for some provisions in an alteration or change of use for an existing building.
- d) Implementation of acceptable fire engineering assessment methodologies was found to be inadequate in 92% of the sample submissions reviewed. The majority of these items were identified in the DRU review of the project.
- e) The quality and technical accuracy of DRU advice is related to the quality to the quality of the fire engineering submission.

It is considered that the DRU role in the building approval process for buildings utilising a performance based fire engineering design is satisfactory based on their technical competence and fire fighting knowledge.

Although the general adequacy of the DRU assessments and memorandums could be improved, the DRU reviewers have identified the majority of limitations contained in the submitted fire engineering reports, despite the low quality and implementation of broadly acceptable fire engineering methodologies in the submissions.

This Technical Audit of the DRU has identified areas, specific to the DRU and general to fire engineering acceptable practice, where opportunities for improvements can be achieved.

11 FINDINGS AND OPPORTUNITY FOR IMPROVEMENT

Based on the technical evaluation and discussion in the body of this report, the following recommendations are derived to improve the effectiveness of the DRU. The overall results indicate that the DRU is fulfilling their obligations under the Building Act Section 47 taking into account the quality and detail of the submissions.

Outcomes from this investigation can be divided into measures which can be controlled by the NZFS Design Review Unit and general opportunities of improvement for the building industry which the NZFS Design Review Unit should actively pursue with relevant parties to have undertaken:

11.1 FINDINGS IN THE PERFORMANCE OF THE NZFS DESIGN REVIEW UNIT

Finding 8-1

A review of the means of escape and fire fighting provisions within a fire engineered design should not be conducted in isolation to other measures of the proposed strategy.

Fire Engineering Design requires a holistic approach to an assessment; therefore, the review should also adopt this principle in associating aspects of a proposed fire engineering design to the provisions for the means of escape and fire fighting. NZFS Design Review Unit should adopt this principle in discharging their duties in accordance with Section 47 of the Building Act 2004.

Finding 8-3

The NZFS Design Review Unit response period of 10 working days should include a mechanism for the request of additional information. Similar to the BCA when considering Building Consent applications, this period should not include the time when additional information is requested from the BCA so that appropriate NZFS Design Review Unit comment can be made.

The NZFS Design Review Unit should request the Department of Building and Housing to provide interpretation of “working days” that is consistent with that provided to Building Consent Authorities in the consideration of building applications, as set out in the Building Act.

Finding 8-4

Adoption of principals in IPENZ Practice Note 2 – *Peer Review, reviewing the work of another Engineer* as the basis for the NZFS Design Review Unit role in undertaking the duties identified in Section 47 of the Building Act 2004.

Finding 8-4 Continued

These principals should be incorporated into an internal document, prepared to assist DRU reviewing engineers in discharging this duty in a consistent and transparent manner. This is to include clear guidance in undertaking a holistic review of a design in context with issues relating to means of escape and fire fighting provisions.

Finding 8-5

The NZFS Design Review Units should endeavour to participate in the Fire Engineering Brief process to enable technical input to the design/assessment and resolution of regulatory and technical issues at the early design stage of the project rather than upon building consent submission.

Finding 8-7

The quality of fire engineering submissions has been shown to significantly influence the quality of the NZFS Design Review Unit assessment. Minimum benchmarks should be set within the DRU to determine an appropriate quality of fire engineering submission that can be reasonably reviewed by them in discharging their duties under Section 47 of the Building Act 2004.

11.2 OPPORTUNITIES FOR IMPROVEMENT IN UNDERTAKING FIRE ENGINEERING ASSESSMENTS

Finding 8-2

The NZFS Design Review Unit should recommend to the Department of Building and Housing that 'Guidance Notes' be developed for fire engineering practitioners and Building Consent Authorities on the preferred format and minimum information contained within Fire Engineering submissions containing assessments for Alternative Solutions.

Finding 8-6

The NZFS Design Review Unit should recommend to the Department of Building and Housing that 'Guidance Notes' be developed for building practitioners (including Building Consent Authorities and fire engineering practitioners) on the expectation of the Department when designers use *reasonable practicable* as justification for variations to Compliance Documents and making submissions to NZFS Design Review Unit under Section 47 of the Building Act 2004.

Finding 9-1

Fire engineering practitioners should be required to adopt a holistic approach to the identification, formulation and assessment of performance based fire engineering designs. Appropriate fire engineering guidelines that set out acceptable practice methodologies are to be adopted, such as the International Fire Engineering Guidelines.

Recommendations should be made to the 'Department of Building and Housing' and IPENZ that an improvement in the general quality of fire engineering submissions is an opportunity for improvement of the building approval process.

Finding 9-2

The NZFS Design Review Unit should recommend to the Department of Building and Housing that "Guidance Notes" should be developed for the guidance of fire engineering practitioners in undertaking performance based fire engineering design. This is to include the minimum expectations to the competency of the designer relevant to the design proposed, from which a fire engineering assessment is provided for submission to BCA, reasonable justification of assessment and assumptions made and involvement of relevant stakeholders.

Suitable assistance in the development of these notes is provided in the International Fire Engineering Guidelines.

APPENDICIES



APPENDIX A DETAILED FIRE ENGINEERING ASSESSMENT REVIEW

A.1 INTRODUCTION

The scope of this assessment was also to make comment on the quality and methodology of the fire engineering assessments reviewed by the DRU.

A.2 TECHNICAL REVIEW OF PROJECT A

The building application is related to a temporary change of use for an existing building coinciding with an exhibition, in accordance with Section 115 of the Building Act 2004.

Designer A of Company A has acknowledged that the building *cannot fully satisfy the requirements of 115 before the required period.*

It has been nominated that the building is to have a WCL purpose group. Given an escape height of two storeys and occupant load greater than 1000 persons on the ground floor, the required FSP's are F0, 3f, 7, 16 and 18c.

The primary variation proposed by Designer A of Company A is the use of trained personnel in lieu of Type 3 fire alarm system, Type 7 sprinkler system and automatic closers to smoke stop doors.

A qualitative argument is provided with what is considered *reasonably practicable* to justify the omissions. This includes the possibility of false alarms, size of available smoke reservoir and the openness of the compartment to allow visual and olfactory cues. However, apart from evacuation assessment, no quantitative assessment is provided to justify the benefits of the available compartment volume. No comparison is made between the expected egress time and the available safe egress time utilizing height of fire compartment. Consideration to the appropriateness of using roller shutter as egress points has not been made.

Fire fighting provisions have been ignored by Designer A of Company A.

As the Designer noted that the design would not satisfy the requirements of the Building Code, consultation with the NZFS would have been expected. No indication of this was provided.

A.3 TECHNICAL REVIEW OF PROJECT B

The building application is related to an alteration to an existing office/workshop facility, in accordance with Section 112 of the Building Act 2004.

Designer A of Company B has been nominated the building to have a WM purpose group with a Fire Hazard Category of 3. Given an escape height of 5.2m and occupant load less than 100 persons, the required FSP's are F60, 3b, 16 and 18c. Designer A has incorrectly noted the requirements of C/AS1 Table 4.1 as being Type 2af and 18c.

The primary variation proposed by Designer A of Company B was the provision of a Type 3 fire alarm system throughout building with the direct connection to Fire Services disconnected. The relevant variation is considered to be C/AS 4.3.1 by way of Table 4.1 but this is not explicitly stated. The relevant Performance Requirements is therefore C3.3.9, but consideration could also be given to other Performance Requirements related to the fire resistance rating of elements to mitigate the expected delay in fire brigade intervention.

The fire engineering analysis undertaken to support variation were the following:

- Designer A of Company B has stated that no FSP's are required to comply with the NZBC; therefore provision of the system is greater than required. This was however based on incorrect selection of fire safety precautions from Table 4.1.
- An ASET/RSET assessment is conducted to demonstrate that occupants are able to evacuate the building before the onset of untenable conditions. The evacuation assessment only accounted for travel time. However, the variation is the automatic notification via direct connection to fire services to provide fire brigade intervention. The analysis method is therefore considered not appropriate to assess the trial concept against the relevant objective.

It is therefore considered that the assessment does not address the relevant Performance Requirement.

As building works is subject to Section 112 of the Building Act 2004, comments to the following items are also considered:

- Means of escape – Designer A of Company B has only incorrectly identified the Fire Safety Precautions from C/AS1 Table 4.1 and stated that *egress travel distance and capacity of egress are within the building code parameter*. No assessment of egress distances or capacity (apart what was used for the evacuation modelling) was provided or any comment to the extent that the building complies *as nearly as is reasonably practicable* with the relevant Performance Requirements. It is clear that some areas of the building, such as large storage room, were only provided with one exit without consideration.
- Access and facilities for person with disabilities – No comment is provided in Fire Engineering Report of the extent that the building complies *as nearly as is reasonably practicable* with the relevant Performance Requirements.
- Continue to comply with the other provisions of the building code as before the alteration – The Fire Engineering Report states that no alteration, other than the Type 3 alarm system, is being undertaken. However, no audit was conducted to determine to what *other provisions* apply and the extent that they have been maintained to provide an adequate level of performance.

Without appropriate consideration to these items, it is therefore considered that Designer A of Company B has not adequately considered the requirements for Section 112 of the Building Act 2004.

A.4 TECHNICAL REVIEW OF PROJECT C

The building application is in regards to an alteration to an existing education building having SR, CL and WL purpose group designation. The alteration is for the refurbishment of existing part that will accommodate class rooms, and includes the addition of floor level and a new stair. Another extension will be new building works.

The Fire Engineering Report states that the new building *will meet the requirements of the New Zealand Building Code for the new works and that the existing works will meet the requirements of the Building Code for means of escape, as far as is reasonably practicable*. Therefore, Section 112 of the Building Act 2004 will apply to the building, not withstanding Section 18 for new building works.

A variation explicitly noted for assessment is the inward door swing of classrooms which have an expected population use then allowed in C/AS1 3.17.3. Designer A of Company C has used a standard Alternative Solution in the Ministry of Education Fire Safety Guidelines 2.9 “Means of Escape” as justification, which states:

Classrooms with a stud height no less than 3m, and a maximum of 50 occupants, provide a minimum of one 810 mm width outward opening door or two 810 mm width inward opening doors.

The basis for this specific concession in the Ministry of Education guidelines is due to limited fuel load, available ventilation and smoke reservoir. However Designer A of Company C has failed to note that drawings indicate a stud height of less than 2.9m, has not considered the actual function of the classrooms (i.e. that it may be used for arts and craft where it may store higher fuel loads than general classrooms) and has not provided an assessment of the available ventilation. It is therefore considered the use of standard Alternative Solutions without appropriate consideration of the specific characteristics of the function of the building or part is not appropriate for the assessment of variations.

Another variation is to C/AS1 3.3.1 for smoke control which the Fire Engineering Report states it is required because the area of intermediate floor exceeds requirements of the provision. Designer A of Company C has proposed that passive smoke control measures be implemented with smoke stop doors serving the stairway serving the floors of the building. C/AS1 3.3.1 prescribes smoke control so that occupants of the intermediate floor need not travel in smoke logged conditions as they are more likely to do so as the path is located closer to the available smoke reservoir. If the location of the fire is in the intermediate floor, a smoke control system would protect the egress paths in that floor whereas passive smoke compartmentation between the floors would not. No assessment of the proposed design was conducted.

There are further recommendations to particulars of the smoke seals to doors in that it states *all door edges shall have smoke seals, except that smoke seals may be omitted at the sill of all doorsets*. It is not considered appropriate to no provide smoke seals to sills of doorsets as smoke may still migrate through this space. Pressure differences between compartments generated by fire or wind effects may drive smoke into stairway. Allowing such openings is considered not to comply with Building Code Performance C.3.3.

There are further irregularities in parts of the Fire Engineering Report where Designer A of Company C has noted what the fire safety systems are required in accordance with the Acceptable Solutions noted in C/AS1. They include the following issues:

- A Type 18c FSP system has not been included in the summary of required system. The Fire Engineering Report states that consideration of hydrant coverage *is not required to be assessed in this review*. However, as the building is subject to Section 112 of the Building Act 2004, it is considered that Building Code Performance C3.3.9, by way of C2.3.3, or the relevant Acceptable Solutions in C/AS1, should also apply. Therefore an assessment of a Type 18c system and an audit of the existing system are considered required to determine if it is reasonably practicable for this provision to comply, and if it isn't, what justification is there for rectification works not be recommended.
- The Fire Engineering Report states a firecell rating of F0 for the ground floor of a building with more than one floor. Designer A of Company C has failed to acknowledge C/AS1 4.5.8, such that the appropriate firecell rating should be F60.
- Designer A of Company C has failed to recognize that firecell rating (F Rating) and fire resistance rating (FRR) have different definitions. The concession to reduce fire resistance ratings by 50% based on the provision of sprinklers, where not required by Table 4.1, is not a direct concession to reduce the FRR.

Section 112 also requires a reasonably practicable level of compliance to disability access and a determination on existing provisions. There is a disclaimer in the report that states disability access is not included in the scope of the Fire Engineering Report. As an identified variation relates to egress, it is considered reasonable that Designer A of Company C consider this in the overall egress assessment.

In consideration of the above items, it was considered that Designer A of Company C did not adequately address the variations against the relevant performance objectives.

A.5 TECHNICAL REVIEW OF PROJECT D

The reviewed Fire Engineering Report was for a change of use of a commercial and residential building into an entire residential building of designated purpose group SR. The proposed arrangement of the building indicated that the building maybe used as student accommodation. A statement is included in the report that the *fire design in this report is not suitable for unit sub-division*, supporting the use of the building as student accommodation.

The objectives for the fire engineering design are identified as Section 115 of the Building Act 2004 for the proposed change of use. The report however does not clearly identify what is assessed as a variation to the Acceptable Solutions with that considered by the designer as not reasonably practicable to upgrade.

The following inconsistencies or comments of the fire safety design by Designer A of Company D were noted:

- The population of the building was based on the number of bedrooms and beds, as acceptable by the Acceptable Solutions. However, “Study Rooms” on the partially enclosed balconies were not considered by the Designer as potential bedrooms, and therefore were not considered in the population assessment. As the building demonstrates potential use as student accommodation, there is potential for the space to be used as a bedroom. It may also be unreasonable to use a population ratio of 2 persons per bedroom. The Designer has not reasonably considered the function or use of the building.
- No plans were provided of the proposed separation between the stairway and the existing top storey residential apartment.
- There are some inconsistencies with the protection of the balcony egress path. The report states -/30/- and 60/60/60 minutes for glazing and study respectively, then 90 minutes in drawings. S Rating calculation confirms 90 minutes. There are many inconsistencies throughout the report and with the provided drawings. The drawing show a consistent 90 minutes for vertical separating elements and 4 hours for slabs, while the floor slab for Level 3 is proposed to be on 60 minutes, however no justification of this reduction is provided.
- Travel distance calculations for Apartment D is only to entry door and not to the entry of the stairway, as stated from Apartment A. Drawings indicate a distance of 24m to doorway and 26.5m to stairway which are more than that stated in the Fire Engineering Report. However, with the provision of a detection system, the DEOP can be 36m (50% bonus) and as such the miscalculation does not alter requirements.

- Designer A of Company D has proposed a single exit from the car park space. The Designer has further proposed that this single exit be a roller door. This has been justified by the Designer by assuming that if the space is occupied the roller door would be up and therefore easy to find. Recommendations are also made to have door opening requirements be in accordance with C/AS1 3.17.1. It is considered that the basis of the strategy is not justified as persons in the car space need not have the door open. There are no management procedures proposed or could there be that could enforce such a requirement in student accommodation. Furthermore, the recommendation for C/AS1 3.17.1 is not appropriate as it only applies to *hinged or pivoted doors on the vertical edge*, where a roller door is clearly not either.
- As the unsprinklered building has an escape height of more than 10m (11m) the Acceptable Solutions requires that two exits be provided from each floor. The Designer has justified a single exit design by stating that it would be unreasonably practicable to require the installation of the second exit. However, it is considered that if a part of the design relies on “reasonably practicable” then consideration of the overall fire safety strategy should still be made to assess the impact of the variation. An assumption also made by the Designer is that the prescribed 10m height threshold is reasonable, but no basis for this or the actual 11m height is provided, apart from comparison to the Acceptable Solutions.
- Consideration for smoke not to enter the stairway from an apartment fire is made, based on the available *balcony travel*. Again, the Designer has not noted that actual opening sizes available for ventilation from the balcony are limited and an assessment is not provided to demonstrate the effectiveness of this ventilation. In not doing so, no consideration is provided regarding the spread of smoke between apartments or any wind effects in spreading smoke throughout the building.
- The Fire Engineering Report has not included the provision of Fire Hose Reels in the building, though required in C/AS1 Table 4.1 for the stated Purpose Group. C/AS1 Appendix A identifies that Fire Hose Reels are required for the primary use by the New Zealand Fire Service. It is therefore considered that *reasonably practicable* does not apply.

In satisfying Section 115 of the Building Act 2004, apart from consideration to *Escape from Fire* and *Fire Performances*, disabled access and an assessment of *other provisions* are required to be made. These issues were not raised in the Fire Engineering Report.

As a Fire Report to satisfy Section 47 of the Building Act 2004, consideration to fire brigade intervention was limited with respect to available water supply to the site. Other issues relating to notification, response, available resources, location of fire services and others were not considered.

A.6 TECHNICAL REVIEW OF PROJECT E

The proposed development was the alteration to an existing warehouse with an addition for a bulky goods retail area. The Fire Engineering Report has limited the scope of the project to *Escape from Fire* for the existing building and *Escape from Fire and Spread of Fire* for the proposed addition.

The Table of Contents for the Fire Engineering Report identify Alternative Solutions for S Rating Calculations and Egress and Smoke Control in the Warehouse. As there were many inconsistencies in this report, comments have been restricted to the stated Alternative Solutions.

As the building has been designated with a Fire Hazard Classification of 4, the Acceptable Solutions require fire engineering analysis to determine S Ratings. This has been conducted by Designer A of Company E by undertaking zone modelling of a sprinkler protected building and assessing expected temperature exposure to roof structural elements. A Fire Severity Assessment was also conducted in the Fire Engineering Report for comparison. FAST was used to undertake the zone modelling with the following issues identified:

- The Designer has proposed an ultra-fast t^2 design fire for the assessment, stating that *it is the fastest growth rate generally used*. In bulky good storage and retail facilities, the fire may grow significantly faster depending on the contents of the building. Potential hazards in the building are required to be considered before selection of the design fire.
- Fast response sprinkler heads with a RTI of $50 \text{ (ms)}^{0.5}$ and an activation temperature of 68°C has been proposed. Justification of this recommendation has not been provided to determine reasonableness of the type of heads. It should also be noted that it may not be reasonable to provide sprinkler heads with an activation temperature of 68°C based on the expected ambient temperatures in warehouse facilities. NFPA Code 13 provides a basis for the selection of activation temperature based on ambient conditions.
- The Designer has added an additional 20 seconds to the sprinkler activation time to be conservative. There is not justification provided with this factor. The International Fire Engineering Guidelines recommends that the delay be assessed by locating the activating detector the second row across in the grid arrangement.
- An additional 30% of temperature was included to assess the upper layer zone temperature; however, this does was not justified and may lead to the proposed design being overly conservative. This resulted in an assessed temperature of 104°C . The Designer indicated that this would not *create a problem for the building structure*.

- Only a sprinkler controlled fire scenario was considered. Sensitivity to sprinkler activation and location of fire event should have been included. No consideration was given to direct flame impingement on structural elements which would provide for localized heating of elements and potential failure.

The zone modelling was also used in conjunction with an evacuation assessment to undertake an ASET/RSET analysis to assess the Alternative Solution for smoke hazard management in the warehouse. The following items were noted:

- A review of the zone model noted that the absolute ground floor levels of the mezzanine and warehouse compartment were the same with different absolute ceiling heights, when the absolute elevation of the mezzanine compartment floor level should have been different. The compartments were modelled incorrectly. In modelling the way that the Designer has, smoke migrating into the mezzanine compartment is delayed as it would require the smoke layer in the warehouse (from a warehouse fire) to fill down to the soffit of the opening.

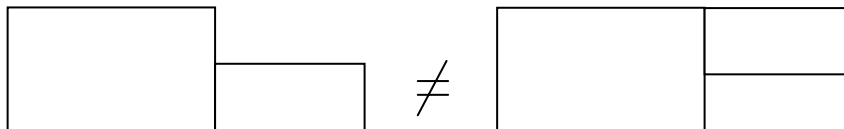


Figure 11-1 – Comparison of compartment arrangement used in zone model with arrangement it was to represent (Profile)

- The Designer has used the Fire Engineering Design Guide (Ed 2) in the evacuation assessment. Activation of the sprinkler system has been used as the cue time for evacuation to begin, however the depressurization of the sprinkler system to activate the sprinkler alarm has not been considered. This could be as much as 360 seconds, rather than instantaneous. If this was adopted then the assessment would not support the proposed design.
- A 90 second premovement time has been used but again this is without justification.
- In calculating available exit width, the Designer has made errors in the number of required exits recommended by only considering on sliding door to be made required, but egress calculations show that all are being used. There are also errors in the arithmetic and how boundary layers are included (for each door, rather than to the aggregate exit width).

The Fire Severity Calculations offered more examples where the Designer has not demonstrated an adequate understanding of the tools used in the fire engineering analysis. Such issues noted were the following:

- The Fire Severity assessment was performed to a compartment that is FHC, contrary to C/AS1.

- The Designer has assumed only a storage racking height of 4m in a warehouse with a height of 8m in calculating the fuel load in the compartment. This is considered unlikely as it would represent a significant loss of storage space.
- The use of Eurocode method is outside the field of application. The results should have a vertical opening area to floor area ratio of 0.025 and 0.25, as stated in Eurocode 1. In the assessment, this ratio was only 0.012.

As all other recommendations were based on the above assessments, it is considered that the Designer demonstrated a poor use and understanding of fire engineering analysis in the Fire Engineering Report.

A.7 TECHNICAL REVIEW OF PROJECT F

The proposed development is an addition of a school building that will be connected to existing buildings. The following variations had been stated in the Fire Engineering Report:

- Heat detectors in lieu of smoke detectors in existing parts of building based on that they may be upgraded in future.
- Fire detection system connected to school security alarm, not all connected to NZFS. Reliance on 111 telephone call being available.
- Egress from sleeping quarters on first floor is into a common non-pressurised vertical exit, in lieu of a horizontal safe path (terminating at separate vertical safe path of outside) or direct exit to outside, or pressurised vertical safe path.
- F30 in lieu of F45 or 60, based on MOE guidelines.

As an existing building, the Designer has used *Reasonably Practicable* to justify not connecting the detection system to NZFS, performance of existing fire and smoke resisting elements and pressurization of exit way that serves a sleeping area. No qualitative or quantitative assessment is forward to further support these provisions or consider the consequence of such variations. An example is that without the connection to the NZFS through direct system, there will be a delay in NZFS notification to the site.

The Designer has also used a standard Alternative Solution from the Ministry of Education to justify the reduction of the Fire Resistance Rating to 30 minutes. There was however no site specific consideration to this concession, which may have included assessment of hazards associated with science buildings as laboratories greatly differ in fuel load and hazards then with other types of classrooms.

Other comments are noted:

- The designer has inferred that in upper floors of existing building, the timber floors (timber joists) lined with plasterboard and light fittings and other services is as "reasonably practicable" to providing 15/15/15 FRR for intermediate floors with no upgrades. This should not be assumed without detailed investigation

- In egress considerations, it was proposed that Gibb West Stair be made safe for sleeping areas; however they are not proposing to make safe Level 2 only Level 1 and Ground based on detection on Level 2. No assessment is provided; including the effects of fire on Level 2 may have to Stair (smoke fill down).
- In considering the locker room opening directly into stairway, the proposed argument of low fire load from particle board lockers is not reasonable and does not take into account actually fuel load (contents included) and occupant characteristics (deliberate fire starts).
- As an existing building, it is considered reasonable for the Designer to undertake an assessment of the performance of existing systems rather than providing assumption to their performance. An example of this is to the level of smoke separation and the smoke seals and doors available.
- The proposal to provide heat detectors in lieu of smoke detection does not consider the potential delay in occupant warning between the systems.

The Designer has not provided a holistic approach to the assessment as shown where it is proposed to provide safe egress from a sleeping area using a stairway, then allowing another Alternative Solution to allow other rooms with potentially high fuel loads and hazards to open into stair without appropriate separation. A disjointed assessment without consideration on the impact of one variation to another or to the Acceptable Solutions is provided.

Specific consideration to fire brigade intervention has been ignored. Though hydrant coverage has been stated to be satisfactory there is no consideration to potential hazards to personnel with respect to hazards associated with science classrooms, the reduced FRR of structural elements to maintain stability during their activities, or the delay in notification for a response.

A.8 TECHNICAL REVIEW OF PROJECT G

The proposed development is for the alteration of a two storey apartment building, with ground floor car park, into three storeys by the addition of a floor. Designer A of Company F has undertaken this assessment without plans for Level 1 or a site audit of the space. This is even though the variation is to C/AS1 3.11.6, where exit doors from apartments directly enter into a vertical safe path, in lieu of a horizontal safe path, pressurised vertical safe path or final exit.

To mitigate against the identified variation the Designer has proposed the stairway to be protected from SOU with 60/60/60 construction, increased from 30 minute. Intumescent seals also proposed. A comparative assessment to demonstrate how the proposal may compare to a complying system should be provided as the variation is to smoke spread while the mitigating proposal is for fire spread.

The following inconsistencies were also noted:

- Discharge from vertical safe path is into ground level car park. Travel to final exit is still required ~20m. It may also be to garage door. Details on door swing and latching devices have not been considered.
- Site inspection was not conducted to resolve identified issues so that assumptions do not have to be made and provide a check in the performance of *other provisions*.
- Table 4.1 requires F45, 2f and 16a. The designer has included F30, instead of F45. A review of the Fire Engineering Report notes S ratings have considered both 30 and 60 minutes to parts on different sides of building. No assessment has been provided to indicate if failure of an element recommended to have a FRR of 30/30/30 will cause failure of elements required higher FRR.

In consideration of the above items, it was considered that Designer A of Company F did not adequately address the variations against the relevant performance objectives.

A.9 TECHNICAL REVIEW OF PROJECT H

A new residential building is proposed in the Fire Engineering Report prepared by Designer A of Company C. The proposed Alternative Solutions were noted as being the following:

- C/AS1 3.15.6 Single exit from SOU with escape height of 33m in lieu of 25m in a sprinklered building. Stair pressurisation is proposed in vertical stairway to protect path of egress for occupants who will need to travel a long distance in the exit. A qualitative comparative argument is presented. Less population and therefore less queuing at the final exit (Maximum pop for 25m building may be 350) will also mitigate the additional time that occupants will be in the stairway due to long travel in stairway. The basis for the base scenario is not however explicitly provided
- C/AS1 5.6 The FRR for primary steel columns and beams in car park is not to be protected in lieu of 60/60/60 based on sprinkler protection and BHP car park test results. The basis for this assessment is the BHP car park experiment with sprinkler protection. The results of the test were used as the design recommendations in the report (ESA/M ratios). The Designer has not considered the potential for sprinkler failure in car park or assessed if the results of the BHP test were appropriate. Other elements with a greater ESA/M are recommended to be protected to fire resistance rating of 45/-/-, however this is without justification.

- C/AS1 6.9.2 Penetrations into stairway to be at a FRR of the adjacent fire cell in lieu of maximum for the safe exit. The Designer has assumed that the FRR is based on S Rating calculation of burnout and the room would burn out before failure of penetration protection. The Fire Engineering Report does not consider any redundancies of a comply system. Possible advantages are in sprinkler failure scenarios, where burning could be for a longer duration, redundancy in case of variation in real fuel load and distribution. It may also minimise the potential for construction mistakes if the fire resistance rating required was consistent throughout project.
- C/AS1 6.9.3 Rising and descending stairs on ground level is not to be separated with fire rated construction. This assessment is based on appropriate separation already provided and directional signage to exit floor to be provided. Qualitative argument appears justified. However, C/AS1 3.3.2 (i) requires where rising and descending stairs meet on level of Final exit, the escape route width at that point increase to accommodate both directions. Drawings indicate that this is not the case.
- C/AS1 6.16.1 The FRR for the lift shaft adjacent to vertical safe path is to be 30/30/30 in lieu of 45/45/45 as 30sm is required for the stairway. The assessment only assumes a fire from the stairway to the shaft because of low fuel load expected in shaft. This assessment has not made recommendation for fuel load control in stairway or the potential for fire to spread from lift shaft to stairway.
- C/AS1 7.3.12 The distance between the external wall parts (metal rain guard) is less than 1m. A radiation calculation was performed using a fuel controlled fire as a radiating panel to boundary and showing that it imposed less than 30kW/m². The temperature of the panel used was 700deg, though the reference in C/AS1 is for a radiation intensity of 87.6kW/m² for the radiating panel. Using this source radiant heat flux 39kW/m² at the boundary is expected. The results in the appendix of the Fire Engineering Report for the vertical flame projection calculation show different inputs used for FireCalc radiation assessment.
- C/AS1 7.9.6 The external wall is not to be protected from the lower roof of an adjacent building. A fuelled controlled scenario was assumed that indicated that flames would not project over walls of the adjacent building. This assumption is not justified as ventilation controlled fire event may occur, creating large flame projections from the building.

The provision for most of the Alternative Solutions is the provision of the sprinkler system. With a strong reliance on the successful operation of the system in the overall fire safety strategy, it is considered that a sensitivity assessment should have been conducted to demonstrate the robustness of the system, i.e. a sprinkler failure scenario may have been considered.

In considering the assessed Alternative Solutions, no assessments have demonstrated an appropriate level of fire engineering analysis to satisfy the fire safety objectives when compared to the Acceptable Solutions.

A.10 TECHNICAL REVIEW OF PROJECT I

The proposed development is the refurbishment of an existing nine storey commercial building. Designer A of Company A has stated that the Fire Engineering Report is limited to the base building only and to the assessment of *Escape from Fire* in accordance with Section 112 of the Building Act 2004.

The following Alternative Solutions were noted in the Fire Engineering Report:

- C/AS1 Table 3.2 vertical travel exit width is 1x1100 and 1 x 770 in lieu of 2 x 1000mm. As the sprinklered building is over 25m, two exits are required in accordance with C/AS1 3.15.3. The door opening widths of one of these exits is 750mm in lieu of 1000mm. Designer A of Company A considers that as the building is just over the 25m requirement, population is low and it is a *reasonable practicable* for an existing building, the design will be satisfactory. No comparative assessment is provided; therefore there is a strong reliance on expert judgement for what is *reasonable practicable*.
- C/AS1 3.1.2 the discharge of vertical safe path into lift lobby on ground floor in lieu of another safe path or final exit. It is proposed to protect this discharge with a smoke curtain based on sprinkler protection. There is however no final exit way noted on plans from this lift lobby. Specific details, such as height and how the curtain is activated are not provided. Occupants may be trapped at the point of discharge if a fire was to smoke log the ground floor mall. Consideration to smoke spread from lift shaft into lobby has also not been considered.
- C/AS1 Table 6.2 Lift doors not provided with smoke control capability based on provision of sprinklered fire cells and smoke detectors at landings, in lieu of smoke detection throughout.
- Vertical projection and radiation assessments were conducted to assess the Alternative Solution for an existing bronze Georgian wire glazed systems. The assumptions for non-certified Georgian wired glazing (incl 50% reduction of radiant heat) and sprinkler protection of bronze framing is not justified to maintain integrity. This assessment was through a comparative assessment. The basis of the C/AS1 scenario is not provided but they have used the results of Comment C/AS1 7.3.15 as the basis to compare results, though they are not similar design cases i.e. differing flame temperatures (though C/AS1 requires sprinklers), the glazing has an absorption of 50% (both should be the same), openings size (the should be equivalent). With all items equal as required by C/AS1, then as the Alternative Solution is closer to the boundary, the results should be worse. The assessment does not demonstrate this.

Other inconsistencies noted in the Fire Engineering Report are the following:

- The design has specified incorrect F Rating for ground level. As the building has more than 2 floor levels, it requires a minimum of Column 2 from C/AS1 Table 4.1. such that it should be F60 in lieu of F0.
- FSR states assumption of the FRR for existing concrete floors/walls, doors and glazing. As an existing building, this is to be inspected and certified or replaced. Assumptions of these elements are inappropriate.
- In considering egress, the Designer A of Company A has promoted both a stay in place and early evacuation strategy. Emergency management procedures should then be implemented to identify trigger events for either strategy.
- An overview of the performances of *other provisions* has not been considered in the Fire Engineering Report. This can be achieved with an audit by suitably qualified persons.

The reliance of sprinklers and *reasonable practicable* is used to justify most of the Alternative Solutions, however the scenario of where it may fail have not been considered for sensitivity nor has the effects a *reasonable practicable* variation to the overall strategy been provided.

A.11 TECHNICAL REVIEW OF PROJECT J

The proposed development is an expansion of an existing single storey congregate care facility. This project differs to others reviewed as a schematic fire safety strategy has been adopted for the building. Designer A of Company G had prepared an overall strategy (Fire Safety Design Basis) that in accordance with documents provided; NZFS had given approval for the basis for any new or existing development. Therefore all design proposals were based on this overall strategy without assessment, rather than to the Acceptable Solutions.

This document did identify potential hazards, building and occupant characteristics and provide prescriptive Alternative Solution design to mitigate these issues.

The Fire Engineering Report however made recommendations without assessment or consideration to the appropriateness based on site specific assessment. The following were noted:

- Manual call points are not to be provided. No justification or analysis is provided.
- C/AS1 6.6.2 and 6.6.8 requires sprinklers and fire separations of 30/30/30 between sleeping areas and communal service functions (i.e. nurse station, lounges, and dining rooms). No fire engineering analysis is provided to justify why this has been omitted.

- C/AS1 6.6.4 sleeping areas may be subdivided with non fire rated partitions having a gap no less than 400mm between top of partition to ceiling or full height smoke separations including smoke control doors (no closers). No reference to separation is provided, however the fire engineering report has proposed all bedroom doors to have cold smoke seals, no self closers and intumescent flush boxed to be installed. There is a reliance of sprinklers, however the recommendation for intumescent flush boxes is related to sprinkler failure or shielded fire event.
- The Fire Engineering Report states that surface properties have been "deemed" to comply without inspection due to what is *reasonably practicable*. This is considered unreasonable as surface linings and other finishes are items that are expected to be regularly changed due to durability of elements. Audits during refurbishments provide an opportunity to ensure existing finishes still comply.

The Fire Safety Design Basis report provides a general assessment of likely issues with related buildings but the Fire Engineering Report has used this as a prescriptive design rather than a guide for the design and assessment. Therefore, fire engineering analysis have been ignored and without consideration to the appropriateness of the design in this instance.

A.12 TECHNICAL REVIEW OF PROJECT K

The Fire Engineering Report is an assessment to a fit out of a retail tenancy in a shopping centre that was already subject to a fire engineering analysis. The assessment for the base building had not been provided and the subject Fire Engineering Report did not stand alone and only considered egress.

Previous recommendations included the following:

- Fire resistance ratings of 60/60/60 to floor slab.
- The base building assessment allowed for penetrations through floor slab from super market below of 500mmx500mm and gaps of 200mm wide (no limit in length provided) This was not provided for review. The gaps noted could represent significant paths for the spread of fire or smoke throughout different fire cells, and therefore can not be considered to satisfy Part C3 of the Building Code.

A reassessment of the egress provisions in the tenancy was conducted by an ASET/RSET analysis. Based on a population of 1134, in accordance with C/AS1 Table 3.1, the required width of horizontal exits is 7.9m, vertical exit 10.2m. They have 4.47m for horizontal and 4.65m for vertical.

The zone modelling included assessment of the mezzanine area. There are recommendations that this space is not to have openable windows at high levels to prevent the spread of smoke from warehouse to mezzanine enclosure. Email correspondence confirms that this means above 6m in a 7.8m high compartment without justification. Based on zone modelling results, this would occur at approx 460s after fire start. No acceptance benchmark is provided to determine the adequacy of the fire engineering analysis.

Designer A of Company H has not presented a Fire Engineering Report that presents base details of the building or assessment to determine the adequacy of the analysis. Additional comments through correspondence by another designer from Company H has overridden or recommended without assessment on items discussed in the Fire Engineering Report. Such comments should be included in an amended Fire Engineer Report so that documentation about the design can be easily retrievable if reassessment is required.

A.13 TECHNICAL REVIEW OF PROJECT L

The proposed new development is for 5 two storey blocks (26 units in total) where the ground floor used for workshop and the top floor used as residential. Designer A of Company I has identified the potential occupant characteristics as contractors and the like with workshops likely to contain potentially combustible or flammable items.

The purpose for the assessment is the presentation of the S Rating calculations which was considered satisfactory.

The design to stairways and the risk of falling have also been included. These included a variation for stairway and landing hand rail to be only 900mm high, but no assessment was presented to justify the design.

Other issues identified in the Fire Engineering Report are the following:

- It is not clear if D7 in stairway is protected or not. This would separate the WL with SR. Overall site plan indicate they are but individual plans show only opening. Plans for Units 1-18 show lower door (D6) with no protection while plans for Units 19-26 show D6 with -/30/30 smoke stope door with closer.
- If not fire and smoke separated, there is no separation between the WL and SR parts of each unit.
- Due to sleeping arrangements, designer has recommended an increase level of detection, from 3f to partial 4f (some smoke detectors installed).
- The designer has stated that 150mm thick concrete tilt panels provide a FRR of 216 minutes but no assessment or certification by a suitably qualified person is provided.

A.14 TECHNICAL REVIEW OF PROJECT M

The proposed redevelopment is to an existing residential building with commercial tenancies. As an alteration, Section 112 of the Building Act 2004 is applicable.

The format of the report made it difficult to identify Alternative Solutions with other general comments made with the assessments. The following items were noted:

- Final exit swings in. Designer of Company J justified this by stating that it was in an unenclosed space and not subject to smoke fill. No assessment was made to identify potential hazards that may cause smoke to migrate into the area or to the effectiveness of the ventilation to maintain the space clear of smoke. The statement does not address other issues such as potential occupant crushing at the doors and the prevention of the final exit door to open to allow egress.
- Potential hazards along the egress path were recognized. The Designer has performed radiation assessment onto path of egress with recommendations for additional exits.
- Zone modelling was used to assess use of Type 3 system in lieu of Type 4 throughout building. The times used for detection, response and investigation (5s) were very short and without justification.
- Acceptance criterion used an above breath height of 1.5m and 100 degC, or 183degC at any height. The height criterion is low and may lead to unconservative results.
- The modelling shows that the outcomes are not adequate as they are outside these tenability criteria, however the summary in the assessment states it is adequate for Case 1 and 2.

The evacuation assessment and zone modelling has not been conducted satisfactory with respect to acceptance criterion and input parameters.

Consideration to disabled access, fire brigade activities or *Other Provisions* has not been made, such that it is considered that the objectives of Section 47 or 112 of Building Act 2004 have not been provided.

A.15 TECHNICAL REVIEW OF PROJECT N

Designer A of Company G has prepared a Fire Engineering Report for a new shopping centre.

The following variations to C/AS1 were identified:

- Table 4.1/3 Type 6 FSP in lieu of Type 4. However, sprinklers are already required because of C/AS1 6.21.5. Therefore the Alternative Solution is for the deletion of smoke detection system. The Fire Engineering Report states that the fire sprinkler system are *over and above* the requirements of C/AS1 Table 4.3 but this does not make it aware that it is already required by C/AS1 5.6.13. The provision of a sprinkler system, in lieu of a smoke detection system may control the fire but will delay the cueing time for occupant evacuation. This has not been considered by the Designer, and has therefore demonstrated that the Designer has a limited knowledge of the Building Code and has not taken a holistic approach to the design.
- C/AS1 6.21.3 - Smoke control in fire cells with intermediate floors is to be by specific fire engineering design. The building is not to be provided with smoke exhaust based on the intermediate floor being smoke separated from warehouse. The designer has justified no smoke exhaust based on the egress time from the mezzanine stating that smoke will have to fall below the door soffit height on ground floor serving mezzanine, *by which time occupant will have had time to escape from intermediate floor*. However no ASET/RSET assessment to demonstrate this has been provided. The deletion of early cue (smoke detection) may further increase the required safe egress time.

Other general comments to the fire engineering report were noted:

- F Rating is not specified in report. It should be F30.
- Para 30 states S Rating Calc has been undertaken and put into Appendix B, to demonstrate S Rating 180minutes, but this was not attached to the report for assessment.

The comparative assessment proposed by the Designer has not appropriately compared the proposed design against a similar design that complies with the Acceptable Solutions. Therefore, it is considered that the relative Performance Objectives have not been satisfied.

A.16 TECHNICAL REVIEW OF PROJECT O

Documentation provided with this report did not indicate the scope of the project as being either a Change of Use or Alteration. Without this identification, the objectives for the assessment can not be clearly defined.

The fire engineering report consisted of calculations for S Rating, identification of fire safety precautions and some analysis without discussion.

The following issues in the calculation sheets were noted:

- Calculations show that rear doors provide 1750mm but the report has rounded this up to *1800mm say*. This manipulation of assessment results is considered inappropriate.

- The Dead End Open Path calculations show the required distance to be 36m (this includes 100% bonus for smoke detectors). The actual calculations show 37m which is a variation to requirements which have not been assessed.
- The FSP's calculated were 4f, 9, 16ad. As no escape heights were given, this was compared with C/AS1 Table 4.1. This did not correspond to any lists for CS and CM purpose group. Therefore it could not be determined if it was a proposed Alternative Solution or subject to an existing fire engineering assessment.
- S Rating calculations were conducted which showed time equivalent values of 56 and 79 minutes. A 50% reduction sprinkler concession was provided though no sprinklers were proposed, so that a 30 minute S Rating was concluded. The actual S Ratings calculated reported with the unsubstantiated concession was 28 and 39 minutes.

It is considered that the submission did not represent a fire engineering report as it did not contain basic details of the proposed fire safety strategy, basis of analysis or provided results that represented the actual outcomes of an assessment without unjustified modification.

A.17 TECHNICAL REVIEW OF PROJECT P

The proposed development is for an upgrade of a student accommodation building to comply with Section 112 of the Building Act 2004.

The only Alternative Solution explicitly identified by Designer A of Company L was for the omission of fire resistant construction between bedrooms based on the social cohesiveness that may be expected between occupants. The following issues with respect to this Alternative Solution are provided:

- The protection of the egress pathway is reduced by the Alternative Solution for bedrooms not are considered as fire cells (C/AS1 6.7.6 would require each suite to be a separate fire cell having fire separations of no less than 30/30/30) and the central stairway being not appropriately fire separated from the RA suite.
- The Designer has stated that *solid core doors having degree of fire separation*. This can not be justified without test or assessment.
- Door closers to bedrooms are not proposed, based on the assumption for occupant privacy, but the assessment uses social cohesiveness as well for not fire rating the bounding constructions. By stating both the basis for the assessment seems to be contradictory.
- The Designer has not appropriately justified social cohesiveness as it does not consider the sole person situation, start of term, different cultural and language backgrounds of occupants, use of buildings for school camps and out of term events etc.

Another variation was noted with respect to the level of separation between one sleeping area with the egress stair. The Designer has stated that occupants can use alternate path if fire in this suite, but no discussion is provided in giving direction to occupants if this is required. What is reasonably practicable has also been used to further support this variation. The smoke and fire spread effects to other fire cells using the stairway to migrate have not been considered.

Reasonably practicable has also been used to justify the reduced exit width, which may delay egress from the building. Considering this with a reduction in the separation resistance of the bounding construction of the stairway there may be impact on the level of safety provided for occupants using the path or fire brigade personnel using stairway to gain access to fire cell of fire origin.

To determine if a variation is *reasonably practicable*, the term itself is to be defined. If it is purely 'not reasonable' because of cost then stakeholders, possibly including insurers, are to agree on this level of safety. This is because the variation may impact on other parts of the design, reducing the overall level of safety.

A.18 TECHNICAL REVIEW OF PROJECT Q

This redevelopment assesses the proposal to change a building into a hostel. As well as the requirement to satisfy Section 115 of the Building Act 2004, the building is constrained by Heritage requirements. The design philosophy for the redevelopment are provided, considering the characteristics of the building, occupants, potential hazards and the appropriate fire safety objectives.

The variations stated in the fire engineering report by Designer A of Company M were the following:

- Non fire rated existing metal bed room doors. Fast response heads proposed, addressable alarm system, smoke control provided, alternate exit provided to pass room of fire origin.
- First floor walkways not fire protected. Brackets to be protected with intumescent paint 30min. Fast response heads proposed, addressable alarm system, smoke control provided, alternate exit provided if localized failure occurs.
- Egress path is required to be in a safe path. It travels through reception area, based on enhanced fire protection services

Emergency management and procedural recommendations are proposed, which include house keeping for paths of egress and limitation of activities for some spaces.

Designer A of Company M has presented a Fire Engineering Report which has clearly identified the fire safety objectives for the design and has considered appropriate measures to mitigate the identified hazards.

A.19 TECHNICAL REVIEW OF PROJECT R

The Fire Engineering Report prepared by Designer A of Company A is for an alteration to an existing childcare centre. The Designer has limited the scope of the assessment to Means of Escape but no variations to this have been noted by the Designer or in the review of the Fire Engineering Report.

As no fire engineering analysis was undertaken, little comment to the methodologies adopted can be made.

As a report for consideration by the DRU in accordance with Section 47 of the Building Act 2004, consideration to fire brigade intervention was also required. In this instance, issues such as fire brigade access, response and available services have not been considered.

A.20 TECHNICAL REVIEW OF PROJECT S

The addition of three storeys to an existing three storey hospital is proposed in the Fire Engineering Report prepared by Designer A of Company A. The design philosophy for the building is based on the acceptance criterion that *the construction around bedrooms in each ward (fire cell) is to be such that it can contain the smoke from a sprinkler controlled fire for the time necessary for safe evacuation of occupants from that fire cell.*

In considering the characteristics of the occupants (staff and patient) it is proposed that a staged evacuation policy be developed with the provision of an emergency warning and intercommunication system to direct the evacuation. Staged evacuations can be effective in this instance if certain issues are resolved:

- Emergency roles and responsibilities of staff are to be identified with several levels of redundancies in case of absence or incapacitation of staff.
- Numbers of staff available to assist in evacuation during each rostered period is known.
- Training of staff to be provided with regular drills.
- The notification of staff to a fire event if they are not located near a mimic panel.
- The requirement for mimic panels to be only on G, 1 and 2 is not justified as sleeping areas are on all floors.
- There is adequate provision of space in adjacent fire cells for evacuees to assemble.

Though staged evacuation provides a strategy to evacuate occupants with respect to patient abilities, it does not assess proposed variation to the fire resistance rating of bounding elements to ward areas. No fire engineering analysis is provided to support the variation and the proposed acceptance criterion is not assessed against. It is therefore considered that the proposed assessment was not appropriate to assess the identified variations.

The design proposes the reduction of the requirements for passive resisting elements with the provision of active fire safety systems. Due to this change in containment systems, issues such as reliability and maintenance need to be considered as part of the assessment. This may be conducted as a sensitivity assessment.

A quantitative assessment, such as an ASET/RSET analysis, has not been provided to determine if there is adequate time to evacuate a fire cell before the onset of untenable conditions. This assessment is required to assess the design against the stated acceptance criterion.

The assessment report presents more like a Fire Engineering Brief, proposing the egress components of the fire safety design strategy, rather than a Fire Engineering Report with detailed assessments and specific recommendations.

A.21 TECHNICAL REVIEW OF PROJECT T

The Fire Engineering Report for this redevelopment of a commercial building is written as an Acceptable Solution compliance report in that no variations are identified to be subject to a fire engineering assessment. This is stated in the *Method of Analysis* of the report

The report identifies critical components of Part 2, 3, 4, 5 and 6 of the C/AS1, in accordance with C/AS1 1.3.1.

The following comments are made:

- Disable access to the building has not been considered in the assessment, as required by Section 112 of the Building Act 2004.
- Method to calculate population has not been provided (i.e. densities from C/AS1 Table 3.2 has not been used).
- The calculation details for external fire spread have not been provided.

As no fire engineering analysis was undertaken outside of the Acceptable Solutions, little comment to the methodologies adopted can be made.

As a report for consideration by the DRU in accordance with Section 47 of the Building Act 2004, consideration to fire brigade intervention was also required. In this instance, issues such as fire brigade access, response and available services have not been considered.

A.22 TECHNICAL REVIEW OF PROJECT U

The project is for the proposed redevelopment. The Fire Engineering Report has been assessed against Section 112 and 115 of the Building Act 2004.

The following variations were identified in the report:

- C/AS1 3.15.6 Single exit from fire cell in SR sprinklered building with escape height of 26.5m in lieu of 25m. Designer A of Company O states *this variation has virtually no effect on the evacuation times and the improvement from installing sprinklers is very considerable*. No assessment of this "virtually no effect" has been provided to justify the proposal and the benefits of a sprinkler system as a mitigating factor for a comparative assessment can not be used as the provision for sprinklers is already an Acceptable Solution.
- C/AS1 3.7.1 Basement stairwell is served by one stair and escape route, though there are smoke lobbies proposed in basement level to protect the stairway, the stair does not discharge to a safe place. The Designer has used *reasonably practicable* as justification for the assessment. There is no consideration to a ground floor fire scenario where the single exit may be blocked. Considering this scenario where the only exit to the building is blocked, it is considered reasonably practicable to rectify this issue to prevent this potential occurrence. It should be assessed against the consideration that two exits are required by the Acceptable Solutions for a building over 25m in height.
- C/AS1 Table 6.1, Lift landing doors (not smoke sealing) are to be protected with a full sprinkler system and partial smoke detection system in each floor, in lieu of a full coverage smoke detection system. The basis for this solution on smoke detection not being justified based on height of building and it is sprinklered protected. Neither of the mitigating factors proposed addresses the prevention of smoke migration throughout building via the lift shaft.
- C/AS1 3.1.1 Discharge of vertical safe place is in an open path in lieu of the final exit. This variation was not identified by the Designer, indicating limited compliance review of the proposal.
- C/AS1 6.9.3 The stairway serves floors lower and upper floors from final exit level in lieu of FRR of 30/30/30. This variation was not identified by the Designer, indicating limited compliance review of the proposal.

Under S.112 and 115 there is a requirement to check if it complies for disabled use and check FRR of existing systems. Reliance on the existing systems being assumed to comply because no works have been undertaken is not considered satisfactory.

A.23 TECHNICAL REVIEW OF PROJECT V

Project V is a proposed new warehouse building. Designer A of Company H has presented a Fire Engineering Report subject to Section 47 of the Building Act 2004. The following variations were identified in the report:

- C/AS1 5.6.13 - Building is not sprinklered protected, as required with FHC 4 with two or more floors, based on limited addition fuel load of under mezzanine and open mezzanine space. This is therefore a comparison between a two storeys building with a one story building. If this is the case, a detailed assessment on available fuel load and measures to control this hazard should be included in the assessment.

- C/AS1 6.21.3 - Smoke control in fire cells with intermediate floors is to be by specific fire engineering design. The mezzanine cannot constitute a limited area in accordance with 6.21.5 as the building is FHC4 or more. The building is provided with natural smoke vents but no assessment is provided. Venting from warehouse is proposed by the use of melting materials (200degC) for 15% of roof area. No details of system provided. No additional smoke management is proposed based on smoke reservoir and smoke detection. No quantitative assessment was conducted to justify this design.

The assessment of the egress part of the Fire Engineering Report generated the following items:

- Two doors provided from the space, however, in considering egress width, only one should be considered if the building is not sprinklered. This has not been assessed.
- The mezzanine is required two exits as well, which it is not provided.
- Egress calculation did not account for unsprinklered building and one exit blocked. For 87 person at 7mm/person, this requires 609mm. An assessment of this figure to that actually provided has not been performed.
- Signage plan layout not provided.

Other issues noted are the following:

- The designer has used Buchanan to determine FRR of wall based on thickness. This is to be confirmed by the structural engineer.
- S Rating calculation performed, but the following flaws were noted. The Fire Severity assessment in C/AS1 is stated as not being appropriate for FHC4. Consideration to the field of application for the assessment method as the vertical opening area to floor area ratio is 0 when it needs to be between 0.025 and 0.25.

The use of comparative assessment should be to a similar building and not to an extreme instance that is in accordance with Acceptable Solutions. This can lead to basing a fire engineering analysis on an argument of a definition rather than an assessment of the hazards.

The review identified potentially more variations to egress, such as distances, egress width and number of exits which have been missed by Designer A of Company H. Involvement from the BCA or other relevant stakeholders may have identified these variations before the detailed fire engineering assessment so that the Designer could assess the impact of these variation may have to already identified variations and Acceptable Solutions.

A.24 TECHNICAL REVIEW OF PROJECT W

The proposed Fire Engineering Report by Designer A of Company P is for a refit of one floor in a multi storey residential building. This assessment is to be against Section 112 of the Building Act 2004 for an alteration of an existing building; however the Designer has excluded disabled access from the assessment.

- Table 4.1/5 requires a Type 7e (Sprinkler system with smoke detectors and MCP) The (e) allows that smoke detectors may be installed in SOU to provide local alarm, in lieu of sprinklers in sleeping areas. As an existing building, the existing edition of the Building Code did not require this building to be provided with sprinklers, but did require F60. Its therefore has been proposed to maintain F60 requirement throughout building. As appropriate, this assessment is subject to the satisfaction by the BCA.
- Table 3.2 requires 1000mm for vertical exit and this may be reduced to 850mm when disable access is not required to be considered. The appropriateness of the exclusion to consideration of disable access needs to be made to justify the proposed design. It is therefore considered that justification for exclusions to parts of the Sections 112 or 115 needs to be made.

The following comments to other parts of the Fire Engineering Report were noted:

- The Designer has made assumption that existing constructions provide fire cell rating of 60 minutes. *It is likely that the construction will provide ratings well in excess of this.* This should be determined by a suitably qualified person and not through assumption.
- Existing surface finished have not been determined. The report states *that it is not reasonable practicable to determine or rectified.* The reasonableness of this statement needs to be considered based on life safety and an appropriate fire engineering analysis rather than judgement of the Designer.

A holistic fire safety strategy has not been assessed as demonstrated by the Designing making brief mentions of existing systems and using *reasonably practicable* as justification for no upgrade. The effects that this may have on the overall fire safety strategy is not been considered. Examples of this is in existing surface (Does this increase the fire hazard and load in the safe vertical path?) and reduced vertical width (Will this detrimentally delay egress from the building?).

A.25 TECHNICAL REVIEW OF PROJECT X

The proposed development is for a new warehouse facility. The Fire Engineering Report prepared by Designer A of Company Q is for the base building only with no recommendations to reassess upon fit out being proposed. The following Alternative Solutions were identified:

- C/AS1 5.6.13 A sprinkler system is not to be installed - In a building with two or more floors and FHC4 the building is to be sprinklered. This has not been identified by the Designer and may be expected to decrease the level of safety provided in the building when compared to a building design that is in accordance with the Acceptable Solutions.
- C/AS1 6.21.5, Though the building is FHC 4 and has an intermediate floor it requires smoke control. This is to be through specific fire engineering design in accordance with 6.21.3. The Designer has attempted to use argument for limited area intermediate floor to justify no smoke control even though concession for limited area is provided for non FHC 4 buildings. This has not been considered in relation to any sprinklers. Designer A of Company Q has stated that the smoke layer will not drop to 2m of floor of intermediate floor, however no assessment is provided to demonstrate this statement.

Other issues that have been noted in the Fire Engineering Report are noted:

- No description is given to the egress from the cool rooms, i.e. distance, latching devices and roller doors in the path of egress.
- Assessment of egress capacity has been made by *observation*. No assessment was provided, instead expert judgement used.
- It is recommended that doors on escape routes comply with 3.17.3, but roller doors are unable to comply with this.
- The design has used the Eurocode method to determine S rating even though it is not for FHC4 and no justification is provided to allow for its use in this assessment.

The Fire Engineering Report displays use of 'expert judgement' as the only basis for assessment or justification. Care should be taken in using this as the only means of assessment, especially when more tangible methods are available (i.e. review of plans in determining available exit width).

The failure to note the requirement for a sprinkler system in accordance with C/AS1 5.6.13 is a concern for the Designer. The provision for such a system is applicable to the general identifiable hazards associated with FHC4 buildings and its absence may significantly reduce the level of life safety offered in the building when compared to a design complying with the Acceptable Solutions. It is therefore considered that the quality in the fire engineering analysis and methodologies adopted did not adequately assess the required fire safety objectives.

A.26 TECHNICAL REVIEW OF PROJECT Y

The building application is related to an alteration to an existing office/workshop facility, in accordance with Section 112 of the Building Act 2004.

Designer A of Company B has been nominated the building to have a WM purpose group with a Fire Hazard Category of 3. Given an escape height of 5.2m and occupant load less than 100 persons, the required FSP's are F60, 3b, 16 and 18c. Designer A has incorrectly noted the requirements of C/AS1 Table 4.1 as being Type 2af and 18c.

The primary variation proposed by Designer A of Company B was the provision of a Type 3 fire alarm system throughout building with the direct connection to Fire Services disconnected. The relevant variation is considered to be C/AS 4.3.1 by way of Table 4.1 but this is not explicitly stated. The relevant Performance Requirements is therefore C3.3.9, but consideration could also be given to other Performance Requirements related to the fire resistance rating of elements to mitigate the expected delay in fire brigade intervention.

The fire engineering analysis undertaken to support variation were the following:

- Designer A of Company B has stated that no FSP's are required to comply with the NZBC; therefore provision of the system is greater than required. This was however based on incorrect selection of fire safety precautions from Table 4.1.
- An ASET/RSET assessment is conducted to demonstrate that occupants are able to evacuate the building before the onset of untenable conditions. The evacuation assessment only accounted for travel time. However, the variation is the automatic notification via direct connection to fire services to provide fire brigade intervention. The analysis method is therefore considered not appropriate to assess the trial concept against the relevant objective.

It is therefore considered that the assessment does not address the relevant Performance Requirement.

As building works is subject to Section 112 of the Building Act 2004, comments to the following items are also considered:

- Means of escape – Designer A of Company B has only incorrectly identified the Fire Safety Precautions from C/AS1 Table 4.1 and stated that *egress travel distance and capacity of egress are within the building code parameter*. No assessment of egress distances or capacity (apart from what was used for the evacuation modelling) was provided or any comment to the extent that the building complies *as nearly as is reasonably practicable* with the relevant Performance Requirements. It is clear that some areas of the building, such as large storage room, were only provided with one exit without consideration.
- Access and facilities for person with disabilities – No comment is provided in Fire Engineering Report of the extent that the building complies *as nearly as is reasonably practicable* with the relevant Performance Requirements.

- Continue to comply with the other provisions of the building code as before the alteration – The Fire Engineering Report states that no alteration, other than the Type 3 alarm system, is being undertaken. However, no audit was conducted to determine to what *other provisions* apply and the extent that they have been maintained to provide an adequate level of performance.

Without appropriate consideration to these items, it is therefore considered that Designer A of Company B has not adequately considered the requirements for Section 112 of the Building Act 2004.

A.27 TECHNICAL REVIEW OF PROJECT Z

The proposed development is for a new multistorey motel accommodation facility. Designer A of Company G. The following variations were explicitly identified but further issues were identified during review if the proposed design:

- C/AS1 Table 4.1 - No direct connection to fire service from alarm system based on concession (f). However (f) is not a listed concession therefore direct connection required. This was not identified as a variation.
- C/AS1 Table 4.1 - Emergency lighting in exits omitted as Designer states all exits open into safe place. This is not correct within undercover car park area as it is required. This was not identified as a variation.
- C/AS1 Type 4.1 Type 7e in lieu of Type 4e. The Designer has stated that sprinkler system is in excess of smoke detection system for alarm. Though sprinklers provide for fire control, the substitution would delay occupant alarm and evacuation, and NZFS notification and arrival to site. These issues have not been considered

Several issues arising with other consideration to the design were noted:

- Most egress paths require travel through single exit car park. This is considered acceptable in FSR (19) because of available ventilation and sprinkler. Appendix B modelling is flawed as it does not justify design fire for car park, does not consider wind effect, opening sizes are unrealistic (fudged), therefore is without effective ventilation. Conclusion of maintained tenability is not demonstrated. Have stated that 8MW fast t2 fire represented the very worst case fire (Not justified)
- Ground floor stores plan have only sliding doors to front. As they have more than 20 persons then they need to swing out.
- The report indicates there are two exit doors from the ground floor restaurant, but this is not shown in plans (sliding doors). No fit out is provided.
- The assessment for travel distance is not provided for review.
- The evacuation assessment in Appendix B does not justify assumptions of response period or appropriate safety factor.

- C/AS1 6.10.3 requires car parking spaces within a building to be a firecell. The statement in the Fire Engineering Report that FRR requirements for walls bounding common areas in sprinklered building (7.2.2) need not be required is not correct. The designer believed that this is not required under 7.2.2 but failed to see that the separation requirement was for other provisions.

A complete understanding of the Acceptable Solutions is not demonstrated by the Designer in that that has been a failure to note all the relevant requirements, and more importantly, the intent of the requirements.

It is therefore considered that relevant objectives for the fire engineering analysis have not been appropriately considered or addressed.

A.28 CONCLUSIONS

| Project | Purpose Identified | Limitation with Documentation Provided | Basic C/AS1 Building Criteria Identified | Early NZFS Involvement | Variations Identified | Use of Reasonable Practicable Justified | Holistic Approach in Assessment | Assessment Method Appropriate |
|---------|--------------------|--|--|------------------------|-----------------------|---|---------------------------------|-------------------------------|
| A | Y | Y | Y | N | Y | N | N | N |
| B | Y | Y | N | N | N | N/A | N | N |
| C | Y | Y | N | N | N | N | N | N |
| D | Y | Y | N | N | N | N | N | N |
| E | Y | N | Y | N | N | N/A | N | N |
| F | Y | Y | Y | N | N | N | N | N |
| G | Y | Y | N | N | Y | N/A | N | N |
| H | Y | Y | Y | N | Y | N/A | N | N |
| I | Y | Y | N | N | Y | N | N | N |
| J | Y | Y | N | Y | N | N | Y | N |
| K | Y | Y | N | N | N | N/A | N | N |
| L | Y | N | Y | N | Y | N/A | Y | Y |
| M | Y | Y | Y | N | Y | N/A | Y | N |
| N | Y | Y | N | N | N | N/A | N | N |
| O | N | Y | N | N | N | N/A | N | N |
| P | Y | Y | Y | N | Y | N | N | N |
| Q | Y | N | Y | N | Y | Y | Y | Y |
| R | Y | Y | Y | N | Y | N/A | N | N/A |
| S | Y | Y | N | N | N | N/A | N | N |
| T | Y | Y | N | N | Y | N/A | N | N/A |
| U | Y | N | Y | N | Y | N | N | N |
| V | Y | Y | Y | N | Y | N/A | N | N |
| W | Y | Y | Y | N | Y | N | N | N |
| X | Y | N | Y | N | N | N/A | N | N |
| Y | Y | Y | N | N | N | N/A | N | N |

| | | | | | | | | |
|---|---|---|---|---|---|-----|---|---|
| Z | Y | Y | N | N | N | N/A | N | N |
|---|---|---|---|---|---|-----|---|---|



APPENDIX B DETAILED DRU RESPONSE REVIEW

B.1 INTRODUCTION

The scope of this assessment was also to make comment on the quality and methodology of the fire engineering assessments reviewed by the DRU.

B.2 TECHNICAL REVIEW OF PROJECT A

- a) The assessment was conducted between the 28/05/05 to 03/05/05 then an additional assessment between the 04/05/05 to 23/05/05.
- b) The review of escape from fire by Reviewer A had noted that the principle mitigating provision for the building was the substitution of the required detection and alarm system with trained personnel and an emergency management and evacuation procedure. Reviewer A has recognized that this proposal is contrary to two determinations set down by the Department of Building and Housing.

Though the above determinations are considered sufficient justification to oppose the submission, Reviewer A has noted further inadequacies of the assumptions and justification for what Designer A of Company A has considered reasonably practicable.

- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting has stated that unless further information is provided with the design the New Zealand Fire Service cannot assume that the existing building features are adequate to support the intended change of use for the two buildings.
- d) Recommendations by the NZFS in the Response are considered reasonable and justified with respect to the obvious inadequacies of the assessment presented in the Fire Engineering Report.

Comments: Reviewer A has assisted the Designer in this instance as instead of limiting advice to the Department of Building and Housing determinations about the reliance on emergency management procedures and policy Reviewer A has still provided advice to the deficiencies of the assessment.

B.3 TECHNICAL REVIEW OF PROJECT B

- a) The assessment was conducted between the 26/05/05 to 03/06/05
- b) The review of *escape from fire* noted errors to escape height and inconsistencies in the zone modelling and evacuation assessment results (missing time steps and evacuation phases). Reviewer B noted that a racking plan had not been provided and as such a detailed review of the egress provisions could not be made. Comments went so far as to direct the Designer of the appropriate parameters that should have been used in the assessment and the references for them.
- c) The review of *the needs of persons who are authorized by law to enter the building to undertake fire-fighting* only commented on the lack of site plans to which a hydrant coverage review could not be made.

- d) The comments to these parts were considered appropriate and consistent with item identified in the review of the Fire Engineering Report prepared for Project B. It was considered that there was sufficient inconsistencies in the Fire Engineering Report and insufficient supplementary documentation (e.g. plans) to **justify** not approving the submission

Comments: The response made by Reviewer B to the review of egress was specific to each inconsistency noted. This was in regards to design fire (fast instead of moderate), smoke height tenability (2.0m above floor height to be used), pre-movement time and activation time for RSET (none was included), safety margins (2 should have been used) and assessment method (considered to be inappropriate as egress calculations can not justify fire brigade intervention). All these issues could have been resolved before the assessment through a FEB process.

B.4 TECHNICAL REVIEW OF PROJECT C

- a) The assessment was conducted between the 25/05/05 to 31/05/05
- b) The review of escape from fire noted acceptance of the fire engineering analysis in the Fire Engineering Report. Reviewer C has not raised any issues that were identified in the technical review of the Fire Engineering Report for Project C (see A.4).
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting has stated that the proposed strategy satisfies Performance Requirement C3.3.9. This is even though appropriate information regarding hydrant requirements, elevation drawing, vehicular coverage or the like had not been provided.
- d) No comments were made as the Response provided approval of the Fire Engineering Report. It is considered that Reviewer C has failed to undertake a detailed assessment such that the approval given was not justified.

Comments: The Fire Engineering Report was undertaken against the Ministry of Education Fire Safety Guidelines 2.9 “Means of Escape”. It appears because a standard Alternative Solution has been used, the appropriate level of scrutiny was provided.

B.5 TECHNICAL REVIEW OF PROJECT D

- a) The assessment was conducted between the 22/06/05 to 05/07/05
- b) The review of escape from fire noted that egress concerns identified in the technical review of the Fire Engineering Report for Project D (A.5). However they have made assumption in the response to correct to type of alarm system to be included. This included advice on location and number. It is considered that instead of making assumptions, Reviewer D should seek clarification from the Designer. In providing this design advice, the Reviewer overlooked consideration to egress from car park (number of doors, use of roller doors, and locking devices).

- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting has stated that fire hose reels have been omitted in the Fire Engineering report and noted inconsistencies with FRR requirements through the report and drawings.

The Reviewer has also made comment to the smoke exhaust system in the car park when there is no requirement to provide such a system. This has included design advice that the mechanical exhaust system should operate when the fire alarm is activated.

- d) It is considered that Response provided by Reviewer D was not justified as it was presented as design advice. The requirements for the smoke exhaust system in the car park are also considered to be a system more than that required by the Acceptable Solutions. Furthermore, the Fire Engineering Report or the Reviewers notes on egress did not identify issues with egress in the compartment.

Comments: It is considered that advice regarding car park exhaust, when no specific requirements are identified or justified, may be more excessive than that required. The DRU are to provide advice on a design rather than re-design, as commented in IPENZ Practice Note 2 – Peer Review.

B.6 TECHNICAL REVIEW OF PROJECT E

- a) The assessment was conducted between the 01/07/05 to 14/07/05
- b) The review of escape from fire noted that there was limited fire engineering provided to justify some of the identified Alternative Solutions and the Fire Engineering Report for Project E. The egress assessment was noted as incorrect with inconsistencies with some of the calculations. NZFS have recommended that the BCA should seek appropriate justification from the Applicant of assumptions and modelling used. Further scenarios were also recommended to be considered.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting has noted that plans indicate that the statement in the Fire Engineering Report that hydrant coverage was adequate so that an internal system is not required maybe incorrect. NZFS has recommended that an assessment of this hydrant coverage to the satisfaction of the BCA.
- d) Recommendations by the NZFS in the Response requested that the inconsistencies and provision of justifications in the Fire Engineering Report be looked at again by the Applicant. It is considered that Reviewer C has undertaken a satisfactory level of assessment such that it is considered justified that the Fire Engineering Report was not approved.

Comments: Though there was sufficient inconsistencies and inadequate analysis in the Fire Engineering Report to justify not approving the submission, the recommendations are limited in their implementation. The extent that the request for further assessment is only to the satisfaction of the BCA, who should have already assessed the Fire Engineering Report and given in-principle agreement. It is considered that as the NZFS has identified the limitation, then any recommendations and reassessment should also be to their satisfaction.

B.7 TECHNICAL REVIEW OF PROJECT F

- a) The assessment was conducted between the 12/06/05 to 25/06/05
- b) The review of escape from fire by Reviewer E only noted some of the inadequacies identified in the review of the Fire Engineering Report for Project F (A.7). The Reviewer had failed to check that the correct table in C/AS1 Table 4.1 was used (less than or more than 500 persons) and did not consider the potential issues with the proposal for the use of heat detectors in lieu of smoke detectors with respect to delays in occupant evacuation and NZFS notification. Again, the basis of the design was a standard Alternative Solution recommended in the Ministry of Education Fire Safety Guidelines 2.9 “Means of Escape”. The appropriateness of the standard design in this instance was not adequately addressed by Designer A of Company A or identified by Reviewer E as a potential issue in the submission.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting has raised the issue of the use of reasonably practicable for the basis of a design. The Reviewer has recommended that if it is used, then there should be a reasonable effort in thorough inspection is made to verify the extent that parts comply as part of a compliance inspection.
- d) Recommendations by the NZFS in the Response requested that a thorough inspection be undertaken to determine the extent of compliance if reasonably practicable is used as the basis for a design, however this is to be to the satisfaction of the BCA. Though Reviewer E had failed to identify several inconsistencies in the Fire Engineering Report and demonstrated an inadequacy to consider holistically the impacts of a variation (heat detectors in lieu of smoke detection) it is considered that Reviewer was justified in not approving the Fire Engineering submission based on items that were identified.

Comments: The extent that further assessment, recommended by Reviewer E, is to be undertaken is limited to the satisfaction of the BCA. It is considered that as the NZFS has identified the limitation, then any recommendations and reassessment should also be to their satisfaction.

In the failing to note any issues relating to the proposal for heat detectors in lieu of smoke detection (identifying both as means for alarm for particular environments) the Reviewer has not demonstrated a holistic fire engineering approach in the review of the design. As there may be delays in occupants evacuation and fire service notification, these delay impact on both parts of Section 47 of the Building Act 2004 that are applicable to the DRU. Though the outcome for not approving the submission is considered appropriate, the extent that Reviewer E has reviewed the submission is not.

B.8 TECHNICAL REVIEW OF PROJECT G

- a) The assessment was conducted between the 03/08/05 to 16/08/05
- b) The review of escape from fire by Reviewer F has made appropriate review of egress provision from the Fire Engineering Report. In one instance, the Designer has provided a reasonable design for smoke control with the mitigating provision for smoke seals to appropriate doors but has not provided any assessment to determine the performance of the proposed system. Recommendation by the Reviewer for this was to demonstrate that the proposal provides an equivalent level of performance when compared to the Acceptable Solutions.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting was not provided as the Fire Engineering Report did not undertake any analysis in this matter. The Reviewer did however make comment to the inadequacies of the Fire Resistance Rating calculations and oversight of the Applicant in providing external vertical fire spread protection provisions.
- d) Recommendations by the NZFS in the Response identified certain inadequacies of the fire engineering analysis that were not in direct correspondence to specific parts of C/AS1 for Egress and Fire Fighting. Instead a holistic approach was taken which coincided with a greater interpretation of Section 47 of the Building Act 2004. Considering the items identified by Reviewer F, it is considered justified that the submission was not approved and recommendations appropriate.

Comments: The approval for the recommended additional assessments has been referred onto the BCA by the Reviewer. It is considered unreasonable for the BCA to provide this approval if the BCA had not initially identified them as issues.

B.9 TECHNICAL REVIEW OF PROJECT H

- a) The assessment was conducted between the 08/08/05 to 19/08/05
- b) The review of escape from fire by Reviewer G has identified that the fire engineering analysis presented in the Fire Engineering Report was inappropriate for the Alternative Solution being proposed. Recommendations for additional fire engineering analysis were considered appropriate.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting was provided to the extent that they were noted by Reviewer G as absent in the Fire Engineering Report.
- d) Recommendations by the NZFS in the Response for egress and fire fighting were considered appropriate as the inadequacies in the fire engineering analysis were relevant to life safety. Considering the items identified by Reviewer G, it is considered justified that the submission was not approved.

Comments: It was noted by the Reviewer that the building application that was submitted with the Fire Engineering Report were not consistent and not appropriate drawings were provided. However, the submission was still assessed without these documents that would provide the basis of the review. Without all the relevant information, or without opportunity to request such information, any recommendations generated would not provide a competent response to the appropriateness of the proposed design in satisfying the relevant performance objectives. It is considered that there must be regulatory pressures available to ensure all relevant documents are submitted to the NSFS for review, especially when a response is required in 10 working days.

B.10 TECHNICAL REVIEW OF PROJECT I

- a) The assessment was conducted between the 20/08/05 to 31/08/05
- b) The review of escape from fire by Reviewer C has identified concerns with the egress strategy as identified in Section A.10 of this report which would potential have occupants internally discharge into a space that had no means of escape. The DRU has recommended that the BCA request the designer to revisit this matter.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting also noted the problems that may arise with the use of smoke curtains in paths of egress. The NZFS has noted that not all relevant plans had been submitted for the review to occur. The Response only notes that for the DRU to be in a position to comment fully, these plans should be submitted.
- d) Recommendations by the NZFS in the Response are for more information and assessment to be provided if comment from the DRU is to be provided. Considering the items it is considered justified that the submission was not approved.

Comments: The Response is based on a review of a design that was not submitted with all the relevant information. The review and the time spent for the review does reflect the limited information that was provided for assessment.

B.11 TECHNICAL REVIEW OF PROJECT J

- a) The assessment was conducted between the 26/05/05 to 03/06/05
- b) The review of escape from fire by Reviewer E has been limited to a standard Alternative Solution for similar facilities that was earlier agreed upon by the NZFS as appropriate solutions (Fire Safety Design Basis). Though this document identified typical hazards and mitigating provisions, the extent that these provisions are provided is prescriptive in its implementation with consideration to specific characteristics of the building or its function. Such a standard fire engineering design solution is against basic fire engineering principals for a solution's uniqueness. The Response did not identify any of the issues raised in the review of the Fire Engineering Report (see A.11) with egress width or the justification of other egress calculations.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting was not commented or a request for further information was recommended.
- d) Recommendations by the NZFS in the Response did not identify many of the issues as it relied on the standard Alternative Solution. The Fire Engineering Report did not identify what is required by the Acceptable Solutions and what variations are proposed. Instead prescriptive requirements were required. The Reviewer failed to provide an appropriate review. It is therefore considered that the DRU approval for the submission was not justified.

Comments: Though the involvement of the NZFS in the early design stages of a development as a relevant stakeholder is consistent with the Fire Engineering Brief process outlined in the International Fire Engineering Guidelines, the over extent of this is considered inappropriate. The standard Alternative Solutions proposed are a prescriptive approach of providing a design that has been deemed as satisfy the relevant performance requirements by the NZFS.

A fundamental aspect of fire engineering is the requirement for a "unique solution". This is because that in taking a holistic approach to the design, site specific considerations must also be taken into account, such as location and characteristics of the building and occupants. As no two facilities can be alike, so can't a performance based design. Therefore in instances where a "standard Alternative Solution" is proposed as the basis for a specific design, reviewers of the design should take careful note of the following:

- a) whether or not the designer has initially identified the Acceptable Solutions requirements for the facility,

- b) the designer has recognized the requirement for a “unique solution” such that appropriate justification of how and why the “standard Alternative Solution” is applicable is provided, and
- c) the Alternative Solution is assessed against the relevant performance objectives.

B.12 TECHNICAL REVIEW OF PROJECT K

- a) The assessment was conducted between the 29/08/05 to 07/09/05
- b) The review of escape from fire by Reviewer H indicate that the submission for review is a specific design for a tenancy fit out of an existing building that is subject to a fire engineering solution. It is noted that this Fire Engineering Report, which the subject submission heavily relied on, was not provided. The Reviewer however persisted with the review of an incomplete submission. Though the Fire Engineering Report was limited in extent, zone and evacuation modelling was provided and satisfactory reviewed, with inadequacies in the analysis noted in the Response. Recommendations for justification of aspects of the modelling.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting made no comment as the Fire Engineering Report stated that the report for the base building provided the assessment for this requirement. As this base building Fire Engineering Report was not provided, no comment by the DRU could be made.
- d) Recommendations by the DRU in the Response for further justification of the assessment provided and the Fire Engineering Report for the base building was appropriate. Considering these items it is generally considered justified that the submission was not approved.

However, one recommendation stated that the building consent documentation is require to be complete to allow the BCA to be “reasonable satisfied” that a building will be constructed in accordance with the BA2004. It further requests additional information to be submitted with the design to satisfy this requirement. Section 47 of the Building Act 2004 limits the role of the NZFS in the same way it specifies the role and responsibility of the BCA. In recommending items that are clearly in the approval jurisdiction of the BCA, it is considered that the Reviewer has acted outside its regulatory authority.

Comments: The Response is based on a review of a design that was not submitted with all the relevant information. Though the Reviewer had noted some obvious inadequacies in the technical aspect of the analysis, recommendations are again only subject to the satisfaction of the BCA and not for re-review by the DRU.

As discussed above, the Building Act 2004 limits the role of the NZFS in providing advice of fire engineering submissions. Though it may be considered appropriate, by way of the NZFS being relevant stakeholders in the project, for the DRU to have comment on all aspects of the proposed design and assessment, Section 47 limits this involvement. It is therefore considered that Reviewer H should take care in expressing opinions on items to which are the responsibilities for the BCA to consider.

B.13 TECHNICAL REVIEW OF PROJECT L

- a) The assessment was conducted between the 28/09/05 to 05/10/05
- b) The review of escape from fire by Reviewer I has noted concerns about provisions for safe egress between different purpose groups in the same tenancy. Recommendations are provided in the form of design advice to the Alternative Solution of where additional smoke detectors and fire doors should be provided.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting was provided to the extent that they were noted by Reviewer I as absent in the Fire Engineering Report.
- d) Recommendations by the NZFS in the Response noted the absence of consideration to fire fighting provisions which in itself would justify not approving the submission.

Comments: The Response noted concerns about the proposed egress strategy. Design advice was then provided by directing the Designer of the location of additional smoke detector and fire doors. This proposed fire engineering design by Reviewer I was not provided with any fire engineering analysis.

It is considered that as the NZFS has identified the limitation, then any recommendations and reassessment should also be to their satisfaction.

B.14 TECHNICAL REVIEW OF PROJECT M

- a) The assessment was conducted between the 26/09/05 to 11/10/05.
- b) The review of escape from fire by Reviewer J has noted drawings and documentation for most of the building was not provided, such that comments could not be given. With regards to the Fire Engineering Report, the Response states The NZFS strongly recommends that the author of the fire report investigates alternative formatting methods that present the relevant information to the end uses in a more effective manner. Upon review of the Fire Engineering Report, it is considered that this was appropriate as there was difficulty in understanding aspects of the design and analysis. Reviewer J did note most items identified in Section A.14 of this report, including inconsistencies in the zone and evacuation modelling.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting noted drawings and documentation for most of the building was not provided, such that comments could not be given. Specific items to structural stability were also noted, recommending structural engineers assessments. This can be considered relevant to Section 47 of the Building Act 2004, as Part C3 is brought in by consideration to Section 112 of the Building Act 2004 through Part C2.

- d) Recommendations by the NZFS in the Response for appropriate information to be provided for their assessment is considered as the basis to **justify** not approving the submission. Inconsistencies determined in the review further supports the recommendations made in the Response.

Comments: The Fire Engineering Design Guide and the International Fire Engineering Guidelines recommends the Fire Engineering Reports be in a certain format or contain specific information so that the arguments for a fire engineering design is progressively layout and justified. The format and information can also then be readily reviewed by the BCA and third parties, and the recommendations can be implemented during design and construction with clear requirements.

In providing a clear and concise Fire Engineering Report, the following practical benefits can be provided:

- a) The approval/review process can occur efficiently. Items that are to be reviewed can easily be identified and commented on. This will assist in stakeholders and approval authorities providing comments. and also assist the DRU in returning Section 47 Memos within 10 working days.
- b) With clear recommendations and justification for them, other designers (fire services, mechanical engineers etc) can gain greater insight to the intent of an Alternative Solution and accommodate the Fire Engineer's requirement in their design accordingly. This will minimize the level of inconsistencies and contradictory statements in the overall design.

B.15 TECHNICAL REVIEW OF PROJECT N

- a) The assessment was conducted between the 03/10/05 to 12/10/05
- b) The review of escape from fire by Reviewer G demonstrates limits to their knowledge of the C/AS1 and assessing a fire engineering design holistically. Reviewer G failed to recognize that a system (sprinklers) that the Designer had proposed, as a mitigating provision, was already a requirement in accordance with the Acceptable Solution. Therefore the qualitative comparative assessment presented in the Fire Engineering Report was based on an inappropriate benchmark design. Furthermore, there were no comments in the regards to the deletion of a smoke exhaust system. No fire engineering analysis was provided to justify the omission of the system.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting noted concerns to the use of concrete panels in the external wall. Recommendations were for the consideration of post fire environmental loads to structural stability. It is however considered that post fire events maybe considered outside the scope of the Building Code.

- d) Recommendations by the NZFS in the Response, or lack of, in consideration of egress may demonstrate issues relating to the competency of Reviewer G for appropriately reviewing a fire engineering assessment. Comments to post fire event conditions are also considered to be inappropriate. Though it is considered that the Section 47 Review by Reviewer G was unsatisfactory, the decision not to approve the submission is justified based on comments in Section A.15 of this Report, and not to the review by Reviewer G.

Comments: As a regulatory authority, the DRU should ensure that Reviewers are appropriately qualified and competent to undertake this level of review so not to impose inappropriate recommendations or onerous requirements to building designs. However, this should not relieve the DRU of their responsibilities to have in place an internal system of review. Time sheets for DRU Reviewers had been provided for some projects, indicating the extent of internal reviews, however their inclusions or their use is not consistent for all projects reviewed.

B.16 TECHNICAL REVIEW OF PROJECT O

- a) The assessment was conducted between the 06/10/05 to 17/10/05
- b) The review of escape from fire by Reviewer I noted that the Fire Engineering Report should contain a minimum amount of information and be current for its application. The submission did not identify the objectives of the proposal, and as such, stated that comment could not be made.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting noted that the submission did not identify the objectives of the proposal, and as such, stated that comment could not be made
- d) Recommendations by the DRU in the Response, based on inadequate documentation and fire engineering analysis, are considered appropriate. It is also considered that the decision not to approve the submission is justified.

Comments: The variability in what constitutes a Fire Engineering Report could be seen as a source of frustration by Reviewers in the DRU. The Fire Engineering Report made in this submission did not attempt to satisfy the minimum requirements of content as specified in the Fire Engineering Design Guide or International Fire Engineering Guidelines. The quality of this Fire Engineering Reports does indicate the minimal extent of the BCA's participation in the fire engineering process, in that no review of the Fire Engineering Report was made or the competency of the Consent Authority was inadequate to make comment.

B.17 TECHNICAL REVIEW OF PROJECT P

- a) The assessment was conducted between the 06/10/05 to 17/10/05
- b) The review of escape from fire by Reviewer B has made several notes on the use of occupant characteristics as the basis for Alternative Solutions. The Reviewer has demonstrated potential scenarios where the Designer's assumptions are invalid. Also raised where inadequacies in the egress strategy and the protection of these paths. Recommendations however state that the BCA is to satisfy itself on the acceptability of the solutions.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting noted that the as the submission did make comment to fire fighting provisions the BCA is to consider these issues.
- d) Recommendations by the DRU in the Response are considered appropriate. The decision not to approve the submission is justified based on inadequate strength of assumptions for the egress strategy and consideration to fire fighting requirements.

Comments: The DRU has made recommendations which are only subject to the satisfaction of the BCA and not for re-review by the DRU. It is considered that as the DRU has identified the limitation, then any recommendations and reassessment should also be to their satisfaction

B.18 TECHNICAL REVIEW OF PROJECT Q

- a) The assessment was conducted between the 10/11/05 to 22/11/05.
- b) The review of escape from fire by Reviewer C has made limited notes on the proposed design with exception that the signage plan is to be provided to the BCA.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting noted only issues relating to water supply to site, which is subject to approval by the BCA and not the DRU.
- d) Recommendations by the DRU in the Response are considered appropriate considering that the Fire Engineering Report presented a fire engineering assessment that was satisfied stated objectives. Comments were directed to what the BCA should check is provided. The decision to approve the submission is justified based the quality of the fire engineering analysis.

Comments: The limited comments by the DRU reflect the relative high quality of the Fire Engineering Report. However, if approval is given by the DRU, comments provided in the Response may confuse the BCA and Designer of the level of acceptance by the DRU. It is therefore considered that the NZFS Building Memorandum should also include additional a consistent statement that provides this measure of acceptance. This could be in the form of the following:

It is the advice of the New Zealand Fire Service that the proposed design adequately addresses matters relating to Section 47 the Building Act 2004, subject to the following items: ...

Recommendations should also be clear to identify when re-review by the DRU is required.

B.19 TECHNICAL REVIEW OF PROJECT R

- a) The assessment was conducted between the 23/11/05 to 06/12/05.
- b) The review of escape from fire by Reviewer F has made recommendation for signage plan, surface finishes and details of the fire rated constructions be provided to the BCA.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting has not made any recommendations. This is inconsistent with other Reviewers who have considered that Section 112 does include fire fighting provisions.
- d) Recommendations by the DRU in the Response state that when considering Section 112, Fire Fighting considerations are not required. This is not justified as consideration to Means of Escape from Fire is required. Part C2 Means of Escape from Fire of the Building Code also requires consideration to Part C3, and therefore consideration to fire fighting provisions.

Comments: The DRU is to be consistent in the provision of advice with respect to the building application (i.e. new building, alteration or change of use). Reviewing Policy should make note the Building Code Performance Parts that are relevant to each type of submission (i.e. Section 112 - Alteration ⇒ Part C2 and C3. Therefore both parts of Section 47 are applicable).

B.20 TECHNICAL REVIEW OF PROJECT S

- a) The assessment was conducted between the 01/12/05 to 14/12/05.
- b) The review of escape from fire by Reviewer B includes detail assessment of the proposed staged evacuation. Outcomes for this includes request for more specific details about the sequence of events after alarm, assessment for the accommodation of evacuees in an adjacent fire cell, and justification of the performance adequacy of the proposed active fire safety systems to satisfy the nominated acceptance criterion as no assessment for this was undertaken.

Reviewer B however did not recommend for additional scenarios to be considered. As the proposed Alternative Solutions was for active systems in lieu of passive fire resisting elements, consideration to the reliability of either method needs to be made. More than just assessing the performance adequacy of the proposed system, assessment of whether or not the system operates at all must be incorporated, with further measures to mitigate the decrease in the reliability of a fire wall when compared to both the successful operation of sprinklers and smoke exhaust simultaneously.

- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting notes that inadequate information is provided to review for this part. Instead of recommending that items be further submitted for review, direction is given to the BCA of what items need to be included in the consent documentation.
- d) Recommendations by the DRU in the Response are for additional information and further justification of components of the proposed staged evacuation strategy. It is considered that the recommendations are reasonable and justified when considering the reliance the strategy has for the successful simultaneous operation of sprinklers and smoke exhaust.

Comments: Where issues have been identified by the DRU in regards to specific evacuation strategies, re-review by the DRU is considered reasonable so that all outstanding items can be appropriately discussed directly between the Reviewer and the Designer, rather than through the BCA.

B.21 TECHNICAL REVIEW OF PROJECT T

- a) The assessment was conducted between the 05/12/05 to 16/12/05.
- b) The review of escape from fire by Reviewer F had noted inconsistencies with the occupancy calculation presented in the Fire Engineering Report. This does not present significant issues as no variations to the Acceptable Solutions of C/AS1 are presented by the Designer.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting state that when considering Section 112, Fire Fighting considerations are not required. This is not justified as consideration to Means of Escape from Fire is required. Part C2 Means of Escape from Fire of the Building Code also requires consideration to Part C3, and therefore consideration to fire fighting provisions. Reviewer F has also noted that S Rating calculations need not be reviewed by the DRU.
- d) Recommendations by the NZFS in the Response are limited as no specific variation to the Acceptable Solutions in C/AS1 is presented in the Fire Engineering Report. It is however considered that notes by the Reviewer that such issues as fire fighting provisions and S Rating analysis are not Section 112 issues is not justified because of the relation between Building Code Performance Parts 2 and 3.

Comments: The DRU is to be consistent in the provision of advice with respect to the building application (i.e. new building, alteration or change of use). Reviewing Policy should make note the Building Code Performance Parts that are relevant to each type of submission (i.e. Section 112 - Alteration ⇒ Part C2 and C3. Therefore both parts of Section 47 are applicable).

B.22 TECHNICAL REVIEW OF PROJECT U

- a) The assessment was conducted between the 05/12/05 to 16/12/05.

- b) The review of escape from fire by Reviewer I had noted inadequacies of the Fire Engineering Report, consistent with those identified in Section A.22 of this report. Recommendations included the requirement for analysis to the Alternative Solution for a single exit, quantifiable engineering analysis to investigate the proposal of non-smoke resistant lift landing doors and justification of reduced fire resistance ratings. Additional variations, such as the separation of rising and descending stairs, were also noted with recommendations that further analysis be provided. Again, this additional assessment was recommended to be to the satisfaction of the BCA and not to the DRU.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting noted that when considering Section 115 Change of Use applications, consideration, through thorough inspection and assessment, to fire resistance ratings and external fire spread issues are applicable and should be included in the Fire Engineering Report.

Reviewer I has also recommended that with a diesel fuel tank in the basement, the applicant prove anticipated fire conditions within the basement will not prevent fire fighters from entering and extinguishing a fire. However, such a recommendation maybe considered unreasonable as the Fire Engineering Report did not make specific proposal for an Alternative Solution with respect to the diesel fuel tank, and the assessment would not be required if the building had no variations. The placement of a diesel fuel tank, though a potential hazard, may be in accordance with Acceptable Solutions of C/AS1 and that such assessment may be considered more than that required by the Building Act 2004.

- d) Recommendations by the DRU in the Response are considered reasonable and justified when considering the Fire Engineering Report with the Reviewers broader interpretation of the requirements for the DRU, in accordance with Section 47 of the Building Act 2004. The inadequacies of the Fire Engineering Report to provide a reasonable and justified analysis for proposed Alternative Solutions also warrants to decision by the DRU not to approve the submission.

Comments: The DRU Reviewer in this instance has looked at Part C2 and C3 in relation to the Section 115 application, thus allowing an assessment against a broader interpretation of Section 47. Consistency between Reviewers is to be provided.

Again where issues have been identified by the DRU in regards to specific evacuation strategies, re-review by the DRU is considered reasonable so that all outstanding items can be appropriately discussed directly between the Reviewer and the Designer, rather than through the BCA.

The DRU have included in the covering note that *The NZFS is restricted to providing advice to the BCA only during the design review process.* If this is the process, there is no opportunity for the Designer to directly involve the NZFS as a stakeholder in the design process. Are greater availability for communication between the Designer and the NZFS is considered advantageous in preparation of designs that are both cost and time effective whilst providing a greater level of safety to the design.

B.23 TECHNICAL REVIEW OF PROJECT V

- a) The assessment was conducted between the 15/12/05 to 19/12/05.
- b) The review of escape from fire by Reviewer E had noted the inappropriateness of using the Eurocode method for a fire severity assessment as the building has been identified as having a Fire Hazard Classification of 4. Recommendations are made for the Designer to satisfy the BCA of the appropriateness of the assessment method. Items that were not reasonably assessed by the Reviewer were the number and available widths of exits.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting noted that Fire Fighting Provisions are required to be considered as part of the Fire Engineering Report and has recommended that information be provided to the BCA for consideration.
- d) Recommendations by the DRU in the Response are considered reasonable and justified when considering the Designer has not justified the use of a fire engineering assessment method that is specifically excluded for this type of hazard.

Comments: The choice of the fire engineering analysis methods and justification for their use forms part of the basis of the Fire Engineering Brief process. With the involvement of the NZFS in this process, concerns of the used of inappropriate methods can be determined before detailed fire engineering assessment occurs, this saving money and time with additional analysis or re-design. It is considered that it would be in the interest of all parties that Fire Engineering Briefs be undertaken.

B.24 TECHNICAL REVIEW OF PROJECT W

- a) The assessment was conducted on 20/12/05.
- b) The review of escape from fire by Reviewer E identified that the use of not reasonably practicable was not sufficient reason to not install a sprinkler system because of S. 112. The extent of upgrade works was identified as not being supplied with the submission. Recommendations were made to satisfy the BCA.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting noted that justification for not upgrading the existing fire hydrant system were not provided.
- d) Recommendations by the DRU in the Response are considered reasonable and justified when considering the Designer has not justified the omission of sprinklers, used the term reasonably practicable without evaluation and had not justified the omission of hydrant upgrade.

Comments: The reviewer did not address the new and existing building parts interface and potential for impact between new and existing fire safety provisions. Most requirements were subject to the BCA approval however more definite recommendations could have been developed. In the absence of proper fire engineering design, compliance with the Acceptable Solutions could have been required in lieu of approval subject to the BCA.

B.25 TECHNICAL REVIEW OF PROJECT X

- a) The assessment was conducted between the 19/12/05 to 20/12/05.
- b) The review of escape from fire by Reviewer E had noted reasonable concerns of the proposal for not installing sprinklers to the building based on it being an existing development and not being reasonably practicable to provide the installation. The DRU Reviewer has requested that justification of why it is not reasonably practicable and assessment of safe evacuation be provided. The Reviewer also comments on that the Designer has not specified the extent of upgrade works required to rectify existing fire walls. This is considered a prompt for the Designer to at least undertake a site inspection.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting did not consider Fire Fighting considerations. This is not justified as consideration to Means of Escape from Fire is required. Part C2 Means of Escape from Fire of the Building Code also requires consideration to Part C3, and therefore consideration to fire fighting provisions.
- d) Recommendations by the DRU in the Response are considered reasonable and justified with respect to the reliance of what is reasonably practicable and the demonstration of why it is appropriate and how does this variation affect the overall fire safety strategy for the building.

Comments: Designers often have a strong reliance on the term *reasonably practicable* in proposed designs for existing buildings. The Reviewer, in this instance, has made a strong intent that the Designer provides the following items:

- a) The Designer undertake an inspection or audit of the existing building to determine the extent that a system *reasonably practicably* complies with the Acceptable Solution and provide justification for its expected performance. This should also be included in the Fire Engineering Report.
- b) The Applicant provides reason why it is not *reasonably practicable* to make an existing system comply with the Acceptable Solution (i.e. structural constraints, heritage status of development, etc).
- c) The Designer provides analysis that life safety is still provided in the building. This may include assessment of the potential impact that the variation or expected reduction in the performance of the system may have on new or other existing systems.

B.26 TECHNICAL REVIEW OF PROJECT Y



- a) The assessment was conducted between the 26/05/05 to 03/06/05
- b) The review of *escape from fire* noted errors to escape height and inconsistencies in the zone modelling and evacuation assessment results (missing time steps and evacuation phases). Reviewer B noted that a racking plan had not been provided and as such a detailed review of the egress provisions could not be made. Comments went so far as to direct the Designer of the appropriate parameters that should have been used in the assessment and the references for them.
- c) The review of *the needs of persons who are authorized by law to enter the building to undertake fire-fighting* only commented on the lack of site plans to which a hydrant coverage review could not be made.
- d) The comments to these parts were considered appropriate and consistent with item identified in the review of the Fire Engineering Report prepared for Project B. It was considered that there was sufficient inconsistencies in the Fire Engineering Report and insufficient supplementary documentation (e.g. plans) to **justify** not approving the submission

Comments: The response made by Reviewer B to the review of egress was specific to each inconsistency noted. This was in regards to design fire (fast instead of moderate), smoke height tenability (2.0m above floor height to be used), pre-movement time and activation time for RSET (none was included), safety margins (2 should have been used) and assessment method (considered to be inappropriate as egress calculations can not justify fire brigade intervention). All these issues could have been resolved before the assessment through a FEB process.

B.27 TECHNICAL REVIEW OF PROJECT Z

- a) The assessment was conducted between the 03/03/06 to 16/03/06.
- b) The review of escape from fire by Reviewer G had noted inconsistency in the basis for the fire engineering analysis and the documentation provided to the DRU for review. The Reviewer has also made concerning comments in the inadequacy and appropriateness of the modelling undertaken to justify several Alternative Solutions. It is therefore considered reasonable for Reviewer G recommend that egress considerations be completely revisited.
- c) The review of the needs of persons who are authorized by law to enter the building to undertake fire-fighting requested that hydrant coverage and location of essential fire fighting systems be appropriately assessed. No comment to other provisions relating to fire fighting was considered by Reviewer G.
- d) Recommendations by the DRU in the Response are considered reasonable and justified with respect to the obvious inadequacies of the modelling presented in the Fire Engineering Report.

Comments: The concerning item in this assessment was that the Fire Engineering Report was subject to a Peer Review. Consideration to potential hazard identification and choice of fire scenarios for modelling was not appropriately undertaken by both the Designer and Peer-Reviewer. Reviewer G is acting as the fourth reviewer of the Fire Engineering Report after the internal reviewer for Company G, the Peer Reviewer of Company J, and the BCA.

As there are many reasonable concerns still identified by the DRU after successive reviews, this indicates that there maybe some concerns for the standard of fire engineering undertaken in Company G and J, if not extending to the rest of New Zealand.

APPENDIX C COMPARISON OF TECHNICAL REVIEWS

A summary evaluation of each DRU Memorandum is provided in Table C. 1. This provides an indication of the technical quality of the DRU review for each building consent audited. Details of each project memorandum and performance of the DRU reviewer are contained in Appendix B.

Table C. 1 – Evaluation of DRU assessment against technical review of relevant fire engineering submission

| Project Index | Reviewer Index | DRU Assessment Details |
|---------------|----------------|--|
| Project A | A | <p>Escape from Fire:</p> <ul style="list-style-type: none"> The Reviewer has taken an initial policy that management procedures are inadequate to justify the mitigation sprinklers in the building. The Reviewer has demonstrated knowledge of available systems that may mitigate concerns for false alarms to smoke detectors. Recommendations for further justification of proposal are considered appropriate. Review of the further assessment provided by the Designer adequately identified additional issues with the egress strategy. <p>Fire Fighting:</p> <ul style="list-style-type: none"> As no information was provided it is considered appropriate that the Reviewer has stated that unless further information is provided with the design the New Zealand Fire Service cannot assume that the existing building features are adequate to support the intended change of use for the two buildings. <p>CONCLUSION: DRU Assessment adequate DRU Memorandum adequate</p> |
| Project B | B | <p>Escape from Fire:</p> <ul style="list-style-type: none"> Assessment conducted without racking plans. This was acknowledged by Reviewer as required for the assessment. ASET/RSET was appropriately reviewed. Comments made noted inappropriate design scenarios and acceptance criterion used. Reviewer also noted missing modelling outputs. The Reviewer failed to note the inadequacies in the number of exits available to some areas of the building. <p>Fire Fighting:</p> <ul style="list-style-type: none"> Reviewer has noted that lack of site plans prevents hydrant coverage review being conducted. <p>CONCLUSION: DRU Assessment adequate</p> |

| Project Index | Reviewer Index | DRU Assessment Details |
|---------------|----------------|---|
| | | DRU Memorandum adequate |
| Project C | C | <p>Escape from Fire:</p> <ul style="list-style-type: none"> Approval is given to the building without appropriate scrutiny of the Fire Engineering Report as Reviewer has accepted a Standard Alternative Solution. The Reviewer has not identified that the Fire Engineering Report did not consider the appropriateness of the Standard Alternative Solution in a 'unique solution' context. The use of the Standard Alternative Solution in this instance is invalid due to compartment heights. The Reviewer has failed to identify that the Designer has not considered a holistic approach to the smoke management design. <p>Fire Fighting:</p> <ul style="list-style-type: none"> Though information such as hydrant plans, elevation drawings and vehicular coverage assessment has not been provided, Reviewer C has approved the fire engineering submission. <p>CONCLUSION: DRU Assessment inadequate DRU Memorandum inadequate</p> |
| Project D | D | <p>Escape from Fire:</p> <ul style="list-style-type: none"> Consideration to egress issues in the residential part of the building has not been appropriately considered. Aspects of the evacuation from the car park have been overlooked. The Reviewer has not noted that the use of the roller door as an exit may be a significant issue with respect to locking devices and the like. The Reviewer has made a query regarding the choice of alarm system in the building. Instead of confirming selection, the Reviewer has assumed what system it would be. Inconsistencies of the FRR recommendations between the drawings and Fire Engineering Report were noted. <p>Fire Fighting:</p> <ul style="list-style-type: none"> The Reviewer did identify that the requirement for fire hose reels had been omitted without justification. Recommendation for the car park included design advice for of a smoke exhaust system even though it is not required by the Acceptable Solutions. <p>CONCLUSION: DRU Assessment adequate DRU Memorandum inadequate</p> |
| Project | C | Escape from Fire: |

| Project Index | Reviewer Index | DRU Assessment Details |
|---------------|----------------|--|
| E | | <ul style="list-style-type: none"> • Reviewer has noted that S Rating assessment is inappropriate. The Reviewer has appropriately questioned the assessment process with additional justification. • The Reviewer did not recognise that additional scenarios should have been requested. This includes direct flame impingement on to structural elements. • Obvious errors by the Designer in inputting compartment details in the zone modelling were not identified by the Reviewer. • The Reviewer noted that the use of Eurocode Fire Severity calculation method is inappropriate for FHC4. <p>Fire Fighting:</p> <ul style="list-style-type: none"> • Reviewer has identified that hydrant coverage is inadequate. <p>CONCLUSION: DRU Assessment adequate DRU Memorandum adequate</p> |
| Project F | E | <p>Escape from Fire:</p> <ul style="list-style-type: none"> • Reviewer has noted only some of the inadequacies of the report. Consideration to the correct population was not made. • The Reviewer has failed to note potential issues of delayed egress and fire brigade notification by the proposal of heat detector in lieu of smoke detection. • Again, the Reviewer has not scrutinised the Standard Alternative Solutions for appropriateness. This includes failing to consider the differing fuel loads between science laboratories and other class rooms. <p>Fire Fighting:</p> <ul style="list-style-type: none"> • Reviewer has correctly questioned the use of <i>reasonably practicable</i> as the sole method of justifying a solution. <p>CONCLUSION: DRU Assessment inadequate DRU Memorandum adequate</p> |
| Project G | F | <p>Escape from Fire:</p> <ul style="list-style-type: none"> • The Reviewer has identified deficient aspects of the Fire Engineering Report. This goes as far as requesting that a comparative assessment be provided to justify proposed smoke exhaust system. • Egress from car park is proposed through roller door. The Reviewer has not identified concerns about security and latching devices that may prevent use. <p>Fire Fighting :</p> |

| Project Index | Reviewer Index | DRU Assessment Details |
|---------------|----------------|--|
| | | <ul style="list-style-type: none"> The Reviewer made no specific comments to fire fighting. Comment was made of the inadequacies of the FRR calculations and the protection of external vertical fire spread assessment. <p>CONCLUSION: DRU Assessment adequate DRU Memorandum adequate</p> |
| Project H | G | <p>Escape from Fire</p> <ul style="list-style-type: none"> The Reviewer inadequate plans and documentation was provided, but continued with the review. Inadequacies of the assumptions by the Designer in the comparative assessment have been noted by the Reviewer. The Designer has used research findings from a BHP Research Report as the basis of the design and assessment of the Alternative Solution. The Reviewer has not raised concerns about this use of research data without justification of the appropriateness of the research to the subject design. <p>Fire Fighting</p> <ul style="list-style-type: none"> The Reviewer has made note that consideration to fire fighting provision is required and has not been included in the report. <p>CONCLUSION: DRU Assessment adequate DRU Memorandum adequate</p> |
| Project I | C | <p>Escape from Fire</p> <ul style="list-style-type: none"> The Reviewer has appropriately raised concerns for internal discharge of a stairway into a space which may be potentially be blocked by a smoke curtain. The Reviewer has not raised concerns about the use of <i>reasonable practicable</i> for reduced exit width of stairways. The potential delay in the evacuation of the floor of fire origin and the building has not been considered. <p>Fire Fighting</p> <ul style="list-style-type: none"> Inadequate plans had been provided with submission. Reviewer has noted that <i>for the DRU to be in a position to comment fully these plans should be submitted.</i> <p>CONCLUSION: DRU Assessment adequate DRU Memorandum adequate</p> |
| Project J | E | <p>Escape from Fire</p> <ul style="list-style-type: none"> The basis of the design is a 'Fire Safety Design Basis' previously agreed with the NZFS. This document offers Standard Alternative Solutions. |

| Project Index | Reviewer Index | DRU Assessment Details |
|---------------|----------------|--|
| | | <ul style="list-style-type: none"> • Appropriate scrutiny has not been provided of the design. • Though the Fire Safety Design Brief identifies typical hazards and potential systems to mitigate these issues, the appropriateness of the design in this instance has not been provided. • No comments was provided by the Reviewer with the Designer recommending the omission of manual call point, appropriate fire separation between sleeping and communal faculties, no self closers on doors, and other elements. • The Reviewer has not raised concerns about the use of <i>reasonable practicable</i> for existing systems without appropriate inspection or audit. <p>Fire Fighting</p> <ul style="list-style-type: none"> • No comments were made by the Designer or Reviewer. <p>CONCLUSION: DRU Assessment inadequate DRU Memorandum inadequate</p> |
| Project K | H | <p>Escape from Fire</p> <ul style="list-style-type: none"> • The Fire Engineering Report submitted was for a tenancy fit out where the base building was already subject to a performance based design. • Though the Reviewer identified that the base building Fire Engineering Report was not provided, the review of the submission continued. • Inaccuracies in the egress width calculation and the inappropriate use of these values in the ASET/RSET assessment were noted by the Reviewer. <p>Fire Fighting:</p> <ul style="list-style-type: none"> • No consideration was made for fire fighting provisions. <p>CONCLUSION: DRU Assessment adequate DRU Memorandum inadequate</p> |
| Project L | I | <p>Escape from Fire:</p> <ul style="list-style-type: none"> • The assessment of S Rating Calculations did not identify issues, consistent with Reviewer findings. • The Reviewer has considered that as two different classifications are present in each tenancy, there should be a level of separation between the floor and egress paths. Advice goes further by recommending the location and number of smoke detectors and fire doors. • Reviewer has not appropriately reviewed the drawings to identify other openings present with the Reviewer proposed |

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| | | <p>Alternative Solution.</p> <p>Fire Fighting:</p> <ul style="list-style-type: none"> • Consideration for fire fighting provision was identified by the Reviewer as required but absent in the submission. • The Reviewer has not raised concerns of the Designer specifying the FRR provided by a certain thickness of concrete with out justification. <p>CONCLUSION: DRU Assessment adequate DRU Memorandum inadequate</p> |
| Project M | F | <p>Escape from Fire:</p> <ul style="list-style-type: none"> • Review undertaken whilst the Reviewer has acknowledged that inadequate plans and documentation had been provided. • Most inconsistencies in the Fire Engineering Report were identified by the Reviewer. <p>Fire Fighting:</p> <ul style="list-style-type: none"> • Has noted that without adequate documentation, comments could not be made. • The Reviewer has identified that structural assessments be also be provided for consideration. <p>CONCLUSION: DRU Assessment adequate DRU Memorandum adequate</p> |
| Project N | G | <p>Escape from Fire:</p> <ul style="list-style-type: none"> • The Reviewer has not demonstrated a detailed understanding of C/AS1 as the Reviewer has failed to recognize that a mitigating provision proposed by the Designer is actually a required system. • Subsequently, the Reviewer has not identified that the benchmark scenario is inappropriate for the comparative assessment. • The Reviewer has not identified the proposed design omits smoke exhaust. No justification for this proposal is included in the Fire Engineering Report. <p>Fire Fighting:</p> <ul style="list-style-type: none"> • Consideration to hydrants and vehicular coverage was not considered by the Reviewer. • The Reviewer has requested post fire event structural assessments of the external wall to be conducted. This is however considered to be outside the scope of the Building Code. |

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| | | CONCLUSION: DRU Assessment inadequate DRU Memorandum inadequate |
| Project O | I | The Reviewer identified that the subject Fire Engineering Report did not provide sufficient information for egress and fire fighting provisions to be considered. CONCLUSION: DRU Assessment adequate DRU Memorandum adequate |
| Project P | B | Escape from Fire: <ul style="list-style-type: none"> Assumptions made by the Designer have been determined flawed by the Reviewer. The Reviewer has appropriately identified inadequacies of the design and assessment for the design. Fire Fighting: <ul style="list-style-type: none"> The Reviewer has recommended that as Fire Fighting provisions have not been considered in the Fire Engineering Report, the BCA is to determine adequacy of the systems. CONCLUSION: DRU Assessment adequate DRU Memorandum adequate |
| Project Q | C | Escape from Fire: <ul style="list-style-type: none"> The Fire Engineering Report provided a holistic design for a change of use. The Reviewer has indicated that a signage plan is to be provided to the BCA. Fire Fighting: <ul style="list-style-type: none"> Recommendations by the Reviewer noted water requirements are to be subject to the approval of the BCA. CONCLUSION: DRU Assessment adequate DRU Memorandum adequate |
| Project R | F | Escape from Fire: <ul style="list-style-type: none"> The Fire Engineering Report submitted a complying Acceptable Solution Design. Technical aspects of the Fire Engineering Report were limited with no noted inconsistencies by the Reviewer or in technical review. Fire Fighting: <ul style="list-style-type: none"> The Reviewer has specifically not assessed this part, stating that it is not required as the building is subject to Section 112. This is in consistent with other DRU Reviewers. CONCLUSION: DRU Assessment inadequate |

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| | | DRU Memorandum inadequate |
| Project S | B | <p>Escape from Fire:</p> <ul style="list-style-type: none"> The Reviewer has assessed a staged evacuation strategy. Further information for the sequence of events is proposed due to the limited detail provided in the Fire Engineering Report. The Reviewer has failed to note that no assessment is provided to justify the stated acceptance criterion. The Designer relies on the successful operation of the sprinkler and smoke exhaust system. The Reviewer has not identified potential issues that may arise with the substitution of passive systems for active system, i.e. reliability and maintenance. Consideration of system failure events should be made to determine sensitivity of designs. <p>Fire Fighting:</p> <ul style="list-style-type: none"> As inadequate information has been provided, the Reviewer has recommended that relevant provision be subject to approval by the BCA. <p>CONCLUSION: DRU Assessment inadequate DRU Memorandum inadequate</p> |
| Project T | F | <p>Escape from Fire:</p> <ul style="list-style-type: none"> Inconsistencies with assessment methodologies for population calculations have been noted by the Reviewer. <p>Fire Fighting:</p> <ul style="list-style-type: none"> The Reviewer has stated that consideration to fire fighting provisions, and S Rating calculations need not be reviewed as the building application is subject to a Section 112. This is not considered justified if adopting a holistic design review. <p>CONCLUSION: DRU Assessment inadequate DRU Memorandum inadequate</p> |
| Project U | I | <p>Escape from Fire:</p> <ul style="list-style-type: none"> The Reviewer provided satisfactory review for egress. The review identified inadequate assessment for single exit and for rising and descending stair arrangements. There is also a recommendation for a quantitative assessment for smoke control through lift landing doors. <p>Fire Fighting:</p> <ul style="list-style-type: none"> Recommendations by the Reviewer include a requirement that in existing buildings the Designer provide an appropriate level of inspection and assessment. |

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| | | <ul style="list-style-type: none"> The Reviewer has identified a potential hazard in the car park and has recommended that justification of the environment during a fire event involving this hazard be provided. This is considered unjustified as no variations to this space are identified in the Fire Engineering Report or by the Reviewer. <p>CONCLUSION: DRU Assessment adequate DRU Memorandum inadequate</p> |
| Project V | E | <p>Escape from Fire:</p> <ul style="list-style-type: none"> The Reviewer has failed to identify several issues with the proposed egress strategy. This included the fire safety systems required (i.e. sprinklers); the number of exits required and exit width. The comparative assessment proposed by the Designer of a single storey and double storey building did not concern the Reviewer. The inappropriate use of the Eurocode Fire Severity Assessment method for FHC4 buildings was identified by the Reviewer. <p>Fire Fighting:</p> <ul style="list-style-type: none"> As inadequate information has been provided, the Reviewer has recommended that relevant provision be subject to approval by the BCA. <p>CONCLUSION: DRU Assessment inadequate DRU Memorandum adequate</p> |
| Project W | E | <p>Escape from Fire:</p> <ul style="list-style-type: none"> The Reviewer has not demonstrated an understanding of the proposed design, which is for the new parts to be consistent with the existing parts of the building. The Reviewer has noted strong concerns in regards to the use of <i>reasonable practicable</i> as the basis for no upgrade. <p>Fire Fighting:</p> <ul style="list-style-type: none"> As inadequate information has been provided, the Reviewer has recommended that relevant provision be subject to approval by the BCA. <p>CONCLUSION: DRU Assessment inadequate DRU Memorandum adequate</p> |
| Project X | H | <p>Escape from Fire:</p> <ul style="list-style-type: none"> The Reviewer had noted reasonable concerns of the proposal for not installing sprinklers to the building based on it being an existing development and not being <i>reasonably practicable</i> to |

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| | | <p>provide the installation.</p> <ul style="list-style-type: none"> • Reviewer has requested that justification of why it is not <i>reasonably practicable</i> and assessment of safe evacuation be provided. • The Reviewer has not identified the variations to egress from cool rooms (i.e. latching devices and use of roller doors). <p>Fire Fighting:</p> <ul style="list-style-type: none"> • Assumptions by the Designer of the FRR of existing construction based on assumed thickness is not raised by the Reviewer as a concern. • The Reviewer has not identified that the use of Eurocode Fire Severity assessment method was inappropriate as the building was designated as FHC 4. <p>CONCLUSION: DRU Assessment inadequate DRU Memorandum adequate</p> |
| Project Y | H | <p>Escape from Fire:</p> <ul style="list-style-type: none"> • The Reviewer has noted that the Designer has not taken into account the function of the facility. Security and immigration requirements have been identified by the Reviewer as possible locations where the proposed egress strategy may fail. <p>Fire Fighting:</p> <ul style="list-style-type: none"> • The Reviewer has not recommended considerations to this part be made. <p>CONCLUSION: DRU Assessment adequate DRU Memorandum adequate</p> |
| Project Z | G | <p>Escape from Fire:</p> <ul style="list-style-type: none"> • The Reviewer has identified that the basis of the Fire Engineering Report and the DRU Review are inconsistent. • The Reviewer has undertaken a detail review of the evacuation and zone modelling of the car park. The recommendation for the Designer to <i>completely revisit</i> the egress strategy is justified. • The Reviewer has not noted that the Designer has omitted direct connection of the alarm system to the NZFS based on concession (f), when the concession is not provided for in C/AS1 Table 4.1. • The Reviewer has not noted that the Designer has recommended that no emergency lighting in exits are required based on all exits opening in safe place, when most exits actually discharge into the undercover car park. |

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| | | <p>Fire Fighting:</p> <ul style="list-style-type: none">As inadequate information has been provided, the Reviewer has recommended that relevant provision for hydrant coverage and the location of essential fire services is subject to approval by the BCA. <p>CONCLUSION: DRU Assessment adequate DRU Memorandum adequate</p> |

APPENDIX D INDEX OF REVIEWED PROJECTS, FIRE ENGINEERING ORGANISATIONS AND DRU REVIEWERS

The tables in this Appendix have been removed to protect the identities of the projects reviewed, the fire engineering organisations involved in the designs and the NZFS Design Review Unit reviewers.

APPENDIX E REFERENCES

- ¹ *The Building Code*, First Schedule of Building Regulations 1992 8th June 1992, New Zealand.
- ² *Building Regulations 1992*, 8th June 1992, New Zealand.
- ³ *Building Act 2004*, 24th August 2004, New Zealand.
- ⁴ NFPA 101, *Life Safety Code*, National Fire Protection Association, Section A1.5.2, 2000.
- ⁵ *International Fire Engineering Guidelines*, Australian Building Codes Board, 0.2-5, March 2005.
- ⁶ Custer, R.L.P. and Meachan, B.J, *Introduction to Performance-Based Fire Safety*, Society of Fire Protection Engineers (SFPE) and National Fire Protection Association (NFPA), 1997.
- ⁷ *International Fire Engineering Guidelines*, Australian Building Codes Board, 0.2-3, March 2005
- ⁸ *International Fire Engineering Guidelines*
- ⁹ Department of Building and Housing Compliance Documents
- ¹⁰ Custer, R.L.P. and Meachan, B.J, *Introduction to Performance-Based Fire Safety*, Society of Fire Protection Engineers (SFPE) and National Fire Protection Association (NFPA), p79, 1997
- ¹¹ *International Fire Engineering Guidelines*, Australian Building Codes Board, 0.2-6, March 2005
- ¹² Wakelin, W, *Peer Review – Reviewing the work of another Engineer*, Practice Note 02, Institution of Professional Engineers New Zealand, June 2003.
- ¹³ Buchanan, A.H. (Ed), *Fire Engineering Design Guide*, Centre for Advanced Engineering, 2nd Edition, University of Canterbury, Christchurch, New Zealand, 2001.
- ¹⁴ *International Fire Engineering Guidelines*, Australian Building Codes Board, March 2005.
- ¹⁵ Custer, R.L.P. and Meachan, B.J, *Introduction to Performance-Based Fire Safety*, Society of Fire Protection Engineers (SFPE) and National Fire Protection Association (NFPA), p225, 1997
- ¹⁶ *Compliance Document for New Zealand Building Code Clauses C1, C2, C3, C4 Fire Safety*, Department of Building and Housing, 2005.
- ¹⁷ *Fire safety engineering in buildings. Part 1 Guide to the application of fire safety engineering principals*, Draft for Development DD240 Part 1 : 1997, British Standards, 1997.
- ¹⁸ Poon, L. and Lau, R, *Important Design Factors for Regulating Performance-Based Fire Safety Engineering Design of Australian Road Tunnels*, Proceeding to the Fire Safety Engineering International Conference 2006, Gold Coast Australia , May 2006.