



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

**Report ref:**  
41562.001  
21 September 2009  
Revision 0

**New Zealand Fire Service**

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<b>Document control</b>						
Document ID: 41562.001.Review Report.rev0						
<b>Rev No</b>	<b>Date</b>	<b>Revision details</b>	<b>Typist</b>	<b>Author</b>	<b>Verifier</b>	<b>Approver</b>
0	2/9/09	Draft Report for Review	IPM	IPM	JS	IPM

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# 1. Executive Summary

Aurecon have been commissioned by the New Zealand Fire Service (NZFS) to undertake a technical audit of a representative sample of work (25 reports) performed by the NZFS Design Review Unit in the discharge of their duties under the Building Act 2004.

In accordance of Section 46 of the Building Act 2004 the Design Review Unit reviews fire engineering assessments and designs and 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 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:

1. The full list of the building consents received and assessed by the DRU was submitted and a representative audit sample of 25 was selected using the process detailed in section 3 of this report.
2. A review of the fire engineering design was undertaken to assess the submitted documentation against the relevant provisions of the Building Act 2004 including relevant design standards. This technical review includes comments on the methodology and quality employed by the fire engineer, and the technical accuracy of the memorandum response provided by the DRU.

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

## 1.1 Summary of Review

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	30%	0%	65%	10%	0%
Well presented format	0%	0%	80%	20%	0%
Technically accurate	0%	20%	65%	15%	0%
Information actionable	0%	20%	60%	30%	0%

Engineering Reports		Percentage of reports				
		Poor	Incomplete	Acceptable	Good	Very Good
Formal fire engineering design	<i>Identified</i>	4%	8%	83%	4%	0%
	<i>Followed</i>	29%	63%	8%	0%	0%
Acceptance criteria	<i>Specified</i>	30%	40%	20%	10%	8%
	<i>Comprehensive</i>	30%	50%	20%	0%	0%
Engineering methods used	<i>Appropriate &amp; Technically correct</i>	20%	50%	30%	0%	0%
Conclusions	<i>Clear</i>	10%	20%	50%	20%	0%
	<i>Substantiated</i>	20%	40%	30%	10%	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.

## 1.2 Findings in the Performance of the NZFS Design Review Unit


### 1.2.1 Current Review

The main findings of this review are detailed below. Many of the findings were a reflection of the quality of the fire reports and the detail and presentation of the fire reports. This has a direct relationship to how the DRU could respond and the number of issues identified by the DRU as not complying that was not addressed within the fire report or was considered as being compliant when they were not.

1. It is considered that many of the fire engineering reports submitted as part of this review do not meet the standard of documentation described in the International Fire Engineering Guidelines or the Fire Engineering Design Guide.


This lack of documentation manifests itself in terms:

- Lack of adequate description of the hazards and fire scenarios
- Discussion of the choice of fire growth rates and peak heat release rates was not made
- Lack of a total view of the fire safety for the entire building and a focus on the specific area of non-compliance
- Incorrect assumptions on the correct application of the Acceptable Solutions such that the impact of the non-conformance or building addition on the compliance of other areas was often over looked

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- Many design assumptions were not translated to drawings for review by the DRU
  - The applicability of the model, the inputs and outputs are not presented clearly
2. The above lack of documentation means that the actual non-conformances are hidden in a report that tends to detail conformances to the acceptable solutions and the parameters of the assessment are not clear. If the parameters were clearer then the review by the DRU could focus more on the fire engineering and less on how the design complies or doesn't comply with the acceptable solutions.
  3. The DRU responses did not provide a background to the project, a description of the project, or a summary of the fire engineering issues to be reviewed. The responses followed a set template for the initial background that would assume a reader was familiar with the building and all issues. It is considered that a more detailed introduction of the building, systems and issues would assist in putting the response into context as well as making it clearer in the reviewer's mind how the building as a whole and the interaction of the fire systems operates. This may require an extension of time from the 10 day review period for more complex projects.
  4. However, the DRU did pick up many instances where the fire report has looked at the area of non-compliance in isolation and not taken into account the affect on other areas of the building and the change in compliance requirements. It is considered that as these issues are in many cases not related to fire services response or provision of escape that they could be picked up by the BCA. This would allow a more focussed review of the fire engineering issues
  5. It was noted that the detail and quality of the DRU response and applicability to the assessment of provision for escape was related to the quality and detail of the fire report. Where only a brief report was made or a qualitative report was made there was limited scope for review but many issues of non-compliance to C/AS1 that were missed in the fire report highlighted. These fire reports tended to be the poorer reports on smaller projects and related to additions to existing buildings.
  6. It was observed that in two of the more detailed fire reports that would be considered to provide an acceptable level of analysis the DRU comments were considered to focus on technical issues, ignore the inherent risks of the use of the area or the proposed improvements such as the addition of sprinklers and were not considered to take a holistic view of the interaction of systems and design. The DRU responses for these more detailed fire reports that were the better fire reports reviewed were considered to be the more thorough responses but overall poorer in their assessment as they did not focus on the entire fire safety system and strategy and came back to a reliance on the acceptable solutions and the fact that there was deviation.
  7. There appears to be a discrepancy between the application of alternative solutions to part of the building in the fire report and the expectation of the DRU that the entire building be considered and what provisions are actually to be addressed. Again the lack of a formal process of looking at the whole building and the inter-relationships of various fire systems appears to result in a report that does not fully address the performance required.

It therefore appears that there is confusion in the fire reports whether the fire report should take into account the entire building as a typical fire engineered solution should do and the DRU comments appear to suggest or just the area of non-compliance.



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8. Very few fire reports detailed the requirements and provisions with respect to the ability of the fire service to undertake fire fighting operations. Where comment in the fire report was made it was generally a repeat of the required provisions from the code but not related to the building and project in question. The DRU input into this aspect of the designs was therefore limited in many projects reviewed to a comment that sufficient detail was not provided.
  9. Very few reports detailed the acceptance criteria or the results of the smoke modelling beyond the time of evacuation. Therefore a complete understanding of safety margins, safety factors and conditions when fire brigade operations may be undertaken was lacking
  10. The comments by the DRU tended to fall back on what a compliant or accepted solution would require without taking a broader more lateral view of the building and suggesting alternative means of assessment. An example is not taking into account the nature of the activities such as metal working that result in a small fire load. Another example is the fact that a smaller population has been assumed than the code compliant solution is not unusual and rather than demand the building be designed to a code compliant population advice could have been provided on an acceptable population or how an acceptable population could be justified.
  11. The DRU review was considered to be limited to reliance on Acceptable Solutions. The 10 day time limit could have prevented further assessment and some form of mechanism to extend the time while information is being gathered would have been of benefit.
  12. The DRU did not appear to accept solutions or designs that relied or contained management procedures and took advantage of the inherent low fire risk or fuel load of the activities as part of the argument for acceptance. Although management procedures can be problematic in terms of ensuring they occur, for some occupancy such as healthcare and schools where supervision is a part of the every day activities, it is seen as one of the main safety systems which have also been backed up by research. The lack of acceptance of these and the inherent low fire risks in areas such as swimming pools suggests that there is a reliance on code solutions rather than looking at the unique nature of the building and occupancy and placing the fire engineering assessment into this context. The use of a fire engineering brief would allow earlier discussion of issues and a longer review time could also allow for more discussion prior to rejection.
  13. Many of the DRU comments relate to the application of the acceptable solutions to areas that are not the specific focus of the fire report. It is unclear as to whether the DRU is required to review the acceptable solutions or whether this should be performed by others thereby allowing the DRU to focus on the fire engineering and non-compliance to the acceptable solutions
  14. The DRU did recommend the use of the IFEG in a number of projects. It is considered that this will improve the level of fire reports and also the reviews.
  15. The lack of final and complete plans and specifications is a reoccurring point in many of the reviews. It is considered that given typical project phases that usually have a number of changes even during the construction phase that to have final and complete plans and specifications that accurately reflect the as built condition is very difficult or would occur

very late in the design and possibly construction process. NZFS input at such a late stage would then mean that if any design changes are required due to fire engineering assessments they would be difficult and costly to incorporate. This is particularly the case where the DRU identified the possible need for sprinklers to overcome issues that were not picked up by the fire report.

It is considered that the value of the DRU would be greatly improved if input could be made earlier in the design and assessment process. This is particularly the case given the quality and detail of some of the fire reports

16. An improvement would be to have a mechanism where the major factors affecting the design and cost requiring fire engineering can be reviewed and commented upon at an earlier stage and the final review of specifications and plans reviewed by the BCA against the previous advice or handled as addendums to the original fire report. This would allow for a more thorough review by the DRU and greater input into the design process.
17. There does not appear to be a follow up on the majority of the projects reviewed to determine if the comments of the DRU were addressed either by a further fire report or design changes. This feedback would be beneficial in improving the DRU responses. (Two projects did have multiple responses and reviews)
18. The assessment of the ability of the fire service to undertake fire fighting operations was not undertaken to a large extent on the majority of reviews. The reviews tended to focus on provision for means of escape. This was partially due to the lack of information contained within the fire reports.

### 1.2.2 Previous DRU Reviews

It is considered that as this is the third review undertake it is considered relevant to revisit the findings of the other reviews to determine if they are still applicable based on the current review or whether some of the findings have been addressed.

Finding	Relevance to current Review
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.	A similar issue was identified in the current review but with the more detail fire reports a more detailed response was obtained from the DRU but it did not take the broader view of the fire safety systems and the interaction with occupants and fire service response. If the more detailed and thorough fire reports are to be developed then the DRU needs to also take a broader view of the fire safety strategy and interaction of systems in the entire building.
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	This was seen as an issue with the current review where many of the DRU responses indicated insufficient detail was provided.

<p>when additional information is requested from the BCA so that appropriate NZFS Design Review Unit comment can be made.</p>	
<p>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</p>	<p>It is considered that many of the reviews did adopt the principles where possible but only one had a formal review sheet. However due to a lack of information in the fire report a full response was not possible. The lack of a formalised fire report content and format also meant that the DRU response could not be made in accordance with IPENZ Practice Note 2.</p>
<p>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</p>	<p>This was seen as an issue in the current review where the lack of early input could potentially affect projects in a major design or cost sense.</p> <p>A few projects indicated that a brief was undertaken but it is unclear if the NZFS had an input. Where the brief was indicated to be undertaken it was on the larger projects but still would not fulfil the IFEG requirements.</p>
<p>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.</p>	<p>This was seen in the current review.</p> <p>Setting of minimum benchmarks is seen as best being set during a brief stage that could take the form of a meeting where the requirements of the assessment can be set and be project specific.</p> <p>Experience in Australia and internationally by the author is that where a brigade sets guidelines that are inflexible they become a pseudo code requirement in many instances above the actual building code and regulations and that as with any code may not be applicable for all projects. Hence any benchmarks are seen as still needing a mechanism for flexibility as well as achieving a certain minimum objective.</p>
<p>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</p>	<p>The current review findings would support this as many of the fire reports did not contain sufficient information to fully assess the fire engineering or used expert judgement with a full discussion of the issues. The DRU did recommend the use of the IFEG in some reviews</p>

<p>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.</p>	<p>This is agreed based on the current findings.</p> <p>It is noted that a number of reviews did recommend the use of the IFEG and hence this point is considered to have been adopted to a certain extent.</p>
<p>The DRU checklist indicates that the process undertaken by the DRU is a well thought out and standardised process. The checklist appears to be very comprehensive and is clearly set out.</p>	<p>The majority of responses of the DRU were considered to be appropriate and adequate taking into account the quality of the reports submitted.</p>
<p>It appears that the BCA provides the building application documentation to the DRU prior to any significant assessment of the application it (the BCA) may make, except to determine whether there is a need to ask for DRU advice.</p> <p>This means that in some cases faults are found in the application by the DRU that would probably (and should) be obvious to a competent BCA. Thus, inherently, the DRU's time is being wasted</p>	<p>Many of the DRU responses in the current review identified issues with the application and interpretation in the fire report of the appropriate acceptable solutions.</p>
<p>The building applications forwarded to the DRU are meant to only be those that involve performance based design. In practice many of the cases appeared to involve either no departure from the acceptable solutions or rather trivial departures from them</p>	<p>This was found to be the case in many reports. However in performing the review the DRU did identify non-compliances in the design to the acceptable solutions that should then form the basis of a fire engineered solution.</p>
<p>To some extent the confusion also appears to come about because of the somewhat complex nature of some of the Acceptable Solutions.</p>	<p>It is agreed that it is difficult to determine at what point a calculation and the inherent assumptions and expert judgement and model limitations that go with that calculation are forming a method of compliance with the acceptable solution and at what point they would form a fire engineered solution. This was particularly seen in the use of Eurocode methods to determine the S rating for windows where the DRU has made comment when it could be argued this does not fall within the sphere of comment.</p>
<p>In my opinion, documentation covering the entire building should normally be supplied to the BCA and DRU in support of any building consent application.</p>	<p>The documentation in the current projects did in many cases cover the entire building but the fire report and modelling did not.</p>





### 1.3 Conclusions

Based on the review of the subject projects and DRU responses it is considered that the DRU responses were in many ways limited by the standard and content of the applications and especially the fire reports. This meant that many responses were a review of the design against the acceptable solutions rather than a review of the fire engineering.

However, where the fire report did provide an alternative solution based on fire engineering and did follow to some degree the recognised format the responses from the DRU were considered to be accurate and professional. The DRU also recommended the use of the IFEG in a number of reviews.

This review and past reviews have produced similar results that are considered to be a reflection of the lack of change in the standard of fire reports and overall approval system rather than the DRU responses.

## 2. Introduction

### 2.1 Scope

The NZFS DRU becomes involved in the building consent process under certain circumstances.

This occurs where:

- A building consent application involves a project that would require an approved evacuation scheme from the NZFS (post-completion) and
- That project also includes fire engineering 'alternative solutions' in respect to means of escape and fire fighting operations.

When these conditions exist, a copy of the documentation supporting the building consent application is sent to the DRU for review. The DRU has ten days in which to respond to the BCA. This response is via memoranda.

The scope this report involves:

- Establishing a sampling methodology, selecting a representative cross-section of designers and DRU reviewers. We will exclude from the sample any of Aurecon's projects. As this represents a small percentage by number of applications and value of work, this is not expected to significantly bias the review
- Using the International Fire Engineering Guidelines as the benchmark commenting upon the general quality and technical accuracy of the DRU memoranda
- Reviewing the applicant's supporting documentation against the eleven nominated 'areas of concern' (outlined in the RFP), and
- Reporting upon the above.

Aurecon considers this review to be a constructive process to assist the DRU and approval authorities in approving a design and providing advice which is supported by a fire engineering report. The review process may also assist the fire engineer in ensuring that all matters, especially the justification of expert judgement, are adequately addressed. It is the overall philosophy of Aurecon that regulatory authorities and approval authorities should assist rather than hinder the approval of a given project to ensure that a safe design is obtained while the process is not unduly protracted nor is the worth of the review by the authorities jeopardised.

### 2.2 Limitations

Aurecon has conducted a review of the fire safety engineering assessment reports. The review has been conducted on the report documents and the referenced drawings noted within the report. Any variations from the detailed design described and assessed within the aforementioned report are not applicable to this peer review report.

The review process does not include any re-analysis either manual or involving computer based programs. Where there may be concerns in regard to the outputs of analyses these will be identified as requiring confirmation should this be the case.

## 3. Methodology

### 3.1 Introduction

This audit was undertaken on the documents contained in the files of 25 cases supplied by the DRU.

There have been approximately 1200 building consents reviewed by the DRU to date. Accordingly, the 25 projects reviewed as part of this project accounts for a sample size of approximately 5%.

The audit of the 25 reports has been performed against the 11 areas of concern identified by the Institute of Professional Engineers of New Zealand (IPENZ) confidential reporting mechanism which are listed as follows:

1. Investigation not thorough enough.
2. Analysis or design not sufficiently rigorous.
3. Inappropriate use of software.
4. Ambiguous or unusual computer results.
5. Use of unproven materials or techniques.
6. Conflict with regulations or codes of practice.
7. Inadequate checking, reviewing or quality assurance (QA).
8. Taking disproportionate risks.
9. Designs not sufficiently robust.
10. Insufficient detail in drawings.
11. Compliance document applied incorrectly.

Comment has also been made on the quality and methodology employed in the fire engineering reports received by the DRU.

A representative cross-section of reports from a broad cross-section of designers and DRU review engineers was chosen using the methodology detailed below.

### 3.2 Selection Process of Reports for Review

The selection process was developed to provide a representative sample of building designs and reviews in terms of the amount of time the DRU spent on the review. This was based on the assumption that the amount of time spent was a reflection of the complexity of the project and review.

The methodology by which the reports for review were selected was as follows:

1. The 1200 reports for review were ranked in terms of the DRU review time as indicated by the invoiced hours. The invoiced hours were assumed to be a reflection of the complexity of the project and the review process by the DRU
2. The invoiced time was ranked into bands as follows:
  - a. < 5 hours
  - b. 5 to 15 hours
  - c. 15 to 30 hours
  - d. > 30 hours
3. The percentage of projects in each of the above groupings was determined
4. The number of each classified use of building within each of the above bands was determined and the percentage of each classified use determined.
5. The above ranked reports were grouped into bands

6. The same percentage of reports within the 25 reports selected for review were selected from each band as the bands made up in the total reports
7. Where possible each class of use was represented to the same extent as within the total number of reports.
8. A further check was made based on the number of reports from each fire engineering firm to ensure that the final selected number of reports did not for a bias towards one fire engineering firm or type of occupancy.

The following percentages were determined.

	Time Invoiced in the DRU Review (hours)			
	<5	<15	<30	>30
Percentage of all 1209 reports	75.0	23.6	0.9	0.5
Percentage of 25 Reports selected for Review	64	20	8	8

It should be noted that 1 report in 25 accounts for 8% and hence the overall percentages had to be modified accordingly.

The split between the various fire engineering organisations was cross referenced to make sure one organisation was not biased as presented below.

Fire Engineering Company	No. projects in selected 25	%	% of reports to NZFS
A	1	4	2
B	2	8	2
C	2	8	4
E	1	4	4
F	1	4	1
G	1	4	3
H	1	4	1
I	5	20	17
J	3	12	7
K	2	8	1
L	1	4	1
M	2	8	4
N	1	4	2
O	1	4	2
P	1	4	1
Total	25		



## 4. New Zealand Regulatory System

### 4.1 Building Consent

A building owner is required to apply for a building consent if they intend to undertake any building work. The requirements to be met vary with the type of work to be undertaken. For an alteration (S112) requires the owner to consider the means of escape from the complete building, a change of use (S114) or extension of design life of a building requires the owner to consider means of escape, protection of neighbors property, structural stability in fire and fire fighting features. A new building must comply with all clauses of the BA.

### 4.2 NZFS Involvement in Building Act 2004

The involvement of the New Zealand Fire Service in the Building Act 2004 covers a number of areas. The reasons given for incorporating the NZFS into the BA was to create better linkages between the Building Act and the Fire Service Act.

It was recognised that the Fire Service Act clearly charges the NZFS with promoting fire safety and has, as a specific function the approval of evacuation schemes. The purpose of evacuation scheme approval is to ensure building occupants can evacuate safely from a building. The inclusion of the NZFS in the consent process is to minimize the possibility of the NZFS raising concerns about a building latter in the process when it becomes difficult and/or expensive to rectify building design faults. The Determination process is still available but should be unnecessary if the designers utilize the advice offered by the NZFS. Reflection on many of the determinations taken to date indicates that poor documentation is central to the problem.

The NZFS are involved directly or indirectly in a number of clauses within the BA. These are:

- Clause 35: Project Information Memorandum
- Clause 46: Building consent applications to be forwarded to NZFS Commission
- Clause 47: NZFS Commission may give advice
- Clause 48: BCA to take regard of NZFS Commission advice
- Clause 108: Building Warrant of Fitness
- Clause 121: Dangerous Buildings
- Clause 170: Department of Building & Housing CEO to consult with NZFS
- Clause 176: Meaning of Party (Determinations)
- Clause 177: Determination
- Clause 363: Offence to occupy public building


Of direct interest to this review are the following clauses:

#### 4.2.1 Clause 46: Building consent applications to be forwarded to NZFS Commission

Clause 46 requires the Chief Executive of the Department of Building and Housing to specify the type of buildings that will be forwarded to the Fire Service Commission by a Building Consent Authority (BCA). The building types will be notified in the NZ Gazette. This notice was published in Gazette no 56, copy attached.

#### 4.2.2 Clause 47: NZFS Commission may give advice

Section 47 allows the Commission to provide a memorandum that provides advice on the following matters:

- 
- 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

The advice offered in the memorandum cannot exceed the performance requirements of the building code. This memorandum is required to be provided within ten days; otherwise the building consent authority (BCA) can determine the application without further fire service commission input.

#### **4.2.3 Clause 48: BCA to take regard of NZFS Commission advice**

In deciding to issue or decline a building consent, the BCA must have regard for the memorandum issued by the Commission.

### **4.3 Design Review Unit**

To discharge the legal obligations of clause 46, 47 & 48 of the Building Act, the New Zealand Fire Service has nationalised the fire engineering function and established a unit, called the Design Review Unit (DRU). This unit will be responsible for reviewing the fire engineering design of selected buildings.

The fire safety reviews conducted by the NZFS will be performed on buildings gazetted by the Chief Executive of the Department of Building & Housing. Currently it is proposed that buildings that require an evacuation scheme (irrespective of the presence of an automatic sprinkler system) and is an alternative design will be forwarded to the NZFS.

The DRU, on behalf of the Commission conducts these reviews and provides this advice back to the Building Consent Authority. Because the NZFS will be reviewing alternative designs it has been decided the unit will consist of qualified fire engineers drawn from both inside and outside the NZFS.

The formal definition of means of escape taken from the BA 2004 is formatted slightly differently from the previous definition in the BA 1992 i.e.

- "Means of escape from fire", in relation to a building which has a floor area,***
- (a) means continuous unobstructed routes of travel from any part of the floor area of that building to a place of safety; and***
  - (b) Includes all active and passive protection features required to warn people of fire and to assist in protecting people from the effects of fire in the course of their escape from that fire"***

Much of the detail of a fire safety design is covered by this definition and will be covered in the units design review. The NZFS has not been involved in the building consent process to replace the fire engineering peer reviewer and thus the role of the DRU will not be to check all aspects of a fire engineering design. However the design parameters for a significant range of fire safety systems will need to be reviewed.



## 4.4 Review Process

Where a BCA receives an alternative design, they will forward the fire safety report and drawings together with a signed NZFS checklist (if provided) to the NZFS DRU. The processing of the work will be assigned to a designated engineer. The design is reviewed against a standard checklist.

On completion of its review the DRU will provide a memo to the BCA. The memo will indicate either the NZFS has no concerns with the design or alternatively will raise concerns.

The memo wording must comply with the requirements of the BA 2004 and will indicate a design if built in accordance with the documents will have fire safety features suitable for fire service use and will be eligible for a draft scheme to be approved. The purpose of the memo is **not** to indicate a design complies with the requirements of the Building Act. The review does not constitute a peer review in terms of the Building Act.

The BCA is still at liberty to reject the advice offered by the Commission. In all cases the BCA will be responsible for the coordination of communication between the various parties.

## 5. Fire Engineering Methodology

### 5.1 Introduction

Section 47 of the Building Act 2004 set the role of the DRU in the approval process.

Section 47 states:

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?

The criteria and method upon which the application is to be judge are not stated. This would provide flexibility in the ability of the DRU to respond but also has the risk of inconsistent advice and advice that is not in a format that aids in the design process or is based on recognised criteria.

The following sections provide some background to the assessment methodologies considered appropriate for a design review as based on the International Fire Engineering Guidelines (2005) and other peer review documentation.

The 10 day response period is also considered to be a limiting criterion on the response especially for the more complex projects where a longer project delivery time due to the size and complexity of the project should also be able to accommodate a longer and more considered response from the DRU. This time for review could be linked to project value such that projects over a certain value are able to have a longer time of response.



## 5.2 International Engineering Guidelines

The International Fire Engineering Guidelines (IFEG) has four parts, as outlined below:

- Part 0 provides background information and guidance.
- Part 1 describes the process by which fire engineering is typically undertaken.
- Part 2 describes a selection of methodologies that may be used in undertaking the fire engineering process.
- Part 3 provides a selection of data that may be used in applying the methodologies of Part 2 or other chosen methodologies.

The Guidelines indicate that the Authority having Jurisdiction (AHJ) would generally:


- be responsible for the approval of designs (utilising the appropriate assessment method (see 0.2.2)
- identify the deviations from the DTS Provisions
- confirm the Performance Requirements applicable to the Alternative Solution
- provide regulatory advice during the fire engineering brief process (see comments below with reference to independence)
- carry out the appropriate regulatory functions
- nominate the elements of the design that will be subject to ongoing maintenance and the standards or performance to which they should be maintained; they may rely on information from the fire engineer to fulfil these functions
- if necessary seek appropriate third party review of Alternative Solutions
- ensure the retention of all relevant documentation for Alternative Solutions

The role of the Fire Engineer is given as:

- (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."

It is anticipated that the design process with respect to the development of an alternative solution will generally follow the process detailed in the IFEG in that a Fire Engineering Brief (FEB) will be developed initially followed by the Fire Engineering Report (FER).

It is further considered that as the complexity of the project increases then the need for a FEB and level of review and time for review increases. For simple projects it is considered that a simple brief in the form of an exchange of letters, faxes or emails will be sufficient. For more complex projects a



formal FEB will be required to be submitted for review and for the most complex projects a peer review of the FEB could be required prior to the commencement of the final Fire Engineering Report.

### 5.3 Fire Engineering Design Guide

The purpose of the Fire Engineering Design Guide is to provide an introduction to fire engineering. 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 Guide indicates that the fire safety performance requirements of the Building Code can be met either by complying with the prescriptive provisions of the BIA Acceptable Solution, or by an "alternative solution" involving specific fire engineering design. The Guide provides a framework for carrying out specific fire engineering design.


The performance requirements of the Building Code are qualitative, not quantitative. Hence there are no simple methods available for quantifying building performance or safety. Acceptance of performance requirements is therefore largely a matter of expert judgement.

Section 1.5 of the Fire Engineering Design Guide states the following factors affect the performance required from a specific fire engineering design include:

- 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.

The Guide indicates it is essential that fire engineering designs be well documented in a rational and consistent manner and that every design submittal should be a written report including:

1. The name and credentials of the person with overall responsibility for the fire safety design, including co-ordination between various trades.
2. The name and credentials of the person or persons doing the actual fire safety design.
3. A statement of design philosophy including at least:
  - a) The performance requirements forming the basis of the design.
  - b) The differences between the performance requirements and those of the Building Code.

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- 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.
  - f) Assumptions about the long-term life and use of the building.
- 4 A clear description of the fire scenarios considered, and why they were used.
  - 5 Assumptions regarding performance of the Fire Service.
  - 6 Calculations which provide sufficient information for the entire procedure to be followed clearly and precisely, with references for all equations and assumptions. References should only be to literature that has been peer reviewed. Copies of important references may be included as an appendix.
  - 7 Full details of any computer input, and a summary of the output with graphs rather than numerical print-out. Actual print-out can be included in an Appendix.
  - 8 A statement of any inspection procedures necessary on site.
  - 9 A schedule of the drawings and specification which form part of the fire design package, including applicable drawing numbers and dates.

It is considered that many of the fire engineering reports submitted as part of this review do not meet the above standard of documentation.

## 6. Technical Reviews

### 6.1 Introduction

This section details the results of the review of the DRU memorandums and supplied fire engineering reports against the 11 areas of concern identified in the brief which are listed as follows:

1. Investigation not thorough enough.
2. Analysis or design not sufficiently rigorous.
3. Inappropriate use of software.
4. Ambiguous or unusual computer results.
5. Use of unproven materials or techniques.
6. Conflict with regulations or codes of practice.
7. Inadequate checking, reviewing or quality assurance (QA).
8. Taking disproportionate risks.
9. Designs not sufficiently robust.
10. Insufficient detail in drawings.
11. Compliance document applied incorrectly.


### 6.2 Results

The technical reviews performed indicated the following points:

1. It is considered that many of the fire engineering reports submitted as part of this review do not meet the standard of documentation described in the International Fire Engineering Guidelines or the Fire Engineering Design Guide.

This lack of documentation manifests itself in terms:


- a. Lack of adequate description of the hazards and fire scenarios
  - b. Discussion of the choice of fire growth rates and peak heat release rates was not made
  - c. Lack of a total view of the fire safety for the entire building and a focus on the specific area of non-compliance
  - d. Incorrect assumptions on the correct application of the Acceptable Solutions such that the impact of the non-conformance or building addition on the compliance of other areas was often over looked
  - e. Many design assumptions were not translated to drawings for review by the DRU
  - f. The applicability of the model, the inputs and outputs are not presented clearly
2. The above lack of documentation means that the actual non-conformances are hidden in a report that tends to detail conformances to the acceptable solutions and the parameters of the assessment are not clear. If the parameters were clearer then the review by the DRU could focus more on the fire engineering and less on how the design complies or doesn't comply with the acceptable solutions.


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3. The DRU responses did not provide a background to the project, a description of the project, or a summary of the fire engineering issues to be reviewed. The responses followed a set template for the initial background that would assume a reader was familiar with the building and all issues. It is considered that a more detailed introduction of the building, systems and issues would assist in putting the response into context as well as making it clearer in the reviewer's mind how the building as a whole and the interaction of the fire systems operates. This may require an extension of time from the 10 day review period for more complex projects.
  4. However, the DRU did pick up many instances where the fire report has looked at the area of non-compliance in isolation and not taken into account the affect on other areas of the building and the change in compliance requirements. It is considered that as these issues are in many cases not related to fire services response or provision of escape that they could be picked up by the BCA. This would allow a more focussed review of the fire engineering issues
  5. It was noted that the detail and quality of the DRU response and applicability to the assessment of provision for escape was related to the quality and detail of the fire report. Where only a brief report was made or a qualitative report was made there was limited scope for review but many issues of non-compliance to C/AS1 that were missed in the fire report highlighted. These fire reports tended to be the poorer reports on smaller projects and related to additions to existing buildings.
  6. It was observed that in two of the more detailed fire reports that would be considered to provide an acceptable level of analysis the DRU comments were considered to focus on technical issues, ignore the inherent risks of the use of the area or the proposed improvements such as the addition of sprinklers and were not considered to take a holistic view of the interaction of systems and design. The DRU responses for these more detailed fire reports that were the better fire reports reviewed were considered to be the more thorough responses but overall poorer in their assessment as they did not focus on the entire fire safety system and strategy and came back to a reliance on the acceptable solutions and the fact that there was deviation.
  7. There appears to be a discrepancy between the application of alternative solutions to part of the building in the fire report and the expectation of the DRU that the entire building be considered and what provisions are actually to be addressed. Again the lack of a formal process of looking at the whole building and the inter-relationships of various fire systems appears to result in a report that does not fully address the performance required.

It therefore appears that there is confusion in the fire reports whether the fire report should take into account the entire building as a typical fire engineered solution should do and the DRU comments appear to suggest or just the area of non-compliance.

8. Very few fire reports detailed the requirements and provisions with respect to the ability of the fire service to undertake fire fighting operations. Where comment in the fire report was made it was generally a repeat of the required provisions from the code but not related to the building and project in question. The DRU input into this aspect of the designs was therefore limited in many projects reviewed to a comment that sufficient detail was not provided.



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9. Very few reports detailed the acceptance criteria or the results of the smoke modelling beyond the time of evacuation. Therefore a complete understanding of safety margins, safety factors and conditions when fire brigade operations may be undertaken was lacking
  10. The comments by the DRU tended to fall back on what a compliant or accepted solution would require without taking a broader more lateral view of the building and suggesting alternative means of assessment. An example is not taking into account the nature of the activities such as metal working that result in a small fire load. Another example is the fact that a smaller population has been assumed than the code compliant solution is not unusual and rather than demand the building be designed to a code compliant population advice could have been provided on an acceptable population or how an acceptable population could be justified.
  11. The DRU review was considered to be limited to reliance on Acceptable Solutions. The 10 day time limit could have prevented further assessment and some form of mechanism to extend the time while information is being gathered would have been of benefit.
  12. The DRU did not appear to accept solutions or designs that relied or contained management procedures and took advantage of the inherent low fire risk or fuel load of the activities as part of the argument for acceptance. Although management procedures can be problematic in terms of ensuring they occur, for some occupancy such as healthcare and schools where supervision is a part of the every day activities, it is seen as one of the main safety systems which have also been backed up by research. The lack of acceptance of these and the inherent low fire risks in areas such as swimming pools suggests that there is a reliance on code solutions rather than looking at the unique nature of the building and occupancy and placing the fire engineering assessment into this context. The use of a fire engineering brief would allow earlier discussion of issues and a longer review time could also allow for more discussion prior to rejection.
  13. Many of the DRU comments relate to the application of the acceptable solutions to areas that are not the specific focus of the fire report. It is unclear as to whether the DRU is required to review the acceptable solutions or whether this should be performed by others thereby allowing the DRU to focus on the fire engineering and non-compliance to the acceptable solutions
  14. The DRU did recommend the use of the IFEG in a number of projects. It is considered that this will improve the level of fire reports and also the reviews.
  15. The lack of final and complete plans and specifications is a reoccurring point in many of the reviews. It is considered that given typical project phases that usually have a number of changes even during the construction phase that to have final and complete plans and specifications that accurately reflect the as built condition is very difficult or would occur very late in the design and possibly construction process. NZFS input at such a late stage would then mean that if any design changes are required due to fire engineering assessments they would be difficult and costly to incorporate. This is particularly the case where the DRU identified the possible need for sprinklers to overcome issues that were not picked up by the fire report.



It is considered that the value of the DRU would be greatly improved if input could be made earlier in the design and assessment process. This is particularly the case given the quality and detail of some of the fire reports

16. An improvement would be to have a mechanism where the major factors affecting the design and cost requiring fire engineering can be reviewed and commented upon at an earlier stage and the final review of specifications and plans reviewed by the BCA against the previous advice or handled as addendums to the original fire report. This would allow for a more thorough review by the DRU and greater input into the design process.
17. There does not appear to be a follow up on the majority of the projects reviewed to determine if the comments of the DRU were addressed either by a further fire report or design changes. This feedback would be beneficial in improving the DRU responses. (Two projects did have multiple responses and reviews)
18. The assessment of the ability of the fire service to undertake fire fighting operations was not undertaken to a large extent on the majority of reviews. The reviews tended to focus on provision for means of escape. This was partially due to the lack of information contained within the fire reports.



# Appendix A

## Detailed Review

# Appendix A Detailed Report and DRU Response Review

## A.1 Introduction

In order to match the fire engineering report to the DRU response both aspects are detailed in the following sections for each project reviewed.

Many of the review comments are the same for a number of projects and many of the reviews highlight the same problems with the fire reports and supplied information. Therefore only if an issue is new or different to the other projects is it highlighted.

## A.2 Project 1614

### Fire Engineering Report

The application relates to an existing building undergoing alterations with less than 100 occupants and an escape height of 4.5m. The NZFS has therefore assessed this design in accordance with s.112 of the Building Act 2004

The existing building and proposed alterations are to have a purpose group CS. Accordingly, the Building Act and associated regulations state that there is no change of use involved in the proposal.

Though there is no change of use: requirements of the Building Act for alterations apply. The means of escape from fire<sup>1</sup> (but not necessarily fire resistance ratings and protection of other property) are to be upgraded to the standard required of new buildings, as nearly as is reasonably practicable.

The report is qualitative and is based on Acceptable Solution C/AS1. A verification method has not been applied.

The report details various aspects of the design that are to be incorporated in the final design drawings and specifications. However, these were not observed on the drawings. Of particular note is the conversion of the stair into a safe path as part of the justification of a dead end travel distance of 37m in lieu of 29m. If the stair is protected then it is assumed in the report that the egress is 23m to an exit and hence acceptable. The report does not comment on the extension of the path of travel given the area concerned is an intermediate level.

The report basically discusses the requirements for compliance but does not indicate that these have been installed and where they haven't been installed perform an alternative solution assessment. The report does not adequately address the risks in that it has not taken into account all aspects of C/AS1 or the fact that even if a floor level is unoccupied how it is to be managed so that occupation or use for storage etc does not occur without the change of use application being enforced.

### DRU Memo

The DRU review occurred between 18 July 2007 and 27 July 2007

The DRU made the following comments:

- The fire report describes installation of a safe path stair serving the various floors of this building as an option for consideration, and no further detail is provided on whether this is actually being implemented. The NZFS notes from the drawings provided for consent that the stairs are not upgraded to provide a safe path, and so has assessed the fire design on the basis that the safe path is not present.
- The fire report states the basement and ground floors are separated by no more than a smoke separation, which is described as 'piecemeal'. The NZFS also notes that while the underside of the stairs to the first floor and ceiling of the ground floor have been upgraded, the existing stairway is not demonstrated to be separated from any of the floors it serves and so complete fire separation between levels is not provided. Therefore, the building can only be treated as a single firecell containing intermediate floors.
- The NZFS considers that fire design provisions should be finalised prior to consent, and the final fire design specified in consent documentation, rather than options for consideration.
- The NZFS recommends the BCA require the applicant to confirm the provision of a safe path stair serving the various levels of this building, or demonstrate the building complies with the requirements of the means of escape from fire provisions of the Building Code as if it were a single firecell with intermediate floors.
- The fire report identifies that the dead end escape route length from the first floor offices exceeds that allowed by C/AS1. The NZFS also notes that since this level is an intermediate floor (as mentioned in paragraph 1.1 above), escape route lengths are subject to the 1.5x multiplication factor required by C/AS1 clause 3.4.6, making this length even farther removed from the limitations required by C/AS1.
- The NZFS does note, however, that the provision of a compliant safe path stair which is considered as an option in the fire report would result in a compliant escape route length.
- The NZFS recommends the BCA require the applicant to provide an alternative escape route, compliant safe path stair or compensatory early warning or suppression system which would result in compliant escape path lengths from this building.
- The fire report states the basement is presently unoccupied, and is therefore not addressed in detail in the fire report. The NZFS considers that irrelevant of its occupation, it still constitutes a basement level and should therefore comply with C/AS1 clause 6.14.4 which requires it to be fire separated from the floors above ground level by no less than 60/60/60. The current separation, described as 'piecemeal', and providing smoke separation only does not meet this requirement.
- The NZFS recommends the BCA require the applicant to separate the basement level from levels above ground as per C/AS1 clause 6.14.4.
- The classification of this building as a single firecell, which is discussed in paragraph 1.1 above, has smoke control requirements which are not necessarily met in this fire design.
- Notwithstanding the requirement for the basement to be fire rated, as per paragraph 1.3 above, C/AS1 clause 6.21.3 requires smoke control to be provided for intermediate floors by specific fire engineering design. While no specific smoke control design is provided, the NZFS notes that the fire report states smoke control doors are provided at the head of the stairs, which would provide a level of smoke control by compartmentation. However, the door specification is not provided so the NZFS is unable to ascertain the smoke control capabilities of this separation. Are door closers fitted? Does the door meet the requirements of a smoke control door as per C/AS1 clause 6.19?



It is considered that the DRU comments are considered reasonable and justified and provide sufficient detail for the design team to progress the design.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	The investigation by the fire engineer was not thorough enough as it has made various assumptions that are incorrect with respect to the regulations and the future areas of the building.
Analysis or design not sufficiently rigorous.	The analysis was not sufficiently rigorous and this was picked up by the DRU memo
Inappropriate use of software.	N/A
Ambiguous or unusual computer results.	N/A
Use of unproven materials or techniques.	N/A
Conflict with regulations or codes of practice.	Conflicts did exist that were picked up in the DRU review
Inadequate checking, reviewing or quality assurance (QA).	The report did not indicate any review of QA was performed.
Taking disproportionate risks.	No disproportionate risks were taken
Designs not sufficiently robust.	Design was not considered to be robust as made a number of assumptions that were not translated to the drawings and assumptions on future changes
Insufficient detail in drawings.	Detail was insufficient
Compliance document applied incorrectly	The compliance document was applied incorrectly that was addressed by the DRU comments.

### Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	No
Analysis of hazards and Building Adequate	No
Acceptance Criteria Identified	No
Modelling Adequate	N/A
Fire Engineering Process Followed	No
Sufficient Documentation	No
FEB Process identified	No
DRU assessment for Escape from Fire	Yes
DRU assessment for Fire Fighting Provisions	N/A
DRU Memorandum Adequate	Yes
DRU Assessment Adequate	Yes
Subsequent reviews or Confirmation of Design Provided	No

### **A.3 Project 1670**

#### **Fire Engineering Report**

Two versions of the report were supplied, Revision B dated 12 July and Revision C dated 18 July.

The consent documentation indicates that the report relates to a new building. Under s.17 of the Building Act 2004, the NZFS considers this building should comply with all clauses of the building code.

The reports indicates that a fire engineering brief has been prepared and provides details of reference documents, stakeholders, building characteristics etc. It is therefore considered that the brief and reports contains the essentials of the fire engineering process as detailed in the IFEG.

Design is generally to the NZ Building Code Acceptable Solutions C/AS1 with an Alternative Solution for smoke control for the mezzanine floor. Therefore this design is considered an Alternative Solution for the purposes of Sections 44 to 50 of the Building Act 2004.

The report determines the occupant load based on the code but then states that full occupancy is unlikely and reduces the number of occupants. This is based on the surrounding population in the community and is considered to be reasonable given the numbers in the surrounding towns. The population is assumed to be fewer than 500 persons and extra precautions are to be written into the Evacuation Scheme if the occupancy is ever to exceed this number. This is considered reasonable.

It is noted however that the population of the mezzanine to which the alternative smoke provisions are assessed is based on code compliant populations.

The report makes assumptions on the detection time, where a calculation could be performed. The detection times are considered to possibly be short. The report uses the British standards for the pre-movement time. With the shortest time as 30 seconds and the longest being 90 seconds. This time should be related to the type of alarm. Given the area issued as a hall and conference area further discussion on the ability of occupants to hear and recognise the alarm could have been made.

No acceptance criteria were stated in the report against which the results of the smoke modelling could be assessed. However it is inferred that the criteria was based on maintaining smoke above 1.5m and 2.1m and also taking into account the visibility, temperature and FED.

The result of the ASET RSET model indicates a safety factor of 1.8 and 1.5 existed for the mezzanine. These are below the required safety factor of 2. It is also noted that Revision B of the report provided results for a fire in the foyer that had a safety factor of 1.1. This fire scenario was not reported in the later version of the report even though no reason why given the two areas are connected the foyer area was not modelled.

The modelling was undertaken using BranzFire. The report did not provide input or output files or graphics. The location of the design fire was not specified.

It is considered that a completed description of the fire scenarios, heat release rates, locations and justification of the locations would have been useful and should have been undertaken given the use of the spaces and egress provisions.

## DRU Memo

The DRU review occurred between ??? 2007 and 28 July 2007

The DRU made the following comments:

- The occupant loading for the building is limited to 500 in the fire report. This is though the building have a capacity of far greater than this. The NZFS notes that the fire report considers that it is “ludicrous” to suggest that half the population of the catchment would be present in the building. However, the NZFS does note that this building is likely to be a focal point of the surrounding communities where large numbers of people from the surrounding areas do gather for important events or presentations. In addition, even if the current population figures are valid, will they remain so over the expected building life? If the population increases, will the building design have to be revisited, and at what stage? Therefore the assumed occupant loading should be justified, and supported my more than a statement that the maximum capacity is considered a “ludicrous” number. The NZFS considers that the number of occupants in the building needs to be fully justified, or the building designed on the basis of the largest population it can hold.
- The NZFS recommends the BCA requires the building to be designed on either a fully justified occupant load or on the basis of the maximum number it can hold.
- Following on from the item above the NZFS notes that the capacity of the escape routes is based on the assumed population, with an extra 1m width. However, if the building population is considered larger than that assumed, then this egress capacity may not be sufficient.
- The NZFS recommends the BCA determine whether the egress capacity is sufficient, based on the assumed occupancy numbers for the building.
- The NZFS is of the opinion that the building design as submitted is acceptable for fire fighting needs and in particular, meets the requirements of Clause C3.3.9 of the New Zealand Building Code

The comments by the DRU are not considered to be appropriate. The fact that a smaller population has been assumed than the code compliant solution is not unusual and rather than demand the building be designed to a code compliant population advice could have been provided on an acceptable population or how an acceptable population could be justified.

As indicated in the fire report the population of the surrounding towns is 2301 so it is considered reasonable that not all the people would arrive at any one time. The fire report also indicates that if the population exceeded the design population of 500 then extra evacuation management provisions would be put place. This is considered reasonable and comments from the DRU requesting details of these provisions or that the provisions are a requirement of occupation could have been made.

It is therefore considered that the response of the DRU was not holistic and was just looking for compliance with a prescriptive set of provisions.

## IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	The fire report was considered to reasonably

	acceptable and to follow the overall fire engineering process. The report was not thorough in its investigation of hazards. The DRU review was not holistic, did not look at the overall performance of the building or the comments regarding extra management provisions during unusual but rare events for high populations
Analysis or design not sufficiently rigorous.	The analysis of the design was considered acceptable
Inappropriate use of software.	Software was appropriate
Ambiguous or unusual computer results.	Results were not provided apart from actual time to events
Use of unproven materials or techniques.	No unproven materials or techniques were used
Conflict with regulations or codes of practice.	No
Inadequate checking, reviewing or quality assurance (QA).	No evidence of review of the fire report prior to issue was provided.
Taking disproportionate risks.	No
Designs not sufficiently robust.	The design was considered acceptable
Insufficient detail in drawings.	Drawings were considered adequate
Compliance document applied incorrectly	No


## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	Incomplete
Acceptance Criteria Identified	Incomplete. Not sufficient detail
Modelling Adequate	No input or output files provided
Fire Engineering Process Followed	Yes
Sufficient Documentation	Yes
FEB Process identified	Yes
DRU assessment for Escape from Fire	Review considered to be limited to reliance on Acceptable Solutions
DRU assessment for Fire Fighting Provisions	Acceptable
DRU Memorandum Adequate	No
DRU Assessment Adequate	No
Subsequent reviews or Confirmation of Design Provided	No

## A.4 Project 1424

### Fire Engineering Report

The report relates to an existing large one/two storey storage building. The building is about 100m long x 40m wide. Half of the building is two storey while half is single storey. The use of the existing building is classified as Fire Hazard Category 3 being a storage facility no greater than 3.0m high. There is no change of use proposed at this time, however as noted below we have considered the



addition of the second floor in the remainder of the building as a change to FHC 4. The building is therefore considered to come under the change of use in the Building Regulations.

The building was assessed as a change of use under Section 115 (1) of the Building Act 2004 which requires that after alterations, the building will;

- i. Comply, as nearly as is reasonably practicable, with every provision of the building code that relates to either or both of the following matters:
  - means of escape from fire, protection of other property, sanitary facilities, structural performance, and fire rating performance.
  - access and facilities for people with disabilities. (Where this is a requirement under section 118) and
- ii. 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 definition of reasonably practicable was not stated in the report.

The report was indicated to form an alternative solution in terms of C/AS1.

A FEB was indicated to have been performed.

The report indicated that when occupied, the building will require an evacuation scheme under the Fire Safety and Evacuation of Buildings Regulations 2006 administered by the New Zealand Fire Service if the number of persons working in the building exceeds 10. However the report indicates that an occupant load of 30 has been allowed without any reference to the details of the evacuation plan. It is noted that the occupant load of 10 is the reported maximum load at any one time based on past experience.

The egress times were predicted via hand calculations while smoke spread was modelled using Branzfire.

Discussion of the choice of fire growth rates and peak heat release rates was not made.

The report provides the smoke conditions at the time of occupant evacuation but does not provide information on the smoke conditions beyond that point. The report also does not relate the structural assessment and assessment of the flooring to the evacuation of the building or fire brigade intervention. It is considered the report does not take an overall fire assessment and performance review.

The report does not explicitly address the lack of smoke management. This is considered to be due to the method

## **DRU Memo**

The DRU review occurred between 10/4/2007 and 16/4/2007.

It is noted in the DRU report that a sprinkler system was once installed but the fire report was based on no sprinklers. The DRU comments were based on there being no sprinklers. It is considered a failing of the fire report not to categorically state the fire systems. However it is considered that the DRU could have found out if sprinklers were installed prior to writing the memo. The 10 day time limit could have prevented this and some form of mechanism to extend the time while information is being gathered would have been of benefit.



The introduction section of the fire report states that 'we have considered the addition of the second floor in the remainder of the building as a change to FHC 4' and goes on to state that for the purposes of building consent 'we have reviewed the layout, and as part of the building is to be increased from FHC 3 to FHC 4, have assessed the requirements of the Building as a change of use under Section 115 (1) of the Building Act 2004...'. However, section 2 of the fire report provides for S ratings taken from table 5.1 of the Acceptable Solutions C/AS1 and section 3 discusses the fire safety precautions taken from table 4.1, both of which have been based on a FHC 3 and not 4. It is considered that the fire report does not clearly state the purpose of the report and this is reflected in the DRU review. If the fire engineering process were followed then any ambiguity should be removed.

The DRU review comments on the inadequate detail provided with the Branzfire modelling.

The DRU also comment that the provision for smoke management was not addressed. There appears to be a discrepancy between the application of alternative solutions to part of the building in the fire report and the expectation of the DRU and what provisions are actually to be addressed. Again the lack of a formal process of looking at the whole building and the inter-relationships of various fire systems appears to result a report that does not fully address the performance required.

Complete documentation was indicated not to have been provided.

Section 3 of the fire report states that a type 18 fire hydrant system is not required as the hose run distance is less than the stipulated 75m. The NZFS notes that the hose run distance to any entrance from the north east corner of the new addition appears to exceed the 75m limit to any entrance into the building.

The NZFS recommends that the BCA requires the applicant to provide a type 18 fire hydrant system unless the hose run distances can be confirmed as being under 75m

The Fire Service is unable to provide any advice regarding provisions for fire fighting activities as insufficient information is contained in the fire report.

The NZFS recommends that the BCA requires the applicant to provide the following information:

- a. Fire Service vehicular access point
- b. Location of the fire alarm panel

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	Partial. Extra time to determine the provision of sprinklers would have been beneficial
Analysis or design not sufficiently rigorous.	Does not provide the results in an overall holistic view or detail the systems such as sprinklers. Assessment of the hydrant system was indicated to be inadequate by the DRU
Inappropriate use of software.	Use of software appropriate but details of

	appropriate inputs and outputs not provided.
Ambiguous or unusual computer results.	Inputs and outputs not provided so ambiguous
Use of unproven materials or techniques.	The fire report states that plastic sheeting is used to provide effective fire venting to 15% of the roof area but does not discuss the actual type of sheeting and its properties. It is therefore that the report relies on unproven materials.
Conflict with regulations or codes of practice.	No
Inadequate checking, reviewing or quality assurance (QA).	No evidence of review of the fire report was provided. The DRU memo was considered to be adequate
Taking disproportionate risks.	No
Designs not sufficiently robust.	Design was considered robust in that it did not look at the fire safety holistically and relied on skylights without discussing their performance
Insufficient detail in drawings.	No
Compliance document applied incorrectly	The fire report did not apply the compliance documents correctly.

## Conclusions


Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	No
Acceptance Criteria Identified	Yes
Modelling Adequate	Partial. No inputs or outputs provided. Modelling not related to the hazards
Fire Engineering Process Followed	Partially
Sufficient Documentation	No
FEB Process identified	Yes
DRU assessment for Escape from Fire	Adequate
DRU assessment for Fire Fighting Provisions	Adequate
DRU Memorandum Adequate	Yes
DRU Assessment Adequate	Yes
Subsequent reviews or Confirmation of Design Provided	No

## A.5 Project 1775

### Fire Engineering Report

This report will determine compliance with Section 17 of the New Zealand Building Act 2004 with respect to the fire regulations.

The addresses an intermediate floor exceeding the C/ASI allowances to be considered a limited area intermediate floor. Smoke control by specific design was required to confirm tenability is maintained for occupants on L2, as a result of a fire on L1. Only the floor of concern appears to have been addressed with all other areas considered via the acceptable solutions that appear to



relate to the area of concern and not taking into account the entire building. This was picked up by the DRU that took the total building population rather than the population of the intermediate level only.

The oversize intermediate level required smoke control via specific fire engineering design. This was performed using Branzfire to model a system of natural ventilation and mechanical make-up air.

The report contains a discussion of the validity of the Branzfire zone model to the situation. This is one of the few reports reviewed that does this.

The report discusses tenability criteria that are considered acceptable.

The method of displaying the results was via hand written tables that were not clear. Although this does not make the results or design unacceptable it is not considered to make understanding easier or be a good practice.

The fire report is indicated to be based on an open plan office. No comment or assessment as to what happens for a multi-tenant or partitioned office was made.

The report provides detail of what is required for fire fighting provisions but does not state that such provisions have been allowed for in the design, where the fire fighters are to respond, etc. The report also does not detail the conditions in the atrium at the time of fire fighter response.

## **DRU Memo**

The DRU review occurred between 12 October 2007 and 24 October 2007.

The DRU made the following comments:

- The fire report states that emergency lighting shall be provided to all exit ways in compliance with F6/AS1. The NZFS notes that this building is to contain more than 250 occupants and that F6 clause 1.2 therefore requires that emergency lighting be provided within all occupied spaces.

The comment regarding 250 occupants is higher than the fire report that was based on 150 occupants on the level of consideration. It therefore appears that there is confusion whether the fire report should take into account the entire building as a typical fire engineered solution should do and the DRU comments appear to suggest or just the area of non-compliance.

This is a recurring theme in many reports and is considered to stem from a lack of application of a fire engineering process such as the IFEG2005 or the earlier versions of the guidelines or similar.

Many of the DRU comments relate to the application of the acceptable solutions to areas that are not the specific focus of the fire report. It is unclear as to whether the DRU is required to review the acceptable solutions or whether this should be performed by others thereby allowing the DRU to focus on the fire engineering and non-compliance to the acceptable solutions. However, it is considered to be thorough to make such an assessment and comment where errors or possible misinterpretations have been noted.

The memo indicated that it was to advise on the following matters:

1. Provision of the means of escape from fire.
2. The needs of persons who are authorised by law to enter the building to undertake fire fighting.

No comment on the adequacy or otherwise of the needs of persons who are authorised by law to enter the building to undertake fire fighting was made in the memo

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	The DRU investigation was considered adequate
Analysis or design not sufficiently rigorous.	The analysis in the fire report only took into account the area of non-compliance. The DRU analysis was considered adequate
Inappropriate use of software.	No
Ambiguous or unusual computer results.	No
Use of unproven materials or techniques.	No
Conflict with regulations or codes of practice.	Yes. Fire report in applying acceptable solutions addresses the level of concern only and not the entire building
Inadequate checking, reviewing or quality assurance (QA).	No. The DRU demonstrated they reviewed the plans in detail even looking at door swing.
Taking disproportionate risks.	No
Designs not sufficiently robust.	Design is based on an open plan office. Future partitioning of the area should be addressed / commented on
Insufficient detail in drawings.	Drawings are sufficiently detailed
Compliance document applied incorrectly	No

### Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	Yes
Acceptance Criteria Identified	Yes
Modelling Adequate	Yes
Fire Engineering Process Followed	Yes
Sufficient Documentation	No. The Building Act 2004 requires plans and specifications accompanying the consent application to be final and complete. This was not performed.
FEB Process identified	No
DRU assessment for Escape from Fire	Adequate
DRU assessment for Fire Fighting Provisions	No. Not provided in the memo
DRU Memorandum Adequate	No. No comment on fire fighting provisions
DRU Assessment Adequate	Yes
Subsequent reviews or Confirmation of Design	No

Provided	
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## A.6 Project 1411

### Fire Engineering Report

The fire report provides fire engineering opinion to demonstrate compliance with the performance requirements of the building code with respect to the smoke control within the garage.

All other aspects of the design were indicated to have been designed to the acceptable solutions.

In providing the above opinion no smoke modelling was performed. The opinion was based on fire separation of the garage from other areas and that smoke would vent from the patio as indicated below;

“As per C/ASI Clauses 6.10.3 and 6.10-4, the required fire safety precautions for the ground floor garage are as follows:

1. Entry to any safe path, or protected shaft containing lifts shall be preceded by a protected path, and
2. Smoke control by specific fire engineering design shall apply and,
3. Where parking is provided with more than 10 cars, a Type 3 (Le, automatic fire alarm system with heat detectors and manual call points) shall be installed.

Notes:

1. The egress from the ground floor garage is directly to the outside. As the door is fire rated and provided with smoke stop capability, smoke from a car fire is expected to be retained within the garage or directly dissipated to outside via vents on patio. Therefore it is ????? opinion that the door into the external safe path does not require to be preceded by a protected path.
2. **It is ????? opinion that the specific smoke control is not required within the garage as smoke from a fire within the garage is not expected to adversely effect the egress of occupants from the garage as the smoke will spill from the space to outside via the vents on the patio.**
3. Automatic fire alarm system with heat detectors and manual call points is to be provided within the garage,

No indication of the impact on the patio or fire spread from the patio was made.

### DRU Memo

The DRU review occurred between 30/3/2007 and 12/4/2007

The DRU made the following comments:

- The DRU memo indicated that the lack of smoke modelling or full consideration of the smoke management in the garage was inadequate and that the application should be made to demonstrate adequate ventilation is provided.
- The DRU memo picked up the change in the plans and the reduced opening size
- The DRU required assessment and demonstration of the operation of the fire rated windows to prevent smoke spread
- It is noted that advice regarding provisions for fire fighting activities as insufficient information is contained in the fire report



## IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	Yes
Analysis or design not sufficiently rigorous.	Analysis of the design by the fire engineer was not rigorous. The review by DRU was considered rigorous
Inappropriate use of software.	N/A
Ambiguous or unusual computer results.	N/A
Use of unproven materials or techniques.	N/A
Conflict with regulations or codes of practice.	No
Inadequate checking, reviewing or quality assurance (QA).	QA and review adequate
Taking disproportionate risks.	No
Designs not sufficiently robust.	Agree
Insufficient detail in drawings.	No
Compliance document applied incorrectly	No

## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	No
Acceptance Criteria Identified	No
Modelling Adequate	No
Fire Engineering Process Followed	No
Sufficient Documentation	No
FEB Process identified	No
DRU assessment for Escape from Fire	Good
DRU assessment for Fire Fighting Provisions	Good
DRU Memorandum Adequate	Good
DRU Assessment Adequate	Good
Subsequent reviews or Confirmation of Design Provided	No

## A.7 Project 2580

### Fire Engineering Report

The fire report does not contain any fire engineering in terms of an alternative design. The report is a review of the design to the approved documents.

However the report does state that the vertical safe path passing through the car park to reach a final exit does not comply with C/AS1. Therefore a fire engineering assessment should have been performed.

The other aspects of the design that were meant to comply with the approved solutions could have been reviewed by others thereby allowing the DRU more time to review fire engineering solutions.

## DRU Memo

The DRU review occurred between 22/10/2008 and 5/11/2008

The DRU made the following comments:

- It is noted that advice regarding provisions for fire fighting activities as insufficient information is contained in the fire report
- It was indicated that the plans and specifications were incomplete

The lack of final and complete plans and specifications is a reoccurring point in many of the reviews. It is considered that given typical project phases that usually have a number of changes even during the construction phase that to have final and complete plans and specifications that accurately reflect the as built condition is very difficult or would occur very late in the design and possibly construction process. NZFS input at such a late stage would then mean that if any design changes are required then due to fire engineering assessments they would be difficult and costly to incorporate.

An improvement would be to have a mechanism where the major factors affecting the design and cost requiring fire engineering can be reviewed and commented upon at an earlier stage and the final review of specifications and plans reviewed by the BCA against the previous advice or handled as addendums to the original fire report. This would allow for a more thorough review by the DRU and greater input into the design process.

- The DRU considers the buildings and new buildings while the fire report appears to have reported provisions for existing buildings.
- As the escape route does not meet the requirements of the acceptable solutions for a safe path the DRU require an alternative solution. If any alternative solution is to be proposed, a design with sufficient level of analysis to demonstrate compliance with the Code must be provided.

## IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	Yes
Analysis or design not sufficiently rigorous.	DRU analysis was rigorous. Fire report analysis was not considered rigorous
Inappropriate use of software.	N/A
Ambiguous or unusual computer results.	N/A
Use of unproven materials or techniques.	No
Conflict with regulations or codes of practice.	Yes
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No

Designs not sufficiently robust.	Design was not considered robust in that it did not perform an alternative solution fire engineering assessment of the egress
Insufficient detail in drawings.	No
Compliance document applied incorrectly	No

## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	No
Analysis of hazards and Building Adequate	No
Acceptance Criteria Identified	No
Modelling Adequate	No
Fire Engineering Process Followed	No
Sufficient Documentation	No Fire report did not contain a fire engineering assessment
FEB Process identified	No
DRU assessment for Escape from Fire	Yes
DRU assessment for Fire Fighting Provisions	Yes
DRU Memorandum Adequate	Good
DRU Assessment Adequate	Good
Subsequent reviews or Confirmation of Design Provided	No

## A.8 Project 2605

### Fire Engineering Report

The consent documentation indicates that this is an existing building undergoing a change of use involving the incorporation in the building of one or more household units where household units did not exist before. The NZFS has therefore assessed this design in accordance with s.115 (a) of the Building Act 2004.

The report does not propose any fire engineering assessments or alternative designs to the acceptable solutions of code requirements.

### DRU Memo

The DRU review occurred between 31/10/2008 and 13/11/2008

The DRU review states that insufficient information was supplied with respect to a large number of sections of the design. However a review was performed on what information was supplied.

The DRU made the following comments:

- The memo notes from the fire report that an alternative means of escape is proposed through the ground floor car park that will mean occupants will pass from a safe path to an open path. This is not allowed within C/AS1. Furthermore both safe path stairs exit to the same ground floor lobby so this should be assessed as a single means of escape.

- It was noted that the report refers to storage in the vertical services and that no items should be stored in any vertical services or riser ducts because of the potential for fire and smoke spread via the shaft.
- The fire report states: “We note that the entry lobby in the Level 1 car park area is existing and does not form a part of the escape route. Therefore we do not consider it to be reasonably practicable to fire separate the lobby”. However insufficient detail was provided for the DRU to make a full assessment.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	DRU investigation was thorough
Analysis or design not sufficiently rigorous.	DRU analysis was acceptable
Inappropriate use of software.	N/A
Ambiguous or unusual computer results.	N/A
Use of unproven materials or techniques.	N/A
Conflict with regulations or codes of practice.	Yes. Design does not appear to have been assessed to C/AS1 correctly
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No
Designs not sufficiently robust.	No
Insufficient detail in drawings.	Yes
Compliance document applied incorrectly	No

### Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	No
Analysis of hazards and Building Adequate	No
Acceptance Criteria Identified	No
Modelling Adequate	No
Fire Engineering Process Followed	No
Sufficient Documentation	No
FEB Process identified	No
DRU assessment for Escape from Fire	Yes
DRU assessment for Fire Fighting Provisions	No
DRU Memorandum Adequate	Adequate given information provided
DRU Assessment Adequate	Yes
Subsequent reviews or Confirmation of Design Provided	No

## A.9 Project 1888

### Fire Engineering Report

The fire report addresses the egress capacity from the buildings and uses smoke modelling based on Branzfire as part of the assessment.

The report indicates that as the smoke layer is maintained above 2.1m even with 10% opening that the design is acceptable and unlimited tenability is provided. A medium fire up to 4MW is modelled.

The report does not provide a description of the hazards, the model inputs as they relate to the hazards, the evacuation plan or overall fire strategy. The acceptance criteria and tenability criteria are not discussed. The report also makes the assumption that people will egress in one direction more than the other. This would require further justification. Given the alternative is related to egress width an egress model should be run to look at the overall affect on time.

The reports also provides a one line opinion that protected lobbies are not required on the basis of sprinklers being installed.

Given the building is fully sprinkler protected this is probably acceptable but has not been assessed thoroughly.

### DRU Memo

The DRU review occurred between 30/11/2007 and 11/12/ 2007

The DRU made the following comments:

- The affect of the new extension on existing escape routes was picked up as an issue that was not addressed in the fire report
- The assessment of the lobbies has not been provided
- The limitations of the assumptions with the fire modelling and lack of egress modelling were noted
- Problems with hose distances are noted based on a review of the plans

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	DRU investigation was considered acceptable
Analysis or design not sufficiently rigorous.	Fire report analysis was not considered sufficiently rigorous. DRU analysis was considered acceptable.
Inappropriate use of software.	No
Ambiguous or unusual computer results.	No
Use of unproven materials or techniques.	No
Conflict with regulations or codes of practice.	No
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No
Designs not sufficiently robust.	Yes. The design has not been proven sufficiently



	with respect to assessment of egress or deletion of the protected lobbies
Insufficient detail in drawings.	No
Compliance document applied incorrectly	No

## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	No
Acceptance Criteria Identified	No
Modelling Adequate	No
Fire Engineering Process Followed	No
Sufficient Documentation	No
FEB Process identified	No
DRU assessment for Escape from Fire	Good
DRU assessment for Fire Fighting Provisions	Adequate
DRU Memorandum Adequate	Yes
DRU Assessment Adequate	Yes
Subsequent reviews or Confirmation of Design Provided	No

## A.10 Project 1529

### Fire Engineering Report

The fire report indicates that “this Fire Safety Design includes an alternative solution in regard to the mezzanine floors”.

A complete alternative solution as per the IFEG methodology has not been provided. Neither has any smoke modelling or assessment of fire hazards, ignition sources fuel load etc. The report uses the translucent sheeting to provide smoke venting but does not assess or provide detail as to the performance of the sheeting.

The application of firecalc to determine radiation levels at notional boundaries is not clear and it is not clear how the results are to be translated to the final building locations.

No clear fire strategy in terms of egress or fire brigade response is provided.

The fire report is considered to be poor and does not address the risk associated with warehouses sufficiently regardless of the code requirements.

### DRU Memo

The DRU review occurred between ?? 2007 and 19/6/ 2007

The DRU made the following comments:

- The DRU comments imply that a person should be able to see an exit sign or directional sign from anywhere in the building. This is considered to be conservative especially given there is racking in aisles so the direction of travel is obvious.
- The DRU notes that no alternative solution has been provided and details various aspects that should be addressed or incorrect assumptions in the report
- The DRU considers sprinklers should be installed based on C/AS1 when none are proposed. This is a large deviation from the proposed design and should be highlighted early in the project so that appropriate provision could be made. The requirement for complete and final specifications when submitting to the DRU for review when major items such as sprinklers need to be address is a problem with the process and late input from DRU.
- The NZFS recommends the BCA requires the applicant to provide calculations to justify the fire rating to the external walls provided as 3 hours in lieu of 4 hours was nominated.
- The NZFS recommends that the BCA requires the applicant to specify the type of translucent sheet to be used, and supply documentation showing that the product will provide effective roof venting in the event of a fire.
- It is noted the assessment of hydrant coverage in the report is inadequate.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	DRU investigation is acceptable
Analysis or design not sufficiently rigorous.	Fire report analysis is inadequate. DRU review is adequate given the level of detail in the fire report.
Inappropriate use of software.	Yes
Ambiguous or unusual computer results.	Yes
Use of unproven materials or techniques.	Yes
Conflict with regulations or codes of practice.	Yes
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No
Designs not sufficiently robust.	Yes
Insufficient detail in drawings.	Yes
Compliance document applied incorrectly	Yes

### Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	No. Report is considered to be poor
Analysis of hazards and Building Adequate	No
Acceptance Criteria Identified	No
Modelling Adequate	No
Fire Engineering Process Followed	No
Sufficient Documentation	No
FEB Process identified	No
DRU assessment for Escape from Fire	Good

DRU assessment for Fire Fighting Provisions	Good
DRU Memorandum Adequate	Yes
DRU Assessment Adequate	Yes
Subsequent reviews or Confirmation of Design Provided	No

## A.11 Project 1886

### Fire Engineering Report

The fire report addresses the egress from the mezzanine platform via and alternative solution.

The analysis is considered poor in that it does not describe the hazards, look at the location of the fire, detail acceptance criteria, etc. The fire engineering methodology within the IFEG was not undertaken.

The results of the Aset vs. Rset analysis did not provide a sufficient safety margin and this was explained by indicating the response time would be considerably lower than that modelled. It is considered that if a response time of 5 seconds is to be relied upon then further justification would be required.

The results are based on a medium fire without justification given the occupancy class or a sensitivity analysis.

The report also uses the Eurocode time equivalence method to determine the S rating for a window. No justification of the input in terms of ventilation for fire load density was made.

It is considered that the fire report spends more time detailing the compliance with C/AS1 than on performing an adequate analysis of the fire engineering issues.

### DRU Memo

The DRU review occurred between ??? 2007 and 15/12/ 2007

The DRU make a number of valid comments regarding the assessment of Aset vs. Rset and the smoke modelling and use of a zone model.

The DRU also note that the Eurocode version was out of date and hence the results possibly invalid.

The possibility for the need for sprinklers was raised to overcome a code compliance issue that was not adequately picked up in the fire report. This is considered to be a significant issue that would have been better raised at an early stage. The process under which DRU reviews are undertaken makes this difficult.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	DRU investigation was considered good and

	thorough
Analysis or design not sufficiently rigorous.	DRU analysis was rigorous. Fire report was considered inadequate
Inappropriate use of software.	Yes
Ambiguous or unusual computer results.	Yes
Use of unproven materials or techniques.	No
Conflict with regulations or codes of practice.	Yes
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No
Designs not sufficiently robust.	Fire report did not provide a robust design
Insufficient detail in drawings.	Yes
Compliance document applied incorrectly	Yes

## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	No
Analysis of hazards and Building Adequate	No
Acceptance Criteria Identified	No
Modelling Adequate	No
Fire Engineering Process Followed	No
Sufficient Documentation	No
FEB Process identified	No
DRU assessment for Escape from Fire	Good
DRU assessment for Fire Fighting Provisions	Adequate
DRU Memorandum Adequate	Yes
DRU Assessment Adequate	Yes
Subsequent reviews or Confirmation of Design Provided	No

## A.12 Project 2423

### Fire Engineering Report

The fire report addresses the egress models via an Aset vs Rset analysis using Branzfire zone model. The applicability of the model to the compartment and scenario being modelled was not discussed especially as it is a large compartment.

The scenario involves a fuel spill fire but a fast rate fire growth is modelled. This may not be applicable to fuel spill and should be justified.

The facility is for metal work which is inherently a relatively safe occupancy. However, the report did not provide a detailed discussion of hazards and fuels loads such that the inherent low risk could be highlighted.

## DRU Memo

The DRU review occurred between 6/8/ 2008 and 15/8/ 2008

The DRU make comments with respect to:

- Use of a zone model in a large space. The area is beyond the area specified by the model author and validation report. Given the very specific information regarding the maximum compartment size it is considered that the DRU comments are valid.
- Comments regarding the use of visual and olfactory detection are considered to be conservative especially for the use of the occupancy
- The DRU recommend the use of a visual / audible alarm system. However the fire report s based on visual and olfactory cues and so the higher noise levels are not a factor in the occupants ability to detect a fire. It is considered that the DRU reviewer has missed the main part of the fire strategy
- It is agreed that plans showing the evacuation routes would be useful.
- It is agreed that the report does not define or address the term 'reasonably practicable'. However given the analysis predicts occupant evacuation with a conservative fire it is considered that it is satisfactory

## IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	DRU investigation was thorough
Analysis or design not sufficiently rigorous.	DRU analysis was robust
Inappropriate use of software.	No
Ambiguous or unusual computer results.	No
Use of unproven materials or techniques.	No
Conflict with regulations or codes of practice.	No
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No
Designs not sufficiently robust.	No
Insufficient detail in drawings.	No
Compliance document applied incorrectly	No

## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	Yes
Acceptance Criteria Identified	Yes
Modelling Adequate	Yes
Fire Engineering Process Followed	Partial
Sufficient Documentation	Yes
FEB Process identified	No
DRU assessment for Escape from Fire	Adequate



DRU assessment for Fire Fighting Provisions	Adequate
DRU Memorandum Adequate	acceptable
DRU Assessment Adequate	acceptable
Subsequent reviews or Confirmation of Design Provided	No

### A.13 Project 2342

#### Fire Engineering Report

The fire report states: "As the building works subject to this report does not fit within the criteria under Clauses 2 and 3 as listed in the DBH Gazette Notice No 56 dated 24 March 2005; this application is NOT required to be forwarded to the DRU".

The DRU memo does not make comments to whether the report should have been reviewed or not.

The fire report does not contain an assessment of the hazards or follow the fire engineering methodologies set out in the design guide and IFEG. This makes the report hard to review with respect to the applicability of the modelling and assessment.

The main area of modelling related to the ventilation in the car park. The modelling was undertaken using Branzfire. The inputs and outputs of the model are provided but the scenarios not detailed.

#### DRU Memo

The DRU review occurred between 23/6/2008 and 4/7/2008

The DRU raise issues with respect to the level of wall openings and stairs leading from lower floors or basements and which continue to floors above the level of the final exit to be fire separated from the final exit level. These were not analysed in great detail in the fire report.

#### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	No
Analysis or design not sufficiently rigorous.	No
Inappropriate use of software.	No
Ambiguous or unusual computer results.	No
Use of unproven materials or techniques.	No
Conflict with regulations or codes of practice.	No
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No
Designs not sufficiently robust.	No
Insufficient detail in drawings.	No
Compliance document applied incorrectly	No

## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	Yes
Acceptance Criteria Identified	Yes
Modelling Adequate	Yes
Fire Engineering Process Followed	Partially
Sufficient Documentation	Yes
FEB Process identified	No
DRU assessment for Escape from Fire	Good
DRU assessment for Fire Fighting Provisions	Insufficient information
DRU Memorandum Adequate	Good
DRU Assessment Adequate	Good
Subsequent reviews or Confirmation of Design Provided	No

### A.14 Project 1495

#### Fire Engineering Report

The fire report relates to a new residential development. The fire report addresses smoke control in the carpark and the fire resistance.

The smoke development in the car park areas was modelled using Branzfire. The assessment is based on areas of over 700m<sup>2</sup>.

The assessment does not discuss tenability criteria but appears to use smoke layer height, temperature and visibility based on the reporting of the results. Given the use of a zone model the location of the fire in the model is not important but a discussion of the hazards and possible fire locations that could result in larger fires or blocking of exits. The assessment would have benefited from following the typical fire engineering process as indicated in the IFEG.

The fire report did not address the issues of dead end travel as the acceptable solutions were not interpreted correctly.

The use of the time equivalence model was considered acceptable however the ventilation openings were not discussed such that it indicated there were zero horizontal and vertical openings but then had a factor. It is unlikely there would be zero openings as the car ramps would normally constitute an opening. The use of the model is therefore considered invalid.

#### DRU Memo

The DRU review occurred between 29 May 2007 and 8 April 2007

The DRU made the following comments:

- A number of escape route issues were identified that were not addressed within the fire report.
- The use of the Eurocode model in a larger compartment
- The DRU report highlights the lack of a protected path from the car park levels that was not addressed in the fire report
- The DRU appears to incorrectly question the time to untenable conditions and makes a comment that visibility should be used as a criteria. Given the smoke layer is to be maintained above 2m the level of visibility is not relevant.
- The use of visual detection is considered acceptable but is questioned by the DRU. The difference in ceiling height between the plans and the model is important

The memo indicates that the NZFS is of the opinion that the building design as submitted is acceptable for fire fighting needs and in particular, meets the requirements of Clause C3.3.9 of the New Zealand Building Code.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	Yes
Analysis or design not sufficiently rigorous.	Fire report was not considered rigour as highlighted by the DRU review that was considered to be rigorous
Inappropriate use of software.	Yes
Ambiguous or unusual computer results.	Yes. Inputs into the model did not correlate with the plans
Use of unproven materials or techniques.	No
Conflict with regulations or codes of practice.	Yes. Certain solutions were missed
Inadequate checking, reviewing or quality assurance (QA).	Yes
Taking disproportionate risks.	No
Designs not sufficiently robust.	Yes
Insufficient detail in drawings.	No
Compliance document applied incorrectly	Yes

### Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	No. A number of non-compliances appear to have been missed
Analysis of hazards and Building Adequate	Yes
Acceptance Criteria Identified	Yes
Modelling Adequate	No. A number of inputs were not considered to be correct
Fire Engineering Process Followed	Yes
Sufficient Documentation	Yes
FEB Process identified	No

DRU assessment for Escape from Fire	The review was considered to be rigorous and picked up a number of issues with the modelling
DRU assessment for Fire Fighting Provisions	Very brief consideration
DRU Memorandum Adequate	Good
DRU Assessment Adequate	Good
Subsequent reviews or Confirmation of Design Provided	No

## A.15 Project 2267

### Fire Engineering Report

The fire report does not detail any fire engineering assessments.

The report appears to detail the design and requirements of C/AS1 but does not demonstrate that compliance has been achieved.

### DRU Memo

The DRU review occurred between 21/5/2008 and 3/6/2008

The DRU makes the following comment:

The NZFS notes that the current floor area of the Music Suite and Auditorium is 912m<sup>2</sup>. Following the completion of Stage 2 (connection to the Drama Room) this may potentially increase the floor area over the 1000m<sup>2</sup> threshold and therefore sprinklers are a requirement of the MoE guidelines.

**The NZFS recommend that the BCA make the requirement to sprinkler protect the building over this threshold as per the MoE guidelines, known to the applicant.**

Given the report states the building is less than 1000m<sup>2</sup> it is not understood why the above recommendation is made.

Given the lack of fire engineering the DRU memo does not make any detailed comments and the need for the review is not well understood.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	No
Analysis or design not sufficiently rigorous.	N/A
Inappropriate use of software.	N/A
Ambiguous or unusual computer results.	N/A
Use of unproven materials or techniques.	No
Conflict with regulations or codes of practice.	No
Inadequate checking, reviewing or quality assurance (QA).	No

Taking disproportionate risks.	No
Designs not sufficiently robust.	No
Insufficient detail in drawings.	No
Compliance document applied incorrectly	No

## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	Yes
Acceptance Criteria Identified	N/A
Modelling Adequate	N/A
Fire Engineering Process Followed	N/A
Sufficient Documentation	Yes
FEB Process identified	No
DRU assessment for Escape from Fire	Yes
DRU assessment for Fire Fighting Provisions	Yes
DRU Memorandum Adequate	Adequate
DRU Assessment Adequate	Adequate
Subsequent reviews or Confirmation of Design Provided	No

### A.16 Project 2372

#### Fire Engineering Report

The fire report uses Branzfire to assess the need for smoke ventilation from the car park.

No discussion of hazards, fire ignition, etc is performed. The car park is modelled and the results presented without any clear discussion.

#### DRU Memo

The DRU review occurred between 10 July 2007 and 18 July 2007

The DRU raise questions regarding the design fire and the discrepancy between the vent areas on the drawings and those used in the model which are considered valid.

#### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	No
Analysis or design not sufficiently rigorous.	DRU analysis was adequate given the information supplied
Inappropriate use of software.	No. Some inputs are questioned
Ambiguous or unusual computer results.	No
Use of unproven materials or techniques.	No



Conflict with regulations or codes of practice.	Yes with respect to emergency lighting
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No
Designs not sufficiently robust.	No
Insufficient detail in drawings.	No
Compliance document applied incorrectly	No

## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	No
Acceptance Criteria Identified	Yes but very limited
Modelling Adequate	No
Fire Engineering Process Followed	No
Sufficient Documentation	No
FEB Process identified	No
DRU assessment for Escape from Fire	Ye
DRU assessment for Fire Fighting Provisions	Yes
DRU Memorandum Adequate	Adequate
DRU Assessment Adequate	Adequate
Subsequent reviews or Confirmation of Design Provided	No

## A.17 Project 1455

### Fire Engineering Report

The original fire report was indicated to have a date of December 18 2005. An amendment to the report was dated February 14 2007.

The reason for the amendment was not stated.

Section 10 of the fire report identifies a non-compliance with C/AS1. Only a brief qualitative discussion is provided without reference to satisfying objectives, acceptance criteria, hazards etc. The area of non compliance is not satisfactorily identified and no alternative solution analysis was undertaken.

### DRU Memo

The DRU review occurred between 18 July 2007 and 27 July 2007

The DRU identified an inconsistency in the work group classification as well as the non-compliance in section 10. The memo recommends the use of the IFEG to adequately assess the non-compliance.

The memo also highlights a number of other non-compliances that have not been addressed or inconsistencies with application and interpretation of the code requirements with respect to egress.

As with many other project reviews insufficient information is provided within the fire report and supplied information to the DRU with respect to fire services response.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	DRU investigation is thorough
Analysis or design not sufficiently rigorous.	DRU analysis was very rigorous. The fire report was considered to be poor
Inappropriate use of software.	N/A
Ambiguous or unusual computer results.	N/A
Use of unproven materials or techniques.	No
Conflict with regulations or codes of practice.	Yes
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No
Designs not sufficiently robust.	Yes
Insufficient detail in drawings.	Yes
Compliance document applied incorrectly	DRU review of compliance was considered to be good

### Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	No
Analysis of hazards and Building Adequate	No
Acceptance Criteria Identified	No
Modelling Adequate	N/A
Fire Engineering Process Followed	No
Sufficient Documentation	No
FEB Process identified	No
DRU assessment for Escape from Fire	Good
DRU assessment for Fire Fighting Provisions	Not sufficient information provided
DRU Memorandum Adequate	Good
DRU Assessment Adequate	Good
Subsequent reviews or Confirmation of Design Provided	No

## A.18 Project 2495

### Fire Engineering Report

The fire report addressed the following alternative solutions to an aged care facility:

- Alternative Solution -Serviced Apartments Unit Doors
- Alternative Solution: Mechanical Smoke Extract Systems In Atria
- Alternative Solution: Glazed Door Fire Separations

The assessment of the doors was based on the installation of solid core doors without closers. The design incorporated sprinklers and type 7 fire alarms in lieu of type 2 domestic alarms.

The analysis was comparative and provided reference to a solid core door having an equivalent 30 minute rating. With respect to the deletion of closer advantage of the 24 hour management is taken to have a procedure of responding and closing the door. This is considered similar to hospital procedures. The report also discusses sprinkler reliability and performance.

The fire sizes and discussion of possible hazards within the atrium is not considered to be adequate in that the fire size is small and based on the assumption that the atrium is not like other atriums. Experience has shown that any enclosed space can be used for functions, meetings, displays etc and so a full assessment of possible use of the space needs to be performed.

The assessment does not follow the fire engineering assessment process in the IFEG. If this has been performed then many of the issues raised by the DRU could have been addressed.

### DRU Memo

The DRU review occurred between 9/9/2008 and 22/9/ 2008

The DRU made the following comments:


- Section 9 of the fire report attempts to rationalize the use of solid core wooden doors without closers in place of fire rated doors between the serviced apartments and a designated safe path and all support activity areas within the SC sleeping purpose group firecells.

The report proposes an alternative solution where the performance requirements of passive fire rated separations (including fire doors) and a Type 2 manual fire alarm for SR Purpose Groups can somehow be met using unrated doors and a Type 7 automatic fire sprinkler system with smoke detectors.

The fire report states that:

“The reliability of automatic sprinkler systems is generally accepted as having a higher reliability than that of other separations”

This generalization is unquantified in terms of what constitutes reliability, is quite situation specific and, as used in this context, is misleading. There is no generic reference that validates the use of a 45 mm thick solid wooden core door as a fire rated door with a rating of -/30/30. There are specific test standards that a specimen must be subjected to in order to be certified as a fire rated door (refer to AS 1530.4 and BS 476 Part 22). Fire test reports



are quite specific to the door system under test. The use of an incomplete fire test summary for an unspecified product to attempt to validate the performance of a generic design is not accepted (refer to Appendix B of the fire report, the terms and conditions for reproduction of fire test reports and the provisions for protection of intellectual property and copyright).

- The use of Marrayatt as a cited reference is misleading. .
- The fire report refers to three fatality fires from 389 documented fires in sprinkler-protected facilities. It seeks to link the fatalities with the use of Standard Response sprinklers, while downplaying the fact that the occupants were in intimate contact with the fire. The speed of sprinkler response can be a significant factor in the effectiveness of sprinkler protection but it does not follow that Residential Sprinklers would have been any more successful at preventing these fatalities.
- NZFS strongly recommend that the BCA reject the application on the basis that the proposed alternative solution fails to provide the minimum performance requirements of the New Zealand Building Code Clause C2.3.3 (d) and C3.3.2. Specifically the BCA should require the applicant to provide fire door sets complete with smoke seals and closers, having a tested fire resistance rating at least that of the element of construction in which they are installed.


It is considered that the above comments do not take into account the entire fire safety strategy that included a staff member to close the door. It is widely accepted that sprinklers are the best life safety mechanism and would normally be seen as compensating for fire ratings. The above comments by the DRU are not considered to be correct. In Australia one of the compensations for installing sprinklers in residential occupancies is the use of solid core doors without closers.

- The NZFS notes that the building needs to be operate under a staged evacuation philosophy. This has to be achieved by the combination of fire safety systems both active and passive within the building. The building is to be provided with an automatic fire sprinkler system and smoke detection fire alarm throughout. However, specific details of the fire alarm sequencing and interaction with the other safety systems or how any of the proposed firecells of the building interact have not been provided. Successful staged evacuation sequencing will demand a high level of co-ordination between the staff and the occupants. How this is to be managed, controlled and maintained has not been addressed.

The NZFS recommends that the BCA requires the applicant to provide further information as to how the evacuation philosophy is to be managed, maintained and be implemented, especially with regards to ensuring that the fire alarm and other safety systems are configured correctly.

The above request is considered acceptable as detailing of the systems especially evacuation systems is important for ensuring the building and occupants behave as modelled.

- The NZFS notes that the fire report does not take into account any staff members or visitors within the calculation of occupant numbers for the building. Given that the number of staff and visitors may be significant, especially when combined, the NZFS considers that such occupants should not be excluded from the analysis.



If a formal fire engineering process had been followed by the fire engineer this would have been addressed as part of the occupant characteristics. However, it is unlikely that visitors would be unescorted and so although technically correct is not considered a reason for rejection.

- From the plans provided the NZFS notes that the stairs 4 and 5 serving an SC purpose group are only 1000 mm wide. C/AS1 Table 3.2 requires that the minimum width for vertical escape routes for SC purpose groups is 1500 mm. The applicant has applied the exceptions in C/AS1 Table 3.2 note 4. The fire report states that the 'occupants are active, ambulant and require no assistance to evacuate'. The NZFS questions this given that this is for occupants in Resthome care and in a Dementia unit. No information is given on how the applicant or future management of the facility will ensure that persons in the Resthome and Dementia ward will be or remain active and ambulant. Given that this requirement assumes that the occupants will require no assistance at any time how will this be managed and maintained for the life of the building? If this cannot be adequately demonstrated and accepted by management as a potential severe limitation on the occupancy characteristics of the persons allowed within the building the NZFS considers that the building will not be fit for purpose.

The NZFS recommends that the BCA requires the applicant to address the width of the vertical escape routes serving the SC purpose groups areas as per C/AS1 otherwise the applicant should provide information on how they will ensure that persons in the Resthome and Dementia ward will remain active and ambulant and require no assistance for the life of the building.

The above comments are considered valid

- Section 6.5 of the fire report proposes that it is considered acceptable to have a door swinging against the direction of travel for a greater number of occupants than is permitted by C/AS1 by referencing the greater allowances provided for in another international building code. The NZFS notes that because another code allows something that is less onerous than what is stated in New Zealand, it does not mean that the restrictions in New Zealand can be relaxed. The NZFS also refers to the item raised above with respect to incorporating items from another code, taken from that code in isolation, and substituting them for clauses in the New Zealand compliance documents. The NZFS therefore considers that such a substitution needs to be supported with an appropriate comparative analysis that demonstrates that the proposed solution provides an equivalent level of safety (or better) than that provided by C/AS1. The NZFS recommends the BCA requires the applicant to provide an appropriate comparative analysis to justify the proposed solution with respect to door swing.

It is considered that part of the reasons for performance based design and fire engineering is to take advantage of other codes and standards that may better reflect the unique building design. However, such a process does require a proper assessment and discussion and form part of a larger assessment. The comments of the DRU are therefore considered appropriate.

- The report provides an assessment for the atrium space smoke control using the computer zone model BRANZFIRE. The NZFS has a number of issues with the assessment provided, including but not limited to the following issues:



- This analysis is based on an almost sterile space. However, the NZFS notes that no account has been made for a larger fire that may occur because of a transient fuel source.
- The NZFS considers that the modelling carried out represents such a fuel restricted space and that the analysis should determine how the proposed system reacts to a larger fire within the atrium space that is attributable to a transient fuel loading. Such an analysis should be provided with an appropriate sensitivity assessment.
- The assessment has assumed that the beam detectors present have exactly the same characteristics as those of a smoke detector. No reference that justifies this comparison has been provided. Given that the mechanical smoke extraction system operates immediately upon smoke detector activation (which is unlikely given the inherent delays and processing that the alarm and mechanical systems are likely include) is this time realistic? This comparison should be justified and any inherent delays inherent to the systems incorporated within the analysis.
- The assessment and level of information provided is limited and does not appear to consider issues such as stratification, testing or commissioning of the systems. There are no mechanical specifications provided or any drawings verifying that the recommendations of the report are to be met.
- The NZFS recommends the BCA requires the applicant to address the issues raised above with respect to the level of information and analysis required to support the smoke control analysis provided.

The above comments are considered to be acceptable and appropriate

- .... the use of non fire rated laminated glazing for fire separations in sprinklered buildings. The NZFS notes that this discussion is based on the premise that the proposed sprinklered glazing system will provide an equivalent level of protection as a fire rated window.

It is agreed that the windows and sprinklers should be referenced.

- The NZFS notes that the rest home units facing the atrium have non-fire rated glass window of which some can be opened. C3.3.2 b of the Building Code states that spaces intended for sleeping are to be fire separated from other firecells to prevent the spread of fire. The proposal does not meet this specific clause requirement. Therefore code compliance cannot be achieved.

The NZFS recommends that the BCA requires the applicant to address the fire separation between the rest home sleeping areas and the atrium in accordance with C3.3.2 of the Building Code.

- The NZFS notes that on level 3, stair number 4 that the door swing blocks the entry to the stairs when opened, therefore preventing access into the stair. It is also noted that some of the plans contradict each other with respect to the direction of the door swings shown within the corridors.

It is considered that the review by the DRU was good and very rigorous. However the comments regarding the use of sprinklers and solid core doors in lieu of no sprinklers and fire rated doors with a minimal fire rating were overly conservative and did not look at the fire systems, rather than the detail of the comments, from an overall building performance point of view.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	Yes
Analysis or design not sufficiently rigorous.	Yes especially regarding the atria
Inappropriate use of software.	No
Ambiguous or unusual computer results.	No
Use of unproven materials or techniques.	Yes
Conflict with regulations or codes of practice.	Yes
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No
Designs not sufficiently robust.	Yes especially with respect to the atrium
Insufficient detail in drawings.	No
Compliance document applied incorrectly	No


### Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Adequate
Analysis of hazards and Building Adequate	Poor
Acceptance Criteria Identified	Yes
Modelling Adequate	No
Fire Engineering Process Followed	No
Sufficient Documentation	Yes
FEB Process identified	No
DRU assessment for Escape from Fire	Good
DRU assessment for Fire Fighting Provisions	No
DRU Memorandum Adequate	Good
DRU Assessment Adequate	Good
Subsequent reviews or Confirmation of Design Provided	No

## A.19 Project 1715

### Fire Engineering Report

The proposed building consists of a large pool space housing two swimming pools, changing rooms, offices, and a classroom at ground level. There are two mezzanine levels; one housing spectator seating and one incorporating offices and a fitness centre. In addition there is a sub-floor basement housing pool plant and air handling equipment.



The fire engineering report addresses the alternative solution for egress from the pool space. As an alternative solution, subject to Territorial Authority approval the building will be provided with a Type 2 alarm system consisting of manual call points and sounders with supplementary smoke detection coverage to all areas except the main pool area, including in-duct detection within the air handling system.

The fire strategy involves wardens located at the top and bottom of tiered seating when in use that can operate the manual call points.

Strategies that rely on human intervention are less reliable and harder to enforce than physical systems. However as the property is a school that is a regulated facility compared to other public assembly occupancies and a number of teaching staff would be present during functions it is considered that the strategy is not beyond implementation.

The visibility criterion is reduced from 10m to 5m with the introduction of photo luminescent strips on the stair treads.

It is considered that the assessment is relatively conservative given the area is a pool and is therefore relatively sterile.

The assessment provides references and discusses hazards, occupant response, fire growth rates; fuel loads etc and hence is considered to follow the basics of a fire engineering assessment.

## **DRU Memo**

The DRU review occurred between 11/9/2007 and 18/9/ 2007

The DRU did not consider that the design as proposed demonstrates compliance with the requirements of the Building Code for the following reasons:

- The limitations of the computer model used have not been accounted for in the design.
- There is complete reliance on a management system that may, or may not, be in place, and may or may not work if it is in place.
- There is complete reliance on early detection of a fire by the wardens, which may or may not occur. The assumptions on which warden detection rely are considered unjustified, unverified and unreliable.
- Tenability analysis was not measured at the appropriate locations in the design.
- The most efficient occupant movement has been assumed with no allowance for egress being blocked by a fire.
- A pre-movement time has been selected which is unsupported by either the building, or the occupant characteristics.

The DRU raises a number of questions regarding the modelling assumptions, calculations and interpretation. Most of these are considered to be valid technical questions but do not take into account the already conservative nature of the fire scenario given the area is a pool area and isolated from other parts of the building. The questions and extra modelling would add conservatism to the analysis that would then make an inherently safe area look unsafe.

The DRU appear to rely on the acceptable solutions without looking at the use of the building and the entire situation.

The fire report was one of the better fire reports of those reviewed and yet has generated one of the most negative reviews by the DRU. It appears it is a case of the more you say the more people have to object and the DRU should have looked at the overall use of the area and the risk from other areas of the building and how they have been addressed. It is agreed that the fire report could also have brought out the relatively safe nature of the pool area.

The DRU did complete an IPENZ engineering report for the project.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	Fire report investigation was considered acceptable
Analysis or design not sufficiently rigorous.	Design is considered to be reasonably rigorous
Inappropriate use of software.	The use of a zone model was acceptable but the area was greater than the specified maximum for the model. Another model should have been used but would most likely not affect the result
Ambiguous or unusual computer results.	The results were as expected and considered to be conservative
Use of unproven materials or techniques.	No
Conflict with regulations or codes of practice.	No
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No
Designs not sufficiently robust.	Design was considered acceptable given the use of the area and the school environment
Insufficient detail in drawings.	No
Compliance document applied incorrectly	No

### Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	Yes
Acceptance Criteria Identified	Yes
Modelling Adequate	Yes
Fire Engineering Process Followed	Yes
Sufficient Documentation	Yes
FEB Process identified	No
DRU assessment for Escape from Fire	Considered to be detailed but focussed on compliance to acceptable solutions, raised technical issues and requested more conservative assessment.
DRU assessment for Fire Fighting Provisions	No
DRU Memorandum Adequate	Adequate

DRU Assessment Adequate	Poor
Subsequent reviews or Confirmation of Design Provided	No

## A.20 Project 2333

### Fire Engineering Report

The fire safety design was for the new Residential building that also contains some hotel and offices.

The fire report specifies AS1668 zone pressurisation and stair pressurisation systems.

The atrium is naturally ventilated with a vent 300mm high and 20m<sup>2</sup> free area. No assessment is provided to demonstrate the effectiveness of the vent area. This is considered to be smaller than past experience has shown to be effective. Also no discussion of the smoke reservoir from which smoke may be vented is made.

The fire report states that the egress widths have been determined using specific design but does not provide an analysis for review.

The report provides an assessment of the structure but does not provide an analysis.

### DRU Memo

The DRU review occurred between 18 June 2007 and 16 July and 23 July 2007

It is noted that the DRU rejected the application as the documentation is not complete but then went on to provide advice. This is considered to assist the design process and demonstrated a desire by the DRU to assist in the design.

The response provides a number of areas where clarification and further details are required of the qualitative description of the fire systems. Given the preliminary nature of the report no technical comments could be made by the DRU. It is considered that the fire report and the review by the DRU could be the start of a fire engineering brief such that later submissions would be able to address all the concerns.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	Yes
Analysis or design not sufficiently rigorous.	Yes
Inappropriate use of software.	N/A
Ambiguous or unusual computer results.	N/A
Use of unproven materials or techniques.	Yes
Conflict with regulations or codes of practice.	Yes
Inadequate checking, reviewing or quality assurance (QA).	No



Taking disproportionate risks.	No
Designs not sufficiently robust.	Yes
Insufficient detail in drawings.	Yes
Compliance document applied incorrectly	Yes

## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	No
Analysis of hazards and Building Adequate	No
Acceptance Criteria Identified	No
Modelling Adequate	N/A
Fire Engineering Process Followed	No
Sufficient Documentation	No
FEB Process identified	No
DRU assessment for Escape from Fire	Assessment was considered to be acceptable
DRU assessment for Fire Fighting Provisions	Assessment was considered to be acceptable
DRU Memorandum Adequate	Assessment was considered to be acceptable
DRU Assessment Adequate	Assessment was considered to be acceptable
Subsequent reviews or Confirmation of Design Provided	No

## A.21 Project 1655

### Fire Engineering Report

The consent documentation indicates that this is a new building linked to an existing hotel building with three major variations from the requirements of C/AS1.

The fire report however indicates that a review by the DRU is not required.

The report follows to some degree the IFEG format and references the IFEG in places. However a full analysis of tenability criteria, acceptance criteria for all fire engineering not just life safety was not provided. The life safety criteria were not considered to be robust.

No evacuation modelling was performed and hence no judgement of safety margins could be determined.

The design fires were not considered sufficient to test the system and design in that the heat release rate was too low and an incubation stage of over 100 seconds was used without justification.

It was considered however that the basic approach of the assessment was one of the better reports in that it did start to follow the IFEG type of format and discuss some issues.

### DRU Memo

The DRU review occurred between??? 2007 and 22/8/07

The DRU makes a number of very strong comments regarding the smoke modelling including:

- a) The NZFS notes that this section states that apart from the visibility issue, no other tenability criteria have been exceeded. The NZFS considers that exceeding even one tenability criteria is sufficient to cause a design to fail, regardless of the status of the other criteria. The NZFS notes that the visibility drops to approximately 2m. this is sufficient to prevent evacuation.
- b) The fire report goes on to state that on the basis of visibility being over 5m toxicity is unlikely to be a concern up to the 210 second mark. It is unclear where this value of 210 seconds is obtained from. There is no other mention of 210 seconds in the report, nor is there any analysis as to indicate the significance of this time.
- c) The NZFS considers that the assumption that furniture in the main foyer is to be non combustible is unsupported. This is the basis of selecting the computer fires as the design fires. The fire report requires that certification be provided for all seating stating that it is non combustible. However, the fire report also states that the foams are to be modified polyurethane foam, imported from England. The NZFS notes that the foams used in British furniture are not non-combustible, but rather fire resistant, meaning they require a more rigorous energy source to ignite them. However, they can still burn, and can still produce large quantities of products of combustion and a heat release rate is still higher than that assumed for a computer (the design fire). The NZFS also understands that they can produce more toxic products than normal foam as the fire retardant chemicals add to the products of combustion. The NZFS considers that it needs to be clarified as to whether the materials are non combustible (meaning they do not burn in any circumstance), or whether they will in fact still burn, but just take a larger ignition source to get started. The NZFS notes that if the furniture will burn, then the assumptions made regarding the fire scenarios that can occur will be required to be revisited.
- d) Notwithstanding the previous point, how the fire loading and fuel characteristics in the main foyer is to be maintained should be clarified.
- e) The fire report states that concerns are raised over the applicability of the use of a t2 fire, and uses test fires of a computer monitor and a computer monitor/CPU combination instead. This is on the basis that “products of combustion can vary [sic] for different for furniture etc”. The NZFS acknowledges that products of combustion do vary for different fuel packages, but this variation is generally taken into account by the selection of the appropriate design fire, fuel characteristics input into the appropriate fire model and by an appropriate sensitivity assessment.
- f) The NZFS notes that no sensitivity assessment has been carried out.
- g) No evacuation modelling is presented. The design makes the assumption under C/AS1 in a space egress widths are designed around the requirement to exit the space within 2.5 minutes. The NZFS notes that this assumption is invalid. The NZFS notes that times associated with C/AS1 of 150 seconds are associated only with the travel time through a constriction such as a door or stairs (this is confirmed by the BRANZ Technical Recommendation #11). Therefore, the maximum time which can be taken to move through the bottleneck is taken as 2.5 minutes. However, as stated before, this only relates to the flow time of occupants through an opening such as a door.
- h) In both of the fire models presented the design fire has no fire for the first 100 seconds of the simulation. This should be justified and the effect this has on artificially increasing the appearance of tenability should be addressed.
- i) As referred to above, the fire modelling indicates that the sprinklers do not activate. When the modelling is carried out to a level where the fire size does activate the sprinklers, the NZFS considers that the current set up, with sprinkler suppression modelled; as opposed to sprinkler control should be justified.

The above comments are considered to be justified based on a review of the fire report

The DRU also makes the following comments:

- a) The fire report proposes that the exposed windows above the unrated roof of the existing hotel may be protected by installing external sprinklers as per NZS 4541. However, the NZFS notes that the external sprinkler provisions relate to “adjacent” buildings, as defined under the standard, and that the existing hotel actually is an adjoining building. The provision of external sprinklers for adjacent buildings in the Standard is to mitigate radiation only, and is not intended to mitigate direct flame impingement, as would be expected to occur in this case. This is the primary reason that external sprinklers are not permitted for adjoining buildings. Therefore, the NZFS does not consider that the proposed application provides an adequate level of protection, and as such the applicant should be required to provide an alternative that provides the required level of protection.
- b) The fire report proposes an alternative solution for the northern glazing in appendix 6 to the fire report. The entire proposal is based on a comparison between what would be allowable under C/AS1. However, the NZFS does not consider that the comparison made is valid. The entire point of a comparative analysis is to base what is allowable under the compliance document for an identical building which meets the requirements of this compliance document. In this comparison the fire report makes repeated comparison and references to what C/AS1 would allow for a curtain walled building which was located at or over 1m from the boundary.

The International Fire Engineering Guidelines (IFEG), a best practice guideline for Fire Engineering Design supported in New Zealand by the Department of Building and Housing, the Institute of Professional Engineers of New Zealand and the NZFS, gives guidance of any comparative analysis carried out. It states :

“Comparative approach

Typically, the fire safety provided by one element, or a sub-system, or the complete fire safety system, is compared to the level of fire safety that would be achieved in an identical building in which that element, sub-system or system is designed in compliance with the deemed-to-satisfy or prescriptive provisions identified in Section 1.2.8. If the analysis is carried out on such a comparative basis, it will involve the same assumptions, models, calculations and input data for the proposed trial design and the deemed-to-satisfy or prescriptive design.”

- a) The fire report proposes an alternative to full compliance with AS 1668 for the stairwell pressurisation systems. There are a number of items that would need clarification and the NZFS considers that more analysis is necessary to demonstrate that the proposed system provides a comparable level of performance to that required by the standard

It is considered that the DRU comments were valid and the assessment of the fire report good. The comments were made taking into account the whole building and the basis of the systems proposed in terms of what performance is expected by the fire engineer compared to that from the code and standards.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
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Investigation not thorough enough.	Yes
Analysis or design not sufficiently rigorous.	Yes
Inappropriate use of software.	Yes
Ambiguous or unusual computer results.	Yes
Use of unproven materials or techniques.	Yes
Conflict with regulations or codes of practice.	Yes
Inadequate checking, reviewing or quality assurance (QA).	Yes
Taking disproportionate risks.	No
Designs not sufficiently robust.	Yes
Insufficient detail in drawings.	Yes
Compliance document applied incorrectly	Yes

## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Poor
Analysis of hazards and Building Adequate	Poor
Acceptance Criteria Identified	No
Modelling Adequate	No
Fire Engineering Process Followed	Partially
Sufficient Documentation	No
FEB Process identified	No
DRU assessment for Escape from Fire	Considered to be robust and looked at the entire building and interaction of systems
DRU assessment for Fire Fighting Provisions	No
DRU Memorandum Adequate	Good
DRU Assessment Adequate	Good
Subsequent reviews or Confirmation of Design Provided	No

## A.22 Project 2651

### Fire Engineering Report


The application relates to an existing shopping mall. The report relates to moving the retail spaces 1m into the mall. The original fire report was written in 1994.

A number of reports were supplied for review by the DRU.

No smoke modelling was performed with respect to the movement of shop fronts. The justification was based on an assessment of occupant numbers and egress widths.

### DRU Memo

The DRU review occurred of 3 memos and reflected an on-going negotiation with the design team.



The initial review (9 July 2008) indicated that insufficient detail or analysis has been provided within the report that demonstrates compliance on 'reasonably practicable' grounds. The NZFS notes that there has been recent guidance published by the DBH in Codewords relating to how reasonably practicable should be assessed.

The memo also raises issues with the occupant density used that did not comply with C/AS1 and did not have an alternative solution developed. There were also issues raised with the occupant numbers on the ground floor that were considerably less than code requirements.

The response also raises questions as to how the evacuation routes and in particular the widths within the mall are to be maintained.

The second memo dated 1 August 2008 only stated that the issues raised in the first memo had not been addressed and was still relevant.

The third memo was dated 15 August 2008.

The third memo stated the NZFS considers that the response from the fire engineer now provides a sufficient level of substantiation to justify the use of the alternative occupant loads as that provided by C/AS1. Notwithstanding this one point, the NZFS still does not consider that the fire report adequately demonstrates that the means of escape requirements of the Building Code are achieved within the proposed design.

The interaction of the DRU and fire engineer to resolve an issue was considered appropriate and what should happen such that the objectives and reason for the DRU review are fulfilled.

The memo also indicated that the plans and specifications were not complete with respect to the intermediate floor and the need for smoke control.

### **IPENZ Areas of Concern**

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

<b>Area of Concern</b>	<b>Comment</b>
Investigation not thorough enough.	No
Analysis or design not sufficiently rigorous.	No
Inappropriate use of software.	N/A
Ambiguous or unusual computer results.	N/A
Use of unproven materials or techniques.	N/A
Conflict with regulations or codes of practice.	No
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No
Designs not sufficiently robust.	No
Insufficient detail in drawings.	Yes
Compliance document applied incorrectly	No



## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	N/A
Acceptance Criteria Identified	N/A
Modelling Adequate	N/A
Fire Engineering Process Followed	No
Sufficient Documentation	Yes
FEB Process identified	No
DRU assessment for Escape from Fire	Review process was considered to be acceptable
DRU assessment for Fire Fighting Provisions	No
DRU Memorandum Adequate	Adequate
DRU Assessment Adequate	Adequate
Subsequent reviews or Confirmation of Design Provided	Yes

### A.23 Project 1552

#### Fire Engineering Report

The fire reports constituted a number of reports for a large retail centre and the various tenancies. A number of peer reviews were also undertaken and referenced by the DRU.

Modelling was performed using a number of smoke spread models from Branzfire to FDS and also evacuation modelling.

The number of issues and reports are too large to detail.

A number of the reports did not follow the IFEG format and given they related to single tenancies in a larger complex did not fully explain the interactions of the centre as a whole. Instead they applied C/AS1 where possible and then just modelled certain areas. Thus a concept of the overall interaction of all areas and systems was difficult to obtain.

It is considered that for large complexes such as this one with large numbers of people and issues that a full brief process and IFEG fire engineering assessment should be undertaken that provides an overall strategy.

#### DRU Memo

The DRU response occurred via 4 memos.

The DRU response was considered to be rigorous and covered the building in a holistic manner and the interaction of the systems. The process was considered to contain all aspects of the IPENZ format.

The DRU response was broken into comments for each tenancy report as well as the overall report and included such detail as the grid size used in the FDS modelling to overall strategy comments.

The level of rigour demonstrated was considered appropriate for the size of project. It was also considered appropriate to consolidate the response for all the reports into the one memo such that an overall concept could be obtained.

Little or no information was supplied regarding fire service response. Given the size of the complex this would be important to responding fire brigade crews. Further detail could have been sought.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	No
Analysis or design not sufficiently rigorous.	No
Inappropriate use of software.	No
Ambiguous or unusual computer results.	No
Use of unproven materials or techniques.	No
Conflict with regulations or codes of practice.	No
Inadequate checking, reviewing or quality assurance (QA).	No
Taking disproportionate risks.	No
Designs not sufficiently robust.	No
Insufficient detail in drawings.	No
Compliance document applied incorrectly	No

### Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	Yes
Acceptance Criteria Identified	Partially
Modelling Adequate	Yes
Fire Engineering Process Followed	Partially
Sufficient Documentation	Yes
FEB Process identified	No
DRU assessment for Escape from Fire	Review occurred over a number of reports via a number of memos. The assessment was considered to be appropriate and rigorous
DRU assessment for Fire Fighting Provisions	Little information was supplied that for such a large complex should be a concern to the responding brigade.
DRU Memorandum Adequate	Good
DRU Assessment Adequate	Good
Subsequent reviews or Confirmation of Design Provided	Yes

## A.24 Project 1528

### Fire Engineering Report

The fire report related to the conversion of a shop into a gym.

The fire report contained reference to a brief and was considered to contain many of the aspects of the IFEG format.

The report makes reference to the lack of smoke control to the store in the intermediate floor that is required by the code compliant solution. The assessment of the impact of the lack of smoke control was performed qualitatively rather than by smoke modelling. The argument is based on the installation of sprinklers, low occupant numbers and lack of connecting spaces.

Although the design solution is considered to be acceptable a greater discussion of hazards, fire system response such as alarm zoning, etc and occupant response should have been undertaken.

### DRU Memo

The DRU review occurred between ??? and 15/6/2007

The DRU made the following comments:

- The NZFS notes that limited information is provided as part of the consent application form. Drawings are provided only for a portion of the building and as such the means of escape from fire from the entire building are unable to be assessed appropriately. The fire report indicates that there are two additional floors located above the floor where the building work is occurring. However, plans for this area are not provided.
- The NZFS recommends the BCA requires the applicant to provide details and plans of the entire building to show that the provisions of the building code relating to means of escape from fire have been satisfied.
- Provisions for fire fighting activities are not required to be addressed in buildings undergoing alterations in accordance with s.112 of the Building Act 2004..

It is considered that given the deletion of smoke control and the minor discussion in the fire report that a more detailed response should have been provided.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

Area of Concern	Comment
Investigation not thorough enough.	Yes
Analysis or design not sufficiently rigorous.	Yes
Inappropriate use of software.	N/A
Ambiguous or unusual computer results.	N/A
Use of unproven materials or techniques.	N/A
Conflict with regulations or codes of practice.	Yes

Inadequate checking, reviewing or quality assurance (QA).	Yes
Taking disproportionate risks.	No
Designs not sufficiently robust.	No
Insufficient detail in drawings.	Yes
Compliance document applied incorrectly	Yes

## Conclusions

Report / Aspect	Rating
Regulatory assessment in the Fire Report Adequate	Yes
Analysis of hazards and Building Adequate	No
Acceptance Criteria Identified	No
Modelling Adequate	No
Fire Engineering Process Followed	Yes
Sufficient Documentation	No
FEB Process identified	Yes
DRU assessment for Escape from Fire	Not performed
DRU assessment for Fire Fighting Provisions	Not performed
DRU Memorandum Adequate	Poor
DRU Assessment Adequate	Poor
Subsequent reviews or Confirmation of Design Provided	No

## A.25 Project 2041

### Fire Engineering Report

The project relates to an existing single level residential dwelling that is used to provide a supported living environment for residents with intellectual disabilities.

The building has a sprinkler system and detection that a house of similar size would not require. It is therefore considered that the building complies with the acceptable solutions.

There does not appear to be a reason to have sent this to the DRU for review.

### DRU Memo

The DRU review occurred between 13/2/ 2007 and 26/2/ 2007

The DRU made the following comments:

- The building design as submitted does not raise any concerns regarding the means of escape from fire.

No comment on the fire service response was made.

### IPENZ Areas of Concern

The following comments relate to the IPENZ areas of concern with respect to peer reviews.

<b>Area of Concern</b>	<b>Comment</b>
Investigation not thorough enough.	N/A
Analysis or design not sufficiently rigorous.	N/A
Inappropriate use of software.	N/A
Ambiguous or unusual computer results.	N/A
Use of unproven materials or techniques.	N/A
Conflict with regulations or codes of practice.	N/A
Inadequate checking, reviewing or quality assurance (QA).	N/A
Taking disproportionate risks.	N/A
Designs not sufficiently robust.	N/A
Insufficient detail in drawings.	N/A
Compliance document applied incorrectly	N/A

### Conclusions

<b>Report / Aspect</b>	<b>Rating</b>
Regulatory assessment in the Fire Report Adequate	N/A
Analysis of hazards and Building Adequate	N/A
Acceptance Criteria Identified	N/A
Modelling Adequate	N/A
Fire Engineering Process Followed	N/A
Sufficient Documentation	N/A
FEB Process identified	N/A
DRU assessment for Escape from Fire	N/A
DRU assessment for Fire Fighting Provisions	N/A
DRU Memorandum Adequate	Adequate
DRU Assessment Adequate	Adequate
Subsequent reviews or Confirmation of Design Provided	No