SCDF
The Life Saving Force
. . . for a safer Singapore

Fire Safety Engineer (FSE) Workshop

28th June 2024 from 10 am to 12 pm

- HQ SCDF City Campus Classroom, Level 3

Agenda

1. PB Regulatory System (Update)
   - FSE Registration
   - Number of PB cases
2. CPE Program (update)
3. Admin Requirements (update)
4. Fire Engineering Technical Requirements (update)
   - Determination of ASET
   - Requirements for corridor ventilation assessment
   - Mark up drawings
5. AOB
6. QnA

Performance-Based Regulatory System

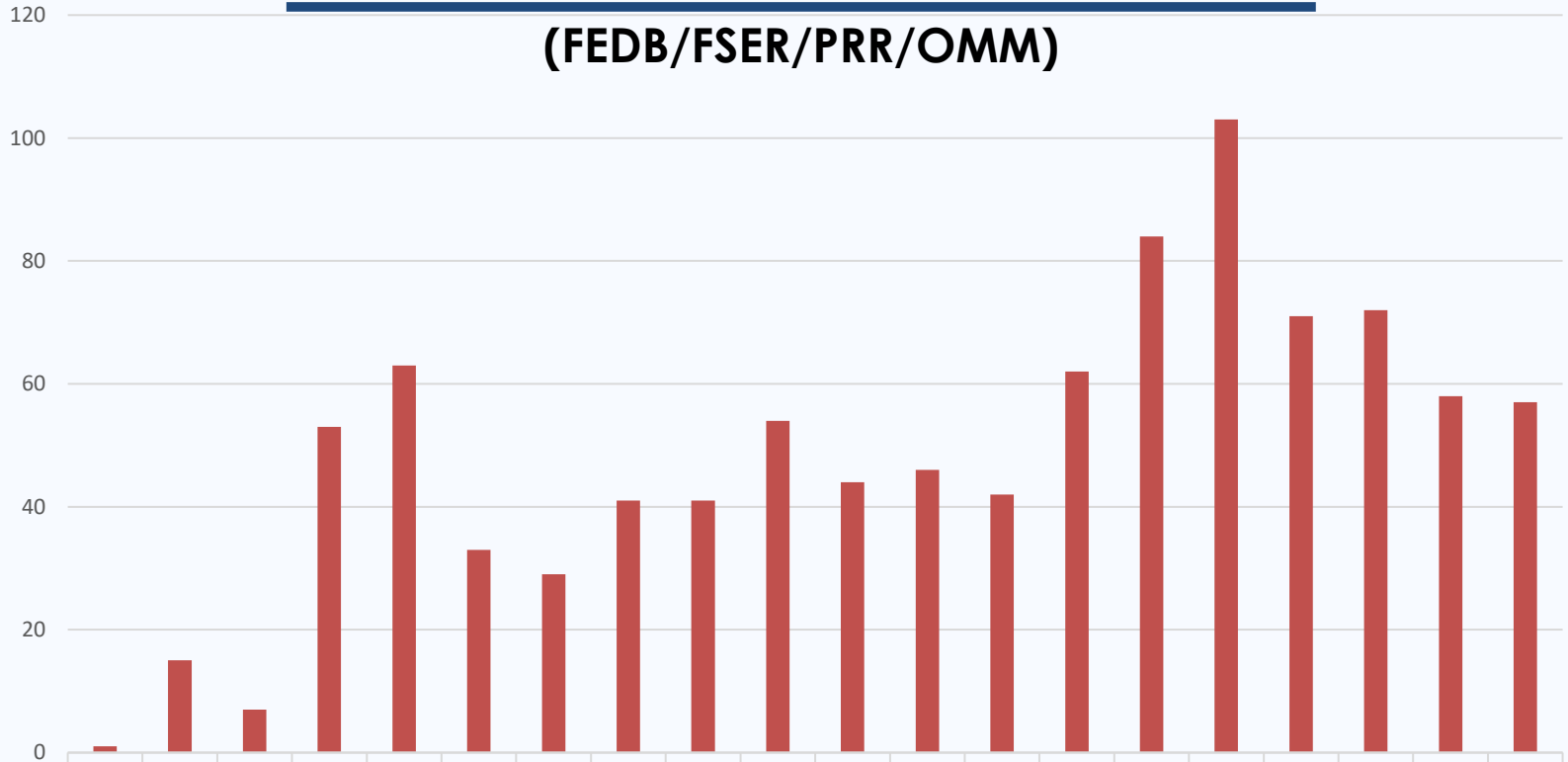
FSE Registration

Year	Number of FSEs registered	Year	Number of FSEs registered	Year	Number of FSEs registered
2004	40	2011	0	2018	2
2005	11	2012	5	2019	0
2006	5	2013	2	2020	0
2007	7	2014	1	2021	0
2008	8	2015	3	2022	1
2009	7	2016	0	2023	1
2010	3	2017	0	2024	0

- Current FSEs ("Practising" & "Restriction of Practice") – 77
  - Deregistered – 19 (No longer practicing)

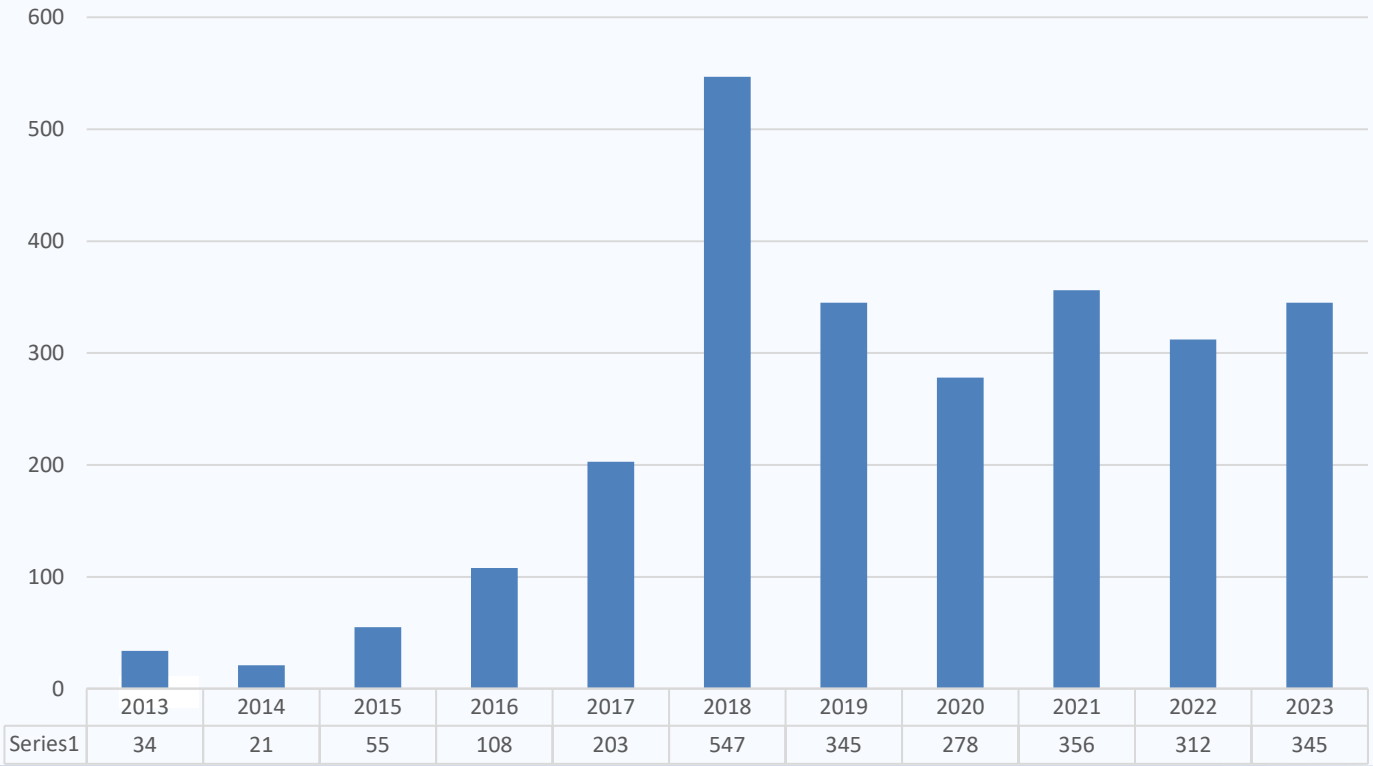
Number of PB Cases

(FEDB/FSER/PRR/OMM)



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Number	1	15	7	53	63	33	29	41	41	54	44	46	42	62	84	103	71	72	58	57

Number of PB WVR Issues



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Series1	34	21	55	108	203	547	345	278	356	312	345

Continuing Professional Education (CPE) Program

Revised Framework

Category	CPE Hours
Qualified formal study courses	1 CPE for each contact hours
Qualified lectures, short courses, conferences, workshops & seminars	1 CPE for each contact hours
Online viewing of qualified lecturers, short courses, conferences, workshops	1 CPE for each 2 hours of e-training (Max 5 CPE hours/cycle)
Contribution to the field of fire engineering a) Conduct lectures, seminars, conferences that has been qualified for CPE, for the first time b) Write or edit technical articles or papers published in distinguished publication, conference proceedings *(published during FSE's CPE cycle)*	 2 CPEs for each lecture hour 5 CPEs for each topic

Admin Requirements Update

Changes to Approved Waiver via Fire Engineering Assessment

For projects with further design changes which may affect the previously approved waiver via fire engineering assessment, QP/FSE may either:

1. Submit a fresh waiver application with revised fire engineering assessment report including updated PB study, or
2. Submit a fresh waiver application with revised fire engineering assessment report to reflect the design changes, including FSE's explanation on these changes and decision not to conduct another simulation study, based on engineering judgement. Subject to SCDF's agreement.

Email address

Email addresses to be included in all :

1. FEDBs
2. FERs and WVR-FERs
3. Operations and Maintenance Manuals
4. Peer Reviewer Reports

Official Correspondences

CORENET shall be the primary means to submit

1. FEDBs
2. FERs and WVR-FERs
3. Peer Reviewer Reports
4. Responses to SCDF's queries/comments

FSE to inform SCDF via email when documents uploaded. May attach documents in same email.

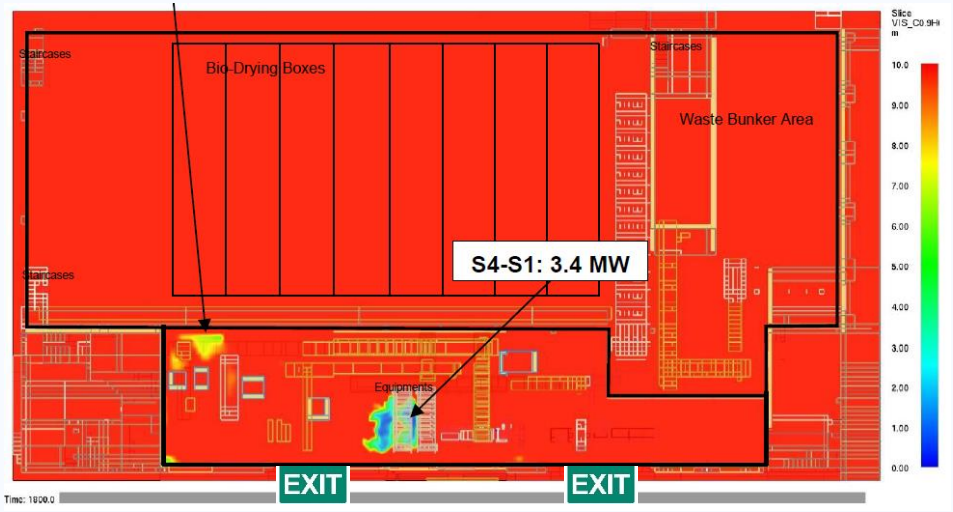
Fire Engineering Technical Requirements Update

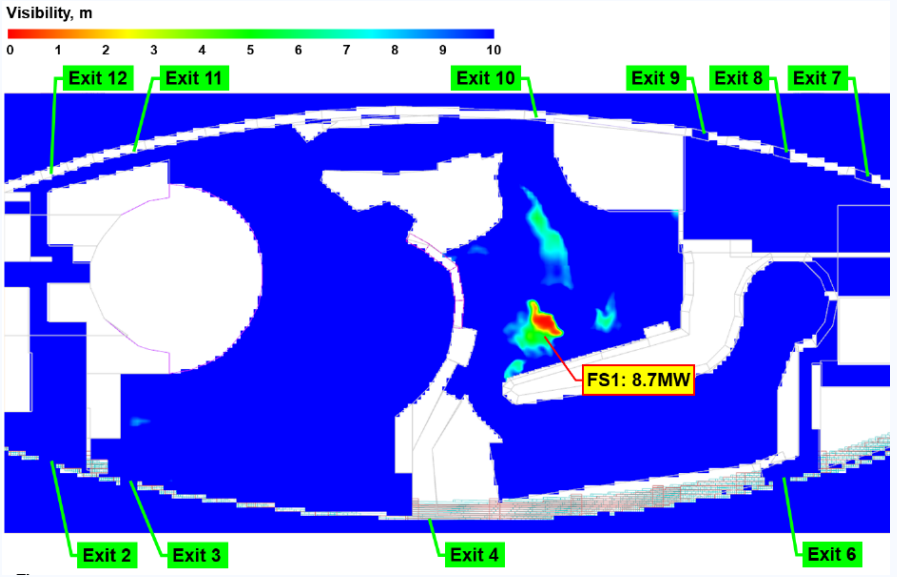
Determination of ASET

If there is any observation of smoke logging in CFD result slice files which FSE deems not affecting the ASET, FSE shall provide justification, for example:

- Smoke logging condition is some distance away from exit points
- Spill plume is limited to vicinity of the room of fire origin
- If the means of egress is well defined:
  - Remaining clear width of the egress route is sufficient for safe egress
- If the means of egress is not well defined:
  - Area which is smoke logged is not significant
  - Extent of each smoke logged area does not adversely impact egress
- Tenability does not improve even after increasing smoke exhaust rate significantly.
- Occupants are able to exit from fire compartment before untenable condition.

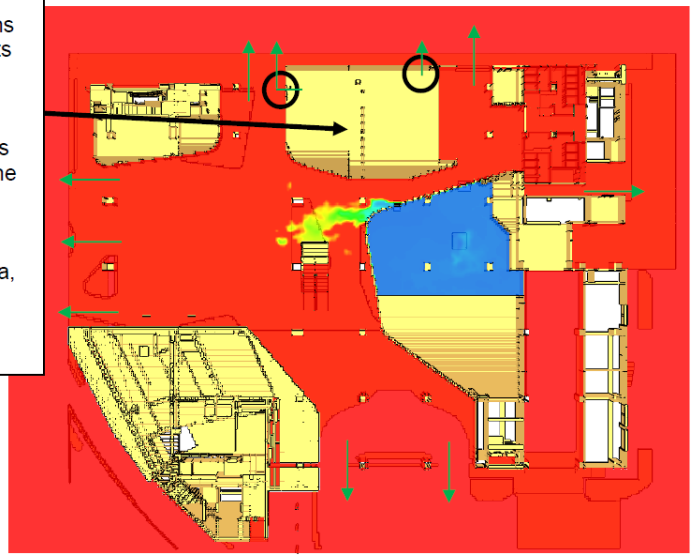
Examples of Acceptable CFD Result

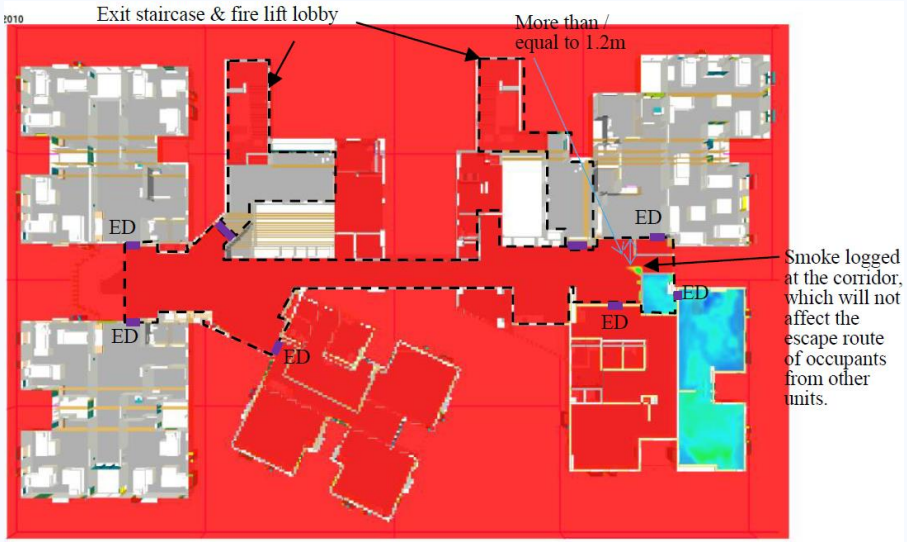




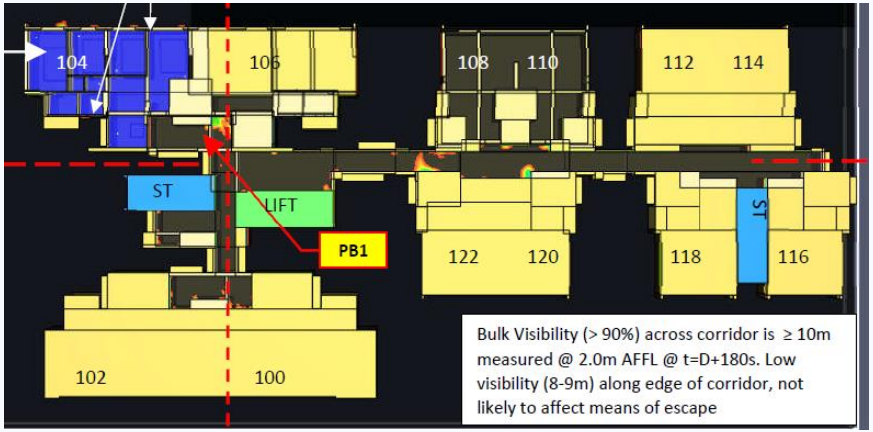
Examples of Acceptable CFD Result

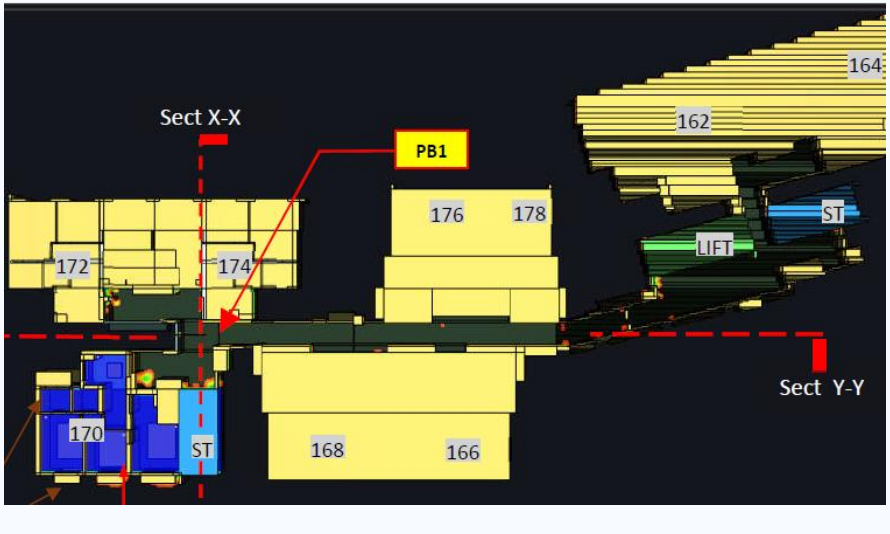
- The green arrows indicate the locations where the occupants can escape to the exterior.
- Occupants of the multi-purpose rooms can escape using the exit doors circled in black.
- For occupants located in other area, there are various escape routes available.





Examples of Unacceptable CFD Result





Requirement For All Corridor Ventilation Assessment

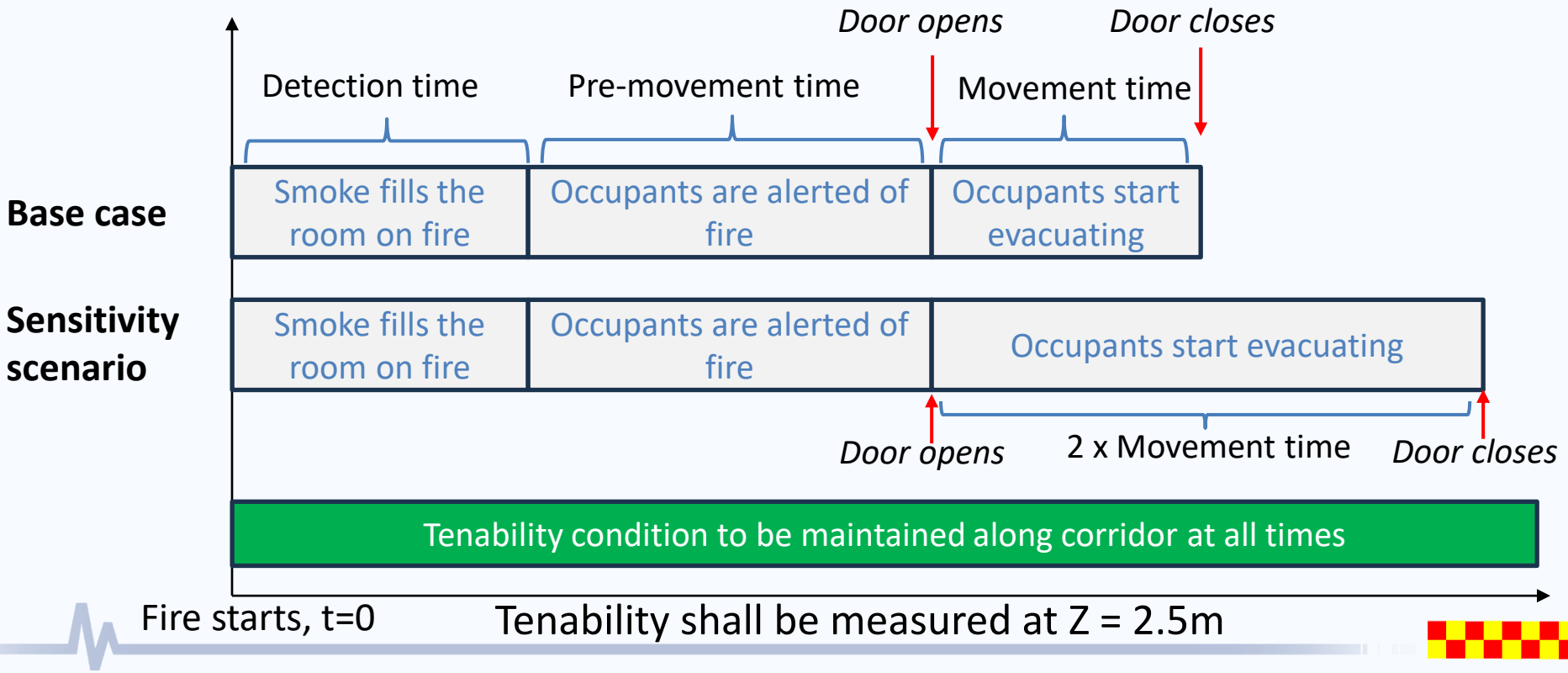
Fire growth rate for all living unit fire scenario (including residential unit, staff quarter, worker's dorm etc) shall be standardized to fast t^2.

Requirements For Non-PG II Corridor Ventilation Assessment (e.g Staff Quarter, Worker's Dorm etc)

For assessments which follow the concept of door opens/ door closes based on calculated detection time, pre-movement time and movement time, the requirements below shall be followed:

1. This assessment method is only allowed for rooms fully fire compartmented away from the corridor.
2. Door shall only be open after detection time + pre-movement time. This is to allow more smoke to accumulate in the room before vented out from the door.
3. Tenability condition shall be maintained along the corridor at all times, measured at 2.5m above finished floor level.
4. A sensitivity scenario of double the movement time for the total door opening duration shall be considered.
5. All other applicable sensitivity scenarios shall be considered accordingly.

Requirements For Non-PG II Corridor Ventilation Assessment (e.g Staff Quarter, Worker's Dorm etc)



Reminder: Natural Ventilation Opening Sizing

- FSE to document clearly the dimension of the openings used for means of natural ventilation and make up air in FER, O&M and Fire Engineering Assessment, for example:
  - Soffit, sill, length, width and aerodynamic coefficient of louvre/ screen/ ventilator/ door
  - Soffit and sill of perimeter openings
- Remind QP to indicate on BP drawings that such openings are used for PB natural ventilation.
- This is for proper peer reviewing, regularizing the design and audit checking.
- The openings should not be altered in future unless submit Letter of No Objection or new PB submission. This shall be emphasized in the O&M.
- Treat it like how you would document details for mechanical ESCS.

Good Examples

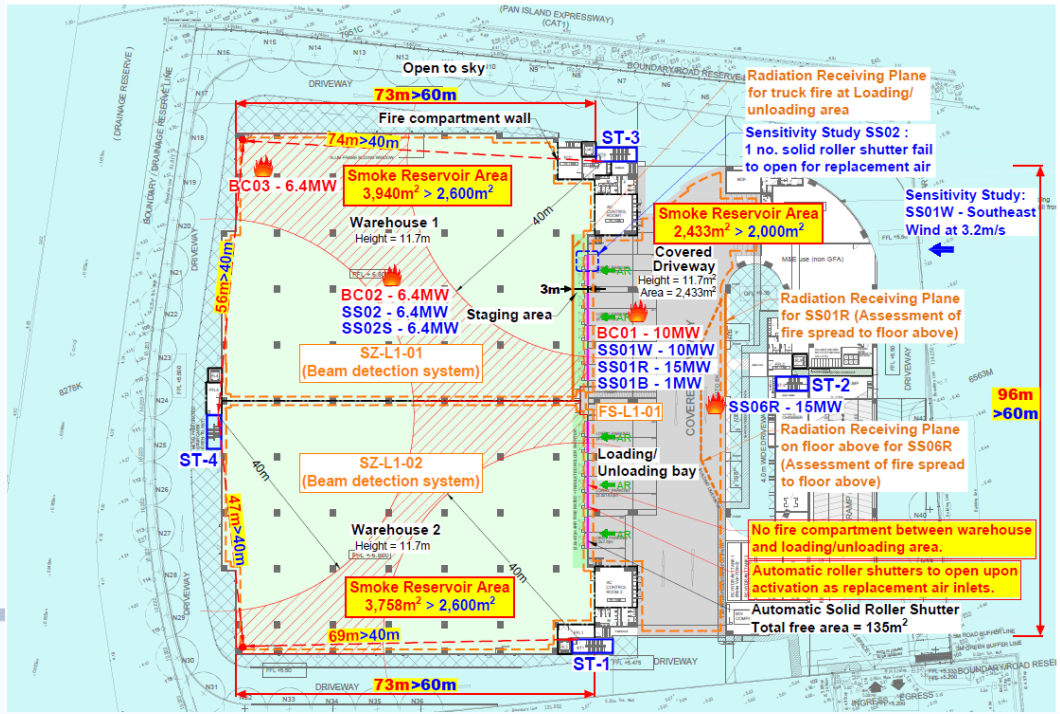
FEDB Reference Drawing

Fire Scenario	Storey	Design Fire Location	Fire Growth Rate	Sprinkler Parameters			Height of Ceiling	Design Fire Size	Design Fire Perimeter	Soot Yield
				Type	Activation Temperature	RTI				
BC01	1st Storey	Loading Bay	Ultra Fast t² Fire	Standard Response Sprinkler	68 °C	105 (m-s)^{½}	11.7 m	10.0 MW	23.0 m	0.1 g/g
BC02 BC03		Warehouse area	Ultra Fast t² Fire	ESFR	74 °C	26 (m-s)^{½}	11.7 m	6.4 MW	12.0 m	0.1 g/g

Note:
- The truck fire size of 10 MW with perimeter 23.0m (9.0m x 2.5m) is based on goods vehicle fire in Chapter 7 of Fire Code 2018 & SFEG 2015.
- The fire sizes are calculated using FPETool Based on 2nd ring activation of sprinklers.
- 0.1g/g soot yield in accordance with SFEG 2015.
- The vehicular ramp & driveway are transient spaces with no commercial activities, storage or parking.
- The layout on 1st to 5th storey are typical in floor plan, ceiling height and configuration including all fire safety provisions. Hence, only the worst fire scenarios on the 1st storey are considered in the fire safety engineering assessment.
- SSB - Delay in detection time based on 1st ring sprinkler activation.

Design Fire Size

Floor	Location	Worst Fire Scenario	Remarks
1st Storey	Loading Bay	BC01 - 10.0 MW	Axis-symmetric plumes of truck fire at loading bay.
		SS01W - 10.0 MW	Sensitivity Study - Wind Effects: Northwest wind at 1.4m/s blowing towards the largest ventilation openings of the loading bay.
		SS01R - 15.0 MW	Sensitivity Study - Radiation assessment: 50% increase in fire size for fire in loading bay nearest to radiation receiving plane in warehouse. Sensitivity Study - Radiation assessment: 50% increase in fire size to assess fire spread to floor above.
		SS01B - 1.0 MW	Sensitivity Study - Buoyancy: 1MW fire to test buoyancy for natural smoke control system.
		SS06R - 15.0 MW	Sensitivity Study - Radiation assessment: 50% increase in fire size to assess fire spread to floor above.
	Warehouse area	BC02 - 6.4 MW	Axis-symmetric plume at the centre of the warehouse for maximum smoke entrainment.
		SS02 - 6.4 MW	Sensitivity Study - 1 no. of automatic solid roller shutter fail to open for replacement air.
		SS02S - 6.4 MW	Sensitivity Study - Solid racking above goods: Solid racking above goods to study the effect of entrainment due to smoke spill.
		BC03 - 6.4 MW	Remote corner fire in warehouse.



Non-Compliance Issues:
- Extended smoke reservoir area >2,000m² (Driveway)
- Extended smoke reservoir area >2,600m² (Warehouse)
- Extended smoke reservoir length >60m
- Extended direct travel distance >40m
- No fire compartment between warehouse area and driveway/ loading bay
- Automatic roller shutters to open upon activation as replacement air inlets

Mitigation measures
- Early Suppression Fast Response (ESFR) to mitigate smaller fire size for the warehouse.
- Beam detection system in accordance with SS645 for the warehouse.
- ESCS by mechanical means for the warehouse.
- Standard Response Sprinklers for the driveway.
- ESCS by natural means for the driveway.

Sensitivity Studies:
- SSB - Delay in Detection Time
- SS01W - Wind blowing from Southeast at 3.2m/s towards largest permanent opening at driveway
- SS01R - 50% increase in fire size for radiation study
- SS01B - 1MW fire to test buoyancy for natural smoke control system
- SS02 - 1 no. of solid roller shutter fail to open for replacement air
- SS02S - Solid racking above goods to study the effect of entrainment due to smoke spill

Bad Examples

1. INTRODUCTION

This is a waiver application for the non-compliance of setback distance relating to the prescribed 1 m spatial distance of the notional boundary for car porches/ canopies per **Clause 3.6.1 (b) Setback distance for Unprotected Areas at grade level of PG II buildings.** The non-compliance is about the notional boundary between 2 adjacent unit which has Private Enclosed Space (PES) that has unprotected sides facing her neighbours who is separated by a common space. The required dimension under the Fire Code for the notional boundary is 1m and there are 5 affected areas (See Table 1 below) and the largest measured clear width is 0.6475m, shortage of 0.3525 m. As per SCDF waiver decision letter in table below, fire safety engineering study by registered FSE is required to justify the discrepancies will still achieve tenable conditions. The proposal in this report is to use the worst-case scenario (Block 2-PB1-Area 4) to justify the remaining 4 other non-compliances with smaller discrepancies. This is taking into account the other 4 cases have less than 10% deviation compared to 35.25% difference in the worst case scenario.

Table 1: Non-compliance issue

Block	PB Issue	Devia-tion	Location (gridline)	Require-ment	Provided	Shortage	Devia-tion	Reference
2	PB1	D1	Area 2: G/L 2-5 to 2-6/ 2-H	1.0m	0.91m	0.090m	9%	WVR/00855/2 dated 6 May 2022
		D2	**Area 3:** G/L 2-15 to 2-16a/ 2-E to 2-H	1.0m	0.6475m	0.3525m	35.25%	
		D3	Area 4: G/L 2-21 to 2-23/ 2-E to 2-H	1.0m	0.965m	0.035m	3.5%	
3	PB1	D1	Area 1: G/L 3-17 to 3-18/ 3-H	1.0m	0.938m	0.062m	6.2%	WVR/01346/22 dated 25 May 2022
		D2	Area 2: G/L 3-5 to 3-6-10/ 3-H	1.0m	0.91m	0.090m	9%	

The Report demonstrate that the worst-case scenario which is **PB1–Block 2–D2–Area 3** with 3 case studies to evaluate setback distance and it was found that tenable conditions for visibility, temperature and FED were achieved in all 3 cases.

7. IDENTIFICATION OF FIRE RISK

Cont'd

It is assumed the apartment unit will have a fully involved fire for all rooms with goods/ material that are combustible. And it is assumed the HRR for each unit is 13MW. Additional 3MW sofa fire at PES, per Figure 14.5, pp 442, SFPE 3rd Edn

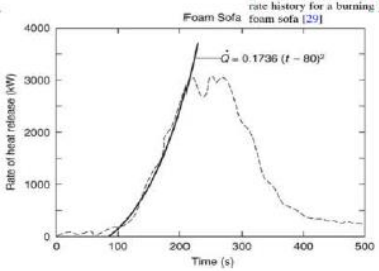
DESIGN FIRE SIZE:

a. Fuel Load inside residential unit

1.Living :	3.0 MW	
2.Dining :	3.0 MW	
3.Master Bedroom:	3.0 MW	
4.Bedroom 2:	3.0 MW	
5.Bathroom:	1.0MW Total:	13.0 MW

b. Fuel Load outside residential unit

7. PES Seatee: 3.0 MW



Blk2-PB1-D1-Area 4	
Location	Blk 2, #01-27
Fire	Steady state
Fire Size	13+3 MW
Growth	t-square
Soot	10%
Case	BC1, BC3
Wind	BC1: 1.2m/s →
	BC3: 1.2m/s ↗

Acceptance Criteria @ 2.5m AFFL	
Visibility	≥ 10m
Temperature	≤ 60 degC
Radiant Heat	≤ 2.5kW/m2
	≤ 200 degC

Figure 17: Blk 2-Area 2 close up layout plan

Blk2-PB1-D1-Area 4	
Location	Blk 2, #01-32
Fire	Steady state
Fire Size	13+3 MW
Growth	t-square
Soot	10%
Case	BC2
Wind	BC2: 1.4m/s ←

Note: from the site photo, there are not much combustibles inside the existing PES. The assumed 3MW fire size for a burning sofa set is conservative given its outdoor condition, such a high combustion item will not be weatherproof. It can be taken Fire in PES is the same 3MW ire sizes adopted in each room.

Please refer to your waiver application dated 24-Aug-2023.

The decision(s) is / are:

Issue No : 1

Description: Please attached appendix 1

Status: REJECTED

Bad example : Waiver description needs to be clear.

Please refer to your waiver application dated 18-Dec-2023.

The decision(s) is / are:

Bad example : Waiver description needs to be clear.

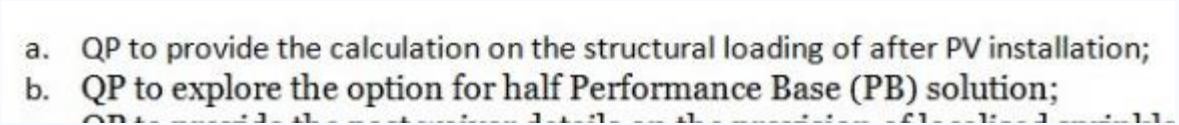
Issue No : 1

Description: Refer to attachment form : fire_safety_waiver_form_20231214

Q&A

Queries Received (#1)

- I would like to raise an issue for SCDF's clarification on the term "half Performance Based (PB) solution". Recently one of my clients came to me for a quotation according to SCDF's reply when his QP submitted a waiver application.



a. QP to provide the calculation on the structural loading of after PV installation;
b. QP to explore the option for half Performance Base (PB) solution;

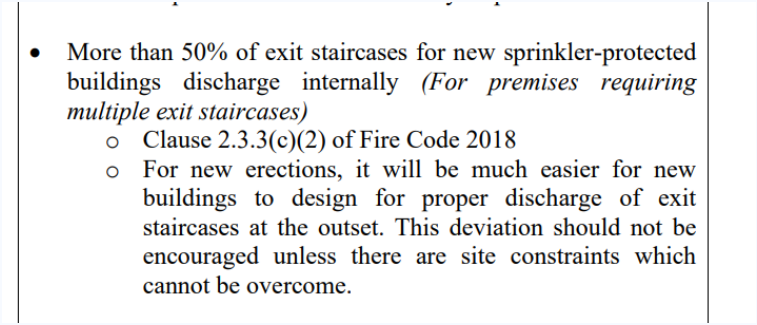
- Based on my understanding, the scaled down version of performance-based solution is FEA in support of waiver application, but the deviation is not in the FEA list. Would appreciate very much if you could help to clarify the term.

SCDF Response to Query #1

- Yes, your understanding that ‘half PB solution’ is the same as waiver via fire engineering assessment (FEA) is correct.
- Generally, only issues listed in SCDF’s December 2015 circular (downloadable from SCDF’s website) are allowed to be submitted as waivers with fire engineering assessments. SCDF may on a case-by-case basis allow other issues to be submitted as waivers with fire engineering assessments. In such instances, SCDF would be explicit.

Queries Received (#2)

- We would like to confirm our understanding that for the following clause below:



- More than 50% of exit staircases for new sprinkler-protected buildings discharge internally *(For premises requiring multiple exit staircases)*
  - Clause 2.3.3(c)(2) of Fire Code 2018
  - For new erections, it will be much easier for new buildings to design for proper discharge of exit staircases at the outset. This deviation should not be encouraged unless there are site constraints which cannot be overcome.

- The QP will need to clear the waiver for more than 50% of exit staircases discharging internally **before** any performance-based approach for the extended internal discharge distance can be considered by SCDF.

SCDF Response to Query #2

- In general yes. Prescriptive waiver must be obtained to allow more than 50% of exit stairs can be discharged internally.
- After the prescriptive waiver is granted, the extended internal discharge distance will then need to be regularized by FSE via waiver with fire engineering assessment.

Queries Received (#3) After Deadline

In one of the past FSE's dialogue session held in 2023, we were informed of the following key changes:

1. Visibility factor of 3 shall be used for all CFD simulations.
2. Soot yield of 0.1 g/g shall be used for all industrial buildings unless justified.

For new PB design projects, the above parameters have been adopted.

However we have concerns for existing PB design projects where new A&A works are proposed.

If the previously approved PB design needs to be re-assessed with fresh CFD simulation run under the recently implemented parameters, the original PB design with previously agreed parameters will fail very badly even without making any changes.

If new A/A works are proposed in existing PB designed building, the property owner would need to substantially enhanced the existing fire safety design in order to achieve tenable conditions under fresh CFD simulation with new parameters.

Queries Received (#3) After Deadline (Cont'd)

Such enhancements may not be feasible due to high cost, operational reason and other existing building constrains.

This change of simulation parameters will seriously affect, particularly the industrial property owners who have plans to carry out new A/A works in their PB designed buildings.

The A/A works may be aborted, failing to meet the tenable conditions under the new CFD parameters.

In view of the above difficulties that both FSEs and building owners are facing, we appeal for SCDF's acceptance to allow previously approved CFD parameters to be used for new A&A works within existing PB designed buildings.

SCDF Response to Query #3

- The visibility factor of 3 for CFD models is not a new requirement by SCDF. The factor of 3 is the default value in FDS software and SCDF has been expecting FSEs to adopt this default value for all modelling studies.

- However, there were still some FSEs using the factor of 8 in their submission which is incorrect. The visibility factor was also not reflected in their report. Hence, at the FSE Workshop 2023, we reminded the FSEs to use the correct visibility factor.

- On the value of soot yield, the default acceptable value is given in SFEG which is 0.1 g/g. A lower value may be adopted if justified. This was also conveyed at the FSE Workshop 2023.

- Notwithstanding the above, SCDF is open to accept design enhancements to mitigate shortfall in result, on a case-by-case basis.

FSE-CPE = 3 hours
for FSE Workshop 2024 attendees

Thank you!