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

Fire Safety Engineer (FSE) Workshop

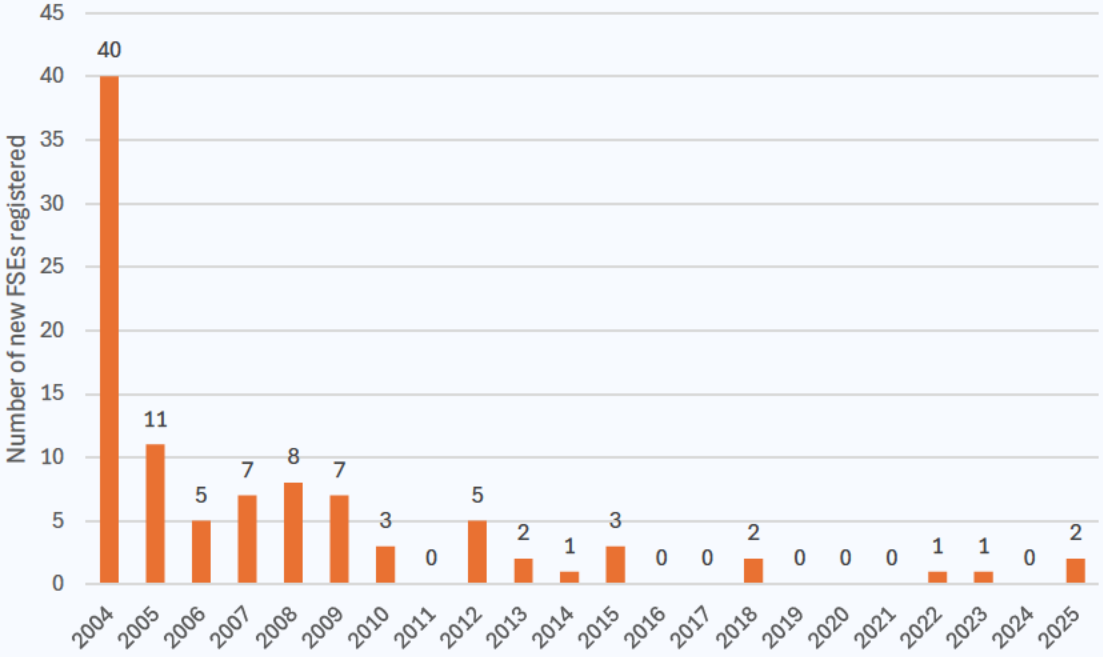
13th June 2025 from 9.30 am to 12.30 pm
HQ SCDF City Campus 1A & 1B

Agenda

1. PB Regulatory System (Update)
   - FSE Registration
   - Number of PB cases & PB waiver issues
2. Admin Requirements (Update)
3. Fire Engineering Technical Requirements (Update)
   - Multiple Air Compressors on Ledge
   - Car Soot Yield
   - Staircase Acceptance Criteria
   - Emergency Illumination Lux Approach for Ductless Jet Fan System in Carpark

Performance-Based Regulatory System

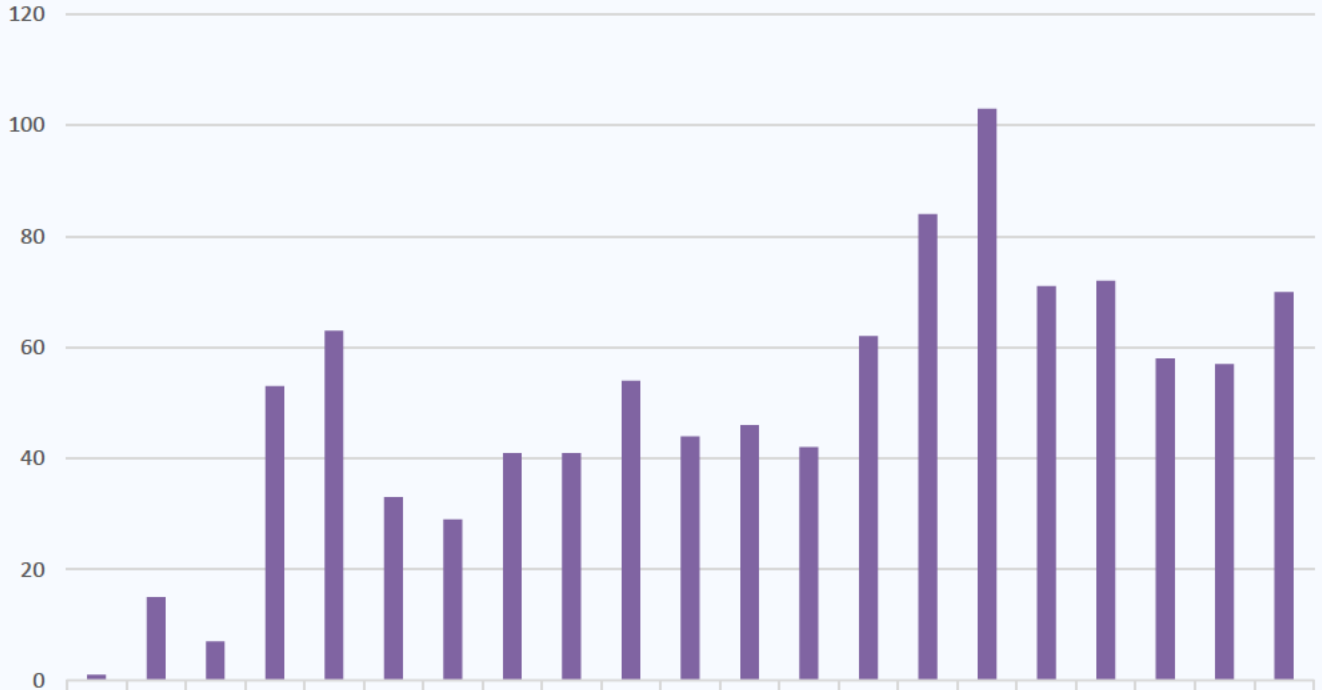
FSE Registration



- 52 practising FSEs
- 25 "restriction of practise"
- 19 deregistered – no longer practising

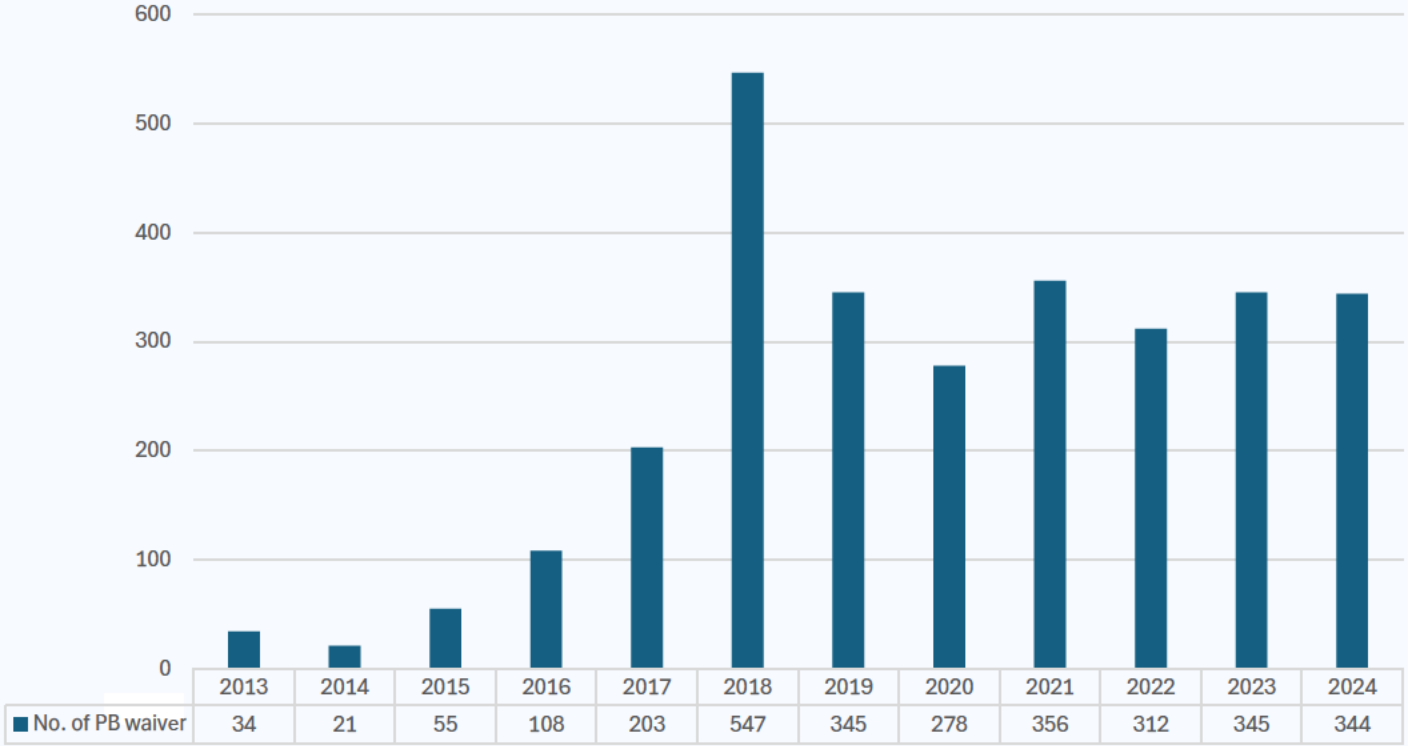
Number of PB Cases

(FEDB)



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
No. of PB cases	1	15	7	53	63	33	29	41	41	54	44	46	42	62	84	103	71	72	58	57	70

Number of PB WVR Issues



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
No. of PB waiver	34	21	55	108	203	547	345	278	356	312	345	344

Admin Requirements Update

Waiver Description

Issue No : 1

Description: Fire Code 2018 Clause 3.2.5(a) ? Any wall and floor separating a residential apartment or maisonette from any other part of the same building, unless permitted (as in the case of an external wall adjoining an external corridor, for provision of window openings). To allow the residential units on the 1st to 17th storey under the roof overhang at the 18th storey of: Block 18 - Unit Type 2BR S1 Block 16 - Unit Type 2BR S1 Block 12 - Unit Type 2BR 2 and Unit Type 2BR 1 Block 10 - Unit Type 2BR 2 Block 8 - Unit Type 2BR DK2

Waiver Description

- 5 deviations instead of 1
- Waiver description (and number of deviations) in CORENET is important
- It has to be aligned with the deviations listed in the waiver submission.

Issue No : 1

Description: Fire Code 2018 Clause 3.2.5(a) ? Any wall and floor separating a residential apartment or maisonette from any other part of the same building, unless permitted (as in the case of an external wall adjoining an external corridor, for provision of window openings). To allow the residential units on the 1st to 17th storey under the roof overhang at the 18th storey of: Block 18 - Unit Type 2BR S1 Block 16 - Unit Type 2BR S1 Block 12 - Unit Type 2BR 2 and Unit Type 2BR 1 Block 10 - Unit Type 2BR 2 Block 8 - Unit Type 2BR DK2

Status: REJECTED

Condition(s)/Reason(s): Number of deviation is incorrect.

Quality of FEDB/FSER/FEA (Bad Example)

- Reminder to review your report before submission (FEDB / FER / PB waiver) to ensure technical accuracy and no typographical error.

From PB waiver:

Table of Deviation

S/N	Description of waiver application and relevant clause number	Provisions made on Plans	Reasons in support of the applications
D1)	For BLOCK 3 (1st sty) Fire Code 2018 **Clause 2.3.3 (c) (3) (d)** Exit Staircase: In the case of a PGII residential building not fitted with an automatic sprinkler system, at least 50% of the total number of exit staircases shall discharge to an external space and the remaining exit staircase can be discharged to the ground level covered circulation space provided the following are complied with: - (d) There shall **not be more than four residential units** opening into the designated escape passageway at grade level into which the exit staircase discharges Deviation: To allow one of the two exit staircases serving block 3 to discharge into the 1st-storey common corridor serving 7 residential units (more than 4 units).	The residential floors are provided with two escape staircases and two lifts inclusive one fire lift. There are eight residential units per floor (typical),and **seven residential units at the 1st-storey**. The common corridors are designed as naturally ventilated with cross ventilation. Floor-to-floor height = 3.15m. **Ceiling height of the common corridor = 2.6m.** With the exception of the above deviation, the common corridor complies with the prescriptive provisions of the Fire Code. Fire safety precautions provided to the block: • Fire sprinkler system (Basement only) • Manual call point in basement, alarm bells in basement and residential floors • Smoke purging system via ductless jet fan system (Basement only) • Fire hose reels • Dry rising mains • Each residential unit is fire compartmented with 1/2 hour fire door • HFAD installed within each residential units • Provision of permanent opening in common corridor for smoke venting • Fire escape staircase • Emergency lighting	Refer to the attached CFD study which demonstrated the effectiveness of the corridor's cross ventilation design of the current design in dissipating the smoke in the corridor whilst maintaining tenable condition for occupants' evacuation as per FSD's requirement. **Visibility and temperature along the corridor measured @ 2m above the finished floor level are within the acceptable criteria of 10m and 60 degC respectively.**

D1/D2/D3
BLK3/5/7 Typ. Floor
Residential Fire

Approach, Assumptions, Input Parameters & Results

Quality of FEDB/FSER/FEA

- The details of fire scenarios shall be indicated clearly in the marked-up layout/section view together with fire location in alignment with the tabulation of proposed fire scenario summary.

Minimum details needed to describe the fire are:	
(i)	Heat Release Rate (HRR)
(ii)	HRR per unit area and/or fire perimeter (nos. & dimension of burner)
(iii)	Fire growth rate
(iv)	Floor to floor or floor to ceiling height
(v)	Soot yield
(vi)	Combustible material
(vii)	2nd ring sprinkler-controlled fire or other type of fire
(viii)	Axis-symmetric plume or spilled plume

Quality of FEDB/FSER/FEA (Good Example)

Table 9.2-1: Summary of Fire Scenarios for Assessment

Floor	Location	Deviation No.	Fire Size	Fire Perimeter	Soot Yield	Worst Fire Scenario	Remarks	Total Exhaust Flowrate
7th Storey	Warehouse 7B	D01, D02, D03, D05	6.1MW	11.7m	0.1g/g	BC01 – 6.1MW	Remote corner fire.	45m³/s
	Warehouse 7B	D01, D02, D03, D05	6.1MW	11.7m	0.1g/g	BC02 – 6.1MW	Axis-symmetric plume at the centre of the warehouse area for maximum smoke entrainment.	45m³/s
	Warehouse 7B	D01, D02, D03, D05	6.1MW	11.7m	0.1g/g	SS02 – 6.1MW	Sensitivity Study 1 no. of exhaust fan is assumed to fail during fire mode operation.	30m³/s
	Warehouse 7B	D01, D02, D03, D05	6.1MW	11.7m	0.1g/g	SS02S – 6.1MW	Sensitivity Study 1 no. of solid roller shutter fails to open for replacement air.	45m³/s
	Warehouse 7B	D01, D02, D03, D05	6.1MW	11.7m	0.1g/g	BC03 – 6.1MW	Fire nearest to replacement air intake.	45m³/s
	Warehouse 7B	D01, D02, D03, D05	6.1MW	11.7m	0.1g/g	SSA	Most utilized staircase made unavailable.	45m³/s
	Warehouse 7B	D01, D02, D03, D05	6.1MW	11.7m	0.1g/g	SSB	Delay in detection time based on 1st ring sprinkler activation.	45m³/s
	Loading/Unloading Bay	D04	15.0MW	23.0m	0.1g/g	SS04R – 15.0MW	Sensitivity Study 50% increase in truck fire size for fire spread assessment	45m³/s

Note:
- The fire sizes area calculated using FPETool based on 2nd ring activation of sprinklers.
- The truck fire size of 15MW with perimeter 23.0m (9.0m x 2.5m) is based on goods vehicle fire in Chapter 7 of Fire Code 2023 & SFEG 2015.
- 0.1g/g soot yield in accordance with SFEG 2015.

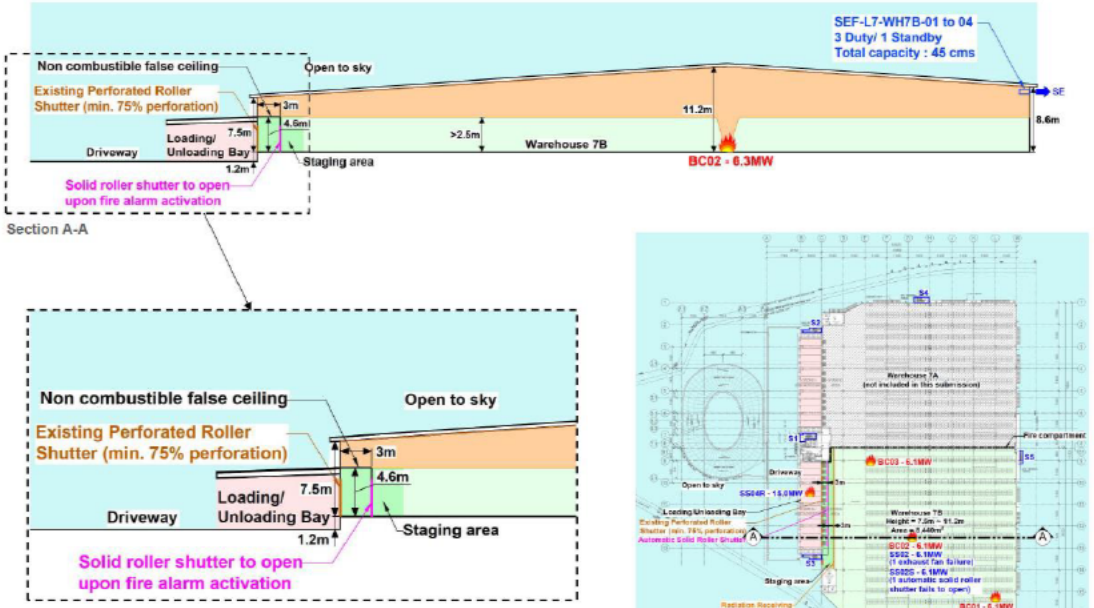
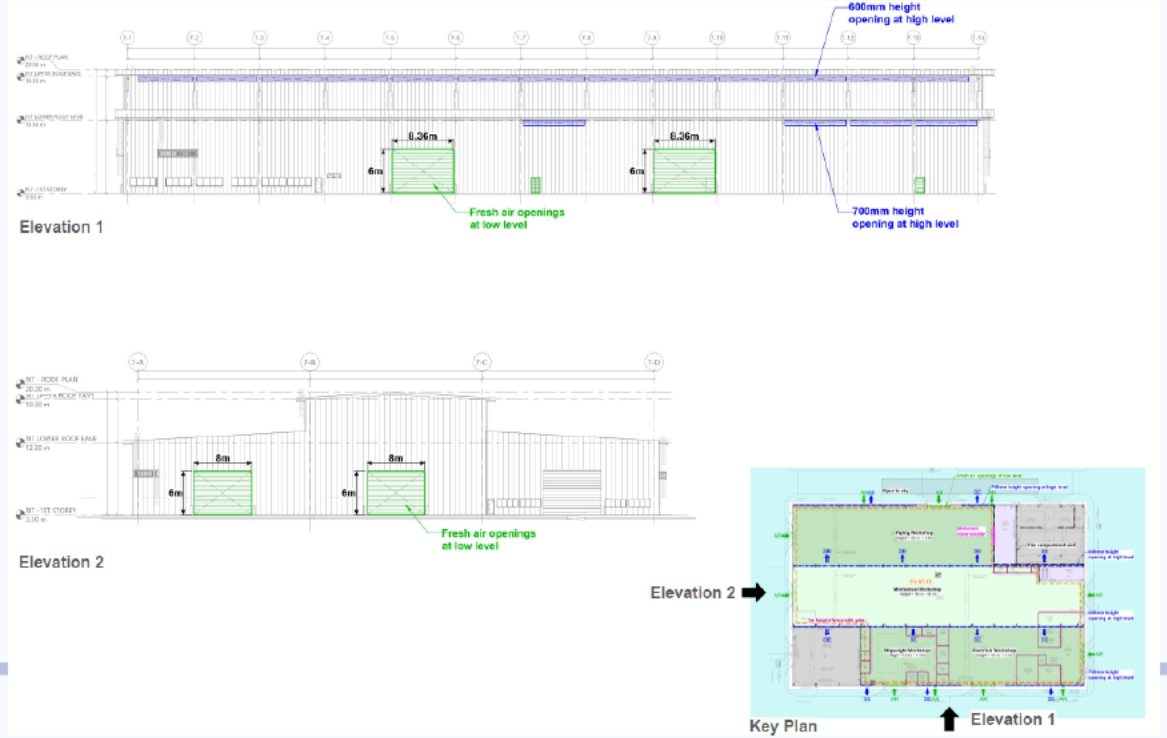


Figure 9.2-1: Smoke Flow Diagram for Fire at 7th Storey Warehouse 7B

Quality of FEDB/FSER/FEA (Good Example)

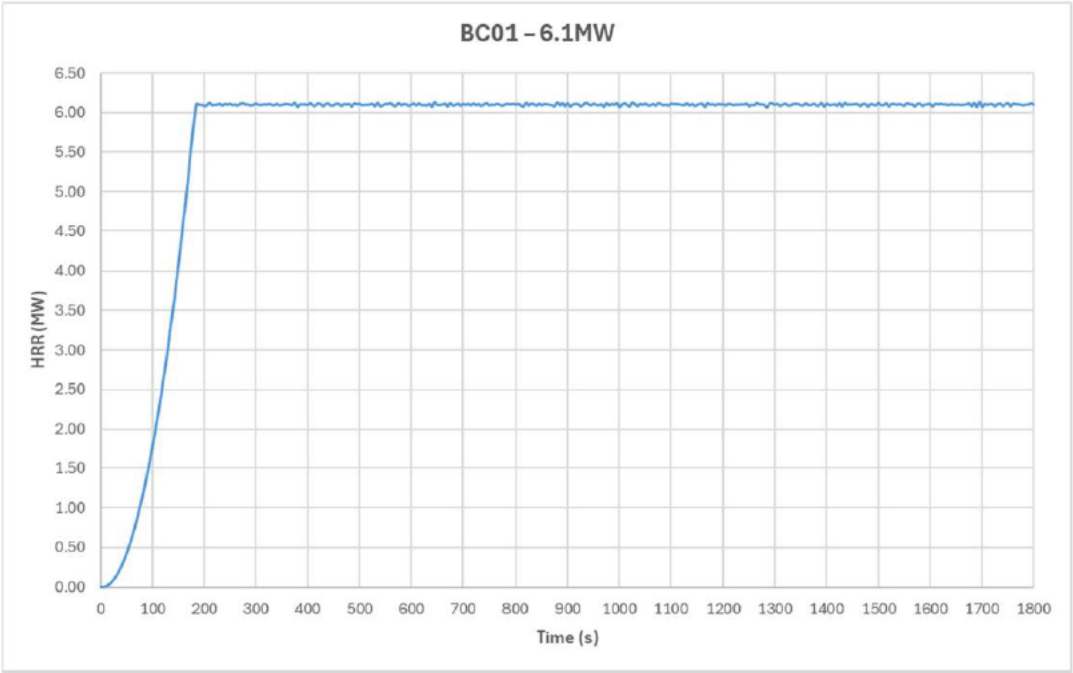
- In case of modeling a fire scenario with natural ventilation, the location and dimension of vent openings shall be indicated clearly in the layout too, together with the section view of fire location. E.g.



Quality of FEDB/FSER/FEA (Good Example)

- FSE to document the overall graphic HRR output within the computational domain for each fire scenario to demonstrate fire size and fire growth rate captured in the simulation in alignment with your proposed fire scenario in the report. E.g.

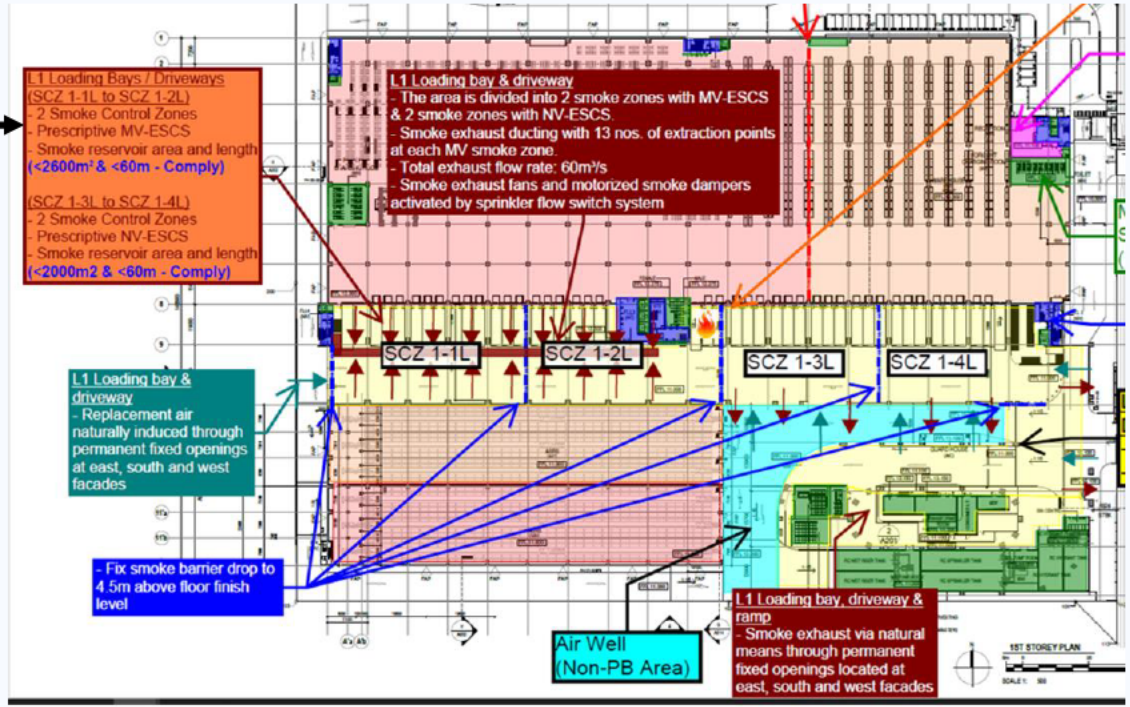
Figure 10.3-3: Heat Release Rate (HRR) Graph – BC01-6.1MW



Quality of FEDB/FSER/FEA (Bad Example)

- FSE to ensure all text are legible with good presentation i.e. colours well contrasted.

Poor colour contrast (text against background)



Reminder on correspondences to PB offices

- Reminder to inform **all PB officers** when submission (PB waiver / FEDB / FER) is made
- Reminder to include **all PB officers** in the email distribution list for all correspondences on PB projects
- PB officers
  - ✓ Kristy Chen (kristy_chen@scdf.gov.sg)
  - ✓ Farah Binte Mohd Faudzi (farah_md_faudzi@scdf.gov.sg)
  - ✓ Nicholas Lee (nicholas_lee@scdf.gov.sg)

Fire Engineering Technical Requirements Update

Emergency Illumination Lux Approach for Ductless Jet Fan System in Carpark

Fire Code Cl.7.4.4.g.(1)(b)

(b) Acceptance criteria

(i) Not more than 1000m^2 of the car park space can be smoke-logged for at least 20 mins, regardless of whether the fire is located within the smoke control zone or across the zone boundaries (Note: After the 20 mins duration, smoke is expected to remain confined within the 1000m^2 area). Within this smoke-logged area, there shall be at least 1 viable route for the firefighters where the following conditions are satisfied:

* Smoke temperature shall not exceed 250^{o}C at a height of 1.7m from floor level.

* Visibility shall not be less than 5m at a height of 1.7m from floor level.

These conditions shall commence at a distance of 5m from the fire location in the direction opposite to the induced bulk air flow induced by the jet fans. All other areas outside the smoke-logged area shall be kept substantially free from smoke i.e. smoke temperature not more than 60^{o}C and visibility of at least 25m (*Diagrams 7.4.4e (4) - 1 & 2*).

(Note: If hot smoke test is performed, assessment is to be made on the operation of the jet fans system, movement of smoke towards the extraction points and smoke spread. The latter 2 aspects can be generally verified using the above visibility criterion. The temperature criterion need not be verified in view of the nature of the hot smoke test.)

Acceptance Criteria Updates

In the event 'visibility ≥ 25m' criterion cannot be achieved for spaces beyond the maximum allowable 1000 m^2 smoke-logged area, FSEs can consider use of emergency illumination and subject to the following:

(1) the illumination shall have **at least an average of 10.8 lux** along the path of egress measured at floor level during hot smoke test;

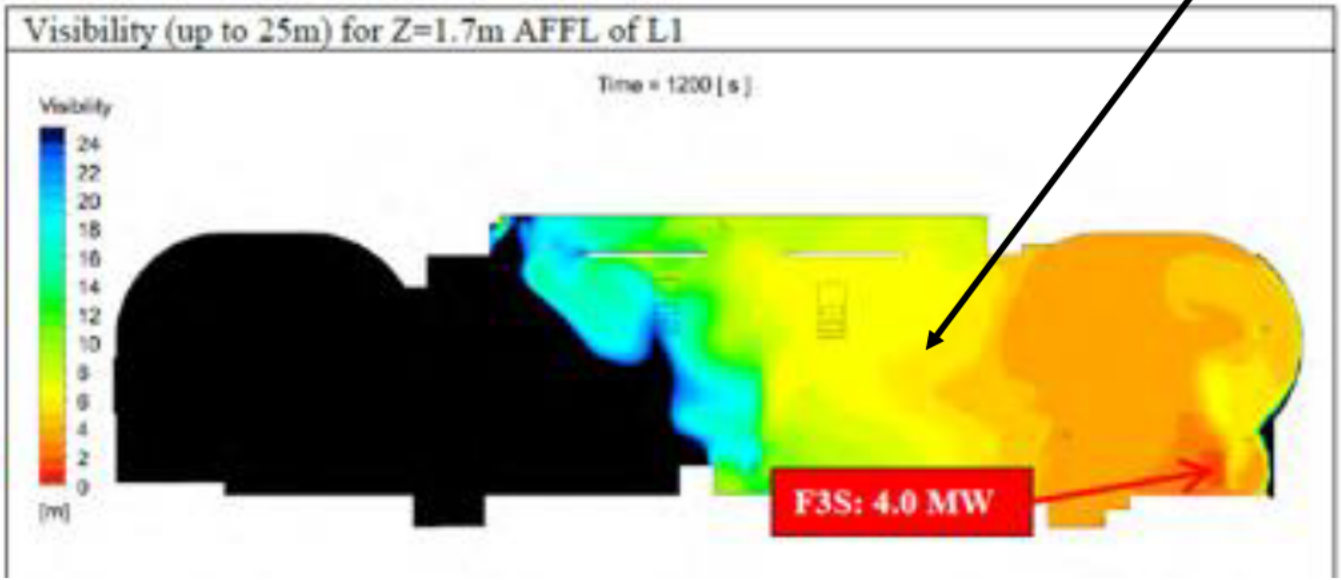
(2) smoke temperature not more than 60°C and **visibility of at least 10 m** at 1.7 m AFFL; and

(3) at least 1 viable route for firefighters within the smoke-logged area, where smoke temperature not more than 250°C and visibility of at least 5 m at 1.7 m AFFL.

CFD Results – Demarcation of smoke-logged area

- Visibility output 1

To show smoke-logged area demarcation by visibility ≥ 25 m, **more than 1000 m2**.

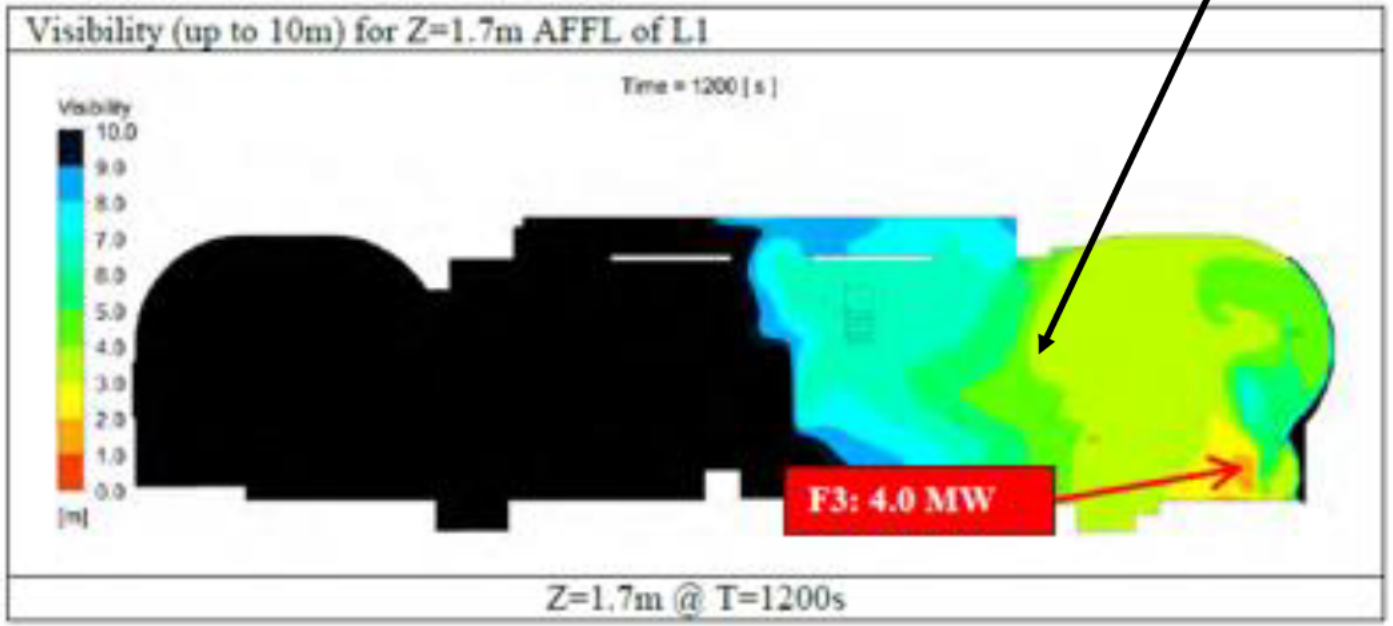


Note: CFD captured C-3 in all scenarios.

CFD Results – Demarcation of smoke-logged area

- Visibility output 2

To show smoke-logged area demarcation by visibility ≥ 10 m, **less than 1000 m2**.



Note: CFD captured C-3 in all scenarios.

International Reference

NFPA 101 Handbook, Section7.9.2.1

- Emergency illumination shall be provided for a minimum of 90 minutes in the event of failure of normal lighting. Illumination must not be less than an average of **10.8 lux** along the path of egress at floor level, and at any point no less than 1.1 lux, measure at floor level.

- Tabulation of designed lux level for the affected carpark floor(s) in the report.

- Lux to be measured on-site
  - During hot smoke test
  - Turn off main power
  - To note that lux measured on-site will be likely less than the designed lux level due to hot smoke. Strongly suggest to provide buffer.

- FSE, RI and QP shall be jointly responsible for the outcome of the assessment of lux level measurements.

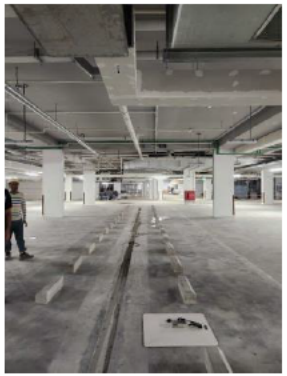


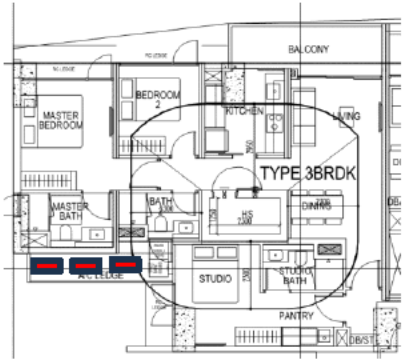
Table 7.4: Mean lux level over escape route of car park

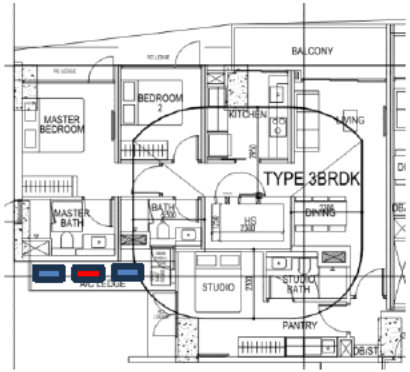
CP level	Watt/e-light (W)	Est. lumen/ e-light (lm)	No. of LED along escape route	Total lumen (lm)	Area of escape route (m2)	Mean lux level - Escape route (lm/m²)
B1	20	1500	106	159,000	4,578	**34.73**
B1M	20	1500	22	33,000	853	**38.69**
1	20	1500	22	33,000	870	**37.93**
2	20	1500	22	33,000	870	**37.93**
3	20	1500	23	34,500	870	**39.66**

Multiple Air Compressors on Ledge

Multiple Air Compressors on Ledge

- FSEs to consider a multiple AC compressor fire scenario.
- Single AC compressor fire scenario can only be acceptable if FSEs provide justification that there is adequate AC separation to prevent fire spread between compressors. The AC layout must match fire engineering report.





Car Fire Soot Yield

Car Soot Yield Value

- SFEG 2015 states that "*FSE may adopt a soot yield, which refers to mass of soot generated during combustion divided by the mass loss of the test specimen, not lower than 0.1 kg/kg, unless he/she has justification to adopt other values.*"

- For vehicle fires, soot yield for general car parks shall **not be lower than 0.07g/g**.

Staircase Acceptance Criteria

Staircase acceptance criteria

Acceptance Criteria for exit staircases:

At <u>all</u> staircase landings (except for carpark Z = 1.7m) at Z = 2.0m:

1. **Temperature < 60◦**
2. **Visibility > 10m**

Throughout whole exit stair

3. FED < 0.3

Thank you!

FSE-CPE = 3 hours
for FSE Workshop 2025 attendees