# A Holistic Approach for Performance-based Design of Data Centres

Lithium-Ion Energy Storage Systems (ESS) in Australia

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# Acknowledgement of Country

Engineers Australia acknowledges the Traditional Custodians of the Countries throughout Australia and recognises their continuing connection to land, waters, skies and community.

We recognise Aboriginal and Torres Strait Islander Peoples, as the oldest continuous cultures on earth and our first engineers.

We pay our respects to them and their cultures: and to Elders past and present.

# Presentation Outline


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1) What is a Data Centre?
2) Key Considerations
   a) Fire Safety Study
   b) Dangerous Goods
   c) Security
   d) Occupant Life Safety
   e) Public Authority Requirements
   f) Building Codes and Standards
3) Performance Based Design
4) Conclusion

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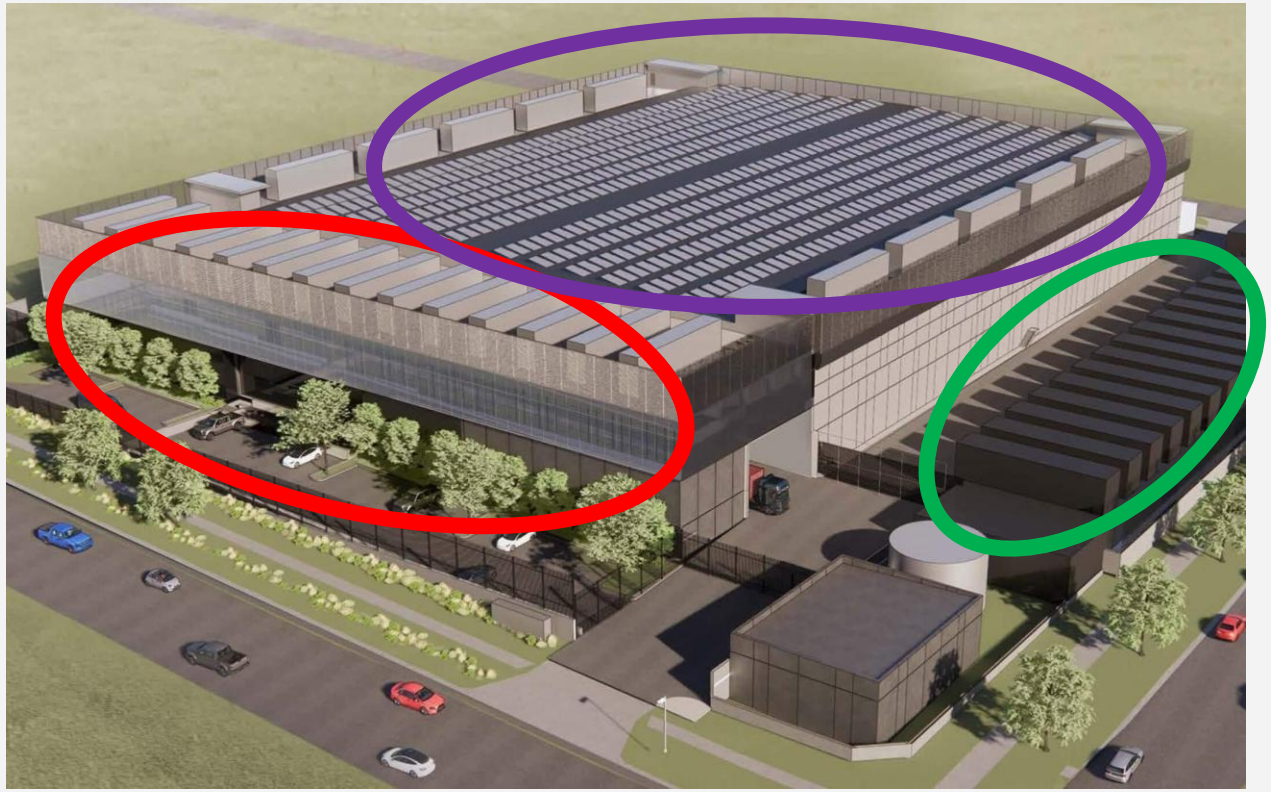
# Data Centres

Typically consist of three (3) main areas:

- Office Areas
- Data Halls
- Plant equipment
  - Diesel generator
  - uninterrupted power supply (UPS) containing Lithium-ion Batteries (LiBs)

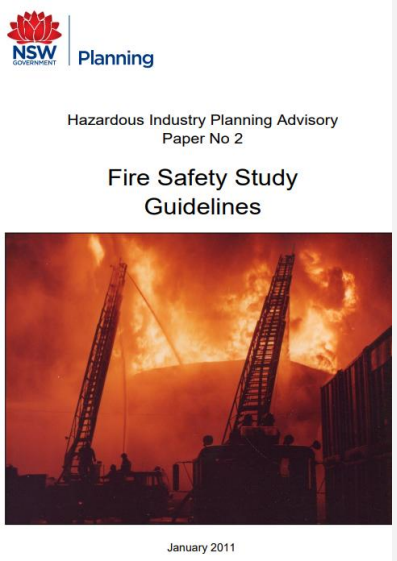
- LiBs can either be within the building or external.
- Battery type, location and specification usually dictated by Tenant within the limitations of Building Owners approvals

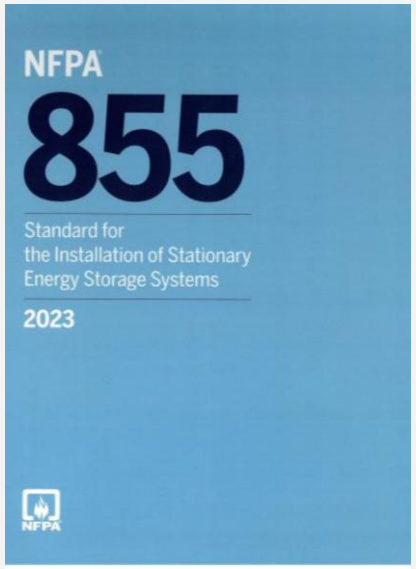


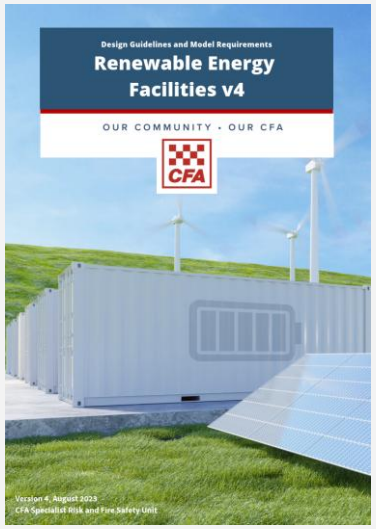
https://dgtlinfra.com/stack-infrastructure-australia-data-centers/

# Key Considerations

# Fire Safety Study (FSS)



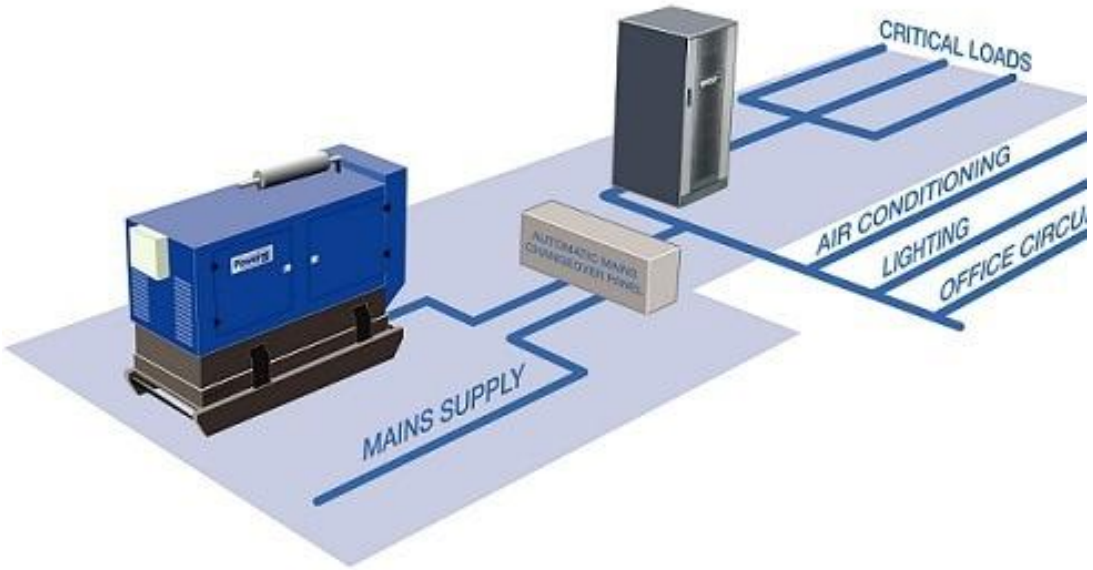

- Prepared as per NSW Hazardous Industry Planning Advisory Paper 2 (HIPAP 2)
- Currently utilised by NSW and VIC
- Also being applied to projects containing LiBs in other states
- Considers:
  - Consequence modelling of credible scenarios
  - Adequacy of fire safety systems relative to the risk
  - Consideration of fire detection, suppression, smoke management and explosive hazard.
  - Fire water runoff and containment
- Assessment extends beyond Australian Standards:
  - NFPA 855
  - UL 9540A Testing
  - CFA Guidelines and other state specific guidelines
  - NSW Best Practice Guidelines for Contaminated Water and Treatment Systems

# Dangerous Goods

Data Centres required continual operation even during a power outage.

Typical goods requiring consideration:

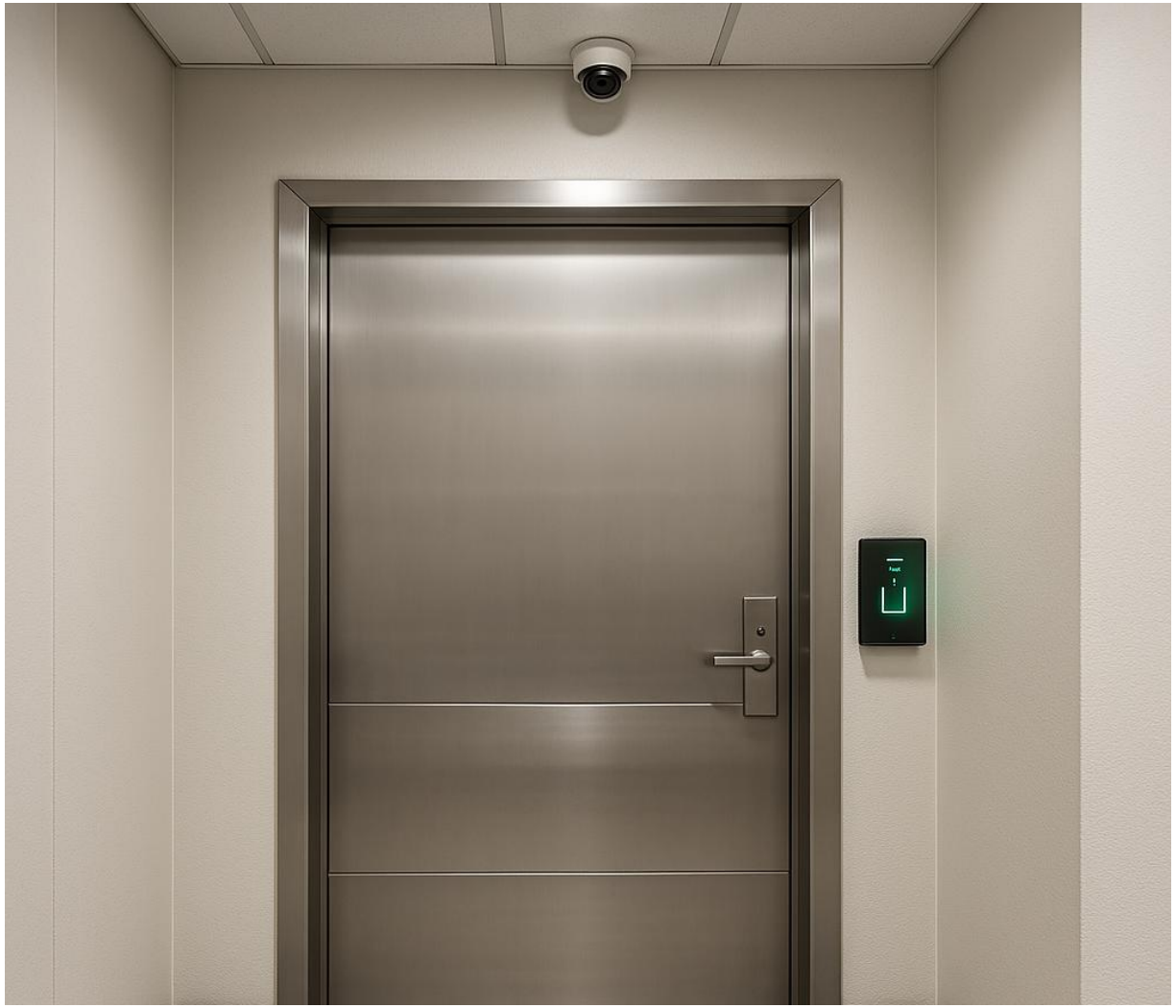
- Lithium-ion Batteries (LiBs) as part of a UPS system to take up the load immediately during a power outage.
- Diesel in generators with day or bulk tank for initial operation
- Diesel bulk storage for ongoing supply to the generators for the duration of the outage
- Transformer cooling oil for onsite equipment ranging from small quantities of oil to large power transformers.




https://www.kohler-ups.co.uk/how-to-pair-your-ups-and-generator/

# Security

- A building may have multiple tenants
- Maintaining the security of the information stored is vital and requires strict access control.
- What happens in an emergency?
- How do the security measure impact evacuation?



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# Occupant Life Safety and Fire Brigade intervention

- Impact of toxic gases that are produced by LiBs
- Potential explosion risk associated with a closed room
- Fire brigade exposure protection
- Information for response planning
- Site access
- Occupant wayfinding
- Occupant notification
- Obstructions as a result of security measures

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# Public Authority Requirements

- Contaminated fire water runoff
- Environmental impacts
- What surrounds the land?
  - Waterways (i.e. Rivers, lakes, etc..)
  - Bushland
  - Sensity environmental sites
- Containing water in room = Electrocution risk
- Where does the contaminated water go?
- Are dedicated tanks required?

# Building Code and Australian Standards

- The NCC and Australian Standards were never designed for such large buildings with special hazards
- The NCC E1D17 and E2D21 special hazards clauses
- These Clauses provide a critical link between the FSS and Fire Engineering performance-based Design.
- Fire safety strategies typically extend beyond the NCC and Australian Standards to international standards:
  - FM Global Data Sheets 5-32 and 5-33
  - NFPA 855
  - UL 9540A Testing
  - ISO 31000 Risk Assessments

**E1D17 Provision for special hazards**

Suitable additional provision must be made if special problems of fighting fire could arise because of—

(a) the nature or quantity of materials stored, displayed or used in a building or on the allotment; or

(b) the location of the building in relation to a water supply for fire-fighting purposes.

**E2D21 Provision for special hazards**

Additional smoke hazard management measures may be necessary due to the—

(a) special characteristics of the building; or

(b) special function or use of the building; or

(c) special type or quantity of materials stored, displayed or used in a building; or

(d) special mix of classifications within a building or *fire compartment*,

which are not addressed in E2D4 to E2D20.

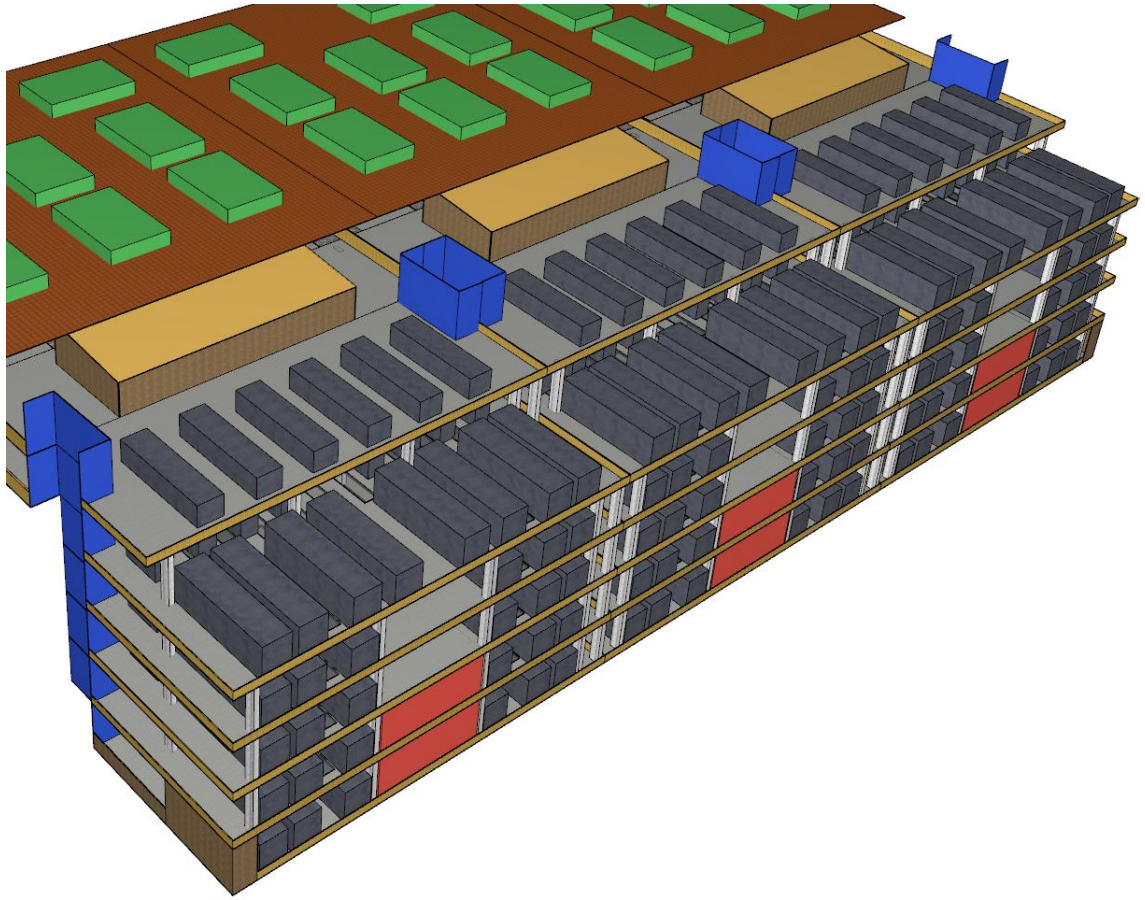
# Performance Based Design – Example

# Building Details

https://dgtlinfra.com/stack-infrastructure-australia-data-centers/

- Rise in storeys 14 with 7 storeys contained.
- Effective Height above 25 m (~32 m)
- Largest fire compartment ~22,000 $m^2$ and 133,000 $m^3$
- Total Floor Area – 150,000 -200,000 $m^2$
- Not a Large Isolated Building
- Type A Construction
- Class 5, 7b, 8 and 10b
- Fifteen (15) fire isolated stairs
- 240/240/240 FRL and 120/120/120 FRL compartmentation

# Occupant Life Safety



Lote Model

## Considerations

- Travel distances up to 90 m in lieu of 40 m.
- Distance between alternative exits up to 170 m in lieu of 60 m
- Security locked doors in the paths of travel

## Performance Design

- Internal compartmentation 120/120/120 FRL and 240/240/240 FRL
- Advanced smoke detection
- Dynamic exit signage
- Computational Fluid Dynamics (CFD) smoke modelling

# Fire Brigade Intervention

**Considerations**

- Travel distances up to 90 m in lieu of 40 m.
- Hydrants outside the fire stairs to provide coverage
- Additional lengths of hose
- Locating the seat of the fire

**Performance Design**

- Internal compartmentation 120/120/120 FRL and 240/240/240 FRL
- Horizontal exits
- Information from FDCIE and Security Systems
- Toxic and flammable gas exhaust systems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# Limitations of Codes and Standards - Hydrants

- AS 2419.1 was updated to the 2021 Version and incorporated as part of NCC 2022.
- Section 1.1 Scope notes

  ***The standard is for Class 7b and 8 buildings not exceeding 108,000 $m^3$***
- Contemporary data centres are likely to substantially exceed this limitation.
- Volumes could be closer to 1,000,000 $m^3$
- Consideration of Appendix C which was designed for single storey large isolated buildings not buildings above 25 m.
- Appendix C requires consideration of:
  - External hydrant and booster location
  - Brigade travel distances
  - Limitations of self-contained breathing apparatus (SCBA)

Lote Photo

# Limitations of Codes and Standards - Sprinklers

- AS 2118.1:2017 lists IT Data Centres as Ordinary Hazard 3 (OH 3)
- Specifically excludes ***Lithium and other exotic materials*** under the classification of commodities.
- Limited full-scale testing
- Consideration of international standards:
  - NFPA 855:2023
  - FM Global Data Sheets 5-32 (Racks less than 20kWh)
  - FM Global Data Sheets 5-33 (Racks exceeding 20 kWh)

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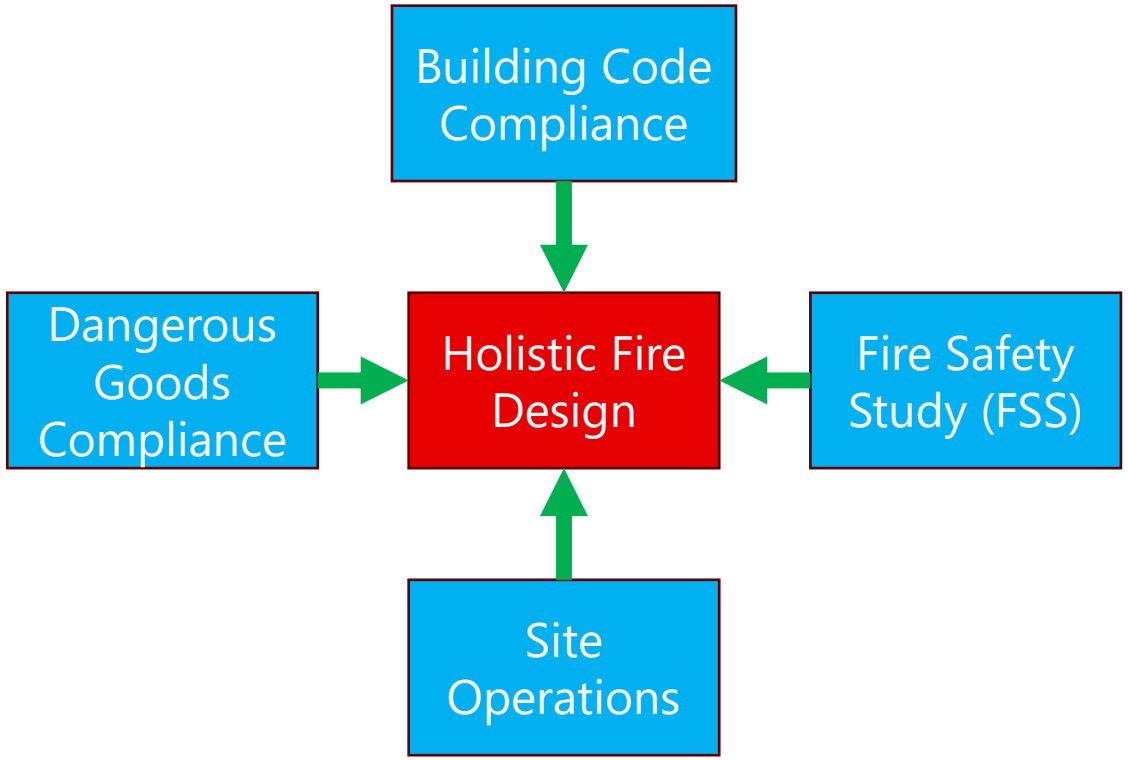
# Summary




- Contemporary data centres require holistic performance-based design
- Early engagement is important with critical stakeholders:
  - Building Certifiers
  - Building Insurers
  - Fire Brigades
  - Regulatory Agencies
- Hazard and risk management within these complex buildings extended beyond minimum Australian Standards


# thank you


- **Christopher Koch & Dr Amer Magrabi**
  - Lote Consulting – Fire | Security
  - www.loteconsulting.com