

Sydney Opera House

Accessibility and Renewals Project

Overarching Fire Strategy

Issue | 19 August 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 243928-10

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Annual Fire Safety Statement

1 Introduction

The Sydney Opera House is undergoing a period of renewals.. This is primarily focused on improving: wheelchair access; services in the House; improved patron and performer experience in the Concert Hall; the Function room, and various Front of House areas. Consequently, there are many parts of the House that are either undergoing design changes, change in purpose or are impacted by the new works.

The Sydney Opera House understands the importance of protecting occupants and the building from the impacts of fire and have appointed Arup to undertake various fire engineering studies since 2003 as outlined in Section 2.1.

The Opera House fire safety design was envisaged in the Utzon Design Principles in 2002 as follows,

“In the Sydney Opera House you are aware of your orientation at all times. It is important that each number of the audience has a simple, easily understood tour, from the entrance to his or her seat and out again.”

“All problems regarding fire and fire staircases are solved in a similar comprehensive manner.”

Whilst the majority of patrons experience a simple and well understood exit system familiar to them via their entry path, there are other parts of the house and previous re-purposing work which have been addressed with a more comprehensive fire strategy approach built on resiliency through a variety of fire safety measures and management controls.

Arup is continuing its involvement in maintaining consistency of fire safety through the provision of advice and design feedback from the early conceptual stages through to the Planning Application stage of the Renewal projects.

This report is intended to support the State Significant Development applications and sets out the fire safety planning and strategy approach to the Renewals Projects and how an acceptable level of fire safety will be maintained throughout the House once the projects are completed.

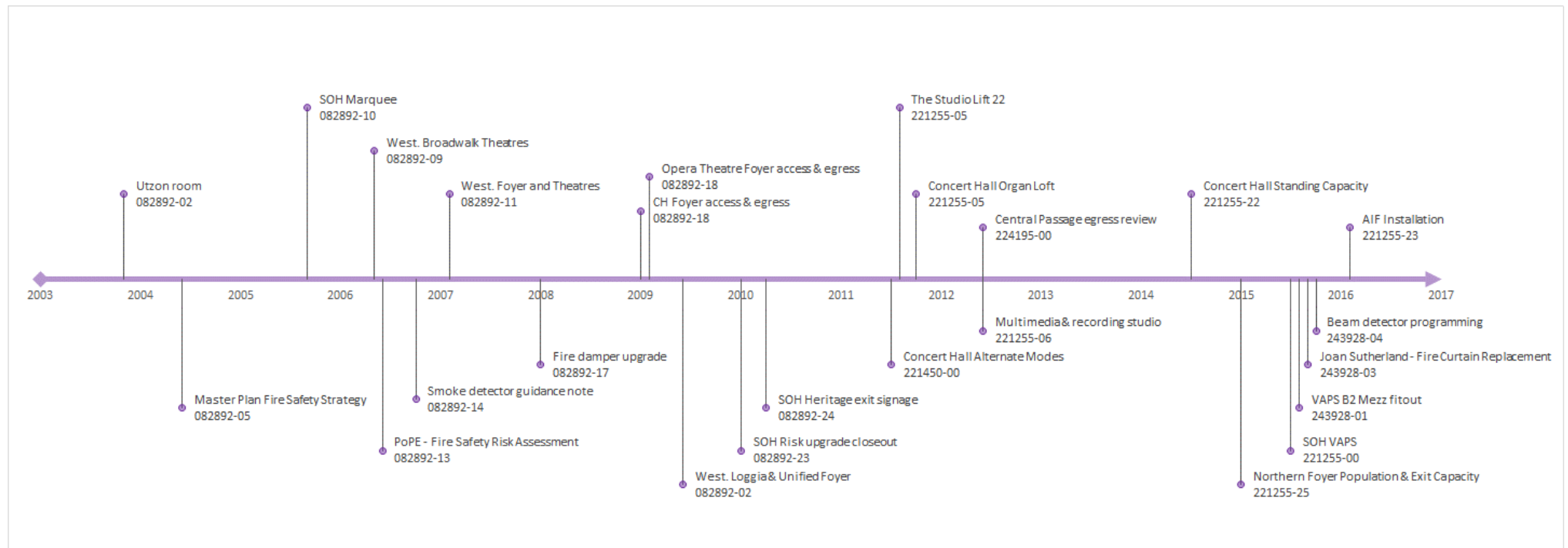
Further details are provided in Section 2.2, however it is recognised the designs will be undergoing a period of design development following the planning consent. Therefore details of the projects, associated non compliances and corresponding fire strategies will need to respond to the final designs where they are in keeping with the consent conditions.

Consequently, the objective of this report is to be referenced in the State Significant Development consent as the guiding approach to fire safety, recognising the detailed fire strategies to achieve compliance will be addressed in subsequent fire safety engineering reports as part of a holistic fire safety approach in harmony with existing fire safety strategy.

2 Fire Safety Engineering at the House

2.1 Timeline of fire engineering

The following timeline illustrates the development of the key fire safety strategies for the House over the last 10-15 years.



2.2 The Renewals Fire Strategy

The advice provided by the Project Planners (Dan Keary Urban Planning) and Group DLA (Building Code of Australia Consultant) indicates the building approvals will be undertaken as Crown building works under Section 109R of the Environmental Planning and Assessment Act 1974 (EP&A).

All new physical works will satisfy the Building Code of Australia (BCA 2016) Performance Requirements relating to fire safety. Where the new works alter existing elements of the building, they will need to be consistent with the current approved strategies to maintain the existing level of safety or otherwise be re-assessed against the acceptance criteria of the existing reports.

Where no existing engineering reports address the issues identified, the works must either maintain or ideally improve the current level of fire safety.

All new works will be consistent with the existing Class 9b Entertainment Venue building classification and the installed fire measures in the building summarised in the Annual Fire Safety Statement in Appendix A.

Performance Solutions will be referred to Fire and Rescue NSW for consultation.

2.2.1 General Strategy

The fire safety strategy for the Sydney Opera House consists of layers of fire safety measures and design features intended to limit smoke and fire spread and aid with simple and intuitive exit from the building. In summary this consists of:

- Fire and smoke protection to limit the spread of fire and smoke to the area of fire.
 - This enables staged managed evacuation of performance spaces which helps to not over-load the exit system.
 - Work has been carried out over the years and is ongoing to check and enhance this.
- Egress is available along the entry path from the CH and JST via the podium (Level 2 and 1) as well as the Ground Level providing multiple alternative exit points utilising familiar routes.
- Smoke detection has been progressively provided through the House such that all main risks and paths of travel are now covered. This is monitored with a 24hr security and fire response team to investigate and manage evacuation.
- Sprinkler protection has been progressively introduced over the years such that all parts of the house are covered apart from the high ceiling spaces of the foyer spaces of the CH and JST. This system significantly enhances protection by limiting fire growth and smoke production giving occupants longer time to evacuate.

- Smoke management is provided to the performance auditoriums throughout the House to provide enhanced conditions during evacuation. This is currently limited in the Joan Sutherland Theatre and Concert hall (subject to the Renewals works). Given the extent of works to the JST no further works to the fire systems are considered necessary and the existing level of safety will not be diminished. For the Concert hall full performance assessment will be necessary to prove up the design.

Further details of the fire strategy are outlined in the following sections.

2.2.2 Fire Protection and Separation

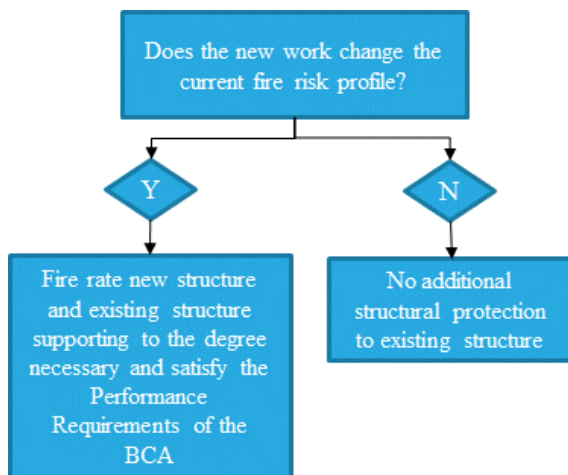
2.2.2.1 Structural Fire Protection

The Sydney Opera House (SOH) is constructed using a series of key structural floors, vertical concrete shafts, and walls. These shafts and walls in some areas run through the entire height of the SOH. They not only provide structural support but also provide substantial service shafts utilised throughout the building. This leads to a number of spaces being fed from centralised points. The understanding of these connections is vital in the overall compartmentation strategy developed by Arup and reported in the May 2007 report.

Another key parameter is the heritage nature of the building and the restrictions put on any design. Generally to bring any existing building up to current standards is often very costly and impractical. The SOH is no exception due to the amount of services running through the building requiring penetrations and service shafts.

Existing steel trusses and portal frames support the back of house functions such as the lighting and sound areas in the “Bio” boxes as well as plant and ceilings located above the auditorium of the CH and JST.

No retrospective upgrades of structural fire protection are considered necessary unless noted below due to changes in risk. Previous major works such as the VAPS project have been fully fire separated from the existing parts with BCA compliant fire protection.



2.2.2.2 Fire Compartmentation

The Sydney Opera House features a number of interconnected foyer spaces including the entry, southern, northern and side foyers which are a unique feature of the architecture and aid with wayfinding and circulation. This is helpful during evacuation but can present challenges to limiting fire and smoke spread.

This challenge has been partly addressed in previous fire strategies through the introduction of sprinklers to the Entry Foyer space to help reduce the consequences of a fire. These studies have investigated the consequence of smoke spread and determined that occupants of the auditoria are able to evacuate to outside before untenable conditions are met. Preliminary investigations indicate this remains the case with the proposed Renewal changes and as such the existing strategies are capable of being maintained.

The existing fire rated wall separation and compartmentation strategy assists with limiting smoke spread as part of these strategies and will be maintained with minor modifications to area and location. Compartmentation will be checked throughout the project to maintain consistency and not adversely impact on the existing level of fire safety.

Examples of this include:

- Where smoke doors are being replaced or relocated in the Auditorium of the JST or CH they will be replaced with a door matching the fire resistance performance.
- The new Function Centre and Creative Learning centre – Fire rated walls will be adjusted to incorporate the functions into a single fire compartment and separate the use from existing parts with fire rated construction.
- Fire ratings of fire exit stairs will be maintained where the arrangement of doors will be changed to accommodate the new works. Discharge of existing fire stairs 02, 26, and 17 will be improved on the current arrangement to enable occupants to exit into a fire rated lobby from where they can exit to a separate alternative fire compartment or the case of stair 26 direct to outside rather than discharge directly into the building as is the current design.

The current fire compartmentation strategy for the building is documented in the 2007 report called “Fire Compartmentation Strategy” (Arup ref 85376-00) and the Master Plan Strategy outlined previously. Arup are working with the House to update a working set of fire wall and compartmentation plans to reflect the current strategies.

2.2.3 Egress

The egress strategy for the House will be reviewed for consistency as the designs progress. It's acknowledged that the new works will improve accessibilities therefore emergency egress provision for mobility impaired occupants will be considered for each of the projects during design development.

The strategy currently relies on travel via the Southern foyers from the CH and JST auditoriums to egress via the Level 2 podium or via the Entry Foyer to the podium or under the steps (UTS).

The Northern foyers are served by fire protected stairs that discharge at Ground level internally as well as direct egress to outside at Level 2. Egress is also available via the side foyers to the South.

The Western Foyer discharges direct to the west and under the steps with the associated Theatres discharging either via the Western Foyer or the Central Passage to outside via the space under the steps.

As far as possible egress routes should be intuitive for the public, utilising entry routes or clear exits to outside.

2.2.4 Fire Detection System and Warning

Areas of new works will be provided with smoke detection, which will be selected, spaced and installed to AS 1670.1 2015. Where it is impracticable to achieve full coverage for a heritage building with contours and ceiling obstructions or where spurious alarms are likely, a performance solution will be considered to achieve an acceptable level of fire safety.

The detection will be integrated with the existing monitoring and warning systems in the House to raise an alarm.

These spaces will also be provided with sounders located and installed to AS1670.4 2015 and adjusted to suite new layout, which will be connected to the existing House emergency warning infrastructure.

2.2.5 Fire Suppression

Areas of new works will be largely provided with sprinklers, which will be selected, spaced and installed to AS 2118.1 1999. There may be some exceptions to this where it is highly problematic to install and the fire life risk acceptably low without them.

The sprinkler heads and runs will be integrated into the existing sprinkler infrastructure. This is described below from the Warren Smith and Partners (fire services consultant) 50% Scheme report for the CH:

“The existing building is partially protected by an Automatic Fire Sprinkler system. The main non protected areas are the North and South foyers for each of the Concert Hall and Opera Theatre. Generally protection covers all of the subject areas.

The Fire Sprinkler system is pressurised by three on-site pumps. The two (2) main Diesel pumps located in the VAPS pumphouse are fed from the on-site water storage tank. A third pump is located in Plantroom 1 and is supplied from incoming water mains from Macquarie Street. Alarm Valve assemblies are located within Plantroom 1 with mains reticulated throughout the buildings to protect various risks.”

2.2.6 Smoke Control

Smoke exhaust is generally only provided to the performance spaces with shut down of non-essential systems. The foyers have large volumes which increase the time to onset of untenable conditions, as previously assessed through smoke modelling as part of a fire engineered assessment of egress from the performance spaces.

2.2.7 Fire Fighting Intervention

2.2.7.1 First-aid firefighting

First aid fire-fighting equipment will be provided to meet the BCA Performance Requirements in areas of the new works. The exception to this will be that all new works will be served by the existing Fire Hose Reel System, fed from the Hydrant system. There will potentially be some changes in compliance as a result of minor upgrades to fire compartmentation requiring coverage to be assessed against the Performance Requirements of the BCA.

2.2.7.2 Fire Hydrants

The existing fire hydrant system will provide coverage throughout the existing areas. The new works are unlikely to adversely impact this coverage. Coverage via fire protected stairs will be improved through the provision of protected lobbies at Ground floor and the introduction of the access tunnels from the Southern Foyer.

The fire services consultant, Warren Smith and Partners 50% Scheme report for the CH states:

“The existing building is protected by a Fire Hydrant system. The existing system has been subject to a staged upgrade over the past 10 years as the result of a Fire Order from FRNSW. The resulting system solution represents a ‘near-as-possible’ compliance to AS 2419 system acknowledging the lack of DTS fire stairs within the SOH.

Given the recent upgrade project the works for the FH system will be limited to retaining full coverage to existing areas, provision of temporary mains pipework to retain system operation outside the construction areas and relocation of pipework and valves to suit new works. It is assumed that localised modifications to pipework including, the rising mains in the current spiral stair void may also be necessary.”

3 Conclusion

The continuity of the fire safety strategy at the Sydney Opera House is dependent on the ongoing review and assessment of the proposed changes against previous fire engineering assessments and the application of first principles design solutions to achieve acceptable fire safety outcomes for this complex building.

The objective of this report is to act as the guiding approach to fire safety, recognising the detailed fire strategies to achieve compliance will be addressed in subsequent fire safety engineering reports.

Consequently, it is considered that the level of fire safety won't be diminished through the Renewals projects and further enhancement to safety can be achieved as part of these works

Appendix A

Annual Fire Safety Statement

A1 Annual Fire Safety Statement



Annual Fire Safety Statement

Under the *Environmental Planning and Assessment Regulation 2000 – Division 5, Clause 175 and 178*

Owner's Details

Name: Sydney Opera House Trust
Address: Bennelong Point Sydney Australia

Identification of Building

Street No. or Building Name: Sydney Opera House
Suburb: Bennelong Point, Sydney
Nearest Cross Street: Macquarie Street Building Use: Performing Arts (Entertainment Venue)

Annual Fire Safety Statement

I GREG MCTAGGART (Director Building Development & Maintenance) on Behalf of the Sydney Opera House Trust.

Certify that:

- (a) each **essential fire safety measure** specified in this **statement** has been assessed by a properly qualified person and was found, when it was assessed, to be capable of performing:
- in the case of an **essential fire safety measure** applicable by virtue of a **fire safety schedule**, to a standard not less than that specified in the schedule, or
 - in the case of an **essential fire safety measure** applicable otherwise than by virtue of a **fire safety schedule**, to a standard no less than that to which the measure was originally designed and implemented, and;
- (b) the building has been inspected by a properly qualified person and was found, when it was inspected, to be in a condition that did not disclose any grounds for a prosecution under Part 9, Division 7 of the Environmental Planning and Assessment Regulation 2000, and;
- (c) the information contained in this **statement** is, to the best of my knowledge and belief, true and accurate.

Signature of Agent

Date: 17/6/15

Essential Fire Safety Measures

Fire Safety Measure	Standard of Performance		Date of Assessment
	Design & Installation	Maintenance	
Access Panels, doors to fire resisting shafts	In part AS1530.4-2005;AS4072.1-2005,C3.13 & C3.15 (BCA)	To meet the relevant performance criteria & manufacturer's Spec, inspections should ensure:- a) No unauthorised penetration or attachment has occurred. b) Proper operation of the device c) No damage has occurred.	DTZ 16/6/15
Automatic fail-safe devices	In part C3.6 (BCA); Spec. C3.4 D2.21(c)&(d)(BCA), AS-1670.1-2004 and in accordance with the Fire Engineering Reports listed below (including North & South Central Passage bronze door operation).	AS1851-2005	COMVISION 27/4/15

Fire Safety Measure	Standard of Performance		Date of Assessment
	Design & Installation	Maintenance	
Automatic fire detection and alarm systems	In part AS1670 -2004; Spec.E2.2a (BCA), AS/NZS 1668-1998; AS1603; Infrared and VESDA systems in accordance with ARUP FIRE Master Plan Fire Safety Strategy Report Doc 82892-005 21/06/04 <ul style="list-style-type: none"> • Opera Theatre • Concert Hall • Western Foyer & western Theatres - in part AS1670.1-2004 & AS/NZS1668-1998 <ul style="list-style-type: none"> • Back of House -AS/NZS1668-1998, AS1670.1-2004 	To meet the relevant performance criteria & manufacturer's Spec	WORMALD 27-30 APRIL 2015 485 MAY 2015
Automatic fire suppression systems (sprinklers)	Sprinkler systems in part CA16-1962, AS2118-1999; E1.5 (BCA), Spec E1.5 (BCA) in accordance with ARUP FIRE Reception Hall (Utzon Room) Refurbishment Doc. 82892-002/Reception Hall Rev C 29/08/03 and ARUP FIRE Master Plan Fire Safety Strategy Report Doc 82892-005 21/06/04 permitting:- <ul style="list-style-type: none"> • Partial coverage throughout the building • Lack of separation between sprinkler protected and non-sprinkler protected areas. • Installation of fast response sprinkler heads Drencher system to Opera Theatre proscenium opening in part AS 2118.1-1999. Pumps to AS2941-2002.	AS1851-2005	WORMALD 27-30 APRIL 2015 485 MAY 2015
Automatic fire suppression systems (Gas)	Manual and automatic Inergen and CO2 systems AS4214 & NFPA 12A <ul style="list-style-type: none"> • Ground level+ 12 (G568B/G523B) INERGEN (Drama theatre lighting) • Ground level + 12 (G566F/G566G) INERGEN (Drama theatre sound) • Ground level +1 (B583B/C) INERGEN (Drama Dimmer room) • First level +30 (GM573B) INERGEN (Playhouse Interpreters) • Above ceiling + 100 (CH 46 & CH45) INERGEN (concert hall sound and lighting) • Ground level+ 12 Opera stage lighting transformer(dimmer) room (GM512/G512A) INERGEN • Fourth level +61 (2509C/O/R) INERGEN (sound, light & control) • Basement +1(B509F) INERGEN main switch room • Equipment Room Basement Level + 1 (B538A/B) INERGEN (security switch) • IT Server room Basement Level + 1 (B600/01.02) INERGEN 	AS 1851-2005 and to meet specified performance criteria	WORMALD 27-30 APRIL 2015 485 MAY 2015
Automatic fire suppression systems (wet chemical)	AS3772-1990 (Ansul Kitchen Suppression Systems) <ul style="list-style-type: none"> • Opera Kitchen commercial kitchen; and • Opera Bar Commercial Kitchen 	To meet specified performance criteria	WORMALD AS ABOVE
Emergency Escape Chutes	Manufacturer's specification	To meet the relevant performance criteria & manufacturer's Spec	DTZ 20 APRIL 2015
Emergency lighting	In part Ord 70 Pt 55.12, AS/NZ 2293.1-1998, AS 2293.1-2005; E4.2 & E4.4 (BCA) (including UPS battery systems)	In part AS2293.2 and AS1851-2005	DOWNER 15/6/2015
Emergency Lifts	BCA Clause E3.4, E3.7, AS1735.1-2003, AS1735.2- 2001 (Amdt 1) AS1735.11-1986, AS1735.12-1999 (Amdt2)	AS1735.1-2003, AS1735.2-2001 (Amdt 1), AS1735.11-1986, AS1735.12-1999 (Amdt2)	THYSSEN KRUPP 15/6/2015
Emergency warning & inter-communication system	In part AS 1670.4-2004, AS 4428.4-2004, AS 2220.1 & 2 & E4.9 (BCA); and in accordance with ARUP Western Broadwalk Theatres Fire Safety Upgrade Report Doc.82892-009 28/11/05 <ul style="list-style-type: none"> • Each of the western theatres and the foyer are to be 	AS1851-2005 and the performance standard of installation	WORMALD 27-30/4/15 485 MAY 15

Fire Safety Measure	Standard of Performance		Date of Assessment
	Design & Installation	Maintenance	
	<ul style="list-style-type: none"> • separate EWIS zones and is to meet AS2220; • Provision of performance mode installation in each theatre 		
Exit signs	In part Ord 70 Pt 55.12, AS/NZ 2293.1-1998, AS 2293.1-2005; E4.5 & E4.6 & E4.8 (BCA)	AS2293.1; AS 1851-2005	DOWNER 15/6/15
Fire Alarm Communication Link (connected to NSW Fire Brigades via private monitoring service provider)	E4.9 (BCA); AS4428.6 -1997 - alarm signaling equipment (ASE); AS3013-1995 - wiring from ASE to network connection point on secondary link; AS1670.3-2004 - monitoring network performance (for primary link comprising a Radio Packet transmission medium)	To meet the relevant performance criteria & manufacturer's Spec	WORMALD/ ADT 3/6/15
Fire Blanket(s)	AS2444-2001 ; AS3504-2006	AS1851-2005	WORMALD 27-30/4/15 + 4/5/15
Fire control centres and rooms	In Part E1.8 (BCA); Spec. E1.8 (BCA)	To meet specified performance criteria	EPRG 12/6/15
Fire dampers	In part AS/NZS1668.1-1998; AS1668.2-1991; AS1682. 1-1990; AS1682.2-1990, C3.15 (BCA)	AS1851-2005 and to meet specified performance criteria	TRILOG 14/5/15
Fire doors	In part Ord 70 Pt 22; AS/NZ 1905.1-1997; AS 1735.11 C2.12, C2.13, C3.4, C3.5, C3.6, C3.7, C3.8, C3.11 (BCA); H101.16 (BCA NSW); Spec.C3.4 (BCA)	AS1851-2005	DTZ APRIL 2015
Fire Doors (Sliding Doors)	In part Ord 70 Part 22 & Theatres & Public Halls Act 1908; (Opera theatre Scenery Dock sliding fire doors 87 & 89)	To meet specified performance criteria, inspections should ensure:- a) No unauthorised penetration or attachment has occurred. b) Proper operation of the device c) No damage has occurred.	DTZ APRIL 2015
Fire Doors (Sliding Doors) Scenery dock 87/89 (central battery bank)	Battery bank capable of holding open and close doors up to 5 times as per manufacturers installed standards	To meet specified performance criteria, inspections should ensure:- a) No unauthorised penetration or attachment has occurred. b) Proper operations of the device c) No damage has occurred.	STATE AUTOMATION 11/6/15
Fire hydrant systems	In part Height of Buildings Act 1912; Ord 70 Part 27.4(1973) and AS2419.1-2005; Part E1.3 (BCA) in accordance ARUP FIRE Western Foyer Upgrade: Grid 59 Works Doc. 82892 Western Loggia & Unified Foyer hydrant installation to HOBAC <ul style="list-style-type: none"> • Hydrant pump to AS2941-2002 	AS1851-2005	WORMALD 27-30/4/15 4 & 5 MAY 15
Fire Safety & Emergency Evacuation Procedure	AS3745-2010 and in accordance with ARUP FIRE Marquee - Fire Safety Strategy Report Doc. 82892-010 23/09/05 <ul style="list-style-type: none"> • Sydney Opera House Emergency Plan • Sydney Opera House Fire & Safety Manual • Marquee to be included in Sydney Opera House Emergency Plan • Isolation Procedures for smoke detection systems in theatres during performances 		EPRG 12/6/15
Fire safety notices	Clause 183 of EP&A Regulation 2000. <ul style="list-style-type: none"> • Concert Hall north fire stairs- east • Concert Hall north fire stairs- west • Joan Sutherland Theatre fire stairs – east 	To meet specified performance Criteria detailed within AS3745-2002	EPRG 12/6/15

Fire Safety Measure	Standard of Performance		Date of Assessment
	Design & Installation	Maintenance	
	<ul style="list-style-type: none"> Joan Sutherland Theatre fire stairs – west Bennelong Kitchen fire stairs 		
Fire Seals (protecting openings in fire resisting components of the building)	In part AS4072.1; AS 1530.3; AS1530.4; AS 1038.15; Part C3.15 (BCA), Spec. C3.15 (BCA), Spec A2.4	To meet specified performance criteria	DTZ JUNE 2015 (HIROTEC)
Hose reel systems	In part CA18-1968, AS2441-1988, AS 2441-2005; AS1221; BCA Spec A2.4, E1.4 (BCA) and } in accordance ARUP FIRE Western Foyer Upgrade: Grid 59 Works Doc. 82892	AS1851-2005	WORMALD 27-30/4/15 4th MAY
Lightweight Construction	In part AS1530.3 & 4 -2005; C1.8 (BCA); Spec A2.4 Spec.C1.8 (BCA) ASTM E72-80, ASTM E695-79 & AS 2185-1978 <ul style="list-style-type: none"> Protection to various steel beams in western foyer in cloak room and kitchen ceilings Protection to steel beams supporting escalators #5 & #6 Lightweight construction including light weight fire rated construction and fire rated lightweight construction enclosure to temporary fire resisting lifts lobbies (lifts 12 and 22) 	To meet specified performance criteria, inspections should ensure:- a) No unauthorised penetration or attachment has occurred. b) No damage has occurred.	EPRG 12-6-15
Material and assemblies required to have fire hazard properties	BCA Clause C1.10, NSW Spec C1.10, Table 4 other materials		EPRG 12-6-15
Mechanical Air Handling systems	In part Ord 70 Cl. 55.8.1, Ministerial Spec 12 Clause 5, Clause 60.9 AS/NZS 1668.1-1979; AS/NZ 1668.1-1998; AS/NZS1668.2-1991 E2.2a & E2.2b (BCA); Spec. E2.2(b) (BCA); and in accordance with ARUP Western Boardwalk Theatres Fire Safety Upgrade Report Doc.82892 009 28/11/05. <ul style="list-style-type: none"> Automatic shutdown of air handling systems Opera Theatre -Mechanical smoke exhaust over stage at 10m3/s. Studio - Mechanical smoke exhaust over stage at 20m3/s. Mechanical make up air to be provided at a rate of 10m3/s at low level. Additional make up to be provided by occupants egress from the theatre. Both smoke exhaust and make up air fans have VSD. Playhouse - Smoke exhaust to be provided over the stage at a rate of 16m3/s and mechanical make-up air supply of 12m3/s to be provided at low level at an inlet rate of no more than 2m3/s. Drama - Smoke exhaust to be provided over the stage at a rate of 8m3/s, with mechanical make-up at a rate of 5m3/s at low level. Western Foyer - Make up air for the playhouse will be drawn through from the Western Foyer. Air will be provided through the entrance doors which power open on fire trip. Two sets of double doors to the foyer will be required to open to provide the necessary make up air for the theatres. 	AS1851-2005	TRILOGY 24-4-15
Paths of travel, stairways,	In part Ord 70, SCA Part D, NSW Part D & EP&A Reg	Ensure no obstruction of any nature encroaches on or into the	EPRG 12-6-15

Fire Safety Measure	Standard of Performance		Date of Assessment
	Design & Installation	Maintenance	
passageways and ramps		designated paths of travel and check that the integrity of the fire-isolation on or in the relevant sections of the path of travel have not been breached or compromised	
Passenger lift fire service controls	BCA clause E3.7	BCA clause E3.7	THYSSEN KRUPP 16-6-15
Portable Fire Extinguishers	AS2444-2001;AS/NZS1841-2007; E1.6 (BCA)	AS1851-2005	WORMALD AS ABOVE
Required (automatic) exit doors	BCA Clause 2.19 and in accordance with ARUP FIRE Western Loggia & Unified Foyer Doc. 82892-02 Rev E 26/06/09 <ul style="list-style-type: none"> Required exit doors to open automatically on fire trip to provide make up air. As such, they will not be supplied with complying panic hardware 	AS1851-2005	BDM 17-6-15
Safety curtains in proscenium openings	In part Theatres & Public Halls Act 1908, Part 30 and NSW H101.10 (BCA NSW), Opera Theatre only	To meet the relevant performance criteria, inspection to ensure that no mechanical damage has occurred, or any interference exists that prevents its operation.	STATE AUTOMATION 9/6/15
Smoke dampers	In part Ord 70. Clause 60.9, E2.2a (BCA); AS/NZS 1668.1-1998; AS1668.2-1991; AS1682.1-1990; AS1682.2-1990	To meet the relevant performance criteria & manufacturer's Spec	TRILOGY 24-4-15
Smoke detectors and heat detectors	In part AS1670-2004: BCA Spec. C3.5, C3.6, C3.7, C3.8, BCA Spec E2.2a	AS1851-2005	WORMALD AS ABOVE
Smoke doors	Spec.C3.4 (BCA) and in accordance with ARUP FIRE Western Loggia & Unified Foyer Doc. 82892-02 Rev E 26/06/09) and ARUP FIRE Master Plan Fire Safety Strategy Report Doc 82892-005 21/06/04 <ul style="list-style-type: none"> Medium temperature smoke seals Four sets double smoke doors to Level +30 	To meet the relevant performance criteria & manufacturer's Spec	DT2 APRIL 2015
Stretcher lift	BCA E3.2, E3.8, Part E3 and Clause 3.10 and in accordance with ARUP FIRE Western Loggia & Unified Foyer Doc. 82892-02 Rev E 26/06/09 (Provision of accessible lift)	To meet specified performance criteria	EPR4 10/6/15
Wall wetting sprinkler and drencher systems	In part CA 16 AS2118.1-1999; C3.4 & E1.5 (BCA), Spec. E1.5 (BCA). Four fire rated doors in (G603) and sliding acoustic door (G603)	AS1851-2005	WORMALD AS ABOVE
Warning and operational signs	BCA Clauses C3.6, D1.17, D2.23, E3.3 (Lifts), Spec D1.12 & Part E1	To meet the relevant performance criteria & manufacturer's Spec	EPR4 12/6/15

Fire Engineering Reports

ARUP FIRE Studio Modeling Doc. 0003 Rev C 30/03/11

- Increase in venue capacity to 600.
- Restriction of combustible materials
- Limitation of theatrical drapes

Management Plan to be developed

ARUP FIRE Western Loggia & Unified Foyer Doc. 82892-02 Rev E 26/06/09

- EP1.4 - No sprinklers under new loggia.
- DP4 - Exit widths are less than the DTS for the populations used to assess the egress design, however exit widths are to be significantly improved, and would be compliant for the more realistic occupant numbers.
- DP4 - Single exit from bio-box and plant room 13, in a building which in total is >25m in effective height.
- DP6 - Extended travel distance from Bennelong Restaurant for second means of egress.

<ul style="list-style-type: none"> • DP2.2(b) - NSW D2.19 and NSW D2.21, the new entrance doors will be swing doors that open on fire trip in event mode. This is required to allow for makeup air for the smoke exhaust systems in the western theatres. • CP2 - Non-fire rated lift shaft interconnecting 3 storeys • DP4 - Deletion of Ben11elong Stair • CP2 - No fire separation between western foyer and Box Office via new corridor due to deletion of Bennelong stair. • EP3.2 Provision of accessible lift - (lift #17)
<p>ARUP FIRE Concert Hall Foyer Access & Egress Works Doc 82892-018/ Concert Hall Foyer Egress 22/01/09 DP4, EP2.2 -Aggregate exit width 22.37m</p>
<p>ARUP Western Broadwalk Theatres (Addendum to Fire Safety Upgrade Report) Doc.82892-09 03/06/08 (requirements limited to the studio only)</p> <ul style="list-style-type: none"> • Sydney Opera House staff operating lighting at the rear of the auditorium are to assist with evacuation. • A control panel to activate the EWIS is located in the stage area and shall be activated by the stage manager during performance mode. • Additional directional exit signage shall be provided in back of house paths of egress to AS2293 .1-2005. • Studio mechanical smoke exhaust to be as described in report 82892-009 below. • The Studio shall be a separate EWIS zone in accordance with AS1670 • Two manual call points (one on the stage and second in the lighting unit) which activate the alarm and smoke exhaust systems. • Smoke Curtains to be provided to all four sides of the studio stage.
<p>ARUP Western Broadwalk Theatres Fire Safety Upgrade Report Doc. 82892-009 28/11/05</p> <p>All theatres</p> <ul style="list-style-type: none"> • All current exits are to be maintained. • Exit signage and emergency lighting are to meet the requirements of the BCA (2004) and relevant codes and standards. Additional directional exit signage is to be provided through complex back-of-house egress routes. • Door hardware is to be maintained to meet the DTS requirements of the BCA (2004) for Entertainment Venues . • Each theatre is to be a separate EWIS zone and is to meet AS1670. <p>Playhouse</p> <ul style="list-style-type: none"> • Smoke curtain to be provided to divide the stage from the auditorium. In performance mode the curtain will be manually operated as the smoke detection system will be turned off when stage smoke is used. • Smoke exhaust to be provided over the stage at a rate of 16m³/s and mechanical make-up air supply of 12m³/s to be provided at low level at an inlet rate of no more than 2m/s. <p>Drama</p> <ul style="list-style-type: none"> • Smoke curtain to be provided to divide the stage from the auditorium. In performance mode the curtain will be manually operated as the smoke detection system will need to be turned off when stage smoke is used. • Smoke exhaust to be provided over the stage at a rate of 8m³/s, with mechanical make-up at a rate of 5m³/s at low level. • Removal of storage from egress corridors. <p>The Studio</p> <ul style="list-style-type: none"> • Smoke curtains will be provided to four sides of the stage to divide the stage from the upper seating of the auditorium. In performance mode the curtain will be manually operated as the smoke detection system will need to be turned off when stage smoke is used. • Smoke exhaust will be provided over the stage at a rate of 20m³/s, the fans are to be provided with a variable pressure transducer and a variable speed fan to ensure doors can be opened. Mechanical make-up air is to be provided at a rate of 10m³/s at low level. <p>Western Foyer</p> <ul style="list-style-type: none"> • The makeup air for all theatres will be drawn through from the Western Foyer. Air will be provided through the entrance doors which power open on fire trip. Two sets of double doors will be required to open to provide the necessary make up air for the theatres.
<p>ARUP FIRE Western Foyer Upgrade: Grid 59 Works Doc. 82892-011/Unified Western Foyer 19/02/07</p> <ul style="list-style-type: none"> • DP6 - Exit width decreases locally to 900mm in lieu of 1000mm between the final doors. • DP6 - Exit width may reduce to 950mm past the fire hose reel i n the corridor, depending on on-site detail s. ARUP FIRE • Marquee - Fire Safety Strategy Report Doc. 82892-010 23/09/05 • Flammability index of materials to be no greater than 6. • 4 exits required with a clear aggregate width of 6.0m for 450 people. • Communication to be provided in event mode between the marquee and security • Marquee to be included in AS3745-2002 evacuation planning. • Fire Extinguishers to AS 2444-2001. • Emergency Lighting to NSW102.15. & NSW102.15.2 (min lux of 0.2 lux at floor for no less than 30 minutes) • Exit and Directional Exit Signage to be provided in accordance with E4.5, E4.6 and E4.8 and AS/NZS 2293.1-2005 • Heating equipment can only be used in accordance with manufacturer's spec.
<p>ARUP FIRE Master Plan Fire Safety Strategy Report Doc 82892-005 21/06/04</p> <p>Concessions:</p> <ul style="list-style-type: none"> • Partial sprinkler protection - there are areas where there is only partial sprinkler protection. • Partial smoke detection - there are areas where the smoke detection system is not installed to the requirements of AS

1668 or AS 1670.

- Lifts are located within the same fire isolated shaft as stairs.
- There are no intermediate handrails on stairs >2m wide
- There are areas in the building with extended travel distances.
- Exit signage - there are areas within the building where exit signage and emergency lighting is obtrusive and not desirable
- Fire hydrants are to be upgraded to partial compliance with AS 2419.

ARUP FIRE Drama theatre - Fire Safety Upgrade Report Doc. 82892-006 10/09/03

- Reinstatement of all exits from auditorium .
- Removal of all storage from egress corridors.
- No standing room tickets to be sold.