



Australian Government

Department of Education, Employment and Workplace Relations

CPCSFS7002A Analyse, design and evaluate complex special hazard fire systems

Release: 1

CPCSFS7002A Analyse, design and evaluate complex special hazard fire systems

Modification History

Not Applicable

Unit Descriptor

Unit descriptor	This unit of competency specifies the outcomes required to analyse options for the design of special hazard fire systems, design their components, and evaluate the designs prior to sign-off by clients. Special hazard fire systems include gaseous, foam and water spray solutions which offer protection for life safety, and to facilities and equipment vital to business operation and success. Special hazard systems may fall outside the ambit of the Building Code of Australia. Client requirements may specify use of the U.S. National Fire Protection Association (NFPA) standards. The development of a fire systems design project is subject to significant complexities due to the typical requirement to integrate multiple fire suppression and detection systems. Licensing, legislative, regulatory or certification requirements may apply to this unit and so the varying state or territory requirements should be confirmed with the relevant body.
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Application of the Unit

Application of the unit	This unit of competency supports the attainment of skills and knowledge necessary for the effective and efficient design of special hazard fire suppression and detection systems.
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Licensing/Regulatory Information

Refer to Unit Descriptor

Pre-Requisites

Prerequisite units	Nil
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Employability Skills Information

Employability skills	This unit contains employability skills.
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Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.
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Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Select appropriate special hazard fire suppression solutions.	1.1. Research is conducted to determine the appropriate fire suppression solutions to address the building or facility's risk profile and the special hazard standards that have been identified for use. 1.2. A cost-benefit and efficiency analysis of the range of fire suppression systems is conducted. 1.3. Recommendations for the selection of preferred solutions are made to the appropriate personnel.
2. Select appropriate special hazard fire detection and occupant warning solutions.	2.1. Research is conducted to determine the appropriate fire detection and occupant warning solutions to address the building or facility's risk profile, ambient conditions and the selected fire suppression solution. 2.2. A cost-benefit and efficiency analysis of the range of fire detection and warning systems is conducted. 2.3. Recommendations for the selection of preferred solutions are made to the appropriate personnel.
3. Set up special hazard fire systems design drawing.	3.1. Relevant project drawings and documentation are requested, received, named and filed according to workplace procedures. 3.2. Drawings are cleaned to leave minimal essential information. 3.3. Layers showing designs of other services are imported into clean architectural or structural drawings. 3.4. Details from drawings of floor or building adjacent to the areas under design consideration are added if these affect the design. 3.5. The detailed design drawing is named, filed and backed up according to workplace procedures.
4. Lay out the special hazard system design.	4.1. A site visit is conducted if possible to confirm dimensions and assess installation risks and constraints. 4.2. The interactions between the various systems are identified and planned. 4.3. The exact locations of sprinklers and other fittings are determined and notated on the drawing according to relevant codes and standards. 4.4. The most efficient and workable layout and location of system components are determined and notated on the drawing. 4.5. Dimensions are calculated, checked and notated on the drawing.

ELEMENT	PERFORMANCE CRITERIA
5. Calculate the requirements for the special hazard solutions.	5.1. Calculations to identify and confirm the required capacity of the special hazards systems are undertaken. 5.2. Infrastructure to support the special hazard solution is identified and quantified. 5.3. Shortfalls in water pressure are determined and the sizes of pumps and tanks required for water spray systems are calculated.
6. Evaluate and implement special hazard fire system solutions.	6.1. The components of the special hazard fire system solution are gathered from relevant expert personnel as required. 6.2. Special hazard system design drawings are evaluated for efficiency and effectiveness. 6.3. Design drawings are submitted to relevant personnel within the scheduled timeframe. 6.4. Required amendments to design drawings are made or negotiated as required. 6.5. Final approved design drawings are processed and distributed according to project and workplace requirements. 6.6. Fittings and components are selected and ordered.

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit.

Required skills

- accurate measuring
- accurate naming and filing of drawings, including:
 - formal document control
 - formal amendments, including:
 - history
 - transmittal notices
- editing and creating drawings, including:
 - layout
 - section
 - detail
 - external references

REQUIRED SKILLS AND KNOWLEDGE

- freezing layers
- fluent detailed hand-drawing and sketching ability to convey information to on-site workers
- operating computer software packages and systems, including:
 - word processing
 - spreadsheet
 - email
 - internet
 - proprietary project management software
 - proprietary hydraulic calculation software
 - proprietary estimating software
 - parametric modelling software
- numeracy skills for:
 - calculating:
 - dimensions
 - pipe lengths
 - piping friction loss
 - pump capacity
 - motor output
 - performing calculations for electrical systems:
 - voltage drops
 - battery capacity
 - battery back-up
 - power supplies
 - performing fluid mechanic calculations
 - determining cost-benefit of solutions
- language and literacy skills for:
 - listening to and communicating clearly with colleagues, fitters, suppliers and contractors
 - participating in meetings, such as negotiations with fire engineering consultant, architect, builder or other service contractor
 - researching, accessing, reading, interpreting and applying current relevant legislation, codes and standards
 - letter writing, especially to formalise:
 - recognition of conflicts and errors on drawings supplied by other service contractors
 - agreements with other services, for example whichever service is fitted last must fit around existing services
 - reading and interpreting drawings, plans and specifications, including:

REQUIRED SKILLS AND KNOWLEDGE

- architectural
- structural
- mechanical
- hydraulic
- electrical
- report writing
- developing constructive and cooperative working relationships with project team members, workplace colleagues, suppliers, fitters and clients
- negotiation and conflict management
- initiating and running meetings with lead contractor and other service contractors
- project management
- organising own work, including creating personal systems and checklists for planning, managing and checking work
- managing detailed input to concurrent fire systems design projects at different stages of the process and with diverse sets of regulatory requirements

Required knowledge

- workplace design tools and processes
- naming conventions for design drawings and drawing register
- fire science, including:
 - fire behaviour and dynamics
 - impact of fire on structures and materials
 - products of combustion
 - fire control strategies
 - fire retardants
 - fire detection technologies
 - fire suppression technologies
 - fire containment
- fire engineering principles, including:
 - engineered solutions
 - innovative fire systems
 - fire modelling
- proprietary fire engineering and modelling programs
- parametric modelling of services coordination using proprietary software, such as Navis-Works or MEP-REVIT
- computer software functions and operation, including:
 - word processing
 - spreadsheet
 - email

REQUIRED SKILLS AND KNOWLEDGE

- internet
- proprietary project management software
- proprietary hydraulic calculation software
- proprietary estimating software
- relevant current legislation, codes and standards, including:
 - building Acts
 - building regulations
 - infrastructure supply regulations
 - the Building Code of Australia
 - Australian standards for fire systems
 - international standards for fire systems
 - other fire system standards commonly required by building insurers
- protection requirements for different buildings, including the existence of special zones, the egress requirements of occupants, and the construction materials used
- passive fire safety elements, including:
 - identification of passive elements
 - impact of fire systems design on passive elements
 - specifications required to safeguard integrity of passive fire element performance where penetrations are necessitated by the fire systems design
- fire systems' technology and components, including:
 - water-based systems, including:
 - wet pipe sprinkler systems
 - deluge and drencher systems
 - dry pipe sprinkler systems
 - pre-action sprinkler systems
 - early suppression fast response (ESFR)
 - hydrants, hose reels and monitors
 - water supply tanks
 - fire pump sets
 - detection and warning systems, including:
 - emergency warning and intercommunications systems (EWIS)
 - fire detection and alarm systems
 - smoke control systems
 - emergency lighting systems
 - special hazard fire systems, including:
 - foam systems (low expansion, medium expansion and high expansion)
 - gaseous agent systems (carbon dioxide, inert gas and halocarbon gases)
 - water spray systems (deluge, medium/high velocity water spray and high

REQUIRED SKILLS AND KNOWLEDGE

- speed deluge)
 - chemical systems, including:
 - powder
 - wet chemical
- purpose and operation of fire systems, including:
 - layout
 - special products and hazards
 - system operation
 - performance requirements
 - maintenance standards
 - system activation and operation
- characteristics and limitations of products and materials used in fire systems and issues relating to material capability
- interconnection of fire systems, including:
 - cause and effect matrix
 - interface with other services
- instruments used in commissioning and measuring fire system performance
- basic principles of structural engineering
- characteristics of building materials
- construction industry terminology
- roles and responsibilities of relevant building project personnel, including:
 - architect
 - lead contractor
 - mechanical engineer
 - hydraulic engineer
 - electrical engineer
- on-site issues that can arise during the construction phase and impose changes to the designs of fire systems and other services
- installation methods, including:
 - access requirements
 - health and safety requirements
- water supplies, including:
 - common water sources
 - conservation requirements
 - in-ground reticulation
 - booster configurations
- fluid mechanics and hydraulics relating to:
 - water supply
 - pressure

REQUIRED SKILLS AND KNOWLEDGE

- pump selection
 - tank selection
 - pressure vessels
 - pipe range
- sustainability requirements and ratings, including:
 - energy conservation
 - water conservation
- pipe fabrication methods and constraints
- mathematic principles, equations and calculation methods, including:
 - financial calculations, for example to assess cost-effectiveness of fire systems
 - trigonometry, for example to amend dimensions of pipe allowing for fittings
 - flow calculations, including:
 - area of operations
 - discharge rates and quantities
 - discharge times
 - pressure gain and loss
 - K-factors
 - pressure, temperature and volume relationship
 - Hazen-Williams equation
 - Darcy Weisbach equation
 - computational fluid dynamics
 - electrical calculations (alarm systems), including:
 - voltage drops
 - battery sizes
 - battery back-up
 - power supplies
 - cabling range
 - system calculations for gas or special hazard fire systems
- principles of organic and inorganic chemistry, including basic chemical substances and reactions
- principles of basic physics, including an understanding of:
 - Boyle's Law
 - Charles' Law
 - Dalton's Law
 - Henry's Law
- principles of thermodynamics, including:
 - effects of heat

REQUIRED SKILLS AND KNOWLEDGE

- stratification of gases
- smoke and heat dynamics
- electrical and electronics theory, including:
 - units used to measure current (AC and DC), power, capacitance, inductance and sound attenuation
 - effects of AC and DC current in series and parallel circuit paths that includes resistive, inductive and capacitive loads
 - relationship between voltage drops around a circuit and applied voltage
 - definition of voltage ratings as defined in communication and electrical safety regulations, including extra low voltage, low voltage and hazardous voltages
 - layout of electrical wiring systems to meet communication and electrical safety regulations applicable to fire detection and warning systems
 - basic operation of common electronic and electrical components used in fire detection and warning systems
 - basic operation of communication protocols on addressable systems, peripheral devices (printers) and high-level interfaces to other communication devices used in fire detection and warning systems
- acoustics and speech intelligibility for occupant warning systems
- human psychology, especially fire avoidance behaviour
- organisational frameworks and functions, including:
 - industry associations
 - enterprises
 - government bodies
- financial management, including:
 - budgeting
 - cost-effectiveness
- contractual processes

Evidence Guide

EVIDENCE GUIDE

The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.

Overview of assessment

This unit of competency could be assessed in the workplace or a close simulation of the workplace environment, provided that the simulated or

EVIDENCE GUIDE

project-based assessment fully replicates workplace conditions, materials, activities, responsibilities and procedures.
This unit could be assessed as an activity involving the analysis, design and evaluation of complex special hazard fire systems, including the application of appropriate codes and standards in accordance with the design requirements of the client.

EVIDENCE GUIDE	
Critical aspects for assessment and evidence required to demonstrate competency in this unit	A person who demonstrates competency in this unit must be able to provide evidence of the required skills and knowledge specified within this unit. In particular the person should demonstrate: • knowledge of fire sciences sufficient to ensure the design of compliant and effective systems that address the specific conditions of the projects being undertaken • numeracy skills sufficient to ensure accurate calculations of system capacities and performance • the ability to read and interpret a range of design documents, including concept briefs, design briefs, drawings, plans and specifications • an understanding of and ability to apply legislation, codes, standards, and regulatory and insurance requirements that may apply to special hazard fire systems design projects, including U.S. NFPA standards • the ability to research appropriate special hazard fire detection and warning systems • the ability to produce accurate technical drawings of the layout for the special hazard design • the ability to design integrated solutions encompassing fire detection, warning and suppression components for special hazard fire systems as they apply to at least three different types of hazards requiring the application of different technical solutions.
Context of and specific resources for assessment	Assessment of essential underpinning knowledge may be conducted in an off-site context. It is to comply with relevant regulatory or Australian standards' requirements. Resource implications for assessment include: • access to relevant Australian and international codes and standards • access to legislation relevant to the jurisdiction • project documentation, including design brief, design drawings, specifications, construction schedules and other supporting documents

EVIDENCE GUIDE

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| | <ul style="list-style-type: none">• research resources, including product information and data• theoretical texts and other information to support the assessment of the unit's required skills and knowledge• relevant computer software packages and suitable hardware. |
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EVIDENCE GUIDE	
Method of assessment	Assessment methods must: • satisfy the endorsed Assessment Guidelines of the Construction, Plumbing and Services Training Package • include direct observation of tasks in real or simulated work conditions, with questioning to confirm the ability to consistently identify and correctly interpret the essential underpinning knowledge required for practical application • reinforce the integration of employability skills with workplace tasks and job roles • confirm that competency is verified and able to be transferred to other circumstances and environments.
Guidance information for assessment	Reasonable adjustments for people with disabilities must be made to assessment processes where required. This could include access to modified equipment and other physical resources, and the provision of appropriate assessment support. Assessment processes and techniques should as far as is practical take into account the language, literacy and numeracy capacity of the candidate in relation to the competency being assessed.

Range Statement

RANGE STATEMENT	
The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.	
<i>Fire suppression solutions</i> include:	• gaseous agent systems, including: • carbon dioxide • inert gases • halocarbon systems

RANGE STATEMENT

- FM-200
- FE-25
- Inergen
- foam systems, including:
 - low expansion foams
 - medium expansion foams
 - high expansion foams
- water spray systems, including:
 - deluge systems
 - medium and high velocity water spray systems
 - high speed deluge systems.

RANGE STATEMENT	
The <i>risk profile</i> of the building or facility will reflect the usage of the building, including:	- the need to protect people - the value of the goods stored - the susceptibility of the stored goods to water or other forms of damage.
The <i>special hazard standards</i> include:	- U.S. NFPA standards, including: - NFPA 2001 Clean Agent Fire Extinguishing Systems - NFPA 11 Low, Medium and High Expansion Foam Systems - NFPA 11A Medium and High Expansion Foam Systems - NFPA 13 The Installation of Sprinkler Systems - NFPA 16 Deluge Foam-Water Sprinkler and Foam-Water Spray Systems - relevant Australian standards, including: - AS4214 Gaseous fire extinguishing systems - AS2008 Part 1 - AS2008 Part 3 - also note: - building insurers may specify the standards they require to issue cover on buildings and facilities - increasingly, international ISO standards are being identified for the industry - special hazards are not referenced in the Building Code of Australia.
<i>Fire detection and occupant warning solutions</i> include:	- smoke-sensing detectors - heat-sensing detectors - fire alarms - flame detectors - fire gas detectors.
<i>Project drawings and documentation</i> may include:	- architectural - structural - mechanical - electrical - hydraulic

RANGE STATEMENT	
	• fire engineer's or estimator's specifications.
Interactions between multiple systems on a complex site are analysed to:	• ensure the most effective selection of systems to protect different assets • maximise the effectiveness of the systems • maximise the efficiency of the installation process.
Efficient and workable layout and location relate to:	• penetrations • conflict with other services • occupational health and safety risks • access constraints • installation problems • aesthetic requirements • efficiencies to facilitate work on site • reduction of labour costing.
System components may include:	• discharge nozzles • pipework • brackets • system valves • zone valves • fire panels.
Calculations that relate to the various forms of special hazard systems include:	• water-spray system calculations • hydraulic calculations to assess pressure requirements and confirm pipe sizes • gaseous system calculations • foam system calculations.
Infrastructure for special hazard solutions include:	• pipework • storage containers • delivery systems for the suppression agent (e.g. foam, gas or water) • tanks.
Large and complex projects may use expert personnel to:	• design sub-components of a total solution, for example electrical components.
Negotiated changes may be made due to:	• non-compliance with applicable legislation, codes and standards • impact on installation risks and constraints • impact on cost-effectiveness.
Fittings and components may include:	• hangers • sprinkler heads • elbows

RANGE STATEMENT

	• tees • pumps • tanks • control valves.
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Unit Sector(s)

Unit sector	Fire systems design
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Co-requisite units

Co-requisite units	Nil
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Competency field

Competency field	Senior management
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