Guideline for Maintenance of Fire Systems

STAY LIVE
Electrical Industry Health & Safety Group

StayLive Process Safety Working Group

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Contents

1 Purpose

This document provides a guideline for the inspection and maintenance of passive and active fire systems within the New Zealand electricity generation industry.

This guideline intends to:

- help companies and contractors to establish a common and consistent guide for inspecting and maintaining fire systems, including defining the scope and frequency of the inspection and maintenance activities
- recommend a minimum level of reporting and information recording required to ensure the continued efficacy and reliability of the fire systems
- provide a means to demonstrate the benefits and reliability of the fire systems inspection and maintenance programme to all stakeholders (including but not limited to management, owners, shareholders, regulators, insurance underwriters and risk management).

2 Background

2.1 Benefits of a Guideline

The StayLive Process Safety Working Group has identified the benefits of setting a guideline for inspection and maintenance of fire systems and for standardising these requirements across the electricity generation industry. These benefits include:

- ensured reliability of operation/activation of the fire system
- ensured efficacy (expected performance) of the fire system
- in the event of a fire, mitigation of the risk and extent of:
  - asset damage
  - business continuity, and
  - life safety
- ability to plan preventative maintenance in line with station outages (mitigate disruption to the site)
- co-ordination of new fire system installations with building alterations or new buildings (develop the compliance of the fire system and support the overall compliance of the works in accordance with the New Zealand Building Code (NZBC))
- support for revalidation of Building Warrant of Fitness (BWoF) and maintaining up to date compliance schedules.

All of the above support mitigating risk of damage to life, asset and business continuity in the event of a fire.

2.2 Fire System Types

Fire systems usually comprise one of more of the following categories:

- active fire protection systems
- passive fire protection systems
- fire safety systems.

Active fire protection systems are fire protections systems in which a component or components must activate for the system to perform its intended function. An example of an active fire protection system is a sprinkler system, which comprises a water supply, pipes (usually charged with water) and sprinkler heads in the pipe. The sprinkler heads comprise a small bulb which, when heated to a certain temperature, breaks and allows the water in the pipe to flow at a designed flow rate and pressure.

Passive fire protection systems are fire protection systems that rarely incorporate moving parts. Examples of passive fire protection systems include doorsets, walls, pipe collars, transit boxes and sealants. Passive fire protection systems are usually the first line of defence against a fire; these systems work to contain the fire. Passive fire protection systems are also the last line of defence because they continue to operate if the active fire protection system is depleted, impaired or overcome.

The efficacy of performance for both types of fire protection systems is governed by their ability to provide the designed fire protection performance over time (ie, time-based performance).

Fire safety systems, unlike active or passive fire protection systems, do very little to suppress or contain the fire. Their functions include:

- alerting occupants
- guiding occupants from a building, and
- supporting early intervention and targeted firefighting operations.

This guidance document highlights key information related to the inspection and maintenance of fire systems to ensure their suitability and efficacy for use in the power generation sector.

3 Scope

3.1 In Scope

This guideline covers inspection and maintenance of fire systems. The main fire systems and equipment covered by this guideline are listed in the table below.

Fire System	System Type	Equipment Type	Section Reference
Active fire systems	Pumps and water storage	Fire water storage and pumps	See section 9.3.1
		Water supplies	See section 9.3.2
	Water-based systems	Sprinklers and deluge	See section 9.5.1
		Sprinkler valve sets	See section 9.5.2
		Water mist	See section 9.5.3
		Hydrants	See section 9.5.4
		Dry riser systems	See section 9.5.5
		Monitors	See section 9.5.6
		Hose reels	See section 9.5.7
		Foam systems	See section 9.5.8

Fire System	System Type	Equipment Type	Section Reference
Active fire systems (continued)	Gas suppression systems	Gas flood systems	See section 9.6.1
		Hybrid systems	See section 9.6.2
	Active ventilation	Smoke extraction	See section 9.9.2
Passive fire systems	Fire and smoke separation	Service penetrations	See section 9.7
		Fire walls	See section 9.7
Fire safety systems	Detection and alerting	Smoke and heat detection	See section 9.4.1
		Flammable gas and flame detectors	See section 9.4.2
		Fire panels	See section 9.4.3
		Manual call points (MCP)	See section 9.4.4
		SCADA and HMI systems	See section 9.4.5
		Aspirated smoke detection systems	See section 9.4.6
		Sounders (audible warning)	See section 9.9.5
	Visibility during escape	Emergency lighting (EML)	See section 9.9.3
		Signage	See section 9.9.4
	Auxiliary systems and interfaces	Emergency shutdown	See section 9.9
Handheld firefighting equipment	Portable firefighting equipment	Portable extinguishers	See section 9.8

3.2 Out of Scope

This guideline specifically excludes:

- asset management – including condition and risk assessments
- modifications of fire system or modifications of buildings
- design of fire systems – other than inspection and maintenance considerations.

4 Deviations from Guideline

This document is a guideline – as such it is intended as a guide for best practice of fire systems inspection and maintenance. It is recommended that any deviations from this document are assessed by experienced personnel and made in consultation with a chartered professional fire engineer.

5 Glossary of Terms

Terms and abbreviations used in this guideline are explained below.

Term or Abbreviation	Definition
BWoF	Building Warrant of Fitness – certificate issued on confirmation that a building's specified systems have been inspected and deemed compliant over the previous 12-month period. Requires a Form 12A for each specified system
FENZ	Fire and Emergency NZ
FPANZ	Fire Protection Association of New Zealand
HMI	Human Machine Interface (Control Panel)
IQP	Independent Qualified Person – independent person responsible for inspecting a particular specified system and issuing a Form 12A
NFPA	National Fire Protection Association – a US-based, global self-funded non-profit organisation devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards, and the source of many of the international standards referenced below
PEW	Prescribed Electrical Work
SCADA	Supervisory Control and Data Acquisition
SSC	Sprinkler System Certifier – An accredited inspection body responsible for reviewing sprinkler system reports and issuing a Compliance Certificate for compliant biennial inspections, approving modifications or new installation

6 Roles and Responsibilities

Generic roles and responsibilities are listed below. Generating companies should add any further roles specific to their own sites in their site-specific fire systems maintenance plan.

The Role…	Is Responsible for…
Facility manager	• Overseeing maintenance of fire systems at a high level, ensuring maintenance and testing is completed to the appropriate standard at the minimum defined maintenance intervals • Ensuring maintenance records are complete, up to date and readily retrievable, ie, a copy is kept on site at all times • Ensuring inspection and maintenance activities are completed by competent persons.
StayLive Group members	Keeping this guide in alignment with industry practice, standards and feedback from users.
Facility manager or client supervisor	Providing safe access to fire equipment.
Fire systems contractor	• Complying with client's health and safety requirements • Making accurate and detailed records of inspections, maintenance and testing • Promptly submitting reports to facility managers and/or the client appointed supervisor • Ensuring fire system interfaces with plant systems are understood.

7 Relevant Codes and Standards

7.1 Introduction

This section contains a list of referenced standards and related documents that are applicable to maintenance of fire systems.

7.2 Fire Strategy Report

Where available for a particular facility, the Site Fire Strategy Report is a key document for understanding the installed systems at a site and the underlying philosophy in their selection and implementation.

The Fire Strategy Report (also referred to as Fire Report or Design Report) generally contains design data for consent including design standards, egress routes, signage, sprinkler design, fire separations and system water demands.

7.3 Statutory Requirements

The following documents are relevant:

- The Building Act 2004 (New Zealand) and associated regulations
- New Zealand Building Code (Schedule 1 of the New Zealand Building Regulations 1992)
- Compliance Schedule Handbook (MBIE publication)
- Fire and Emergency Act 2017
- Fire and Emergency New Zealand (Fire Safety, Evacuation Procedures, and Evacuation Schemes) Regulations 2018
- Hazardous Substances Regulations 2017
- Health and Safety at Work (Hazardous Substances) Regulations 2017
- Health and Safety at Work (Major Hazard Facilities) Regulations 2016
- FPANZ COP 01 Code of Practice for Gaseous Fire Suppression Systems
- FPANZ COP 02 Code of Practice for Water Mist Fire Protection Systems.

7.4 New Zealand Standards

Maintenance requirements and recommendations for fire systems are detailed in the following New Zealand standards.

Standard	Title
AS/NZS 1221:1997	Fire hose reels
AS/NZS 60079.29.2:2016	Explosive atmospheres – Part 29.2: Gas detectors – Selection, installation, use and maintenance of detectors for flammable gases and oxygen
NZS 2293.2:2019	Emergency lighting and exit signs for buildings – Part 2: Routine service and maintenance
NZS 4503:2005	Hand operated fire-fighting equipment
NZS 4510:2008	Fire hydrant systems for buildings
NZS 4512:2010	Fire detection and alarm systems in buildings

Standard	Title
NZS 4522:2010	Underground fire hydrants
NZS 4541:2013	Automatic fire sprinkler systems[1]
NZS 6104:1981	Specification for emergency electricity supply in buildings
SNZ PAS 4509:2008	NZ Fire Service firefighting water supplies code of practice
SNZ HB 4525:2006	Fire Risk Management Handbook

7.5 International Standards

The following international standards may be referred to or applied in situations where the equipment is not covered by an applicable New Zealand Standard.

Standard	Title
AS 1851-2012	Routine service of fire protection systems and equipment
AS 4214:2018[2]	Gaseous fire extinguishing systems
AS ISO 7240	Fire detection and alarm systems
NFPA 11:2016	Standard for Low-, Medium-, and High-Expansion Foam
NFPA 12:2018	Standard on Carbon Dioxide Extinguishing Systems
NFPA 15:2017	Standard for Water Spray Fixed Systems for Fire Protection
NFPA 25:2020	Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems
NFPA 80:2019	Standard for Fire Doors and Other Opening Protectives
NFPA 221:2021	Standard for High Challenge Fire Walls, Fire Walls and Fire Barrier Walls
NFPA 750:2019	Standard on Water Mist Fire Protection Systems
NFPA 770:2021	Standard on Hybrid (Water and Inert Gas) Fire Extinguishing Systems
NFPA 850:2015	Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations

7.6 General Notes on Use of Standards

Legacy systems designed to older version of standards may demonstrate non-compliances when measured against current (later) versions of standards – in these cases, the older standard, ie, the standard to which the system has been designed, should be applied for inspection and maintenance purposes.

Note, there is currently no requirement under New Zealand law to retrospectively upgrade systems to comply with later fire systems standards each time they are revised. However, it is prudent to observe the developments in later versions of standards as, sometimes, they may highlight a significant deficiency in older systems and, therefore, warrant consideration to upgrade to a more compliant system. An example of this is seismic bracing for sprinkler system pipes or additional seismic requirements for timber water storage tanks.

Circumstances requiring an upgrade to an existing fire system could include an alteration to or change of use of a building that requires a building consent and/or Code Compliance Certificate (CCC). Depending on the scope and extent of the work, the authority having jurisdiction (AHJ) may require the system to be upgraded as due to alteration works, the building may end up complying

[1] NZS 4541:2013 is currently under update (NZS 4541:2020 is scheduled to be released on 1 July 2021)
[2] AS 4214 does not contain any maintenance requirements, however, refers to AS 1851

less than it did before the work started (see section s112 and s115 of the NZ Building Act 2004). A chartered professional fire engineer should be engaged to discuss any potential requirements because of building alterations.

The statutory requirements listed in section 7.3 and New Zealand Standards listed in section 7.4 set the minimum requirements for fire systems maintenance.

Generally, it is expected that the standard used for design should be used as a basis for developing the maintenance requirements – for example, if a National Fire Protection Association (NFPA) standard is used for design then the applicable NFPA standard should be used as the basis for maintenance activities.

The design standard does not always cover maintenance requirements. In such instances it is recommended that the manufacturer's recommendations or an alternative applicable standard, recommended by a suitably qualified person with design experience or chartered professional fire engineer, are followed.

Some equipment may not be covered by any applicable standards. In such cases, design and maintenance should be based on a manufacturer's standard or company standard – generally these alternative standards should be endorsed by a chartered professional fire engineer.

Where applicable, New Zealand statutory requirements set the minimum requirements and take precedence when they are more stringent than an alternative design standard.

8 Design Considerations

This guideline does not consider design work for new or modified systems. However, the specification, design and commissioning of any type of new or modified fire system should consider future inspection and maintenance requirements.

Specific design considerations for inspection and maintenance include:

- accessibility to inspect and maintain equipment
- the frequency and nature of inspections to ensure performance and efficacy for specific fire systems – this may have to be adjusted for the environment in which the fire systems are installed
- suitability of the materials/components for the environment in which they are expected to work
- minimisation of the possibility that inadvertent operation of the fire system (specifically, active fire protection systems) during a maintenance activity can cause damage to plant or result in a risk to health and safety, eg, ensuring deluge test valves cannot accidently flow into a generator or block an access route
- consideration of benefits of two means of detection, not just to ensure redundancy (eg, flame and gas, heat and smoke), but also to provide a backup means of detection during a maintenance outage of a system
- consideration of appropriate segregation of zones to allow isolation of part of the installation without impairing the whole facility (eg, sprinkler zones, heat/smoke/gas detector zones, etc).

It is recommended that design documentation and inspection and maintenance manuals for new or modified systems should include:

- manufacturer's recommended inspection and maintenance activities and intervals
- list of design standards and codes for each component group of the fire system for which they apply
- list of spare parts and replaceable equipment including all relevant specifications to allow procurement of replacements that maintain code and design compliance
- list of NZ and international standards that are applicable to the maintenance of the equipment.

9 Maintenance Guidelines for Fire Systems Equipment

9.1 Introduction

This section contains a guide to managing fire systems equipment.

All fire protection systems and appliances should always be in good order and available for immediate use. If a fire protection system is under repair, then suitable arrangements should be made to ensure safety is not diminished.

9.2 Compliance

9.2.1 Introduction

Fire systems protect both life and assets. Fire systems for the protection of life are subject to external regulation through local government. Fire systems for the protection of assets do not always need to be subject to external regulation. However, asset owners should reach agreement with local government (council) if specific asset protection fire systems are to be excluded from external oversight.

9.2.2 Life Safety

Typically, compliance of life safety systems is managed through the building warrant of fitness process under which each specified system requires annual signoff by an Independent Qualified Person (IQP) to verify condition, maintenance and operation meets or exceeds requirements (Form 12A).

Fire systems required to be inspected by an IQP are listed on the building compliance schedule.

A Form 12A is issued by the applicable IQP for each specified system certifying that the inspection and maintenance procedures stated in the compliance schedule for all specified systems have been fully complied with for the previous 12 months.

Specified systems related to fire systems include:

- SS1 Automatic systems for fire suppression
- SS2 Automatic or manual emergency warning systems for fire or other dangers
- SS4 Emergency lighting systems

- SS14 Emergency power systems for, or signs relating to, a system or feature specified in any of SS1 to SS13
- SS15 Other fire safety systems or features (systems for communicating information intended to facilitate evacuation, final exits, fire separations, signs).

The Building Act requires that each specified system has inspection and maintenance procedures to ensure the system is performing and continues to perform to the performance standards set out for that specified system.

9.2.3 Asset Protection

Compliance of fire systems for asset protection, such as equipment deluge and plant fire detection systems, can be managed by internal company processes when council agreements are in place.

Council agreement is required as the Building Act and regulations do not consider the **purpose** of a system. As such, unless specifically agreed, all fire detection and suppression systems are considered **specified systems**.

Fire systems that have warning alarms to evacuate staff should be considered life safety by default.

Even if a protection system is not externally regulated as a specified system, there is a need for a maintenance plan to achieve owner objectives and to assure interested parties such as insurers that systems are well maintained.

Systems used for asset protection should be maintained to similar (or the same) standards as those for life safety, unless there are specific reasons that preclude this. As maintenance of asset protection systems is typically risk based, differences may arise due to equipment being out of service, mothballed or maintained to an older standard. Refer to section 9.10 for further details.

9.3 Maintenance Guidelines for Pumps and Storage

9.3.1 Fire Water Storage and Pumps

Maintenance requirements for fire water storage tanks and pumps should be based on NZS 4541.

In addition to the requirements of NZS 4541, general maintenance of fire water storage tanks should comply with the recommendations of the tank manufacturer or a suitability qualified person.

9.3.2 Water Supplies

Water supply pressure for fire systems should be monitored periodically for any potential decrease over time that may impair the ability of fire water pumps to meet the required pressure and flow rates for the system's specified design point.

NZS 4541 considers it to be a significant deficiency requiring urgent attention if the water supply pressure unexpectedly decreases more than 10% from the last test result or to a point below system demands.

9.4 Maintenance Guidelines for Detection and Alerting Systems

9.4.1 Smoke and Heat Detectors

Maintenance and inspection intervals for fire detection systems in buildings is covered within NZS 4512 Part 6.

9.4.2 Flammable Gas and Flame Detectors

Maintenance recommendations for flame and flammable gas detection systems are included in the following standards for consideration:

- section 11 of AS/NZS 60079.29.2, Explosive atmospheres Gas detectors – Selection, installation, use and maintenance of detectors for flammable gases and oxygen, recommends that detection equipment be checked regularly at defined intervals – frequently at first, with increasing time intervals as confidence grows in the installation based on maintenance records
- NZS 4512 suggests that testing be completed annually by a means appropriate to the detector type
- AS/ISO 7240 contains performance requirements.

9.4.3 Fire Panels

All batteries that form part of an uninterruptable power supply for a fire panel should be listed separately on maintenance logs to ensure all batteries are inspected and tested.

Ventilation of battery enclosures should be inspected and tested regularly to prevent build-up of dangerous concentrations of hydrogen.

Maintenance and inspection intervals for fire panels is covered within NZS 4512 Part 6.

9.4.4 Call Points

Inspection of call points should include checking for obstructions and visibility in addition to the required operational checks.

Be aware that layouts in buildings or outside may change and prevent access to call points. So, the maximum distances between call points and the location (along escape routes) should be observed during routine inspection.

Maintenance and inspection intervals for fire alarm call points are covered within NZS 4512 Part 6.

9.4.5 SCADA and HMI Systems

SCADA and HMI used in fire systems are not covered by general fire system standards. Inspection and maintenance requirements and intervals for such systems should be determined in consultation with the supplier of the fire system and/or SCADA/HMI system.

9.4.6 Aspirated Smoke Detection Systems

NZS 4512 requires testing to manufacturer's recommendations.

9.5 Maintenance Guidelines for Water Suppression and Sprinkler Systems

9.5.1 Sprinklers and Deluge

Automatic sprinklers and deluge systems require regular testing to ensure the system will operate as required.

Upwards facing deluge nozzles installed in outdoor or exposed locations have potential for ingress of debris and bugs. Periodic cleaning and/or testing should be considered to demonstrate that nozzles are not blocked. In some instances, this cleaning and/or testing may be required by the insurer or SSC. Generally, this additional maintenance would not be required for an enclosed indoor installation unless exposed to dusty environments.

It is important that deluge systems are adequately dried out following testing to avoid internal corrosion from trapped water.

Maintenance and inspection frequencies should be based on one of the following:

- NZS 4541, or
- AS 1851.

If the above standards are not appropriate or achievable, the building code allows for an alternative testing and maintenance schedule to be specified as developed by a chartered professional fire engineer.

9.5.2 Sprinkler Valve Sets

Sprinkler valve sets have the capacity to compromise an entire system. It is important that they are adequately inspected and maintained to prevent failure on demand.

Sprinkler valve sets may include test valves, isolation valves, valve supervisory sensors (position sensors), jockey pumps and deluge valves.

Maintenance and inspection requirements are considered in NZS 4541 Part 12. Of note in the maintenance requirements for valve sets to ensure reliable operation is the routine overhaul of valves and replacement of elastomeric components within valves and pumps.

9.5.3 Water Mist

Water mist systems, eg, for bearing fire protection, are not covered by New Zealand Standards. Instead, maintenance requirements should be based on:

- manufacturer's recommendations
- fire engineer's requirements where applicable
- FPANZ COP 02 Code of Practice for Water Mist Fire Protection Systems
- NFPA 770 Standard on Hybrid (Water and Inert Gas) Fire Extinguishing Systems.

9.5.4 Hydrants

Maintenance and inspection intervals for fire hydrants are covered in NZS 4510 Part 9.

9.5.5 Dry Riser Systems

Maintenance and inspection intervals for fire hydrant riser systems are covered in NZS 4510 Part 9.

9.5.6 Monitors

Generally regular maintenance of a monitor will include inspections for signs of leakage and damage, lubrication and strainer checking where applicable.

Monitor nozzles should be inspected and tested annually in accordance with NFPA 25.

9.5.7 Hose Reels

Maintenance and inspection intervals should be based on NZS 4503.

9.5.8 Foam Systems

Refer to section 9.5.1 for general recommendations and requirements of deluge systems.

There are no New Zealand standards which specifically cover the testing and maintenance of foam for firefighting, therefore requirements should be based international standards. Typically, this would include:

- NFPA 11, or
- AS 1851.

It is recommended that fire water run-off routes and containment areas should be inspected regularly to ensure that potential chemicals such as process refrigerants and firefighting foam are adequately contained from the environment where it is not suitable to discharge directly to stormwater drains.

9.6 Maintenance Guidelines for Gas Suppression Systems

9.6.1 Gas Flood Systems

Gas cylinders (eg, CO_2, FM200, etc) should be hydrostatically tested every 10 years in accordance with FPANZ COP01 and AS 1851 section 7.

CO_2 cylinder testing can be extended to 12 years under certain conditions when applying the requirements of NFPA 12.

It is recommended that gas cylinders are tested following a discharge event prior to being refilled.

It is a requirement that gas cylinders are tested following a discharge event if it has been 5 years since the last test:

- The Hazardous Substances Regulations 2017 (Schedule 22) and NFPA 12 (section 4.6) specify a gas cylinder test period validity of 5 years.
- These regulations allow cylinders to continue to be used after the specified test interval, however after this period cylinders cannot be refilled without being tested.

Enclosure integrity testing and/or inspection is recommended every 12 months in accordance with FPANZ COP 01 and AS 1851 Table 7.4.4.

All gas cylinders in New Zealand need to meet the testing requirements detailed within the Health and Safety at Work (Hazardous Substances) Regulations 2017, with further guidance available within WKS-4 Guide to Gas Cylinders.

There are no New Zealand standards which specifically cover the general testing and maintenance of gaseous fire equipment; therefore, requirements should be based on the FPANZ code of practice and international standards. Typically, this would include:

- FPANZ COP 01 Code of Practice for Gaseous Fire Suppression Systems
- AS 1851 section 7 Special Hazard Systems
- NFPA 12 for CO_2 systems
- additional requirements recommended or specified by the manufacturer.

9.6.2 Hybrid Systems

Maintenance for water and gas hybrid fogging systems is typically as per the manufacturer's recommendations.

NFPA 770:2021 chapter 14 outlines the inspection, testing and maintenance requirements.

9.7 Maintenance Guidelines for Passive Features and Interfaces

A fire or smoke separation is considered as part of the compliance schedule when the fire separation forms part of the means of the means of escape. Fire separations installed for asset protection rather than building compliance should be subject to the same inspection and maintenance requirements.

Fire separations require regular inspection to ensure they are able to prohibit the spread of fire. Fire separations should be inspected monthly for:

- continuity of fire separations
- signs of damage that could affect their fire resistance function
- new penetrations without suitable fire stopping.

A schedule or drawing set indicating location and rating of fire and smoke separation walls should be maintained and readily available to site staff to ensure any repairs or new penetrations are adequately sealed to the correct fire resistance rating. All penetrations and holes should be appropriately sealed and labelled with the fire resistance rating and the sealing product details.

Maintenance and inspection requirements for fire and smoke separation should be based on:

- Building Code Acceptable Solutions C/AS2 Protection from Fire
- AS/NZS 1905 (for fire-resistant doors)
- NZS 4520 (for fire-resistant doors)
- AS 4072.1 (R2016) – Service penetrations and control joints
- NFPA 221 Standard for High Challenge Fire Walls, Fire Walls and Fire Barrier Walls
- a specifically designed solution (engineering judgement) prepared by a competent person (ie, chartered professional fire engineer who is deemed proficient in passive fire protection).

Note, the Compliance Schedule Handbook, section 2, SS 15/3 Fire Separations, provides a good reference to required inspection activities and building code requirements.

9.8 Maintenance Guidelines for Handheld Firefighting Equipment

Maintenance and inspection intervals for portable extinguishers are to be based on NZS 4503. The minimum inspection frequency and test frequency for portable extinguishers is 12 months.

It is recommended that additional inspections are undertaken at monthly intervals to ensure the extinguishers are available, of the correct class, located correctly and accompanied with suitable signage to AS 4503.

Additional testing requirements are detailed in NZS 4503 and vary for different types of extinguishers; these include pressure testing and further detailed inspections.

9.9 Maintenance Guidelines for Fire Safety Systems

9.9.1 Testing for Interfaces and Auxiliary Systems

Fire system interfaces should be recorded with enough details to enable interface testing to ensure compliance with the fire report and to reduce the risk of affecting interconnected plant during maintenance and testing activities.

It is recommended to develop specific maintenance check sheets for fire equipment interfaces with generation equipment to ensure that interfaces are well understood and are tested adequately.

Common fire system interfaces include:

- plant shutdown
- HVAC fire dampers
- operator alerts
- evacuation alarms
- fire suppression systems.

Test frequencies for common interfaces include the following:

- Where a brigade interface from the fire panel exists, where an alarm signal is sent directly to a monitoring centre, the signal should be tested monthly in accordance to NZS 4512 by an automatic fire alarm service provider.
- Where a fire panel interfaces with the site owner's own monitoring centre or remote-control centre, the same alarm testing provisions apply.
- Interfaces between an automatic fire suppression system and an emergency warning system should be tested annually.
- Interfaces between a fire warning system and emergency lighting system should be tested annually.

9.9.2 Smoke Extraction and Dampers

Generally, a system designed solely for controlling or discharging smoke during a fire will be considered a specified system.

Maintenance and inspection frequencies will depend on the type of installation. Either of the following will typically be used:

- AS 1851, or
- a specifically designed testing and maintenance schedule as developed by a competent person (typically a fire engineer).

9.9.3 Emergency Lighting

Emergency lighting should be tested back to the battery or power source.

Maintenance and inspection frequencies should be based on one of the following:

- NZS 6742 for existing systems installed in accordance with this standard (note this standard was superseded by NZS 2293 in 1995)
- AS/NZS 2293 for systems installed in accordance with this standard.

If a generator is part of the emergency lighting system, the generator should be inspected in accordance with NZS 6104.

If the above standards are not appropriate or achievable, the building code allows for an alternative testing and maintenance schedule to be specified as developed by a competent person (typically a chartered professional Fire Engineer with support from a chartered professional electrical engineer).

9.9.4 Egress Signage

Egress signage is a specified system and should be checked regularly to ensure compliance with the fire report. Monthly inspection and testing is required for illuminated signs to ensure they are correct, present and illuminated. Annual inspection is required for all other egress signage to ensure they are correct and visible.

As a minimum, signage should utilise the guidance of the acceptable solution F8-Signs and inspected to AS/NZS 2293.2:2019.

9.9.5 Emergency Warning Systems

Maintenance and inspection frequencies should be based on one of the following:

- NZS 4541, or
- AS 1851.

If the above standards are not appropriate or achievable, the building code allows for an alternative testing and maintenance schedule to be specified as developed by a fire engineer.

9.10 Engineered and Bespoke Fire Systems

In some instances, a bespoke engineered fire protection or monitoring system will be required to meet specific protection requirements – performance-based design. Examples include a performance-based design of a turbine fire suppression system or a flammable gas detection system.

If maintenance of this type of equipment is not covered by New Zealand standards, requirements should be aligned with a manufacturer's and/or designer's standard, an alternative international standard or a specifically developed internal standard.

Generally, specification of maintenance requirements will be developed in conjunction with the fire system designer and supplier and endorsed by a chartered professional fire engineer who is proficient in the design of performance-based systems and understands the environment in which the fire safety system is required to be operated.

10 Suggested Inspections and Maintenance Matrix

10.1 Matrix

The following table is intended to serve as a guide to develop a company-specific testing and maintenance service matrix for fire systems equipment. Note, the table below is not fully comprehensive and may require additional inspections, equipment, reference standards in order to meet the site-specific installation and equipment requirements.

Item	Recommended Operational Inspections and Required Contractor Service Levels								References
	Daily/Weekly	Monthly	Quarterly	6-monthly	Yearly	2-yearly	4-yearly[4]	Other	
Sprinkler valve sets (incl brigade alarm connections	O	C	C[1]			S	C		NZS 4541 Part 12
Fire sprinkler and hydrant pump sets	O	C			C[2]	S	C		NZS 4541 Part 12
Fire sprinkler water supplies		C	C		C[3]	S	C		NZS 4541 Part 12
Fire hose reels		O	C (water supply only)		C	S	C		NZS 4503
Fire extinguishers		O			C			C (5-yearly) C (after use)	NZS 4503
Alarm systems (incl warning systems)	O	C			C				NZS 4512 Part 6
Fire hydrants					C			C (5-yearly)	NZS 4510 Part 9
Evacuation systems	O	C		C	C				NZS 4512 Part 6
Fire walls				C	C	C			Building Code (Specified System SS15)
Fire blankets					C				NZS 3504
Fire doors	O	C	C	C	C				AS/NZS 1905 NZS 4520
Gas flood systems	O	C			C			C[5] (3-yearly) C[6] (10-yearly)	AS 1851 Section 7
Deluge sprinkler systems	O		C		C	S	C		NZS 4541 Part 12
Emergency lighting		C (if specified)		C	C			C[7] (6-monthly)	AS 2293.2
SCADA/HMI	O	C			C				

Key to table:

O = routine checks normally carried out by operators
C = routine maintenance normally carried out by a contractor
S = tests carried out during a two-yearly water systems survey

Notes to table:

1 Including subsidiary stop valve(s) and associated supervisory systems
2 Diesel pumps only
3 Including testing of town main backflow prevention devices and checking tail end anti-freeze installations (check valves and density of anti-freeze)
4 4-yearly (quadrennial) checks are additional to the 2-yearly biennial inspection, additional inspection requirements are detailed in NZS 4541 Part 12
5 Allow for fan pressurisation test
6 Pressure test of cylinders
7 NZS 4510 and NZS 4541 contain different maintenance schedules for fire pumps. Where fire water pumps supply both sprinkler/deluge systems and hydrants, the more onerous standard NZS 4541 should be applied for the pump maintenance routines.

10.2 Tolerances

Routine tests and maintenance frequency tolerances are specified in NZS 4541 for fire sprinkler systems:

Frequency	Tolerance (±)
Weekly	2 working days
Monthly	5 working days
Quarterly	2 weeks
Six-monthly	2 weeks
Yearly	1 month
Biennial and greater	4 months

Table 1: Above from NZS 4541, Table 12.1

For equipment with maintenance intervals based on AS 1851, the frequency tolerances are:

Frequency	Tolerance (±)
Monthly	5 working days
Three-monthly	10 working days
Six-monthly	1 month
Yearly	2 months
Five-yearly	3 months
Ten-yearly	6 months
Twenty-five yearly	6 months
Thirty-yearly	6 months

Table 2: Above from AS 1851-2012 Table 1.11B

Note, consider any outage requirements to align with maintenance intervals.

11 Inspection and Maintenance Activities, Changes and Modifications

11.1 Introduction

This section contains guidance on major inspection and maintenance activities and modifications.

11.2 Impairments

Formal notification is generally required for impairments:

- Any defects or work requiring shutdown of a fire protection system requires written notice to the insurer. Failure to do so could void insurance cover.
- Defects affecting the performance of a fire protection or fire safety system should be attended to immediately and may require immediate isolation and/or shutdown (requiring notification).
- Reinstatement of fire protection system(s) following defect remediation and/or work requiring the shutdown should be communicated to the insurers and Fire and Emergency NZ (FENZ). The purpose of a FENZ notification is to advise of direct brigade monitoring connection impairments and/or reduced firefighting capabilities.
- If the work causing the shutdown of a fire protection system and/or fire safety system is carried out over a number of days, where possible, fire protection systems should be reinstated when the work has stopped or during prolonged breaks in the work programme. The appropriate steps for issuing a fire protection system shutdown notice repeated as needed.
- An impairment of the fire water supply requires written notification to the FENZ in addition to the insurer.
- Consideration should be given to identifying other personnel to be notified such as fire brigade and anyone working at the affected location.
- Specific impairment reporting should be detailed though company specific procedures. This includes:
    - fire protection system shutdown notices
    - system impairment notices.

An example of these forms is provided in Appendix K of NZS 4512.

Impairment notification should be issued 24 hours prior to work commencing or as soon as possible if immediate action is required.

Further guidance on minimum requirements and recommendations can be found in NZS 4541 Part 11, Precautions to be Taken When a System is Rendered Inoperative.

11.3 Isolations

Isolations of fire equipment to be worked on shall be as per site specific work controls and isolation requirements, StayLive work control requirements and the GPG documents.

All personal isolation locks (recipient-applied safety measures – RASMs) must be installed as per site work controls requirements and tagged for identification.

Care should be taken to ensure that interface isolations are considered as well as process isolations, for example interconnected control systems.

11.4 Major Maintenance and Modifications

In order to ensure inspection and maintenance requirements are kept up to date, the following are considerations for fire system modifications and upgrades:

- Commissioning and maintenance activities should be considered during any design work along with ensuring there is adequate documentation to describe the system design basis, test requirements and maintenance recommendations.
- It is important to keep fire compliance reports up to date as a record of the design basis and compliance requirements. The fire compliance reports should also be revised where an alteration, change of use or new building is being constructed.
- Fire wall and egress route plans must be maintained and be up to date for reference by IQPs. A register of fire walls, ceilings, floors, service penetrations, doorsets should be established and periodically reviewed against the latest fire compliance report for the building.
- Seismic requirements have increased over the years – significant modifications or upgrades will likely require the system to be brought up to compliance with current standards.
- Fire systems requirements have changed over the years – significant modifications or upgrades may require the system to be brought up to compliance with current standards. This is a likely requirement where building consent and/or code compliant certificates are required.
- Fire systems around hazardous containment vessels may need to be upgraded to meet latest HSNO requirements.

The following are considerations for fire system installation, commissioning and return to service:

- Consider tie-ins and interfaces to other systems.
- Cleanliness should be checked for any pipework that has been removed and reinstated, eg, deluge piping. Air or water flush may be considered.
- Fire systems or interfaces that require a plant outage need to be appropriately co-ordinated to ensure that the maintenance intervals are not exceeded beyond the allowable tolerances.
- Development of a start-up or recommissioning check sheet is recommended for use following major work, eg, requirements for gas turbines with gas flood systems (when pulling turbine enclosure apart):
    - detail what needs to be checked on reassembly
    - specify return to service checks.

11.5 Spare Parts

Periodic review of spare parts is recommended. The intent of the review should be to ensure availability of spare parts is understood and to minimise downtime. Long-lead items should feed into system risk reviews where failure of in-service plant will lead to a system impairment.

Specific focus should consider:

- ensuring key critical spare parts are available and in good condition
- reviewing availability and lead times on spare parts.

12 Reporting Requirements

12.1 Introduction

This section contains guidance to ensure reporting and information provided to third parties (WorkSafe, insurers, etc) is suitable to prove the maintenance programme is effective.

All maintenance records and information should be recorded and retained in a maintenance management system.

12.2 General Reporting Requirements

Reporting should be undertaken to a level to:

- satisfy the IQP, WorkSafe and insurer
- verify work has been completed and signed off
- monitor condition and allow condition trending
- accurately document condition of the plant – highlight any defects within reasonable timeframe:
  - raise defects urgently for impaired systems
  - allow for corrective work orders to be raised within reasonable timeframe
  - preferably note work order numbers on maintenance reports.

The preferred method of storing maintenance records is electronic rather than paper based. This can be achieved through:

- contractor providing written copies of inspection documents to the client for scanning and filing in the client's computerised maintenance management system
- contractor directly providing electronic copies of test results/observations/suggested remedial work to the client.

Note, NZS 4541 section 1201.4 specifies contractor requirements for recording test results electronically.

12.3 Maintenance Technician or Contractor Reporting Requirements

The maintenance technician or contractor should be responsible for:

- ensuring that all required maintenance is completed at the intervals required by the governing standards
- presenting proposed maintenance check sheets to company for review and approval
- returning maintenance check sheets for input into computerised maintenance management systems
- highlighting defects promptly to their company contact person or supervisor
- issuing maintenance reports in a timely manner to the nominated company supervisor
- reporting on what was done, who did it, deviations to the procedure and reasons for any required work or checks not being done
- immediately raising any significant defects with client supervisor and/or facility manager (where applicable).

12.4 Company Specific Inspection and Maintenance Check Sheets

Companies may elect to produce their own format inspection and maintenance check sheets for fire contractors to complete as long as the minimum level and frequencies of inspections are met as per the standard to which the system has been designed.

Benefits include:

- equipment specific rather than generic
- inclusion of isolation guidance – particularly where systems can trip plant if not treated correctly
- inclusion of interfaces with control systems and other plant
- identification of critical equipment
- ease of loading into computerised maintenance system and ease of maintenance reporting
- identification and recording of deficiencies.

12.5 General Reporting Recommendations

The fire systems maintenance plan should be designed and structured to facilitate reporting. Inspection and maintenance plans should be developed in consultation with maintenance planners, contractors, owner's representative and operations.

Fire protection systems inspection and maintenance routines should be classified as safety-critical, and on-time completion rates should be reportable to easily identify overdue items.

Documentation, inspections, checks, audits and continuous improvement activities should be recorded in a readily available location for the appropriate persons to access:

- maintenance records
- maintenance strategy reviews
- condition assessments against asset plans
- BWoF
- risk register
- fire compliance report and modification records
- design and operating documentation:
  - fire compliance reports (where available)
  - fire separation (fire cell) drawings
  - fire system interfaces
  - operating and maintenance manuals for all maintainable fire equipment and systems.

The computerised inspection and maintenance management system is recommended to drill down to include reporting for the following level of equipment:

- gas flood bottles (in particular rotable spares)
- sprinkler/deluge systems (rather than individual piping/sprinklers)
- individual sprinkler/deluge valves
- smoke detector groups (rather than individual detectors)
- critical equipment should be reported on individually rather than in groups (ie, not just batteries, valves, etc) to reduce possibility of missing maintenance activities.

It is important to ensure that multiple pieces of identical equipment are allocated and marked with appropriate unique identification to ensure maintenance covers every item.

13 Performance Measures

Dashboards can be a useful tool for quick visual indication of the system's health and operability and may be used to easily identify process safety risk.

For the inclusion of fire systems equipment within a dashboard reporting system, consider a fire-specific dashboard or integration into a process safety dashboard.

Typical reporting metrics include:

- safety critical maintenance completed on time
- defects/deficiencies raised and completed.

When developing a process safety specific dashboard, it should be noted that not all fire system components are necessarily safety critical (to be defined in accordance with company policy and WorkSafe MHF regulations). Inclusion of all fire system components may unnecessarily skew the dashboard and remove focus from safety critical elements.

14 Competency Requirements

14.1 Introduction

This section contains recommendations on general competency requirements for work on fire systems, covering both general work on fire systems and work on fire systems within hazardous areas.

14.2 General Work on Fire Systems

There are various levels of work on fire systems performed by people holding various roles, such as:

- contract manager
- operations
- technician
- fire inspector
- QA verifier
- chartered professional fire engineer.

Competency requirements for each of these roles to work on fire systems is to be confirmed by the facility/company initiating the work, based on the type of work to be undertaken. Considerations include:

- contract manager – basic training and understanding of the work required
- general site-based competency requirements (inductions, work controls, etc)
- site-based staff (operators and/or maintenance technicians) – competency for tasks such as daily/weekly/monthly inspections, for example:
  - isolating fire equipment as part of generating plant work controls
  - isolating faulty equipment
  - restoring systems to service after testing or maintenance
  - fire impairment reporting
  - risk mitigation in the event of fire system defects

- fire technicians – relevant training for more significant or specialist works being undertaken, for example:
  - suitable qualifications for the work that the technician is undertaking
  - manufacturer's training
- any technician performing prescribed electrical work (PEW) – registered and licensed as per Electricity Act 1992 and Electrical Safety Regulations 2010:
  - PEW is defined in both the Electrical Safety Act and the Electrical Safety regulations
  - New Zealand Gazette, Notice Number 2017-go1984 defines limits of work for each class of licence
- fire inspector – IQP registered
- QA verifier – competency requirements defined by company policy
- chartered professional fire engineer (CPEng)
  - current CPEng status with Engineering New Zealand or similar organisation, with CPEng proficiency in design, specification and inspection of fire systems
  - additional qualifications and/or experience related to fire systems.

14.3 Work on Fire Systems in Hazardous Areas

This section typically applies to fossil fuelled facilities and binary cycle geothermal facilities:

- PEW in hazardous areas includes work on equipment operating at extra-low voltage.
- PEW includes like for like replacement of equipment (eg, detector replacement).
- PEW on facilities deemed electrical installations is classified as High Risk electrical work.

Competency requirements specific for electrical work in hazardous areas:

- any technician performing PEW must hold an appropriate practicing licence or work under an Employer Licence or supervision regime approved by the asset owner
- additionally, persons performing PEW in hazardous areas shall demonstrate hazardous area competency in accordance with AS/NZS 4761 series of standards, Competencies for Working with Electrical Equipment for Hazardous Areas

14.4 General Notes on Competencies

The following should be considered when assessing competency:

- For works in hazardous areas, it may be better to train electrical contractors to work on fire and detection systems versus training fire technicians to be qualified to work in a hazardous area.
- It is possible to complete work internally and request IQP signoff rather than rely on a fire contractor. May be beneficial for restricted access or proprietary equipment. Note, this would require the IQP to accept an agreed level of proof of completion of work to a standard that would have been undertaken by a qualified contractor.
- Fire technicians may not meet competency requirements for other interconnected or proprietary systems and for work in hazardous areas.
- A contractor is required provide evidence of their quality management systems and competency of each technician.

15 Audit Guide

This section is intended as a guide for what to check during a routine audit or inspection and maintenance review. An audit would typically cover aspects such as maintenance records, design documents and compliance with standards.

An internal fire systems maintenance audit should take place at regular intervals to ensure controls and procedures are working. The recommended frequency is annually, and the results should be used for continuous improvement.

Below is a list of inspections that may be conducted:

- review of maintenance results and records – in conjunction with a testing frequency table such as that included in section 10
- review of planned maintenance (PMs) and reporting in computerised maintenance system
- review of any events such as:
  - fire
  - unintended system activations
  - system failure to operate (eg, during testing)
- review of fire compliance report for current compliance and to identify any changes
- monthly system checks completed on time
- system performance issues and defects addressed
- scheduled annual/biennial surveys completed
- biennial report defects remedied.

Appendix A: Generic Maintenance Risks and Hazards

Introduction

Incorrect operation, deliberate interference and maintenance errors are major causes of fire protection system faults. This can result in a fire suppression or alerting system:

- failing to operate under fire conditions, or
- inadvertently operating when no fire is present.

Process safety Bowties are recommended as a means of documenting fire risk events and controls. Sound maintenance practices are a key control to ensure barriers on threat-lines are not degraded.

Typical Maintenance Risks/Hazards

Typical maintenance errors affecting fire systems include:

- substandard or degraded equipment not identified, eg, blocked strainers and filters, under capacity batteries
- inadequate recommissioning, eg:
  - end to end testing not carried out
  - alarms not checked prior to return to service
- incorrect reassembly, eg:
  - weather protection compromised
  - missing or incorrect components
  - fasteners torqued incorrectly
  - foreign or domestic object present
  - sprinkler head orientation changed
- poor or out-of-date procedures and drawings used, undocumented changes
- failure to consult documentation
- firing heads not reset prior to refitting on suppression bottles
- damage to components from other work parties
- temporary storage impedes spray pattern and/or increases fire load
- temporary changes not used correctly or not reversed prior to return to service (ie, poor management of overrides), eg:
  - simulations
  - shorting and isolation links, temporary wiring changes
  - detector maintenance covers
  - trip isolation devices
- wiring reinstated incorrectly, eg, transposed, poor terminal continuity, damaged insulation
- valves in incorrect position
- SOPs inadequate and specific details for specialised, complex and interfaced systems, eg:
  - plant tripping functions
  - ventilation systems

- poor priming of pressurised systems
- hidden failures of unmonitored equipment not identified
- systems impaired for maintenance fail to operate during high risk outage maintenance, eg:
  - turbine oil systems commissioned prior to fire systems return to service
  - hot work
- errors by persons working on systems with fire protection interfaces, eg:
  - ventilation systems
  - electrical protection systems
- inadvertent impairment of related systems due to poor understanding of process safety function, eg:
  - enclosure doors or dampers prevented from closing or opening
  - ventilation fans with smoke extraction function isolated
- incorrectly specified systems in the initial design (perpetuates mistakes).

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