Designers' guide to firefighting operations

Radio communications

F5-03 GD

Document Title: Radio communications

Published: 10 December 2021

Document review date: 10 December 2023

Status of this document

This document is issued by Fire and Emergency New Zealand.

Recommendations for change

The document, its content and specific processes are not to be altered except through Fire and Emergency New Zealand document management processes.

Requests or recommendations for changes to this material should be sent to National Manager Response Capability.

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1. Context

Scope

Communications are an essential part of all our emergency operations. This chapter provides an overview of our radio communications, including:

- why our communication systems are important
- using radio communications appropriately at an incident
- how design can identify and overcome the limitations of radio communications in problematic areas such as tunnels, large footprint and high-rise buildings.

Who this chapter is for

This document has been written from a Fire and Emergency point of view. It is based on practical experiences, supported with information and best practice, and aimed at informing all stakeholders of the issues that may impact on effective communications for us at an emergency.

It applies to:

- new buildings
- buildings being refurbished
- other structures including tunnels.

What is not included in this chapter

This document is a guide to provide advice to industry on the Fire and Emergency position and operations, it does not replace any statutory requirements. This chapter is a broad overview and not intended as a reference on the intricacies of our communication systems.

We recommend it is read alongside, and in conjunction with, other chapters within this guide. This is not an exhaustive guide to Fire and Emergency operations, but an overview of the relevant expectations building industry stakeholders can have of our operations.

Legislative framework

We aim to reduce the risk to both firefighters and building occupants through encouraging appropriate building design which allows us to achieve our statutory objective (under the Fire and Emergency New Zealand Act 2017) to reduce the incidence of unwanted fire and the associated risk to life and property. Our functions include responding to and suppressing fires and attending to other types of emergencies that may occur in a building.

Read this guide alongside the:

- mandatory requirements of the New Zealand Building Code (Building Code)
- requirements of New Zealand Standards (Standards), and
- Building Act 2004.

This guide **does not** replace any part of the Building Code or Standards or other mandatory building requirements.

We note that the Building Code clauses C1–C6 (Protection from fire) define Building Code performance requirements of the Building Act 2004. Clause C5 is the performance requirement on access and safety for firefighting operations.

Part 6 of C/AS2 Acceptable Solutions provides only limited information on requirements for firefighting operations and this Designers' Guide provides further guidance to industry.

2. Definitions

The following definitions apply for the purposes of this chapter. Defined terms used throughout this document are consistent with the Building Act 2004, Building Code and Acceptable solutions C/AS2.

Appliance	An emergency vehicle that provides capability to Fire and Emergency's mandated functions.
Breathing apparatus (BA)	A device firefighters wear to provide breathable air in an atmosphere that is immediately dangerous to life or health. Also known as self-contained breathing apparatus (SCBA) or compressed air breathing apparatus (CABA).
Communications Centre (ComCen)	Fire and Emergency New Zealand Communications hub, which manages 111 emergency calls, the dispatch of Fire and Emergency resources and all radio messages sent via land mobile radio (LMR) from an incident. The three centres are located in Auckland, Wellington and Christchurch.
Fire engineering brief (FEB)	A formal process outlined in the International Fire Engineering Guidelines for all stakeholders to define and agree on the scope of work for fire engineering analysis.
Fire resistance rating (FRR)	Building Code Clause C regarding protection from fire defines FRR as: [t]he term used to describe the minimum fire resistance required of primary and secondary elements as determined in the standard test for fire resistance, or in accordance with specific calculation method verified by experimental data from standard fire resistant tests. It comprises three numbers giving the time in minutes for which each of the criteria stability, integrity and insulation are satisfied and is presented always in this order.
Incident ground communication (IGC) radio	Handheld two-way radios firefighters use to communicate with one another when working at an incident. Personnel cannot communicate with other handheld radios that are set on different channels or with Fire and Emergency ComCen's handheld radios.
Land mobile radio (LMR)	A land mobile radio network that allows the ComCens to activate the station alert system to dispatch resources and to communicate with Fire and Emergency vehicles.
UHF	Ultra-High Frequency, F Band, 470–494 MHz
VHF	Very-High Frequency, ESA Band, 75–79 MHz

3. Our operations

Importance of communications

As many major fires and incidents internationally have shown, communications problems are one of the biggest barriers to emergency services successfully managing incidents.

To keep us safe and allow us to implement our command and control procedures at an incident, it's critical for firefighters to be able to communicate both inside and outside buildings. By communicating effectively, we can coordinate our resources to resolve incidents efficiently.

As a rule, the larger an incident becomes, the more complex and critical the communications become.

Communication Centres (ComCens)

Fire and Emergency operates three ComCens, 24 hours a day. These are in Auckland, Wellington and Christchurch, and cover the entire country.

If one centre can't operate, dispatchers in another centre cover for it, ensuring we maintain 24-hour national capability for emergency response coverage.

Response alert

The ComCens activate individual fire station alerts for response and communicate directly via LMR radio with any responding Fire and Emergency vehicles. They also monitor non-incident (routine) radio communications.

Individual fire station alert activation (for response) operates on a Selcal unit in each fire station. Once our vehicles are mobile, response alert and radio communications operate on an LMR network.

Land mobile radio (LMR)

Figure 1 – Shows both a UHF and a VHF LMR terminal

Fire and Emergency vehicles have LMR fixed radio communications equipment from which firefighters can send and receive verbal and coded messages to and from the ComCen.

This allows firefighters to send and receive emergency call requests and status messages. They can select from a range of options by entering a code or pressing one of the buttons (as shown in Figure 1, above).

When it receives a fire call (alert) message from the ComCen, the LMR screen automatically displays information. It also triggers a strobe light and audible alert on the outside of our vehicles, to alert firefighters if they are away from the appliance. At the same time, it also activates pagers which the firefighters carry.

The LMR network operates on UHF for the greater Auckland area, and on VHF for the rest of the country.

Figure 2 – An emergency pager

4. Challenges

4.1. How we use communications

Handheld (IGC) radios

At incidents, firefighters use two-way handheld radios to communicate with each other. This is called Incident Ground Communication (IGC).

Handheld radios:

- Use open channels, which means everyone tuned to one of those channels can hear what everyone else says
- Can only communicate with other handheld radios that are tuned to the same channel
- Have limited range in built-up areas, which means firefighters may need line of sight with the person they are trying to talk to.

Handheld radios **can't** communicate with:

- vehicle radios on the LMR network
- Fire and Emergency ComCen
- other handheld radios on different channels.

We only use the Motorola APX 6000 XE (UHF) and APX 8000 XE (dual band UHF/VHF) radios, which have been issued across the country.

IGC frequency range

Band	Frequency range (MHz)
VHF (ESB Band)	138–174 MHz
UHF (ESC Band)	450–502 MHz

LMR

It is a requirement for us to send a message to the ComCen through the LMR within the first five minutes of arrival and at least every 30 minutes thereafter, informing them of the current situation at the incident. This is known as a situation report or SitRep.

This can only be done from our vehicles as the IGC radio cannot be used. This highlights the importance of good appliance access and being able to position our vehicles close to the incident. See chapter F5-02 GD FFO Firefighting vehicle access.

Incident Command Unit (ICU)

We operate a number of Incident Command Unit (ICU) vehicles nationally. These are strategically located in areas to respond as a mobile command centre. Some of these are also referred to as Hazmat Command Unit (HCU) Vehicles, due to their dual-purpose functionality. Their primary roles are to:

- become the mobile Command and Communication Centre at incidents in a localised area
- provide hazardous materials support for specialised equipment and decontamination at a hazardous substance incident.

Incident communication monitoring

At an incident, when in attendance and set-up, the ICU can monitor all incident communications, including:

- IGC communications
- communication with Fire and Emergency ComCens
- communication with other Fire Commanders on the incident ground
- communication with other vehicles responding to the incident.

Once established on site, whenever Fire and Emergency is the lead agency under the New Zealand Coordinated Incident Management System (CIMS) model, the ICU becomes the incident control point (ICP) for all command and control functions.

The Incident Controller (IC) takes overall command and control of the incident, operating from the ICU if and when it is established.

4.2. Operations

Environment

Our IGC communications at incidents are fast-paced and noisy. We are often working with loud power and striking tools, and our vehicle engines will be revving to power pumps to supply water. Smoke makes it hard to see and wearing BA and full PPE makes communication difficult.

We also respond to and operate in many buildings and incident locations, where it can be difficult to establish and maintain effective incident ground communications.

Topography

It's also difficult to communicate at complex incidents over large geographical areas during firefighting or rescue operations, often because the topography makes us lose radio contact.

Interference

The following can interfere with the radio frequency (RF) of IGC radios:

- vehicle ignitions
- electric motors
- high-voltage transmission lines
- computers
- light sources, including LEDs, fluorescent lights and energy-efficient bulbs.

Smoke from an intense fire can cause signal refraction, ionisation and scattering.

Building construction material can seriously disrupt UHF signal penetration, preventing effective IGC communications. This particularly affects buildings made of dense concrete and steel, tall buildings or those with large footprints, such as:

- multi-storey, high-rise buildings
- large footprint commercial warehouses or manufacturing facilities

- shopping malls
- hospitals
- prisons
- rest/care homes
- subterranean buildings, including underground rail stations.

These factors all contribute to reduced or weaker signal penetration when sending and receiving radio transmissions with portable handheld IGC radios.

Communications in buildings

In high-rise, large footprint, and subterranean buildings, IGC radios can have significant limitations for us. While there are other radio communication options, some used by international fire services, our experience and testing have shown that there is no single solution.

In some locations, we are currently using IGC portable repeaters with directional antennae. However, this is a stop-gap measure, not a long-term solution: it has significant limitations, and we are rapidly outgrowing this capability.

In high-rise or complex buildings, we prefer to use hardwired telephone systems, such as Warden Interface Phones (WIP), usually integrated with Emergency Warning and Intercommunication Systems (EWIS).

EWIS systems must be installed in accordance with **NZS 4512:2021**

Note: This includes references to the relevant Australian standards for EWIS design, equipment and installation.

As well as the above standards, we recommend:

- WIPs in a fire-rated stairwell or adjoining protected lobby
- use of fire rated cables
- that WIP or EWIS:
  - can be controlled from the high-rise building's fire control centre (FCC) – for more information, see F5-09 GD FFO Fire control centres.
  - can be used by multiple operators at once.

Radio communications in tunnels

Fire and Emergency vehicles have very limited or no LMR radio communication ability in a road tunnel. In most instances we need a leaky feeder cable installed in tunnels to provide LMR radio coverage for our vehicles (see 4.3 Radio signal rebroadcast systems, below). Leaky feeder must be tuned using the frequency for our exclusive use.

We also need a separate system for incident ground radio (IGC) communications in road or rail tunnels.

For specific IGC tunnel radio requirements, contact the Fire and Emergency Regional Telecommunication Specialist or National Telecommunications at telecoms@fireandemergency.nz

4.3. Radio signal rebroadcast systems

Signal transmission

Fire and Emergency IGC radios are critical and used frequently during an emergency incident. However, the environments we work in affect the signal. As outlined above, communications can be unreliable inside buildings and other structures. And unless our personnel are in line of sight, radio communication can be poor or impossible. This puts both our firefighters and our operations at risk.

Phones

Firefighters don't routinely carry mobile phones for various safety reasons and because they have limitations – the same factors that interfere with handheld radio signals also affect mobile phones.

Firefighters could use your building's landline phones to communicate with ComCens, but not with other Fire and Emergency vehicles or other firefighters at a scene. Landlines are also at risk of damage during incidents, e.g. from water or cables burning.

All of these factors may delay operations and put firefighters at risk.

Fixed communication technology

Fixed communication technology can improve signal transmission within buildings and structures. These can be either passive or active. Passive approaches simply provide a conduit to help transmit signals, while active methods use powered devices to amplify and retransmit signals.

A passive antenna system includes both an internal and an external antenna, connected with a short coaxial cable. A radiating cable, also known as a leaky co-ax, is a network of coaxial cables, with slots in the outer conductor that create a continuous antenna effect. These are often installed in lift shafts in taller multi-storey buildings and tunnels.

Figure 3 – Sectionalised view of leaky co-ax cable

This helps firefighters communicate more easily, which makes their job safer.

5. Recommendations

Improving communications for Fire and Emergency operations

This section summarises recommendations to help overcome the challenges to radio communications outlined in the previous sections. Improving radio communications both reduces the risk to firefighters and helps us to operate more effectively/quickly at incidents.

We recommend the following to ensure we have effective communications to manage incidents and keep our firefighters safe:

- Engagement with Fire and Emergency early in the design process of high-rise, large footprint, subterranean, complex buildings or tunnels.
- Install Warden Interface Phones (WIP) in fire-protected stairways or adjoining fire-protected lobbies, integrated with an Emergency Warning and Intercommunication System (EWIS), installed in accordance with NZS 4512:2021.
- Give us access to and control of installed systems from fire control centres – see **F5-09 GD FFO Fire control centres** for more information.
- Install active or passive antenna systems, such as leaky co-ax cabling.
- Install fixed repeaters designed for our use.

6. Related information

6.1. Designers' Guide to Firefighting Operations

- F5 01 GD FFO Introduction
- F5-02 GD FFO Emergency vehicles access
- F5-03 GD FFO Radio communications
- F5-04 GD FFO Fire alarm panels
- F5-05 GD FFO Building hydrant systems
- F5-06 GD FFO Automatic sprinkler systems
- F5-07 GD FFO Stairs in buildings
- F5-08 GD FFO Lifts
- F5-09 GD FFO Fire Control Centres
- F5-10 GD FFO Evacuation and rescues
- F5-11 GD FFO Water supplies
- F5-12 GD FFO Construction, refurbishment and demolition sites
- F5-13 GD FFO Multi-tiered vehicle stacking buildings
- F5-14 GD FFO Firefighting shafts in taller buildings

6.2. Legislation

- Fire and Emergency New Zealand Act 2017
- Building Act 2004
- New Zealand Building Code (Building Regulations 1992 > New Zealand Building Code > C Protection from fire)
- Health and Safety at Work Act 2015

6.3. Standards

- AS 1670.4:2015 Fire detection, warning, control and intercom systems – System design, installation and commissioning Emergency warning and intercom systems
- AS 4428.4:2004 Fire detection, warning, control and intercom systems – Control and indicating equipment, Part 4: Intercommunication systems for emergency purposes

6.4. References

- New Zealand Building Code Compliance C Protection from fire
- New Zealand Building Code handbook, third edition, amendment 13
- C/AS2 Acceptable Solutions

Note: The legislation, standards and references referred to in this guide (including those listed above) are relevant at the time that this document was published. Note however that the legislation/links may have been updated since this document was published.

Document information

Owner	National Manager Response Capability
Last reviewed	10/12/2021
Review period	Every second year

Record of amendments

Date	Brief description of amendment
December 2021	Format update and SME content review
March 2018	Initial version