The Institution of Engineers, Malaysia

IEM GUIDELINE ON

Testing and Commissioning of Fire Protection Systems

FIRST EDITION, DECEMBER 2021

The Institution of Engineers, Malaysia

IEM GUIDELINE ON

Testing and Commissioning of Fire Protection Systems

FIRST EDITION, DECEMBER 2021

Published by: **The Institution of Engineers, Malaysia**
Bangunan Ingenieur, Lot 60/62, Jalan 52/4, Peti Surat 223 (Jalan Sultan), 46720 Petaling Jaya, Selangor Darul Ehsan, Malaysia. General Line: (603) 7968 4001/4002 Fax: (603) 7957 7678
E-mail: sec@iem.org.my Homepage: http://www.myiem.org.my

NOTICE AND DISCLAIMER OF LIABILITY CONCERNING THE USE OF IEM GUIDELINES

The Institution of Engineers, Malaysia (IEM) disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether accidental, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on IEM guidelines. The IEM also makes no guarantee or warranty as to the adequacy, accuracy, oversight or completeness of any information published herein.

In publishing and making IEM Guidelines available, the IEM is not undertaking to render professional or other services for or on behalf of any person or entity. Anyone using this document or making reference to this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

This document shall be used to complement existing statutory laws, authority's requirements, standards, codes of practice and guidelines. The IEM has no power, nor does it undertake, to police or enforce compliance with the contents of IEM Guidelines. Nor does the IEM list, certify, verify, test, or inspect products, designs, installations or commissioning work conducted for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the IEM and is solely the responsibility of the certifier or maker of the statement.

Printed by: **Reproprint Solutions Sdn. Bhd.**
Lot 203, 2nd Floor, Podium Block, Faber Towers, Jalan Desa Bahagia, Taman Desa, 58100 Kuala Lumpur.
Tel: 03-7972 8282 E-mail: accounts@reproprint.com.my Homepage: http://www.reproprint.com.my/

Content

Abbreviations

BAS	Building Automation System
BoD	Basis of Design
Cx	Commissioning
FAB	Fire Advisory Board
FACP	Fire alarm and control panel
FRDM	Fire and Rescue Department Malaysia
IEM	The Institution of Engineers Malaysia
M&E	Mechanical and Electrical
MS	Malaysian Standard
NFPA	National Fire Protection Association
O&M	Operation and maintenance
PSP	Principal Submitting Person
SP	Submitting Person
T&C	Testing and Commissioning

Technical Committee on Testing and Commissioning Guideline for Fire Protection Systems

Testing and Commissioning Guideline Working Group

Chairman:

Ir. Yim Hon Wa

Working group (WG) members:

Ir. Leong Siew Meng -Deputy WG Chairman
Ir. Wong See Foong
Ir. Tan Chew
Ir. Gary Lim Eng Hwa
Ir. Chong Peng Kwong
Ir. Loo Chee Kin
Ir. Cha Hoong Kum
Ir. Chong Chew Fan

Fire Advisory Board (FAB)

Ir. Yim Hon Wa – FAB Chairman
Ir. Alan Chan Teck Wai – Deputy Chairman
Ir. Thin Choon Chai – Immediate-Past FAB Chairman (2004-2020)
Ir. Tan Chew – Secretary
Ir. Wong See Foong – Advisor
Datuk Ir. Prof. Dr Ow Chee Sheng
Ir. Chong Chew Fan
Ir. Gary Lim Eng Hwa
Ir. Chong Peng Kwong
Ir. Loo Chee Kin
Ir. Cha Hoong Kum
Ir. Daniel Lim Kim Chuan
Ir. Dr. Tan Chee Fai
Ir. Vasan A/L Mariappan
Ir. Lim Kim Ten
Ir. Dr. Hee Choi
Ir. Low Kai Wah
Ir. Selvakumar A/L Krishnan
Ir. Siow Yun Tong
Ir. Soong Peng Soon
Ms. G. Marahathananggai A/P Govindan
Ir. Leong Siew Meng

Foreword by **President Ir. Ong Ching Loon**

We are now living in a world where buildings are getting larger, taller and also more technologically complicated. The cities are also denser, and mixed developments are more common nowadays. With so many people congregating inside buildings, the fire protection systems must always be 100% functional when need to fight fire arises.

Fire-fighting and fire protection system have always been mandatory to be designed and installed in all designated premises under the Fire Services Act 1988. Designated premises, among others, include hospitals, hotels, factories and office buildings, shops and places of worship that satisfy the criteria set out in the Fire Services (Designated Premises) Order 1998. While the premises are installed with all the fire-fighting and fire safety equipment, the lack of best practices and/or guidelines on testing & commissioning and maintenance of these systems may result in these systems to be inoperable and/or non-functional during an emergency.

Therefore, it is extremely crucial that periodic and structural testing and commissioning of the fire protection systems adopting the guidelines will mitigate the fire safety risks.

One of my aspirations for IEM is to compile the immense knowledge and expertise of our talented members in all the engineering disciplines for publication as guidelines or handbooks of IEM for adoption by the engineering industry not just in Malaysia but internationally. I am truly pleased with the Fire Advisory Board (FAB) of IEM for publishing this Guideline, which defines certain terminologies besides detailing the workflow, documentation and reporting requirements of the whole Testing and Commissioning process, as well as the responsibilities of the relevant personnel. My heartiest congratulations to FAB Chairman Ir. Yim Hon Wa and all the team members for this great success!

By adhering to the IEM Guidelines, it is our hope that the functionality and operability of the fire protection systems in all designated premises all over Malaysia can be further enhanced. It is my sincere hope that this guideline will be beneficiary to all. Let's do everything we can to prevent fires, because life is precious.

Thank you.

Preface

The importance of design code compliance in the design of fire protection systems cannot be over-emphasized and its significance is well-recognized. The regulations and design requirements of fire protection systems are also well-disseminated to engineers and other stakeholders. On the other hand, it is the Fire Advisory Board's (FAB) opinion that there is a lack of documented guideline on testing and commissioning (T&C) procedural requirements for consistent and systematic execution. Fire protection T&C activities are normally managed by engineers but executed by installation contractors. As a design engineer and after having completed the fire protection system design and subsequently obtained the authority's design approval, the installation work is primarily left with the installation contractor who will conduct subsequent T&C activities towards the end of the contract work. In practice, it is common to encounter tight project schedules, which means that fire protection system T&C activities might be subjected to constraints such as limited timeframe for the thorough completion of T&C activities. Such scenario can pose a challenge to engineers, who are required to ensure that a comprehensive completion of all T&C activities is achieved.

The FAB of IEM have deliberated about the challenge of getting proper T&C done in a systematic manner. It was agreed that IEM should prepare a Fire Protection System T&C guideline, which will be useful to provide guidance for the principal submitting person (PSP) or submitting person (SP) and all parties involved to adhere to a consistent administrative and procedural execution of fire protection system T&C, which if necessary, can provide direction on integrated system tests. This guideline will outline a systematic and consistent approach to providing documented requirements that fire protection systems will be subjected to systematic and consistent T&C to be executed by responsible installation contractors who will confirm that all systems and equipment function as intended by the owner and the design team.

This guideline is intended to address the gaps in the current practice of T&C process while helping the PSP or SP to ensure that systematic and consistent T&C activities are conducted with traceable records of T&C information, persons-in-charge, etc. The objectives of this T&C guideline are to establish a consistent and best-practiced approach to fire protection and life

safety system testing and commissioning throughout the country. This guideline makes reference to the National Fire Protection Association (NFPA) 3 and 4, which address the administrative and procedural concepts of fire protection and life safety system commissioning, and also provides direction on the integrated system tests. For detailed T&C requirements of each fire protection system, reference should be made to the relevant standards of the respective systems such as MS1745-14:2009 Fire Detection and Fire Alarm Systems – Part 14: Guidelines for Planning, Design, Installation, Commissioning, Use and Maintenance and other Malaysian Standards.

The structure of this guideline provides users definitions, flow of T&C activities and responsibilities, documentation and reporting requirements. Useful examples and a guide to assist users for the preparation of commissioning documentation are provided in Appendices. The forms and sample documents are intended to be used as a guide to document critical path activities related to system commissioning and good practices in project management including traceable records for T&C activities. Users should develop and incorporate T&C details to suit their project requirements. Installation contractors are required to coordinate and ensure that his specialist vendors prepare T&C documentation based on the guides given herein.

It is hoped that this T&C guideline contributes to ensuring and enhancing the effectiveness and reliability of fire protection systems prior to handing over of building operations to building owners, particularly in complex fire protection installations.

Last but not least, the comments and input from IEM members who had attended the guideline dialogues organized by FAB are appreciated.

Ir. Yim Hon Wa
Chairman
IEM Fire Advisory Board and T&C Guideline Working Group

1.0 Introduction

The IEM Testing and Commissioning (T&C) guideline document is intended for use as an administrative and procedural guide for testing and commissioning of fire protection and life safety installations pertaining to active fire protection systems. This guideline provides assistance to make planning, organization, preparation, coordination, implementation and documentation of commissioning activities. For detailed T&C requirements of each fire protection system, reference should be made to the relevant standards of the respective systems such as MS1745-14:2009 Fire Detection and Fire Alarm Systems – Part 14: Guidelines for Planning, Design, Installation, Commissioning, Use and Maintenance, other Malaysian Standards and relevant Fire and Rescue Department (FRDM) guidelines.

The objectives of the testing and commissioning guideline are:

a) To establish a fire protection and life safety system testing and commissioning process that provides proper documentation with traceable records. This is to ensure that the systems and components are planned, designed, installed and preformed, in conformity with the basis of design (including applicable governing laws, codes, regulations, and/or standards) prior to the FRDM inspection.
b) To provide a guidance for systematic execution and coordination of the testing and commissioning process and activities, which may include integrated system tests subject to project requirements.
c) To ensure that all T&C procedures and records are properly documented so that the owner's operating and maintenance team can verify the system performance and continue with effective operation of the commissioned systems.

2.0 Scope

This guideline covers the minimum requirements for testing and commissioning of active fire protection systems, which require engineers' input. Passive systems are not included because they are normally specified by architects.

The application of this guideline depends on project specifications and how extensive the design and requirements are. The testing and commissioning process described in this

guideline is generic. The actual process to be implemented must be adapted to the specific requirements of each project.

3.0 Referenced Publications

This guideline makes reference to the following:

1) NFPA 3: Standard for Commissioning of Fire Protection and Life Safety Systems
2) NFPA 4: Standard for Integrated Fire Protection and Life Safety System Testing

4.0 Definitions

The definitions of various terms used in this guideline are defined below.

4.1 **Basis of Design (BoD)**: A document that records the concepts, intents including fire safety strategies, and design parameters complete with design values that satisfy the owner's project requirements and applicable regulatory requirements, codes, standards, and guidelines.

BoD is required to include the following:

a) A description of the building functions, size, etc.;
b) A description of fire protection or life safety systems and main components/systems;
c) Performance objectives and criteria;
d) List of applicable codes and standards;
e) Alternative means and methods incorporated into the original design;
f) Testing and start-up requirements.

4.2 **Construction phase**: The project phase during which the systems and materials are fabricated, installed, tested, inspected and accepted.

4.3 **Fire and Rescue Department Malaysia (FRDM)**: The authority having jurisdiction for all fire protection installations in Malaysia.

4.4 **Integrated system**: A combination of individual systems that are required to operate together as a whole to achieve the fire protection and life safety objectives.

4.5 **Principal Submitting Person or Submitting Person**: The principal submitting person or submitting person shall be a person qualified to make the submission of M&E plans to the authority having jurisdiction. He/she shall ensure that the persons who will perform

the commissioning activities for the whole fire protection system are competent and knowledgeable about the fire protection installations in accordance with the BoD.

4.6 **System training**: Training of owner's personnel should be conducted during construction phase or after Bomba inspection subject to site construction schedule. Training session scope, materials and attendees should be documented as part of the commissioning record.

4.7 **Testing and Commissioning (T&C)**: T&C is a process that includes testing and commissioning preparation and coordination work, checking and verification, pre-functional testing, functional testing, integrated system testing, acceptance testing and reporting of fire protection installations.

4.7.1 **Test:** A procedure intended to establish the operational status or performance of a system or component.

Pre-functional test: Test performed prior to functional test to confirm connectivity and system readiness for functional testing.

Functional test: Test performed prior to acceptance testing to confirm compliance with applicable requirements.

Acceptance test*:* Test performed on an individual system to verify compliance with applicable specifications and to verify installation in accordance with governing laws, regulations, codes and standards, and the project basis of design.

Integrated system test*:* Test performed on fire protection and life safety systems to confirm that operation, interaction, and coordination of multiple individual systems perform according to their intended functions together as a whole to achieve an overall objective for the initial T&C testing.

Integrated testing plan needs to be prepared. Basic test scenarios should include events and combination of events, including but not limited to the following:

1. Loss of normal power
2. Water flow
3. Presence of smoke

Other test scenario events shall be based on the specified requirements and applicable codes and standards. Integrated fire protection and life systems should have periodic system testing (appropriate intervals to be in accordance with specified requirements).

The test should begin with each initiating device and end with the actions and responses identified in the integrated testing plan. Where all the conditions and tests identified in the integrated testing plan are verified, it would not be required to test all devices on one individual system used to initiate a common response on other individual systems.

4.8 **T&C submittals**: A T&C document that describes the pre-T&C and T&C procedures or methodology complete with checklists and recording formats for each fire protection system. Manufacturer's recommended T&C procedures shall be incorporated.

5.0 T&C Process Activities

The T&C process and guides are summarized in the Testing & Commissioning flowchart below ***(Figure 4.1)***. It is applicable for testing and commissioning of fire protection installations during the construction phase. This guideline is intended for use by fire protection installation contractors to execute pre-T&C and T&C activities in a systematic, coordinated and consistent manner as described below. The conventional T&C activities for each active system is still required to be conducted in accordance with the requirements of the authority, standards and specifications. This guideline does not address the detailed T&C of each active system. However, it guides a fire contractor to carry out a systematic and coordinated T&C activities, which are normally conducted separately by their specialist suppliers and installers.

This guideline focuses on two areas, namely:

a) Pre-T&C activities;
b) T&C activities
    i. Functional T&C
    ii. Integrated system test

5.1 Pre-T&C Activities

Pre-T&C activities are important for the planning, preparation and coordination of the T&C activities, which allow SP to check and ensure that documentation is complete and that the T&C activities areas prepared in accordance with the specified requirements.

Should there be any shortcoming or non-conformance items, the issues can be rectified before conducting the T&C activities. Pre-T&C activities require the following to be carried out:

a) Contractor shall assign a knowledgeable commissioning personnel, who is familiar with this guideline, so that he/she will execute the procedural requirements given in this guideline that includes both the pre-T&C and T&C activities;
b) Pre-T&C preparation and coordination activities are required to be carried out. Refer to appendices for examples on the preparation of submittals. Pre-T&C activities shall include:
    1) Prepare pre-T&C schedules of all active systems including testing sequences;
    2) Prepare T&C submittals that include pre-T&C details, checklist, recording formats comprising safety testing, continuity tests, hydrostatic tests, pre-functional tests, etc. complete with respective design values, where applicable.
    3) Verification of materials and installations shall be conducted to confirm compliance with BOD.
    4) Conduct pre-functional tests in accordance with the T&C submittals;
    5) Review all installation checklist and pre-functional test records.

5.2 T&C Activities

Upon the satisfactory completion of the pre-T&C activities, T&C activities require the following to be carried out:

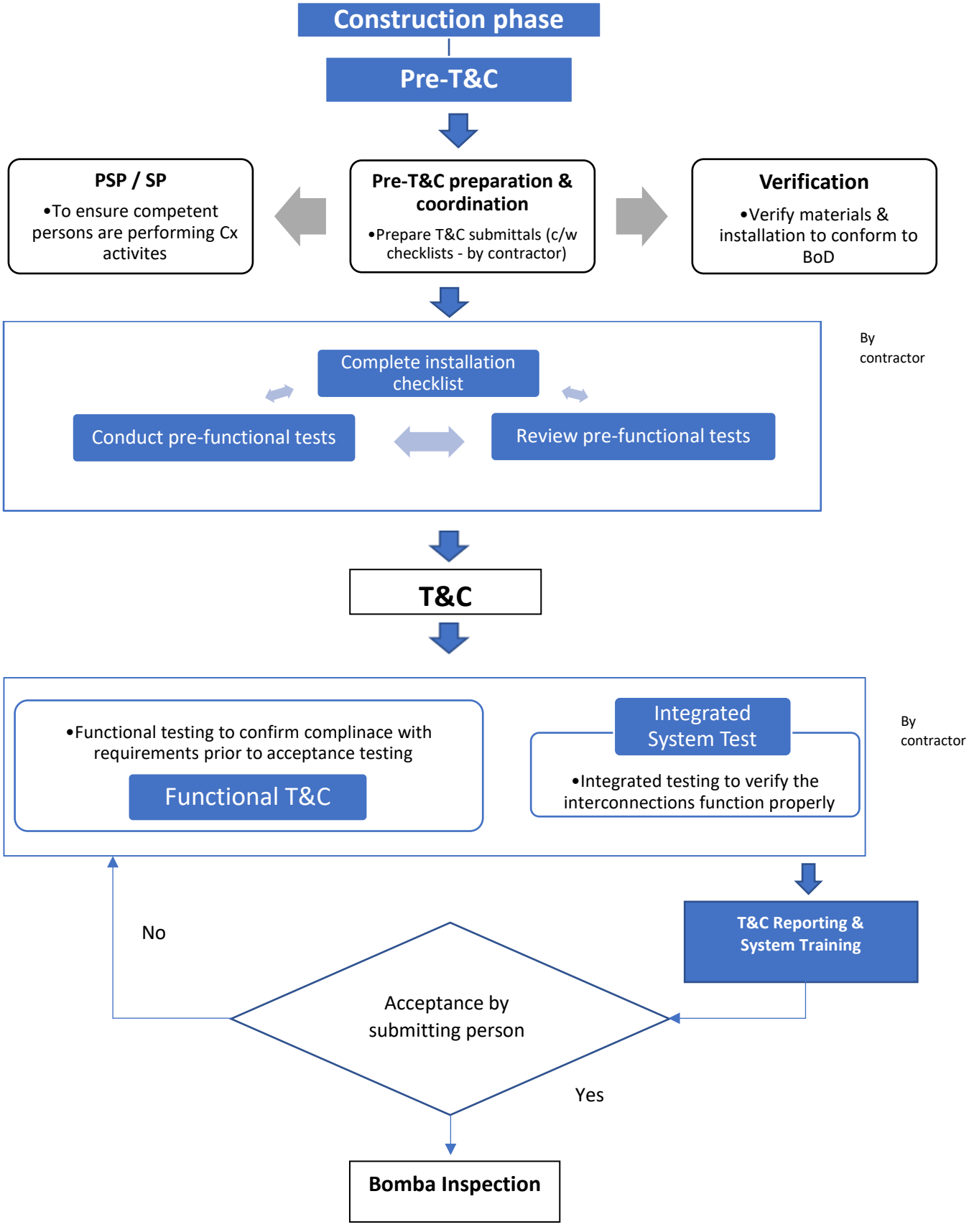
a) Active fire protection systems
    1) Conduct functional T&C activities in accordance with the T&C submittals, which would include T&C sequential activities and recording formats. Tests shall be performed on an individual system to verify compliance with approved design documents, and verify installations and their functions comply with specifications, governing laws, codes and standards. Refer to Appendix C and E which provide examples for the preparation of submittals;
    2) Except for small premises where the active systems are stand-alone and do not have interfacing functions, integrated tests should be performed on fire protection and life safety systems to confirm that operation, interaction, and

coordination of multiple individual systems perform their intended functions. Refer to Appendices A and B which provide examples for the preparation of submittals.

5.3 T&C Reporting

Upon completion of the T&C activities after all issues and discrepancies have been resolved, the fire protection installation contractor will submit a T&C report to SP for review and acceptance. The report shall include a summary of all the T&C results and functional status, including all the T&C records of testing, adjustments (or remedial actions) and measurements.

Figure 4.1: Testing & Commissioning Flowchart



Note:

1) *The T&C flowchart is confined to construction phase only.*
2) *The T&C flowchart is adapted and simplified from NFPA3 to suit local practices. The concept presented in the flowchart is relatively simple and straightforward for both the professionals and industry stakeholders to follow. It is intended to facilitate the preparation for Bomba inspection.*
3) *For commissioning guides, records and reporting, refer to Appendices A to K.*

6.0 Explanatory notes on appendices

The appendices provide examples and guides to assist users for the preparation of commissioning documentation. The forms and sample documents are intended to be used as a guide to document critical path activities related to system commissioning and good practices in project management including traceable records for T&C activities. The installation contractor is required to coordinate and ensure that his specialist vendors prepare T&C documentation based on the guide given herein.

It is not the intent of this guideline to provide all the T&C submittals, checklists and exact details that may be required. User should modify the forms and checklists to suit the project requirements. The extent of T&C documentation is subject to the complexity of systems installed within a building. For example, a hospital or high-rise building would most likely require a strict conformance to all the requirements of this guideline and other requirements to be stipulated by the consultant. T&C documentation for other buildings with simpler fire protection systems, such as a convenience store or small warehouse may be modified to suit the simpler fire protection installations.

6.1 **Appendix A: Typical fire operation matrix showing system inputs and outputs** (by consultant)

Fire operation matrix provides a useful guide and example to give an overview of system inputs and outputs, and also to conduct integrated tests. This fire operation matrix should be prepared according to the actual systems installed. The matrix would also provide useful overview of the sequence of operations. Based on this operation matrix, designer and building owner's representative can check the completeness and integrated functions of the fire protection system operation, and also whether it meets the design

requirements. In addition, operating staff can also use this matrix to conduct operational checks during building operation.

6.2 Appendix B: Fire operation matrix for a typical shopping mall (by consultant)

Appendix B provides another example of fire operation matrix that can be developed to suit particular building operational requirements.

6.3 Appendix C: Sequence of Operation Test Form (by contractor)

The details of this operation test form would correspond with the details given in the fire operation matrix, i.e. the system outputs on the fire operation matrix would correspond with the system outputs on the sequence of operation test form. This test form would serve as a useful record and confirmation of all the operation tests conducted during T&C.

6.4 Appendix D: Basis of Design (by consultant)

This document should be prepared by the fire protection system designer. It serves to record the original design intent of various fire protection systems for the building as described in this document. Typical details to be included are the building size, functions, occupancies or hazards, compliance codes and standards, resources for fire fighting to manage the hazards as stated, and any particular consideration.

6.5 Appendix E: Sequence of Operation and Functional Test Procedures Submittal (by contractor)

This document is a document control and provides information on status of test submittals, as part of project management on fire protection installations.

6.6 Appendix F: Commissioning Issues Log (by contractor)

This document keeps a summary of issues that requires more explanations, follow-up and tracking, as part of project management on fire protection installations.

6.7 Appendix G: Corrective Action Report (by contractor)

This document keeps a record of corrective action that maybe required, for further review and tracking as part of project management on fire protection installations.

6.8 Appendix H: Commissioning Functional Testing Plan Overview (by contractor)

This document keeps an overview of functional testing plan for site coordination, records and project management documentation purposes.

6.9 Appendix I: Commissioning Functional Testing Status (by contractor)

This document records the status of functional testing of various equipment and systems and confirmation of any follow-up retest. Functional performance testing can be done on a sampling basis. The determination of the extent of sampling should be made should be made by the design consultant.

6.10 Appendix J: Training of Operation and Maintenance (by contractor)

This document provides a formalized record of completing fire protection system training, which should include pre-approved topics and training outlines during the submission of T&C submittals. The training should cover but not limited to the following:

i. Provide an overview of the purpose and operation of this equipment, including required interactions of trainees with the equipment.
ii. Provide technical information regarding the purpose, operation, and maintenance of this equipment at a basic level, expecting that serious malfunctions will be rectified by suppliers' or manufacturers' representatives.
iii. Provide technical information regarding the purpose, operation, trouble-shooting, and basic maintenance of this equipment at a very detailed level, expecting that almost all operation, basic service, and faulty alarm repair will be provided by the trainees.
iv. Incorporate any unique trouble-shooting encountered during the T&C of various systems.

6.11 Appendix K: Extract of FRDM T&C Checklist

Appendix K provides an example of fire protection active system T&C checklist, which were extracted from the FRDM checklists for reference and compliance purposes, where appropriate.

APPENDIX A

Typical Fire Operation Matrix showing system inputs and outputs

System Outputs				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
	Other Required fire Safety	Actuate smoke control and pressurisation fans	P		X	X				X														P
		Lift homing	O	X	X	X		X	X			X	X	X	X									O
		Shut down associated mechanical equipment (see Note 3)	N								X													N
		Recall associated elevator in accordance with recall sequence (see Note 2)	M		X																			M
		Release all magnetically held doors	L	X	X	X	X	X		X														L
	Notifi-cation	Actuate all evacuation signals for the building	K	X	X	X	X	X																K
		Actuate associated exterior fire alarm beacon(s)	J	X	X	X	X	X																J
	Fire alarm Control Centre	Illuminate associated detector LED indicator at mimic panel	I			X										X								I
		Transmit alarm to fire department and to central station - master box	H	X	X	X	X	X		X														H
		Display and print change of status and time of initiating event	G	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		G
		Actuate audible trouble signal	F					X									X	X	X	X	X	X	X	F
		Actuate common trouble signal indicator	E														X	X	X	X	X	X	X	E
		Actuate audible supervisory signal	D						X			X	X	X	X	X								D
		Actuate common supervisory signal indicator	C						X			X	X	X	X	X								C
		Actuate audible alarm signal	B	X	X	X	X	X		X														B
		Actuate common alarm signal indicator	A	X	X	X	X	X		X														A
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
				1	Typical manual call point (by device)																				
				2	Typical elevator recalls smoke detector (by device) – by floor (lobby)																				
				3	Elevator machine room smoke detector (by device)																				
				4	Typical car park smoke detector (by device) – by floor																				
				5	Typical wet sprinkler system flow control valve assembly flow switch-by floor																				
				6	Typical wet sprinkler system flow control valve assembly tamper switch-by floor																				
				7	Kitchen cafeteria hood and duct extinguishing system – first floor																				
				8	Typical duct-in smoke detector (by device) – by floor																				
				9	Fire pump Running – by sprinkler/wet riser system																				
				10	Fire pump power failure – by sprinkler/wet riser system																				
				11	Fire pump phase reversal – by sprinkler/wet riser system																				
				12	Fire pump connected to emergency power – by sprinkler/wet riser system																				
				13	Fire water tank & generator fuel tank low levels																				
				14	Fire alarm system open circuit																				
				15	Fire alarm system ground fault																				
				16	Fire alarm system battery disconnect																				
				17	Fire alarm system low battery																				
				18	Fire alarm system ac power failure																				
				19	Fire alarm system amplifier failure																				
				20	Generator status indicator																				
						Fire Alarm Inputs								Building				FACP								
						Fire Alarm System								Fire Alarm System Inputs												
						System Inputs																				

Notes:

1. System inputs and outputs to be adjusted to suit actual installations, e.g. PA system with automatic recording, etc.
2. Upon activation of elevator recall the elevator should stop at primary recall floor. If fire is on primary recall floor the elevator should stop at an alternate recall floor. Primary and alternate recall floor should be coordinated with the fire department.
3. Information from the fire alarm system may be linked to building automation system (BAS). However, fire alarm system should not take instructions from the BAS system.

APPENDIX B

Fire Operation Matrix for a typical shopping mall

Zone on Fire	Zone Name	Cause of Alarm			Control									
		Sprinkler Flow Switch	Smoke Detector	Manual Call Point/Breakglass	AHU (Affected)	AHU (Non-Affected)	Smoke Spill Fan (Affected)	Sliding Door Actuator (Ground Floor)	Door Closure (To Back of House)	Fire Curtain	Roller Shutter	Pressurisation System (Staircase & Lobby)	Sounder & Strobe	Lift System
1	**Anchor Tenant**	x			Trip	Activate	Activate	-	Activate	Activate	Activate	Activate	Activate	Homing
				x	-	-	Activate	-	-	-	-	Activate	Activate	Homing
			x		Trip	Activate	Activate	-	Activate	Activate	Activate	Activate	Activate	Homing
2	**Mini Anchor Tenant**	x			Trip	Activate	Activate	-	Activate	Activate	Activate	Activate	Activate	Homing
				x	-	-	Activate	-	-	-	-	Activate	Activate	Homing
			x		Trip	Activate	Activate	-	Activate	Activate	Activate	Activate	Activate	Activate
3	**Public Mall Corridor (6 Zones)**	x			Trip	Activate	Activate	-	Activate	Activate	Activate	Activate	Activate	Homing
				x	-	-	Activate	-	-	-	-	Activate	Activate	Homing
			x		Trip	Activate	Activate		Activate	Activate	Activate	Activate	Activate	Activate
4	**Atrium Void (6 Zones)**	x			Trip	Activate	Activate	-	Activate	Activate	Activate	Activate	Activate	Homing
				x	-	-	Activate	-	-	-	-	Activate	Activate	Homing
			x		Trip	Activate	Activate	-	Activate	Activate	Activate	Activate	Activate	Activate
5	**Retail Outlets**	x			Trip	Activate	Activate	-	Activate	Activate	Activate	Activate	Activate	Homing
				x	-	-	Activate	-	-	-	-	Activate	Activate	Homing
			x		Trip	Activate	Activate	-	Activate	Activate	Activate	Activate	Activate	Activate
6	**Level 3 Retail Atrium**	x			Trip	N/A	Activate	Activate	Activate	Activate	Activate	Activate	Activate	Homing
				x	-	-	Activate	-	-	-	-	Activate	Activate	Homing
			x		Trip	-	Activate	-	Activate	Activate	Activate	Activate	Activate	Activate

Note:

1. Similar fire operation matrix may be prepared to suit particular project requirements.
2. The installation of smoke detectors is subject to project design purpose and requirements.
3. Indicate the sounder and strobe light arrangement according to BoD, e.g., for high rise buildings, a 2-stage alarm design is required and should be tested.

APPENDIX C
Sequence of Operation Test Form

Building Information

Building name: _____

Building address: _____

Owner's name: _____

PSP/SP (name) & company name: _____

_____

Installing Contractor

Company name: _____

Address: _____

Contact person: _____

Phone/fax/email: _____

System Input	System Output	Test Result	Date	Initials
1. Typical manual call points (by device)	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	C. Display and print change of status and time of initiating event			
	D. Transmit alarm to FD and central station master panel			
	E. Actuate associated exterior fire alarm beacons			
	F. Actuate all evacuation signals for the building			
	G. Release all magnetically held doors			
2. Typical lift recall smoke detector (by device) by floor (lobby)	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	C. Display and print change of status and time of initiating event			
	D. Transmit alarm to FD and central station master panel			
	E. Actuate associated exterior fire alarm beacons			
	F. Actuate all evacuation signals for the building			
	G. Release all magnetically held doors			
	H. Recall associated elevator in accordance with recall sequence			
	I. Elevator hoist way open			

System Input	System Output	Test Result	Date	Initials
3. Lift motor room smoke detector	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	C. Display and print change of status and time of initiating event			
	D. Transmit alarm to FD and central station master panel			
	E. Illuminate associated detector LED indicator			
	F. Actuate associated exterior fire alarm beacons			
	G. Actuate all evacuation signals for the building			
	H. Release all magnetically-held doors			
	I. Elevator hoist way open			
4. Typical car park smoke detector (by device) by floor	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	C. Display and print change of status and time of initiating event			
	D. Transmit alarm to FD and central station master panel			
	E. Actuate associated exterior fire alarm beacons			
	F. Actuate all evacuation signals for the building			
	G. Release all magnetically held doors			
	H. Recall associated elevator in accordance with recall sequence			
	I. Actuate smoke control and pressurisation fans			
5. Typical wet sprinkler system flow control valve assembly flow switch – by floor	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	C. Actuate audible trouble signal			
	D. Display and print change of status and time of initiating event			
	E. Transmit alarm to FD and central station master panel			
	F. Actuate associated exterior fire alarm beacons			
	G. Actuate all evacuation signals for the building			
	H. Release all magnetically held doors			
6. Typical wet sprinkler system flow control valve assembly tamper switch – by floor	A. Actuate common supervisory signal indicator			
	B. Actuate audible supervisory signal			
	C. Display and print change of status and time of initiating event			
7. Kitchen cafeteria hood and duct extinguishing system	A. Actuate common alarm signal indicator			
	B. Actuate audible alarm signal			
	C. Display and print change of status and time of initiating event			
	D. Transmit alarm to FD and central station master panel			
	E. Release all magnetically held doors			
	F. Elevator hoist way open			
8. Typical duct smoke detector (by device) – by floor	A. Display and print change of status and time of initiating event			
	B. Shutdown associated mechanical equipment			

System Input	System Output	Test Result	Date	Initials
9. Fire pump Running – by sprinkler/wet riser system	A. Actuate common supervisory signal indicator			
	B. Actuate audible supervisory signal			
	C. Display and print change of status and time of initiating event			
10. Fire pump power failure – by sprinkler/wet riser system	A. Actuate common supervisory signal indicator			
	B. Actuate audible supervisory signal			
	C. Display and print change of status and time of initiating event			
11. Fire pump phase Reversal – by sprinkler/wet riser system	A. Actuate common supervisory signal indicator			
	B. Actuate audible supervisory signal			
	C. Display and print change of status and time of initiating event			
12. Fire pump connected to emergency power – by sprinkler/wet riser system	A. Actuate common supervisory signal indicator			
	B. Actuate audible supervisory signal			
	C. Display and print change of status and time of initiating event			
13. Fire pump circuit breaker at generator output	A. Actuate common trouble signal indicator			
	B. Actuate audible trouble signal			
	C. Display and print change of status and time of initiating event			
14. Fire alarm system open circuit	A. Actuate common trouble signal indicator			
	B. Actuate audible trouble signal			
	C. Display and print change of status and time of initiating event			
15. Fire alarm system ground fault	A. Actuate common trouble signal indicator			
	B. Actuate audible trouble signal			
	C. Display and print change of status and time of initiating event			
16. Fire alarm system battery disconnect	A. Actuate common trouble signal indicator			
	B. Actuate audible trouble signal			
	C. Display and print change of status and time of initiating event			
17. Fire alarm system low battery	A. Actuate common trouble signal indicator			
	B. Actuate audible trouble signal			
	C. Display and print change of status and time of initiating event			
18. Fire alarm system ac power failure	A. Actuate common trouble signal indicator			
	B. Actuate audible trouble signal			
	C. Display and print change of status and time of initiating event			
19. Fire alarm system amplifier failure	A. Actuate common trouble signal indicator			
	B. Actuate audible trouble signal			
	C. Display and print change of status and time of initiating event			
20. Generator status indicator	A. Actuate common trouble signal indicator			
	B. Actuate audible trouble signal			
21. Fire water tank – low level	A. Actuate common trouble signal indicator B. Actuate audible trouble signal			
22. Generator fuel tank – low level	A. Actuate common trouble signal indicator B. Actuate audible trouble signal			

Date system left in service after completion of Cx activities: _____

Tested by:

_____	_____	_____
Contractor's representative	Title	Date

Test witnessed by:

_____	_____	_____
PSP / SP	Title	Date

Test witnessed by:

_____	_____	_____
Owner's representative	Title	Date

Additional explanations/notes:

_____

_____

_____

_____

_____

_____

APPENDIX D

Basis of Design

Project name _____

Contract number _____

BUILDING

Intended use _____

_____

Construction type(s) _____

Building height _____ Total area (m^2) _____

Number of floors above ground_____ Number of floors below ground _____

Area per floor (m^2) _____

DESCRIPTION OF OCCUPANCIES OR HAZARDS WITHIN BUILDING

DESIGN CODES/STANDARDS *(Indicate editions.)*

SITE ACCESS FOR EMERGENCIES *(Include changes during construction stages.)*

RESOURCES FOR FIRE FIGHTING TO MANAGE THE HAZARDS STATED ABOVE *(also list when available during construction stages.)*

SPECIAL CONSIDERATIONS

APPENDIX E

Sequence of Operation and Functional Test Procedures Submittal

Project: _____ Submittal No: _____

☐ New ☐ Resubmittal

From (initially): _____ To (initially): _____

Equipment/System tag and name: _____

Included:

☐ Sequences of operation
☐ Functional test procedures and forms

Submissions/Returns

The following checked individuals will receive these documents for review and/or approval:

Party	**For review and comment only**	**For review and approval**	**For records only**
Main contractor	☐	☐	☐
Fire contractor	☐	☐	☐
Electrical contractor	☐	☐	☐
Mechanical contractor (smoke control, etc.)	☐	☐	☐
Construction manager/RE	☐	☐	☐
Owner's representative	☐	☐	☐
Architect	☐	☐	☐

Path	To: _____ From: _____	To: _____ From: _____	To: _____ From: _____	To: _____ From: _____	To: _____ From: _____
Comments by submitter	See Key (1) ☐ Notes attached	See Key (1) ☐ Notes attached	See Key (1) ☐ Notes attached	See Key (1) ☐ Notes attached	See Key (1) ☐ Notes attached
Copies					
Submitter signature					
Title					
Date					
Review code					

Key: (1) Review and comment on the sequences and/or test procedures as to their compliance with the specs.
(2) Check test for personnel safety and to keep equipment warranty in force.

Review Codes: AF = Approved by fire contractor (or electrical contractor) as complying with the contract documents.
Test will not void warranty or damage equipment and do not present unsafe conditions for personnel.
AE = Approved by electrical contractor as complying with the contract documents.
AD = Approved by the design engineer as complying with the contract documents.
NC = Note corrections. Approved, but need to resubmit for the record, after correcting.
NA = Not acceptable. Resubmittal required for review.

APPENDIX F
Commissioning Issues Log

Project: _____ Prepared by: _____ Page _____ of _____

Attach additional pages as necessary for issues requiring more explanations and tracking.

#	Issue / Non-compliance	Date Found	Code/ Document Reference	Possible Cause	Recommendations	Action Taken	O&M Doc. issue date	Signature and Date

APPENDIX G

Corrective Action Report

Project: _____ ID:_____

Equipment/System: _____ Equipment/System ID: _____

Identified from: ☐ Test ☐ Review ☐ Discussion _____ ☐ Site visit _____
Date

The above equipment has been observed and tested, or the performance report reviewed, and was found to not comply with the contract documents.

Deficiencies or issues and effects:

_____

_____

_____

Corrective action: ☐ Required ☐ Recommended

_____

_____

_____

For testing to proceed in a timely manner, it is imperative that the required corrective action be completed by:

_____
Date or event

_____ _____ _____ _____
SP Date Owner's Representative Date

Forwarded to the following parties on _____ for corrective action:
Date

_____

_____

Attachments? ☐ Yes ☐ No

_____
Fill in the following section and return entire form to SP when corrected.

Statement of Correction

The above deficiencies have been corrected with the following actions:

_____

_____

_____

_____

_____ _____ _____
Signature Firm Date

APPENDIX H
Commissioning Functional Testing Plan Overview

Project: _____ Date: _____ Prepared by: _____

Equipment/System and Related Controls	When Testing Can Start (date or event)	Estimated Duration of Test (hrs)		Test witnesses	Test records	Test Procedure. Needs Review
		During Occupied Period	During Unoccupied Period*			

APPENDIX I
Commissioning Functional Testing Status

Project: _____ Date: _____ Prepared by: _____

Equipment/System	Functionally Tested?	Pass/Fail	When Can It Be Retested?	Next Test Date

APPENDIX J

Training of Operation and Maintenance

Project: _____ Date of training: _____

Equipment/System: _____ Spec section: _____

Section 1. Audience and General Scope *(Owner and PSP/SP fill out this section and transmit entire form to responsible contractors. Attach training specification section.)*

Intended audience type (enter number of staff): _____ facility manager, _____ facility engineer, _____

facility technician, _____ project manager, _____ operation personnel, _____

other: _____

General objectives and scope of training (check all that apply)

☐ A. Provide an overview of the purpose and operation of this equipment, including required interactions of trainees with the equipment.

☐ B. Provide technical information regarding the purpose, operation, and maintenance of this equipment at an intermediate level, expecting that serious malfunctions will be addressed by factory reps.

☐ C. Provide technical information regarding the purpose, operation, trouble shooting, and basic maintenance of this equipment at a very detailed level, expecting that almost all operation, basic service, and faulty alarm repair expected to be provided by the trainees.

Section 2. Instructors *(Commissioning agent fills in company. Trainer fills out the balance, prior to training.)*

ID	Trainer	Company	Position/Qualifications
1)			
2)			
3)			

Section 3. Training Programme / Subjects *(This section is required to be filled out and submitted to owner and SP for review and approval prior to conducting training.)*

Location: ☐ Site: _____ Date: _____

☐ Venue (location): _____ Date: _____

General Subjects Covered (✓ all that will be covered) (✓ when completed)	Duration (min.)	Instructor (ID)	Completed (✓)
☐ General purpose of this system or equipment (design intent)			
☐ Review of control drawings and schematics (have copies for Attendees and show that they are part of the O&M Manual and as-built drawings, which will be made available)			
☐ Start-up, loading, normal operation, unloading, shutdown, unoccupied operation, seasonal changeover, etc., as applicable			
☐ Integral controls (packaged): programming, troubleshooting, alarms, manual operation			
☐ Interface with other integral controls and building automation systems			

To attach attendance list (complete with company names and respective job title)

APPENDIX K

Extract of FRDM T&C Checklist

BORANG PEMERIKSAAN DAN PENGUJIAN PEPASANGAN KESELAMATAN KEBAKARAN (BORANG PKK)

The following are examples of fire protection active system T&C checklists extracted from the FRDM checklists for reference purposes. For the complete set of T&C checklist details, reference should be made to the FRDM Checklist.

List of complete set of Borang PKK in the FRDM checklists (only PKK 27-29 are appended below):

JENIS	LAMPIRAN	/
Pili Bomba	PKK (1)	
Sistem Pili Bomba Bertekanan	PKK (2)	
Sistem Hos Gelung	PKK (3)	
Sistem Pancur Basah	PKK (4)	
Sistem Panchur Kering	PKK (5)	
Sistem Pancur Kering Menurun	PKK (6)	
Sistem Semburan Automatik (Sprinkler)	PKK (7)	
Sistem Karbon Dioksida	PKK (8)	
Water Spray System	PKK (9)	
Sistem Sangga Kembangan Tinggi	PKK (10)	
Alat Pemadam Api Mudah Alih	PKK (11)	
Duluge System	PKK (12)	
Pintu Api	PKK (13)	
Lantai (Termasuk Lantai Petak)	PKK (14)	
Dinding Luar	PKK (15)	
Dinding Pengasing	PKK (16)	
Dingding Pangsa	PKK (17)	
Dinding Bawa Beban	PKK (18)	
Pengasingan Kawasan Risiko Kebakaran	PKK (19)	
Pengadang Api	PKK (20)	
Sesekat Api (Fire Damper)	PKK (21)	
Sistem Pengudaraan	PKK (22)	
Lubong Terlindung	PKK (23)	

JENIS	LAMPIRAN	/
Suis Pengasing Elektrik	PKK (24)	
Fire Roller Shutter	PKK (25)	
Sistem Pengesan Api Automatik	PKK (26)	
Sistem Penggera Kebakaran	PKK (27)	
Sistem Penggera Penunjuk Isyarat	PKK (28)	
Panel Penggera Kebakaran	PKK (29)	
Akses Perkakas Bomba	PKK (30)	
Lif Bomba	PKK (31)	
Ruang Asap	PKK (32)	
Tangga Menentang Kebakaran	PKK (33)	
Ruang Terlindung	PKK (34)	
Pusat Pemerintahan dan Kawalan	PKK (35)	
Sistem Komunikasi Suara	PKK (1)	
Unit Titik Isyarat	PKK (1)	
Bateri Pusat (Central Battery)	PKK (1)	
Set Janakuasa (Generator Set)	PKK (1)	
Lampu Kecemasan (Emergency Light)	PKK (1)	
Lampu Kecemasan (Tanda KELUAR)	PKK (1)	
Pintu Keluar	PKK (1)	
Koridor Terlindung	PKK (1)	
Pintu Keluar Tingkat	PKK (1)	
Tangga Terlindung	PKK (1)	

PKK (27)

SISTEM PENGGERA KEBAKARAN (Fire Alarm System)

1.	Jumlah Alat Pecah Kaca *(Call point)* yang ditentukan mengikut pelan yang diluluskan oleh JBPM?	☐		**Ulasan**
2.	Apakah jenis pendawaian *(Wire)* yang di gunakan:	**Ya**	**Tidak**	
	1. Pecah kaca *(Call point)* 3/039	☐	☐	
	2. Loceng *(Bell)* 7/029	☐	☐	
3.	Cara pendawaian yang di gunakan:			
	1. PVC	☐	☐	
	2. G.I Conduit	☐	☐	
	3. Lain-lain (kelulusan JBPM)	☐	☐	
		Ada	**Tidak**	
4.	Adakah terdapat Alat Pecah Kaca *(Call point)* terlindung dan terhalang *(penggunaannya)*?	☐	☐	
5.	**Cara Uji** : (yang mana pecah kaca)	**Berfungsi**	**Tidak Berfungsi**	
	1. Ujian *"Alarm Mode" (bunyi)*	☐	☐	
	2. Ujian *"General alarm" (selepas 5 minit seluruh penggera akan berbunyi)*	☐	☐	
	3. Ujian *"Fault" (lihat indikasi di "Main fire alarm panel")*	☐	☐	
6.	Ujian Indikasi di *"Main fire alarm panel" (untuk "Main fire alarm system" sahaja)*			
	1. *"Alarm test"*	☐	☐	
	2. *"Fault test"*	☐	☐	
	3. *"Isolate test"*	☐	☐	

Komen: ……

……

PKK (28)

SISTEM PENGGERA PENUNJUK ISYARAT

		Ada	Tidak
1.	Adakah ianya ditempatkan pada lokasi yang betul dan berkesan?	☐	☐
2.	Adakah ianya dihubungkan ke *"Main fire alarm panel"*?	☐	☐
3.	Adakah pendawaian mengikut spesifikasi Jabatan Bomba dan Penyelamat Malaysia?	☐	☐
4.	Setelah diuji, adakah ianya dalam keadaan yang memuaskan?	☐	☐

Komen: ……

……

PKK (29)

PANEL PENGGERA KEBAKARAN

1. Lokasi *"Main fire alarm panel"* mengikut pelan asal Bomba: **Ya / Tidak**

2. Jenis *"Main fire alarm panel"*:

   "Wall mounted" ☐
   "Console" ☐
   "Micro processor" ☐

		Ada	Tidak	Ulasan
3.	Adakah terdapat *"Sub-panel"* disetiap tingkat/zon?	☐	☐	
4.	Adakah terdapat bateri?	☐	☐	
5.	Adakah ia dilabelkan mengikut zoning?	☐	☐	
6.	Adakah lakaran *"Mimic plan"* dan *"Circuitory diagram"* diadakan dalam ruang panel utama?	☐	☐	
7.	Adakah semua system kebakaran dipertalikan ke *"Main fire alarm panel"?*	☐	☐	
8.	Adakah terdapat alat perhubungan/siaraya *(P.A. system)?*	☐	☐	
9.	Adakah terdapat interkom Bomba?	☐	☐	
10.	Cara Uji	…….		

Komen: ……

……

Acknowledgements

This guideline is a joint effort of the FAB working group members and also the FAB committee members. The immediate-past FAB Chairman, Ir. Thin Choon Chai has been persistent and instrumental in getting the drafting of this guideline commenced during his tenure as the FAB Chairman. In particular, I would also like to thank Ir. Wong See Foong and Ir. Leong Siew Meng for their dedicated effort in compiling and editing during the drafting of this guideline.

Special thanks go to the Director General of the Fire and Rescue Department Malaysia, Datuk Seri Mohammad Hamdan bin Hj. Wahid, and his team of senior officers who have expressed their support for this testing and commissioning guideline.

Acknowledgement is also given to IEM secretariat staff, Ms. Noor Afzan and others who have helped coordinated and compiled the preparation of this guideline. Last but not least, the comments and inputs from IEM members who participated in the guideline dialogues organized by FAB are appreciated.

Ir. Yim Hon Wa
Chairman
IEM Fire Advisory Board and T&C Guideline Working Group

ISBN 978-967-18427-1-3

Published by: **The Institution of Engineers, Malaysia**
Bangunan Ingenieur, Lot 60/62, Jalan 52/4, Peti Surat 223 (Jalan Sultan), 46720 Petaling Jaya, Selangor Darul Ehsan, Malaysia.
General Line: (603) 7968 4001/4002 Fax: (603) 7957 7678
E-mail: sec@iem.org.my Homepage: http://www.myiem.org.my