EXPRO National Manual for Projects Management

Volume 6, chapter 7

ELV System Integration Guideline

Document No. EPM-KE0-GL-000007 Rev 002

Document Revisions History:

Revision:	Date:	Reason For Issue
000	04/01/2018	For Use
001	23/12/2018	For Use
002	15/08/2021	For Use

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1.0 PURPOSE

To identify the Commissioning Process required for the integration between Extra Low Voltage (ELV) System in any projects. Commissioning Process covers design and construction requirements to prove the functionality and reliability of the integrated ELV Systems.

2.0 SCOPE

This document defines Extra Low Voltage (ELV) within a building that can be integrated to attain fully functional and coordinated systems, depending on the requirement of the contract and as applicable for project types. The procedure defines minimum requirements for integration, the scope of each entity required for successful integration, and the process of integration during the design and construction stage.

3.0 DEFINITIONS

Definitions	Description
Owner Project Requirements (OPR)	A client/owner generated mandatory pre-design document by ASHRAE, LEED, and NFPA which is the basis of the Basis of Design (BOD) preparation, construction, acceptance, and operational requirements. The document contains the specific and detailed functional requirement (in less technical terms) of the project and expectations how the project will be used and operate
Commissioning Record	T&C documentation that Includes issues log, commissioning plan & methodology, progress reports, submittal and O&M manual reviews, training record, test schedules, construction checklists, start-up reports, functional tests, and trend log analysis.
Integration Testing Plan	This can be part of the overall T&C Plan which is a strategic project specific procedure of documentation on how to complete the T&C for a given scope of work in a given project time duration. It outlines the scope and extent of the work, organization, schedule, recording, allocation of resources, and coordination planning.
Integration Methodology	This can be part of the over-all T&C Methodology which is a written protocol which defines procedures and expectations for test conducted on equipment, assemblies, systems, and interfaces (or integration). The document includes test prerequisites, test conditions, limitation and tolerance, tools and instruments to be used, schematics, and safety risk assessment.

4.0 REFERENCES

Document Number	Title of the Document
EPM-KT0-PR-000006	Project Testing and Commissioning Procedure
EPM-KT0-GL-000003	Project Testing and Commissioning Guideline
EPM-KE0-TP-000015	Checklist - ELV System Integration
EPM-KEE-GL-000002	ELV System Design Guideline
EPM-KEE-TP-000022	Template – ELV System Design Criteria
EPM-KEE-RG-000002	List of ELV Design Deliverables
EPM-KEE-GL-000004	ELV System Design Aid
EPM-KEE-TP-000010	Checklist – CCTV Surveillance System Layout
EPM-KEE-TP-000011	Checklist – ELV System Checklist
EPM-KEE-TP-000012	Checklist – Structured Cabling System Layout
EPM-KEE-TP-000025	Checklist – Access Control System Layout
EPM-KEE-TP-000026	Checklist – Public Address System Layout
EPM-KEE-TP-000027	Checklist – Master Clock System Layout
EPM-KEE-TP-000028	Checklist – Distributed TV System Layout
EPM-KEE-TP-000029	Checklist – Audio/Visual System Layout
EPM-KEE-TP-000030	Checklist – Fire Alarm System Layout
EPM-KEE-TP-000031	Checklist – Intercom System Layout

5.0 RESPONSIBILITIES

5.1 Owner/Entity

Establish an Owner Performance Requirement (OPR) and ensure contract includes a Commissioning Authority to review completeness of design and construction documents related to the ELV System integration. For the detailed SoW (Scope of Works) for the Owner during design, construction, and occupancy, refer the Project Testing and Commissioning Guideline EPM-KT0-GL-000003.

5.2 Commissioning Authority (CA)

Assist the Owner/Entity to ensure that the OPR is completely developed and requirements for the integration are included. For the detailed SoW of the CA during design, construction, and occupancy, refer to the Project Testing and Commissioning Guideline EPM-KT0-GL-000003.

5.3 Designer (Architect/Engineer) - A/E

Establish the requirements of integration between ELV Systems and provide clarification to all enquiries during the construction phase. For the detailed SoW of the A/E during design, construction, and occupancy, refer to the Project Testing and Commissioning Guideline EPM-KT0-GL-000003.

5.4 Owner Representatives - Consultants, Project Management or Construction Management

Participate in the review of the integration requirements and advise improvements to ensure compliance to Codes and Standards. Conduct site inspection and supervise the T&C implementation to ensure quality control. For the detailed SoW of the Owner Representative during design, construction, and occupancy, refer to the Project Testing and Commissioning Guideline EPM-KT0-GL-000003.

5.5 T&C Agent – Main Construction Contractor In-house T&C Entity or Specialized Third Party

Lead the coordination between Trade Contractors involved in ELV Systems, supervise the integration works as per the contract requirements and approved T&C Plan and Methodology, witness all testing activities, and ensure that quality control measures are implemented. For the detailed SoW of the T&C Agent during design, construction, and occupancy, refer to the Project Testing and Commissioning Guideline EPM-KT0-GL-000003.

5.6 Operation and Maintenance Personnel (OMP)

Address operational and maintenance requirement of the systems and participate during testing of the systems as standalone and as integrated. For the detailed SoW of the OMP during design, construction, and occupancy, refer to the Project Testing and Commissioning Guideline EPM-KT0-GL-000003.

6.0 ELV SYSTEM INTEGRATION PROCESS

6.1 General

ELV System that can be integrated to other ELV Systems depends on project requirements and classification, and are itemized as follows;

1. Security and Access Control System to:
   a. Closed Circuit Television
   b. Intrusion Detection System
   c. Door Intercom System
2. Public Address and Voice Alarm to Digital Signage and IPTV/Analogue TV
3. Building Management System to:

   a. Security and Access Control System
   b. Electrical Power Management System
4. Master Clock Integration to:
   a. Building Management System
   b. Fire Detection and Alarm System
   c. Security and Access Control System
   d. Closed Circuit Television
   e. Voice and Data Infrastructure
   f. Nurse Call System
   g. Real Time Location System
   h. Q-Matic
   i. Public Address and Voice Alarm System
   j. Electrical Power Management System
   k. Parking Management and Assistance System
5. Admission, Discharge, and Transfer to Nurse Call System and Voice/Data Infrastructure
6. Nurse Call System integration to:
   a. Patient Room Lighting System
   b. Real Time Location System
   c. Security Panic Alarm
   d. Enterprise Telephone System (PABX or VoIP Server)
   e. Voice/Data Infrastructure and Wireless Network

The user is advised to refer to document EPM-KT0-GL-000003, Project Testing and Commissioning Guideline part 5 for functional explanation of integrating ELV Systems.

6.2 During Design Stage

1. ELV Systems to be integrated shall be defined in the OPR during the pre-design stage. The OPR shall also define the intended functions, scope, and limitations for integrating ELV Systems or the design team can refer to the Project testing and Commissioning Guidelines EPM-KE0-GL-000003 for guidance as applicable to the project. The Commissioning Agent (CA) and the Owner Representative shall assist the Owner in establishing the requirements.
2. A Particular Specifications shall be developed by the design team for the ELV System Integration to indicate method of connection between systems and controllers inclusive of the preferred communication protocols. For other Integration Specification requirements during the design phase, refer to ELV Checklist EPM-KE0-TP-000015.
3. An ELV System integration diagram shall be developed and prepared by the design team to aid the Main Contractor and ELV System Trade Contractor regarding the requirements for systems connectivity and integration. The diagram shall indicate connectivity either by electro-mechanical interlink thru relays and contacts, hardwire analogue or digital interface, hardwire software interface, or fiber optic software interface, etc.
4. Cyber Security needs to be addressed, assigned responsibility, and direction for codes to follow shall be included for all ELV systems.
5. The degree of management of electrical protection settings, and the ability to change/edit either off-line (or on-line) with separate levels of password control should be addressed with regard to Electrical Power Management Systems.

6.3 During Construction Stage

1. The Main Contractor and his T&C Agent shall prepare a comprehensive Testing Plan and Methodology for ELV System Integration to be approved by the CA and the Owner Representatives.
2. The Main Contractor shall coordinate with the Design Team and Trade Contractors to populate and develop the ELV System Integration Diagram to indicate method of connectivity and communication protocols as applicable based on the selected ELV System manufacturers, controllers, and field devices. Requirements for gateways shall also be indicated as required.

3. The Main Contractor shall ensure that field devices procurement shall be coordinated with the T&C schedule and re-certification shall be based on date of installation or use and not on the date of last test. All required testing shall immediately commence upon installation.
4. All ELV Systems shall pass all required testing independently (as a standalone system) prior to the integration works.
5. The Main Contractor with his T&C Agent shall conduct testing for integrated ELV Systems to be witnessed and accepted by the CA and Owner's Representative prior to the preliminary project handover (refer to document EPM-KE0-GL-000003 part 5 for guidance).
6. Integrated testing and commissioning records, to prove the completeness of the integrated testing works shall be submitted by the Main Contractor and his T&C Agent to the Client duly approved by the Commissioning Authority.
7. All testing plans and procedures shall conform to best construction practices.

7.0 ATTACHMENTS

1. EPM-KE0-TP-000015 - ELV System Integration Checklist
2. EPM-KEE-13-000001 - ELV Integration Block Diagram

7.1 Attachment 1 : EPM-KE0-TP-000015 - ELV System Integration Checklist

PROJECT NAME:		DISCIPLINE:	REV.
EQUIPMENT TYPE: ELV System Integration	EQUIPMENT TAG:	EQUIPMENT LOCATION:	

No.	QUESTIONS	ORIGINATOR		
		N/A	YES	NO
	ELV (Extra Low Voltage) System Integration			
	Specification Requirements			
1	A dedicated Specification is provided for ELV System Integration which includes sequence of operation of the following integrated systems, as applicable:	☐	☐	☐
	• Security and Access Control System to CCTV	☐	☐	☐
	• Security and Access Control System to Intrusion Detection System	☐	☐	☐
	• Security and Access Control System to Door Intercom System	☐	☐	☐
	• Public Address and Voice Alarm System to Digital Signage	☐	☐	☐
	• Public Address and Voice Alarm System to IP or Analogue TV	☐	☐	☐
	• Master clock Integration to BMS, FDAS, Voice and Data Infrastructure, Nurse Call System, Real Time Location System, Q-Matic, PAVA, and Parking Management and Assistance System.	☐	☐	☐
	• ADT (Admission, Discharge, and Transfer) to Voice and Data Infrastructure and Nurse Call System	☐	☐	☐
	• Nurse Call System Integration to Patient Room Lighting System, Security Panic Alarm, Enterprise Telephone System (or VoIP), and Wireless Network	☐	☐	☐
	• BMS (Building Management System) and EPMS (Electrical Power Management System)	☐	☐	☐
	• BMS Integration to Security and Access Control System	☐	☐	☐
	• BMS Integration to Lighting System	☐	☐	☐
	• BMS, EPMS, Security and Access Control, PAVA, and Q-Matic to Wireless Network	☐	☐	☐
2	Routing and other communication level protocol requirements such as IP or Non-IP based (TCP/IP) are identified in the Specification for all ELV Systems.	☐	☐	☐
3	Mains power supplies for controllers, interface modules, and devices are included (24v DC, 24v AC, or 220 v AC) in the Specification or POE (Power Over Ethernet) is required for ELV Systems. Requirements for essential power is indicated for POE and non-POE.	☐	☐	☐
4	ELV System field devices power requirements matches the POE Switch Chassis power availability. Up to 15 watts for POE switch, up to 30 watts for POE plus, and up to 60 watts for Universal POE.	☐	☐	☐
5	The architectural RCP reflects all ELV System field devices and third fix (Access Points, Speakers, exciters, CCTV camera, etc.)	☐	☐	☐
6	Specification indicates preferred communication protocol for all ELV System. Communication protocol is truly open for inter-operability for all system level integration.	☐	☐	☐
7	Designer must consider and coordinate aspects of system integration, such as Quality of Service (QoS), delay and packet loss management, delay variation, security, bandwidth, scalability, information storage, authorization level, and redundancy to ensure successful system integration	☐	☐	☐
8	Design Site Survey was conducted for Wireless Network System to ensure proper signal strength coverage of each Access Points. Parameters used for the Site Survey has been discussed and accepted by the Client Representatives.	☐	☐	☐
9	Specification clearly defines method of integration between systems, equipment, devices, and other items within the controller hierarchies. Integration method shall indicate either of the following method: a. Electro-mechanical interlink thru relays and contactors. b. Hardwire analogue integration by voltage (0-10 v, 0-5v, 2-10 volts), or current signal (4-20mA) c. Hardwire digital integration d. Hardwire software integration by Modbus, BACNet, LON, KNX, DALI, OPC, M-Bus, EnOcean, and other BAS protocol. e. Fiber Optic software integration by Modbus, BACNet, LON, KNX, and other BAS protocol. f. Communication cabling type.	☐	☐	☐

PROJECT NAME:		DISCIPLINE:	REV.
EQUIPMENT TYPE: **ELV System Integration**	EQUIPMENT TAG:	EQUIPMENT LOCATION:	

10	ELV System Integration Diagram is developed and provided by the designer which includes methods of connection between systems, equipment, devices, and other items, inclusive of gateways as required.	☐	☐	☐
11	Field devices (sensors, measuring devices, actuators, etc.) are NIST calibrated. Required criteria for the accuracy of field devices stated in the specification including device drift (during storage and during use) to identify re-calibration requirements.	☐	☐	☐
12	Clear description of division of responsibilities between integrating parties.	☐	☐	☐
13	A Commissioning Authority/ System Integrator was employed by the Client to provide comprehensive review and recommendation for all documents related to ELV Integration (e.g. ELV Integration Specification, BOD, OPR, etc.) to comply with the Client's requirements, Codes, and Standards during the stages of design development.	☐	☐	☐
14	Level controller control signal output matches field devices signal input and vice versa.	☐	☐	☐
15	Testing and Commissioning requirements are defined in the Specification such as:	☐	☐	☐
	a. Comprehensive methodology for Integrated Testing.	☐	☐	☐
	b. Integration Testing Plan to include:	☐	☐	☐
	• Identification of procedure, limits, and process of inspection.	☐	☐	☐
	• Scope and list of systems, equipment, devices, and other items covered under the FLS Integration Program.	☐	☐	☐
	• Overview of the Integration Strategy.	☐	☐	☐
	• Milestone schedule.	☐	☐	☐
	• Integrating Agent Organizational Chart.	☐	☐	☐
	• Reporting procedure for progress, defects, and corrections.	☐	☐	☐
	• Division of Responsibilities between Trade Contractors.	☐	☐	☐
	• Integration checklist and templates.	☐	☐	☐
16	Training requirements for Maintenance Staff identified in the Specification (duration, programming, hands-on, external or local training, etc.)	☐	☐	☐
17	Clear description of division of responsibilities and Scope of Work between integrating parties which includes provision of gateways as required.	☐	☐	☐
18	Cyber Security needs to be addressed, assigned responsibility, and direction for codes to follow shall be included.	☐	☐	☐
19	The degree of management of electrical protection settings, and the ability to change/edit either off-line (or on-line) with separate levels of password control should be addressed with regard to Electrical Power Management Systems.	☐	☐	☐
	Drawings, Tables and Diagrams			
20	ELV Safety Integration Diagram is developed and provided by the designer which includes methods of connection between systems, equipment, devices, and other items, inclusive of gateways as required for inter-operability between different application level communication protocols.	☐	☐	☐
21	The architectural RCP reflects all ELV System field devices/ third fix (smoke detectors, Access Points, strobes, speakers, camera, etc.). Architectural RCP is the only base layout/reference for almost all ELV field devices during design.	☐	☐	☐
22	The architectural plan reflects all ELV System field devices/ third fix (manual pull stations, strobes, speakers, camera, data outlets, telephone outlets, etc.) installed on the wall. Architectural layout is the only base layout for ELV field devices installed on the wall during design and should show elevations of devices from finished floor.	☐	☐	☐
23	The structured cabling lay-out complies to the total requirement of UTP cables for all ELV systems and matches the requirement of field devices as per architectural RCP and floor plan.	☐	☐	☐

No.	Reviewer's Comments	Resolution
Originator's Name / Signature and Date:		Checker's Name / Signature and Date:

PROJECT NAME:		DISCIPLINE:	REV.
EQUIPMENT TYPE: **ELV System Integration**	EQUIPMENT TAG:	EQUIPMENT LOCATION:	

7.2 Attachment 2 : EPM-KEE-13-000001 - ELV Integration Block Diagram