Book 10
Technical Specifications and Requirements of Smart Devices for a Building Energy Management System (BEMS)

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1.0 <u>GENERAL</u>

This document describes the specifications of smart devices to be acquired and deployed in the smart building. Smart devices shall have Open API and allow monitoring and/or control from PEA HiVE- an open-architecture platform for building energy management developed by PEA. PEA HiVE will be provided, and integration of smart devices to PEA HiVE will be performed by PEA.

1.1 Components of the smart building
Smart devices in the smart building shall consist of:
- A solar photovoltaics (PV) system at least10kWp
- A smart inverter at least 10kVA
- Power/energy meter(s)
- Air conditioning unit(s)
- Lighting load controller(s)/occupancy sensor(s)
- Plug load controller(s)
- Integrated security system
- Smoke detector(s)
- Wall mount Battery storage System at least 10kW/10kWh
- Smart curtain(s)
- Projector with screen control
- KVM switch(es)

1.2 General requirements
The smart building shall be certified based on the Thai's Energy and Environmental Sustainability (TREES) Rating System, which is a green building rating system developed by Thai Green Building Institute (URL: http://www.tgbi.or.th/).

Smart devices shall allow communications with PEA HiVE. Hence, the following requirements are necessary:
- All smart devices shall have open Application Programming Interface (API).
- All smart devices shall be able to connect to the building Ethernet/WiFi network. In case a converter/gateway is needed to allow smart devices to connect to the building Ethernet/WiFi network, such a converter/gateway shall be provided.
- API documentation that describes a means to obtain device readings and send control commands to smart devices shall be provided.

1.3 Environmental requirements
The system shall be designed for use in the following operating conditions:

Operating temperature	0°C - 45°C
Humidity	0% - 100%
Maximum altitude	1,000 m

2.0 <u>SOLAR PHOTOVOLTAICS (PV) SYSTEM</u>

A solar photovoltaics (PV) system coverts sunlight into electricity. The PV system shall comprise a solar PV array and balance of system components, i.e., a smart inverter, wirings, a PV circuit breaker and disconnects. Solar PV array and other balance of system components are discussed in this Section. Inverter specifications are discussed in Section 3.0.

2.1 Standards and codes
- IEC 61730: Photovoltaic (PV) module safety qualification
- IEC 61215:Terrestrial photovoltaic (PV) modules – Design qualification and type approval

2.2 Array location and orientation
- The solar PV array shall be installed on the roof of the smart building.
- The section of the roof to install solar PV shall have little to no current or anticipated shading.
- Care shall be taken to ensure that the solar PV array location is not affected by plumbing or mechanical roof penetrations.
- Azimuth of the proposed PV array shall not be deviated more than ±45° off of due south, as the energy output of a solar energy system is optimized by setting the array where the roof is oriented due south at 180° azimuth.

2.3 PV array specifications
PV modules shall conform to the following specifications.

Table 1. PV array specification requirements

Details	Technical requirement
PV module	
PV module type	Mono/Polycrystalline
PV array	
Output	At least 10kWp
Grid-tied	Yes
Maximum DC voltage	* specified by the bidder
Number of PV modules connected in series	* specified by the bidder
Number of PV modules connected in parallel	* specified by the bidder

2.4 Balance of system components
Balance of system components are a smart inverter, wirings, a PV circuit breaker, disconnects and mounting system. These are described below:
- Smart inverter:
  - See Section 3.0.
- DC conduit:
  - A metal conduit shall be installed from the designated array location to the designated inverter location with the end of the conduit clearly labeled, indicating its intended use.
  - The conduit shall be located in an area that provides sufficient accessibility and clearance for a solar installer to continue the conduit run above the roof deck to the solar array area at a future point in time.
  - The conduit shall have three or fewer 90-degree turns from the roof to the designated inverter location, as required by the National Electric Code.

- o The conduit shall terminate near the edge of the designated inverter location to facilitate the final connections to the balance of system components, or for aesthetic reasons, terminate into a flush mount junction or pull box near the designated inverter location.
  - o Both conduit ends shall be sealed.
  - o The conduit run shall be identified on the electrical and architectural diagrams.
- AC conduit:
  - o A metal conduit from the designated inverter location to the main service panel where the system is intended to be tied into the building's electrical service shall be installed.
  - o The conduit should be capped and clearly labeled, indicating its intended use, on the stubbed end near the inverter location.
  - o Both conduit ends shall be sealed.
  - o The conduit run shall be identified on the electrical and architectural diagrams.
- Circuit breaker:
  - o A circuit breaker shall be installed in the electrical service panel for use by the solar PV system.
  - o The circuit breaker shall be labeled for use by the PV system.
- Disconnects:
  - o Properly rated DC and AC disconnects shall be provided.
- Mounting system:
  - o Mounting system shall be provided to allow PV to be mounted on the rooftop of the smart building.
  - o Voltage drop shall be low enough to allow the inverter to operate as intended. Voltage drop shall be less than 3% overall from the modules through to the interconnection.

2.5 Installation
The PV unit shall be installed in accordance with the manufacturer's installation instructions.

2.6 Field testing and certification
The PV unit shall be tested in accordance with the following:
- Conduct a complete inspection and test of the PV system. This includes testing and verifying all connections.
- Provide staff to test the device and all operational features of the PV/inverter system (the inverter is discussed in Section 3.0) for witness by PEA's representatives as applicable.
- Correct deficiencies until satisfactory results are obtained.
- Submit written copies of test results.

2.7 Documentation
The following documents shall be provided for the PV system:
- PV specifications
  - o Model and spec sheet of solar PV modules
  - o Electrical characteristics of PV modules (maximum power, open circuit voltage, short circuit current, voltage at maximum power point, current at maximum power point)
  - o Number of PV modules connected in series and parallel
- Architectural drawings that summarize the installed system equipment:
  - o Location of the solar PV array
  - o Square footage of the solar PV array area relative to the building roof space
  - o Detailed orientation (azimuth) of the array location relative to the roof plane
  - o Inclination (tilt) for the solar PV array
  - o Location of the inverter and balance of system components
  - o Conduit size, type and location

- o Electrical circuit panel location and dedicated circuit breaker slots
- o Length of conduit from the designated array location to the designated inverter location
- o Length of conduit from the designated inverter location to the electrical service panel
- o Location and number of necessary pull boxes in line with each conduit run
- Electrical drawings of PV system components that provide in sufficient detail to call out the electrical components, the wire types and sizes, number of conductors, conduit type and size, as well as the dedicated location for the mounting of the balance components.
- The code-compliant documentation of the structural capacity of the roof and of the current dead loads on the roof, demonstrating that the roof has the capacity to support a minimum of 6 pounds per square foot additional dead load for a future PV system.

3.0 SMART INVERTER
3.1 Relevant standards and codes
- ANSI C12.1: Electric Meters
- ANSI/IEEE C62.41: IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
- CSA C22.2 No. 107.1-01: General User Power Supplies
- CSA TIL M-07: Interim Certification Requirements for Photovoltaic (PV) DC Arc- Fault Protection
- IEC 62109-1: Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
- IEEE 1547: Standard for Interconnecting Distributed Resources with Electric Power Systems
- IEEE 1547.1: Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems
- UL 1699B: Outline of Investigation for Photovoltaic (PV) DC Arc-Fault Circuit Protection (or Equivalent)
- PEA Grid Code 2016 or later

3.2 Inverter location
- The inverter shall be installed in a dedicated area– which shall be free of direct sunlight, excessive heat, or any harsh or extreme weather conditions. The inverter mounting area shall not share a common wall with a working space, such as an office or a meeting room, where slight noise and vibration may be considered a nuisance.
- A finished aesthetic to the wall area shall be maintained.

3.3 Inverter specifications
The technical specification requirements of the smart inverter are summarized in Table 2. In addition to the inverter, sensors for measuring irradiance, wind speed, ambient temperature and module temperature shall be supplied.

Table 2. PV inverter specification requirements

Details	Technical requirement
Input	
PV power	At least 10kWp
Maximum DC voltage	1000V DC
Output	
Maximum output power	Compatible with PV output, i.e., 10kW
Grid connection	380V AC
Grid voltage tolerance	±10%

Phase	3
Frequency	50Hz
Total harmonic distortion	< 5%
Power factor	0.85-1
Efficiency	
Efficiency	> 95%
Functions/Features	
Maximum power point tracker	Yes
Grid voltage/frequency monitoring	Yes
Islanding condition monitoring	Yes
Fault ride through	Yes (can be enabled or disabled)
Revenue grade meter	Yes – the inverter shall measure the amount of energy fed into the grid in accordance with ANSI C12.1, accuracy class 2%.
Inverter topology	Transformer-less
Cooling	Yes
Night time consumption	< 1W
Control features	
On/off	Yes
Active power control	Yes
Reactive power control	Yes
Constant power factor control	Yes
Limited control from specific IP addresses	Yes
Protectivedevices	
DC insulation measurement	Yes
DC disconnector	Yes
Reverse polarity protection	Yes
Overload behavior	Yes
Indicators	
Display values, settings, menus	Yes
Operating status of PV	Yes
Interruption of grid power	Yes
Status diagnosis	Yes
Communications	
Communication technology	Wire/Wireless
Communication protocol/data exchange format	Open API, such as SunSpec,HTTP/JSON and Modbus
Enable remote data collection and control of PV output, including power, reactive power and power factor from PEA HiVE	Yes
Data logger and webserver	Yes
USB	Preferred, data logging
External relay control	Optional
SMS or email in case of errors	Yes
Android and iOS APP	Yes
General	
Installation	Indoor
Degree of protection	At leastIP54 or equivalent

3.4 Communications with PEA HiVE

The inverter shall provide an Ethernet interface (Wi-Fi and serial communications are optional) to allow PEA HiVE to obtain readings from and send control commands to the inverter. Open communication protocols (e.g., SunSpec, JSON/XML and Modbus), shall be used for communicating with the inverter. The ON/OFF status, active/reactive power and power factor of the inverter shall be controlled via its OpenAPI interface (such as Modbus). API documentation shall be provided.

At the minimum, the following inverter data shall be available.
- AC output power (W)
- AC reactive power (VAr)
- AC voltage (V)
- AC output current (A)
- AC frequency (Hz)
- Power factor
- DC power (W)
- DC voltage (V)
- DC current (A)
- AC energy yield (kWh/MWh)
- AC maximum output power (W)
- AC max voltage (V)
- DC maximum voltage (V)

Data logging intervals shall be adjustable (e.g., 5, 10, 15, 20 and 30 minutes).

At the minimum, the following control features shall be available.
- On/off
- Active power control (W)
- Reactive power control (VAr)
- Constant power factor control

For a security purpose, the inverter shall provide the "limit control" option where inverter control commands are only permitted form specific IP address(es).

3.5 Installation
The inverter shall be installed in accordance with the manufacturer's installation instructions.

3.6 Field testing and certification
The inverter shall be tested in accordance with the following:
- Conduct a complete inspection and test of the PV/inverter system. This includes testing and verifying all connections.
- Provide staff to test the device and all operational features of the PV/inverter system for witness by PEA's representatives as applicable.
- Correct deficiencies until satisfactory results are obtained.
- Submit written copies of test results.

3.7 Documentation
The following documents shall be provided for the smart inverter:
- API documentation—This documentation provides a means for third parties to obtain data from the inverter and send control commands in a defined format.
- Instruction to connect the device to a Wi-Fi network (if Wi-Fi is used).
- Product Data—This documentation includes catalog sheets and technical data sheets indicating physical data and electrical performance, electrical characteristics, and connection requirements.

- Operation and Maintenance—This documentation includes a manual for preparing, operating, and maintaining the inverter. This includes equipment wiring connection outlines and written instruction for troubleshooting.
- System Electrical Connection Drawings—This documentation includes drawings for properly connecting electrical wiring at the time of installation.
- Installation Instructions—This documentation includes step-by-step installation instructions for properly installing the unit.
- Device setup instructions on Android/iOS APP

4.0 POWER/ENERGY METER
4.1 Relevant standards and codes
- ANSI C12.xx: Electric Meters(or Equivalent)
- EN 61000 – Electromagnetic Compatibility(or Equivalent)
- UL/IEC STD 61010-1/CSA STD C22.2 No. 61010.1: Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

4.2 Meter location
Power/energy meter(s) shall be installed next to the main distribution breaker box. The meter(s) shall be used to measure power/energy consumption of the entire smart building, floor#1, floor#2, the CRAC circuit and PV output as shown in Figure 1.

Additionally, power/energy meter(s) shall be installed to measure power consumption of (a) lighting circuits;(b) plug load circuits and (c) air conditioning circuits; of floor#1 and floor#2 as show in Figure 2. Power/energy consumption of critical load circuits shall also be monitored.

Note: one power meter may be capable of measuring power/energy consumption of 12 circuits or more.
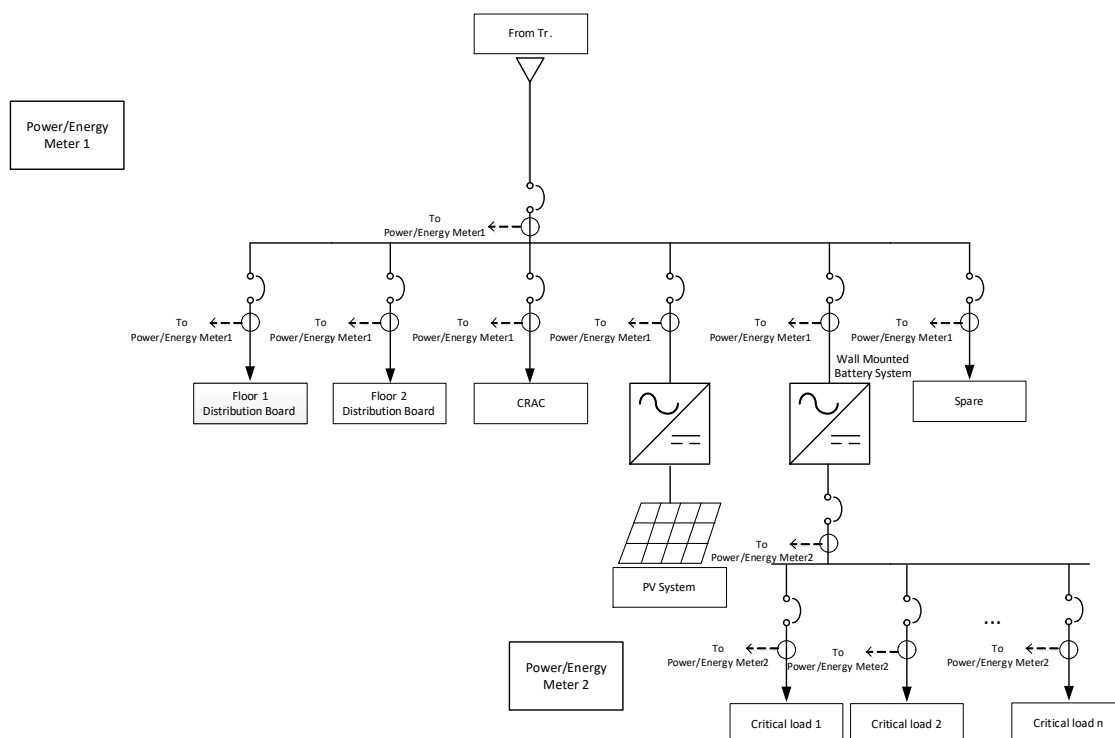
Figure 1. Main Distribution Board with Power/Energy Meter
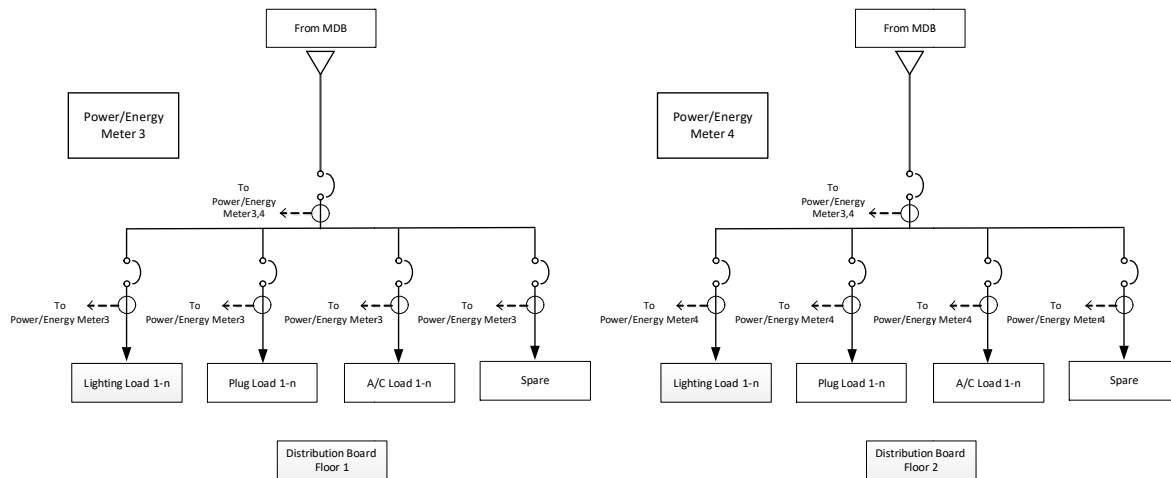
Figure 2. Distribution Board with Power/Energy Meter for Floor 1 and Floor 2

4.3 Power/energy meter specifications

Power/energy meters, including current transformer, shall conform to the following specifications.

Table 3. Power/energy meter specification requirements

Details	Technical requirement
Power/energy meter	
Logging values	V, A, W, Wh, Hz, VA, VAr, THD, deg
Voltage	0-460Vrms
Current	Refer to PEA
Phase	3
Electrical frequency	50Hz
Accuracy	ANSI C12.1 –1% with certificate (or equivalent)
Data resolution	Adjustable at 1-second, 1-minute, 15-minute, 30-minute and 1-hour intervals
Internal storage capacity	Capable of storing 1 minute data for at least 1 year
Communication technology	Ethernet or Serial
Communication protocol/data exchange format	Open API, such as HTTP/XML
Enable remote data collection from PEA HiVE	Yes
Current transformer	
Type	Split-core
Amperage rating	Refer to PEA
Accuracy	1%
Enclosure	
Degree of protection	At least NEMA 3X(or equivalent)

4.4 Communications with PEA HiVE

The power/energy meter shall provide an interface to allow PEA HiVE to obtain readings from the power/energy meter(s). Open communication protocols, e.g., JSON/XML, shall be used for communicating with the power/energy meter(s). API documentation shall be provided.

At the minimum, the following data shall be available.
- Voltage (V)
- Current (A)
- Real power (W)

- Reactive power (VAr)
- Apparent power (VA)
- Energy (Wh)
- Frequency (Hz)
- Harmonic distortion (THD)
- Power factor

Data logging intervals shall be adjustable at 1-second, 1-minute, 15-minute, 30-minute and 1-hour intervals.

4.5 Installation
The power/energy meter shall be installed in accordance with the manufacturer's installation instructions.

4.6 Field testing and certification
The power/energy meter shall be tested in accordance with the following:
- Conduct a complete inspection and test of the power/energy meter. This includes testing and verifying all connections.
- Provide staff to test all operational features of the power/energy meter for witness by PEA's representatives as applicable.
- Correct deficiencies until satisfactory results are obtained.
- Submit written copies of test results.

4.7 Documentation
The following documents shall be provided:
- API documentation—This documentation provides a means for third parties to obtain data from the power/energy meter in a defined format.
- Product Data—This documentation includes catalog sheets and technical data sheets indicating physical data and electrical performance, electrical characteristics, and connection requirements.
- Operation and Maintenance—This documentation includes a manual for preparing, operating, and maintaining the power/energy meter. This includes equipment wiring connection outlines and written instruction for troubleshooting.
- System Electrical Connection Drawings—This documentation includes drawings for properly connecting electrical wiring at the time of installation.
- Installation Instructions—This documentation includes step-by-step installation instructions for properly installing the unit.
- Ethernet network set up instruction—This documentation includes step-by-step instructions to connect the device to an Ethernet network.

5.0 AIR CONDITIONING (AC) UNIT
5.1 Relevant standards and codes
- Thai Industrial Standards Institute (TISI)
- Thai Energy Efficiency Standards and Labeling (Label N.5)

5.2 AC locations
5.2.1 Air conditioning units(AC) shall be properly sized to provide sufficient cooling needs to the smart building. Please refer to drawing in Building for AC locations.

5.2.2 The AC serving the main control room (Computer Room Air Conditioning: CRAC) should be able to provide enough cooling needs and operate 24 hrs. a day. The set-point and relative humidity of the AC serving the main control room should be set at 22 degree C and 45%, respectively. The sizing of the main control room AC shall be approved by PEA.

5.3 Air conditioning specifications for 5.2.1
Air conditioning units shall obtain the Thai Energy Efficiency Rating of Number 5, and conform to the following specifications.

Table 4. AC specification requirements

Details	Technical requirement
Type	
Split system	Yes
Power supply	
Voltage input	208-230V or 380 V
Phase	1 or 3
Electrical frequency	50Hz
Basic functions	
Inverter power control	Yes
COOL mode	Yes
AUTO mode	Yes
FAN-only mode	Yes
Multiple fan speeds	Yes
ECONO operation	Yes
Indoor unit ON/OFF button	Yes
Self diagnosis	Yes
System ratings– cooling	
Cooling capacity range (BTU/h)	* specified by the bidder to provide sufficient cooling need
SEER	> 13
EER	> 8
Energy Star rated	Yes
Sensor/timer	
Built-in occupancy sensor	Yes
24 hour ON/OFF timer	Yes
Protection	
Low voltage start-up	Yes
Over current protection	Yes
Anti-freeze protection	Yes
High and low pressure protection	Yes
Communication and control	
Remote control	Yes
Communication technology	Ethernet or Wi-Fi connection–required
Communication protocol/data exchange format	Open API, such as HTTP/JSON
Enable remote data collection and control of its ON/OFF status, mode and set-point from PEA HiVE	Yes
Android or iOS APP	Yes

Note:
- EER: Energy Efficiency Rating. It measures the ratio of output power to the input power.
- SEER: Seasonal Energy Efficiency Ratio. It provides an annual measure of the efficiency of the air conditioner. Higher numbers use less energy.

- COP: Coefficient of Performance. It is the ratio between the cooling or heating provided and the electrical power consumption.

5.4 Communications with PEA HiVE

The air conditioning unit(s), except the CRAC, shall provide an Ethernet or Wi-Fi interface to allow PEA HiVE to obtain readings from and send control commands to the air conditioning unit(s). Open communication protocols, e.g., HTML/JSON, shall be used for communicating with the unit(s). API documentation shall be provided.

At the minimum, the following data shall be available.
- Indoor temperature (°C)
- AC mode (COOL/HEAT/AUTO/OFF)
- FAN mode (ON/AUTO/OFF)
- Cool set point (°C)

At the minimum, the following control features shall be available.
- AC mode (COOL/HEAT/AUTO/OFF)
- FAN mode (ON/AUTO/OFF)
- Cool set point (°C)

For security purpose, the AC serving the main control room (CRAC) shall not be controlled by PEA HiVE. Additional temperature/humidity sensor(s) that has open API shall be provided to monitor in-door temperature of the main control room.

5.5 Installation

The AC units shall be installed in accordance with the manufacturer's installation instructions.

5.6 Field testing and certification

The AC units shall be tested in accordance with the following:
- Conduct a complete inspection and test of all AC units. This includes testing and verifying all connections.
- Provide staff to test all operational features of all AC units for witness by PEA's representatives as applicable.
- Correct deficiencies until satisfactory results are obtained.
- Submit written copies of test results.

5.7 Documentation

The following documents shall be provided:
- API documentation—This documentation provides a means for third parties to obtain data from the AC unit(s)in a defined format.
- Product Data—This documentation includes catalog sheets and technical data sheets indicating physical data and electrical performance, electrical characteristics, and connection requirements.
- Operation and Maintenance—This documentation includes a manual for preparing, operating, and maintaining the AC unit(s). This includes equipment wiring connection outlines and written instruction for troubleshooting.
- System Electrical Connection Drawings—This documentation includes drawings for properly connecting electrical wiring at the time of installation.
- Installation Instructions—This documentation includes step-by-step installation instructions for properly installing the unit.

- Communication set up instruction—This documentation includes step-by-step instructions to connect the device to a communication network.
- Device setup instructions on Android/iOS APP

6.0 LIGHTING LOAD CONTROLLER AND OCCUPANCY SENSOR

6.1 Relevant standards and codes
- Illuminating Engineering Society (IES) lighting handbook
- ASHRAE 90.1 – Energy standard for commercial buildings
  - Automatic lighting shutoff (9.4.1.1) – "All indoor lighting must include a separate automatic shut-off control, such as an occupancy sensor or timer switch."
  - Space control (9.4.1.2b) – "An occupancy sensor that automatically turns lighting off within 30 minutes must be installed in classrooms, conference rooms, break rooms, storage rooms, printing rooms, private offices, restrooms and dressing rooms."
  - Additional control (9.4.1.6) – "Lighting in enclosed stairwells shall have one or more control devices to automatically reduce lighting power by at least 50% within 30 minutes of all occupants leaving."
- IECC 2012 – International Energy Conservation Code
  - Occupancy sensors (405.2.2.2) – "Requires use of occupancy or vacancy sensors in classrooms, conference/meeting room, break rooms, private offices, restrooms, storage rooms, janitorial closets and all spaces 300 sq. ft. or less."

6.2 Lighting requirements
All lighting fixtures shall be of LED type and provide lighting levels to meet standard illumination requirements in offices.

Table5. Lighting type requirements

Lighting type requirement	Technical requirement
Lighting type	Dimmable LED
Voltage input	220V
Phase	1
Electrical frequency	50Hz

Table 6. Recommended illuminance by space type

Recommended illuminance by space type (per IES lighting handbook)	Illuminance (LUX) (fc = footcandle)
Open offices	30-50fc or 323-538lux
Private offices	50fc or 538lux
Conference rooms	30fc or 323lux
Corridors	5fc or 53.8lux
Restrooms	10fc or 108lux
Lobby	10fc or 108lux
Kitchen	50fc or 538lux
General warehousing/storage	10fc or 108lux
Inactive storage	5fc or 53.8lux

There are different lighting requirements in different sections of the building, as described below.Please refer to PEA for the lighting zones.

6.2.1 Conference room

Lighting in conference room shall be divided into several zones. Each zone shall be controlled by a separate wireless smart switch. Occupancy/vacancy sensors are required to automatically turn all lights ON with occupancy detection and OFF after a configurable period of inactivity.

Table 7. Lighting requirements – conference room

Details	Technical requirement
Number of zones	Setting by PEA
Light switch for ON/OFF/dimming control	Yes – wireless smart light switch
Occupancy/vacancy sensor	Yes
Light ON	Automatic
Light OFF	After a configurable period (e.g., 30 minutes) of inactivity

6.2.2 EO

Lighting in EO shall be divided into several zones. Each zone shall be controlled by a separate wireless smart switch. Occupancy/vacancy sensors are required to automatically turn all lights ON with occupancy detection and OFF after a configurable period of inactivity.

Table 8. Lighting requirements – EO

Details	Technical requirement
Number of zones	Setting by PEA
Light switch for ON/OFF/dimming control	Yes – wireless smart light switch
Occupancy/vacancy sensor	Yes
Light ON	Automatic
Light OFF	After a configurable period of inactivity (e.g., 30 minutes)

6.2.3 Employee bedroom

Lighting in the employee bedroom shall be controlled by a smart switch. Occupancy/vacancy sensors are required to automatically turn all lights off after a configurable period of inactivity.

Table 9. Lighting requirements – employee bedroom

Details	Technical requirement
Light switch for ON/OFF/dimming control	Yes – wireless smart light switch
Occupancy/vacancy sensor	Yes
Light ON	Manually – occupant flips the switch
Light OFF	After a configurable period of inactivity (e.g., 30 minutes)

6.2.4 Main control room

Lighting in main control room shall be divided into several zones. Each zone shall be controlled by a separate wireless smart switch. Occupancy/vacancy sensors are required to automatically turn all lights ON with occupancy detection and OFF after a configurable period of inactivity.

Table 10. Lighting requirements – main control room

Details	Technical requirement
Light switch for ON/OFF/dimming control	Yes – Wireless smart light switch
Occupancy/vacancy sensor	Yes
Light ON	Automatic
Light OFF	After a configurable period of inactivity (e.g., 10 minutes)

6.2.5 Office

Lighting in office shall be divided into several zones. Each zone shall be controlled by a separate wireless smart switch. Occupancy/vacancy sensors are required to automatically turn all lights ON with occupancy detection and OFF after a configurable period of inactivity.

Table 11. Lighting requirements – the office

Details	Technical requirement
Number of zones	Setting by PEA
Light switch for ON/OFF/dimming control	Yes – wireless smart light switch
Occupancy/vacancy sensor	Yes
Light ON	Automatic
Light OFF	After a configurable period of inactivity (e.g., 30 minutes)

6.2.6 Storage room

Lighting in the storage room shall be occupancy-based. The occupancy sensor shall automatically turn lights on when someone enters the room, and off after a configurable period of inactivity.

Table 12. Lighting requirements – the storage room

Details	Technical requirement
Number of zones	1
Light switch for ON/OFF control	No
Occupancy sensor	Yes
Light ON	Automatically with an occupant entering the storage room
Light OFF	After a configurable period of inactivity (e.g., 10 minutes)

6.2.7 Restrooms

Lighting in each restroom shall be occupancy-based. The occupancy sensor shall automatically turn lights on when someone enters the room, and off after a configurable period of inactivity.

Table 13. Lighting requirements – restrooms

Details	Technical requirement
Number of zones	One for women restroom and one for men restroom
Light switch for ON/OFF control	No
Occupancy sensor	Yes
Light ON	Automatically with occupant entering the restroom
Light OFF	After a configurable period of inactivity (e.g., 10 minutes)

6.2.8 Stairs

Stairs lighting shall have control devices to automatically change lighting intensity based on ambient light level (0-50% intensity). The light intensity shall be increased to 100% when occupancy is detected, and change back to illuminance-based control at 0-50% after an adjustable period of inactivity.

Table 14. Lighting requirements – stairs

Details	Technical requirement
Number of zones	1
Light switch for ON/OFF/dimming control	Yes
Occupancy sensor	Yes – one on the first floor; one on the second floor
Light ON	- Illuminance-based control 0- 50% intensity - Increase intensity to 100% when occupancy is detected - Change to illuminance-based control 0-50% intensityafteran adjustable period of inactivity
Light OFF	None

6.3 Lighting load controller specifications

Lighting load controllers shall conform to the following specifications.

Table 15. Lighting load controller requirements

Lighting load controller details	Technical requirement
Type	In-wall
Dimmer	Yes
Voltage input	220V
Phase	1
Electrical frequency	50Hz
Communication technology	Wireless
Communication protocol/data exchange format	Open API, such as HTTP/JSON
Enable remote ON/OFF control from PEA HiVE	Yes
Android and iOS APP	Yes
Certification and listing	IEC/EC or equivalent certified

6.4 Communications with PEA HiVE

The lighting fixtures in the conference room, EO, the employee bedroom, main control room, office room shall be controlled by wireless smart switches (in-wall type) that allow PEA HiVE to obtain their ON/OFF status and send ON/OFF control commands to the switches. Open communication protocols, e.g., HTML/JSON, shall be used for communicating with the unit(s). API documentation shall be provided.

At the minimum, the following data shall be available.
- Status (ON/OFF)
- Brightness level (%)

At the minimum, the following control features shall be available.
- Status (ON/OFF)
- Brightness level (%)

6.5 Occupancy/vacancy sensor specifications

In some applications discussed in Section 6.2, occupancy sensors are required, while in the other applications vacancy sensors are required. An occupancy sensor automatically turns lights on when one enters a room and off when one leaves. A vacancy sensor also turns off the light when one leaves a room, but the lights need to be manually turned on when one enters a room. Vacancy sensing maximizes the energy savings from the sensor because it is not always necessary to turn lights on when someone walks into a room.

Table 16. Occupancy/vacancy sensor requirements

Occupancy/vacancy sensor details	Technical requirement
Technology	PIR, ultrasonic or both – for very fine motion detection
Adjustable timeout	Yes – 1, 5, 15 or 30 minutes
Occupancy/vacancy	Yes – Auto-on/auto-off and manual-on/auto-off
Type	Wall-mounted or ceiling mounted* specified by the bidder
Power supply/battery	Wired or wireless; if wireless, at least 5-year battery life is required.
High-low sensitivity adjustment	Yes

6.6 Installation

The lighting load controllers and sensors shall be installed in accordance with the manufacturer's installation instructions.

6.7 Field testing and certification

The lighting/sensor system shall be tested in accordance with the following:

- Conduct a complete inspection and test of the entire lighting/sensor system. This includes testing and verifying all connections.
- Provide staff to test all devices and all operational features of the entire system for witness by PEA's representatives as applicable.
- Correct deficiencies until satisfactory results are obtained.
- Submit written copies of test results.

6.8 Documentation

The following documents shall be provided:

- API documentation—This documentation provides a means for third parties to obtain data from the light switches in a defined format.
- Product Data—This documentation includes catalog sheets and technical data sheets indicating physical data and electrical performance, electrical characteristics, and connection requirements.
- System Electrical Connection Drawings—This documentation includes drawings for properly connecting electrical wiring at the time of installation.
- Installation Instructions—This documentation includes step-by-step installation instructions for properly installing the unit.
- Set up instruction—This documentation includes step-by-step instructions to connect the device to a communication network.
- Device setup instructions on Android/iOS APP.

7.0 PLUG LOAD CONTROLLER (SMART PLUG)

7.1 Relevant standards and codes

- CE Certification (CE = Conformity of Europe) or UL certification.

7.2 Plug load controller location

At least five plug load controllers shall be installed. Please refer to PEA for their locations. These smart plugs shall be of in-wall type.

7.3 Plug load controller specifications

Plug load controllers shall conform to the following specifications.

Table 17. Plug load controller requirements

Details	Technical requirement
Type	In-wall
Voltage rating	220V
Current rating	15A
Electrical frequency	50Hz
Phase	1
Communication technology	Wireless
Communication protocol/data exchange format	Open API, such as HTTP/JSON
Enable remote ON/OFF control from PEA HiVE	Yes
Android and iOS APP	Yes
Certification and listing	IEC/EC or equivalent certified

7.4 Communications with PEA HiVE

The plug load controllers shall allow PEA HiVE to obtain their ON/OFF status and send ON/OFF control commands. Open communication protocols, e.g., HTTP/JSON, shall be used for communicating with the unit(s). API documentation shall be provided.

At the minimum, the following data shall be available.
- Status (ON/OFF)
- Energy or power consumption (kW or kWh)

At the minimum, the following control features shall be available.
- Status (ON/OFF)

7.5 Installation

The smart plugs shall be installed in accordance with the manufacturer's installation instructions.

7.6 Field testing and certification

The smart plugs shall be tested in accordance with the following:
- Conduct a complete inspection and test of the smart plugs. This includes testing and verifying all connections.
- Provide staff to test all devices and all operational features of smart plugs for witness by PEA's representatives as applicable.
- Correct deficiencies until satisfactory results are obtained.
- Submit written copies of test results.

7.7 Documentation

The following documents shall be provided:
- API documentation—This documentation provides a means for third parties to obtain data from the smart plugs in a defined format.
- Product Data—This documentation includes catalog sheets and technical data sheets indicating physical data and electrical performance, electrical characteristics, and connection requirements.
- System Electrical Connection Drawings—This documentation includes drawings for properly connecting electrical wiring at the time of installation.
- Installation Instructions—This documentation includes step-by-step installation instructions for properly installing the unit.
- Set up instruction—This documentation includes step-by-step instructions to connect the device to a communication network.
- Device setup instructions on Android/iOS APP

8.0 <u>INTEGRATED SECURITY SYSTEM</u>

The integrated security system shall include a network-enabled access control and security camera system.

8.1 Access Control System

An access control system shall be installed for managing the entrance and exit of people through secure areas. The access control system shall be network-enabled and installed at the smart building to allow employees to swipe ID cards to access the building, and scan the cards/fingerprints to access particular rooms in the building according to their access rights. This will provide management, traceability and forensics to building access. The entire system shall support at least three (3) card readers and two (2) card/biometric readers. The system shall support at least 20 cards. The card/biometric readers shall be

capable of performing authentication based on both card scan and fingerprint scan. The system shall allow PEA to install additional card and card/biometric readers or fix the readers. Access control management software shall be provided.

8.1.1 Relevant standards and codes

- UL294 – Access Control System (or Equivalent)
- ISO/IEC 27001 – Information Security Management (or Equivalent)

8.1.2 Access control system location
Please refer to PEA for the location(s) of the access control devices, including three (3) card readers and two (2) card/biometric readers.

8.1.3 Access control specifications
The access control system shall conform to the following specifications.

Table 18. Access control requirements

Access control system details	Technical requirement
Features:	
Support multiple operator workstations via LAN/WAN	Yes
Multi-level password protection	Yes
Provide graphical user interface	Yes
Support industry standard database management systems, which allows edit, add, delete, search, sort and print options for records in the database	Yes
Automatic backup of database files	Yes
Provide encryption	Yes
Ability to activate or deactivate cards	Yes
Monitor and log intrusion system events and send alerts	Yes
Alert:	
Provide a display of the most current transactions in real time	Yes
Send an alert (e.g., email) based on events	Yes
Allow to send an email message selectable per card event type	Yes
Allow an operator to acknowledge and clear alarms	Yes
Access level:	
Provide option to restrict access to sensitive information by user ID	Yes
Provide an option to define specific access time	Yes
Provide an option to define specific readers for access	Yes
Customizable card access level with beginning and end dates	Yes
Report:	
Provide card holder report with filter options to define doors, card holder name	Yes
Generate history report for an alarm point state (e.g., normal, alarm)	Yes
Generate history report of system alarm (e.g., power failure, panel tamper)	Yes
Generate history report for system operator activities	Yes
Generate history report based on the frequency of usage of a card	Yes
Card:	
Contain information inside card shall include at the minimum: First name, last name, card number, activation date, de-activation date, status, note fields and a photo image	Yes
Provide special card options for visitor/temporary use	Yes
Card/biometric reader:	
Card reader	Yes
Fingerprint	Yes

8.1.4 Communications with PEA HiVE

The access control system shall allow PEA HiVE to access its database to obtain data on entry and exit information of individuals with time stamp. Only read-only access shall be granted to PEA HiVE. No write privilege shall be allowed.SDK/API documentation shall be provided.

8.2 Security Camera System

The security camera system shall include a digital video recorder (DVR) and a total at least 10 security cameras.

8.2.1 Relevant standards and codes
- Open network video interface forum (ONVIF) or equivalent.

8.2.2 Security camera system location

Please refer to PEA for the location(s) of the DVR and security cameras.

8.2.3 Security camera system specifications

The IP camera system shall be an IP-based wire or wireless solution and conform to the following specifications.

Table 19.Security camera system specification requirements

Security camera system details	Technical requirement
DVR specifications	
Real-time recording on all channels	Yes
Built-in Power-over-Ethernet ports or external power supply	Yes
Automatic detection of all compatible IP cameras in the network	Yes
Video compression	Yes
Pentaplex operation (view, record, playback, back up & remote control)	Yes
Motion detection	Yes
Motion detection alert (by email or upload image snapshot)	Optional
Sound detection	Optional
Sound detection alert (by email or upload image snapshot)	Optional
Schedule recording	Yes
Password protection	Yes
Support multi-camera operation	Yes
Firewall	Supports IP filtering
Local storage	Yes
FTP or cloud storage	Optional
Communications	
Communication technology	Ethernet, RJ-45 connection, or WiFi
Enable communications with PEA HiVE	Yes
Security camera specifications	
Camera power	Power-over-Ethernet connectivity through the DVR or an external power supply
Video resolution	At least 2 Megapixels
Support night vision	Yes – with IR illuminator
IR range	At least 8 meters
Pan	Yes
Tilt	Yes
Zoom	Yes
Hue, brightness, contrast, saturation, sharpness	Adjustable
Operating condition	
Installation	Both Indoor and Outdoor

8.2.4 Communications with PEA HiVE

The security camera system shall use Real-time Steaming Protocol (RTSP), and allow PEA HiVE to obtain real-time video stream, and send control commands (e.g., pan, tilt, zoom) to the camera(s). API documentation shall be provided.

8.3 Installation

The integrated security system including access control and security camera system shall be installed in accordance with the manufacturer's installation instructions.

8.4 Field testing and certification

The access control and security camera system shall be tested in accordance with the following:
- Conduct a complete inspection and test of all installed access control system. This includes testing and verifying all connections.
- Provide staff to test all devices and all operational features of the entire access control system for witness by PEA's representatives as applicable.
- Correct deficiencies until satisfactory results are obtained.
- Submit written copies of test results.

8.5 Documentation

The following documents shall be provided:
- SDK/API documentation—This documentation provides a means for third parties to obtain readings from the access control/security camera system in a defined format.
- Manufacturer's Product Data—This documentation indicates systems and components proposed for use.
- Shop drawings—This documentation indicates system components and wiring diagrams.
- Record drawings—This documentation indicates location of equipment and wiring.
- Operation and maintenance data—This documentation includes manufacturer's operation and maintenance data customized to the access control system installed, as well as system and operator manuals.
  Maintenance service agreement—This documentation includes a copy of manufacturer's maintenance service agreement, including cost and services for a two-year period for PEA review.

9.0 SMOKE DETECTOR

9.1 Relevant standards and codes
- UL 2034 – Single and multi station carbon monoxide alarms(or Equivalent)
- UL 217 – Single and smoke alarm (or Equivalent)
- NFPA-72 – National Fire Alarm and Signaling Code (or Equivalent)

9.2 Smoke detector location

Bidder(s) shall determine the location(s) of the smoke detector(s) to be approved by PEA.

Table 20. Smoke detector specification requirements

Smoke detector details	Technical requirement
Electrical	
Wired connector	Yes
Backup batteries	Yes
Feature/function	
Voice alarms	Yes
Detect smoke	Yes
Detect carbon monoxide	Yes
Alert for low battery	Yes
Alert for sensor failure	Yes
Sensors	
Carbon monoxide sensor	Yes
Smoke sensor	Yes
Heat sensor	Optional
Humidity sensor	Optional
Occupancy sensor	Optional
Ambient light sensor	Optional
Speaker	
Speaker	Yes
Communications	
Communication technology	Wire or wireless
Communication protocol/data exchange format	Open API, such as HTTP/JSON
Enable communications with PEA HiVE	Yes
Operating condition	
Installation	Indoor

9.3 Communications with PEA HiVE

The smoke detector(s) shall allow PEA HiVE to obtain status readings. Open communication protocols, e.g., HTTP/JSON, shall be used for communicating with the unit(s). API documentation shall be provided.

At the minimum, the following data/parameters shall be able to retrieve by PEA HiVE.
- Get online/offline status
- Get carbon monoxide alarm state
- Get smoke alarm state
- Get battery status

9.4 Installation

The smoke detectors shall be installed in accordance with the manufacturer's installation instructions.

9.5 Field testing and certification

The smoke detectors shall be tested in accordance with the following:
- Conduct a complete inspection and test of the smoke detectors. This includes testing and verifying all connections.
- Provide staff to test all operational features of the smoke detectors for witness by PEA's representatives as applicable.
- Correct deficiencies until satisfactory results are obtained.
- Submit written copies of test results.

9.6 Documentation

The following documents shall be provided:

- API documentation—This documentation provides a means for third parties to obtain data from the smoke detector in a defined format.
- Product Data—This documentation includes catalog sheets and technical data sheets indicating physical data, electrical characteristics, and connection requirements.
- Installation Instructions—This documentation includes step-by-step installation instructions for properly installing the unit.
- Communication set up instruction—This documentation includes step-by-step instructions to connect the device to a communication network.

10.0   WALL MOUNTED BATTERY STORAGE SYSTEM

10.1 Relevant standards and codes

- IEC 62109-1 – Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
- IEC 62619 – Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications

10.2 Wall mounted battery storage location

Wall mount battery storage units shall be installed at the smart building. Please refer to PEA for the location(s) of the batteries.

10.3 Critical loads served by the wall mounted battery storage system

A dedicated critical load circuit shall be served by the wall mounted battery storage as shown in Figure 3. For the list of critical loads, please refer to PEA.
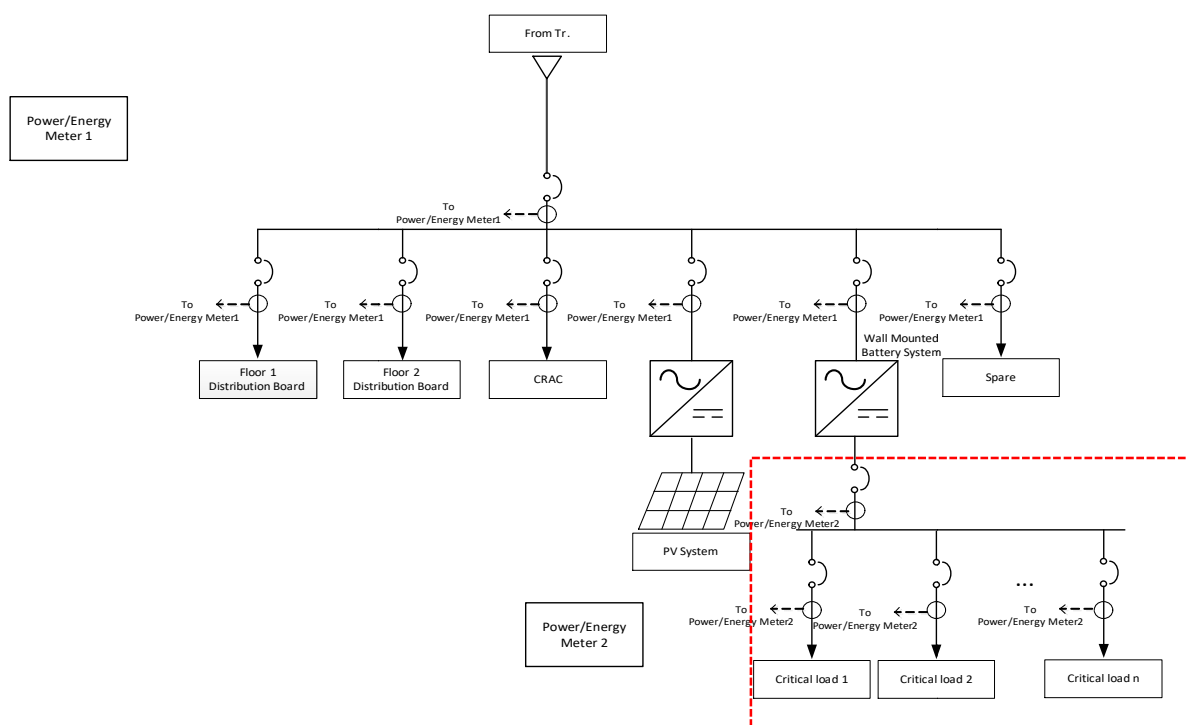

Figure 3. Critical Load Supply by Wall Mounted Battery Storage

10.4 Wall mounted battery storage specifications

Wall mounted battery storage units shall conform to the following specifications.

Table 21.Wall mounted battery storage system requirements

Details	Technical requirement
Feature/Performance	
Type	Wall mounted
Battery type	Li-Ion
Efficiency	At least 90% round trip
Total power output	At least 10kWcon.
Total storage size	At least 10kWh
Inverter	Provide
Depth of discharge	100%
Operating condition	
Operating output voltage	220V
Operating frequency	50Hz
Installation	Indoor or outdoor rated
Interface	
Communication technology	Wire or Wireless
Communication protocol/data exchange format	Open API, e.g., Modbus or HTTP/JSON
Enable remote ON/OFF control from PEA HiVE	Yes

10.5 Communications with PEA HiVE

The wall mounted battery system shall allow PEA HiVE to obtain their charge/discharge and state-of-charge status. Open communication protocols, e.g., Modbus, HTTP/JSON, shall be used for communicating with the unit(s). API documentation shall be provided.

At the minimum, battery charge/discharge schedule shall be controlled via manufacturer's APP, or the battery system shall allow PEA HiVE to set charge/discharge schedule.

10.6 Installation

Wall mounted battery systems shall be installed in accordance with the manufacturer's installation instructions.

10.7 Field testing and certification

The system shall be tested in accordance with the following:
- Conduct a complete inspection and test of the wall mounted battery systems. This includes testing and verifying all connections.
- Provide staff to test the battery systems and all operational features for witness by PEA's representatives as applicable.
- Correct deficiencies until satisfactory results are obtained.
- Submit written copies of test results.

10.8 Documentation

The following documents shall be provided:
- API documentation—This documentation provides a means for third parties to obtain data from the battery units in a defined format.

- Product Data—This documentation includes catalog sheets and technical data sheets indicating physical data and electrical performance, electrical characteristics, and connection requirements.
- System Electrical Connection Drawings—This documentation includes drawings for properly connecting electrical wiring at the time of installation.
- Installation Instructions—This documentation includes step-by-step installation instructions for properly installing the unit.
- Communication set up instruction—This documentation includes step-by-step instructions to connect the device to a communication network.

11.0 SMART CURTAIN

11.1 Relevant standards and codes

N/A

11.2 Smart curtain location
At least five (5) smart curtain sets shall be installed in main control room, office, conference room, EO, employee bedroom. Please refer to PEA for the location(s)and dimensions of the smart curtains.

11.3 Smart curtain specifications
Smart curtains shall conform to the following specifications.

Table 22. Smart curtain requirements

Details	Technical requirement
Feature	
Type	Motorized shades or blinds
Power	Wired (220V 50Hz) or solar + battery (if powered by solar + battery, battery life shall be up to six months with no sun with automatic notification for low battery)
Control option	Smart phone, on-device
Ambient light sensor	Allow for automatic operation of motorized curtains according to the amount of sunlight (optional)
iOS and Android app	Yes
Smart home integration	Capable
Openness factor	Specified by the contractor
UV blockage	At least 90%
Interface	
Communication technology	Wire or Wireless
Communication protocol/data exchange format	Open API
Enable remote open/close control and schedule setting from PEA HiVE	Yes

11.4 Communications with PEA HiVE
The smart curtains shall allow PEA HiVE to perform remote open and close control and set schedules/scenes. API documentation shall be provided.

11.5 Installation
Smart curtains shall be installed in accordance with the manufacturer's installation instructions.

11.6 Field testing and certification

The system shall be tested in accordance with the following:

- Conduct a complete inspection and test of the curtains.
- Provide staff to test the curtains and all operational features for witness by PEA's representatives as applicable.
- Correct deficiencies until satisfactory results are obtained.
- Submit written copies of test results.

11.7 Documentation

The following documents shall be provided:

- API documentation—This documentation provides a means for third parties to obtain data from the curtains in a defined format.
- Product Data—This documentation includes catalog sheets and technical data sheets indicating physical data and electrical performance, electrical characteristics, and connection requirements.
- System Electrical Connection Drawings—This documentation includes drawings for properly connecting electrical wiring at the time of installation (if applicable).
- Installation Instructions—This documentation includes step-by-step installation instructions for properly installing the unit.
- Communication set up instruction—This documentation includes step-by-step instructions to connect the device to a communication network.

12.0   PROJECTOR WITH SCREEN CONTROL

12.1 Relevant standards and codes

- CE Certification (CE = Conformity of Europe), which is a combination of safety and electromagnetic compatibility requirements.

12.2 Projector and screen location

One projector and one motorized projector screen shall be installed at the smart building. Please refer to PEA for the location(s) and dimensions of the smart curtains.

12.3 Projector and screen specifications

Projector and screen shall conform to the following specifications.

Table 23. Projector and screen requirements

Details	Technical requirement
Projector	
Power	Wired (220V 50Hz)
Lumen	At least 1500
Contrast ratio	At least 1000:1
Lamp	LED
Lamp life	At least 20,000 hours
Resolution	Max resolution 1920x1080
Work noise	<50dB
Aspect ratio	16:9
Connectivity technology	VGA, HDMI-
Compatible projection size	Adjustable
Screen	
Aspect ratio	16:9
Diagonal screen size	At least 200 inch

Screen material	High contrast, washable with soap and water
Viewing angle	At least 160 degree
Installation	Wall or ceiling
Motor system	Energy efficient, quiet motor
Projector compatibility	All projectors (e.g., LCD, HD, 3D, DLP, CRT)
Control	Remote, iOS/Android App, and wall-mounted control panel for use without remote or App
Communication technology	Wire or Wireless

12.4 Communications with PEA HiVE
The projector screen shall allow PEA HiVE to perform remote open and close control. API documentation shall be provided.

12.5 Installation
The projector and screen shall be installed in accordance with the manufacturer's installation instructions.

12.6 Field testing and certification
The system shall be tested in accordance with the following:
- Conduct a complete inspection and test of the projector & screen. This includes testing and verifying all connections.
- Provide staff to test all devices and all operational features for witness by PEA's representatives as applicable.
- Correct deficiencies until satisfactory results are obtained.
- Submit written copies of test results.

12.7 Documentation
The following documents shall be provided for screen control:
- API documentation—This documentation provides a means for third parties to obtain status of the projector screen, and send ON/OFF control command in a defined format.
- Product Data—This documentation includes catalog sheets and technical data sheets indicating physical data and electrical performance, electrical characteristics, and connection requirements.
- System Electrical Connection Drawings—This documentation includes drawings for properly connecting electrical wiring at the time of installation (if applicable).
- Installation Instructions—This documentation includes step-by-step installation instructions for properly installing the unit.
- Communication set up instruction—This documentation includes step-by-step instructions to connect the device to a communication network.

13.0   KVM SWITCH
KVM switch shall be installed at the smart building.

13.1 Relevant standards and codes
- HDMI 1.4 and HDCP (High-bandwidth Digital Content Protection) compliant

13.2 KVM switch specifications
The KVM switch shall conform to the following specifications.

Table 24. KVM switch requirements

Details	Technical requirement
Power supply	220V 50Hz
Form factor	1U rack mount-PLEASE SPECIFY
HDMI input	Yes, at least 2
HDMI output	Yes, at least 1
Maximum resolution	Up to 4K (3840x2160)
USB	Yes, at least 2
Audio	Yes, embedded in HDMI signal
Ethernet (TCP/IP) via RJ-45	Yes

13.3 Installation
The system shall be installed in accordance with the manufacturer's installation instructions.

13.4 Field testing and certification
The system shall be tested in accordance with the following:
- Conduct a complete inspection and test of the KVM switch. This includes testing and verifying all connections.
- Provide staff to test all devices and all operational features for witness by PEA's representatives as applicable.
- Correct deficiencies until satisfactory results are obtained.
- Submit written copies of test results.

13.5 Documentation
The following documents shall be provided:
- Product Data—This documentation includes catalog sheets and technical data sheets indicating physical data and connection requirements.
- System Electrical Connection Drawings—This documentation includes drawings for properly connecting electrical wiring at the time of installation (if applicable).
- Installation Instructions—This documentation includes step-by-step installation instructions for properly installing the unit.
- Set up instruction—This documentation includes step-by-step instructions to connect the device to a communication network.

Appendix

List of PEA HiVE-Compatible Devices

Part No.	Item	BRAND	MODEL
2	SOLAR PHOTOVOLTAICS (PV)	Kyocera	y-series
		CanadianSolar	MAXPOWER
		TALLMAX	FRAMED 72-CELL MODULE
		JA Solar	JAP72S01
		JinKO solar	JKM330P-72
3	SMART INVERTER	Fronius Smart Inverter	Fronius Primo
		Growatt	
		Chuphotic	
4	POWER/ENERGY METER	eGauge	EG3000
		Wattnode	
5	AIR CONDITIONING (AC) UNIT		
	- AIR CONDITIONING (AC) UNIT	Daikin	Ekira, Cassette
	- Computer Room Air Conditioning: CRAC	STULZ	MiniSpace EC
		VERTIV	LIEBERT DX 35kW
		APC	
		OCEANAIRE	
		RITTAL	CRAC CW 3300.384
6	LIGHTING LOAD CONTROLLER AND OCCUPANCY SENSOR		
	LIGHTING LOAD CONTROLLER	Philips	Philips Hue
		AeoTec	LED Bulb 6, LED Strip
		AeoTec	Nano Switch, Nano Dimmer, WallMote, WallSwipe
	- OCCUPANCY SENSOR	orvibo	Motion Sensor
		FIBARO	Motion Sensor
		AeoTec	TriSensor, MultiSensor 6
7	PLUG LOAD CONTROLLER (SMART PLUG)	KMC	KMC70011(3-Pack)
		HITRENDS	W-US003
		Orvibo	Wi-Fi Smart Socket Outlet, GEEKRAV ZigBee Smart Switch

Part No.	Item	BRAND	MODEL
8	INTEGRATED SECURITY SYSTEM		
	- Camera (IP camera, control by PEA HiVE ; RTSP)	Sumsung	SNH-V6430BNH
		Tp-link	NC450
		Zmodo	
		YI	YI Dome Camera
		Netatmo	Netatmo Welcome, Home Security Camera with Face Recognition
	- Finger Scan and Door Lock	ZKTEco	G3
		ZKTEco	SF 400
		TIP	F18
		HIP	C806
		Yale	
		Orvibo	
	- Door/ Window Sensor	AeoTec	Door/ Window Sensor 6, Door/ Window, Doorbell 6
		Orvibo	
9	SMOKE DETECTOR	Nest	Protect
		First Alert	Onelink Wi-Fi Smoke + Carbon Monoxide Alarm, Hardwired, Apple HomeKit-enabled
		First Alert	First Alert 2-in-1 Z-Wave Smoke Detector & Carbon Monoxide Alarm
10	WALL MOUNTED BATTERY STORAGE SYSTEM	LG Energy Storage System	
		Tesla	Powerwall
		sonnen	sonnenBattery
		SAMSUNG SDI	
		Panasonic	Harbor
11	SMART CURTAIN	Somfy	
		ORVIBO	ZigBee Multi-Functional Relay

Part No.	Item	BRAND	MODEL
12	PROJECTOR WITH SCREEN CONTROL		
	- Projector	SIM2 Multimedia	NERO 3 PLUS
		DIGITAL PROJECTION	Titan LED 1080p 3D
		Optoma	HD91+
	- Projector screen control	Somfy	
		ORVIBO	ZigBee Multi-Functional Relay
13	KVM SWITCH	iPGARD	SDHN-4D-P
		SmartAVI	SmartAVI UHDN-4PS
		EMERSON	SV340H-001
		Avocent	SV240H