



O&M DEPARTMENT MANAGEMENT SYSTEM

**STANDARD TECHNICAL
REQUIREMENTS FOR
SUB-METERING SYSTEM**

DOC. NO.	TECH-ST-001
REVISION	08
DATE	30-Dec-21
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THIS DOCUMENT HAS BEEN ISSUED AND AMENDED AS FOLLOWS

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1.0 SUMMARY

The purpose of this document is to be used as overview and guidelines for the Customer for the installation of Sub-Metering & Smart Valve system and to define the scope of work of Empower and the Customer.

Sub-meters & Smart Valve shall only be installed for apartments, offices and retails.

2.0 DEFINITIONS

- A. "Sub-Metering System" Energy meters, set of instruments and its network to measure the consumption of chilled water of each tenant.
- B. "Smart Valve" means set of instruments and its network to remotely operate valves as per customer requirement.
- C. "Energy Meter" means set of instruments to measure rate of enthalpy change in the chilled water by measuring flow rate and temperature different which indicates rate of consumption of cooling.
- D. "Empower" means Emirates Central Cooling System Corporation and its authorized representative or assignee.
- E. "Customer" means a Master Developer/Building Owner or Individual Customer of district cooling service provided by Empower, as the context applies.
- F. "Sub-meter Cabinet" means dedicated place where sub-meters for the floor apartments will be installed containing the Btu Calculator, Flow sensor, Isolation valves, Smart, Valve Tee Junctions with Temperature sensors and unions. Refer Appendix 3.3 – typical installation details. Sub-meter cabinet size can vary. Empower will give approval for the design as long as clear access to meter installation is attained.

3.0 SCOPES & RESPONSIBILITIES

This document is applicable to Empower Customers and unit owners wherever there is provision for Empower to directly charge the tenants as further detailed in this document.

Sub-metering cabinet is one of the mandatory requirements in order to approve NOC request. Customer can approach Empower Sales and Marketing department (S&M) to request for all necessary requirements and can ask for technical meeting for the details on how to follow installation requirement.

All the new projects should comply with sub-meter cabinet in order to get final approval of the compliance statement. Project Management Office (PMO) is responsible for ensuring its compliance to sub-meter cabinet prior approval of NOC request.

Upon approval of submitted compliance statement and tendering offer letter for sub-metering payment; Empower thru S&M shall further elaborate to customer about the timeline of availability of sub-meters and smart valves since those instruments will go on



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commercial evaluation process which will take time to finalize. Hence, all the technical queries about exact sub-meter spool details and smart valve containment including gateway locations will not be provided until vendors are appointed by Empower.

Responsibility matrix is presented in Appendix 1 of this compliance statement.

Supply of sub meters, smart valves including gateways, lockable enclosure / panel with master key, testing & commissioning and configuration in MDMS system and smart valve server is in Empower scope under customer's cost. However, remaining requirements such as sub-meter cabinet, lock shield valves, gate valves, tee-junctions, pipe fittings, LAN cables, power cables, Mbus cables and UPS are under the scope of the customer (supply and install) subject to Empower review and approval. Installation of both BTU meter, smart valve and all supplied accessories shall be done by customer under the supervision of Empower representative / supplier.

All sub-meter accessories such as lock shield valve, gate valve, union and reducer fittings shall be under responsibility of building side for future maintenance and replacement of the part as needed. Any issues relevant to meter accessories hindering the performance to do meter maintenance will be escalated to building owner for them to do rectification such as valve passing, valve stuck-up, cracked fittings and any other source of water leakage from meter accessories.

Customer shall provide specific control room for sub-metering system (2 m x 2m size) inside the ETS room, air conditioned, where active equipment and controls will be installed (Mbus master panel and smart valve panel including all accessories for remote connectivity). This room will be in Empower's possession; hence, customer will provide access to this room at all times. Room must be lockable & 3 sets of 2 x 2 room & ETS room key to be handed over to Empower.

Customer shall submit as built drawing for complete sub metering system which is composed of installed sub meter, smart valve, wire routing of 2C/6C as per appendix 2.1 and wiring containment (power and communication cables) provided for smart valve forwarder and master gateway.

4.0 SUBMITTALS

- A. Customer to submit data on the chilled water flow rate, pipe diameter for each unit i.e. each flat, office, common area, corridor etc. for installed cooling capacity.
- B. Customer to submit the installation program for the sub meters based on the following duration,

Number of meters	Tentative installation Duration (calendar days)
< 300	60 Days



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300 – 600	90 Days
600 – 900	120 Days
900 – 1200	150 Days
1200 – 1500	180 Days

- C. Customer to submit the following documents,
- a. Compliance Statement to this specification document – TECH-ST-001 along with all the appendices. The customer shall comply with each points by hand writing stating "COMPLY" only along with official signature & stamp on each page. Below are the acceptance criteria:
 - i. **COMPLY – acceptable (without any comments)**
 - ii. COMPLY WITH COMMENTS – not acceptable
 - iii. NOTED – not acceptable
 - b. Typical floor layout which includes piping layout from BTU Meter Room up to sub-meter cabinet.
 - c. Secondary chilled water piping layouts, clearly indicating details of riser / shaft availability for carrying Empower chilled water services.
 - d. Typical Sub meter installation information indicating the sub-meter cabinet, Flow sensor, Temperature sensors, Tee junctions, Lock shield valve, Isolation valves, smart valves, etc. for one Btu meter. Sub-meter cabinet size can vary. Empower will give approval for the design as long as clear access to meter installation is attained.
 - e. System architecture indicating all the meters in the M-Bus network up to gateway with tenant information, prepared in co-ordination with Empower’s Btu meter supplier.
 - f. System architecture drawing for smart valve architecture down to gateway/concentrator located inside the 2m x 2m room.
 - g. Cable routing lay out drawing, indicating the M-Bus cable path from the sub meter room to the top most floor (including spare cable).
 - h. Material Submittal shall be made for Empower approval for the Isolation Locks Shield Valve, Gate valves, Insulation materials, Belden Mbus cable, Tee junctions (1/2" reducing tee) and 3KVA UPS Panel, prior to installation.

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Note: 1 Nos 3KVA UPS Panel is sufficient for both sub-meter and smart valve panels

- i. The entire compliance statement shall be submitted to Empower having below information:
 - i. Project details, customer details and sign / stamp from the consultant and contractor involved in the project should be made available at first page of the compliance statement.
 - ii. Remaining pages should have stamp and signature with date from consultant and contractor.

5.0 SUPPLY & INSTALLATION

- A. The Customer shall design conduit based on schematic drawings provided in appendix 2 and as follows"
 - i. Two number 1" PVC conduit shall be used for the riser with junction box in each floor.
 - ii. 1" PVC conduit from the floor junction box to the meters.
- B. Sub-meters for each floor shall be installed in a common location inside the cabinet/room. All the meters will be grouped in that particular cabinet, covering full meter installation as per appendix 3, including smart valve, and Mbus wire termination. Sub-meter cabinet shall be secured to avoid unauthorized access by having a door lock for each cabinet. Three sets of key will be handed-over to Empower while spare key will be under building security's possession. Only authorized Empower personnel are allowed to access sub-meter cabinet. As an example, kindly refer to typical sub meter cabinet drawing (A3.5) for total 8 numbers of sub meter.
- C. Sub meter cabinet/room must be having sufficient light and proper floor drain pit.
- D. Sub-meter cabinet shall be provided as per the drawing submitted by the customer. Drawing is subject to further review and approval by Empower. Sub-meter cabinet size can vary. Empower will give approval for the design as long as clear access to meter installation is attained. More than one vertical riser (if needed) is allowed to be reviewed and approved by Empower.
- E. Customer shall carry out conduit work & wiring required for M-Bus network through building contractor from the 2m x 2m Metering room (to be located inside the ETS room) to all the energy meters. Conduit shall be heavy grade PVC material.
- F. Junction Boxes (JB) in the main riser for each floor are required for 2 numbers of 6 cores cable as indicated in the schematics. Junction Boxes shall be of size 150 x 150 x 100 mm or standard available.

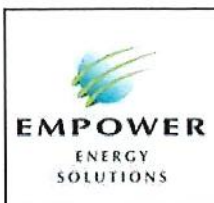




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- G. Junction Boxes in the floor for each tapping in the flat are smaller size and are required to accommodate 2 c x 1.5 Sq.mm twisted pair cable with size 50 x 50 x 40 mm or standard available.
- H. Customer shall supply and install 2 numbers of 6C x 1.5 Sq.mm twisted pair unshielded, PVC Jacket cable for the raiser cable. The Customer shall supply and install one number of 2C x 1.5 Sq.mm twisted pair unshielded, PVC jacket cable for each floor. The cable shall be BELDEN CABLE only. (Connection details as per schematic drawings provided in appendix 2). The Customer shall carry out the termination of the cables on all ends.
- I. Supply and installation of TCP/IP cables & power cables for smart valves from main gateway till farthest forwarder gateway is in customer scope.
- J. Empower's Sub-Metering solution provider shall check continuity of wiring along with building contractor before and after the installation of meters.
- K. Communication including Mbus cables shall be routed away by at least 50cm from other power cables.
- L. Customer to provide 500 mm spool piece or a spool piece of length equal to 16 times the diameter of the pipe (whichever is greater). The Spool piece shall be replaced with Flow sensor, two isolation gate valves across the flow sensor and one Tee in return line. Return line unions on both sides shall be installed across the flow sensor. Same spool piece is required in supply line where customer will provide one isolation gate valve, one lock shield valve, two unions and one Tee in the supply line. Smart valve shall be installed across two unions at supply line. Thermo wells will be provided by the Empower's Sub-Metering solution provider. Please refer to appendix A3.3.
- M. The Tee junctions (reducing tee with 1/2' thread) shall be installed by the customer, with the tip pointing sideward facing the door cabinet. Tee-Junction shall be mounted without any extension to minimize linkage that might be source of water leak in the future if the part will break.
- N. Since BTU calculator and smart valve controller are detached from the pipeline, these devices shall be fixed in rigid mounting away from pipeline.
- O. Customer must ensure CHW pipe routing is correct. Undertaking letter shall be provided for the same. Empower has right to perform flow simulation at the time of inspection.
- P. Empower's supplier shall deliver and hand over all the sub-meters, Mbus master, smart valves, router, gateway (forwarder and master), lockable enclosure / panel with master key and accessories to customer at site. Customer / Customer's representative shall be responsible for inspection of delivered material and shall notify to Empower for any missing parts, defects, damages, wire cuts etc. Customer shall be responsible for proper storage of meters and smart valves and accessories at site in accordance with the guidelines provided by the Empower's supplier. Customer / Customer representative shall be responsible for the



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damages / defects or loss occurred during the storage or handling of all supplied items by Empower.

- Q. Customer / Customer’s representative shall be responsible for the damages during the installation of the meter, smart valves and its accessories. It is primary responsibility of Customer / Customer representative to notify Empower if any defects found during the stage of installation and should be in position to demonstrate that identified defect was not caused due to improper installation practice.
- R. Sub-meters & smart valves including accessories shall be installed by the building contractor under the supervision of supplier.
- S. Customer to notify Empower if any defects found during the installation stage (Btu meter and smart valve) and shall be in a position to demonstrate the identified defect was not caused due to the proper installation practice.
- T. Customer shall carry out all the flushing work while the spool piece is in place and prior to the installation of smart valve, flow and temperature sensor. No flushing shall be done after the installation of the Sub-Meters.
- U. The Flow sensor part of the Sub-Meter is installed on the Return line unless otherwise instructed by Empower or Empower’s Sub-Metering solution provider.
- V. Individual tagging attached to each sub-meter is mandatory to be provided for all installed sub-meters to clearly identify proper allocated sub-meter for each apartment. Tagging should include Empower BTU Meter with Apartment Reference No. Tagging shall be attached also to smart valves. Please find below pattern. Similarly requires tagging for supply & return line isolation valves.

- For Sub-meter to be attached in BTU Calculator

EMPOWER BTU – APT 101

- For Smart Valve to be attached in valve controller

SMART VALVE – APT 101

- W. Empower require a room of 2 meter x 2 meters inside the ETS room, air conditioned, where active equipment and controls will be installed (Mbus master panel and smart valve panel including all accessories for remote connectivity). This room will be in Empower’s possession; hence, customer will provide access to this room at all times. Room must be lockable & 3 sets of 2 x 2 room & ETS room key to be handed over to Empower.

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- X. UPS with 4 hours back-up shall be provided for the equipment connected inside the panel (Mbus master and its gateway for remote connectivity, and Smart Valve Gateway).
- Y. The room should contain 2 numbers power sockets with 230 V power supply and normal room lighting. 2 numbers TCP / IP / Internet port provision shall be made available.
- Z. Customer must ensure strong communication signal strength inside ETS control room where modems for MDMS and smart valve remote connectivity will be required during configuration, T&C and operation of assets.
- AA. Each flat should be supplied with the chilled water from a single standalone branch.
- BB. Insulation Material and the work shall be carried out as detailed in Appendix 5 – Insulation Material and Appendix 6 – Insulation work.
- CC. Customer shall submit as built drawing for complete sub metering system which is composed of installed sub meter, smart valve, wire routing of 2C/6C as per appendix 2.1 and wiring containment (power and communication cables) provided for smart valve forwarder and master gateway.

6.0 LOCATION

- A. Sub-meters and smart valves shall only be installed for apartments, offices and retails. No sub-metering is required for common area cooling equipment.
- B. Sub-meters and smart valves shall be installed in a dedicated sub-metering cabinet near the chilled water vertical riser of each floor. Sub-meter cabinet size can vary. Empower will give approval for the design as long as clear access to meter installation is attained. More than one vertical riser (if needed) is allowed to be reviewed and approved by Empower.

Note: Customer has an option to propose room instead of cabinet – subject to Empower review and approval

7.0 MOCKUP & SITE ACCEPTANCE TEST

- A. Customer to arrange installation mock-up for sub-meter and smart valve installation along with all components (sub-meter cabinet) subject to Empower approval. There will be single, floor and full floor inspection to be carried-out by Empower. Customer is not allowed to install meters and smart valves for remaining floors if sub-meter cabinet mock-up is not yet approved.
- B. Customer to perform the Site Acceptance Test jointly with sub-meter / smart valve supplier's and Empower. The handing over of the individual units shall be jointly



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signed by Customer or Customer's representative, sub-meter / smart valve suppliers and Empower representative using the form in Appendix 9 – Sub metering Installation Acceptance and handing-over checklist.

- C. Customer to demonstrate hindrance free removal of the Btu meter, smart valve and its components when demanded by Empower during Site Acceptance Test.
- D. Customer to demonstrate that sub-meters and smart valves for specific apartments are properly installed. Empower has the right to ask individual apartment testing (switching on/off) FCU and verify if the sub-meter and smart valve status are functional.

8.0 APPENDIXES

Appendix 1 - SUB-METERING RESPONSIBILITY MATRIX

SN	Description	Empower	Building Owner
1	Details of each apartment AC load (RT), diameter of Chilled Water Pipe (mm) and flow rate (l/s) shall be prepared and submitted to Empower in their prescribed format.		X
2	Selection and Approval of BTU meters supplier	X	
3	Selection and Approval of Smart Valve supplier	X	
4	Provide guidelines for QTY and location of BTU meters	X	
5	Provide guidelines for QTY and location of Smart Valves	X	
6	Prepare drawings showing QTY and location of BTU meters and smart valves according to guidelines.		X
7	Review and approve the drawings listed in points 6 above.	X	
8	Determine location and requirement (socket outlets, data points, A/C ventilation, UPS, ...etc.) for BTU meter room	X	
9	Determine containment and wires specification	X	
10	BTU meters and Smart valve shop drawings and details preparation		X
11	BTU meters and Smart valve shop drawing and details approval	X	
12	Control Room Shop Drawing Preparation (2m x 2m room) including containment for sub-meter M-bus wiring and smart valve forwarder and master gateways (data concentrator)		X
13	Control Room Shop Drawing Approval	X	
14	Supply of BTU meters	X	
15	Supply of Smart valves	X	
16	Supply of hardware & software for MDMS system including gateway and enclosure panel	X	
17	Inspect and delivery of BTU meters made to site	X	
18	Inspect and delivery of smart valves made to site	X	





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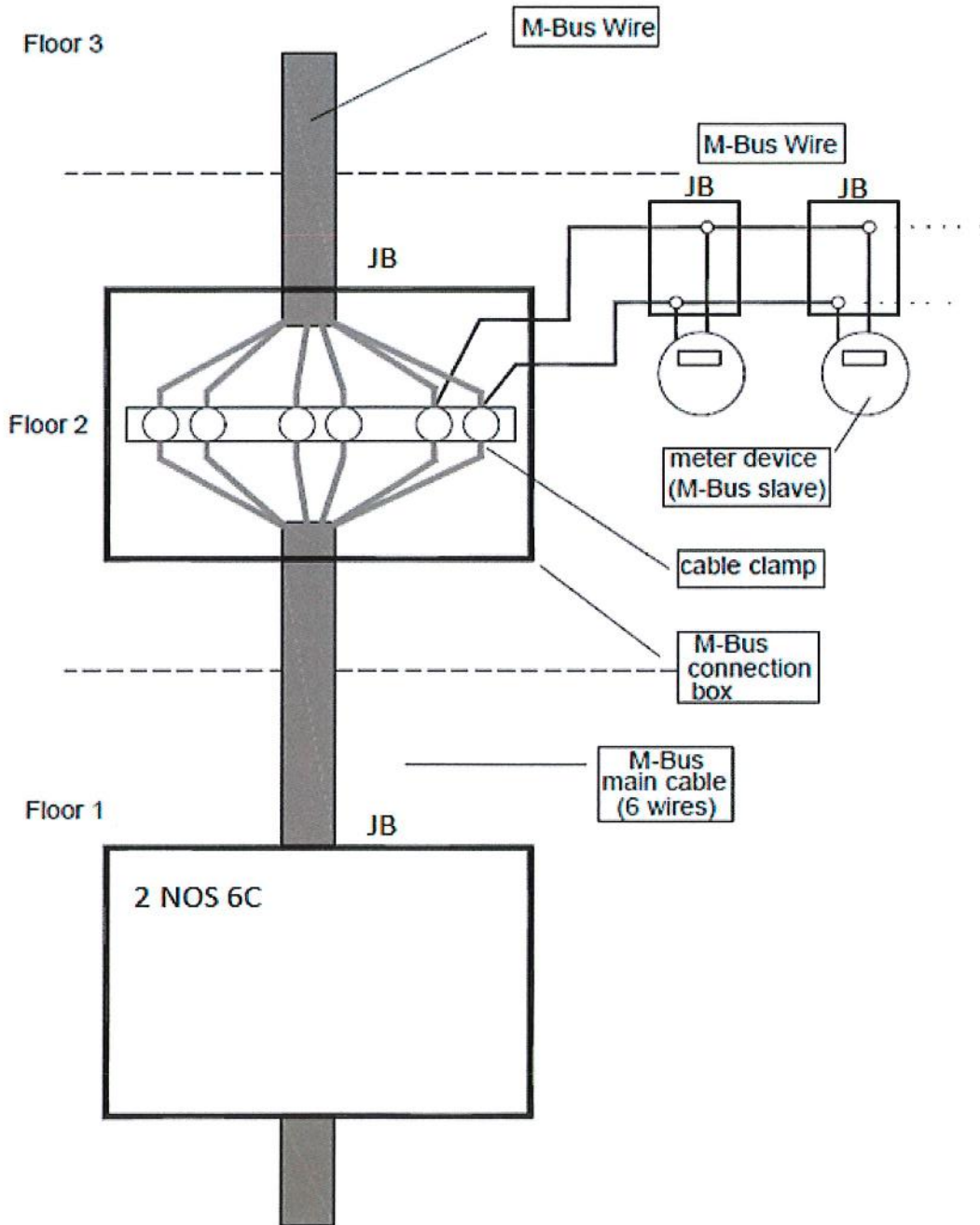
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SN	Description	Empower	Building Owner
19	Receive, Inspect & Store of BTU meters at site		X
20	Receive, Inspect & Store of smart valves at site		X
21	Installation of Spool pieces at the location of each BTU meter and smart valve for flushing		X
22	Removal of spool pieces, installation of BTU meters and Smart Valve with proper insulation and pressure test under the supervision of sub-meter and smart valve supplier		X
23	Installation of Sub-meter & Smart Valve with accessories inside Cabinet, Containment, Gateways, and wires for BTU meters and smart valves		X
24	Inspection of Containment and Wires for BTU meter	X	
25	Inspection of Containment and Wires for smart valve	X	
26	Termination of wires for all BTU meters, Smart valve receiver and data concentrator, M-Bus Masters, Repeaters, Gateway from all ends under the supervision of Empower supplier		X
27	Supervision of BTU meters installation	X	
28	Supervision of smart valve installation	X	
29	Inspection of BTU Meter, Smart Valve and Gateway Installation / Commissioning	X	
30	Testing & Commissioning of all BTU meters	X	
31	Supply, Installation, Testing and Commissioning of Billing system	X	
32	MDMS Configuration in EMPOWER server	X	
33	Testing & Commissioning of all smart valves including remote setup at Empower headquarters	X	
34	Handing-over of complete sub-metering system including MDMS by supplier to O&M-Metering <i>Note: Customer must ensure strong communication signal strength inside MDMS panel for uninterrupted MDMS connectivity.</i>	X	
35	Handing-over of complete smart valve system including remote setup by supplier to O&M-Metering	X	
36	Handing-over of relevant documents and keys (LSV, cabinet, control room) to Empower		X
37	Communication to commence tenant registration process	X	
38	Operation and maintenance of BTU meters and Billing system	X	
39	Operation and maintenance of all smart valves	X	
40	Maintenance and replacement of all sub-meter accessories such as lock shield valve, gate valve, union and reducer fittings as per scopes and responsibilities		X
41	Bill Cycle Data Collection	X	

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Appendix 2 – Typical connection from Riser cable to Floor cable

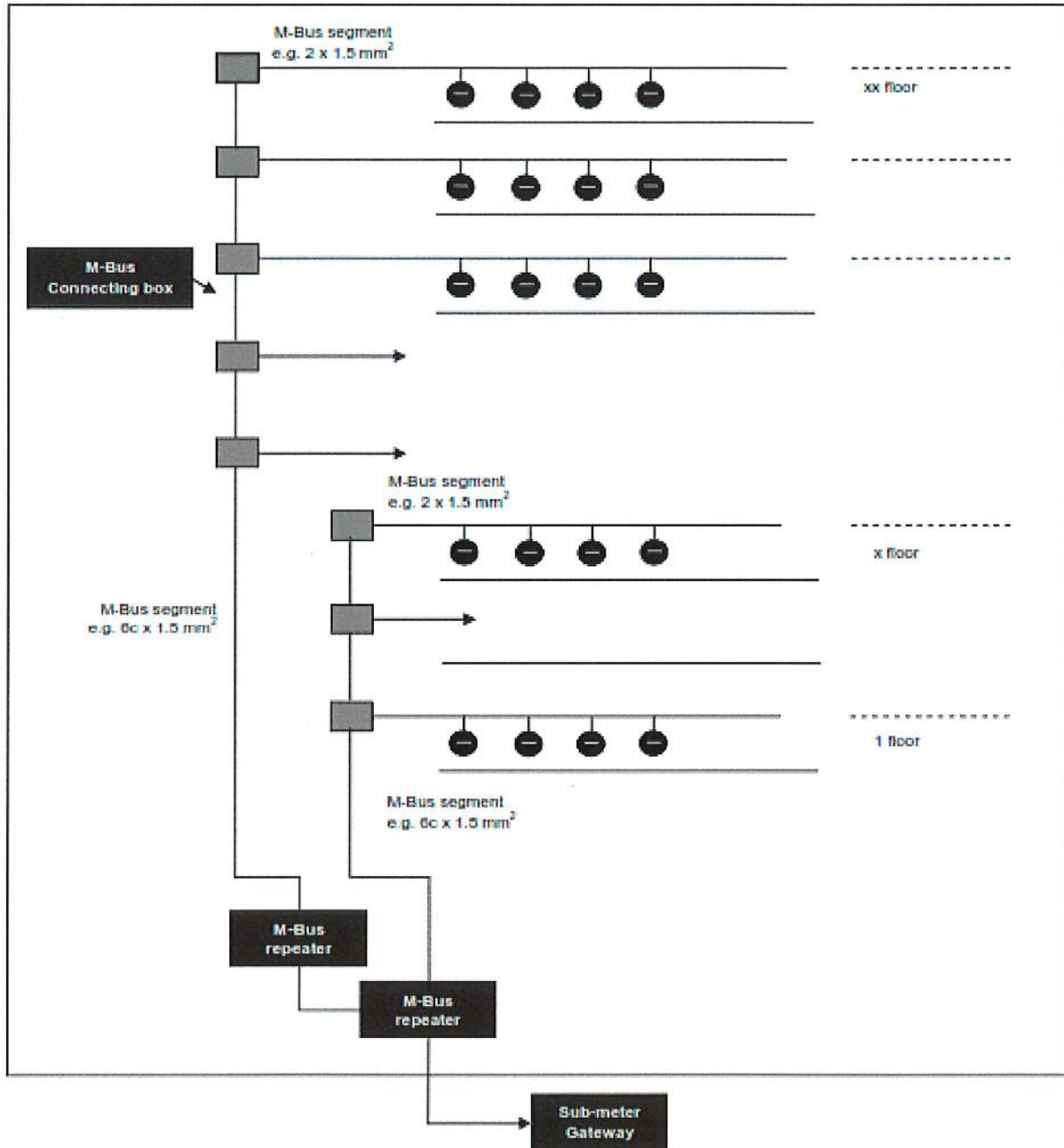



Drawing A2.1 section details of Mbus cable



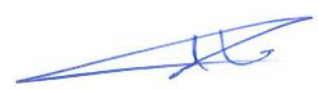
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Drawn by:	K.S.	Project:	GENERAL	
Prepared & checked by:	S.H.K.			
Approved by:	S.H.K.	Drawing:	Sub-metering Schematic	
Drawing no.	10-001/MISCH-01			

Drawing A2.2





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Appendix 2.3 – Sub-meter Gateway Setup for Remote Connectivity

- A. Supply of sub meter & MDMS panel including accessories is in Empower scope under the cost of customer.
- B. Sub-metering reading integration will be carried-out by Empower team. Empower supplier is responsible to integrate the reads up to billing export, regardless of meter brand and model.
- C. Customer must ensure strong communication signal strength inside MDMS panel for uninterrupted MDMS connectivity.
- D. Compliance to product specifications and installation package shall be followed which is subject to Empower approval. Please find below details.

SUBMETERS CONNECTIVITY SPECIFICATION COMPLIANCE STATEMENT (c/o EMPOWER SUPPLIER)				
SN	CRITERIA/SOW	DESCRIPTION	EMPOWER'S SUPPLIER COMPLIANCE	REMARKS
1	System's Communications	From M-Bus Sub-meter to M-Bus Master: M-Bus		
		From M-Bus Master to Collector: Modbus TCP/IP through M-Bus to Modbus Converter		
		From Collector to MDMS: High speed 4G LTE secured network		
2	Alternate device	Smart Phone/Tablet as a backup and routine/ emergency use		Alternate device shall be used as secondary back-up in case remote setup from Empower office failed
3	System Security	Encrypted and Secured solution		
4	Meter Search	Individual Sub-meter Search Option by Meter Serial No. & Location		
5	Design & Operating temperature	Robust design, industrial grade +70°C		
6	Capacity	Capacity to connect 60,000+ Sub-meters on the server; With security firewall and shall have software updates regularly to prevent any communication breach		
7	Unique Identity	Read-only unique identity that can be read and transmitted thru communication module		



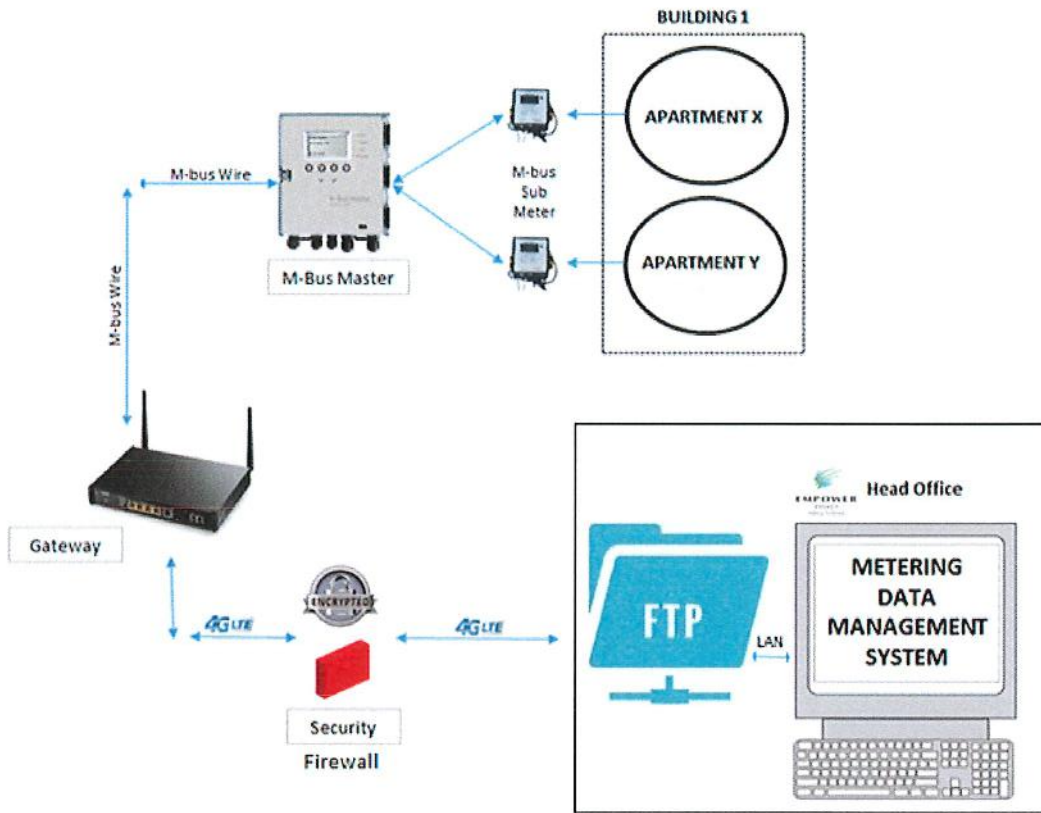
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SN	CRITERIA/SOW	DESCRIPTION	EMPOWER'S SUPPLIER COMPLIANCE	REMARKS
8	Logic Design	Log 12x Meter Reading per day, Data Analysis, plot the history of the meter reading, Generating reports and provide meters status, Alarms & Notifications.		
		Error Detection System: Design the logic where all the acceptable parameters will be considered as good readings.		
		Provide alarms for the meter faults that are outside the defined metering logic		
9	Tampering Alarm Notification	Meter will automatically notify in the event of tampering. Eg - If Valve Status is Off and flow is available Or if the device is being tampered by someone, it should sent alarm notification		
10	CONTRACTOR Scope: Method of Statement / Risk Assessment	CONTRACTOR scope shall identify full MOS with RA and to provide schematics drawings and layout for the entire setup.		
		Moreover, Supply, Installation, Testing and Commissioning shall be satisfactory completed.		
		Installation shall satisfy Empower acceptance criteria.		
11	After Sales Support	CONTRACTOR's ability to provide any technical support after successful handing-over of the project to ensure smooth remote operations of the connected Sub-meters.		
12	Training	CONTRACTOR shall conduct Operations and maintenance training for both hardware and software		
13	Origin	Shall be made in USA or Europe		
14	2 Years Warranty	CONTRACTOR to provide 2 years warranty after successful commissioning and handing-over		

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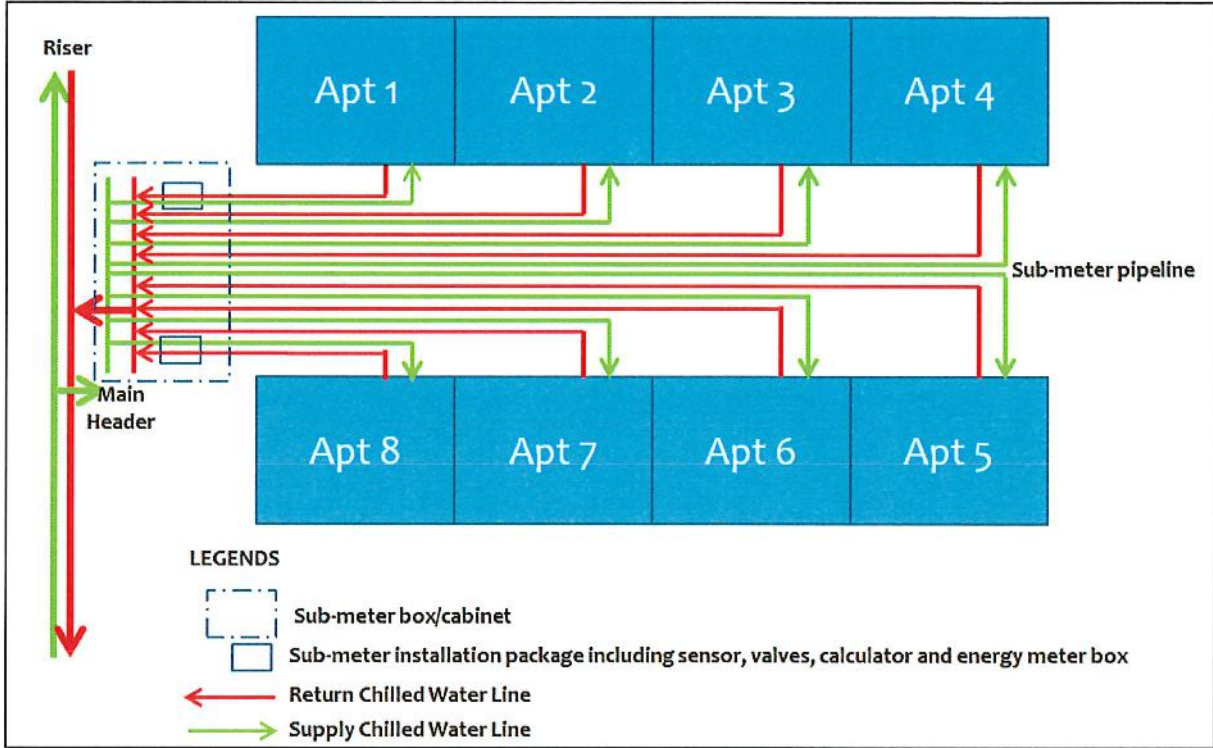
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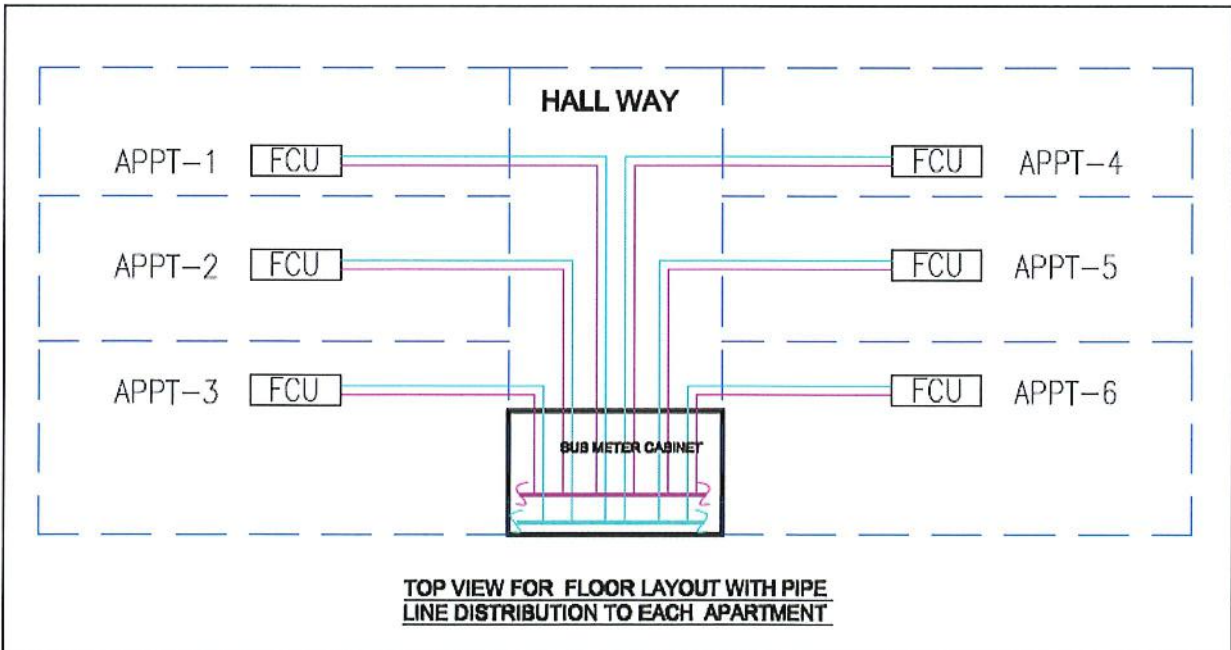
A2.4 – Typical Sub-meter Gateway Connection Details



Appendix 3 – Sub-meter Cabinet Drawing Details



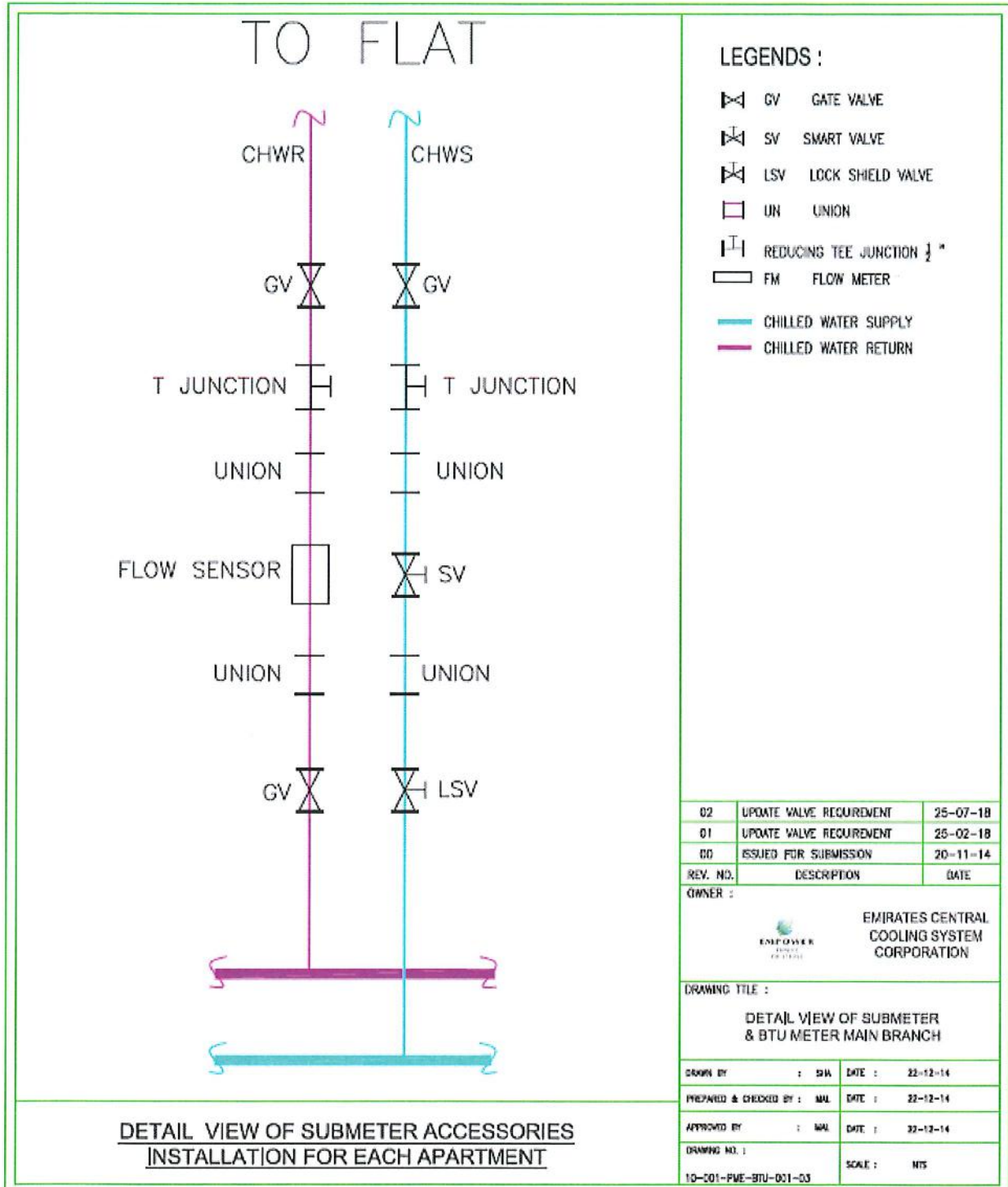
Drawing A3.1 Typical Sub-meter Cabinet Diagram



Drawing A3.2 Top View – pipeline distribution from Sub-meter Cabinet

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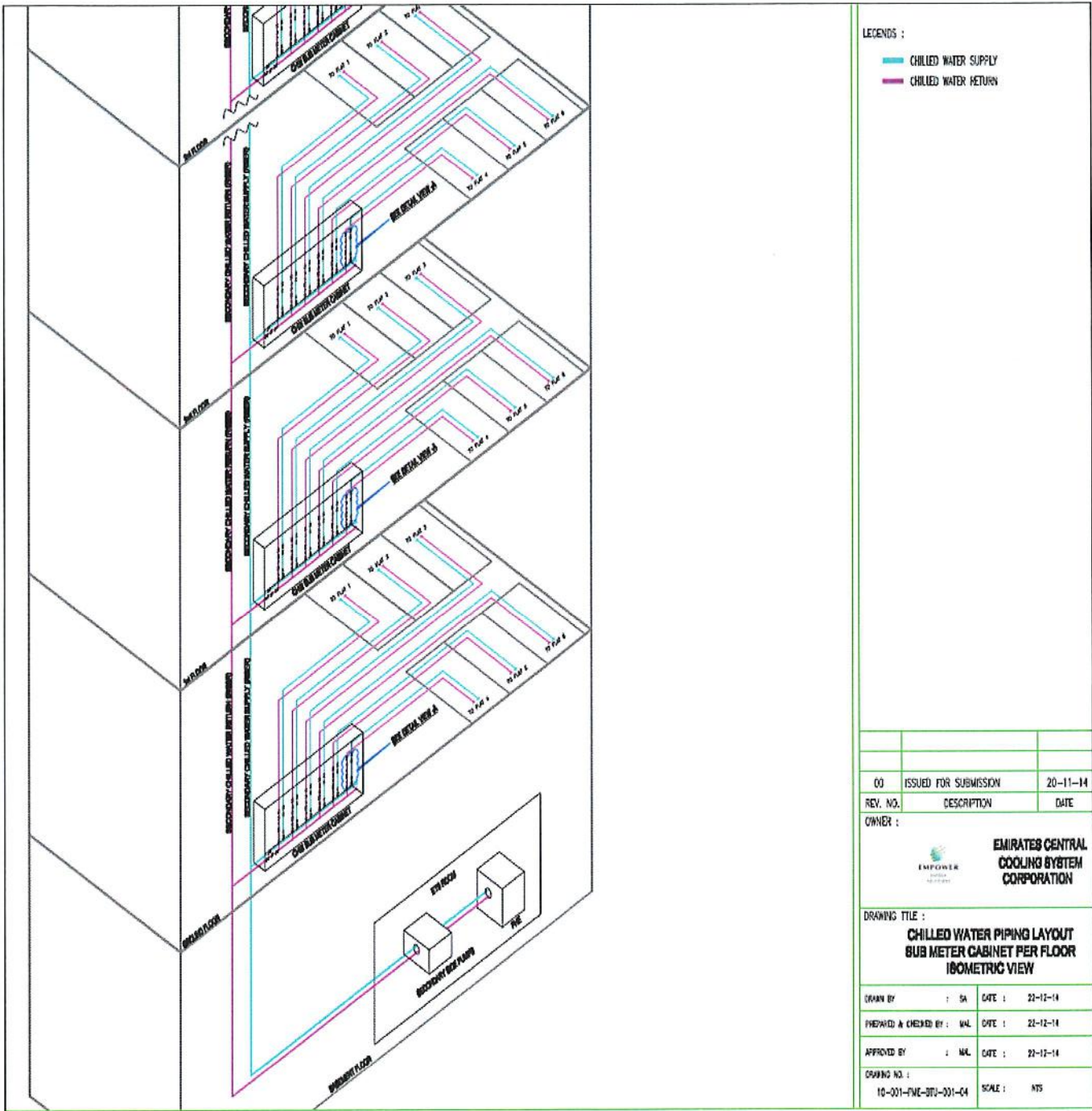
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Drawing A3.3 Typical Installation Detail Including Smart Valve



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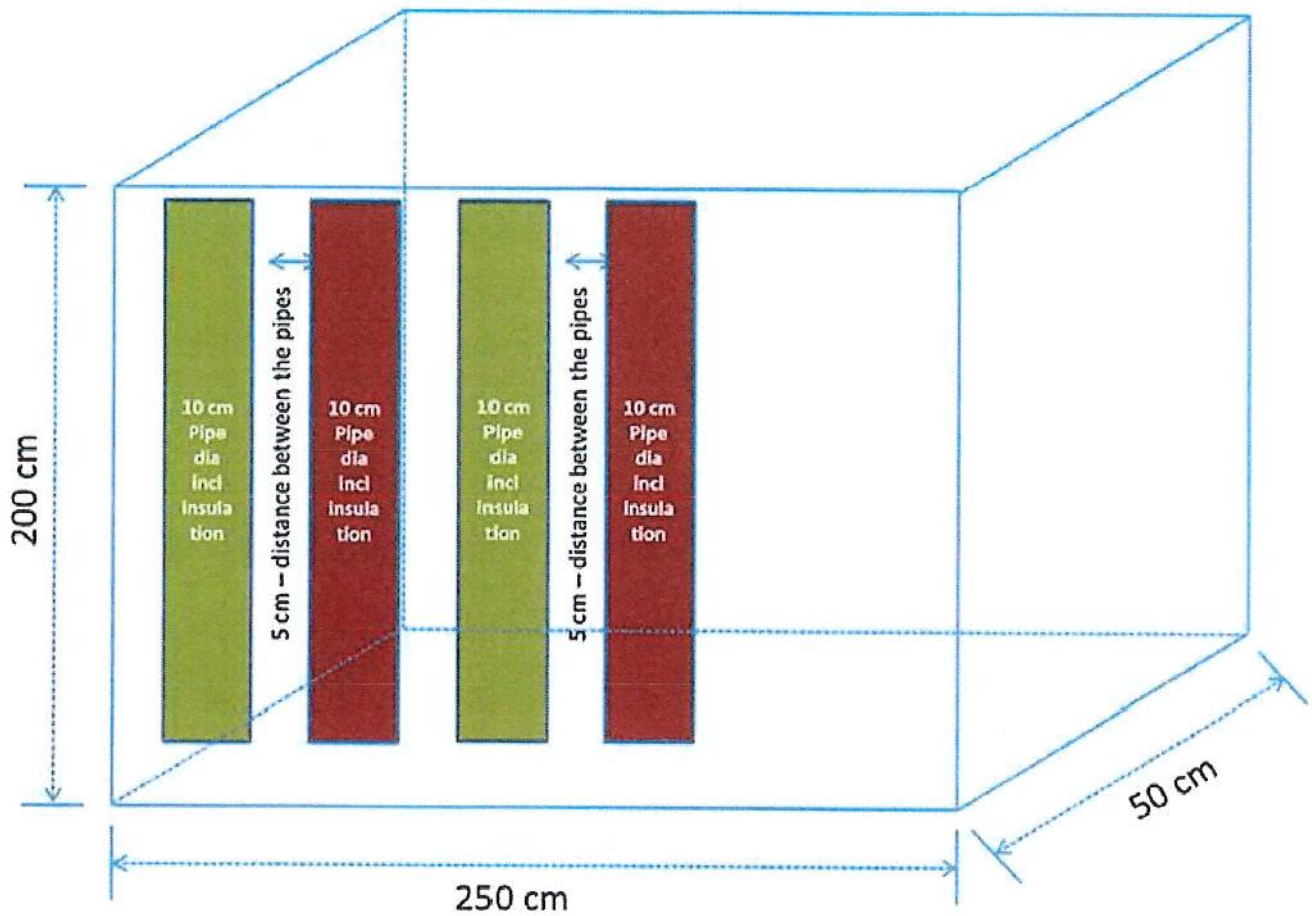
LEGENDS :
 — CHILLED WATER SUPPLY
 — CHILLED WATER RETURN

CO	ISSUED FOR SUBMISSION	20-11-14
REV. NO.	DESCRIPTION	DATE
OWNER :		
		EMIRATES CENTRAL COOLING SYSTEM CORPORATION
DRAWING TITLE :		
CHILLED WATER PIPING LAYOUT SUB METER CABINET PER FLOOR ISOMETRIC VIEW		
DRAWN BY :	SA	DATE : 22-12-14
PREPARED & CHECKED BY :	WAL	DATE : 22-12-14
APPROVED BY :	WAL	DATE : 22-12-14
DRAWING NO. :	10-001-FWC-001-04	SCALE : NTS

Drawing A3.4 Chilled water piping layout distribution



**STANDARD TECHNICAL
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- Lockable door with master key
- Minimum cabinet dimension
 - Length = 250 cm or flexible length considering in-between CHW pipe with insulation distance shall be min. 50 cm
 - Width / Depth = 50 cm (inner dimension)
 - Height = 200 cm (standard door ht door is acceptable)
- With floor drain pit

Drawing A3.5 Sub metering cabinet typical drawing & specification

Appendix 4 – Lock Shield Valve

- A. The Lock shield valve to shut off individually to allow trouble free maintenance or repair
- B. The Lock Shield valve shall be of 'Straight version' and Nickel plated
- C. A brass hand wheel to be provided
- D. Working pressure 16 bar
- E. Test pressure 24 bar
- F. Water temperature -5 Deg.C to 80 Deg.c



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Appendix 5 - Insulation Material

- A. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
 - 1. Adhesive: Solvent base, contact adhesive, as recommended by insulation material manufacturer.
 - 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
 - 3. Thermal Conductivity: ≤ 0.038 W/mK at 20 °C (68 deg. F).
 - 4. Density: 65 to 80 kg/m³.
 - 5. Water Vapor Permeability: 0.15 perm-inches.
 - 6. Thickness: 38 mm (single-layer)

Appendix 6 – Insulation Work

- A. PREPARATION
 - 1. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. GENERAL APPLICATION REQUIREMENTS
 - 1. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of equipment.
 - 2. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
 - 3. Keep insulation materials dry during application and finishing.
 - 4. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
 - 5. Apply insulation with the least number of joints practical.
 - 6. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 7. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
 - 8. Insulation Terminations: For insulation application where vapor retarders





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are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

9. Apply insulation with integral jackets as follows:
 - a. Pull jacket tight and smooth.
 - b. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
10. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
11. Install vapor-retarder mastic on equipment scheduled to receive vapor retarders. Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.

Appendix 7 – Isolation Gate Valves

- A. Gate valves, 25 mm and Smaller: Rated for 1030 kPa saturated steam pressure, 2760 kPa WOG pressure; two piece construction; with bronze body conforming to ASTM B 62, standard (or regular) port, chrome-plated brass gate, replaceable "Teflon" or "TFE" seats and seals, blowout-proof stem, and vinyl-covered steel handle. Provide solder ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water and low-pressure steam. Provide PN 16 valves where system pressure requires.
- B. Gate valves, 32 mm to 50 mm: Rated for 1030 kPa saturated steam pressure, 2760 kPa WOG pressure; 3 piece construction; with bronze body conforming to ASTM B 62, conventional port, chrome-plated brass gate, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide solder ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water and low-pressure steam. Provide PN 32 valves where system pressure requires.
- C. For flange type installation, butterfly valve with the same PN is applicable for DN65 and above.

Appendix 8 – Smart Valve

- A. Supply of smart valve including main gateway & forwarder gateways is in Empower scope under the cost of customer.
- B. Customer is responsible for installation, under the supervision of Empower supplier.
- C. Smart valve shall be provided for all installed meters.



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- D. Customer to supply and install containments such as power cables for smart valve with proper conduiting & termination as per Empower supplier recommendation.
- E. Customer must ensure strong communication signal strength inside smart valve panel for uninterrupted connectivity.
- F. Compliance to product specifications and installation package shall be followed which is subject to Empower approval under Empower supplier's scope. Please find below details.
- G. Below specification is for customer's information.

SMART VALVE PRODUCTS SPECIFICATION AND INSTALLATION COMPLIANCE STATEMENT (C/O EMPOWER)

SN	CRITERIA/SOW	DESCRIPTION	EMPOWER'S SUPPLIER COMPLIANCE	REMARKS
1	Wireless Communications	Valve's ability to communicate thru multi RF paths including GSM/GPRS, WIFI, Bluetooth and LTE		
2	Handheld device as an alternative with 200m range	Valve can be controlled from handheld and any mobile application		
3	Software Setup for Remote Connectivity of Smart Valve	Capacity to connect 60,000+ smart valves on the server; With security firewall and shall have software updates regularly to prevent any communication breach		
4	Unique Valve / Device ID	Read-only unique identity that can be read and transmitted thru communication module		
5	Battery Power Source	3.6VDC, 15 years D-Cell battery powered		
6	Tampering Alarm Notification	Valve will automatically notify in the event of tampering		
7	Valve IP68 Protection / Class NEMA Enclosure	Valve shall be IP68 while enclosure is NEMA for better protection of the device		
8	Valve Fail Safe with Alarm	Valve to retain last position. Corresponding alarm shall be sent in central control room to notify maintenance for the status and rectification		
9	Secured Manual Valve Override Access	Access for Empower maintenance in doing rectification / repair of the valve side		
10	Compact Type	Valve and enclosure are built together, while cards and batteries can be replaced during maintenance		
11	Valve Size DN 15 to DN 65	Mandatory size requirement		
12	Valve Material	Brass Ball valve, PN 16		



**STANDARD TECHNICAL
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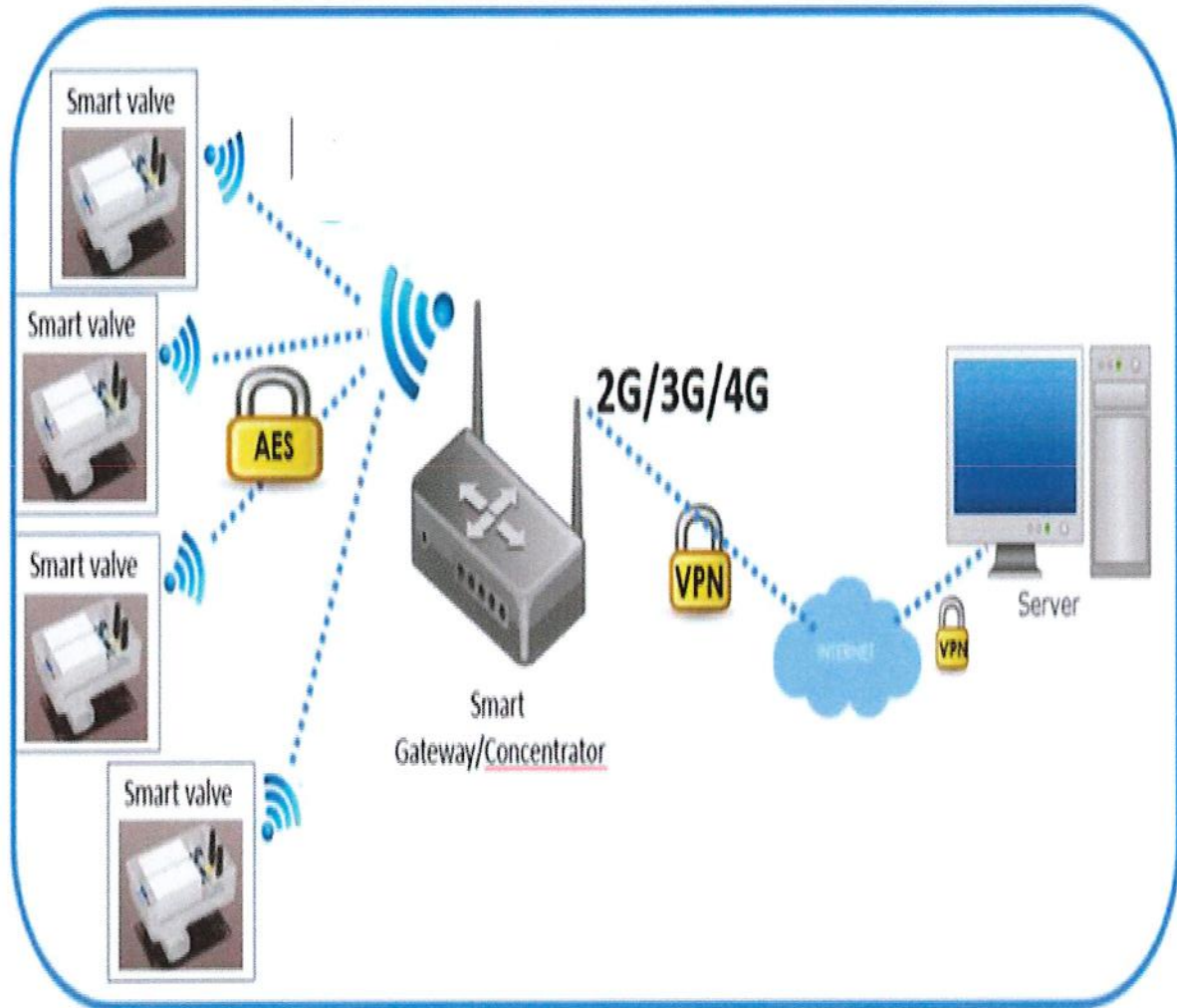
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SMART VALVE PRODUCTS SPECIFICATION AND INSTALLATION COMPLIANCE STATEMENT (C/O EMPOWER)

SN	CRITERIA/SOW	DESCRIPTION	EMPOWER'S SUPPLIER COMPLIANCE	REMARKS
13	Valve Dimension	Valve shall be compatible with standard Crane or Pegler length and thread size		
		Note: <i>In some cases, flanged valve is required for DN50 and DN65</i>		
14	10 years Valve Life Span	Valve including its communication module shall have guaranteed life span of at least 10 years		
15	Method of Statement / Risk Assessment	Supplier shall identify full MOS with RA and to provide schematics drawings and layout for the entire setup. Note: <i>Smart valve shall be insulated properly to avoid condensation</i>		
16	After Sales Support	Supplier's ability to provide any technical support after successful handing-over of the project to ensure smooth flow of valve operations.		
17	Training	Supplier shall conduct Operations and maintenance training for both hardware and software		
18	Origin	Shall be made in USA or Europe		
19	2 Years Warranty	Supplier to provide 2 years warranty after successful commissioning and handing-over		

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Drawing A8.1 Typical Smart Valve Connectivity Diagram





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Appendix 9 – Sub Metering Installation Acceptance Sheet

Meter Part Number		Meter Serial Number	
Meter DN / QP		Meter Year of Make	
Smart Valve Part Number		Smart Valve Serial Number	
Smart Valve DN		Smart Valve Year of Make	
Project Name		Building Name	
Inspection Date		Apartment Number	

Meter Installed In: **Supply Line** **Return Line**

SN	INSPECTION CRITERIA	ACCEPTABLE	NOT ACCEPTABLE	REMARKS
1	Two Unions across Flow Sensor at return line and one union at Supply line	<input type="checkbox"/>	<input type="checkbox"/>	
2	Supply Temperature Sensor	<input type="checkbox"/>	<input type="checkbox"/>	
3	Return Temperature Sensor	<input type="checkbox"/>	<input type="checkbox"/>	
4	Tee-Junction Installation Facing Downward	<input type="checkbox"/>	<input type="checkbox"/>	
5	Insulation Done Correctly (Single layer 38mm)	<input type="checkbox"/>	<input type="checkbox"/>	
6	Two Isolation Valves Across Flow Sensor	<input type="checkbox"/>	<input type="checkbox"/>	
7	1 Lock Shield Valve and 1 isolation Valve at Supply line	<input type="checkbox"/>	<input type="checkbox"/>	
8	BTU Calculator Location (Properly mounted away from pipe)	<input type="checkbox"/>	<input type="checkbox"/>	
9	Smart Valve installed at Supply Line	<input type="checkbox"/>	<input type="checkbox"/>	
10	M-Bus Terminations properly connected to BTU meters	<input type="checkbox"/>	<input type="checkbox"/>	
11	Flow Sensor Installation at Return Line	<input type="checkbox"/>	<input type="checkbox"/>	
12	Submeter Cabinet arrangement – all parts are accessible without access restriction (Valves, Flow Sensors, Unions, Tee's)	<input type="checkbox"/>	<input type="checkbox"/>	
13	Tagging attached to BTU Meter for each apartment	<input type="checkbox"/>	<input type="checkbox"/>	
14	Tagging for each Smart Valves for each apartment	<input type="checkbox"/>	<input type="checkbox"/>	
15	Tagging for Supply & Return Line Gate Valve	<input type="checkbox"/>	<input type="checkbox"/>	
16	Secured Submeter Cabinet (with master key)	<input type="checkbox"/>	<input type="checkbox"/>	
17	Local readings from BTU Meter Display	<input type="checkbox"/>	<input type="checkbox"/>	

A9.1 Individual Meter and Smart Valve Installation Acceptance Checklist



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Project Name		Date Handed Over	
Building Name		M-Bus Software Used	
Total Nos. of Installed Meters		Total Nos. of M-Bus Master	
M-Bus Master Make / Part Number		BTU-Meter Room Location	
Gateway for Smart Valve Connectivity		Total Nos of Installed Smart Valves	

SN	SUBMETER & SMART VALVE DOCUMENT HANDING OVER & COMMISSIONING ACCEPTANCE SHEET	ACCEPTABLE	NOT ACCEPTABLE	Remarks
1	M Bus master installed inside the enclosure box inside BTU meter room	<input type="checkbox"/>	<input type="checkbox"/>	
2	M Bus cable laying from main raiser up to each floor using specified 8471 2C cable & 27615A cable	<input type="checkbox"/>	<input type="checkbox"/>	
3	Availability of spare M Bus cable 6C belden 27615A	<input type="checkbox"/>	<input type="checkbox"/>	
4	Check the continuity of M Bus loop, As built drawing of Mbus cables 2C & 6C cable laying to be submitted to Empower	<input type="checkbox"/>	<input type="checkbox"/>	
5	ETS room key, M-Bus master enclosure key, BTU meter room key, LSV key, smart valve panel key- 3 sets each	<input type="checkbox"/>	<input type="checkbox"/>	
6	Smart Valve Documents (Manual, Hardware Arch, As-built drawings)	<input type="checkbox"/>	<input type="checkbox"/>	
7	Smart Valve Warranty Certificate	<input type="checkbox"/>	<input type="checkbox"/>	
8	Risk Assessment for Smart Valve Information Security	<input type="checkbox"/>	<input type="checkbox"/>	
9	Handing-over of the Smart Valve application	<input type="checkbox"/>	<input type="checkbox"/>	
10	Configuration & Connectivity of Smart valves to Empower Server	<input type="checkbox"/>	<input type="checkbox"/>	
11	Handing over and Configuration of mobile application for Smart valves	<input type="checkbox"/>	<input type="checkbox"/>	
12	Smart valve demonstration and training	<input type="checkbox"/>	<input type="checkbox"/>	
13	Smart valve asset registration in Empower latest template	<input type="checkbox"/>	<input type="checkbox"/>	
14	Testing & Commissioning Report of Smart Valves	<input type="checkbox"/>	<input type="checkbox"/>	
15	Submeters connectivity to MDMS system in Empower HQ	<input type="checkbox"/>	<input type="checkbox"/>	
16	BTU Meter Installation Log sheet	<input type="checkbox"/>	<input type="checkbox"/>	
17	Asset Register for BTU Meters in Empower latest template	<input type="checkbox"/>	<input type="checkbox"/>	
18	Testing & Commissioning Report of BTU Meters	<input type="checkbox"/>	<input type="checkbox"/>	
19	Error Free BTU Meter Data Readout- 3 Days	<input type="checkbox"/>	<input type="checkbox"/>	
20	Individual Calibration Certificate for BTU Meters	<input type="checkbox"/>	<input type="checkbox"/>	
21	BTU Warranty Certificate with BTU Meter serial numbers (PDF + Excel)	<input type="checkbox"/>	<input type="checkbox"/>	
22	Spare parts list of BTU meters	<input type="checkbox"/>	<input type="checkbox"/>	
23	M-Bus Architecture of BTU meters	<input type="checkbox"/>	<input type="checkbox"/>	
24	O&M Manual for BTU meter	<input type="checkbox"/>	<input type="checkbox"/>	
25	BTU Meter - Database	<input type="checkbox"/>	<input type="checkbox"/>	
26	AMR software	<input type="checkbox"/>	<input type="checkbox"/>	
27	Availability of 3KVA UPS with min. 4 hours back up	<input type="checkbox"/>	<input type="checkbox"/>	

	NAME	SIGNATURE	DATE
Meter and Smart Valve Installed By (Contractor)			
Meter Commissioned By (Supplier)			
Smart Valve Commissioned By (Supplier)			
Handed Over To (Empower)			

A9.2 SUBMETER & SMART VALVE HANDING OVER & COMMISSIONING ACCEPTANCE SHEET

*** End of Document ***