South Energy

District Cooling ETS Guidelines

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1. INTRODUCTION

South Energy will deliver District Cooling chilled (DC) water to different developers in order to cater the cooling needs of the buildings. The source of the chilled water is from single or multiple District Cooling Plants (DCP) distributed all over DUBAI SOUTH cities.

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2. PURPOSE

This document is intended to be used as overview and guidelines for Investors, Building Owners, Client Representatives, Consultants and Contractors to design and operate the Energy Transfer Stations (ETS) chilled water cycle, where in to define the scope of work for DUBAI SOUTH customer and SOUTH ENERGY.

All DUBAI SOUTH Customers, their Consultants and Contractors will be required to demonstrate their compliance incorporating during designing, constructing and handover of District Cooling ETS stations, meeting the SOUTH ENERGY standards and requirements.

3. SCOPE

This document is applicable to customers who shall apply to SOUTH ENERGY for DC connection for chilled water network and ETS design / construction / handover.

4. REFERENCES

- ASHRAE
- ARI
- ASME
- PED – European Pressure Equipment Directive

- API
- AHRI
- EN 55081-1
- CE conformity directive 92/31/EWG
- **American National Standard Institute**
- **International District Energy Association (IDEA)**
- **TRAKHEES**
- **DEWA Regulations**
- **Dubai Municipality Regulations**
- **Dubai Civil Defense Authority**

5. DEFINITIONS & ABBREVIATIONS

- ✓ "Primary side" refers to the plant side chilled water and "Secondary Side" refers to the Customer's side chilled water cycle.
- ✓ ETS means Energy Transfer Station, a set of heat exchangers inside a dedicated room with its piping, pipe fittings, pumping and control system; it is acting as a buffer segregate chilled water cycle produced by the District Cooling Plant and chilled water cycle inside buildings.
- ✓ PHEX's means plate heat exchanger, a type of heat exchanger consisting of parallel gasketed plates to create fluid channels.
- ✓ "Energy Meter" means set of instrument installed inside the ETS to measure the rate of enthalpy change in the chilled water by measuring flow rate and the temperature different which indicates bulk rate of consumption of cooling.
- ✓ "Sub-Metering System" means set of instruments installed at the secondary side's apartment, office, retail, common area,…etc, to measure rate of enthalpy change in the chilled water by measuring flow rate and temperature different which indicated rate of consumption of cooling for that dedicated area.
- ✓ AHU means – Air Handling Unit and FCU means fan coil unit, equipments that include a fan or blower, heating and/or cooling coils, regulator controls, condensate drain pans and air filters to blow temperature controlled to a dedicated area.
- ✓ "Customer" means a Master Developer, Building Owner, Individual Customer Unit Owner or other and user of district cooling service provided by SOUTH ENERGY.
- ✓ SI unit means "System International D'Unite".
  a. M; is meter.
  b. mm; is millimeter.
  c. ºC; is degree Celsius.
- ✓ Surcharge means lower than design secondary sides return chilled water
- ✓ temperature.
- ✓ MCB - Miniature circuit breaker.

- ✓ BMS – Building management System.
- ✓ VFD - Variable Frequency Drive.
- ✓ NOC - No objection Certificate.
- ✓ AAV - Automatic Air Vent
- ✓ MAV - Manual Air Vent.
- ✓ PVC – Plot Valve Chamber
- ✓ DCP – District Cooling Plant
- ✓ DCS – District Cooling Services
- ✓ CHW – Chilled Water
- ✓ PVC – Plot Valve Chamber
- ✓ TR – Tons of Refrigeration
- ✓ SOUTH ENERGY DWC-LLC means, SOUTH ENERGY District Cooling Service provider, PO Box 282228, Dubai, UAE, and its authorized consultants or contractors or its representatives

6. RESPONSIBILTIES

6.1 SOUTH ENERGY Responsibilities

SOUTH ENERGY shall be responsible for communicating the requirements to its DC customers stated herewith ensuring ETS standard and guidelines compliance, such requirements may correlate with district cooling plant construction and operation, confirming the allocated cooling load for the customers with regards to its development, and therefore SOUTH ENERGY is the authority to control and regulate these ETS guidelines conforming to all relevant ETS standards and requirements to meet design criteria for both primary DC and Building secondary sides at ETS stations.

6.2 DUBAI SOUTH Customers Responsibilities –

The building developer / owner through his consultant and Contractor shall be responsible for the items listed below:

a. To design, procure, supply, install, test and commission all necessary ETS Room equipments such as Plate Heat Exchangers, CS piping / fittings, strainers, valves, flowmeter, energy-meter and necessary P&ID instrumentation to provide fully functional ETS system to meet design criteria for both District Cooling Plant side & Building side (material submittal and specifications to be submitted to SOUTH ENERGY approval)

b. To supply, install, test and commission underground pre-insulated (HDPE) CS piping (from tie-inn point of DC plot valve chamber up to building penetration point and related ETS piping). The plot valve chamber will be within plot limit where in connected to main District Cooling CHW piping network (Plot Valve Chamber details with levels to be coordinated with DUBAI SOUTH-Planning & Zoning as per infrastructure consultant details)
c. To design (stress / surge analysis), supply, install, test, commission and chemically treated both primary side (from tie-inn point of plot valve chamber) and secondary side piping and ETS Room equipments. (The design data, ETS equipments selected and piping testing and chemical treatment analysis to be by approved third party certified, submitted to SOUTH ENERGY)
d. Customers with high rise buildings must consider their building internal pressures prior to ETS equipments selected. Further PHEX may be required at high levels fed from the primary PHEX's.
e. The customer or its consultant representative to comply and incorporate allocated cooling load in their building design CHW system.
f. Sweet water supply line for filling ETS piping, expansion tank and drain connection to the nearest external manhole and drain.
g. Actual completion dates for ETS completion should be provided in advance to SOUTH ENERGY dept. for readiness to connect / supply DC CHW.
h. To provide proper regular maintenance of ETS DC secondary side CHW network, its associated pumps, chemical dosing / pressurization systems, AHU's / FCU's. The building CHW chemical analysis to be done monthly and reports to be submitted to SOUTH ENERGY. However, the Primary side ETS maintenance and its management (Energy-metering, controls) will be done by SOUTH ENERGY.
i. The PHEX shall not be connected to CHW piping for both primary / secondary sides, until the final chemical analysis is done and accepted within limits that should be approved by third party and the reports to be submitted to SOUTH ENERGY.
j. The allocated cooling loads shall be provided either by SOUTH ENERGY or its authorized infrastructure consultant.

7. TECHNICAL REQUIREMENTS

7.1 ETS Room Standard Requirements:

1. SI units to be used while corresponding SOUTH ENERGY Dept.
2. The work will consist of the design, supply, installation, testing and commissioning of all necessary ETS installations such as PHEX, Energy Meter, flow meter, CS piping (from DC plot valve chamber tie-inn to PHEX piping connections), fittings, piping drain & vent points, valves, controls, piping supports, wiring and P&ID instrumentation to provide a fully functioning ETS system to meet designed criteria for both District Cooling Plant side and Building side CHW systems.
3. The Term Primary Side to be read as Plant side or Cold side, and Secondary side to be read as Customer side or Hot side.
4. The DC primary CHW supply and return temperatures are 4.5°C and 13.5°C
5. The DC secondary CHW supply and return temperatures are 5.5°C and 14.5°C
6. Only one ETS room (with minimum two PHEX) for the given Building project is to be designed and only one building chilled water piping at entry point (CHW supply / CHW return). Selection of PHEX to be considered as per SOUTH ENERGY drawing note (3) ref: DWG/-SE/DCS/ETS/LAY Rev-1 and any Stresses in the PHEX shall be avoided.
7. The CHW pipe penetration for the building entry point to have puddle flange or sleeve installed (MS plate, circumferentially full butt weld, sand blasted and hot dipped galvanized), at take off point from the plot valve chamber coming through the main CHW piping network.
8. Mechanical hydrostatic link seal (complying with international standard for District Cooling application) should be installed between sleeve and CHW-piping entering to the building.
9. Each building should have dedicated plot valve chamber (PVC) within the plot, sized according to chilled water pipe size or cooling load of the building.
10. The room ceiling (soffit) to be designed to allow for the supports of the chilled water piping headers operating loads in the structural design and same to be considered for allowing operational loads of ETS branch CHW piping for ETS room floor area.

11. The flow meter installation should be in the main header of return CHW piping required to be 5D (upstream) and 3D (downstream) of pipe diameter as straight pipe with no fittings and instrumentation. Flow meter to have isolation valves to the extent of 8D straight pipe installed, and separate pipe spool piece of flowmeter size or 8D straight pipe size with flanges to be made available during flowmeter maintenance.
12. The energy meter and flow meter installations to be as per manufacturers requirement and factory calibration / test certificates to be provided to SOUTH ENERGY.
13. Drain and gully traps to be provided in suitable locations of the ETS Room for PHEX condensation and at CHW piping (branch / main) drain points.
14. The ETS room must be located near and practically possible to the main chilled water network piping entry point to the building, preferably at least one side of the ETS wall to be exposed outside.
15. The ETS room location is required to be in the ground floor level unless otherwise specified to be in the first (1^{st}) basement level directly below in order to maintain design static pressure on DC system side and less CHW piping installation that to be approved by SOUTH ENERGY with adequate lighting facility.
16. ETS control schematics with necessary P&ID to be designed for each building DC CHW systems for both primary and secondary sides, in order to achieve designed parameters.
17. Provide minimum 3-phase, 32A, 5 pin industrial type socket (water proof) outlet for maintenance purpose
18. Provide separately un-switched power to Energy Meter directly from the SMDB, clearly indicated / labeled for District Cooling BTU Meter.
19. ETS pipe sizing requirement shall be max water velocity of 1.2m/s for pipe size 50mm and smaller, and 3.0m/s for pipe size starting from 65mm and larger sizes. However, the min / max pressure drop to be 100Pa/m-400Pa/m. The complete ETS system circuit pressure drop shall not exceed 150 Kpa (1.5 bars) (depends on ETS capacity).
20. The PHEX to be installed on the concrete plinth foundation to be constructed as per the operating loads of PHEX as recommended by the PHEX manufacturer, maintaining clearances as per the section (ETS space requirement) provided in this guidelines.

21. The underground CHW piping tie-inn from plot valve chamber and as well as ETS above ground piping, to be NDT tested (10% X-Ray / 100% UT), hydro-tested (16 Bar), chemically flushed and passivated and third party certified and all necessary reports to be submitted for SOUTH ENERGY approval. The CHW lines (supply / return) to be pressurized as per District Cooling Plant operation pressure.
22. The BMS should support open protocol communication structure to enable it to communicate with the remote monitoring system at the DCP, BACnet / IP is the required protocol.
23. PHEX design working pressure shall be defined by the highest point of building chilled water piping network working pressure. Vents to be provided at high points and drains to be provided at lowest points in ETS piping.
24. Air conditioning in the ETS to maintain a temperature between 24 ± 1°C, for correct functioning of control, etc.
25. All ETS piping to be rubber/Armaflex insulated (thickness – 40mm / density - 70Kg/m^3) and aluminum cladded (material submittal and specifications to be submitted for SOUTH ENERGY approval)
26. ETS room to be lighted and Air Conditioned Temperature shall be maintained between 21 ºC to 26 ºC.
27. As built ETS dossier / drawings, showing the dimensions and clearances of entire ETS room layout, testing and commissioning reports, third party certification, O&M manuals and warranty documents for all ETS equipments / installations to be issued to SOUTH ENERGY Dept.
28. ETS room must be of rectangle in shape (curved, round or sharp shapes not accepted)
29. The above works shall be fully responsible for the correct functioning of the ETS system to meet DC design criteria and to carry any liability or guarantee necessary to protect all parties in this regard.

8. BUILDING SECONDARY SIDE REQUIREMENTS

1. To avoid surcharge phenomena, the Customer shall strictly ensure the following:
   a. Do not oversize cooling coils in the building secondary side cycle from the prevalent / allocated cooling load for the building.

b. Do not utilize three way valves to control cooling rate in the cooling coil of the secondary side.

2. As minimum requirement, the Customer shall design and select his building cooling coils based on the specified ΔT 9ºC chilled water temperatures; designing such coils at 1.1 ºC above specified (10 ºC differential temperature) is highly recommended to allow for future unavoidable fouling over time.
3. Secondary or building side CHW circuit shall be with VFD / variable flow system.
4. Sub-metering provision to be taken into consideration for each individual building customer, to be easily interfaced with ETS main metering system (This to be clearly communicated and agreed between SOUTH ENERGY and the client)

9. ETS SPACE REQUIREMENTS

1. The minimum height of the ETS room is 4.2 m.
2. Allow min 1000mm clear space on the back side of the Plate Heat Exchangers.
3. The minimum clear space above the PHE top side to be not less than 800mm.
4. The clearance between the PHEX to be 1500mm.
5. Allow minimum 2000mm clear space in front of the PHEX for branch piping, P&ID, fittings and control valves installation.
6. The PHEX concrete plinth foundation to be of 300mm height, with 150mm clearance at all sides of PHEX frame.

10. BMS SYSTEM FOR THE REMOTE MONITORING AND CONTROL OF THE CUSTOMER CHW ETS FROM THE DCPs WITH FIBER OPTIC LINK

- A BMS system is to be installed in each building ETS room to facilitate remote monitoring and control of the CHW ETS system from the District cooling plant
- The proposed BMS system by the contractor for the ETS Room should be approved by South Energy.
- The BMS system for the ETS room will be of the make and supplier specified by South Energy to maintain consistency for integration and long term maintenance and operation of the system.

- Suitable compatible makes are Johnson Controls, Siemens, and Honeywell etc. with BACnet protocol structure.
- The BMS should support open protocol communication structure to enable it to communicate with the remote monitoring system at the DCP. **The communication protocol should be BACnet/IP.**
- The BMS system DDCs will be housed in a separate enclosure with a reliable UPS power supply.
- The connectivity to the remote monitoring station in the DCP plant will be through Fiber optic cable pair. The building developer / contractor is responsible to install & test fiber optic cable from the DDC panel to the CHW valve chamber outside the building. The fiber pair is to be spliced to the main BMS fiber ring cable there by the building developer / contractor. Optic Fiber Test Certificate must be submitted to South Energy.
- Media converter is required in the DDC panel to link the DDC Ethernet remote communication port to the FO cable.
- It is the responsibility of the building developer/contractor to configure and avail all the points as per South Energy requirements from ETS room BMS.
- The building developer/contractor shall be responsible along-with the South Energy team for testing, commissioning and integration of the ETS Room with the plant.
- It is the responsibility of the building developer/contractor to make sure all the required points are available and reliable all the time and necessary maintenance of the ETS Room BMS shall be carried out.

CHW Pipe Leak Detection system: (if provided)

- CHW Pipe Leak detection panels for the various parts of the CHW network will be placed in some of the customer's building ETS rooms as required. These panels will be remotely monitored in the BMS through Volt free contacts from the Leak detection system to the BMS panels.

- The operation, maintenance and upkeep of the leak detection panels will be the responsibility of DS. Only power supply for these panels will be from the customer building.

Control / Monitoring Points:

The following points are required to be monitored by the DDC controller to achieve control and provide feedback to the DCS operations:

- Individual line pressure (sensor) on the primary and secondary side of the PHEX.
- Individual line inlet and outlet temperatures (sensor) on the primary and secondary side of the PHEX.
- Flow status on the supply line to the building.
- Motorized (flow control) PICV valve control command & Feedback.
- The following BTU meter parameters shall be communicated with the plant
  - Flowrate
  - Temperatures
  - MWH readings
- Volt free contacts for CHW pipe leak detection and panel healthy status.(if provided)
- PID tuning parameters.

- The building developer/contractor shall coordinate with SE before finalizing the point name or Device ID for ETS Room devices.
- The control philosophy will be that as per the changes in the building cooling load, a variation in the building side chilled water flow or CHW temperature will take place. The variation in the AC load will result in the change of heat transfer rate across the Plate heat exchangers (PHEX) and will eventually reflect as a change in the return chilled water temperature on the district cooling side. This change in temperature will be immediately sensed through the temperature transmitter (TT) located on the return CHW

pipe of the district cooling side of the PHEX in the ETS room. Upon receiving the signal from the TT, the DDC will signal the control valve (PICV) located on the return CHW pipe of the DCS side to modulate accordingly till the time that the return CHW temperature on the DCS side comes to the set-point temperature. (Refer the schematic diagram for the ETS room control schematics : ref: DWG/DWC-DS/DCS/ETS/Con-Sch Rev-1)

- There must be a Manual and Auto mode of control for the PICV and the SCADA/HMI must mention on the screen in which mode the PICV is been controlled.
- Auto mode control must be as per the control philosophy mentioned above.
- In Manual mode operation, the operator at the DCP should be able to override the PICV command.
- Since an abrupt change in the PICV command can cause harm to the valve or actuator, the transfer between manual and auto mode must be bump less.
- The PICV Feedback must not have any difference with the PICV command. In such cases, an alarm should be generated to notify the operator.
- The PICV position and feedback must be expressed in %.
- The Temperatures displayed on the HMI or workstation should be having one decimal place.
- PID tuning parameters must be available only for admin & not for the operators to change.
- It is noted that the Heat exchanger output may not be linear with the valve operation, however control will be achieved through the modulating PICV valve controlled by the BMS.
- The remote HMI workstation at the DCP requires the above monitoring and control logic to be programmed in the ETS room BMS DDC panel.
- The choice of sensors and transmitters are to be of high reliability and to be guaranteed for the readings for a long period.

- One BTU meter shall be installed in the return line to the district cooling plant. This BTU meter along with the Sub-meters shall be integrated with the DCP station.

- The BTU meter to be installed is to be of a reputed make (like KAMSTRUP, Landis & Gyr, Siemens etc) with a long term guarantee of the readings. (At least 5 years).

- An agreement will be signed between DS and the CHW customers for the provision of CHW supply with several terms and conditions included for the BMS system setup, maintenance and operation.

- Some items of the CHW supply agreement, relevant to the ETS BMS system implementation, operation and maintenance are listed below for understanding and implementation :

  Metering and Testing:
  Installation and Maintenance - On or before the Start Date the Customer shall, at its own expense, supply and install the Metering Equipment and ETS control BMS system in accordance with above guidelines, thereafter and throughout the Supply Period (and any Extension Period) the Customer shall maintain the above Equipment in good condition, all at its sole cost, risk and expense and in accordance with the above guidelines.
  Right of Access - For the purposes of fulfilling its obligations pursuant to Clause 0 the Supplier-DS (and its employees, agents and representatives) shall have right of access at all times to the Customer Premises and the Metering Equipment. The Customer shall ensure such access and shall further ensure that such access may be obtained safely at all times.
  Meter Readings - The readings of the Metering Equipment for billing purposes shall be recorded by the Supplier-DS, at the end of each month or at such time as otherwise mutually agreed between the Parties. If requested, copies of the meter readings shall be provided to the Customer within 5 Business Days of request.
  Inaccuracy - If either Party becomes aware of, or should reasonably have been aware of, any inaccuracy in the meter readings or defect in the Metering Equipment, then it shall forthwith notify in writing the other Party of such inaccuracy or defect (as the case may be).
  Testing and Calibration - The Customer shall test and calibrate the Metering Equipment for accuracy every two years, or at any time within 30 days after a written request by the Customer in the event that the Customer reasonably

believes that the measurements from the Metering Equipment are inaccurate by more than 2%. The following shall apply to all such tests:

(a) at the Customer's option, testing of the Metering Equipment may be witnessed by a representative of the Customer;

(b) metering measurement accuracy of the Metering Equipment (or any part thereof) between 98% and 102% shall be deemed acceptable;

(c) In the event that the Metering Equipment are found to be operating outside the parameters provided in Clause 0(b) above, the Metering Equipment shall be immediately repaired, calibrated or replaced at the Supplier DS's cost and expense.

(d) Upon completion of any examination, maintenance, repair, calibration or replacement of any Metering Equipment, such equipment shall be sealed by the Supplier DS.

Reconciliation for Inaccurate Readings - In the event that the Metering Equipment (or any part thereof) are found to be inaccurate the amount of Chilled Water delivered to the Customer for the period during which such inaccurate measurement were made shall be determined by the Parties jointly preparing an estimate of the reading on the basis of the available information (including the assumption that if the duration of metering inaccuracy cannot be reasonable estimated, such duration shall be deemed to have persisted for 50% of the time between the last meter reading and the discovery of the inaccuracy). Following such determination, adjustments shall be made to the amounts payable under the next invoice submitted in accordance with Clause **Error! Reference source not found.** To account for any under or over p ayment which may have been made.

Measurement Disputes - In the event of any dispute in relation to the accuracy of the Metering Equipment, any reading therefrom, any estimate of the reading pursuant to Clause 0 or any other matter in connection with the Metering Equipment (a "Measurement Dispute") then either Party may at any time refer such dispute to determination in accordance with Schedule 6.

Representations and Warranties

Supplier Warranties - The Supplier DS warrants and represents that:

(a) it has good and merchantable title to the Chilled Water delivered to the Customer, free and clear of all encumbrances and claims;

(b) it has secured approvals from all relevant regulatory bodies, made any filings or reports, as required, pertaining to (i) the construction, operation and maintenance of the District Cooling Generating Facilities and (ii) the

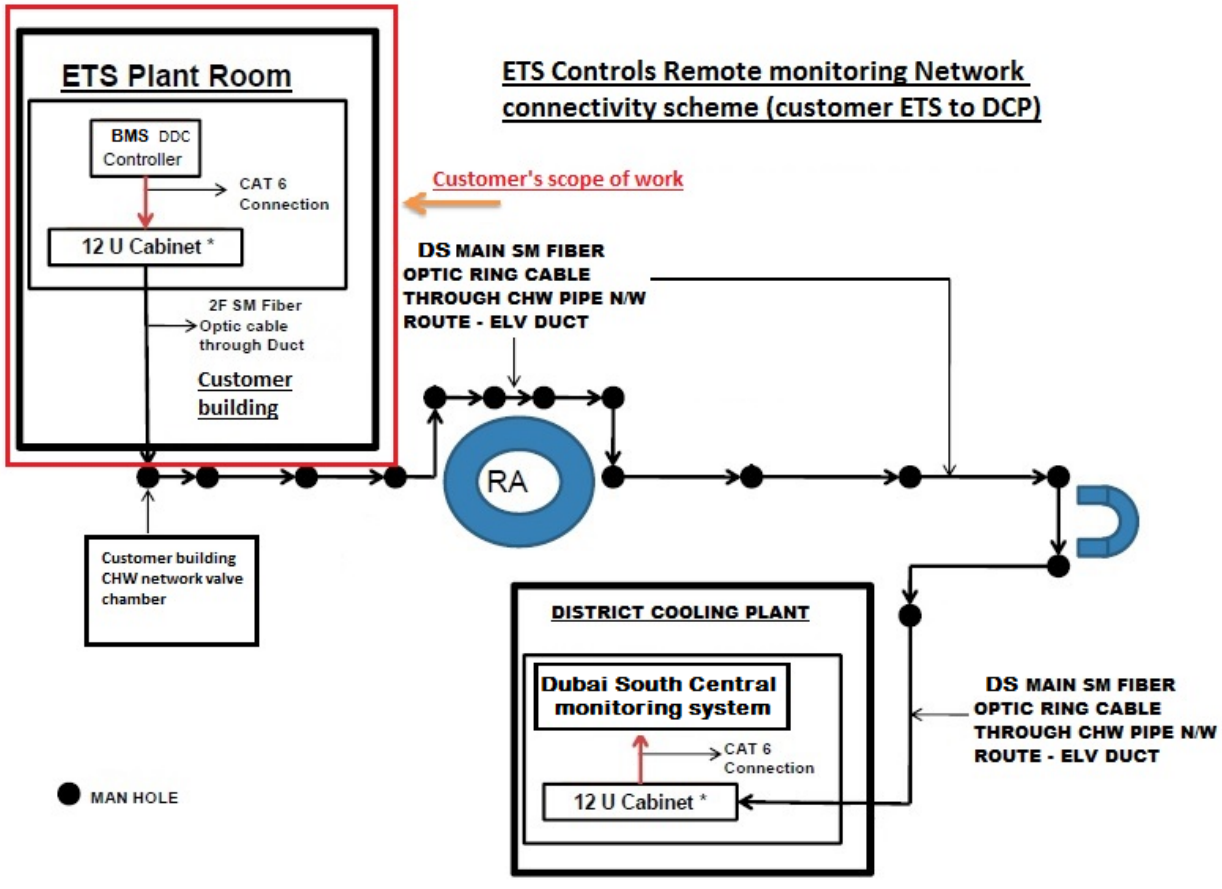
acquisition and transportation of Chilled Water on the Supplier DS's transmission pipeline;

(c) it is in compliance in all respects with all applicable laws (including, without limitation, those regulating or affecting any spillage, discharge or release of any hazardous waste into or upon any of its land, air, surface water, ground water or improvements located thereon); and

(d) In performing its obligations under this Agreement, it shall operate in accordance with Good Industry Practice and all relevant governmental rules and shall seek to minimise costs.

Customer Warranties - The Customer warrants and represents that it will take all economically reasonable steps to ensure that the Chilled Water supply is used efficiently and effectively and will avoid excessive use or wastage of cooling.

SCHEMATIC DIAGRAM AND FIBER ROUTE



The following conditions to be noted and considered:

1. The SMDB should preferably to be separate for ETS control panel with 32A, 3-phase MCCB
2. Chilled water flow shall be based on the ΔT = 9°C, with tolerance of +/- 1.1°C

11. ATTACHMENTS

- ETS NOC format ref SE-DCS-F-001
- ETS Drawing title: Details of ETS Room Controls Schematics ref: DWG/SE-DCS/ETS/Con-Sch Rev-1
- ETS Drawing title: Connections detail of Heat Exchangers (Primary DC side) ref: DWG/SE-DCS/ETS/Lay Rev-1
- ETS Drawing title: ETS Room Spacing ref: DWG/SE-DCS/ETS/rs Rev-1