14TH ANNUAL CLIMATE CONTROL AWARDS 2024

CONSISTENT ENGINEERING CONSULTANTS

PROPOSED SCHOOL PROJECT AT MANKHOOL DUBAI

PROJECT DETAILS

CLIENT – THE AMBASSADOR SCHOOL

MAIN CONSULTANT – WINNER HOLISTIC CONSULTANTS

MEP CONSULTANT – CONSISTENT ENGINEERING CONSULTANTS

TOTAL BUA – 36,823.46 SQ. M.

TOTAL AC LOAD – 1085 TR

AC SYSTEM – VRF SYSTEM

BUILDING CONFIGURATION – G+3F

TYPE – K-12 (EDUCATIONAL FACILITY)

NABD PROPOSAL

NEEDS

- **EFFICIENT HVAC** SYSTEM FOR THE PROJECT DUE TO LIMITATION OF PLOT ALLOCATED POWER & DISTRICT COOLING UNAVAILABILITY.
- SPECIFIC REQUIREMENT OF **ENHANCED IAQ** IN EACH CLASSROOM DUE TO MORE PEOPLE AND K-12 APPLICATION.
- **OPTIMIZING** THE MEP SPACES
- CATERING **HEATING AND COOLING** BOTH THE REQUIREMENTS.
- **SUSTAINABLE** DESIGN SOLUTION.

BENEFIT

- **LOWER CAPEX & OPEX** OF MEP SYSTEMS.
- **OPTIMIZED UTILIZATION OF ELECTRICITY**
- MICROSHAFTS ARE UTILIZED TO MINIMIZE LONGER PIPE RUNS AS WELL AS TO REDUCE THE **DERATION** OF EQUIPMENT
- **LOWER CAPEX & OPEX** OF MEP SYSTEMS
- **ENERGY MONITORING** OF DIFFERENT ZONES .

APPROACH

- **OPTIMIZED SELECTION** OF VRF SYSTEM
- **USE OF SCHEDULING** FOR COOLING LOAD CALCULATION
- **FILTRATION UNITS** IN EACH CLASSROOM FOR ENHANCED IAQ
- **SMART BUILDING MANAGEMENT SYSTEM** TO ACCESS & MANAGE THE AC SYSTEMS
- **ENERGY MONTIORING** FOR SUSTAINABLE OPERATION.

DIFFERENTIATION

- **REDUCED CAPEX** DUE TO OPTIMIZED SELECTION OF UNITS.
- **LOCALIZED AIR FITRATION UNITS** FOR ENHANCED IAQ
- EASE OF **MONITORING** & **MAINTENANCE**
- UNITS ARE STRATEGICALLY LOCATED IN **DECENTRALIZED** MANNER TO AVOID LARGE MEP ZONES.

NABD - **NEEDS**

SIMPLE , RELIABLE & COST-EFFECTIVE SYSTEM

SUSTAINABLE DESIGN

ACCURATE **COMFORT COOLING** MEASURES WITH REDUNDANCY

OPTION OF SWITCHING TO **COOLING AND HEATING** BASED ON ZONE NEEDS.

FOCUS ON **ENHANCED IAQ** THROUGH CONTROL OVER **VOC & ALLERGENS**

OPTIMAL SPACE UTILIZATION FOR MEP PLANT ROOMS

ENERGY MONITORING & REPORTING

REMOTE **MONITORING & CONTROL** OF SYSTEM

NABD - **APPROACH**

SIMPLE , RELIALBLE & COST-EFFECTIVE SYSTEM :

- We have performed the detailed life cycle analysis, CAPEX & OPEX calculations, based on the same VRF system has been proposed over the complex chilled water system. **Annexure # 1 .**

SUSTAINABLE :

- Due to the particular application of K-12 Educational , we studied the UAE temperature profiles and performed analytical calculation to eliminating the peak load hours of July / August to optimize unit selections.
  - BASED ON UAE TEMPARATURE BIN FILE , HEAT LOAD ANALYSIS IS PERFORMED ON **45 deg C DB/28.5 deg C WB**
  - INSTEAD OF TRADITIONAL TEMPARATURE OF **46 deg C DB/29 deg C WB**

- Also, out of the box sustainable approach has been adopted to throw the FAHU exhaust over the VRF units to reduce the localized temperature of the ODU. Please refer the **Annexure # 2 .**

Hr	January	February	March	April	May	June	July	August	September	October	November	December
	DB	DB	DB	DB	DB	DB	DB	DB	DB	DB	DB	DB
0	25.4	26.5	29	30.5	32.7	34.1	34.7	34.7	33.6	31.6	28.5	25.9
100	24.7	25.8	28.3	29.8	32	33.4	34	34	32.9	30.9	27.8	25.2
200	24	25.1	27.6	29.1	31.3	32.7	33.3	33.3	32.2	30.2	27.1	24.5
300	23.4	24.5	27.1	28.5	30.8	32.2	32.8	32.8	31.6	29.6	26.5	24
400	23	24.1	26.7	28.1	30.3	31.8	32.3	32.3	31.2	29.2	26.1	23.6
500	22.9	24	26.5	28	30.2	31.6	32.2	32.2	31.1	29.1	26	23.4
600	23.1	24.3	26.8	28.3	30.5	31.9	32.5	32.5	31.4	29.4	26.3	23.7
700	23.8	24.9	27.5	28.9	31.2	32.6	33.2	33.2	32.1	30.1	26.9	24.4
800	25.1	26.2	28.7	30.2	32.4	33.9	34.4	34.4	33.3	31.3	28.2	25.6
900	26.9	28	30.5	32	34.2	35.6	36.2	36.2	35.1	33.1	30	27.4
1000	28.9	30	32.6	34	36.3	37.7	38.3	38.3	37.2	35.2	32	29.5
1100	31.3	32.4	35	36.4	38.6	40.1	40.6	40.6	39.5	37.5	34.4	31.8
1200	33.5	34.6	37.2	38.6	40.8	42.3	42.8	42.8	41.7	39.7	36.6	34
1300	35.1	36.3	38.8	40.3	42.5	43.9	44.5	44.5	43.4	41.4	38.3	35.7
1400	36.3	37.4	39.9	41.4	43.6	45	45.6	45.6	44.5	42.5	39.4	36.8
1500	36.7	37.8	40.3	41.8	44	45.4	46	46	44.9	42.9	39.8	37.2
1600	36.3	37.4	39.9	41.4	43.6	45	45.6	45.6	44.5	42.5	39.4	36.8
1700	35.3	36.4	39	40.4	42.6	44.1	44.6	44.6	43.5	41.5	38.4	35.8
1800	33.8	34.9	37.4	38.9	41.1	42.5	43.1	43.1	42	40	36.9	34.3
1900	32	33.1	35.6	37.1	39.3	40.8	41.3	41.3	40.2	38.2	35.1	32.5
2000	30.2	31.3	33.8	35.3	37.5	39	39.5	39.5	38.4	36.4	33.3	30.7
2100	28.7	29.8	32.3	33.8	36	37.4	38	38	36.9	34.9	31.8	29.2
2200	27.3	28.4	30.9	32.4	34.6	36.1	36.6	36.6	35.5	33.5	30.4	27.8
2300	26.2	27.3	29.8	31.3	33.5	35	35.5	35.5	34.4	32.4	29.3	26.7

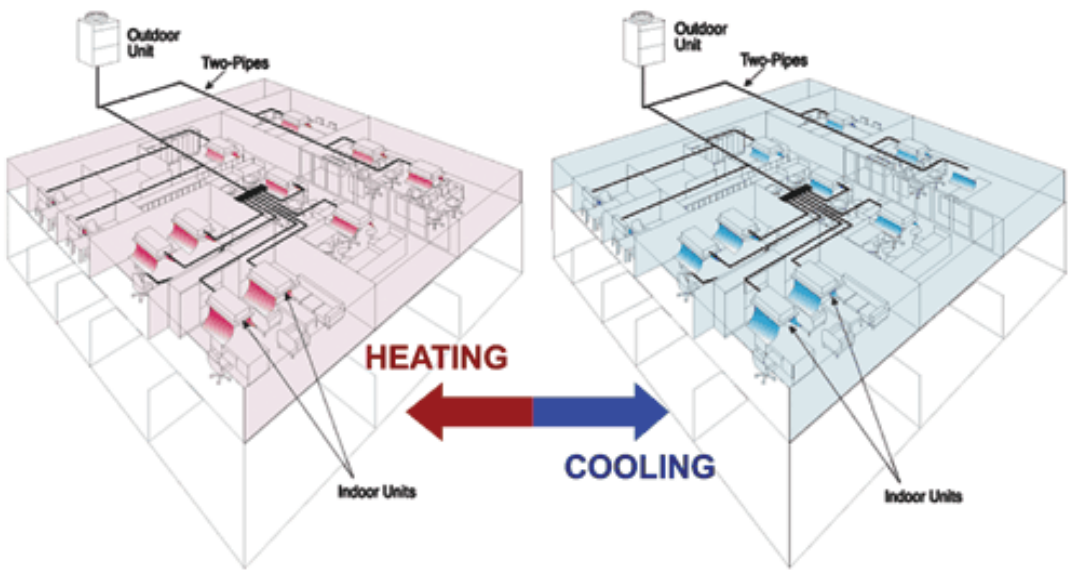
N**A**BD - **APPROACH**

ZONING :

- The ODU zoning is done with achieve the maximum diversity of the zone and optimized IDU to ODU piping length.
- The selective zoning shall help for switching from cooling to heating mode.
- The same zoning shall provide accurate energy monitoring.

ENHANCED IAQ :

- ASHRAE defined "**OACF"** & "**EATR**" considered for better IAQ & zero contamination of polluted air as per **ASHRAE position-document on infectious-aerosols.**
- Each classroom shall have the **Terminal** (standalone) air filtration units with HEPA Filters.



NABD - **APPROACH**

MONITORING & CONTROL :

- All FAHUs are designed with AI based temperature sensors to run on Economizer mode. If the ambient temperature is **28 Deg C** . The FAHU shall only run on FAN mode to deliver the required air in the non occupied time.
    - TOTAL **1354 HRS** OF FREE COOLING IN A YEAR.
- **Occupancy sensors** to control lights, and AC units in the classrooms.
- Stringent specification with mention that **Superheat** should not exceed **4 deg. C.**

Hr	January	February	March	April	May	June	July	August	September	October	November	December
	DB	DB	DB	DB	DB	DB	DB	DB	DB	DB	DB	DB
0	25.4	26.5	29	30.5	32.7	34.1	34.7	34.7	33.6	31.6	28.5	25.9
100	24.7	25.8	28.3	29.8	32	33.4	34	34	32.9	30.9	27.8	25.2
200	24	25.1	27.6	29.1	31.3	32.7	33.3	33.3	32.2	30.2	27.1	24.5
300	23.4	24.5	27.1	28.5	30.8	32.2	32.8	32.8	31.6	29.6	26.5	24
400	23	24.1	26.7	28.1	30.3	31.8	32.3	32.3	31.2	29.2	26.1	23.6
500	22.9	24	26.5	28	30.2	31.6	32.2	32.2	31.1	29.1	26	23.4
600	23.1	24.3	26.8	28.3	30.5	31.9	32.5	32.5	31.4	29.4	26.3	23.7
700	23.8	24.9	27.5	28.9	31.2	32.6	33.2	33.2	32.1	30.1	26.9	24.4
800	25.1	26.2	28.7	30.2	32.4	33.9	34.4	34.4	33.3	31.3	28.2	25.6
900	26.9	28	30.5	32	34.2	35.6	36.2	36.2	35.1	33.1	30	27.4
1000	28.9	30	32.6	34	36.3	37.7	38.3	38.3	37.2	35.2	32	29.5
1100	31.3	32.4	35	36.4	38.6	40.1	40.6	40.6	39.5	37.5	34.4	31.8
1200	33.5	34.6	37.2	38.6	40.8	42.3	42.8	42.8	41.7	39.7	36.6	34
1300	35.1	36.3	38.8	40.3	42.5	43.9	44.5	44.5	43.4	41.4	38.3	35.7
1400	36.3	37.4	39.9	41.4	43.6	45	45.6	45.6	44.5	42.5	39.4	36.8
1500	36.7	37.8	40.3	41.8	44	45.4	46	46	44.9	42.9	39.8	37.2
1600	36.3	37.4	39.9	41.4	43.6	45	45.6	45.6	44.5	42.5	39.4	36.8
1700	35.3	36.4	39	40.4	42.6	44.1	44.6	44.6	43.5	41.5	38.4	35.8
1800	33.8	34.9	37.4	38.9	41.1	42.5	43.1	43.1	42	40	36.9	34.3
1900	32	33.1	35.6	37.1	39.3	40.8	41.3	41.3	40.2	38.2	35.1	32.5
2000	30.2	31.3	33.8	35.3	37.5	39	39.5	39.5	38.4	36.4	33.3	30.7
2100	28.7	29.8	32.3	33.8	36	37.4	38	38	36.9	34.9	31.8	29.2
2200	27.3	28.4	30.9	32.4	34.6	36.1	36.6	36.6	35.5	33.5	30.4	27.8
2300	26.2	27.3	29.8	31.3	33.5	35	35.5	35.5	34.4	32.4	29.3	26.7
	5	**5**	**9**	**10**	**12**	**15**	15	15	14	11	8	5

Months	January	February	March	April	May	June	July	August	September	October	November	December
Hrs	310	308	186	30	0	0	0	0	0	0	210	310

NA**B**D - **BENEFIT**

CAPEX AND OPEX:

- Due to optimized VRF SYSTEM selection following benefits are achieved (Refer **Annexure # 1**):
  - CAPEX : **AED 3.0 MILLION** SAVING (VRF vs CHILLER)
  - OPEX : **AED 11.0 MILLION** SAVING **YEARLY** SAVING (VRF vs CHILLER)

SUSTAINABLE :

- The computer based analytical heat load except the peak months (July/August) shall help to achieve following : (traditional condition VRF system vs optimized condition VRF system)
  - CALCULATED COOLING LOAD REDUCTION **: 9 %**
  - SELECTED ODU COOLING LOAD REDUCTION : **11 %**
  - REDUCTION IN TOTAL ELECTRICAL CONNECTED LOAD FOR AC : **14%**

  Please refer **Annexure # 3 .**

Hr	January	February	March	April	May	June	July	August	September	October	November	December
	DB	DB	DB	DB	DB	DB	DB	DB	DB	DB	DB	DB
0	25.4	26.5	29	30.5	32.7	34.1	34.7	34.7	33.6	31.6	28.5	25.9
100	24.7	25.8	28.3	29.8	32	33.4	34	34	32.9	30.9	27.8	25.2
200	24	25.1	27.6	29.1	31.3	32.7	33.3	33.3	32.2	30.2	27.1	24.5
300	23.4	24.5	27.1	28.5	30.8	32.2	32.8	32.8	31.6	29.6	26.5	24
400	23	24.1	26.7	28.1	30.3	31.8	32.3	32.3	31.2	29.2	26.1	23.6
500	22.9	24	26.5	28	30.2	31.6	32.2	32.2	31.1	29.1	26	23.4
600	23.1	24.3	26.8	28.3	30.5	31.9	32.5	32.5	31.4	29.4	26.3	23.7
700	23.8	24.9	27.5	28.9	31.2	32.6	33.2	33.2	32.1	30.1	26.9	24.4
800	25.1	26.2	28.7	30.2	32.4	33.9	34.4	34.4	33.3	31.3	28.2	25.6
900	26.9	28	30.5	32	34.2	35.6	36.2	36.2	35.1	33.1	30	27.4
1000	28.9	30	32.6	34	36.3	37.7	38.3	38.3	37.2	35.2	32	29.5
1100	31.3	32.4	35	36.4	38.6	40.1	40.6	40.6	39.5	37.5	34.4	31.8
1200	33.5	34.6	37.2	38.6	40.8	42.3	42.8	42.8	41.7	39.7	36.6	34
1300	35.1	36.3	38.8	40.3	42.5	43.9	44.5	44.5	43.4	41.4	38.3	35.7
1400	36.3	37.4	39.9	41.4	43.6	45	45.6	45.6	44.5	42.5	39.4	36.8
1500	36.7	37.8	40.3	41.8	44	45.4	46	46	44.9	42.9	39.8	37.2
1600	36.3	37.4	39.9	41.4	43.6	45	45.6	45.6	44.5	42.5	39.4	36.8
1700	35.3	36.4	39	40.4	42.6	44.1	44.6	44.6	43.5	41.5	38.4	35.8
1800	33.8	34.9	37.4	38.9	41.1	42.5	43.1	43.1	42	40	36.9	34.3
1900	32	33.1	35.6	37.1	39.3	40.8	41.3	41.3	40.2	38.2	35.1	32.5
2000	30.2	31.3	33.8	35.3	37.5	39	39.5	39.5	38.4	36.4	33.3	30.7
2100	28.7	29.8	32.3	33.8	36	37.4	38	38	36.9	34.9	31.8	29.2
2200	27.3	28.4	30.9	32.4	34.6	36.1	36.6	36.6	35.5	33.5	30.4	27.8
2300	26.2	27.3	29.8	31.3	33.5	35	35.5	35.5	34.4	32.4	29.3	26.7

NA**B**D - **BENEFIT**

SUSTAINABLE :

- Modular Construction **FASTER** construction process

ZONING :

- The zoning has been performed to strategically to avoid the piping length more than 40 m .
  - **NO DERATION** OF THE UNIT AND NO HIGHER SIZE UNIT SELECTION.
- The zone is done based on the applications (like LAB zone , Classroom zone , Sports Arena etc.) so that end user can switch to **Cooling and Heating** Mode based on the needs. Additional requirement of client to have the heating mode during wintertime has been achieve with VRF units and selective zoning .
- This has led to **optimum** space utilization due to non – concentric location of MEP Plantrooms.

NA**B**D - **BENEFIT**

ENHANCED IAQ :

Having in room localized **air purification** units shall provide following benefits :

- IMPROVED AIR QUALITY
- REDUCTION IN ILLNESS TRANSMISSION
- ODOR REDUCTION
- ALLERGY RELIEF
- SUPPORT FOR HIGH-RISK INDIVIDUALS

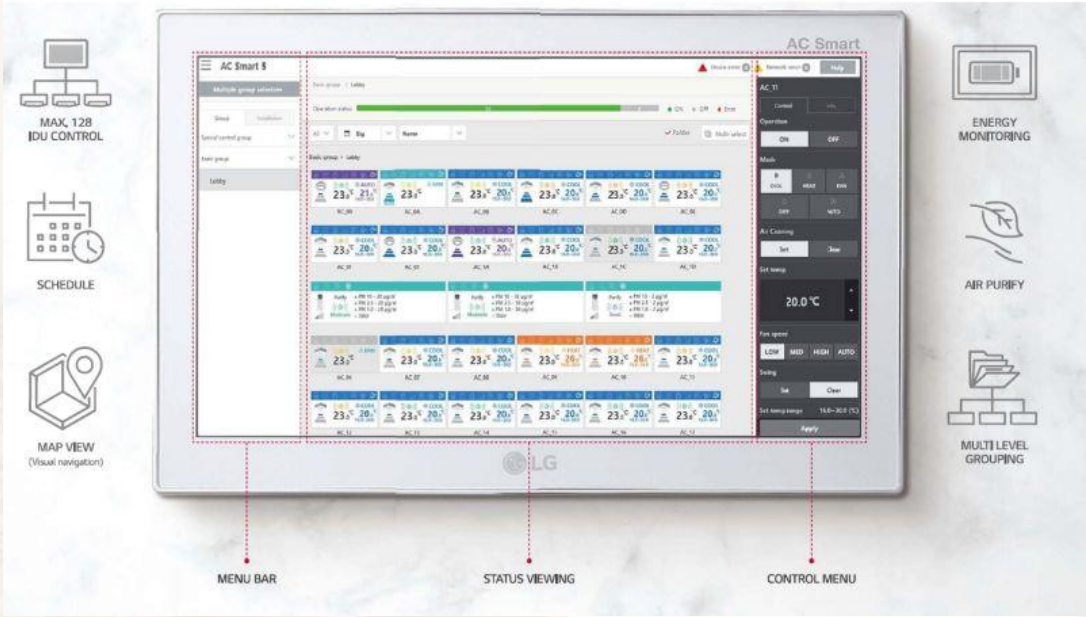
FAHUS with better than ASHRAE Recommended **OACF** and **EATR** provides following benefits :

- IMPROVED ENERGY EFFICIENCY
- ENHANCED INDOOR AIR QUALITY
- COMPLIANCE WITH VENTILATION STANDARDS
- INCREASED COMFORT FOR OCCUPANTS

NA**B**D - **BENEFIT**

MONITORING & CONTROL :

- Demand Side Management (**DSM**) via occupancy sensors to reduce the **energy consumption.**
- The central controller shall be connected to BMS system provide following :
  - **ONE STOP SOLUTION** FOR
    - ENERGY MONITORING
    - SYSTEM DIAGNOSTIC
    - PREDICTIVE MAINTENANCE
    - AIR PURIFICATIONS' CONTROL AND MONITORING



NAB**D** - **DIFFERENTIATION**

CAPEX AND OPEX:

- On top of Capex and Opex benefit following USP comes as inherent benefit which creates difference :

    - ALL INDOOR COMES WITH **BLDC** MOTOR BETTER FLOW
    - LOW **NOISE** GENERATED BY INDOOR UNITS
    - **SELF CLEANING** OF ODU TO REDUCE MAINTENANCE .

SUSTAINABLE :

- The analytical approach has led to carbon footprint reduction by **203025 kg of CO2 per year.** Please refer the **Annexure # 4**
- Saving on **Construction** related emissions due to Modular Approach.

NABD - **DIFFERENTIATION**

ZONING:

- **USER COMFORT :**Due to VRF System Selection , **Heating** has been provided without additional capex. Heating is non-traditional approach in the region.
- **ENERGY EFFICINECY :** Inverter Technology better part load efficiency
- **COST SAVING :** Lower Capex and Opex .
- **ENVRIONMENTAL IMPACT :**Reduced Carbon footprint

ENHANCE IAQ :

- **REPUTATION** : Best in class K-12 facility with additional feature I
- Increased **comfort and well being**
- **Lower** illness rates.

NAB**D** - **DIFFERENTIATION**

MONITORING AND CONTROL

- **ENERGY MONITORING**
- **PREDICTIVE** MAINTENANCE AND REDUCED DOWNTIME
- **DATA-DRIVEN** DECISION MAKING.
- **EASY** INTEGRATION WITH OTHER BUILDING SYSTEM


THE
END

Zone # 02 (ODU # 2) Cooling load Evaluation					
Description	**Total Calculated Load of the Zone (TR)**	**Total selected Unit Load (TR)**	**Selected Odutdoor Unit (TR)**	**Connected Electrical Load (kW)**	**Remarks**
Traditional Condition (46 deg C /29 deg C)	28.63	38.38	29.03	37.5	with ODU selection at 46 deg C
Improvised Condition (45 deg C /28.5 deg C)	26.39	37.59	25.96	32.5	with ODU selection at 44 deg C
Complete Building Cooling load Evaluation (Except FAHU & MAHU)					
Description	**Total Calculated Load of the Zone (TR)**	**Total selected Unit Load (TR)**	**Selected Odutdoor Unit (TR)**	**Connected Electrical Load (kW)**	**Remarks**
Traditional Condition (46 deg C /29 deg C) with ODU selection at 46 deg C	773.39	1036.81	784.14	1012.91	with ODU selection at 46 deg C
Improvised Condition (45 deg C /28.5 deg C) with ODU selection at 44 deg C	706.57	1006.55	695.15	870.29	with ODU selection at 44 deg C
Overall Saving	**66.82**	**30.26**	**88.99**	**142.62**	
Overall reduction in percentage	**9%**	**3%**	**11%**	**14%**	

* the complete building data is based on the prorata basis per the intial selection received for Zone # 2.

ODU Temparature Reduction with FAHU Extract				
S.No	***System***	***Extract Air Flow Rate (CFM)***	***Temparature (deg C)***	***Remarks***
1	FAHU Extract	90000	**40.50**	FAHU Extract Air Flow Rate
2	VRF ODU (approx fan flow rate)	396475	**45.00**	VRF flow rate
3	Mixed Air Temparature	N/A	**43.98**	

Project No : P462	**Client : WINNER HOLISTIC CONSULTANTS**
Project Name: AMBASSADOR SCHOOL, MANKHOOL,DUBAI	**End User : AMBASSADOR SCHOOL**

COMPARISON BETWEEN AIR COOLED CHILLER vs VRF

DATE: 20.05.2024

DESCRIPTION		CHILLED WATER SYSTEM AIR COOLED CHILLERS AND CHILLED WATER PUMPS	VRF SYSTEM VRF INDOOR AND OUTDOOR	Remarks
POWER CONSUMPTION	Specified Capacity (kW)	3570 kW (1000 TR)		As per the preliminary cooling load estimation. 4045 kW with diversity of 85%.
	Proposed Actual capacity @ 46 deg C	4220kW (1200 TR) 1428 kW (400 TR) X 3 Nos	4045 kW (1150 TR)	Chillers sized with 40% capacity to cater any maintenance requirement. VRF sized with safety of 15%
	Total Power Input @ 46 deg C (Chiller / VRF) Connected Load	1560 kW (520 kW/Chiller X 3 Nos)	1495 kW (Power Input for the Condensing unit)	Capacities as per the manufacturer catalogue.
	Total Power Input @ 46 deg C for chilled water Pumps (3W & 1S)	126 kW (42 kW/pump X 3 Nos)	Not Required	Chilled water pump Power Input taken from the manufacturer catalogue.
	Total Power Input	1686 kW (1560 kW+126 kW)	1495 Kw	Indoor units are excluded.
Power Consumption		1.6 kW/TR	1.3 kW/TR	Due to multiple Inverter compressors of smaller capacities, the cooling load is precisely monitored and controlled by advanced control system resulting into higher part load efficiency. The full load is only for max. 10 days in the entire year. IPLV factor of 0.66 shall be considered for establishing yearly power consumption.
Total service space required on roof (Sq.m)		550 Sq.m	800 Sq.m	Space including the clearance area required around the units.
Pump room-Enclosed civil structure (Sq.m)		100 Sq.m (Air-conditioned space)	Not required	-
Weight (Kgs)		47,900 Kgs	41,000 Kgs	Chiller & VRF weights - As per the manufacturer catalogue.
Concentrated Weight / Area for Chiller/VRF		47,900 Kgs / 550 m2 = 87.1 Kg/m2	41,000 Kgs / 800m2 = 51.3 Kg/m2	Due to higher concentrated load in Chiller system, it will need thicker slab. Additionally Chiller needs floating foundation to avoid transfer of vibration to the building.

DESCRIPTION		CHILLED WATER SYSTEM AIR COOLED CHILLERS AND CHILLED WATER PUMPS	CHILLED WATER SYSTEM COST (AED)	VRF SYSTEM VRF INDOOR AND OUTDOOR	VRF SYSTEM COST (AED)	Remarks
EQUIPMENT COST WITH LABOUR	Approx. Equipment Cost	Chillers - 400 TR x 3#=1200 TR		VRF Outdoor (557 TR approx.)		
	CHW Pumps incl MCC Panel	Chilled water pump incl MCC panel and Interlocking system		Not needed		
	Chemical dosing, Exp tank	Chemical dosing and Exp tank		Not needed		
	FAHU's	FAHU with Heat recovery		FAHU with Heat recovery		
	FCU's	CHW FCU's	6,960,000	FCU's for VRF	5,750,000	-
	Actuator and valves	Actuator and 2 way valve		Not needed. Part of FCU		
	Chiller Plant manager	For efficient operation of Chiller		Part of ODU		
	Chilled water valves & field devices	Balancing valves, Gate valves, strainer, etc.		Part of FCU		
	Pipes and insulation	Chilled water MS pipes with insulation		Copper Pipes with Insulation		
	Electrical	LV Panels, Capacitor & Cabling	2,820,000	LV Panels, Capacitor & Cabling	1,840,000	For chillers minimum two transformers required where as for VRF one transformer is sufficient..
Total Equipment Price (A)			9,780,000		7,590,000	
INSTALLATION COST	Installation of Piping & Labor	MS Pipes with Insulation and supporting	2,400,000	Copper Pipes with Insulation	1,495,000	-
Total Installation Cost (B)			2,400,000		1,495,000	
Total Capital Cost (A+B) (Installation+Equipments) (AED)			12,180,000		9,085,000	The difference in the capital cost of Chiller and VRF is AED 3,095,250.

DESCRIPTION		CHILLED WATER SYSTEM AIR COOLED CHILLERS AND CHILLED WATER PUMPS	CHILLED WATER SYSTEM COST (AED)	VRF SYSTEM VRF INDOOR AND OUTDOOR	VRF SYSTEM COST (AED)	Remarks
OPERATIONAL COST	Annual Maintenance Cost	600 AED / TR for air cooled chiller	600,000	450 AED/TR for VRF	450,000	-
	Annual Electrical Cost AED	(Overall cooling capacity 1000TR x IPLV x (0.75 kW/TR) x 16 hrs/day x 365 days) x 0.45 AED/KWH *(Chillers + Pumps)*	2,775,168	(1150 TR x IPLV (0.57 kW/TR) x 24 hrs/day x 365 days) x 0.45 AED/KWH	2,081,376	Annual Electricity is calculated on the basis of the IPLV taking into consideration the same working hours. IPLV of 0.66 considered considering the load pattern and part load efficiency of the equipment.
Total Operational Cost (AED) / Annum			3,375,168		2,531,376	The difference in the operation cost of Chiller and VRF is AED 800,000/-
Operational cost for 10 years			33,751,680		25,313,760	
Initial + 10 years O&M cost AED.			45,931,680		34,398,760	Saving of AED 11,532,920.0 per annum.

DESCRIPTION	CHILLED WATER SYSTEM	VRF SYSTEM		Observation & Recommendation	Preferred	
					Chillers	VRF
System Capital Cost	The initial cost is higher considering the equipment & Piping cost.	The initial cost is lower than chillers for VRF system compared to chillers.		For CAPEX: VRF Cheaper		✓
Operation Cost	Operation cost will be higher and will have to be borne by the Landlord for Chiller Plant and piping. Tenant area operation cost shall be by respective tenant. BTU meters to be installed for metering and billing.	Only the operation cost of common area cooling and Utility area shall be by landlord. The operation cost is paid by Tenant for leased areas as part of utility bills.		For OPEX: VRF Cheaper		✓
Electrical Power requirement	Substation: Due to restriction on transformer loading by DEWA having Chillers, more number of transformer required. This increases LV installation cost and space. Power: As 90% of total electrical power required in Chilled water system pertains to Chiller Plant and hence this major power component shall be on Landlord account. Energy Consumption: Major energy consumption for this system is incurred by Landlord. And same to be recovered from tenants based on BTU meters thus requiring a dedicated FM team for same.	Substation: No such restriction and hence cost of LV is minimal. Power: As the 90% of total electrical power required in VRF system shall be equally distributed to Tenant Electrical connection, hence only minor (10%) electrical power for common area AC loads comes to Landlord account. Energy Consumption: Major Energy (nearly +90%) is incurred by respective Tenants.		Substation: VRF is Better Power: Electrical Installation cost to Landlord higher for Chillers. VRF better option. Energy: For electricity Billing & recovery the VRF option far cheaper for Landlord.		✓ ✓ ✓
Quantum of Maintenance Cost to Landlord	Major quantum of maintenance cost due to overall chilled water system and common area equipment's shall be by landlord.	Very minor component of Maintenance cost to Landlord for common area only as all major VRF component shall be on Tenant account for Tenant area.		Maintenance: VRF is Cheaper.		✓
Prone to Failure	Comparatively larger compressors and hence the failure rate is low.	Comparative to chillers smaller compressors and hence the failure rate is higher. However, replacement cost is low.		Chiller Failure comparably low.	✓	
Life of equipment	Around 15-18 years	Around 12-13 years		Chiller Plant has more operating Life if maintained as per manufacturer recommendations.	✓	

RECOMMENDATION : CONSIDERING THE OVERALL TECHNO-COMMERCIAL ANALYSIS, VRF SYSTEM SHALL BE USED ON THE PROJECT.