



شركة البدرى للأعمال الكهروميكانيكية

إحدى شركات مجموعة البدرى للتنمية والاستثمار

BADRY Electro-Mechanical Works Co.

MEP CONTRACTOR

MODERATE GEOTHERMAL GHP HVAC SOLUTION

ORANA Food Plant HVAC Systems Upgrade @ Badr City

FACILITY MODERATE GHP / HVAC SYTEMS 300 TONs

Quotation # 16235-01-010-1434, Rev 01 – Feb. 2020



BADRY MEP

Electro-Mechanical Works Co.

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Group

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DATE 26/02/2020
Quotation # 16235 (Rev 1)
Customer ID 1434

Quotation For:

Project Geothermal GHP HVAC Solution for Badr Plant
Name Mr. Mahendra Dhote
Company/Auth. ORANA
Address Plot 145, Area 250 Yard, Robeyky - Badr City
Tel / Fax 02 23 10 82 23 / 23 10 82 27
Cel / Mob +2 0109 532 2552
E-Mail msd@orana.com.eg

Quotation valid until: 30/04/2020
Prepared by: Gehad Salah

Moderate Geothermal Solution

Facility HVAC Systems - 300 Ton

Terms or Special Cond.: 20% In Advance (A.P), R.T (Raise To) 50% Material, R.T 95% Install Invoices, 05% RET. / Delivery
Delivery 10 Working Months (W.M) From W.O & A.P, Design, Approved WSDs (2 W.M) Design Receipt

SALES PERSON	QUOTE NUMBER	DELIVERY	SHIP VIA	SITE	TERMS
Gehad Salah	16235-1 / 010 / 1434	12 Months (10 + 2) W.M	LAND - DTD	Badr City	Due on Order

CODE	DESCRIPTION	BOQ	ADD / ENG	AMOUNT USD)
VENT-01	GEOTHERMAL SYSTEM FOR AREA VENTILATION Acc. To. Table D-1-01: BOQ - Geothermal Ground Coupled System for the Ventilation of Production Area	410,000	15,000	USD 425,000
ACND-01	GEOTHERMAL SYSTEM FOR AIR CONDITIONING Acc. To. Table D-2-01: BOQ - Geothermal Ground Coupled System for the Air Conditioning of the Adminstrative Area	660,000	15,000	USD 675,000
HEAT-01	GEOTHERMAL SYSTEM FOR WATER / STEAM HEATING Acc. To. Table D-3-01: BOQ - Geothermal Ground Coupled System for the Heating Steam of Food Production Area	524,542	28,000	USD 552,542

A. Client is Required to Provide at Site (Our Prices Exclude Any of);	SUBTOTAL	USD 1,652,542
1- Site Facilities; Power, Lighting, Water, Drainage - Sources	VAT TAX	USD 231,356
2- Storage Area, Site Office, Lisences, Permits from Any /others Entrance & Exist Fees	SOC. INSUR	USD 66,102
B. Quote Prices based on RE-MEASURE SUB-CONTRACT, FIRST Perurity is BOQ	OTHERs	USD 50,000
C. ADD / ENG express Engineering, Work-Shop-Drawings & AS-Builts Drawings	TOTAL	USD 2,000,000

D. Others is a non refund cost values express Mobilization, Accomodation

If you have any questions concerning this quotation contact Ms. Gehad Salah
Tel +20 2 219 06 401, Fax +20 2 219 06 823, hasoegypt@gmail.com, mep@badrygroup.com

THANK YOU FOR YOUR BUSINESS!



Table C - Air Equipments Calculation

Ventilation for Production Area Project - Quote 16231-00

Table C-1: Air Equipment Calculation for the Ventilation for Production Area Project

Production Area Ventilation - Water To Air "a" - GHP/ AHU (s) Calculation												
S.N	Area Description	Class	ISO	Area (m ²)	Area (ft ²)	Height (ft)	Volume (ft ³)	ACPH	CFM Steady	Add CFM Fresh Air	Add CFM Heat Load	CFM SUM
1	Production Area	N/A	N/A	308	3315	33	109395	15	27,349	0	2,000	29,349
2	Corridors Area	N/A	N/A	105	1130	33	37290	12	7,458	746	400	8603.80
3	Services Area	N/A	N/A	37	398	10	3980	20	1,327	199	522	2047.67
a	AHU(s) / G.H.P(s)	8,000	40,000	CFM	20	100	TR	5	36,133	945	2,922	40,000

CFM
A.H.U

Ton
G.H.P

ALL
Geothermal Heat Pumps

QTY
G.H.P

CFM_{Total}



Table C - Air Equipments Calculation

Air Condition for Adminstrative Area Project - Quote 16232-00

Table C-2: Air Equipment Calculation for the Air Condition for Adminstrative Area Project

Adminstrative Area Air Condition - Water To Water "b" - GHP/ AHU (s) Calculation												
S.N	Area Description	Class	ISO	Area (m ²)	Area (ft ²)	Height (ft)	Volume (ft ³)	ACPH	CFM Steady	Add CFM Fresh Air	Add CFM Heat Load	CFM SUM
1	Ground Floor Area	N/A	N/A	182	1960	10	19600	30	9,800	1,960	2,000	13,760
2	First Floor Area	N/A	N/A	173	1862	10	18620	30	9,310	1,862	2,000	13,172
3	Services Area	N/A	N/A	145	1560	10	15600	36	9,360	1,872	1,836	13,068
b	AHU(s) / G.H.P(s)	10,000	40,000	CFM	25	100	TR	4	28,470	5,694	5,836	40,000

CFM
A.H.U

ALL

Ton
G.H.P

ALL

Geothermal Heat Pumps

QTY
G.H.P

CFM_{Total}



Geothermal System Air Equipment Calculation

Table C – Air Equipment's Calculation

Heating Steam for Food Production Project - Quote 16233-01

Table C-3: Air Equipment Calculation for Heating Steam for Food Production Project

Heating Water with Steam Heat Exchangers - Shell and Tube Exchanger		
Steam is on the Shell side		
Product to heat is on the Tube Side		
Temperature in	68	F
Temperature out	320	F
Delta T	252	F
Gallons to Heat	5.00	US GPM
Gallons to Heat	4	IMP Gall / Minutes
Gallons to Heat	250	Imp Gallons / Hour
Based on S.Gravity	2498	Lbs / Hour
Heating	19	Litres / Minutes
Specific Heat of Liquid (Cp)	1	BTU / LB F
Specific Gravity	1	
Steam Pressure	150	psig
Latent Heat at Steam Pressure	880	BTU / LB
Safety Factor (Eff. H. Exch)	85	% Efficiency
	740,586	BTU / Hour Required
	186,628	Kcal / Hr to Exchanger
Load of Heat Exchanger	842	LBS / Hour of Steam Required
BHP - Using Heat Exchanger	24.4	BHP ☆
Direct Injection of Steam into Water	630.0	LBS / Hour of Steam Required
BHP - Direct injection of Steam into water	18.3	BHP ☆

Geothermal / Ground Source Coupled Heat Pump – Water To Water G.H.P:

Total Heat Load =

$$\begin{aligned}
 & 186,628 \text{ K.Cal/Hr (Heat Steam for Production)} \\
 & + 113,372 \text{ K.Cal/Hr (Hot Water for Cooking)} \\
 & \text{-----}
 \end{aligned}$$

$$\begin{aligned}
 \text{Total Heat Load} &= 300,000 \text{ K.Cal/Hr} \\
 &= 1,200,000 \text{ BTU/Hr}
 \end{aligned}$$

Total Heat Load = 100 Ton

Using: # 3 G.H.P (2+1); 2 Operation + 1 Backup / Standby
Each of 50 Ton, Water To Water Heat Pump (Ground Coupled)



Moderate Geothermal System Costing Calculation

Table A-01 – Per TON's Cost Calculation - 2020

Moderate Geothermal System Project – Per Ton Calculations

Table A-01 : Moderate Geothermal HVAC Systems Construction Cost & Per Ton Calculation :-

S.N	Area	HVAC System	Load (Ton)	Notes	Total COST (USD)	Per Ton (USD)
1	Production Area	Ventilation	100	Cool Only	425,000	4,250
2	Adminstration Area	Air Condtion	100	Cooling + Hydronic Warming	675,000	6,750
3	Production Area	Heating	100	Heating (Water / Steam)	552,542	5,525
S	Facility HVAC	SUM	300	Exclude TAXs	1,652,542	5,508
				Taxes & Social Insur.	297,458	992
				Others, Mobilization	50,000	167
P	Facility HVAC	Total	300	Enclude TAXs	2,000,000	6,667
			TON		Total HVAC COST	Per Ton Cost

Geothermal Facility HVAC Systems Construction Cost:

- Total Facility Moderate GHP / HVAC Systems Load = 300 Ton
- Total Facility Moderate GHP / HVAC Systems Cost = 2,000,000 USD
- Per Ton Moderate GHP / HVAC Systems Cost = 6,667 USD

Notes of Pricing:

- 1) Above [Moderate Solution](#) HVAC Facility Systems has (40% Energy Reduction) with 5Y Warranty from 25Y Lifetime, of (2,000,000 USD), China GHPs total price = 700,000 USD (35% of Total System Price) and Per Ton Price (6,667 USD) based on China Origin GHPs via brands same as AMRTA, NE and Mango.
- 2) [Economical Solution](#) (60% Energy Reduction) with 5Y Warranty from 25Y Lifetime, of (3,000,000 USD), China GHPs total price = 1,110,000 USD (37% of Total System Price) and Per Ton Price (10,000 USD) based on China Origin GHPs via brands same as AMRTA, NE and Mango.
- 3) [Hi-Level Solution](#) (70% Energy Reduction) with 10Y Warranty from 30Y Lifetime for HVAC Facility Systems will be of (5,250,000 USD), US GHPs total price = 3,360,000 USD (64% of Total System Price) and Per Ton Price (17,500 USD) based on US Origin GHPs via brands same as Northern, Bard and Thermal-Air.



Moderate Geothermal HVAC System Savings Calculation

Table B-01 – Comparison of Energy Sources Cost Calculation - 2020

Moderate Geothermal HVAC System Project – SAVINGS Calculations

Table B-01 : Moderate Geothermal HVAC Systems Compared Energy Cost & Savings :-

Traditional Electric Resistant HVAC Systems -- Annual Costs										
S.N	Area	HVAC System	Load (Ton)	Annual Operational Energy Used (QTY / COST)				SUM Annual Energy COST (USD)	SUM Annual Maintenance COST (USD)	TOTAL Annual T. HVAC COST (USD)
				Electricity		Natural Gas				
				KWH (s)	Cost / USD	MMBTU (s)	Cost / USD			
1	Production Area	Ventilation	100	150,000	15,000	0.00	0.00	15,000	20,000	35,000
2	Adminstration Area	Air Condtion	100	650,000	65,000	0.00	0.00	65,000	50,000	115,000
3	Production Area	Heating	100	200,000	20,000	16,667	100,000	120,000	30,000	150,000
S_T	Facility HVAC	SUM	300	1,000,000	100,000	16,667	100,000	200,000	100,000	300,000

Moderate Geothermal GHP Heat Pump HVAC Systems -- Annual Costs										
S.N	Area	HVAC System	Load (Ton)	Annual Operational Energy Used (QTY / COST)				SUM Annual Energy COST (USD)	SUM Annual Maintenance COST (USD)	TOTAL Annual G. HVAC COST (USD)
				Electricity		Natural Gas				
				KWH (s)	Cost / USD	MMBTU (s)	Cost / USD			
1	Production Area	Ventilation	100	135,000	13,500	800	4,800	18,300	30,000	48,300
2	Adminstration Area	Air Condtion	100	530,000	53,000	1,400	8,400	61,400	30,000	91,400
3	Production Area	Heating	100	135,000	13,500	11,133	66,800	80,300	30,000	110,300
S_G	Facility HVAC	SUM	300	800,000	80,000	13,333	80,000	160,000	90,000	250,000

Moderate Geothermal Facility HVAC Systems Savings:

- Applied Moderate GHP HVAC Systems has cost 80% of existing Electric Resistant Systems for same load of 300 Tons
- Applied Moderate GHP HVAC Systems has the Lower Operating Cost, Lower CO2 Emissions and so Lower Sound Ratings
- Estimated Annual Savings for HVAC Operations & Maintenance = 50,000 USD "Per Year"

Notes of Savings:

- 1) Estimated Energy costs based on industrial applications tariff @ EGY - 2020 via 6 USD for MMBTU Natural Gas and .10 Cent for KWH, and within given data that operation through 8-10 working hours a day at facility.
- 2) Moderate Energy (Qty & Cost) Savings due to the existing Air Condition system based on Mini Split AC Units and Electric Heaters and Boilers for Administrative heating and air conditions in which all will be replaced by Moderate GHP Centralized HVAC Systems.
- 3) Moderate GHP HVAC Systems all will be higher efficiency, comfort and echo friendly plus lower cost compared to existing traditional Electric Resistant HVAC System.



Moderate Geothermal HVAC System Payback Calculation

Table E-01 – Geothermal HVAC System PAY-BACK Calculation - 2020

Moderate Geothermal HVAC System Project – PAY-BACK Calculations

Table E-01 : Moderate Geothermal HVAC Systems PAY-BACK :-

G	Facility HVAC Systems	300	2,000,000	6,667	250,000
	Moderate Geothermal System	TON	First Base COSTs	Per Ton First Base Cost	Energy + Maintenance Annual COSTs
E	Facility HVAC Systems	300	1,650,000	5,500	300,000
	Traditional Electric Resistant	TON	First Base COSTs	Per Ton First Base Cost	Energy + Maintenance Annual COSTs
S	SAVINGS	300	350,000	1,167	50,000
	Moderate Geothermal System	TON	First Base SAVINGS	Per Ton First Base Saving	Energy + Maintenance Annual SAVINGS
P	PAY-BACK	300	350,000	50,000	7
	Moderate Geothermal System	TON	First Base SAVINGS	Energy + Maintenance Annual SAVINGS	YEARS

Moderate Geothermal Facility HVAC Systems Payback year's calculation:

- Estimated Payback years for Submitted Moderate Geothermal GHP HVAC Systems of 300 Tons is 7 Years.
- Successful Geothermal HVAC System Paybacks are within 5 – 10 Years.
- Noting the Life-Time of existing Air Condition (Split AC Units) is around 5 – 7 Years, compared to Geothermal HVAC System of 30 Years Life-Time – Thus makes additional added value for GHP savings and Payback years.
- HVAC System Economics lead to its Bottom Line equals the sum of First Base Costs (Initial Construction and building Costs) and the Energy Costs (for Operation) and the Maintenance Cost (Preventive & Services Repair).
- First Base Cost is greatly influenced by effective design.
- Moderate Geothermal HVAC System has Higher Economic Benefits of Performance, Energy Efficient, Comfortable Operation, Reduction of Energy Costs, Payback rates than Electric Resistant HVAC System.



GEOHERMAL SYSTEM FOR AREA VENTILATION -- Project Quote 16231-01 (VENT-01)

Table D-1: BOQ - Geothermal Ground Coupled System for the Ventilation of Production Area

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
1	Geothermal System Design & Ground Testing								
	Ground Geothermal Sytem Testing & Designing, provides the designer with accurate information on the thermal conductivity, loop design can be optimized and the path of of piping and Bore-Holes. Tests with Field Testing Appartus will be conducted by drilling borehole and adding loop with hot water from a portable electric heater is circulated. Data log is run over 48 hours and energy absorbed by the ground is measured so that the conductivity and diffusivity could been calculated. Then, Submitting of Trenched Horizontal / Vertical Loop Design, c/w Bore-Hole Layout using Software Design for Ground Loops, Piping								
1-a	Ground Testing for Geothermal of the Planned / Upgrade Area	LS	1	BADRY	0	0	7500	7,500	7,500
1-b	Ground Loop Design for Geothermal of the Planned / Upgrade Area	LS	1	BADRY	0	0	7500	7,500	7,500



GEOHERMAL SYSTEM FOR AREA VENTILATION -- Project Quote 16231-01 (VENT-01)

Table D-1: BOQ - Geothermal Ground Coupled System for the Ventilation of Production Area

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
2	Ground Closed Loop Hydraulic Piping Works								
	Under Ground Geothermal closed loop; Trenched Horizontal / Drilled Vertical, Loop Piping works via HDPE System, c/w Bore-Hole Layout using Software Design for Ground Loops, Piping of HDPE material c/w all required fittings to act as a heat exchanger same to cooling coil. Item complete with Backfill & Grouts for the piping jacket avoiding Air Gaps or separations via grouting with Thermal Grouts of 60% Quartezil and 20% Cement, 10% Fly Ash, 10% Sand. Hydraulic Fluid of Antifreeze Water Based Solution as a water source refrigerant for Heat Pump to be supplied and equipped.								
2-a	Trenched horizontal HRZ Loop with 6 ft depth, Bore-hole 3 Inch	Ton	40	BADRY	400	16,000	900	36,000	52,000
2-b	Drilled Vertical VER Loop with 100 ft depth, Bore-hole 5 Inch	Ton	60	BADRY	600	36,000	1200	72,000	108,000



GEOHERMAL SYSTEM FOR AREA VENTILATION -- Project Quote 16231-01 (VENT-01)

Table D-1: BOQ - Geothermal Ground Coupled System for the Ventilation of Production Area

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
3	Geothermal System Equipments (GHP Equipments)								
	Supply, installation, testing and commissioning of Geothermal water source Heat Pump with R-410a Refrigerant with wider fluid operating range and additional insulation of internal co-axial coils, thermal expansion TX Valves and heat exchangers optimized for geothermal operating conditions. GHP to be designed and supplied with <u>FIXED 3 GPM</u> Flow System c/w two-way isolating valves at each heat pump that shut off the flow when the compressors is not runing. Heat Pump to be modulated and equieped with <u>Electric Protection Panel</u>								
3-a	GHP <u>Constant</u> Flow, 20 Ton (Cool Only)	No	5	AMRTA	17000	85,000	4000	20,000	105,000
3-b	GHP <u>Constant</u> Flow, 25 Ton (Cool + Warm)	No	0	AMRTA	32000	0	6750	0	0
3-c	GHP <u>Constant</u> Flow, 50 Ton (Heating / Child)	No	0	AMRTA	40000	0	8000	0	0
3-d	Rooftop Unit with Enthalpy Wheel	No	0	Mc-Quay	49000	0	6000	0	0
3-e	Templifier Water to Water Heat Recovery	No	0	Mc-Quay	41000	0	4000	0	0



GEOHERMAL SYSTEM FOR AREA VENTILATION -- Project Quote 16231-01 (VENT-01)

Table D-1: BOQ - Geothermal Ground Coupled System for the Ventilation of Production Area

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
4	Pumping & Mechanical Room Works								
	Supply, installation, testing and commissioning of Geothermal system redundant pump package system to meet the design flow and to be connected and controlled with <u>Electric Control Panel</u> System to be complete with Supply & Return Headers @ Mechanical Rooms c/w pipes, fittings, taps and valves for supply / return lines and expansion tanks and air separators to act the whole system operation more over system flushing; air removing from ground loop into piping								
4-a	Pumping System for Flow (1-Operation +1-Standby)	Pkg	1	WEILER	17000	17,000	4000	4,000	21,000
4-b	Mechanical Room Works c/w Headers, Valves, Accessories	LS	1	BADRY	13000	13,000	6000	6,000	19,000



GEOHERMAL SYSTEM FOR AREA VENTILATION -- Project Quote 16231-01 (VENT-01)

Table D-1: BOQ - Geothermal Ground Coupled System for the Ventilation of Production Area

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
5	Delivery / Distribution System								
5-1	SITC Water Transfer / Piping System c/w Valves & Fittings	LS	0	BADRY	75000	0	25000	0	0
5-2	SITC Air Transfer / Ducting System c/w Registers & Dampers	LS	1	BADRY	55000	55,000	15000	15,000	70,000
5-3	SITC Radiant Floor Warming System c/w Outlets	LS	0	BADRY	80000	0	20000	0	0
5-5	Civil / Arch. Ancilaary Works to furnish Distribution System	LS	1	BADRY	0	0	25000	25,000	25,000
6	Control & Management System								
6-1	DDC Control System	LS	0	Rockwell	19000	0	4000	0	0
6-2	BMS / HDMI Operation System with PLC	LS	0	Rockwell	22000	0	5000	0	0
7	Testing & Balance								
7-1	Testing & Ballancing of HVAC / Ducting / Piping Systems of Each Area Acc. To ASHARE / SMACNA / ISO Classification	LS	1	BADRY	0	0	10000	10,000	10,000
S1	GEOHERMAL - SUM / VENTILATION WORKS				Four Hundred Twenty Five Thousands USD			425,000	



GEOHERMAL SYSTEM FOR AIR CONDITIONING -- Project Quote 16232-01 (ACND-01)

Table D-2: BOQ - Geothermal Ground Coupled System for the Air Conditioning of the Adminstrative Area Project

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
1	Geothermal System Design & Ground Testing								
	Ground Geothermal Sytem Testing & Designing, provides the designer with accurate information on the thermal conductivity, loop design can be optimized and the path of of piping and Bore-Holes. Tests with Field Testing Appartus will be conducted by drilling borehole and adding loop with hot water from a portable electric heater is circulated. Data log is run over 48 hours and energy absorbed by the ground is measured so that the conductivity and diffusivity could been calculated. Then, Submitting of Trenched Horizontal / Vertical Loop Design, c/w Bore-Hole Layout using Software Design for Ground Loops, Piping								
1-a	Ground Testing for Geothermal of the Planned / Upgrade Area	LS	1	BADRY	0	0	7500	7,500	7,500
1-b	Ground Loop Design for Geothermal of the Planned / Upgrade Area	LS	1	BADRY	0	0	7500	7,500	7,500



GEOHERMAL SYSTEM FOR AIR CONDITIONING -- Project Quote 16232-01 (ACND-01)

Table D-2: BOQ - Geothermal Ground Coupled System for the Air Conditioning of the Adminstrative Area Project

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
2	Ground Closed Loop Hydraulic Piping Works								
	Under Ground Geothermal closed loop; Trenched Horizontal / Drilled Vertical, Loop Piping works via HDPE System, c/w Bore-Hole Layout using Software Design for Ground Loops, Piping of HDPE material c/w all required fittings to act as a heat exchanger same to cooling coil. Item complete with Backfill & Grouts for the piping jacket avoiding Air Gaps or separations via grouting with Thermal Grouts of 60% Quartezil and 20% Cement, 10% Fly Ash, 10% Sand. Hydraulic Fluid of Antifreeze Water Based Solution as a water source refrigrant for Heat Pump to be supplied and equiped.								
2-a	Trenched horizontal HRZ Loop with 6 ft depth, Bore-hole 3 Inch	Ton	40	BADRY	400	16,000	900	36,000	52,000
2-b	Drilled Vertical VER Loop with 100 ft depth, Bore-hole 5 Inch	Ton	60	BADRY	600	36,000	1200	72,000	108,000



GEOHERMAL SYSTEM FOR AIR CONDITIONING -- Project Quote 16232-01 (ACND-01)

Table D-2: BOQ - Geothermal Ground Coupled System for the Air Conditioning of the Adminstrative Area Project

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
3	Geothermal System Equipments (GHP Equipments)								
	Supply, installation, testing and commissioning of Geothermal water source Heat Pump with R-410a Refrigerant with wider fluid operating range and additional insulation of internal co-axial coils, thermal expansion TX Valves and heat exchangers optimized for geothermal operating conditions. GHP to be designed and supplied with <u>FIXED 3 GPM</u> Flow System c/w two-way isolating valves at each heat pump that shut off the flow when the compressors is not runing. Heat Pump to be modulated and equieped with <u>Electric Protection Panel</u>								
3-a	GHP <u>Constant</u> Flow, 20 Ton (Cool Only)	No	0	AMRTA	17000	0	4000	0	0
3-b	GHP <u>Constant</u> Flow, 25 Ton (Cool + Warm)	No	4	AMRTA	32000	128,000	6750	27,000	155,000
3-c	GHP <u>Constant</u> Flow, 50 Ton (Heating / Child)	No	0	AMRTA	40000	0	8000	0	0
3-d	Rooftop Unit with Enthalpy Wheel	No	0	Mc-Quay	49000	0	6000	0	0
3-e	Templifier Water to Water Heat Recovery	No	0	Mc-Quay	41000	0	4000	0	0



GEOTHERMAL SYATEM BOQ

Table D - BOQ for Geothermal System



GEOTHERMAL SYSTEM FOR AIR CONDITIONING -- Project Quote 16232-01 (ACND-01)

Table D-2: BOQ - Geothermal Ground Coupled System for the Air Conditioning of the Adminstrative Area Project

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
4	Pumping & Mechanical Room Works								
	Supply, installation, testing and commissioning of Geothermal system redundant pump package system to meet the design flow and to be connected and controlled with <u>Electric Control Panel</u> System to be complete with Supply & Return Headers @ Mechanical Rooms c/w pipes, fittings, taps and valves for supply / return lines and expansion tanks and air seprators to act the whole system operation more over system flushing; air removing from ground loop into piping								
4-a	Pumping System for Flow (1-Operation +1-Standby)	Pkg	1	WEILER	17000	17,000	4000	4,000	21,000
4-b	Mechanical Room Works c/w Headers, Valves, Accessories	LS	1	BADRY	13000	13,000	6000	6,000	19,000



GEOHERMAL SYATEM BOQ

Table D - BOQ for Geothermal System



GEOHERMAL SYSTEM FOR AIR CONDITIONING -- Project Quote 16232-01 (ACND-01)

Table D-2: BOQ - Geothermal Ground Coupled System for the Air Conditioning of the Adminstrative Area Project

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
5	Delivery / Distribution System								
5-1	SITC Water Transfer / Piping System c/w Valves & Fittings	LS	1	BADRY	75000	75,000	25000	25,000	100,000
5-2	SITC Air Transfer / Ducting System c/w Registers & Dampers	LS	1	BADRY	55000	55,000	15000	15,000	70,000
5-3	SITC Radiant Floor Warming System c/w Outlets	LS	1	BADRY	80000	80,000	20000	20,000	100,000
5-5	Civil / Arch. Ancilaary Works to furnish Distribution System	LS	1	BADRY	0	0	25000	25,000	25,000
6	Control & Management System								
6-1	DDC Control System	LS	0	Rockwell	19000	0	4000	0	0
6-2	BMS / HDMI Operation System with PLC	LS	0	Rockwell	22000	0	5000	0	0
7	Testing & Balance								
7-1	Testing & Ballancing of HVAC / Ducting / Piping Systems of Each Area Acc. To ASHARE / SMACNA / ISO Classification	LS	1	BADRY	0	0	10000	10,000	10,000
S2	GEOHERMAL - SUM / AIR CONDITIONING WORKS					Six Hundreds Seventy Five Thousands USD			675,000



GEOHERMAL SYSTEM FOR WATER / STEAM HEATING -- Project Quote 16233-01 (HEAT-01)

Table D-3: BOQ - Geothermal Ground Coupled System for the Heating Steam of Food Production Area Project

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
1	Geothermal System Design & Ground Testing								
	Ground Geothermal Sytem Testing & Designing, provides the designer with accurate information on the thermal conductivity, loop design can be optimized and the path of of piping and Bore-Holes. Tests with Field Testing Appartus will be conducted by drilling borehole and adding loop with hot water from a portable electric heater is circulated. Data log is run over 48 hours and energy absorbed by the ground is measured so that the conductivity and diffusivity could been calculated. Then, Submitting of Trenched Horizontal / Vertical Loop Design, c/w Bore-Hole Layout using Software Design for Ground Loops, Piping								
1-a	Ground Testing for Geothermal of the Planned / Upgrade Area	LS	1	BADRY	0	0	14000	14,000	14,000
1-b	Ground Loop Design for Geothermal of the Planned / Upgrade Area	LS	1	BADRY	0	0	14000	14,000	14,000



GEOHERMAL SYSTEM FOR WATER / STEAM HEATING -- Project Quote 16233-01 (HEAT-01)

Table D-3: BOQ - Geothermal Ground Coupled System for the Heating Steam of Food Production Area Project

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
2	Ground Closed Loop Hydrulic Piping Works								
	Under Ground Geothermal closed loop; Trenched Horizontal / Drilled Vertical, Loop Piping works via HDPE System, c/w Bore-Hole Layout using Software Design for Ground Loops, Piping of HDPE material c/w all required fittings to act as a heat exchanger same to cooling coil. Item complete with Backfill & Grouts for the piping jacket avoiding Air Gaps or separations via grouting with Thermal Grouts of 60% Quartezil and 20% Cement, 10% Fly Ash, 10% Sand. Hydraulic Fluid of Antifreeze Water Based Solution as a water source refrigrant for Heat Pump to be supplied and equiped.								
2-a	Trenched horizontal HRZ Loop with 6 ft depth, Bore-hole 3 Inch	Ton	40	BADRY	400	16,000	900	36,000	52,000
2-b	Drilled Vertical VER Loop with 100 ft depth, Bore-hole 5 Inch	Ton	60	BADRY	600	36,000	1200	72,000	108,000



GEOHERMAL SYSTEM FOR WATER / STEAM HEATING -- Project Quote 16233-01 (HEAT-01)

Table D-3: BOQ - Geothermal Ground Coupled System for the Heating Steam of Food Production Area Project

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
3	Geothermal System Equipments (GHP Equipments)								
	Supply, installation, testing and commissioning of Geothermal water source Heat Pump with R-410a Refrigerant with wider fluid operating range and additional insulation of internal co-axial coils, thermal expansion TX Valves and heat exchangers optimized for geothermal operating conditions. GHP to be designed and supplied with <u>FIXED 3 GPM</u> Flow System c/w two-way isolating valves at each heat pump that shut off the flow when the compressors is not runing. Heat Pump to be modulated and equiped with <u>Electric Protection Panel</u>								
3-a	GHP <u>Constant</u> Flow, 20 Ton (Cool Only)	No	0	AMRTA	17000	0	4000	0	0
3-b	GHP <u>Constant</u> Flow, 25 Ton (Cool + Warm)	No	0	AMRTA	32000	0	6750	0	0
3-c	GHP <u>Constant</u> Flow, 50 Ton (Heating / Child)	No	3	AMRTA	40000	120,000	8000	24,000	144,000
3-d	Rooftop Unit with Enthalpy Wheel	No	0	Mc-Quay	49000	0	6000	0	0
3-e	Templifier Water to Water Heat Recovery	No	1	Mc-Quay	41000	41,000	4000	4,000	45,000



GEOHERMAL SYSTEM FOR WATER / STEAM HEATING -- Project Quote 16233-01 (HEAT-01)

Table D-3: BOQ - Geothermal Ground Coupled System for the Heating Steam of Food Production Area Project

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
4	Pumping & Mechanical Room Works								
	Supply, installation, testing and commissioning of Geothermal system redundant pump package system to meet the design flow and to be connected and controlled with <u>Electric Control Panel</u> System to be complete with Supply & Return Headers @ Mechanical Rooms c/w pipes, fittings, taps and valves for supply / return lines and expansion tanks and air separators to act the whole system operation more over system flushing; air removing from ground loop into piping								
4-a	Pumping System for Flow (1-Operation +1-Standby)	Pkg	1	WEILER	17000	17,000	4000	4,000	21,000
4-b	Mechanical Room Works c/w Headers, Valves, Accessories	LS	1	BADRY	13000	13,000	6000	6,000	19,000



GEOHERMAL SYATEM BOQ

Table D - BOQ for Geothermal System



GEOHERMAL SYSTEM FOR WATER / STEAM HEATING -- Project Quote 16233-01 (HEAT-01)

Table D-3: BOQ - Geothermal Ground Coupled System for the Heating Steam of Food Production Area Project

S.N	Item Description	Unit	QTY	Offered Makes	Supply (USD)		Erection (USD)		Total Supply & Erection (USD)
					Unit Rate	Amount	Unit Rate	Amount	
5	Delivery / Distribution System								
5-1	SITC Water Transfer / Piping System c/w Valves & Fittings	LS	1	BADRY	75000	75,000	25000	25,000	100,000
5-2	SITC Air Transfer / Ducting System c/w Registers & Dampers	LS	0	BADRY	55000	0	15000	0	0
5-3	SITC Radiant Floor Warming System c/w Outlets	LS	0	BADRY	80000	0	20000	0	0
5-5	Civil / Arch. Ancilaary Works to furnish Distribution System	LS	1	BADRY	0	0	25000	25,000	25,000
6	Control & Management System								
6-1	DDC Control System	LS	0	Rockwell	19000	0	4000	0	0
6-2	BMS / HDMI Operation System with PLC	LS	0	Rockwell	22000	0	5000	0	0
7	Testing & Balance								
7-1	Testing & Ballancing of HVAC / Ducting / Piping Systems of Each Area Acc. To ASHARE / SMACNA / ISO Classification	LS	1	BADRY	0	0	10542.373	10,542	10,542
S3	GEOHERMAL - SUM / HEATING WORKS								552,542.3729



Water Source Heat Pump Unit

Cooling capacity from 10 to 133 kW

Heating capacity from 12.1 to 156.2 kW

Functions



Cooling



C&H



Heat Recovery



Characteristics

Structure

Panels and frame are made from galvanized steel protected with polyester powder painting to ensure total resistance to atmospheric agents

Hermetic compressor

Single phase (mod. 10, 12,15) and 3-phase (mod.17 to 130) scroll type compressors, with built-in thermal overload cut-out and crankcase heater, mounted on rubber vibration dampers

Evaporator

High efficiency plate type heat exchanger, factory insulated with flexible close cell material

Condenser

High efficiency plate type heat exchanger, factory insulated with flexible close cell material

Desuperheater

High efficiency stainless steel brazed plate heat exchanger, factory insulated with flexible close cell material

Refrigerant circuit

Copper tube connection with charge valves, filter drier, thermostatic expansion valve (capillary for mod.10 to 15), gas-liquid separator, high pressure switch and low pressure switch

The heat pump units are complete also with 4-way valve and one way valve

Hydraulic circuit

Built with user side and source side water inlet/outlet connectors, water discharge connectors, air vent valve (mod.10 to 30 the user side is complete also with expansion vessel, water pump and flow switch.)

Electric panel

Consists of:

- ◆ Compressor contactor
- ◆ Compressor protection breaker
- ◆ User side water pump contactor (for mod.10 to 30)
- ◆ User side water pump breaker (for mod.10 to 30)
- ◆ Microprocessor with function display

Optional

- ◆ Sight glass which must be installed in factory
- ◆ Source side flow switch
- ◆ Source side water pump
- ◆ Anti-vibration rubber
- ◆ Metallic filter for the water circuit
- ◆ Heat recovery exchanger
- ◆ Tube in tube heat exchanger

Technical Data R410a

Model WW	Unit	10	12	15	20	25	30	40	45	50
Nominal cooling capacity*	kW	10	12	15	20	25	30	40	45	50
Nominal heating capacity**	kW	11.6	14	17.5	21	27.3	34.6	41.7	47	55.9
Power supply	V/PH/Hz	220/1/50				380/3/50				
Hermetic compressors										
Qty	Nr.	1	1	1	1	2	2	2	2	2
Cooling power input*	kW	2.77	3.22	3.89	4.21	5.63	7.09	8.24	10.4	11.04
Cooling current*	A	13.8	16.2	19.1	7.8	10.6	12.8	14.9	18.8	20.1
Heating power input**	kW	3.51	4.15	5.05	5.76	7.63	9.69	11.34	13.97	14.77
Heating current*	A	17.1	20.3	24.5	10.2	13.6	16.8	19.7	24.3	25.8
User side heat exchanger										
Pressure drop	kPa	33	33	36	38	38	38	40	40	42
Water flow	m³/h	1.7	2.1	2.6	3.4	4.3	5.2	6.9	8.1	8.6
Water pipe	DN	25	25	25	25	40	40	40	40	40
Source side heat exchanger										
Pressure drop	kPa	33	33	36	38	38	38	40	40	42
Water flow	m³/h	0.7	0.8	1	1.2	1.6	2	2.5	2.5	3.3
Water pipe	DN	25	25	25	25	40	40	40	40	40
Water pump										
power input	kW	0.4	0.49	0.49	0.55	0.75	0.75	0.92	1.05	1.05
current	A	2.2	2.4	2.4	1.1	1.2	1.2	1.5	2	2
Water head	m	17	20	18	16	19	16	17	18	17
Dimension(mm)	L	820	820	820	820	1400	1400	1400	1400	1400
	W	575	575	575	575	850	850	850	850	850
	H	910	910	910	910	1050	1050	1050	1050	1050
Sound pressure level***	dB(A)	56	58	62	62	62	64	64	66	66
Net weight	kg	130	140	150	180	265	280	320	340	360

Model	Unit	55	60	68	75	95	110	130	150
Nominal cooling capacity*	kW	56	62	69	75	94	113	130	150
Nominal heating capacity**	kW	62.2	70.1	76.4	83.4	105.1	124.1	140.1	165.4
Power supply	V/PH/Hz	380/3/50							
Hermetic compressors									
Qty	Nr.	2	2	2	4	3	3	4	4
Cooling power input*	kW	11.03	12.66	13.7	14.64	18.99	22.11	25.32	29.48
Cooling current*	A	19.6	22.8	24.3	26.8	34.2	38.7	45.6	51.6
Heating power input**	kW	15.41	17.02	18.71	20.84	25.53	30.6	34.04	40.8
Heating current*	A	26.3	29.4	31.9	36.4	44.1	51.6	58.8	68.8
User side heat exchanger									
Pressure drop	kPa	42	48	48	50	52	52	55	55
Water flow	m³/h	9.6	10.7	11.9	12.9	16.2	19.4	22.4	25.8
Water pipe	DN	50	50	50	50	65	65	80	80
Source side heat exchanger									
Pressure drop	kPa	42	48	48	50	52	52	55	55
Water flow	m³/h	3.7	4.1	4.5	4.9	6.2	7.3	8.3	9.7
Water pipe	DN	50	50	50	50	65	65	80	80
Water pump									
Power input	kW	/	/	/	/	/	/	/	/
Current	A	/	/	/	/	/	/	/	/
Water head	m	/	/	/	/	/	/	/	/
Dimension(mm)	L	1400	1400	1400	1400	1400	1850	1850	1850
	W	850	850	850	850	850	880	880	880
	H	1050	1050	1050	1050	1050	1250	1250	1250
Sound pressure level***	dB(A)	68	72	72	72	73	73	74	74
Net weight	kg	280	300	340	360	460	500	550	620

Performance values refer to the following conditions:

* Source side water inlet/outlet temperature 18°C/29°C, user side water inlet/outlet temperature 12°C/7°C.

** Source side water inlet/outlet temperature 15°C/7°C, user side water inlet/outlet temperature 40°C/45°C.

*** Sound pressure measured at a distance of 1 m and a height of 1.5 m above the ground in an open field.

Water Cooled Packaged Unit

2.5kW-45kW



Application areas

- Offices, Hotels, Hospitals
- Industry
- Administration
- Commercial buildings

Why this choice?

- Saving space
- Galvanised steel construction
- AMWCP are well insulated to minimise condensation and attenuate noise.



Characteristics

Structure

Galvanised steel construction, closed cell foam lined compressor and fan compartments, with an insulated and powder coated drain tray for complete moisture protection, the drain tray is easily removed for inspection and cleaning.

Refrigerant

Each unit is factory charged with refrigerant R410a, which is deemed to have zero ozone depletion potential.

Hermetic compressor

Single phase rotary compressor is used for this type unit, with built-in thermal overload cut-out, mounted on rubber vibration dampers.

Centrifugal fan

High efficiency, double inlet centrifugal fan Protection level IP44. Low noise, low speed, big air flow and high ESP.

Water side heat exchanger

High efficiency coaxial heat exchanger, factory insulated with flexible close cell material.

Air filter

An optional filter integrated return air spigot is available on all models. The filter is a washable polypropylene net media. Care should be taken, when locating each unit, that to enough space is provided to enable the one-piece filter to be withdrawn to its full length from either side of the unit.

Insulation

AMWCP are well insulated to minimise condensation and attenuate noise.

Electric heater(optional)

Electric heater is optional on cooling only versions. Electric elements have spirally wound stainless steel fins to give increased area and low surface temperature. They are totally enclosed within the unit and are supplied with safety cutouts. An optional fan run-on timer for rapid heat dissipation is available.

Electric panel

Consists of:

Compressor contactor

Compressor protection breaker

Microprocessor with function display

All models are equipped with wire controller with the following features

- 7 days programmable timer
- Auto random restart
- Error self diagnostic

Safety protection

High pressure switch

Low pressure switch

Discharge temperature protection

Anti freezing protection



Technical Data

Model	Unit	WCP2.5	WCP3.5	WCP5	WCP7	WCP10	WCP12	
Nominal cooling capacity	kW	2.5	3.5	5	7	10	12.2	
Cooling power input	kW	0.71	0.98	1.4	1.92	2.8	3.32	
Nominal heating capacity	kW	3	4.5	6.4	8.1	12.2	14.5	
Heating power input	kW	0.72	1.07	1.5	2	2.9	3.25	
Power		220V/1Ph/50Hz						
Minimum wiring specification		2×1.5mm ² +1×1mm ²		2×2.5mm ² +1×1.5mm ²		2×4mm ² +1×2.5mm ²		
Compressor type		Rotary						
Air flow amount	m ³ /h	490	680	950	1280	1900	2160	
External static pressure	Pa	60	60	120	120	160	200	
Refrigerant	Type	R410A						
	Charge	Kg	0.4	0.6	0.85	1.1	1.7	
Condenser	Type	Tube in tube coaxial heat exchanger						
Fan	Type	High efficiency low noise centrifugal fan						
	Power	220V/1Ph/50Hz						
Evaporator	Type	High efficiency copper tubes aluminum fins heat exchanger						
Water flow amount	m ³ /h	0.4	0.6	0.9	1.2	1.7	2.1	
Water pressure drop	Kpa	8	8	10	14	16	20	
Diameter of water in/out pipe	mm	DN20						
Diameter of condensing pipe	mm	DN25						
Dimension	L	mm	910	910	1030	1090	1140	1370
	W	mm	743	743	743	863	864	864
	H	mm	430	430	430	530	530	530
Weight	kg	70	75	90	100	130	135	
Noise level	dB(A)	54	54	57	57	60	60	

Note:

1. Nominal cooling capacity test condition: Water side water inlet/outlet 30°C/35°C, Ambient temperature DB 27 °C, WB 19 °C.
2. Nominal heating capacity test condition: Water side water inlet 20°C, Ambient temperature DB 20 °C, WB 15 °C.
3. Noise level measured in the noise lab with background noise of 25 dB(A), at a distance of 1 m.
4. As our continuous products improvement, Amrta reserves the right to change specifications and design without notice.

Technical Data

Model	Unit	WCP14	WCP18	WCP23	WCP30	WCP35	WCP45	
Nominal cooling capacity	kW	14.4	18	23	30	34	46	
Cooling power input	kW	4.06	5.1	6.18	7.8	8.26	11.6	
Nominal heating capacity	kW	17.3	22.6	25.9	30	35.4	49	
Heating power input	kW	4	5.6	6.86	8.6	9.1	12.84	
Power		220V/1Ph/50Hz			380V/3Ph/50Hz			
Minimum wiring specification		2×6mm ² +1×4mm ²		3×2.5mm ² +1×1.5mm ²	3×4mm ² +1×2.5mm ²			
Compressor type		Rotary			Scroll			
Air flow amount	m ³ /h	2500	3200	4000	5200	6200	8000	
External static pressure	Pa	200	200	250	250	250	250	
Refrigerant	Type	R410A						
	Charge	Kg	2.2	3	4	4.8	6	8
Condenser	Type	Tube in tube coaxial heat exchanger						
Fan	Type	High efficiency low noise centrifugal fan						
	Power	220V/1Ph/50Hz						
Evaporator	Type	High efficiency copper tubes aluminum fins heat exchanger						
Water flow amount	m ³ /h	2.4	3.1	4	5.2	5.8	7.9	
Water pressure drop	Kpa	20	23	26	30	33	33	
Diameter of water in/out pipe	mm	DN20			DN40			
Diameter of condensing pipe	mm	DN25						
Dimension	L	mm	1370	1370	1370	1540	1790	1950
	W	mm	864	864	934	934	1084	1084
	H	mm	530	530	630	685	685	685
Weight	kg	140	155	170	200	200	245	
Noise level	dB(A)	63	66	66	68	68	69	

Note:

1. Nominal cooling capacity test condition: Water side water inlet/outlet 30°C/35°C, Ambient temperature DB 27 °C, WB 19 °C.
2. Nominal heating capacity test condition: Water side water inlet 20°C, Ambient temperature DB 20 °C, WB 15 °C.
3. Noise level measured in the noise lab with background noise of 25 dB(A), at a distance of 1 m.
4. As our continuous products improvement, Amrta reserves the right to change specifications and design without notice.



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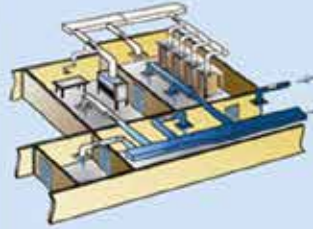
شركة البدرى للأعمال الكهروميكانيكية

إحدى شركات مجموعة البدرى للتنمية والاستثمار

BADRY Electro-Mechanical Works Co.



BADRY Group Member
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MEP Engineering & Solutions
MEP Project Management
MEP Systems Operation & Maintenance
MEP Infrastructure Networks
MEP Landscape & Irrigation
Power Distribution & Transmission
Control & Automation
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MEP



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