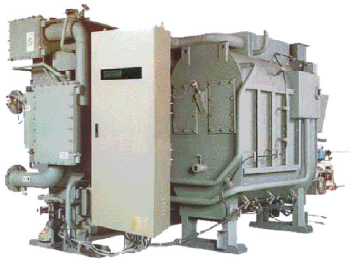
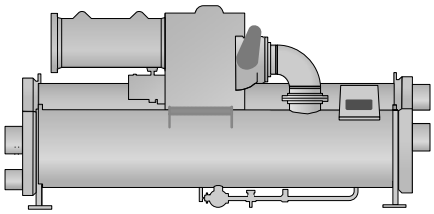
CASE STUDY

ELECTRIC OR NATURAL GAS





Solar District Cooling

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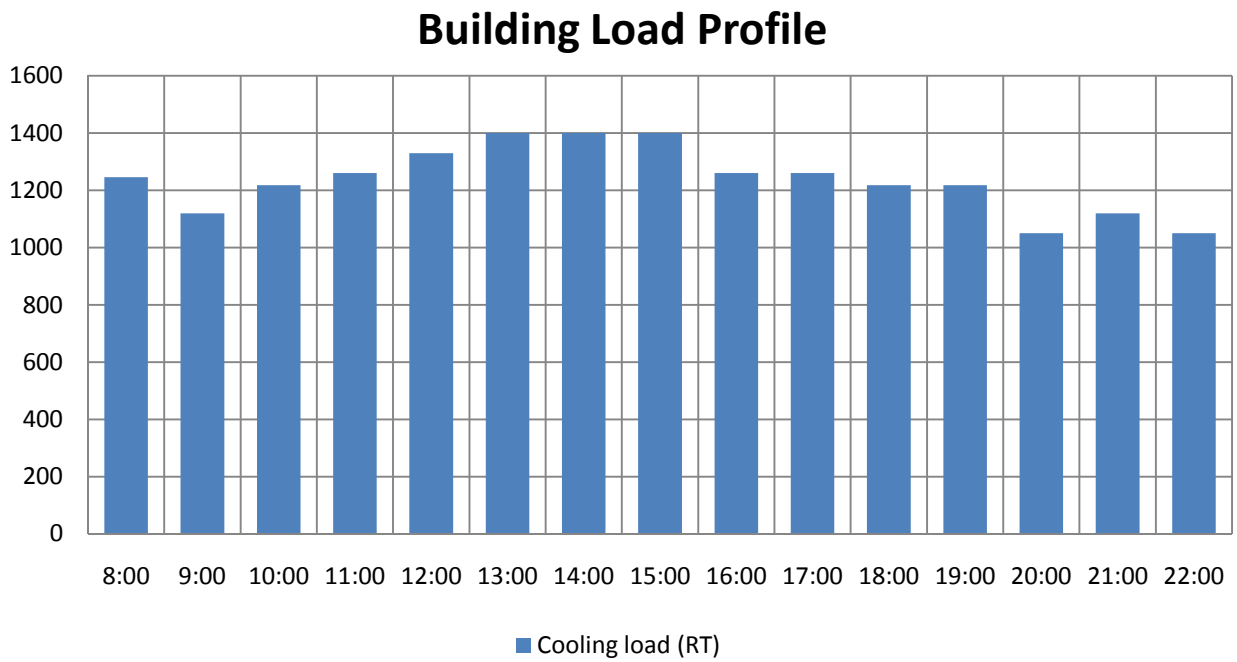
1.0 Introduction:

a.	Project:	Replacement of aged electric chiller with absorption chiller
b.	Background:	Existing electric chillers have been operated for the past 16 years, the performance of the chillers drop and cause high electricity consumption. Due to the availability of natural gas supply to the premise, the owner is considering to change to direct-fired absorption chiller, or upgrade to high efficiency electric chiller.
c.	Existing Equipment:	Electric centrifugal chiller, open-drive compressor Refrigerant of HCFC-22 Capacity: 600RT Quantity: 3 nos.

2.0 System Analysis:

Existing plant room allows the measurement of the chillers' performance and the building load profile summarize as shown below. Others finding inclusive of:

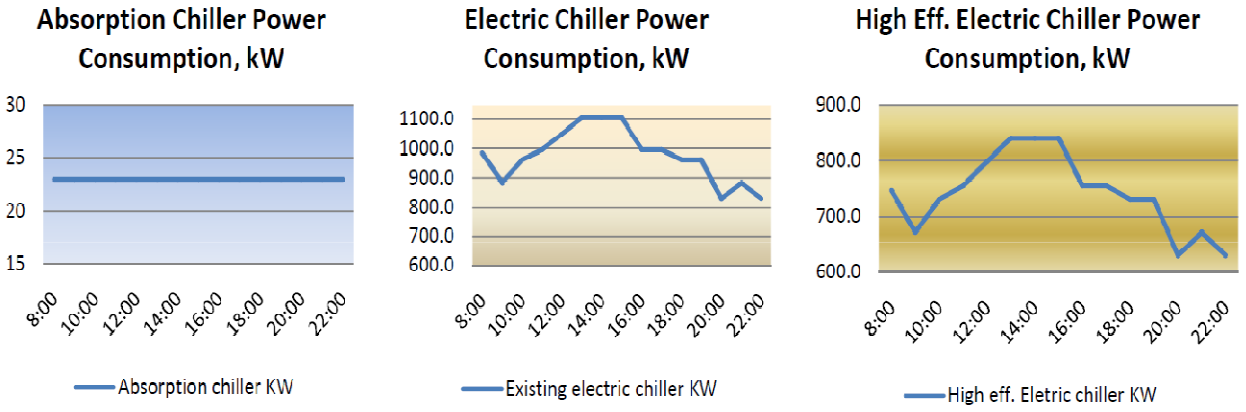
1. The condition of the electric chillers is getting worse. The hard scaling inside the coil cause the heat exchange efficiency decline.
2. Malfunction of control panel's press buttons.
3. Chillers always trip at low evaporation pressure.
4. HCFC-22 refrigerant will be phased out by 2010.
5. This premise has Natural Gas supply for boilers.
6. During design, the cooling capacity is estimated of less than 1200RT. As business growth, the peak load increase to 1400RT, happen between 1pm to 3pm. Hence, new chiller combination should be revise to suite current operation.



3.0 Energy Consumption Analysis

Before Replacement	After Replacement
a. The building served by 3 x 600RT electric powered chillers and the building load profile is as shown above.	a. Install 3 nos. 700RT Sanyo, model: DG-E43H Series *(Enhancement Model)* direct-fired LiBr double effect absorption chiller
b. Chiller operation sequence as below: - 8am to 10pm [3 chillers running, Peak]	b. Chiller operation sequence as below: - 8am to 10pm [2 chillers running, Peak]
c. All 3 chillers need to run during day time and hence there is no redundancy for schedule maintenance.	c. New chiller selection enables 2+1 config. All 3 chillers running in alternate sequence and there is always a standby unit for emergency or schedule maintenance.
d. <u>Data logging during operation:</u> Peak load condition 1) CH No. 1 running at 96% (576RT) Input power: 420kW Ave. efficiency (kW/RT) : 420/576=0.73 2) CH No. 2 running at 70.7% (424RT) Input power: 343.5kW Ave. efficiency (kW/RT): 343.5/424=0.81 3) CH No. 3 running at 66.7% (400RT) Input power: 340kW Ave. efficiency (kW/RT): 340/400=0.85	d. <u>Data logging during operation:</u> Peak load condition 1) 2 nos. of absorption chiller operating with the following pumps running: 2) Absorber pump No. 1 = 3.8kW per CH Absorber pump No. 2 = 1.8kW per CH 3) Refrigerant pump = 0.4kW per CH 4) <u>Gas blower = 5.5kW per CH</u> Each CH = 11.5kW
Ave. peak kW = 1103.5kW @ 1400RT Ave. combined efficiency: 0.79 kW/RT Peak RThr = 18,550 RTh/day	For 2 nos. CH : 11.5kW x 2 = 23kW Peak kW = 23kW On-peak kWh = 345kWh/day Natural gas consumption = 145.8NM^3/hr
CHW temp In/Out: 44/54˚F (6.67/12.2˚C) CDW temp In/Out: 87/97˚F (30.6/36.1˚C)	CHW temp In/Out: 44.6/53.6˚F (7/12˚C) CDW temp In/Out: 89.6/99.5˚F (32/37.5˚C)

4.0 Operating Cost Comparison:



Description	Sanyo Absorption Chiller	Electric Chiller (Existing)	High Efficiency Electric Chiller
Electricity			
Max. demand kW/month	RM36.60	RM36.60	RM36.60
Tariff C2, on-peak	RM0.296 /kWh	RM0.296 /kWh	RM0.296 /kWh
Tariff C2, off-peak	RM0.182 /kWh	RM0.182 /kWh	RM0.182 /kWh
Natural Gas			
Tariff E	RM22.06/mmBtu (RM0.84/NM^3/hr)	Nil	Nil
OPEX Calculation	**Annual Energy Consumption**	**Annual Energy Consumption**	**Annual Energy Consumption**
1.Max Demand kW	23kW x 12 months = 276kW	1,103.5kW x 12 months = 13,242kW	840kW x 12 months = 10,080kW
2.On peak kW	345kW x 365 days =125.9MW	14,654.5kW x 365 days =5,348.9MW	11,130kW x 365 days =4,062.5MW
3.NG NM3/hr	3894NM^3/hr x 365 days =1.421x$10^6$$NM^3$/hr	Nil	Nil
	Operation cost per year	**Operation cost per year**	**Operation cost per year**
1.Max Demand KW	RM10,101.60	RM484,657.20	RM368,928.00
2.On peak KW	RM22,918.35	RM1,583,274.40	RM1,202,500.00
3.NG NM3/hr	RM1,193,900.40	0	0
TOTAL	**RM1,226,920.35**	**RM2,067,931.60**	**RM1,571,428.00**

5.0 Benefits of Operate Absorption Chiller :

a. **Lower Upgrading Cost**
Due to the increase requirement of extra cooling capacity, changing the incoming power transformer, diesel generator, switchboard, and electric cables is a must for electric chiller upgrading. However, only alteration of natural gas piping is needed for absorption chiller.

b. **Lower Maintenance Cost**
The existing open drive chillers are due to replace, in which the replacement of compressor and motor is very expensive. Absorption chiller with only minor moving parts (e.g. pumps) provide long term operation saving.

c. **Minimum Operation Cost**
Operation cost saving at RM 841,011.25 (68.5%) comparing to existing open drive chillers; Or RM 344,507.65 (28%) comparing to the market available high efficiency electric chiller.