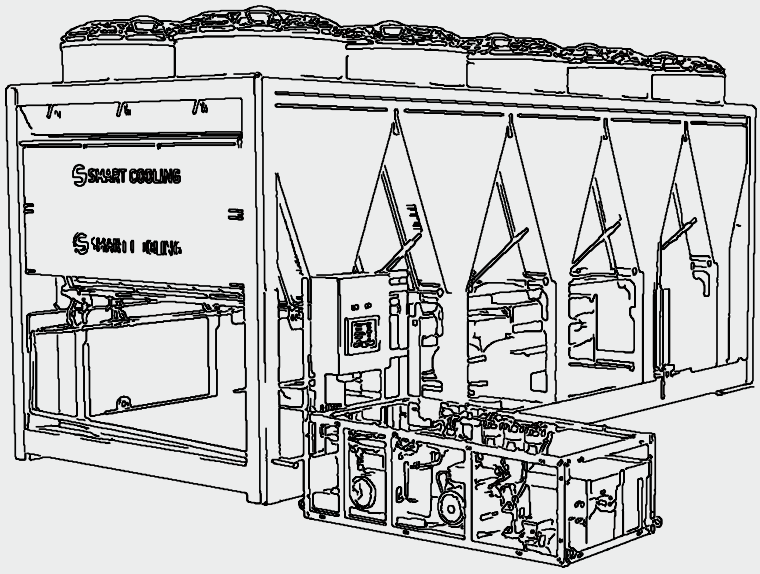
25 August 2022

TEST REPORT

160



SMART COOLING™ PRO10 SYSTEM

Saudi British Bank

Test Participants:
Project name: **SAUDI BRITISH BANK** Location: **Dammam, KSA**
Customer: **SAUDI BRITISH BANK**
Contractor: **Mr. Adel Batsh**
Swiss Integrated Energy Technologies: **Armands Mucenieks**

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Introduction:

Type of building: SABB Bank, Dammam.
Cooling units: Air cooled water chiller **Trane RTAA 324**
Chiller booster: *Smart Cooling™ PRO 10*, adiabatic technology with condenser protection.

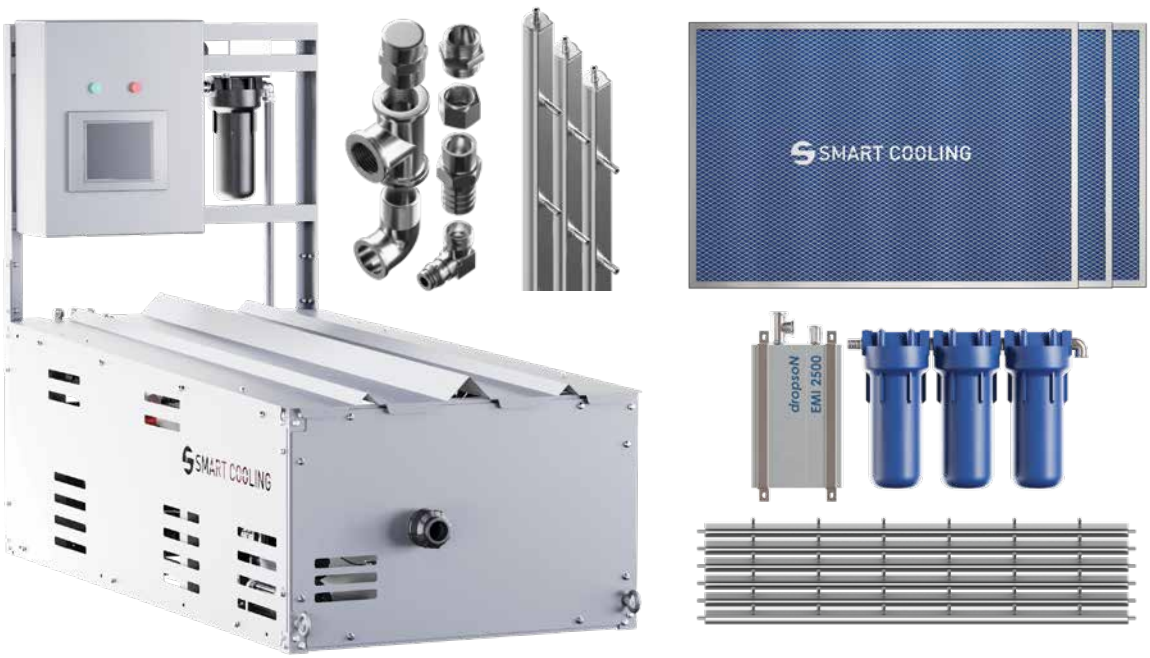
Chillers were retrofitted with the intelligent adiabatic *Smart Cooling™* system to reduce their electricity consumption and increase COP (Coefficient of Performance) efficiency.

The intelligent adiabatic *Smart Cooling™* system combines an adiabatic evaporative pre-cooling process and condenser protection with mechanical air filtration. The intelligent adiabatic *Smart Cooling™* system is mounted externally in front of the condensers of the cooling equipment. *Smart Cooling™* initiates the adiabatic process even before the mechanical cooling kicks in and the equipment receives a temperature-reducing fine mist of processed water that within the cooling circuit.

Main components:

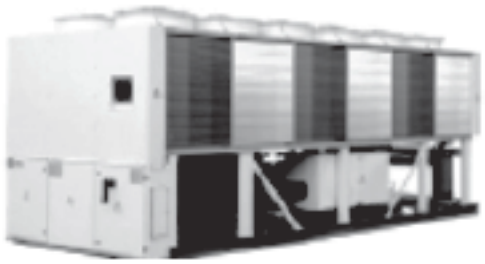
Smart Cooling™ comprises the following key components: protective membranes, water treatment and recirculation systems, high-pressure water pump, control unit, high-pressure nozzle panels, fasteners, and fixings.

- **Protective membranes** cover the condenser surface, preventing direct water contact.
- **Water system** purifies and sterilizes water to prevent mineral buildup and bacteria.
- **Pump** provides 70 bar pressure.
- **Control unit** regulates operation via real-time data (temperature, humidity, chiller parameters).
- **Nozzles** spray 5–40 µm droplets.
- A set of **fasteners and fixings** ensure the compatibility of the equipment with the chiller.



Measuring instruments:

A RIF600 ultrasonic water flow meter was used to measure the effectiveness of the chiller. The energy monitoring equipment Enicope analytics (BEST) was used to measure energy consumption. The Temperature & Humidity monitoring data logger (Elitech) was used to measure ambient temperature, humidity & air entering temperature into the condenser coils.



Chiller without Smart Cooling™ system

Chiller with Smart Cooling™ system

- **Equipment tested:** Air-cooled water chillers, **Trane RTAC 500**

BTU Reader

Temperature and Humidity Reader

Eniscope (Energy Reader)

Testing procedures:

Testing has been carried out on chiller No. 1.

Testing period: 2022/08/21 to 2022/08/23 – adiabatic system *Smart Cooling*™ switched ON
Testing period: 2022/08/23 to 2022/08/25 – adiabatic system *Smart Cooling*™ switched OFF

Step 1:
A data logger is installed on the subject HVAC equipment to collect all applicable real-time energy consumption and unit performance information. Data is collected by using an Eniscope Analytics temperature sensor and BTU reader.

Step 2:
The *Smart Cooling*™ system is switched ON

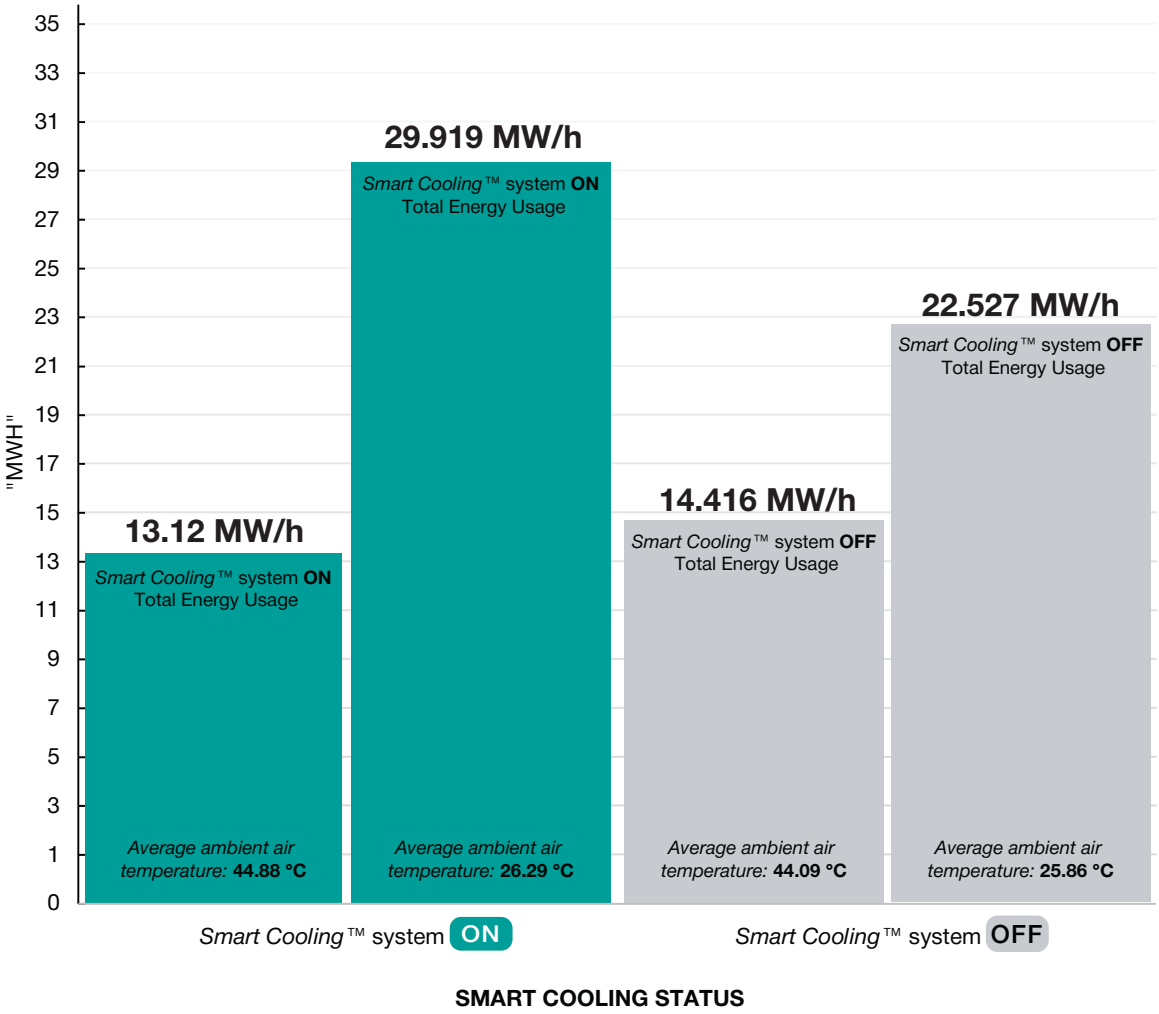
Step 3:
During the period between *21/08/2022* and *23/08/2022*, the test measured energy used by the chillers with the intelligent adiabatic system *Smart Cooling*™ turned ON (Chiller #1 was in operation). During this period, the chiller operated 48 hours, consumed **13.12 MW/h** of electricity, produced **29.396 MW/h** of cooling, with average chiller efficiency **2.27 kW/kW** and average ambient temperature **44.88 °C**.

Step 4:
The *Smart Cooling*™ system is switched OFF

Step 5:
During the period from *23/08/2022 – 25/08/2022*, the test measured energy used by the chiller without the intelligent adiabatic system *Smart Cooling*™ unit turned OFF (Chiller #1 was in operation). During this period, the chiller operated 72 hours, consumed **14.416 MW/h** of electricity, and produced **22.527 MW/h** of cooling, with average chiller efficiency **1.55 kW/kW** and average ambient temperature **44.09 °C**.

Test Results Comparison

Smart Cooling™ system **OFF** – Total Energy Usage: **14.416 MW/h**
Smart Cooling™ system **ON** – Total Energy Usage: **13.12 MW/h**



Post-analysis of data monitoring shows **46.8% improvement** in chiller performance achieved by the *Smart Cooling*™ system **during 4 working days**.

Testing Results Overview:

Smart Cooling™ Test Report in Chiller **– SABB Bank, Dammam, KSA**

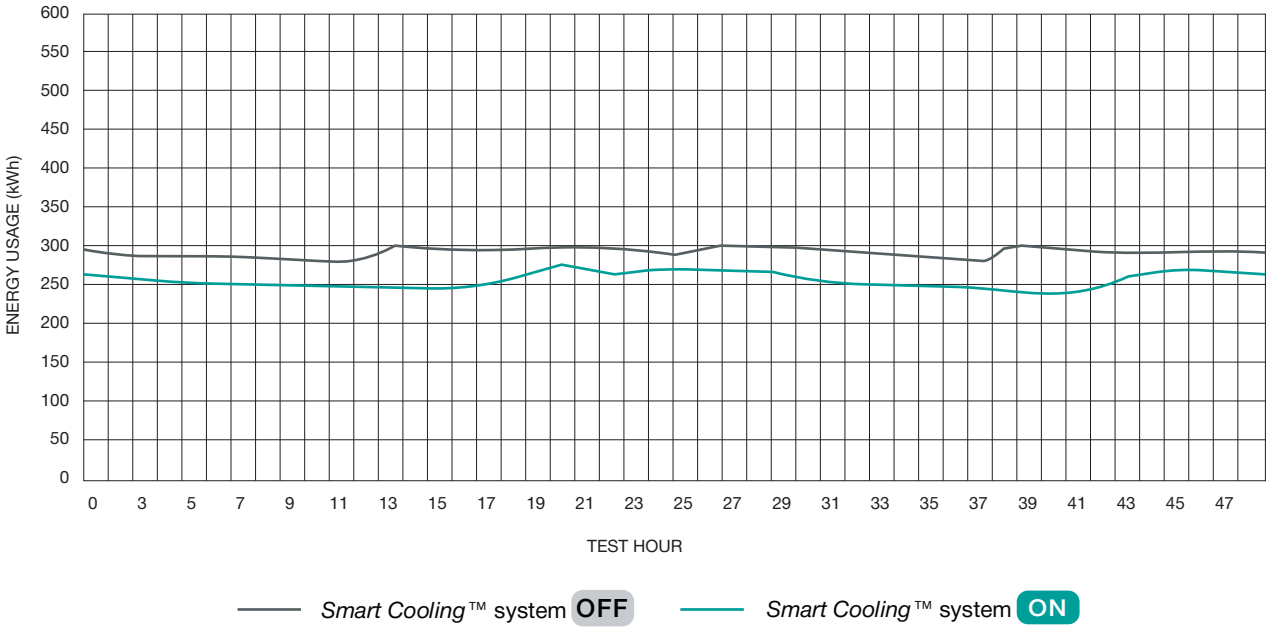
SC STATUS	SC **OFF**	SC **ON**
TEST PERIOD	Tue – 23/08/2022 Thu – 25/08/2022	Tue – 23/08/2022 Thu – 25/08/2022
CHILLER OPERATING HOURS (“hrs”)	48 hrs	48 hrs
AVG. AMBIENT TEMPERATURE (°C)	44.09 °C	44.88 °C
AVG. HUMIDITY (%)	37.17 %	38.27 %
TOTAL ENERGY USAGE (kWh)	14,416 kWh	13,121 kWh
TOTAL PRODUCED COOLING (kWh)	22,527 kWh	29,919 kWh
AVG. UNIT EFFICIENCY (kW/kW)	1.55 kW/kW	2.27 kW/kW
CHILLER EFFICIENCY (%)	46.8% improvement	

Test Date/Time	Chiller Oprational	Ambient T	Ambient RH	CHW Flow	CHWR T	CHWS T	Cooling CAI	Energy Usage	Chiller Efficiency
DD/MM/YYYY	*Hrs*	*°C*	*%*	*m^3/hr*	*°C*	*°C*	*kWh*	*kWh*	*KW/KW*
8/21/2022	24.0 hrs	43.4 °C	38.6 %	155.66	10.13 °C	6.78 °C	608.06	260.38	2.33
8/22/2022	24.0 hrs	43.7 °C	38.7 %	155.30	9.74 °C	6.42 °C	600.35	259.55	2.31
8/23/2022	24.0 hrs	47.6 °C	37.6 %	154.96	9.40 °C	6.15 °C	585.05	269.78	2.18

Test Date/Time	Chiller Oprational	Ambient T	Ambient RH	CHW Flow	CHWR T	CHWS T	Cooling CAI	Energy Usage	Chiller Efficiency
DD/MM/YYYY	*Hrs*	*°C*	*%*	*m^3/hr*	*°C*	*°C*	*kWh*	*kWh*	*KW/KW*
8/23/2022	24.0 hrs	43.6 °C	38.2 %	150.25	12.75 °C	10.60 °C	376.91	284.77	1.32
8/24/2022	24.0 hrs	44.1 °C	36.7 %	156.59	10.35 °C	7.85 °C	455.30	289.70	1.57
8/25/2022	24.0 hrs	44.6 °C	36.6 %	163.97	9.38 °C	6.72 °C	505.46	289.03	1.75

NOTE: refer to the supported document for hourly data.

Chiller Energy Usage Overview

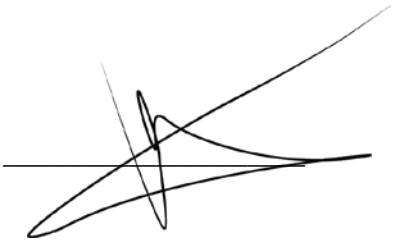


Conclusion:

Test results data show that the adiabatic equipment *Smart Cooling*™ increases chiller performance, on average, by **46.8%** during 4 operating days.

Armands Mucenieks

August 25, 2022



Annex:

Riels instruments srl
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RIF600 | Clamp-on Ultrasonic Meter Calibration Report

Pipe diameter	DN80		Date	15/12/2018
Ambient temperature	29°C			
Standard Device before test	Normal		Model:	RIF600W
Standard Devide After Test	Normal			
Test result	Qualified			
Measured Medium	Water			
Accuracy	1%			
Signal Strength	UP:	90		
	DOWN:	90		
Standard device name	Static volumetric method/standard Meter Method Water Flow/Standard Device			
Standard device accuracy	0,20%			

Test	Standard Meter flow		Temperature	Pressure	Tested Meter Flow		Basic Error		Repeatability	
Point	m3/h		°C	Mpa	m3/h		%		%	
Point 1	101,52	101,47	25,0	0,300	102,27	102,10	0,739	0,759	-0,147	0,147
	101,47		25,0	0,300	102,07		0,591			
	101,42		25,0	0,300	101,97		0,542			
Point 2	71,27	71,27	25,0	0,300	71,75	71,75	0,673		-0,146	
	71,19		25,0	0,300	71,65		0,646			
	71,34		25,0	0,300	71,86		0,729			
Point 3	26,32	26,36	25,0	0,300	26,51	26,55	0,722		-0,132	
	26,36		25,0	0,300	26,56		0,759			
	26,39		25,0	0,300	26,58		0,720			

Verification Based on JJG 1030-2007 < Ultrasonic flowmeter verification procedures >
Scale Factor=1

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RIF600 |Test Report misuratore di portata ad ultrasuoni clamp on

Diametro tubazione	DN80		Date	15/12/2018
Temperatura ambiente	29°C			
Dispositivo standard prima del test	Normale		Model:	RIF600W
Dispositivo standard dop il test	Normale			
Risultato del test	Qualified			
Liquido	Acqua			
Accuratezza	1%			
Potenza dei segnali	UP:	90		
	DOWN:	90		
Tipo di dispositivo standard	Metodo volumetrico statico/Misuratore di portata volumetrico			
Accuratezza del dispositivo standa	0,20%			

Test	Misuratore standard		Temperatura	Pressione	Misuratore testato		errore base		Ripetibilità	
Punti	m3/h		°C	Mpa	m3/h		%		%	
Punto 1	101,52	101,47	25,0	0,300	102,27	102,10	0,739	0,759	-0,147	0,147
	101,47		25,0	0,300	102,07		0,591			
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	26,36		25,0	0,300	26,56		0,759			
	26,39		25,0	0,300	26,58		0,720			

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