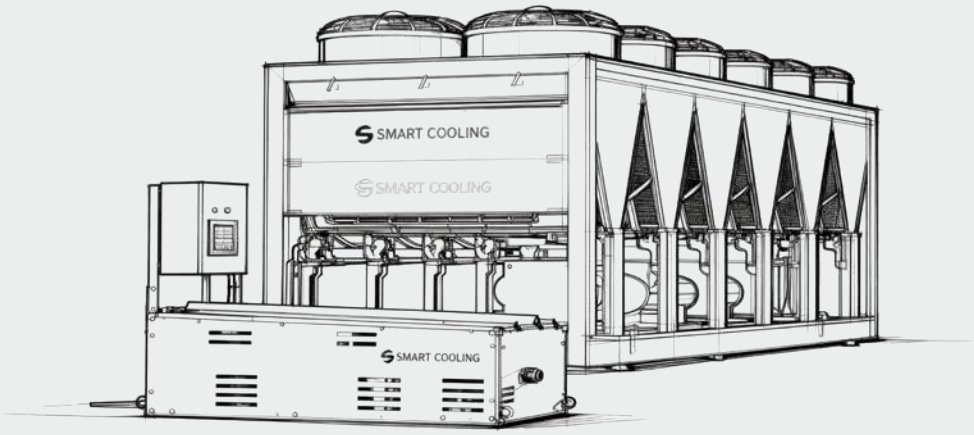
18 July 2022

TEST REPORT

159



SMART COOLING™ PRO10 SYSTEM

Al Hammadi Hospital

Test Participants:
Project name: **MICROSOFT LAVALLE** Location: **Riyadh, KS**
Integrated International Power Co: **Mr. Owais Mir**
Facility Engineer: **Mr. Ahmad Suliman**
Swiss Integrated Energy Technologies: **Armands Mucenieks**

Table of Contents

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.

Smart Cooling™ ensures 100% condenser protection from direct contact with water.

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 are installed outside the condenser and cover its entire surface, preventing water mist from coming into direct contact with the condenser.

Water filtration, purification, and sterilization: the system purifies water from minerals and sterilizes water to prevent bacterial occurrence.

A **high-pressure pump** provides water pressure of up to 70 bar while a water recirculation system reintroduces non-evaporated water into the water purification and pump system.

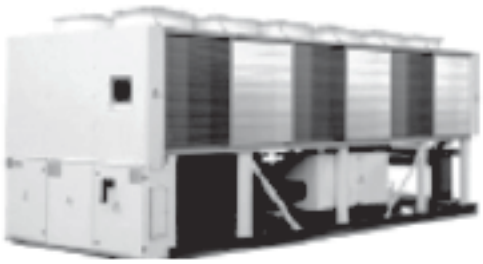
The **control unit** regulates the system according to real-time data sets such as chiller parameters, ambient air temperature, and humidity to supply the adiabatic system with the appropriate amount of water.

A **high-pressure nozzle** provides water spray with **5- to 40-micron 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: *2022/07/09 to 2022/07/12* – adiabatic system *Smart Cooling*™ switched ON
Testing period: *2022/07/13 to 2022/07/16* – 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

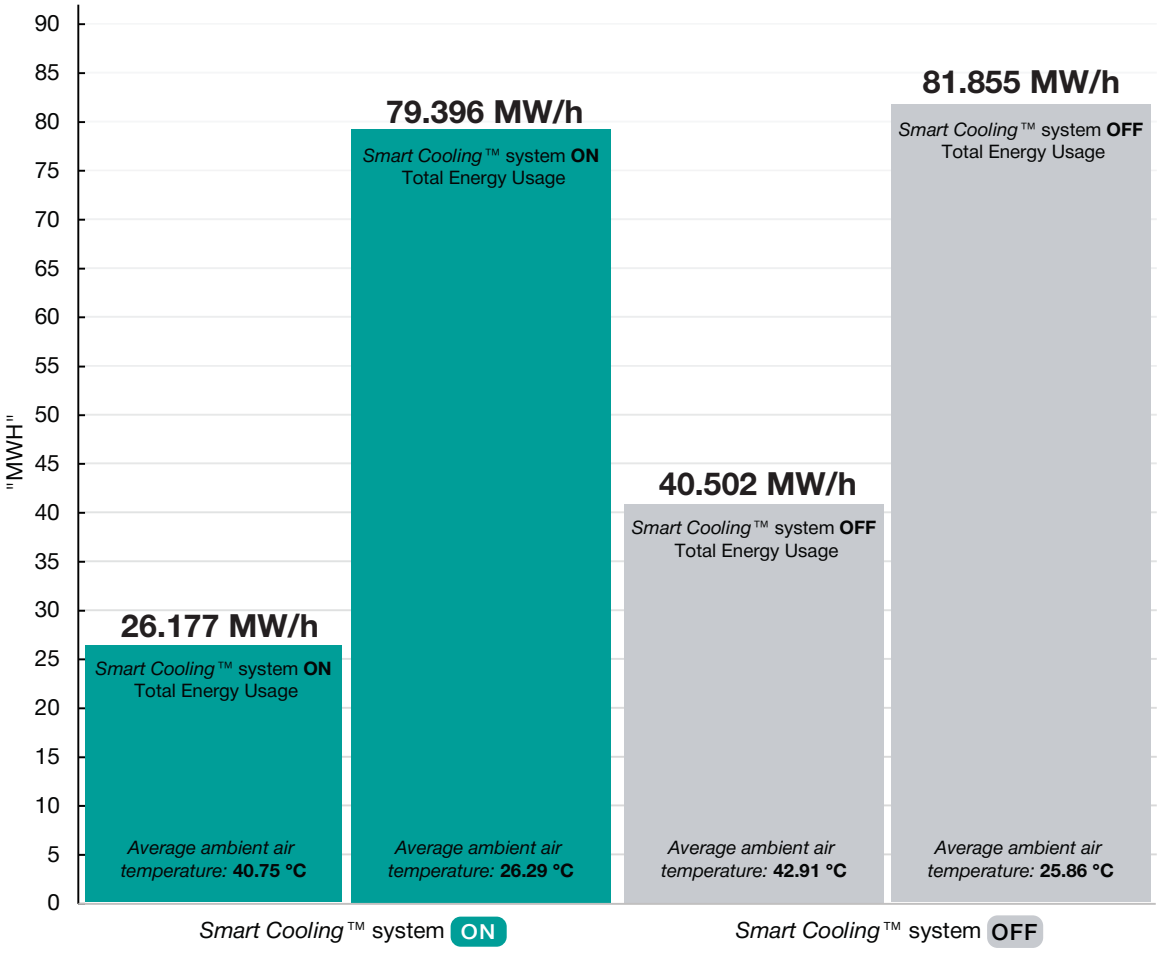
Step 3:
During the period between *09/07/2022* and *12/07/2022*, the test measured energy used by the chillers with the intelligent adiabatic system *Smart Cooling*™ turned ON (Chiller #1 was in operation). During this period, the chiller operated 96 hours, consumed **26.177 MW/h** of electricity, produced **79.396 MW/h** of cooling, with average chiller efficiency **3.15 kW/kW** and average ambient temperature **40.75 °C**.

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

Step 5:
During the period from *13/07/2022 - 16/07/2022*, 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 96 hours, consumed **40.502 MW/h** of electricity, and produced **81.885 MW/h** of cooling, with average chiller efficiency **2.18 kW/kW** and average ambient temperature **42.91 °C**.

Test Results Comparison

Smart Cooling™ system **OFF** – Total Energy Usage: **2.18 kW/h**
Smart Cooling™ system **ON** – Total Energy Usage: **3.15 kW/h**



Post-analysis of data monitoring shows **44.5 %** improvement in chiller performance achieved by the *Smart Cooling*™ system during **4 working days**.

Testing Results Overview:

Smart Cooling™ Test Report in Chiller 1 **– Al Hammadi Hospital, Riyadh, KSA**

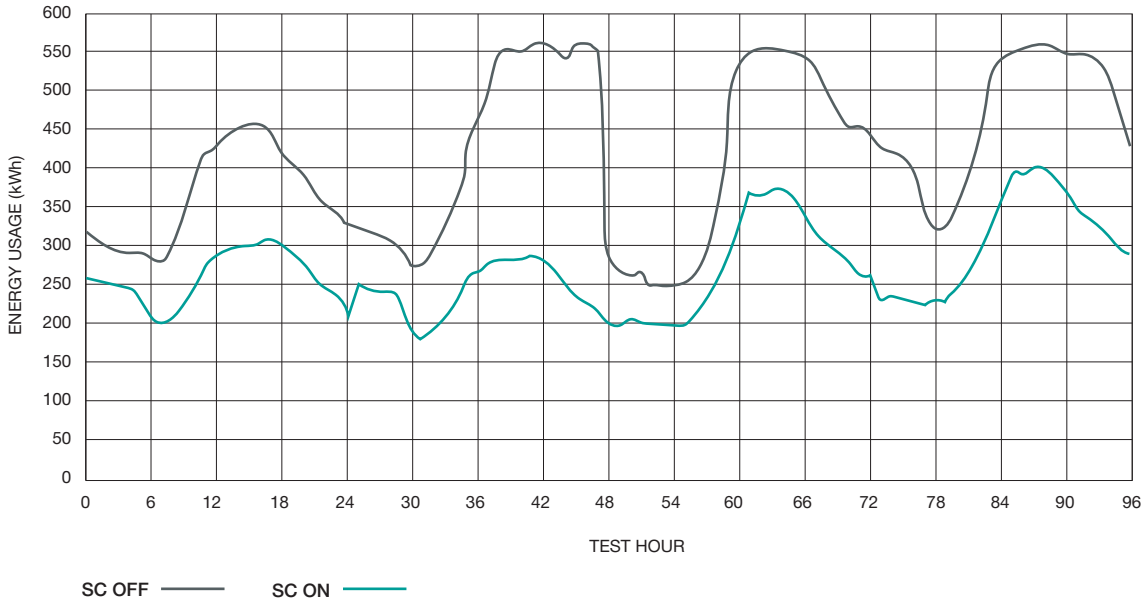
SC STATUS	SC **OFF**	SC **ON**
TEST PERIOD	Wed – 13/07/2022 Sat – 16/07/2022	Sat – 09/07/2022 Tue – 12/07/2022
CHILLER OPERATING HOURS (“hrs”)	96 hrs	96 hrs
AVG. AMBIENT TEMPERATURE (°C)	42.91 °C	40.75 °C
AVG. HUMIDITY (%)	11.35 %	12.85 %
TOTAL ENERGY USAGE (kWh)	40,502 kWh	26,177 kWh
TOTAL PRODUCED COOLING (kWh)	81,885 kWh	79,396 kWh
AVG. UNIT EFFICIENCY (kW/kW)	2.18 kW/kW	3.15 kW/kW
CHILLER EFFICIENCY (%)	44.5% improvement	

Test Date/Time *DD/MM/YYYY*	Chiller Oprational *Hrs*	Ambient T *°C*	Ambient RH *%*	CHW Flow *m^3/hr*	CHWR T *°C*	CHWS T *°C*	Cooling CAI *kWh*	Energy Usage *kWh*	Chiller Efficiency *KW/KW*
09/07/2022	24.0 hrs	40.9 °C	13.6 %	206.28	8.62 °C	5.25 °C	19413.82	6245.71	3.11
10/07/2022	24.0 hrs	40.7 °C	12.5 %	199.75	9.23 °C	5.42 °C	21257.43	5857.19	3.73
11/07/2022	24.0 hrs	41.0 °C	12.0 %	205.76	9.01 °C	5.59 °C	19623.80	6676.71	3.09
12/07/2022	24.0 hrs	40.3 °C	13.3 %	206.87	8.83 °C	5.52 °C	19100.65	7397.00	2.67

Test Date/Time *DD/MM/YYYY*	Chiller Oprational *Hrs*	Ambient T *°C*	Ambient RH *%*	CHW Flow *m^3/hr*	CHWR T *°C*	CHWS T *°C*	Cooling CAI *kWh*	Energy Usage *kWh*	Chiller Efficiency *KW/KW*
13/07/2022	24.0 hrs	41.7 °C	11.3 %	208.76	9.12 °C	5.56 °C	20739.45	8820.66	2.44
14/07/2022	24.0 hrs	42.5 °C	11.9 %	212.64	9.15 °C	5.90 °C	19260.44	10417.45	2.02
15/07/2022	24.0 hrs	43.6 °C	11.7 %	211.91	9.28 °C	5.86 °C	20195.94	9946.28	2.29
16/07/2022	24.0 hrs	44.0 °C	10.4 %	211.26	9.64 °C	5.96 °C	21688.98	11318.08	1.97

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 **44.5%** during 4 operating days.

Ali Soufan 
July 18, 2022

Annex:

Riels instruments srl
Viale Spagna, 16
35020 Ponte San Nicolò (PD) - ITALY
Ph. +39 0498961771 | info@riels.it

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			
	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

Riels instruments srl
Viale Spagna, 16
35020 Ponte San Nicolò (PD) - ITALY
Ph. +39 0498961771 | info@riels.it

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			
	101,42		25,0	0,300	101,97		0,542			
Punto 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			
Punto 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