TEST REPORT: Nr.159

Date: July 18, 2022

CHILLER EFFIENCY PERFORMANCE WITH INTELLIGENT ADIABATIC CHILLER BOOSTER **SMART COOLING™** PRO10 SYSTEM FOR YORK YVAA0345 CHILLER

Test Participants:

Al Hammadi hospital Engineer: Mr. Ahmad Suliman

INTEGRATED INTERNATIONAL POWER CO.: Mr. Owais

Swiss Integrated Energy Technologies Engineer: Armands Mucenieks

Project name: Al Hammadi Hospital

Location: Riyadh, KSA

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Introduction:

Type of building: Al Hammadi Hospital, Riyadh, KSA.

Cooling units: air-cooled water chiller Trane RTAC 500

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 reduces the temperature of condensation within the cooling circuit.

Smart Cooling™ ensure 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.

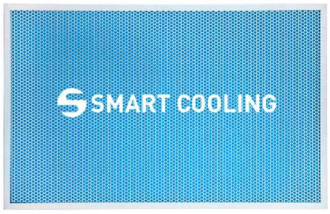
Water filtration, purification, and sterilization: the system purifies water from minerals and sterilizes water to prevent bacterial occurrence.

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

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.

BTU Reader	Temperature & Humidity Reader:	Eniscope (Energy reader)
		

Step 2

The **Smart Cooling™** system is switched **ON.**

Step 3

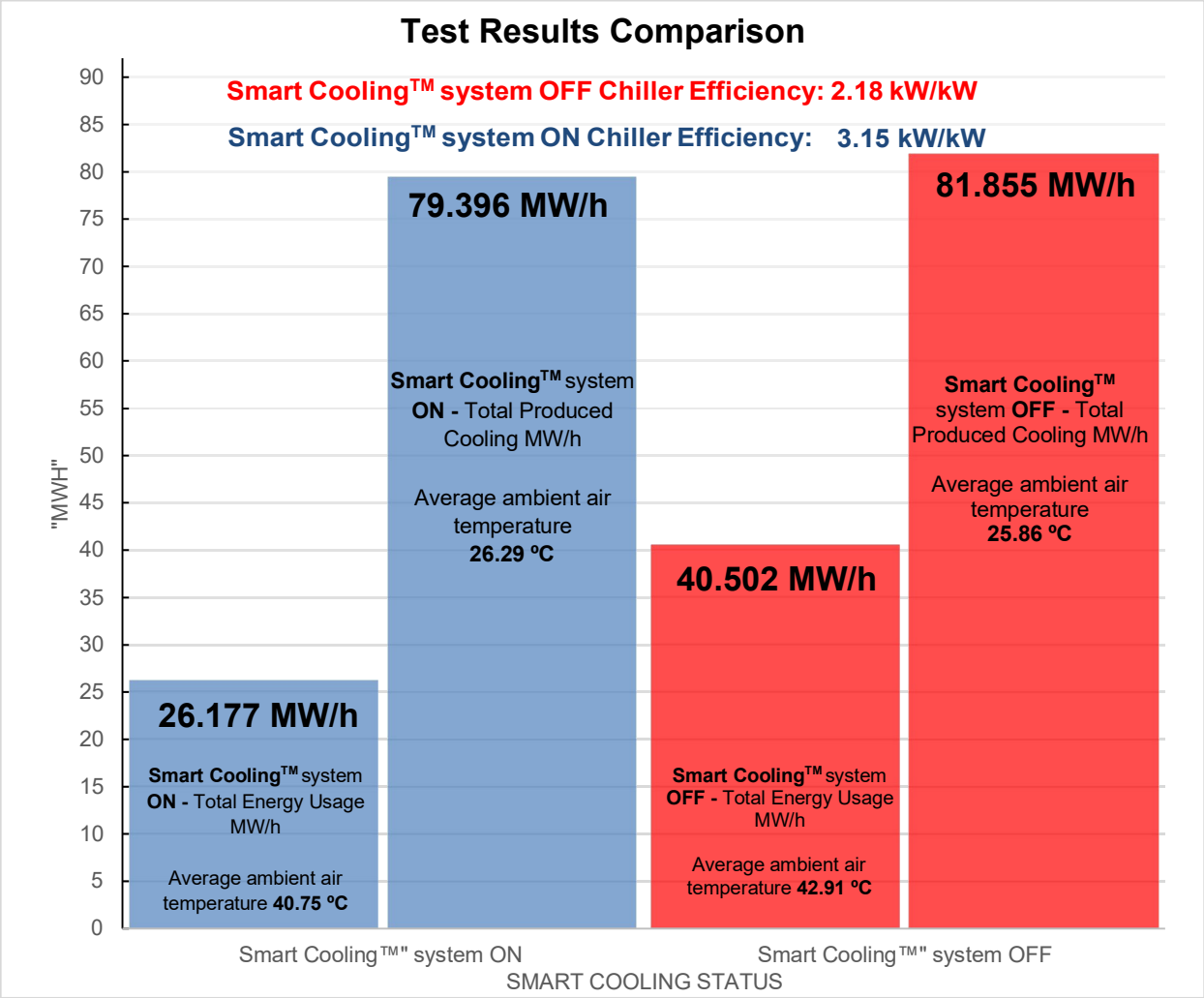
During the period between 09/07/2022 and 12/07/2022, the test measured energy used by the chillers with the intelligent adiabatic system **Smart Cooling™** turned ON **(Chiller # 1 was in operation)**. During this period, the chiller operates 96 hours, consumed **26.177 MW/h** of electricity, produced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

Step 4

The **Smart Cooling™** system is switched **OFF**.

Step 5

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



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

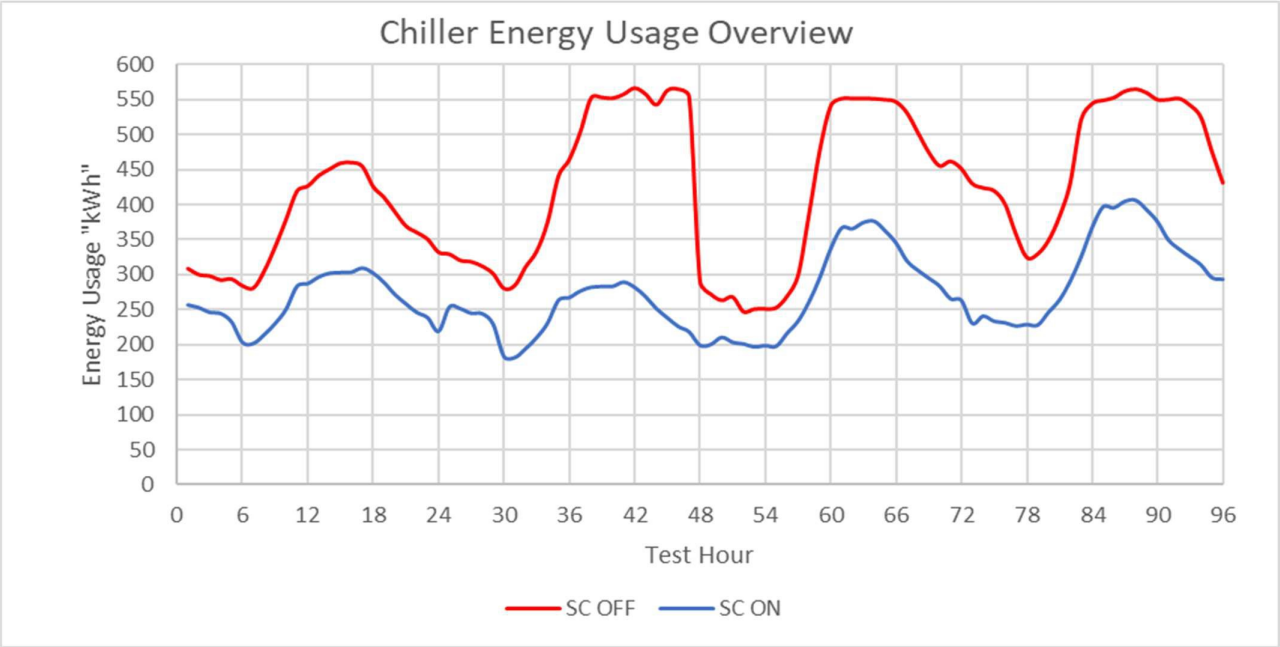
Testing Results Overview:

Smart CoolingTM 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 Usages "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%	

Test Date & Time DD/MM/YYYY	Chiller Operational Hrs	Ambient - T °C	Ambient - RH %	CHW - FLOW m3/hr	CHWR - T °C	CHWS - T °C	Cooling CAP kWh	Energy Usage kWh	Chiller Efficiency KW/KW
09/07/2022	24.0 hrs	40.9 °C	13.6 %RH	206.28	8.62	5.25	19413.82	6245.71	3.11
10/07/2022	24.0 hrs	40.7 °C	12.5 %RH	199.75	9.23	5.42	21257.43	5857.19	3.73
11/07/2022	24.0 hrs	41.0 °C	12.0 %RH	205.76	9.01	5.59	19623.80	6676.71	3.09
12/07/2022	24.0 hrs	40.3 °C	13.3 %RH	206.87	8.83	5.52	19100.65	7397.00	2.67

Test Date & Time DD/MM/YYYY	Chiller Operational Hrs	Ambient - T °C	Ambient - RH %	CHW - FLOW m3/hr	CHWR - T °C	CHWS - T °C	Cooling CAP kWh	Energy Usage kWh	Chiller Efficiency KW/KW
13/07/2022	24.0 hrs	41.7 °C	11.3 %RH	208.76	9.12	5.56	20739.45	8820.66	2.44
14/07/2022	24.0 hrs	42.5 °C	11.9 %RH	212.64	9.15	5.90	19260.44	10417.45	2.02
15/07/2022	24.0 hrs	43.6 °C	11.7 %RH	211.91	9.28	5.86	20195.94	9946.28	2.29
16/07/2022	24.0 hrs	44.0 °C	10.4 %RH	211.26	9.64	5.96	21688.98	11318.08	1.97

*Note: refer to the supported document for hourly data.



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

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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			
	101,42		25,0	0,300	101,97		0,542			
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	71,19		25,0	0,300	71,65		0,646			
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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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