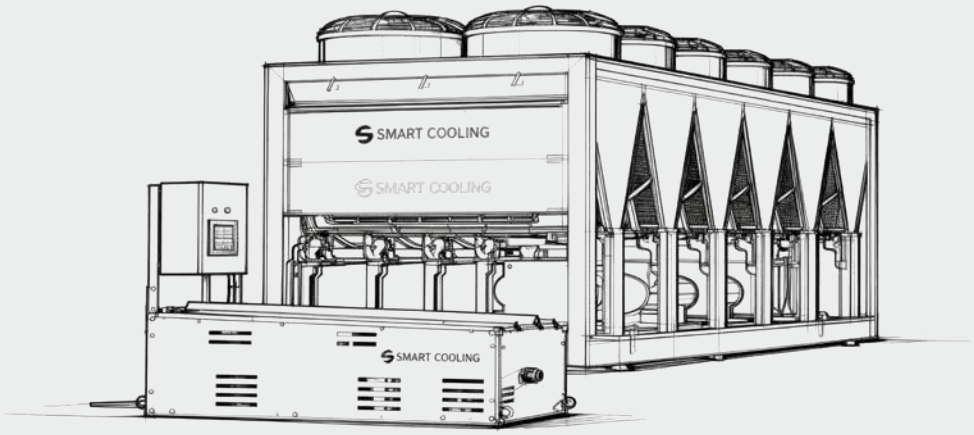
13 July 2021

TEST REPORT

156



SMART COOLING™ PRO10 SYSTEM

DU Al Qudra

Test Participants:
Project name: **DU AL QUDRA** Location: **Dubai, UAE**
Condor Building Contracting Enginee: **Sanal Kumar**
Gerab Energy Engineer: **Ali Soufan**
Swiss Integrated Energy Technologies: **Armands Mucenieks**

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Introduction:

Type of structure: DU Al Qudra Broadcasting Center, Dubai, United Arab Emirates
Cooling units: Air cooled water chiller **McQuay ATS 160 x3** and **DAIKIN EWAD660 x1**
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** 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:

An *Eniscope Analytics energy monitoring equipment* (BEST) was used to measure electricity consumption

.

Chiller **with** *Smart Cooling™ system*

Chiller **without** *Smart Cooling™ system*

- **Equipment tested:** Air-cooled water chillers.

Testing procedures

Testing has been carried out on the following chillers:

- Chiller 1 **McQuay ATS 160**
- Chiller 2 **McQuay ATS 160**
- Chiller 3 **McQuay ATS 160**
- Chiller 4 **DAIKIN EWAD660**

Testing period: *06/07/2021* to *06/14/2021* – adiabatic system *Smart Cooling™* switched **OFF**
Testing period: *06/21/2021* to *06/28/2021* – adiabatic system *Smart Cooling™* switched **ON**

Enscope:

- **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*.

- **Step 2**

Smart Cooling™ system is switched **OFF**

- **Step 3**

During the period between *06/07/2021* and *06/14/2021*, the test measured electricity usage data by the chillers with the intelligent adiabatic *Smart Cooling™* system in operation.
During this period, the chiller consumed **44.520 MW/h** of electricity, while water consumption was 0 m^3, and the average temperature during the period was **35° C**.

- **Step 4**

Smart Cooling™ system is switched **ON**

- **Step 5**

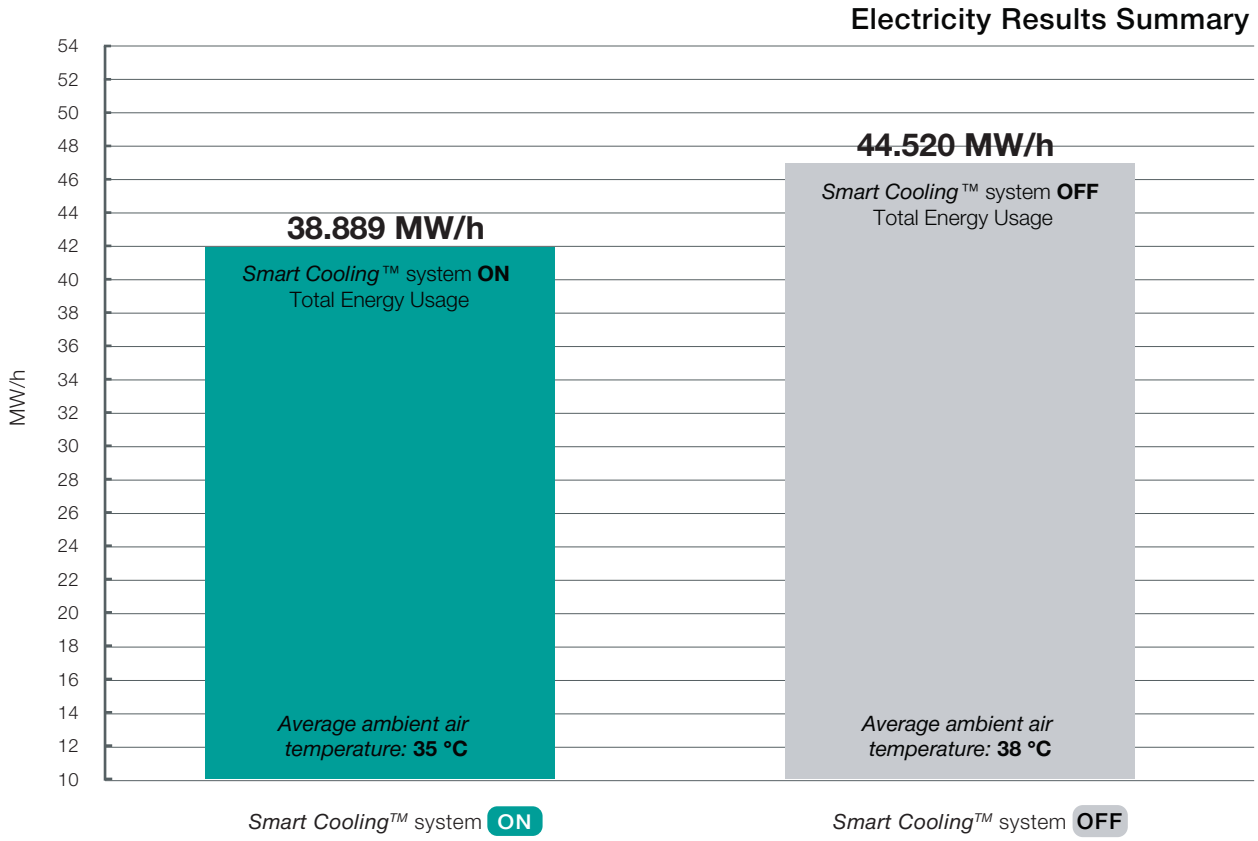
During the period between *06/21/2021* and *06/28/202*, the test measured electricity usage data by chillers with the intelligent adiabatic *Smart Cooling™* system turned **ON** During this period, the chiller consumed **38.889 MW/h** of electricity, while water consumption was 4**0 m³** and the average temperature during the period was **38° C**.

Temperature Sensors:

Condenser Air Inflow Sensor

Ambient Condition Sensor

Testing Results



Post-analysis of data monitoring shows the electricity savings generated by the *Smart Cooling™* system in 8 operation days is **5.63 MW/h** of electricity.
Within these 10 days, the customer **saved 5631 kW/h of electricity**.
At an electricity rate of **AED 0.45 per kW/h**, the total savings amount to **AED 2,534**.

To achieve this result, **54 m³ of water were used**, with water expenses of AED 10 per m³.
In total, **AED 400** were spent on water.

Testing Results

Smart Cooling™ **Test Report:** *Al Baywa Greenhouse, Alain, UAE*					**Electrical Consumption**
Status of *Smart Cooling*™	**ON**		**OFF**		15%
Test Duration	7 Days		7 Days		
	From	**To**	**From**	**To**	
	15.06.2021	21.06.2021	23.06.2021	29.06.2021	
Average Ambient Temperature	42 °C		41 °C		
Total Electrical Consumption	257,155 kW/h		295,236 kW/h		
Average Electrical Consumption Per Hour	1,531 kW/h		1,757 kW/h		
Total Water Consumption	280.0 m³		0.0 m³		

Chiller Operation During The Test:

During the test, a single chiller was mostly in operation. Thus, the ROI Calculation is based on the Daikin* **EWAD660MZP *chiller, as it is the unit with the highest operational hours during the test period (117 hours out of 192 hours).*

Chillers Operating	Hours
1 Chiller out of 4	153 Hours
2 Chillers out of 4	17 Hours
3 Chillers out of 4	22 Hours
4 Chillers out of 4	0 Hours
Test Duration (*8 Days*)	192 Hours

ROI:

	kW/h	**AED**	**Summary**
Actual Chiller savings in 8 Days	5,631 kW/h	0.45	2,534
	m³	**AED**	**Summary**
Actual water consumption in 8 Days	40 m³	10	400
	kW/h	**AED**	**Summary**
Projected Chillers savings per season (240 days)	168,941	0.45	76,023
	m³	**AED**	**Summary**
Projected water consumption per season (240 days)	1,200 m³	10	12,000
	QTY	**AED**	**Total**
Maintenance per year	1	6,460	6,460

- Net savings after all running costs for 1 Chillers: **AED 57,563**
- Cost of 1 adiabatic Smart Cooling™ delivered & installed: **AED 100,371**
- ROI Period (in calendar years, after all running costs for 1 Chillers): **1.74 year**
- Reduction of CO2 Emissions for 1 Chillers: **71 Ton**

**Note: For more details about test please refer to the supported document (Excel file).*

Review Of Air Entering Condenser Coils

Temperature Sensor recording the temperature entering Condensers was installed on chiller Number 3

DATE	AMBIENT CONDITION		TEMPERATURE ENTERING CONDENSERS	CHILLER 3 RUNNING STATUS	SMART COOLING STATUS	TEMPERATURE DROP
	T °C	H %				
Monday - 21/06/2021 00:00	33.1	14.1	31.3	OFF	OFF	
Monday - 21/06/2021 01:00	33.4	14.9	31.3	OFF	OFF	
Monday - 21/06/2021 02:00	32.4	25.8	30.9	OFF	OFF	
Monday - 21/06/2021 03:00	30.7	28.6	28.8	OFF	OFF	
Monday - 21/06/2021 04:00	30.8	34.8	28.8	OFF	OFF	
Monday - 21/06/2021 05:00	30.7	33.7	28.8	OFF	OFF	
Monday - 21/06/2021 06:00	30.8	23.0	28.8	OFF	OFF	
Monday - 21/06/2021 07:00	34.3	16.2	30.9	OFF	OFF	
Monday - 21/06/2021 08:00	37.9	25.4	37.3	OFF	OFF	
Monday - 21/06/2021 09:00	40.4	24.8	40.0	OFF	OFF	
Monday - 21/06/2021 10:00	43.4	21.5	27.7	ON	ON	16
Monday - 21/06/2021 11:00	45.9	17.8	40.4	OFF	OFF	
Monday - 21/06/2021 12:00	47.3	15.5	47.1	OFF	OFF	
Monday - 21/06/2021 13:00	47.9	13.8	48.0	OFF	OFF	
Monday - 21/06/2021 14:00	47.9	13.0	48.4	OFF	OFF	
Monday - 21/06/2021 15:00	47.6	19.1	48.1	OFF	OFF	
Monday - 21/06/2021 16:00	45.3	23.7	33.2	ON	ON	12
Monday - 21/06/2021 17:00	43.9	26.1	27.3	ON	ON	17
Monday - 21/06/2021 18:00	40.6	32.9	26.8	ON	ON	14
Monday - 21/06/2021 19:00	40.4	29.4	25.7	ON	ON	15
Monday - 21/06/2021 20:00	37.6	42.4	25.9	ON	ON	12
Monday - 21/06/2021 21:00	36.1	46.8	27.1	ON	ON	9
Monday - 21/06/2021 22:00	34.4	51.1	29.0	OFF	OFF	
Monday - 21/06/2021 23:00	33.3	59.7	30.0	OFF	OFF	
Tuesday - 22/06/2021 00:00	32.5	65.2	32.3	OFF	OFF	
Tuesday - 22/06/2021 01:00	31.2	67.9	30.0	OFF	OFF	
Tuesday - 22/06/2021 02:00	30.2	65.5	29.5	OFF	OFF	
Tuesday - 22/06/2021 03:00	29.6	66.0	29.2	OFF	OFF	
Tuesday - 22/06/2021 04:00	29.1	70.3	28.6	OFF	OFF	
Tuesday - 22/06/2021 05:00	28.1	68.9	26.8	OFF	OFF	
Tuesday - 22/06/2021 06:00	30.0	44.2	26.8	OFF	OFF	
Tuesday - 22/06/2021 07:00	34.0	29.4	30.9	OFF	OFF	
Tuesday - 22/06/2021 08:00	38.5	24.7	36.4	OFF	OFF	
Tuesday - 22/06/2021 09:00	40.7	23.0	40.6	OFF	OFF	
Tuesday - 22/06/2021 10:00	42.9	20.0	43.6	OFF	OFF	
Tuesday - 22/06/2021 11:00	44.8	18.2	46.0	OFF	OFF	
Tuesday - 22/06/2021 12:00	47.3	15.2	48.1	OFF	OFF	
Tuesday - 22/06/2021 13:00	48.2	13.5	48.5	OFF	OFF	
Tuesday - 22/06/2021 14:00	47.0	23.2	46.6	OFF	OFF	
Tuesday - 22/06/2021 15:00	45.3	30.2	32.1	ON	ON	13
Tuesday - 22/06/2021 16:00	43.3	34.1	29.0	ON	ON	14
Tuesday - 22/06/2021 17:00	43.7	28.2	27.0	ON	ON	17
Tuesday - 22/06/2021 18:00	41.7	23.4	28.2	OFF	OFF	
Tuesday - 22/06/2021 19:00	40.7	22.9	23.5	ON	ON	17
Tuesday - 22/06/2021 20:00	39.7	22.5	24.7	OFF	OFF	
Tuesday - 22/06/2021 21:00	38.9	23.1	36.0	OFF	OFF	

Tuesday - 22/06/2021 22:00	37.7	25.8	35.3	OFF	OFF	
Tuesday - 22/06/2021 23:00	36.3	34.8	34.0	OFF	OFF	
Wednesday - 23/06/2021 00:00	35.9	42.9	28.2	ON	ON	8
Wednesday - 23/06/2021 01:00	34.7	47.0	26.2	ON	ON	8
Wednesday - 23/06/2021 02:00	33.7	51.1	26.0	ON	ON	8
Wednesday - 23/06/2021 03:00	33.2	49.5	25.2	ON	ON	8
Wednesday - 23/06/2021 04:00	33.0	42.1	24.1	ON	ON	9
Wednesday - 23/06/2021 05:00	31.8	41.4	23.0	ON	ON	9
Wednesday - 23/06/2021 06:00	31.8	37.3	22.5	ON	ON	9
Wednesday - 23/06/2021 07:00	34.4	33.2	23.2	ON	ON	11
Wednesday - 23/06/2021 08:00	39.2	22.5	26.7	ON	ON	12
Wednesday - 23/06/2021 09:00	41.5	19.3	27.6	ON	ON	14
Wednesday - 23/06/2021 10:00	43.4	17.5	24.1	ON	ON	19
Wednesday - 23/06/2021 11:00	45.8	15.4	24.9	ON	ON	21
Wednesday - 23/06/2021 12:00	47.0	14.7	23.7	ON	ON	23
Wednesday - 23/06/2021 13:00	47.3	13.9	23.7	ON	ON	24
Wednesday - 23/06/2021 14:00	48.0	12.8	23.4	ON	ON	25
Wednesday - 23/06/2021 15:00	48.5	14.9	22.7	ON	ON	26
Wednesday - 23/06/2021 16:00	48.5	19.2	26.5	ON	ON	22
Wednesday - 23/06/2021 17:00	45.5	19.4	26.2	ON	ON	19
Wednesday - 23/06/2021 18:00	45.1	19.0	25.6	ON	ON	20
Wednesday - 23/06/2021 19:00	42.1	19.4	34.5	OFF	OFF	
Wednesday - 23/06/2021 20:00	40.5	21.1	25.5	ON	ON	15
Wednesday - 23/06/2021 21:00	39.3	22.6	23.3	ON	ON	16
Wednesday - 23/06/2021 22:00	37.8	23.2	24.3	OFF	OFF	
Wednesday - 23/06/2021 23:00	36.1	24.8	29.9	OFF	OFF	
Thursday - 24/06/2021 00:00	34.9	25.5	33.2	OFF	OFF	
Thursday - 24/06/2021 01:00	33.8	27.2	21.1	ON	ON	13
Thursday - 24/06/2021 02:00	33.0	28.0	21.8	ON	ON	11
Thursday - 24/06/2021 03:00	31.6	29.2	20.7	ON	ON	11
Thursday - 24/06/2021 04:00	31.1	30.5	20.3	ON	ON	11
Thursday - 24/06/2021 05:00	30.6	31.7	20.6	ON	ON	10
Thursday - 24/06/2021 06:00	31.4	30.6	20.8	ON	ON	11
Thursday - 24/06/2021 07:00	34.7	27.0	21.2	ON	ON	13
Thursday - 24/06/2021 08:00	40.0	22.5	29.0	ON	ON	11
Thursday - 24/06/2021 09:00	42.3	19.0	29.3	ON	ON	13
Thursday - 24/06/2021 10:00	43.9	17.5	28.9	ON	ON	15
Thursday - 24/06/2021 11:00	45.4	15.0	26.1	ON	ON	19
Thursday - 24/06/2021 12:00	46.7	14.2	23.6	ON	ON	23
Thursday - 24/06/2021 13:00	48.2	12.2	23.3	ON	ON	25
Thursday - 24/06/2021 14:00	48.7	15.5	23.0	ON	ON	26
Thursday - 24/06/2021 15:00	47.1	21.2	27.5	ON	ON	20
Thursday - 24/06/2021 16:00	45.7	28.7	28.4	ON	ON	17
Thursday - 24/06/2021 17:00	41.1	37.0	28.1	ON	ON	13
Thursday - 24/06/2021 18:00	40.7	33.1	26.6	ON	ON	14
Thursday - 24/06/2021 19:00	38.7	34.5	27.8	OFF	OFF	
Thursday - 24/06/2021 20:00	38.1	34.5	25.6	ON	ON	13
Thursday - 24/06/2021 21:00	36.4	38.6	25.8	ON	ON	11
Thursday - 24/06/2021 22:00	34.8	40.6	27.3	OFF	OFF	
Thursday - 24/06/2021 23:00	33.5	43.3	24.8	ON	ON	9
Friday - 25/06/2021 00:00	32.3	45.3	25.5	OFF	OFF	
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Friday - 25/06/2021 02:00	31.5	47.4	26.8	OFF	OFF	
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Friday - 25/06/2021 06:00	31.8	32.3	28.4	OFF	OFF	
Friday - 25/06/2021 07:00	34.5	28.4	32.1	OFF	OFF	
Friday - 25/06/2021 08:00	38.1	26.2	36.0	OFF	OFF	
Friday - 25/06/2021 09:00	40.7	22.5	40.0	OFF	OFF	
Friday - 25/06/2021 10:00	42.8	19.3	42.6	OFF	OFF	
Friday - 25/06/2021 11:00	44.9	15.9	35.8	ON	ON	9
Friday - 25/06/2021 12:00	47.0	12.9	25.8	ON	ON	21
Friday - 25/06/2021 13:00	48.2	12.2	47.8	OFF	OFF	
Friday - 25/06/2021 14:00	45.8	24.4	46.2	OFF	OFF	
Friday - 25/06/2021 15:00	44.4	27.5	45.0	OFF	OFF	
Friday - 25/06/2021 16:00	43.2	27.8	44.3	OFF	OFF	
Friday - 25/06/2021 17:00	41.3	33.8	41.6	OFF	OFF	
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Saturday - 26/06/2021 05:00	27.3	62.3	26.0	OFF	OFF	
Saturday - 26/06/2021 06:00	29.1	43.6	26.7	OFF	OFF	
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Saturday - 26/06/2021 09:00	40.1	22.6	39.7	OFF	OFF	
Saturday - 26/06/2021 10:00	42.1	21.7	42.6	OFF	OFF	
Saturday - 26/06/2021 11:00	44.2	19.0	44.8	OFF	OFF	
Saturday - 26/06/2021 12:00	45.6	16.7	46.1	OFF	OFF	
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Sunday - 27/06/2021 00:00	31.5	26.1	30.4	OFF	OFF	
Sunday - 27/06/2021 01:00	31.9	24.2	30.8	OFF	OFF	
Sunday - 27/06/2021 02:00	31.9	23.1	31.1	OFF	OFF	
Sunday - 27/06/2021 03:00	31.5	25.9	30.5	OFF	OFF	
Sunday - 27/06/2021 04:00	32.6	28.5	31.4	OFF	OFF	
Sunday - 27/06/2021 05:00	33.7	28.2	32.8	OFF	OFF	
Sunday - 27/06/2021 06:00	33.9	31.8	33.6	OFF	OFF	
Sunday - 27/06/2021 07:00	34.9	33.5	34.3	OFF	OFF	
Sunday - 27/06/2021 08:00	36.7	31.8	36.3	OFF	OFF	
Sunday - 27/06/2021 09:00	38.9	28.9	38.9	OFF	OFF	
Sunday - 27/06/2021 10:00	40.8	25.3	41.2	OFF	OFF	
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Sunday - 27/06/2021 23:00	34.8	28.3	33.8	OFF	OFF	
Monday - 28/06/2021 00:00	34.9	25.0	34.2	OFF	OFF	
Monday - 28/06/2021 01:00	33.4	26.6	32.3	OFF	OFF	
Monday - 28/06/2021 02:00	32.3	28.2	31.6	OFF	OFF	
Monday - 28/06/2021 03:00	31.7	29.9	31.0	OFF	OFF	
Monday - 28/06/2021 04:00	31.9	33.8	30.9	OFF	OFF	
Monday - 28/06/2021 05:00	32.4	40.5	32.1	OFF	OFF	
Monday - 28/06/2021 06:00	32.2	46.5	32.0	OFF	OFF	
Monday - 28/06/2021 07:00	32.8	46.6	32.5	OFF	OFF	
Monday - 28/06/2021 08:00	34.2	43.5	33.8	OFF	OFF	
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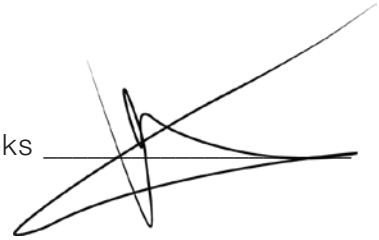
Monday - 28/06/2021 22:00	35.1	43.7	34.4	OFF	OFF	
Monday - 28/06/2021 23:00	33.8	46.3	33.3	OFF	OFF	

Conclusion:

Test results data shows that the intelligent adiabatic *Smart Cooling*™ system decreased the chiller electricity consumption by **14.5%**, on average, during 24 operational hours.

Armands Mucenieks
July 13, 2021



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			
	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