12 September 2022

TEST REPORT
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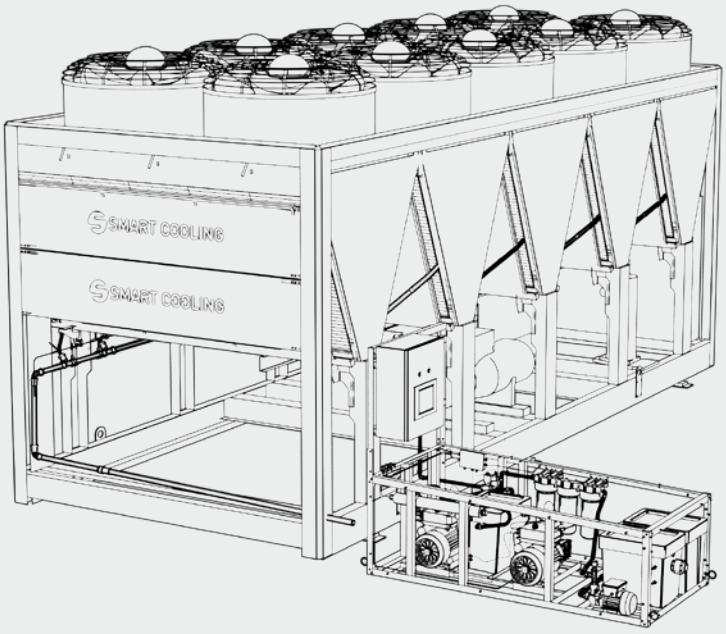

SMART COOLING™ PRO10 SYSTEM

AENA Madrid Airport

Test Participants:
Project name: **AENA TERMINAL T3 CHILLER** Location: **Madrid, Spain**
Customer: **AENA (SPANISH AIRPORT AUTHORITY)**
Organization Responsible: **iON Smart Energy**
Measurement & Verification: **Abel Bascuñana Avila**

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Introduction:

Type of structure: AENA Madrid Barajas Airport, Terminal T3.
Cooling units: Air cooled water chiller **TRANE RTAC 185.**
Chiller booster: *Smart Cooling™ PRO 10*, adiabatic technology with condenser protection (BY70).

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:

All measurements were collected via the ***blauLabs*** Energy Management Platform, recording quarter-hourly data:

- Active Energy (kWh)
- Power (kW)
- Water consumption (m^3)
- Temperature (°C)
- Relative Humidity (%RH)

- **Formula:**
  COP = Cooling (kW) ÷ Electrical (kW)

Temperature/RH sensor with M-Bus protocol

M-Bus GPRS Gateway Cme2100

Network Analyzer with M-Bus protocol

COMBI water meter with M-Bus protocol

Equipment tested: Air-cooled water chillers, **TRANE RTAC 185**.

- The chiller's condensers fully enveloped by ***Smart Cooling's***™ protective membranes, which prevent water mist infiltration and damage.

- In the foreground is the ***Smart Cooling***™ pump station, pumping meticulously treated water at 70-bar pressure.

- The system is equipped with an automated Siemens controller.

- The system also includes a water drain line to re-filter and safely reuse water.

The *blauLabs* Energy Management platform was used to capture, register and monitor data.

blauLabs energy management platform

Testing *Smart Cooling*™**:**

Between *24/07/2016 - 03/09/2016*,a full M&V evaluation (IPMVP Option B) was conducted to measure efficiency improvements after installing the *Smart Cooling*™ adiabatic system.
The evaluation compared the chiller's electrical consumption with *Smart Cooling*™ **OFF** vs. **ON**, adjusted for outdoor temperature as required by the IPMVP protocol.

The *Smart Cooling*™ system improves chiller efficiency through intelligent adiabatic pre-cooling and condenser air temperature reduction. This reduces compressor load and improves the system's kW/TR performance.

System activation logic:
Smart Cooling™ activates when outdoor temperature **≥ 24°C**, using three algorithms:

- 24–27°C
- 27–32°C
- >32°C

Key results:

- Savings with 2 compressors operating: **13.2% reduction in kWh/°C**
- Savings with 1 compressor operating: **4.10% reduction in kWh/°C**
- Estimated monthly energy savings: **19,315.82 kWh**
- Monetary savings: **€2,124.74 / month**

Air cooled water chiller
TRANE RTAC 185

Testing Data:

System with 2 compressors:

- OFF period: *24/07/2016 - 31/07/2016*
- ON period: *01/08/2016 - 08/08/2016*

Both periods showed nearly identical environmental conditions.

Key findings:

Average Outdoor Temperatures

OFF : **31.816°C**

ON : **31.491°C31.491°C**

Measurement data system OFF with two operating compressors

Day	System	Average temperature	Total *kWh*	Average *kWh*	Average *kWh/°C*
24 Jul	OFF	31.746	3999.7	215.100	6.776
25 Jul	OFF	30.618	4898.1	203.179	6.636
26 Jul	OFF	32.126	4958.6	206.604	6.431
28 Jul	OFF	35.628	4227.4	209.992	5.894
29 Jul	OFF	33.354	4643.2	196.209	5.883
30 Jul	OFF	31.532	4842.3	202.117	6.410
31 Jul	OFF	29.889	4891.9	204.859	6.854
9 Aug	OFF	29.635	4566.1	187.850	6.339
8		31.816	37027.3	203.239	6.403
Total days		Average	Total	Average	Average

Measurement data system ON with two operating compressors

Day	System	Average temperature	Total *kWh*	Total *m³*	Average *kWh*	Average *kWh/°C*
1 Aug	ON	33.350	4317.3	2.512	186.125	5.581
2 Aug	ON	31.833	4124.9	5.372	172.038	5.404
3 Aug	ON	30.581	2444.3	3.87	158.362	5.178
4 Aug	ON	33.353	2791.2	3.546	200.350	6.007
5 Aug	ON	31.006	3514.1	4.915	145.996	4.709
6 Aug	ON	33.084	3512.7	2.087	188.079	5.685
7 Aug	ON	31.103	4293.6	2.456	191.148	6.146
8 Aug	ON	27.621	4601.3	1.128	158.136	5.725
8		31.491	29599.4	25.886	175.029	5.554
Total days		Average		Total	Average	Average

Measurement data system OFF with two operating compressors

Day	System	Average temperature	Total *kWh*	Average *kWh*	Average *kWh/°C*
16 Aug	OFF	29.405	2978.8	124.408	4.231
17 Aug	OFF	29.214	2328.7	96.604	3.307
18 Aug	OFF	29.546	2724.5	114.192	3.865
19 Aug	OFF	29.780	2812.8	117.029	3.930
20 Aug	OFF	29.970	3033.1	107.850	3.599
21 Aug	OFF	28.856	2584.6	107.850	3.737
22 Aug	OFF	29.980	2717.5	113.271	3.778
23 Aug	OFF	30.701	2816.5	115.933	3.776
8		29.681	21996.5	112.142	3.778
Total days		Average	Total	Average	Average

Measurement data system ON with two operating compressors

Day	System	Average temperature	Total *kWh*	Total *m^3*	Average *kWh*	Average *kWh/°C*
13 Aug	ON	28.662	2387.7	3.139	100.392	3.503
14 Aug	ON	28.093	2685.7	3.218	111.879	3.982
29 Aug	ON	30.833	2866	3.078	118.350	3.838
30 Aug	ON	28.893	2392.7	3.12	99.208	3.434
31 Aug	ON	29.351	2483.2	3.054	103.642	3.531
1 Sep	ON	29.285	2579	3.053	107.254	3.662
2 Sep	ON	29.633	2498.2	3.064	104.446	3.525
3 Sep	ON	30.210	2544.1	3.141	106.013	3.509
8		29.370	20436.6	24.867	106.398	3.623
Total days		Average		Total	Average	Average

Conclusion:

The *Smart Cooling*™ system demonstrated clear efficiency gains.
With both compressors operating, it achieved **13.20%** energy savings, and with one compressor, **4.10%**. Based on the reference consumption, this corresponds to an estimated **19,315.82 kWh** of energy saved per month and about **€2,124.74** in monthly cost reduction.

Overall, *Smart Cooling*™ effectively reduced the chiller's kWh/°C ratio and improved performance under comparable outdoor conditions.

Annex:

CMVP®

The Efficiency Valuation Organization

EVO

y

The Association of Energy Engineers

aee

Certifican que

Abel Bascuñana Avila

Ha completado con éxito la certificación de profesional en medida y verificación, ha demostrado un alto nivel de competencia y aptitud ética en el dominio de la medida y la verificación y se concede el título de

Profesional certificado en medida y verificación*

Válido hasta: December 31, 2016

2604

Presidente de la junta de EVO

Presidente de la junta del programa CMVP

Director de la certificación internacional

EVO

ASSOCIATION OF ENERGY ENGINEERS CORPORATE SEAL GEORGIA

*CMVP –Certified Measurement and Verification Professional