09 September 2017

TEST REPORT
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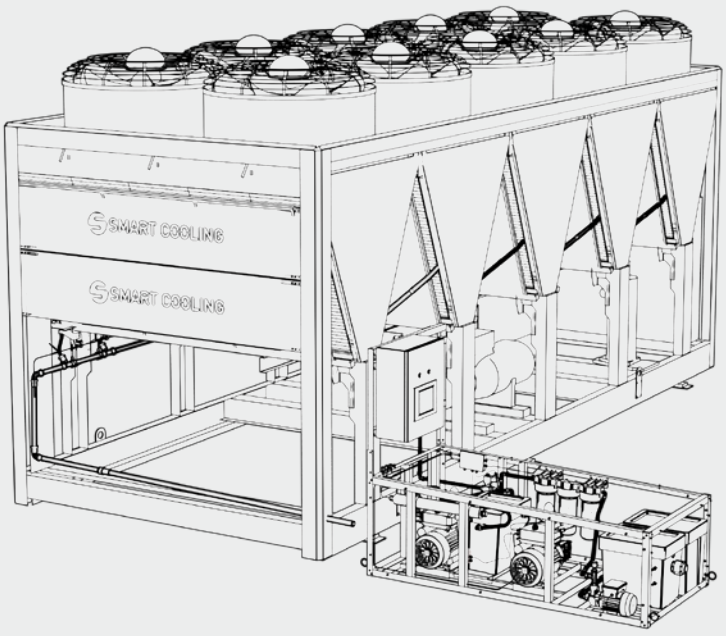

SMART COOLING™ PRO10 SYSTEM

NOVOTEL, IBIS Hotels

Test Participants:
Project name: **NOVOTEL / IBIS FUJAIRAH** Location: **Fujairah, UAE**
Organization Responsible: **Ecovis Engineering Ltd**
Compiled by: **Alexander Alzamora**

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Introduction:

Type of structure: Hotel complex with air-cooled water chillers.
Cooling units: Air cooled water chiller **Petra APSa 325-2.**
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.

System installation on chiller condensers

Existing chillers on site

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 using the following set of professional diagnostic tools:

- **ENICOPE analytics energy measurement system** — main platform for real-time energy logging (kWh, temperatures, humidity, load profiles).
- **Cooling power calculator** — modules for evaluating cooling capacity and operating parameters of the chiller.
- **Ultrasonic flowmeter RIF 600** — non-intrusive ultrasonic sensor for measuring chilled-water flow.
- **Thermal camera Testo 882** — used to detect condenser surface temperatures and visualize temperature drop provided by Smart Cooling™.
- **Clip-on current probes (ENICOPE sensors)** — for measuring electrical load and phase consumption on chiller power lines.

ENICOPE analytics

Cooling power calculator

Thermal camera Testo 882

Current sensors, clip-on probes

Ultrasonic flowmeter RIF 600

Testing *Smart Cooling*™**:**

Step 1 — Installation of data logging equipment
A data logger was installed on the **PETRA APSa 325-2** chiller system to collect all real-time energy consumption and operational parameters.
Measurements were recorded using the ENICOPE analytics energy monitoring platform.

Step 2 — Measurement period with *Smart Cooling*™ **OFF**
The first 4 days (96 hours) were monitored without the Smart Cooling™ system. During this period:

- Electrical consumption: 44,264 kWh
- Water consumption: 0 m³
- Average temperature: 36.56°C
- Average humidity: 39.9% RH

Step 3 — Activation of *Smart Cooling*™ system
The adiabatic pre-cooling system *Smart Cooling*™ BY-70 was switched **ON**

Step 4 — Measurement period with *Smart Cooling*™ **ON**
The next 4 days (96 hours) were monitored with the system operating.
During this period:

- Electrical consumption: 34,955 kWh
- Water consumption: 69 m³
- Average temperature: 36.28°C
- Average humidity: 41.32% RH

Step 5 — Comparative analysis
Energy consumption for both 4-day periods was compared under similar temperature and humidity conditions.
The measured energy savings delivered by *Smart Cooling*™ over the 4-day **ON** period were: 9,308 kWh saved

Air cooled water chiller
Petra APSa 325-2

Testing Data:

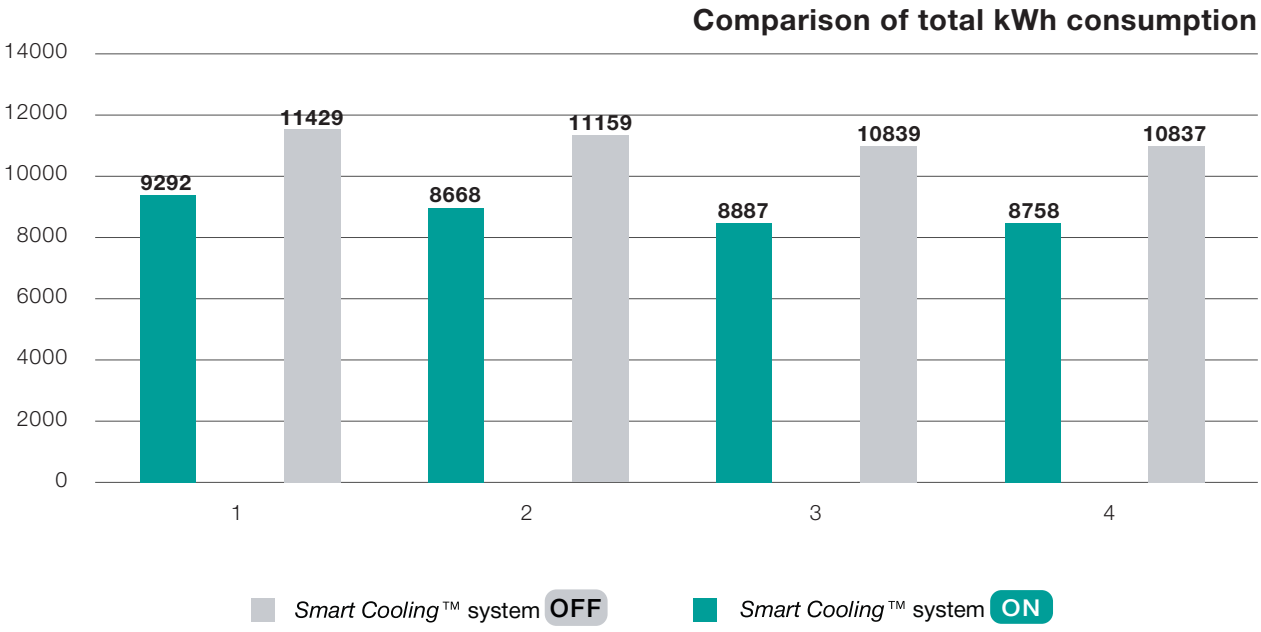
Comparison of total KWh consumed by rack «B» chiller system for 4 consecutive days with adiabatic pre-cooling system **OFF** – to 4 consecutive days with adiabatic system **ON** (with comparative temp. & RH data).

- **Equipment tested:** Air cooled water chillers **Petra APSa 325-2**.

Date	System	Time	Average Temp C	Average Humidity HR%	Saving KWh	Saving %	Hrs used per test	KWh used per test	Rain	m3 Water consumption
08.09.2017	OFF	15:01	36.20	41.55	0	0	22:15:00	11429	No	0
09.09.2017	OFF	15:00	36.01	39.47	0	0	45:15:00	11159	No	0
10.09.2017	OFF	15:04	36.60	38.52	0	0	72:00:00	10839	No	0
11.09.2017	OFF	15:00	37.42	40.40	0	0	96:00:00	10837	No	0
Total					**0**			**44264**		**0**

Date	System	Time	Average Temp C	Average Humidity HR%	Saving KWh	Saving %	Hrs used per test	KWh used per test	Rain	m3 Water consumption
15.09.2017	ON	14:00	36.09	42.58	2137	19%	96:00:00	9292	No	17.42
16.09.2017	ON	14:03	36.69	45.40	2209	21%	120:00:00	8868	No	15.80
17.09.2017	ON	14:05	35.25	39.57	2501	23%	144:00:00	8387	No	18.34
18.09.2017	ON	14:00	36.49	43.04	2379	22%	167:00:00	8458	No	17.99
Total					**9226**	**21.25%**		**35005**		**69.55**

Comparison of total KWh consumed by rack «B» chiller system for 4 consecutive days with adiabatic pre-cooling system **OFF** – to 4 consecutive days with adiabatic system **ON** (with comparative temperature & RH data).



Chillers energy consumption

16.09.2017 Smart Cooling™ system **ON** *vs 09.09.2017 Smart Cooling™ system* **OFF**

		Adiabatic on	Adiabatic OFF	Difference in %	Adiabatic on	Adiabatic OFF	Difference in %	Adiabatic on	Adiabatic OFF	Difference in %
date	timestamp	Chiller 6 - E	Chiller 6 08/09/2017		chiller 3 - E	chiller 3 08/09/2017		chiller 3 - E	chiller 3 09/09/2017	
16.09.2017 00:00	1505505600	150544	226359	33%	113379	151486	25%	107821	50565	
16.09.2017 01:00	1505509200	146580	223988	34%	95372	150135	36%	105127	50356	
16.09.2017 02:00	1505512800	147089	223513	34%	92127	149811	39%	85383	28478	
16.09.2017 03:00	1505516400	145309	221858	34%	91080	150338	39%	87734	47320	
16.09.2017 04:00	1505520000	148356	219116	33%	90557	150230	40%	68561	38316	
16.09.2017 05:00	1505523600	160804	219555	27%	89824	150644	40%	74120	51089	
16.09.2017 06:00	1505527200	183312	221900	17%	92548	150649	39%	80088	51717	
16.09.2017 07:00	1505530800	179124	226865	21%	93279	153580	39%	80925	52348	
16.09.2017 08:00	1505534400	177554	278580	36%	115473	177554	35%	84360	61558	
16.09.2017 09:00	1505538000	184045	283186	35%	120289	184778	35%	110238	62186	
16.09.2017 10:00	1505541600	189929	278941	34%	119481	185824	36%	110238	61244	
16.09.2017 11:00	1505545200	188651	284338	34%	120289	184045	35%	111390	61662	
16.09.2017 12:00	1505548800	191581	278312	31%	122173	184359	34%	113274	62081	
16.09.2017 13:00	1505552400	188251	282144	33%	121291	183207	34%	113170	62605	
16.09.2017 14:00	1505556000	187290	278789	33%	121126	181370	34%	113379	62081	
16.09.2017 15:00	1505559600	187340	278580	33%	120603	173262	30%	113274	61558	
16.09.2017 16:00	1505563200	231469	282159	18%	118300	165526	28%	110762	60919	
16.09.2017 17:00	1505566800	234978	278105	16%	117881	161015	27%	110543	60615	
16.09.2017 18:00	1505570400	220886	275135	20%	115682	160804	28%	108554	59778	
16.09.2017 19:00	1505574000	217650	277951	22%	113579	158919	28%	74748	61767	
16.09.2017 20:00	1505577600	217231	269158	19%	112846	158814	29%	85117	62395	
16.09.2017 21:00	1505581200	215242	275879	21%	111589	155778	28%	84489	62136	
16.09.2017 22:00	1505584800	216917	268948	19%	112125	155150	28%	84908	26068	
16.09.2017 23:00	1505588400	192638	249581	39%	104271	154105	32%	84489	49917	
	TOTAL IN KW/H	4457	6200	28%	2625	3930	33%	2210	1299	
	Difference in KW/H	1743			1306			-912		
	Total consumtion OFF 24H				1 14 29					
	Total consumtion ON 24H				92 92					19%
	Difference Kw/h total 3 units in 24h				21 37					

Chillers energy consumption

17.09.2017 Smart Cooling™ system **ON** *vs 10.09.2017 Smart Cooling™ system* **OFF**

		Adiabatic on	Adiabatic OFF	Difference in %	Adiabatic on	Adiabatic OFF	Difference in %	Adiabatic on	Adiabatic OFF	Difference in %
date	timestamp	Chiller 6 - E	Chiller 6 10/09/-11/09		chiller 3 - E	Chiller 6 10/09/-12/09		chiller 3 - E	Chiller 6 10/09/-13/09	
17.09.2017 00:00	1505592000	114217	233354	51%	92022	153057	40%	63756	32768	
17.09.2017 01:00	1505595600	127931	233144	45%	90661	154103	41%	63861	40620	
17.09.2017 02:00	1505599200	174099	235447	26%	92650	154103	40%	65012	25858	
17.09.2017 03:00	1505602800	185301	231469	20%	91604	153114	40%	65536	26470	
17.09.2017 04:00	1505606400	182160	229689	21%	91708	152638	40%	64698	21252	
17.09.2017 05:00	1505610000	182893	229375	20%	96733	151591	36%	61558	27952	
17.09.2017 06:00	1505613600	182998	228957	20%	112542	151905	26%	67734	47948	
17.09.2017 07:00	1505617200	188546	233458	19%	114321	153685	26%	76005	52868	
17.09.2017 08:00	1505620800	222780	240787	7%	115473	175251	34%	109087	55381	
17.09.2017 09:00	1505624400	226653	255338	11%	117567	191687	39%	112646	63023	
17.09.2017 10:00	1505628000	233563	262667	11%	120603	183626	34%	114217	53337	
17.09.2017 11:00	1505631600	234505	262248	11%	121440	185720	35%	112227	64908	
17.09.2017 12:00	1505635200	233668	262147	11%	122173	169388	28%	113274	63023	
17.09.2017 13:00	1505638800	232621	265912	13%	122068	161432	24%	114635	63547	
17.09.2017 14:00	1505642400	181113	271984	33%	120184	164468	27%	115892	63547	
17.09.2017 15:00	1505646000	151277	272298	44%	117462	183521	36%	115578	62081	
17.09.2017 16:00	1505649600	153475	272194	44%	121440	177135	31%	96003	61024	
17.09.2017 17:00	1505653200	150649	278161	46%	119870	170854	30%	68572	59883	
17.09.2017 18:00	1505656800	145205	267587	46%	118195	156721	25%	67211	42190	
17.09.2017 19:00	1505660400	146880	264028	44%	116310	157139	26%	66792	52240	
17.09.2017 20:00	1505664000	140389	263818	47%	109610	156825	30%	67106	51717	
17.09.2017 21:00	1505667600	143844	262353	45%	109401	155883	30%	79460	51507	
17.09.2017 22:00	1505671200	143949	261934	45%	102491	155360	34%	78622	37898	
17.09.2017 23:00	1505674800	141331	250313	44%	74539	154941	52%	77575	33710	
	TOTAL IN KW/H	4720	6069	30%	2611	3923	33%	2037	1167	
	Difference in KW/H	1849			1312			-870		
	Total consumtion OFF 24H				1 11 59					
	Total consumtion ON 24H				88 68					21%
	Difference Kw/h total 3 units in 24h				22 90					

Chillers energy consumption

18.09.2017 Smart Cooling™ system **ON** *vs 11.09.2017 Smart Cooling™ system* **OFF**

		Adiabatic on	Adiabatic OFF	Differnece in %	Adiabatic on	Adiabatic OFF	Differnece in %	Adiabatic on	Adiabatic OFF	Differnece in %
date	timestamp	chiller 6 - E	chiller 6 11/09/2017		chiller 2 - E	chiller 2 08/09/2017		chiller 3 - E	chiller 3 08/09/2017	
18.09.2017 01:00	1505682000	137353	235345	42%	72445	153899	53%	79355	19857	
18.09.2017 02:00	1505685600	141750	230517	39%	71715	155560	54%	78622	41981	
18.09.2017 03:00	1505689200	135575	232850	42%	71294	154627	54%	78413	33710	
18.09.2017 04:00	1505692800	141017	228558	38%	71922	153324	53%	78517	19891	
18.09.2017 05:00	1505696400	142064	228224	38%	72027	151905	53%	78622	14288	
18.09.2017 06:00	1505700000	135992	226653	40%	72541	152324	53%	78831	17795	
18.09.2017 07:00	1505703600	184572	230631	29%	81972	153999	47%	79250	30670	
18.09.2017 08:00	1505707200	182474	240877	24%	113274	187709	40%	80718	58522	
18.09.2017 09:00	1505710800	210741	272508	23%	114112	176507	35%	94326	56478	
18.09.2017 10:00	1505714400	228957	276800	17%	116520	143425	19%	110887	56897	
18.09.2017 11:00	1505718000	221524	277742	20%	114112	164258	31%	109181	67734	
18.09.2017 12:00	1505721600	144577	278894	48%	114112	182684	38%	109181	67734	
18.09.2017 13:00	1505725200	133480	279212	52%	113065	181056	38%	90033	67650	
18.09.2017 14:00	1505728800	136618	279208	44%	112960	179543	37%	76528	67650	
18.09.2017 15:00	1505732400	187709	277533	32%	112856	179962	37%	101340	67630	
18.09.2017 16:00	1505736000	217964	280359	22%	110871	179857	38%	115264	67001	
18.09.2017 17:00	1505739600	212520	283800	25%	110029	178601	38%	108401	65641	
18.09.2017 18:00	1505743200	207914	271147	23%	108563	174099	38%	75795	61976	
18.09.2017 19:00	1505746800	209638	265598	22%	108877	154841	30%	78099	55067	
18.09.2017 20:00	1505750400	207391	251465	18%	109401	155674	30%	110134	59468	
18.09.2017 21:00	1505754000	204883	236076	13%	108354	157454	31%	98304	52051	
18.09.2017 22:00	1505757600	162897	233040	30%	96838	155569	38%	67211	51193	
18.09.2017 23:00	1505761200	138714	232411	40%	89910	152475	41%	68572	48681	
	TOTAL IN KW/H	4023	5849	31%	2287	3780	40%	2047	1209	
	Difference in KW/H	1825			1513			-837		
	Total consumtion OFF 24H				1 08 39					
	Total consumtion ON 24H				83 37					23%
	Difference Kw/h total 3 units in 24h				25 01					

Chillers energy consumption

19.09.2017 Smart Cooling™ system **ON** *vs 12.09.2017 Smart Cooling™ system* **OFF**

		Adiabatic on	Adiabatic OFF	Differnece in %	Adiabatic on	Adiabatic OFF	Differnece in %	Adiabatic on	Adiabatic OFF	Differnece in %
date	timestamp	chiller 6 - E	chiller 6 12/09/2017		chiller 2 - E	chiller 2 08/09/2017		chiller 3 - E	chiller 3 08/09/2017	
19.09.2017 00:00	1505764800	140703	230108	39%	89510	143111	37%	68792	40410	
19.09.2017 01:00	1505768400	142483	216499	34%	89510	141959	37%	67211	37060	
19.09.2017 02:00	1505772000	146461	212102	31%	88149	143216	38%	66478	43237	
19.09.2017 03:00	1505775600	141645	211284	33%	89929	143216	37%	69723	38476	
19.09.2017 04:00	1505779200	137582	210950	35%	90138	142483	37%	68467	18425	
19.09.2017 05:00	1505782800	141017	209275	33%	90452	141331	36%	68781	21199	
19.09.2017 06:00	1505786400	164886	208856	21%	102957	142169	27%	80821	37219	
19.09.2017 07:00	1505790000	170854	211997	19%	109934	143844	24%	80192	51403	
19.09.2017 08:00	1505793600	175157	235238	26%	112437	147927	24%	81667	55287	
19.09.2017 09:00	1505797200	177854	276691	36%	114321	164886	31%	83857	60092	
19.09.2017 10:00	1505800800	213567	282348	24%	116310	171168	32%	86578	61244	
19.09.2017 11:00	1505804400	232621	283500	18%	120079	172424	30%	88777	61767	
19.09.2017 12:00	1505808000	238169	282663	16%	123011	173262	29%	91080	61958	
19.09.2017 13:00	1505811600	237122	282977	16%	124476	170644	27%	93441	61662	
19.09.2017 14:00	1505815200	235133	283081	17%	123487	170854	28%	91918	61179	
19.09.2017 15:00	1505818800	154522	284338	46%	120184	172215	30%	90975	60720	
19.09.2017 16:00	1505822400	133081	288944	54%	120707	168027	28%	90871	60720	
19.09.2017 17:00	1505826000	137144	275783	50%	118718	166457	29%	88882	59359	
19.09.2017 18:00	1505829600	134736	272612	51%	117985	163526	28%	87521	56553	
19.09.2017 19:00	1505833200	136201	240787	43%	105015	162060	36%	86788	39573	
19.09.2017 20:00	1505836800	135573	235657	42%	87362	161118	46%	87311	50251	
19.09.2017 21:00	1505840400	134845	232097	42%	96001	158396	39%	87207	49625	
19.09.2017 22:00	1505844000	137144	225188	39%	89582	161177	37%	86893	49623	
19.09.2017 23:00	1505847600	136087	216499	37%	83802	147913	36%	85950	43995	
	TOTAL IN KW/H	3832	5809		2548	3763		1977	1165	
	Difference in KW/H	1977			1215			-813		
	Total consumtion OFF 24H				1 08 37					
	Total consumtion ON 24H				84 58					22%
	Difference Kw/h total 3 units in 24H				23 79					

Conclusion:

The *Smart Cooling*™ adiabatic pre-cooling system demonstrated a clear and measurable improvement in chiller efficiency during the testing period.
Across two comparable four-day cycles, the system reduced electrical consumption from **44,264 kWh** OFF to **34,955 kWh** ON, resulting in a total saving of **9,308 kWh** over the 4-day ON period.

Based on these results, the projected monthly savings amount to **69,195 kWh**, corresponding to **USD 7,611.45** at an electricity rate of **$0.11/kWh**.
The reduction in energy use equates to a decrease of more than 13,000 pounds of CO_2 emissions per month.

Considering the achieved savings, the Return on Investment (ROI) for installing the *Smart Cooling*™ system at this site is estimated to be 12 months.

Smart Cooling™ effectively lowered chiller energy consumption under similar temperature and humidity conditions, confirming its ability to enhance system efficiency and reduce operating costs.

Alexander Alzamora
September 20, 2017