Review of

TRANE RTWD-200HE
XX Hotel XX

Analyses and visualization of the process is done with

ClimaCheck *online*

ESG Management summary

Measurements have been collected from the Chiller Trane RTWD-200HE in (undisclosed) hotel environment. The SEI (System Efficiency Index) at the low load conditions in the measurement reaches only 30% and stays far below the desirable 45% at full load to 30%: **the efficiency loss in this chiller is 33%!**

On the following page we list our recommendations to reach the desirable SEI of 45%.

Assuming an average of 40% load around the year on this relatively small unit with 130 kW electricity uptake, the annual expected electricity consumption of this chiller is 450,000 kWh.

Based on mentioned 33% efficiency loss this chiller, although functioning well in terms of delivering the expected cooling, currently has an avoidable annual waste that is greater than 150,000 kWh on electricity (excluding wasted energy from pumps)

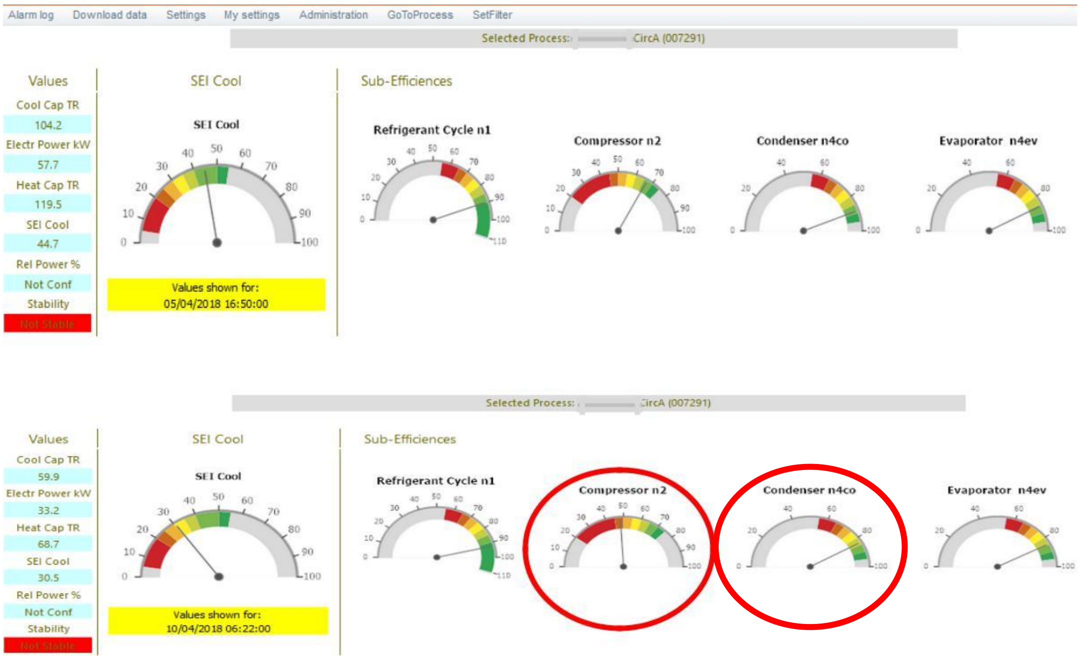
Monetary value of the avoidable waste:

- Electricity cost: 150,000 kWh @ US$ 0.11: US$ 16,500
- Carbon Tax: 58,350 kg CO_2 @ US$ 51/MT: US$ 2,975 (PM)

NOTE: at the time of this report carbon taxes are not (yet) applicable and the rate indicated is based on expectations.

Main Recommendations for Efficiency improvement

Avoid running at low loads:
The chiller gives relatively high performance at full load but is not performing well at the loads dominating at the conditions measured so far. Below dashboard show difference of SEI and sub efficiencies at full versus part load (for Circuit A - Circuit B has only operated at part load).
Review chiller sequencing and consider additional small size chiller to handle low loads. Alternatively, use thermal storage.



Avoid Condenser fouling:
The condenser performance is lower than expected for an efficient chiller at full load, caused by a high approach temperature. High approach indicates **fouling of condenser** (otherwise small surfaces by design). Regular cleaning and cooling water management is recommended in combination with automatic condenser cleaning system.

Reduce cooling water flow, save pumping electricity;
Water flow is high versus what would be expected to be optimal for the part load condition. Significant saving potential in pump energy possible through flow reduction within allowed flow range for chiller and system.

Decrease sensitivity of capacity controls:
Control of capacity as well as cooling water temperature is at periods unstable and could be improved – rapid changes in capacity is not desired in chilled water systems. Evaporation is fluctuating several degrees as a result of unstable operation.

Increase setpoint for Chilled Water:
The chilled water temperature is low for the ambient conditions measured. A floating chilled water temperature offer a saving of several approximately 4% per degree Celcius.

Contents

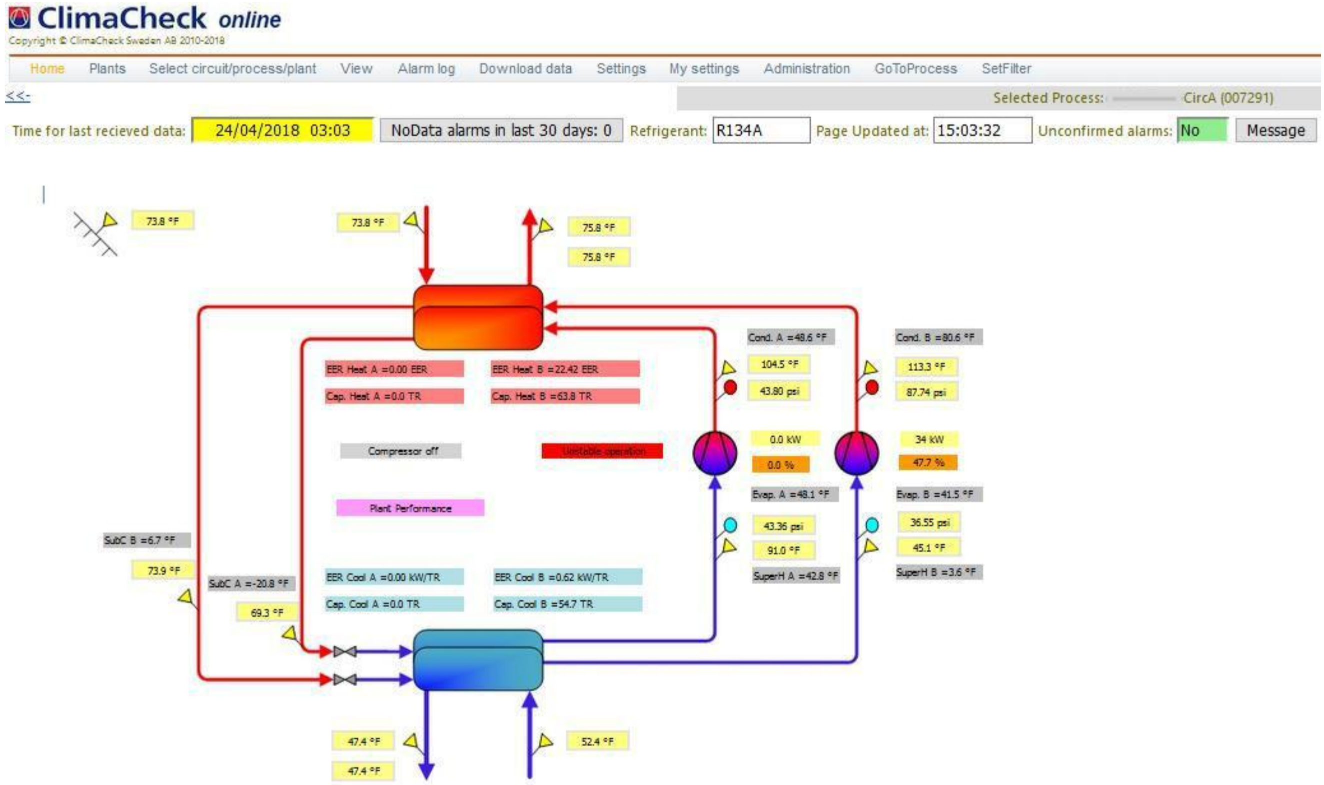
Appendices:

A. SEI Introduction
B. Methodology for the ClimaCheck Internal Measurement approach

1 System

System is a two-circuit chiller with screw compressor from Trane RTWD 200 HE/PE. Nominal tonnage is 200 RT.
Chiller has two circuits with one screw compressor on each and is supplying cooling to the hotel.

A cooling tower is installed but primary focus in this report has at this stage been the chiller whereas cooling tower energy and water efficiency are relevant to include in future evaluation.

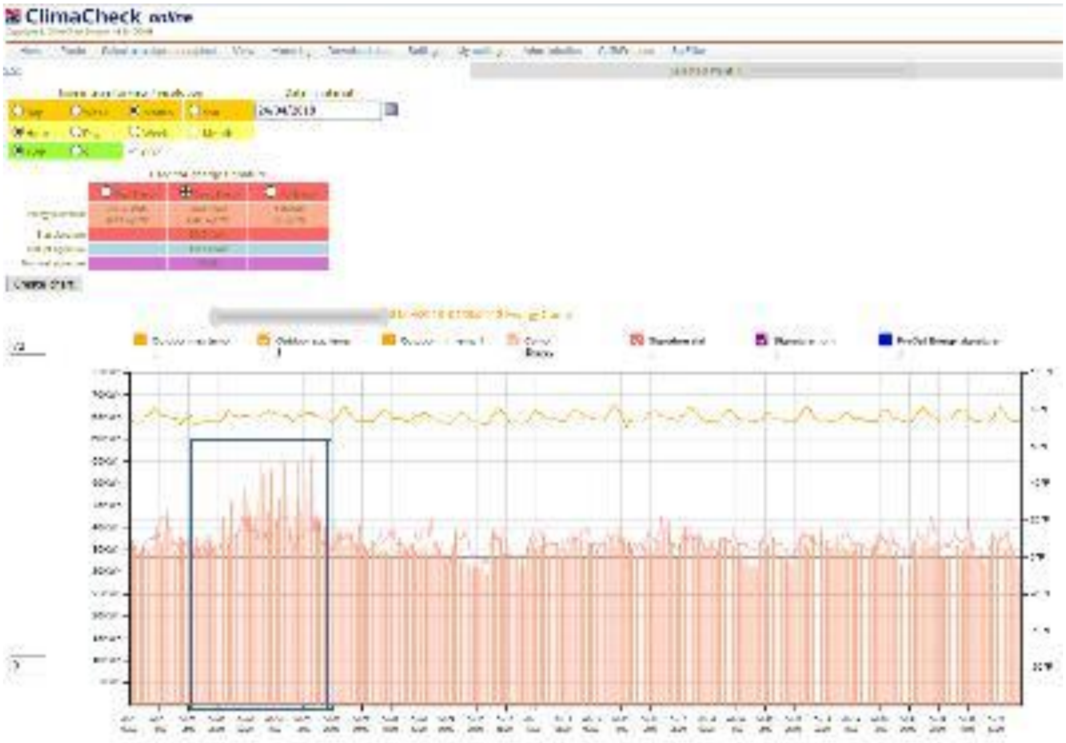


2 Energy consumption

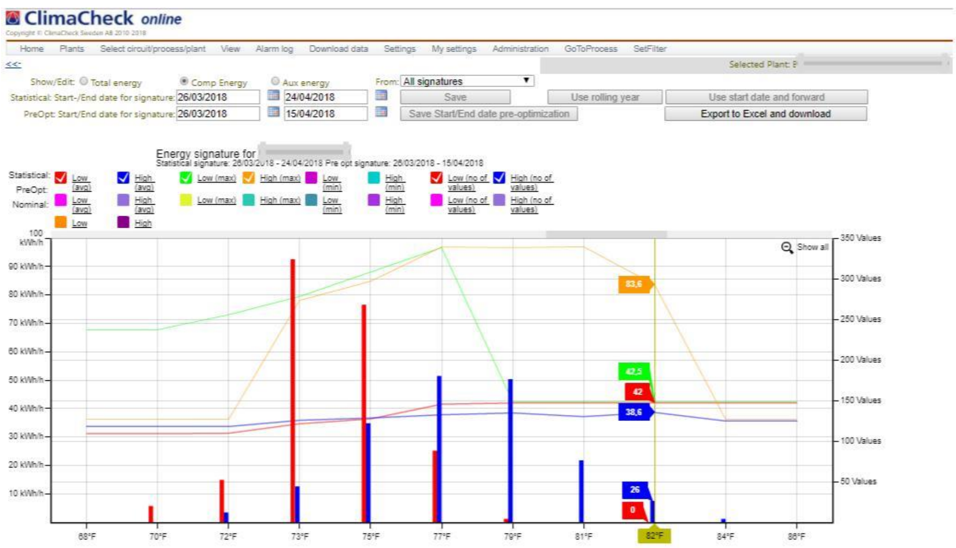
The compressor energy consumption is relatively constant regardless of temperature encountered over the measured period (1 month). The temperature during measured period has stayed between 22 and 28°C but only a few hours is below 22°C or above 28°C making energy signature less reliable outside of this interval (see second graph below).

The significantly higher consumption between April 3rd and April 6th can either be caused by increased load due to i.e. more guests, a big conference, higher humidity or decreased performance in system. Looking at performance indicators and cooling capacity it is clear that the load was higher during this period.

In graph below yellow line represents ambient temperature and pink bars represent energy per 24 hours. The pink curve is the energy signature by using all hours since M&V system was commissioned.



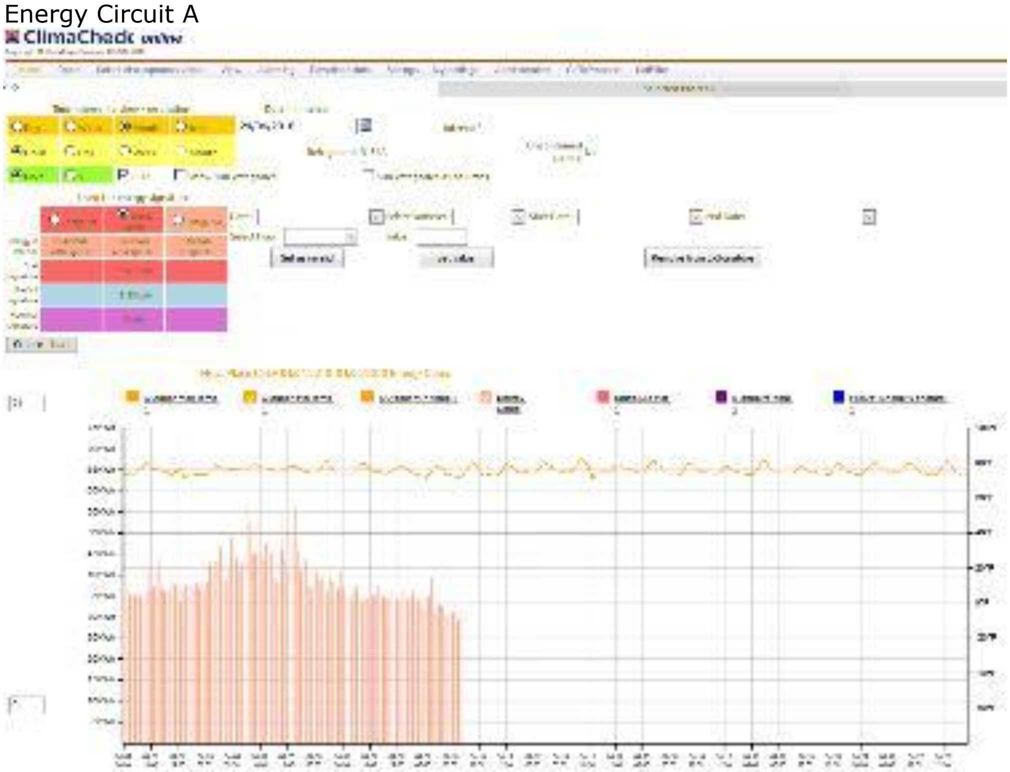
Energy consumption is clearly higher during the period in blue box. Graph below show average and max energy consumption during day and night at different ambient conditions. And number of hours that has occurred at each ambient since M&V system start-up. Few hours means less statistical certainty of representative data.



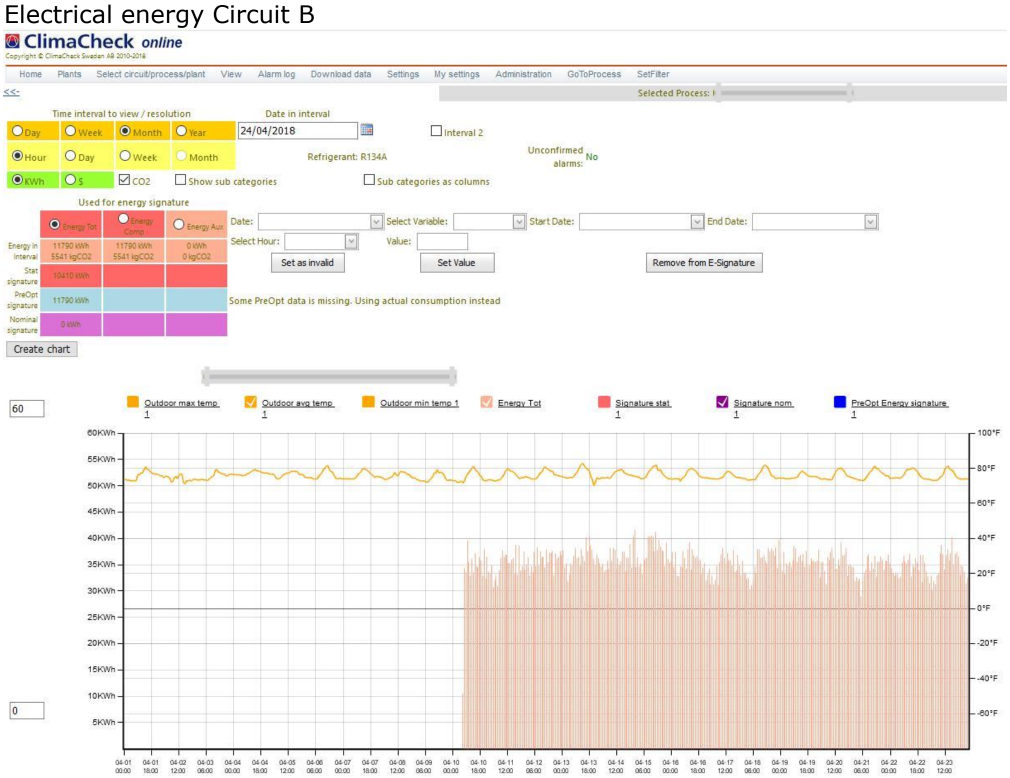
By selecting the period with higher energy consumption as an example the value of energy signature becomes clear. Using this period only give the blue energy signature indicating a significant higher level. This period is short but it is of interest to understand cause of difference that is more than 20%.

There are two circuits in system and they are at low part load operating one at a time e.g. with the load pattern that has occurred during measured period they are used alternatively so one circuit is operating and one is blocked as can be seen in graphs below.

Energy Circuit A



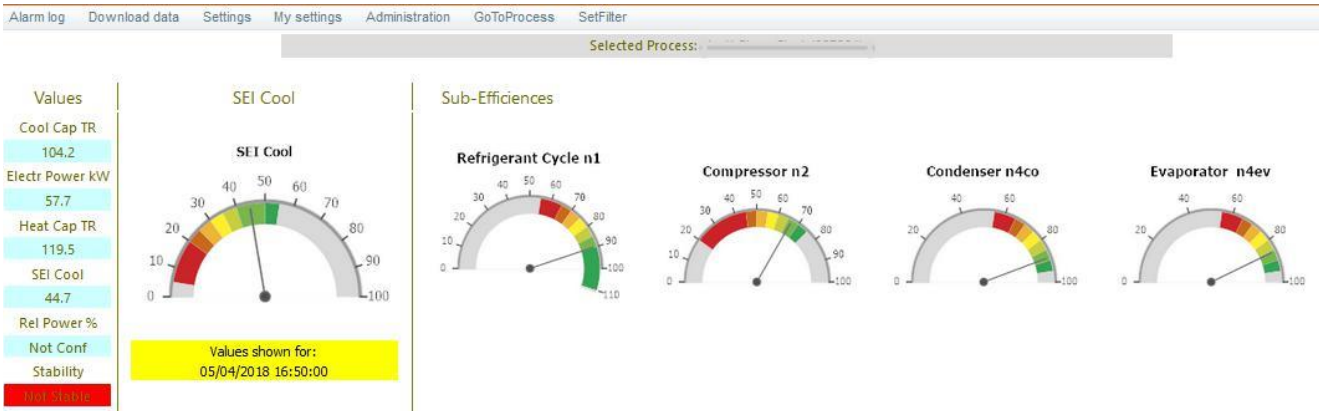
Electrical energy Circuit B



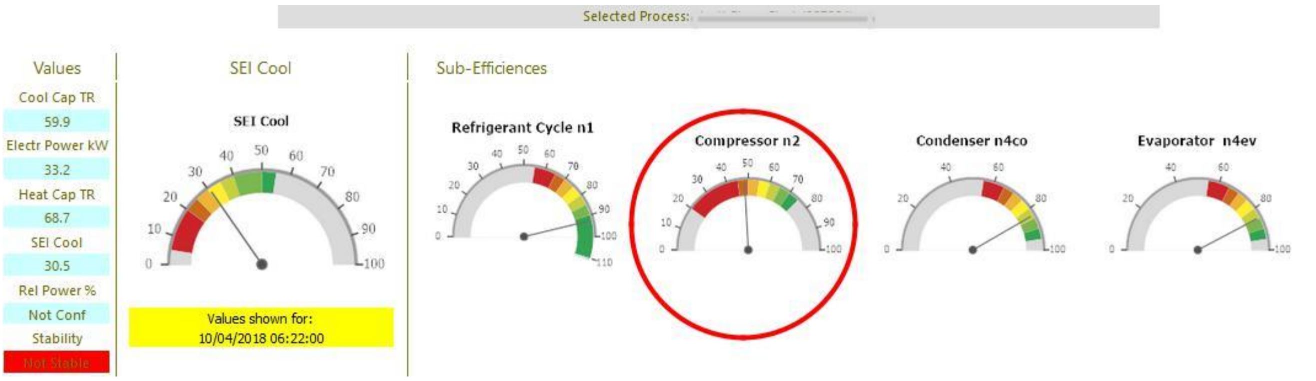
3 Performance of chiller – System efficiency Index (SEI)

3.1 Total efficiency Circuit A

At full load (100 RT per circuit) the efficiency is as expected for this type of chiller reaching 45% of the theoretical possible performance with the chilled and cooling water temperatures it is operating at. Due to low load versus installed capacity Circuit B has not operated at high capacity during measured period. It can also be noted that system is not operating with a high degree of stability which introduce a higher uncertainty in measurements but below data is reflecting the general operation of the plant.



Performance at 50RT capacity is affected by poor part load performance of compressors. Part load results in poor compressor efficiency affecting total SEI that decrease from 45 to 30% representing a significant loss of efficiency as the chiller does not operate at high efficiency at the prevailing loads.



3.2 Total efficiency Circuit B

Circuit B show similar operation to circuit A but only part load has been recorded. Below graph also show fluctuations in system that are explained later in this report.

3.3 Detailed performance of Circuit A

ClimaCheck deliver real time performance data on the level of a factory test rig. All relevant indicators of compressor, evaporator, condenser, expansion valve and charge can be evaluated. Water flows of cooling and chilled water are documented as well as approach temperatures.

Condenser performance is not state of the art and should be compared to manufacturer recommendation for approach temperatures. Current approach of 8-9°F is significantly higher than what is expected of high efficiency chiller today which would be 2-5°F. Every degree in condensing increase power consumption with 1-2%.

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Time	SecC Evap in (°F)	SecC Evap out (°F)	Ref Low press. (psi)	Ref Evap (°F)	Ref Comp in (°F)	Super heat (°F)	SecW Cond in (°F)	SecW Cond out (°F)	Ref High press. (psi)	Ref Cond (°F)	Ref Exp. Valve in (°F)	Sub cool total (°F)	Ref Comp out (°F)	Power input Comp. (kW)	Cooling Load Cool Ref (kW/TR)	Cap. Cool (TR)	Cap. Heat (TR)	SEI 1 cool (%)	Eff 1 Cycle (%)	Eff 2 Comp. Isen. (%)	Eff 4 Evap (%)	Eff 4 Cond. (%)
2018-04-05 16:59:53	54.0	47.4	38.72	43.7	45.6	1.9	78.9	83.6	106.74	91.3	85.2	6.1	108.0	58.9	0.53	110.6	125.8	46.68	89.54	69.9	84.05	90.42
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2018-04-05 16:57:51	53.9	47.4	39.30	44.3	45.6	1.3	78.9	83.6	106.31	91.0	85.2	5.9	109.7	56.6	0.56	101.3	116.2	44.58	89.63	65.2	85.37	90.75
2018-04-05 16:56:50	53.9	47.4	39.01	44.0	45.6	1.6	78.9	83.6	108.48	92.2	85.6	6.7	106.4	57.7	0.52	111.4	122.0	48.26	89.60	74.3	85.11	89.00
2018-04-05 16:55:49	54.0	47.2	39.01	44.0	45.6	1.6	78.9	83.6	108.92	92.4	85.6	6.9	107.9	58.4	0.52	111.4	122.9	47.25	89.63	72.1	85.17	87.83
2018-04-05 16:54:48	53.9	47.4	38.72	43.7	45.6	1.9	78.9	83.4	106.74	91.3	85.0	6.3	109.0	58.3	0.54	107.2	122.6	46.71	89.62	68.3	84.25	91.94
2018-04-05 16:53:47	53.9	47.4	39.59	44.6	45.6	1.0	78.9	83.4	107.18	91.5	85.0	6.5	109.5	57.5	0.55	103.7	118.9	45.60	89.84	65.8	86.10	90.94
2018-04-05 16:52:46	53.9	47.2	39.59	44.6	45.6	1.0	78.9	83.6	107.18	91.5	85.2	6.3	107.5	54.4	0.53	103.1	117.4	47.53	89.76	69.1	86.31	90.17
2018-04-05 16:51:45	54.0	47.2	39.01	44.0	45.6	1.6	78.9	83.6	107.61	91.7	85.4	6.4	107.3	55.8	0.52	107.0	118.9	47.54	89.60	71.5	84.97	89.10
2018-04-05 16:50:44	54.0	47.4	38.72	43.7	45.6	1.9	79.1	83.6	106.74	91.3	85.2	6.1	109.1	58.9	0.55	107.8	123.4	45.66	89.54	68.0	84.05	90.80
2018-04-05 16:49:43	53.9	47.2	39.30	44.3	45.6	1.3	79.1	83.6	107.61	91.7	85.0	6.7	109.7	57.7	0.55	104.2	119.5	44.66	89.82	66.7	85.77	88.66
2018-04-05 16:48:42	54.0	47.4	39.30	44.3	45.6	1.3	78.9	83.8	108.48	92.2	85.4	6.8	108.0	59.5	0.53	112.3	126.4	46.67	89.74	70.5	85.49	88.18
2018-04-05 16:47:41	54.0	47.4	38.72	43.7	45.4	1.7	78.9	83.8	108.48	92.2	85.4	6.8	107.5	59.6	0.52	114.1	125.1	47.56	89.61	72.6	84.32	88.69
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2018-04-05 16:45:39	54.0	47.2	39.01	44.0	45.4	1.4	79.1	83.8	108.05	92.0	85.4	6.6	110.0	59.7	0.56	106.9	122.7	45.01	89.64	67.0	85.04	89.80
2018-04-05 16:44:38	54.0	47.2	39.30	44.3	45.6	1.3	79.1	83.8	109.79	92.9	85.6	7.3	109.3	59.3	0.54	109.2	124.4	46.59	89.77	69.7	85.88	88.41
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2018-04-05 16:39:33	53.9	47.4	38.72	43.7	45.6	1.9	79.1	83.9	107.18	91.5	86.1	5.4	106.4	59.6	0.51	115.9	126.9	49.83	89.18	73.4	84.32	92.24
2018-04-05 16:38:32	54.0	47.4	38.72	43.7	45.6	1.9	79.1	83.9	108.48	92.2	86.3	5.9	109.3	59.7	0.55	109.4	125.2	46.64	89.21	69.7	84.32	90.55

3.4 Detailed part load performance of Circuit A

It can be noted that instability increase at part load which will shown in graphs later.

The water flow is high relative the capacity which results in a low DT in the condenser which indicate that a significant amount of pumping power can be saved if flow can be decreased while staying above minimum flow for chiller and cooling power. A reduction of flow with 25% would reduce the pumping power to below 50%. Also chilled water flow higher than what would be seen as optimal but as system is running at around 25.

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2018-04-10 06:09:00	52.3	49.0	40.90	45.8	46.9	1.1	72.2	74.0	80.64	76.2	73.3	2.9	114.2	28.3	0.65	43.4	50.9	23.81	92.60	35.1	83.29	89.78
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2018-04-10 06:06:58	52.3	48.3	41.19	46.1	46.7	0.6	72.2	74.2	80.64	76.2	73.1	3.1	113.1	28.0	0.64	43.5	50.9	24.67	92.74	35.3	85.39	89.98
2018-04-10 06:05:57	52.4	48.3	39.01	44.0	47.2	3.2	72.2	74.0	84.55	78.7	73.1	5.6	117.4	32.6	0.66	48.9	57.5	23.63	92.72	39.4	80.64	83.90
2018-04-10 06:04:56	52.3	48.8	40.90	45.8	46.9	1.1	72.1	73.8	81.07	76.5	73.1	3.4	115.4	28.1	0.66	42.3	49.7	23.24	92.72	34.7	83.73	88.38
2018-04-10 06:03:55	52.6	47.0	38.72	43.7	46.9	3.2	72.2	74.4	84.99	79.0	73.1	5.9	112.4	32.6	0.61	53.7	62.3	26.77	92.70	43.9	81.63	83.90
2018-04-10 06:02:54	52.6	49.0	40.61	45.5	46.9	1.4	72.1	73.8	80.20	76.0	73.0	3.0	114.4	28.1	0.65	43.0	50.4	23.39	92.64	35.1	81.67	90.12
2018-04-10 05:57:53	52.4	47.6	41.48	46.4	46.9	0.5	71.7	73.8	80.20	76.0	72.8	3.2	114.7	27.7	0.66	41.9	49.2	23.79	92.90	33.5	87.11	89.21
2018-04-10 05:56:52	52.3	49.4	36.55	41.5	47.6	6.0	71.9	73.3	84.12	78.5	72.4	6.0	121.7	32.9	0.70	47.0	55.7	21.48	92.47	40.1	73.49	84.13
2018-04-10 05:55:51	52.4	49.2	39.30	44.3	47.6	3.3	71.9	73.5	80.20	76.0	72.6	3.4	117.6	28.3	0.67	41.9	49.3	22.35	92.54	35.4	78.40	89.64
2018-04-10 05:54:50	52.3	47.8	41.48	46.4	47.4	1.0	72.1	74.0	80.20	76.0	72.6	3.4	116.5	27.8	0.67	41.1	48.4	23.58	92.97	32.8	87.11	90.12
2018-04-10 05:53:49	52.3	48.8	40.32	45.2	47.6	2.4	72.2	73.7	79.33	75.4	72.8	2.6	120.1	28.3	0.71	39.7	47.1	21.71	92.56	32.0	81.43	91.89
2018-04-10 05:52:47	52.3	48.8	40.90	45.8	47.6	1.8	72.2	73.8	80.20	76.0	73.0	3.0	118.7	28.3	0.70	40.7	48.1	22.30	92.70	32.6	83.45	90.32
2018-04-10 05:51:47	52.1	48.7	40.61	45.5	47.0	1.5	72.4	74.0	80.64	76.2	73.1	3.1	114.5	28.3	0.65	43.5	51.0	24.21	92.61	35.5	83.35	90.17
2018-04-10 05:50:46	52.6	47.0	41.48	46.4	46.7	0.3	72.6	74.8	80.64	76.2	73.5	2.8	112.4	28.0	0.64	44.1	51.5	25.90	92.65	35.3	87.85	91.39
2018-04-10 05:49:45	52.4	48.7	40.61	45.5	46.7	1.2	72.4	74.2	80.20	76.0	73.3	2.6	114.0	28.3	0.65	43.5	51.0	24.10	92.49	35.2	82.59	91.30
2018-04-10 05:48:44	52.6	47.4	39.30	44.3	47.2	2.9	72.6	74.4	85.42	79.3	73.1	6.1	115.6	32.9	0.64	51.1	59.8	25.25	92.87	40.9	82.74	83.49
2018-04-10 05:47:43	52.4	48.8	40.61	45.5	47.0	1.5	72.6	74.2	81.07	76.5	73.5	3.0	112.9	28.3	0.63	44.7	52.2	24.85	92.51	37.0	82.59	89.94
2018-04-10 05:46:42	52.3	46.5	41.19	46.1	46.5	0.4	72.6	75.1	81.51	76.8	73.8	3.0	110.0	28.2	0.61	46.5	53.9	27.88	92.53	38.1	88.70	90.40
2018-04-10 05:45:41	52.6	47.4	41.48	46.4	46.9	0.5	72.6	75.1	81.51	76.8	73.8	3.0	111.1	28.1	0.62	45.6	53.0	26.70	92.59	37.1	87.44	90.30
2018-04-10 05:44:39	52.4	48.5	41.48	46.4	46.7	0.3	72.6	74.6	81.07	76.5	73.5	3.0	112.4	28.3	0.63	44.6	52.1	25.14	92.69	35.6	85.78	90.24
2018-04-10 05:39:39	52.8	48.3	41.48	46.4	47.2	0.8	72.2	74.2	80.64	76.2	73.3	2.9	111.3	28.0	0.61	45.6	53.0	25.42	92.72	36.4	85.34	89.88
2018-04-10 05:38:38	52.6	46.3	41.48	46.4	46.7	0.3	72.1	74.6	80.64	76.2	73.1	3.1	111.3	27.9	0.62	44.8	52.2	26.51	92.80	36.0	89.11	90.18

3.5 Detailed part load performance of Circuit B

ClimaCheck *online*

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System settings active 24/04/2018 | 40 | 60 min | yyyy-mm-dd hh:mm | Page to XL | All to XL | Page to PDF

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Time	SecC Evap in (°F)	SecC Evap out (°F)	Ref Low press. (psi)	Ref Evap (°F)	Ref Comp in (°F)	Super heat (°F)	SecW Cond in (°F)	SecW Cond out (°F)	Ref High press. (psi)	Ref Cond (°F)	Ref Exp. Valve in (°F)	Sub cool total (°F)	Ref Comp out (°F)	Power input Comp. (kW)	Cooling Load Cool Ref (kW/TR)	Cap. Cool (TR)	Cap. Heat (TR)	SEI 1 cool (%)	Eff 1 Cycle (%)	Eff 2 Comp. Isen. (%)	Eff 4 Evap (%)	Eff 4 Cond. (%)
Max last 60 min	52.6	48.8	40.61	45.5	45.7	4.8	73.7	76.0	88.18	80.9	73.9	7.3	120.1	34.3	0.74	54.6	63.7	28.58	92.85	49.3	84.65	93.45
Min last 60 min	51.9	46.1	35.53	40.6	44.8	-0.7	72.8	74.4	81.07	76.5	72.7	3.1	111.8	28.5	0.61	39.0	46.6	21.96	91.95	32.3	75.83	83.32
Avg last 60 min	52.3	47.8	38.59	43.6	45.1	1.5	73.4	75.4	83.83	78.2	73.5	4.7	114.9	30.8	0.66	46.6	54.8	25.44	92.39	39.8	80.54	89.20
2018-04-24 04:29:57	52.3	48.7	39.59	44.6	45.0	0.4	73.3	75.3	81.94	77.1	73.6	3.5	111.8	28.9	0.64	45.2	52.8	25.73	92.40	38.4	81.03	91.45
2018-04-24 04:24:56	52.6	47.2	38.72	43.7	44.8	1.1	73.1	75.5	81.07	76.5	73.2	3.3	112.2	28.9	0.64	44.9	52.5	26.19	92.27	38.7	80.05	93.23
2018-04-24 04:23:55	52.6	48.5	40.32	45.2	45.0	-0.2	73.0	75.1	81.51	76.8	73.2	3.6	114.7	28.5	0.67	42.4	49.9	24.11	92.62	35.4	82.20	91.24
2018-04-24 04:18:54	52.1	48.3	40.32	45.2	45.1	-0.1	72.8	74.4	81.51	76.8	72.7	4.1	120.1	28.7	0.74	39.0	46.6	21.96	92.85	32.3	83.39	89.81
2018-04-24 04:13:53	52.1	48.5	36.84	41.8	45.7	3.9	73.1	74.6	86.29	79.8	73.0	6.8	118.3	33.6	0.68	49.4	58.3	23.92	92.50	42.3	76.50	84.33
2018-04-24 04:12:52	51.9	48.3	39.59	44.6	45.1	0.5	73.3	74.8	81.94	77.1	73.2	3.9	117.4	29.0	0.70	41.2	48.9	23.49	92.55	34.8	82.18	90.62
2018-04-24 04:11:51	52.1	46.1	39.01	44.0	45.1	1.2	73.3	75.5	81.07	76.5	73.4	3.1	115.3	29.0	0.68	42.8	50.5	25.83	92.25	36.4	83.44	93.45
2018-04-24 04:06:50	52.3	48.7	40.32	45.2	44.8	-0.4	73.5	75.1	82.38	77.4	73.6	3.8	117.8	29.1	0.71	41.1	48.8	23.25	92.56	34.2	82.78	90.50
2018-04-24 04:05:49	52.3	48.7	36.84	41.8	45.1	3.3	73.5	75.1	87.31	80.3	73.6	6.8	115.1	34.2	0.65	52.8	61.9	25.42	92.37	45.2	76.31	84.33
2018-04-24 04:04:48	52.3	46.5	35.53	40.6	45.3	4.8	73.5	75.8	86.87	80.1	73.6	6.5	112.7	31.1	0.61	50.8	59.0	28.58	92.06	49.3	76.39	86.31
2018-04-24 04:03:47	52.3	47.0	39.88	44.9	44.8	-0.1	73.5	75.7	82.38	77.4	73.6	3.8	113.3	29.0	0.65	44.2	51.9	26.27	92.50	37.3	84.58	91.42
2018-04-24 03:58:46	52.1	46.1	39.30	44.3	45.3	1.0	73.5	75.8	82.38	77.4	73.6	3.8	114.5	29.7	0.66	44.6	52.5	26.61	92.38	37.6	84.65	91.85
2018-04-24 03:57:45	52.3	47.9	38.43	43.4	45.0	1.6	73.5	75.5	82.38	77.4	73.6	3.8	112.9	29.6	0.64	45.8	53.6	26.10	92.19	40.0	79.20	91.54
2018-04-24 03:56:44	52.3	48.7	40.61	45.5	44.8	-0.7	73.5	75.3	81.94	77.1	73.6	3.5	114.2	29.0	0.66	43.8	51.4	24.91	92.58	35.9	83.47	91.49
2018-04-24 03:55:43	52.4	48.5	37.13	42.2	45.3	3.2	73.3	75.3	87.74	80.6	73.4	7.2	114.7	33.8	0.64	52.8	61.7	25.70	92.55	45.5	77.13	83.62
2018-04-24 03:50:42	52.3	48.8	38.14	43.1	45.1	2.1	73.3	74.9	87.31	80.3	73.4	6.9	117.8	34.1	0.69	49.6	58.6	23.72	92.70	41.0	78.79	83.32
2018-04-24 03:45:41	52.3	48.7	37.13	42.2	45.0	2.8	73.7	75.3	87.74	80.6	73.8	6.8	114.5	34.1	0.64	53.0	62.0	25.75	92.40	45.3	77.13	84.08
2018-04-24 03:44:40	52.3	47.0	35.53	40.6	45.3	4.8	73.7	75.8	87.31	80.3	73.9	6.4	114.0	34.3	0.63	54.6	63.7	27.68	91.95	48.5	75.83	85.96
2018-04-24 03:43:39	52.3	46.9	38.72	43.7	44.8	1.1	73.7	76.0	82.81	77.6	73.9	3.7	113.1	29.6	0.65	45.5	53.3	26.85	92.15	39.6	81.77	91.78
2018-04-24 03:42:38	52.4	47.4	39.30	44.3	44.8	0.5	73.7	75.8	82.38	77.4	73.9	3.4	114.0	29.2	0.67	43.8	51.5	25.74	92.23	37.6	82.09	92.12

3.6 Superheat

Super heat is within expected levels.
Indicating acceptable operation of expansion device – no indications of liquid carry over or incorrect refrigerant charge.

3.7 Sub cool

Subcool is within expected levels.
Indicating acceptable operation of expansion device – no indications of liquid carry over or incorrect refrigerant charge.

3.8 Compressor efficiency

Acceptable at high load – low at low load which is normal for compressor with slide regulations.

3.9 Evaporator efficiency

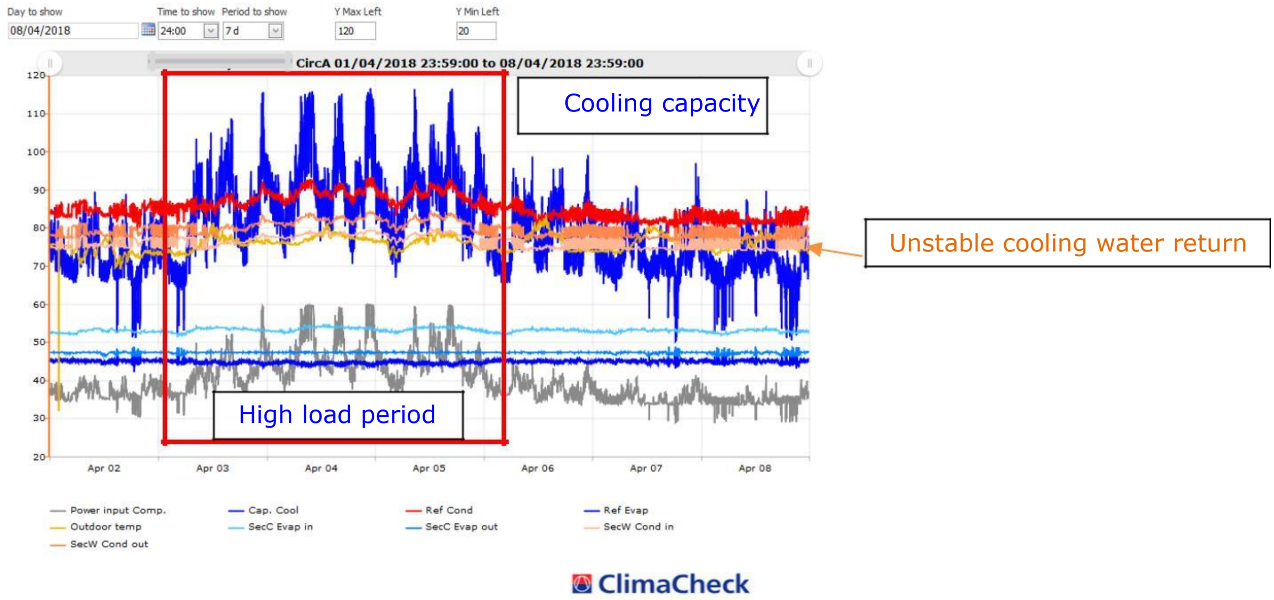
Evaporator does not show poor performance during measured period operates within expected performance.

3.10 Condenser efficiency

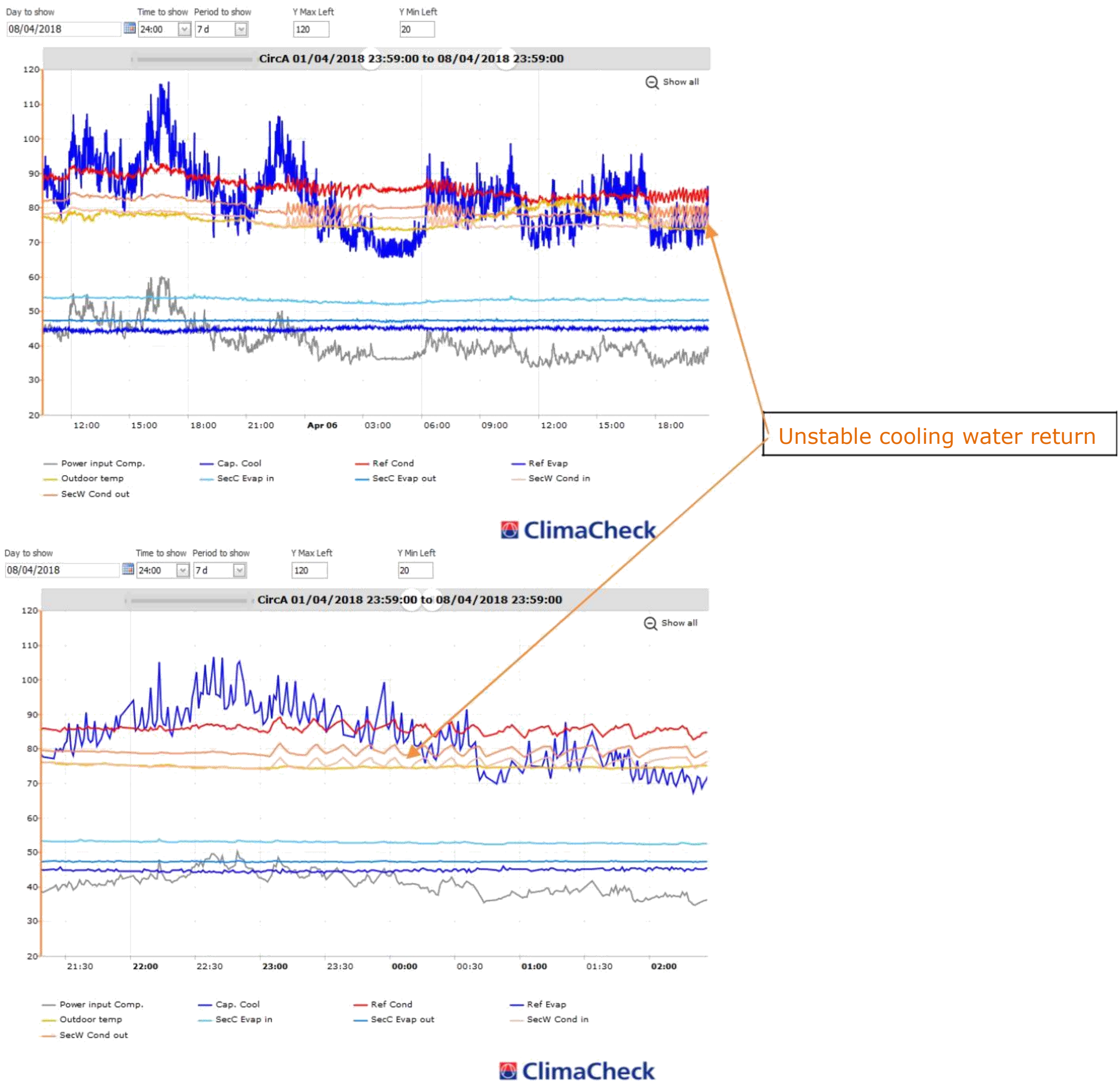
Condenser is at full load showing lower performance than expected of an efficient chiller. Approach is higher than expected at full load. Should be checked with manufacturer specification.

4 Operation of chillers and controls

Below sequence show the sequence with increased load (blue line) 2nd to 5th April (Easter time) and after that example of the for the period dominating load structure from 6th of April.
It can also be noted the unstable operation of cooling water at low load magnified below.

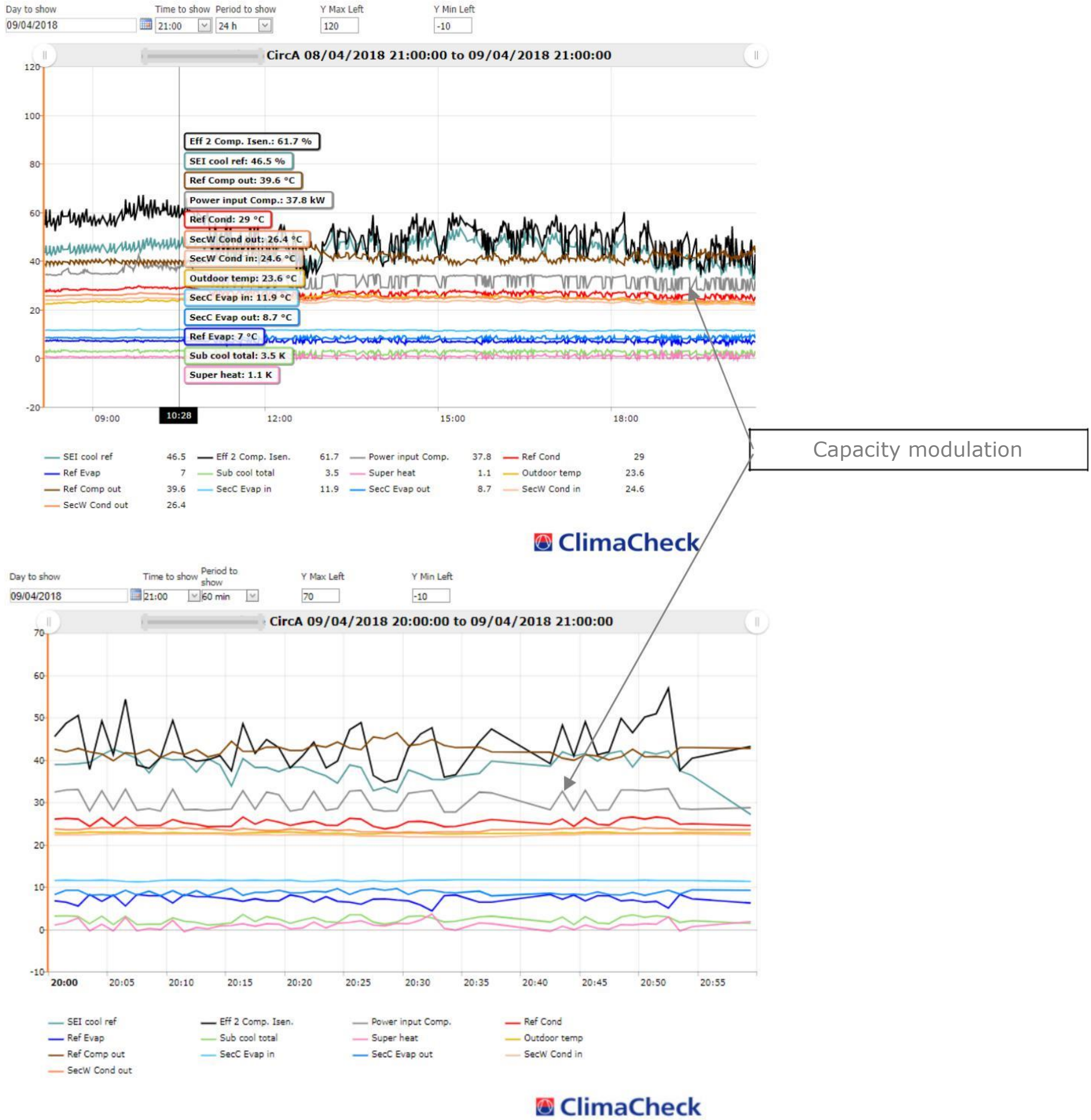


The control of cooling water over the cooling tower should be reviewed.


Day to show
08/04/2018
Time to show
24:00
Period to show
7 d
Y Max Left
120
Y Min Left
20
CircA 01/04/2018 23:59:00 to 08/04/2018 23:59:00
Show all
12:00 15:00 18:00 21:00 Apr 06 03:00 06:00 09:00 12:00 15:00 18:00
Power input Comp.
Cap. Cool
Ref Cond
Ref Evap
Outdoor temp
SecC Evap in
SecC Evap out
SecW Cond in
SecW Cond out
ClimaCheck
Unstable cooling water return
Day to show
08/04/2018
Time to show
24:00
Period to show
7 d
Y Max Left
120
Y Min Left
20
CircA 01/04/2018 23:59:00 to 08/04/2018 23:59:00
Show all
21:30 22:00 22:30 23:00 23:30 00:00 00:30 01:00 01:30 02:00
Power input Comp.
Cap. Cool
Ref Cond
Ref Evap
Outdoor temp
SecC Evap in
SecC Evap out
SecW Cond in
SecW Cond out
ClimaCheck

4.1 Capacity Controls

Below graphs show how capacity is stepping in and out within minutes. This does not correspond to demand in system but that controls is stepping in capacity that immediately result in a change of temperature that result in that a new change is triggered. Controls should be set to allow more change before new change to avoid unstable operation. Current sensitivity tend to create risk of short cycling at lower load.



5 Appendixes

5.1 Chiller design data

RTWD Series R(TM) 70-250 Ton Water-Cooled Chiller

Job Information

TRANE

Tag	RTWD-200 HE
Model Number	RTWD 200 HE
Quantity	1
Product Version	155
Unit nominal tonnage	200
Unit type	High efficiency

General Information

Cooling capacity	196.80 tons	Refrigerant	R134a
		Sound reduction package	None
Cooling efficiency	0.666 kW/ton	Sound pressure	79 dBA
IPLV	0.511 kW/ton		
NPLV	0.510 kW/ton		

* At 1 meter in free field.

Evaporator Information

Evaporator application	Std cooling	Evap fouling factor	0.00010 hr-sq ft-deg F/Btu
Entering temperature	54.00 F	Number of evap passes	2 pass evap
Leaving temperature	44.00 F	Saturated evap temp-ckt 1	41.60 F
Fluid flow rate	475.40 gpm	Saturated evap temp-ckt 2	40.90 F
Pressure drop	21.50 ft H2O	Minimum flow rate	186.40 gpm
Evap fluid type	Water	Pressure drop at min flow rate	4.00 ft H2O
Evap fluid freeze point	32.00 F	Maximum flow rate	683.30 gpm
Evap fluid concentration	–	Pressure drop at max flow rate	40.50 ft H2O

Condenser Information

Unit application	Std ent cond <=95F/35C	Cond fouling factor	0.00025 hr-sq ft-deg F/Btu
Cond entering temp	85.00 F	Saturated cond temp-ckt 1	96.70 F
Cond leaving temp	94.30 F	Saturated cond temp-ckt 2	99.00 F
Cond flow rate	600.00 gpm	Min cond flow rate	276.90 gpm
Cond pressure drop	22.30 ft H2O	Press drop at min cond flow	5.50 ft H2O
Cond fluid type	Water	Max cond flow rate	765.00 gpm
Cond fluid concentration	–	Press drop at max cond flow	34.80 ft H2O
Cond tubes	Enhanced fin - copper		

Compressor Information

			RLA	LRA
Number of compressors	2	Comp A	227.00 A	600.00 A
Number of circuits	2	Comp B	227.00 A	600.00 A

Electrical Information

Unit voltage	200 volt 3 phase	Unit power	130.40 kW
Incoming power line conn	Dual point	Compressor starter type	Wye-delta
Dual point MCA - ckt 1	288.00 A	Dual point MOP - ckt 1	500.00 A
Dual point MCA - ckt 2	284.00 A	Dual point MOP - ckt 2	500.00 A
Short circuit rating	10000.00 A		