AN

EVALUATION

OF

THE EFFECTS OF

PERMAFROST TREATMENT

FOR

ON A

CARRIER 30 GB WATER CHILLER

AT THE

PCCW EXCHANGE BUILDING

TAI PO MARKET, HONG KONG, SAR

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INTRODUCTION

The aim of this report is to examine the effects of a product known as PermaFrost upon one of the refrigeration circuit of the air-cooled Carrier 30BG060012E water chiller at the PCCW Building, Hong Kong.

PermaFrost has previously been claimed to enhance the performance of refrigeration and air conditioning systems elsewhere. Literature from the Polar Oil Company (which markets the product) states that PermaFrost – a molecular technology that relies on highly activated thermal conductive compounds - will improve heat transfer on metal surfaces and increase lubricity of the refrigerant oil.

It further states: "When PermaFrost's *Thermo-Conductive* compound is added to the compressor, it blends with the oil and moves through the system. As each molecule attaches itself to metal surfaces within the system, it displaces dirt, carbon deposits, and stagnant oils, eventually forming a thin layer. As a result, the system can move more heat for the same amount of compressor action. Energy demand and consumption can be reduced."

METHODOLOGY

The testing procedure included an analysis of the refrigeration system on two occasions:

1) Before the addition of PermaFrost, and
2) After the addition of the product.

To measure the performance of the refrigeration system, an "ETM" refrigeration system analyser was used to datalog the operating conditions of the systems during testing. For each test, the analyser collected the data on the following operating conditions over a 9 to 12 hour period at one minute interval:

- Power input
- Cooling capacity
- Coefficient of performance (COP)
- Suction superheat
- Liquid subcooling
- Compressor discharge temperature
- Evaporating temperature & pressure
- Condensing temperature & pressure

TESTING

The refrigeration system of the chiller was first tested on February 23, 2004 before the product, PermaFrost was introduced into the system and then on April 18, 2003 after the treatment. On both occasions the compressor was running at full capacity.

In order to have the same "yardstick" for comparing the performance of the refrigeration system for the two tests, the data used in the analysis for both the pre-test and post test were for those steady state periods where the condensing temperature and pressure were approximately similar.

Due to varying ambient conditions, the data used in the pre-test was taken during the night and for the post test during the day. The mean condensing temperature and pressure for the pre-test were 46.39°C and 16.85 Bar respectively and for the post test were 46.40°C and 16.86 Bar respectively

RESULTS OF TESTING

Detailed results of the operating conditions are provided in the following charts, all found in Appendix A:

1. Pre-treatment Test (February 23 - 24, 2004)

Chart 1A: Cooling Capacity, Power Input & Coefficient of Performance
Chart 1B: Discharge, Condensing, & Evaporating Temperatures, Superheat and Subcooling
Chart 1C: Evaporator & Condenser Pressures

2. Post-treatment Test (April 18 - 19, 2004)

Chart 2A: Cooling Capacity, Power Input & Coefficient of Performance
Chart 2B: Discharge, Condensing, & Evaporating Temperatures, Superheat and Subcooling
Chart 2C: Evaporator & Condenser Pressures

Observations

A comparison of the mean operating conditions for each of the tests are summarised in table below:

Test Results : Operating Mean Values

	Pre-treatment	Post-treatment	% change
Cooling Capacity (kW)	88.66	102.41	15.5
Power Input (kW)	31.10	31.08	-0.06
Coefficient of Performance, COP	2.85	3.32	16.5
Discharge Temperature (°C)	93.42	96.30	0.03
Evaporating Temperature (°C)	-1.04	-4.31	-314
Condensing Temperature (°C)	46.39	46.40	0.02
Liquid Subcooling (K)	18.96	12.85	-32.2
Suction Superheat (K)	5.80	10.02	72.8
Condensing Pressure (bar)	16.85	16.86	0.06
Evaporating Pressure (bar)	3.81	3.31	-13.1

From this table, a number of observations can be made about the effects of PermaFrost on the chiller:

- Cooling capacity increased by 15.5 % in the post-treatment test. ***This indicates a significant improvement in heat transfer in the evaporator.***
- The COP (a ratio of the cooling capacity and power input) increased by 16.5% in the post-treatment test. ***This indicates a significant improvement in the overall system performance.***
- The decrease in the evaporating temperature and pressure **further indicates significant improvement in heat transfer in the evaporator.**
- The decrease in the liquid subcooling and increase suction superheat in the tests do not appear to have impact on the system performance.
- The changes in power input and compressor discharge temperatures were insignificant.

CONCLUSION

The tests carried out on the chiller indicated an improvement in the cooling capacity of 15.5% and an overall increase in system performance of 16.5 % after treatment with PermaFrost. **The increase in cooling capacity and system performance will result in the compressor using less energy to achieve the same cooling effect on the chilled water as prior to treatment with Permafrost**. The decrease in energy usage by the compressor will correspond approximately to the increase in the system performance. This is achieved by a reduction of the compressor run time to produce the same cooling effect on the chiller.

The salient results are summarised in the bar graphs in Appendix B.

Pre Treatment Test

February 23-24, 2004

Appendix A

Chart 1A - Carrier Chiller at PCCW: Operating Cooling Capacity, Power Input & COP (Pre- treatment)

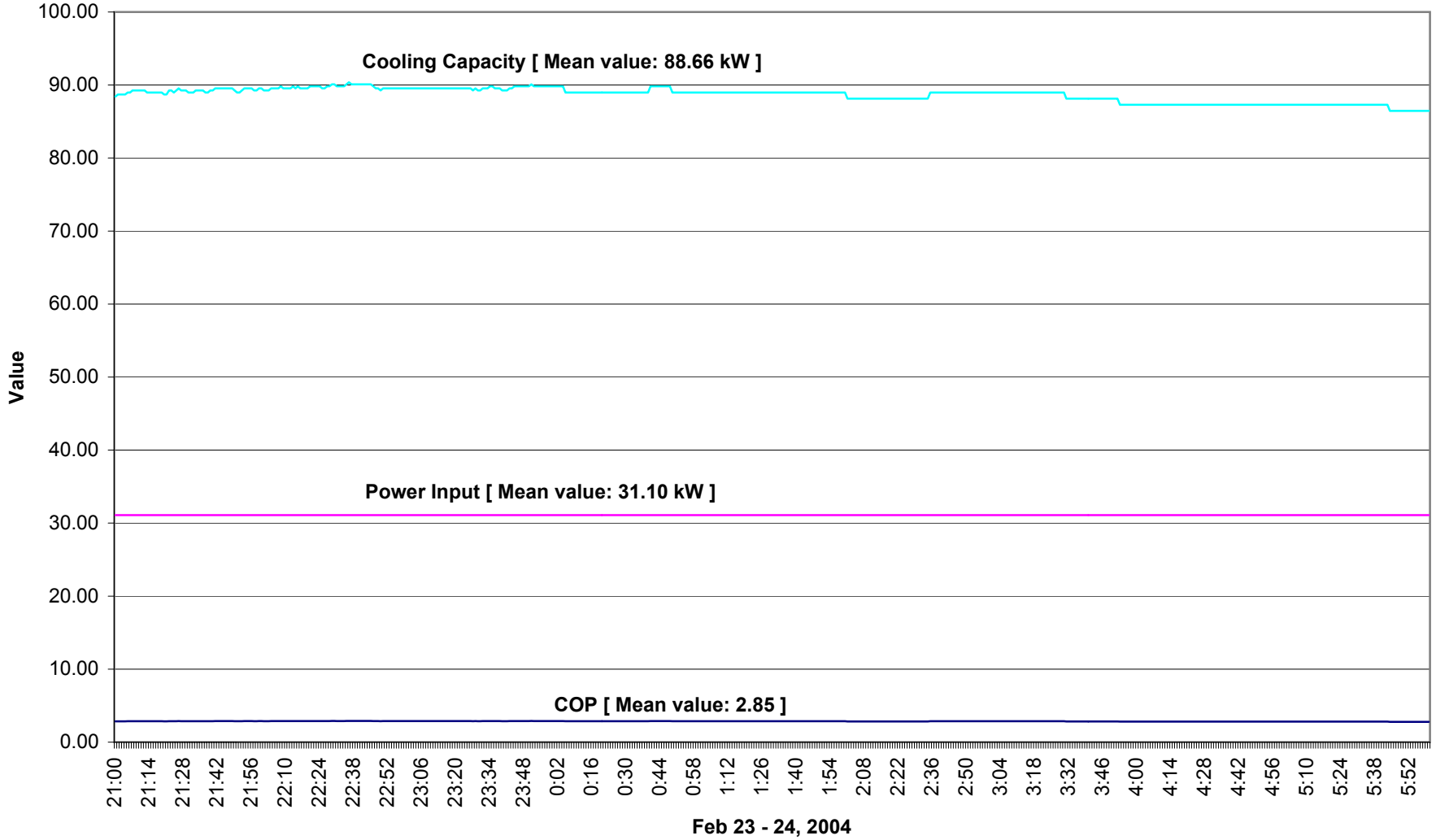


Chart 1B - Carrier Chiller at PCCW: Operating Temperatures (Pre- treatment)

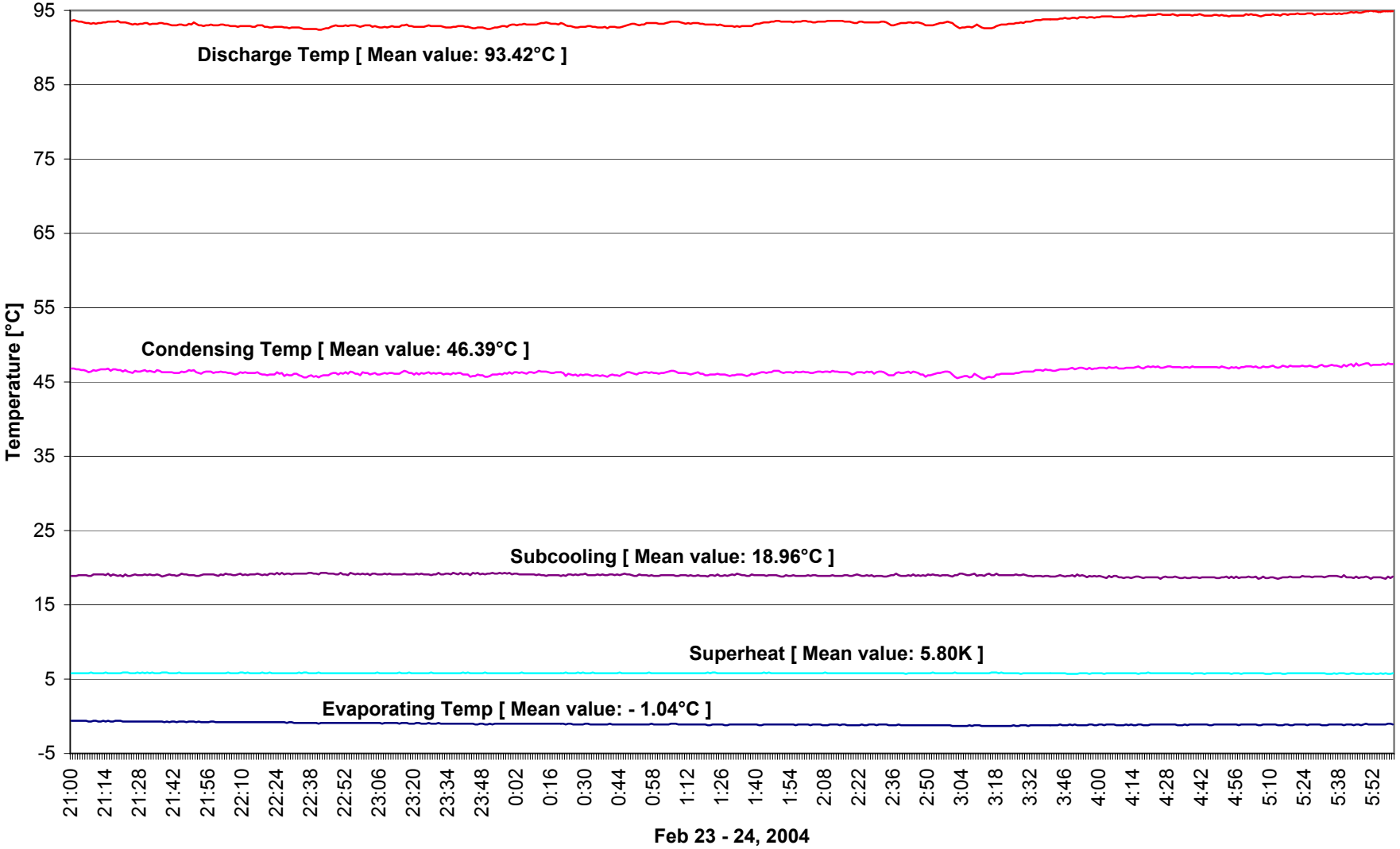
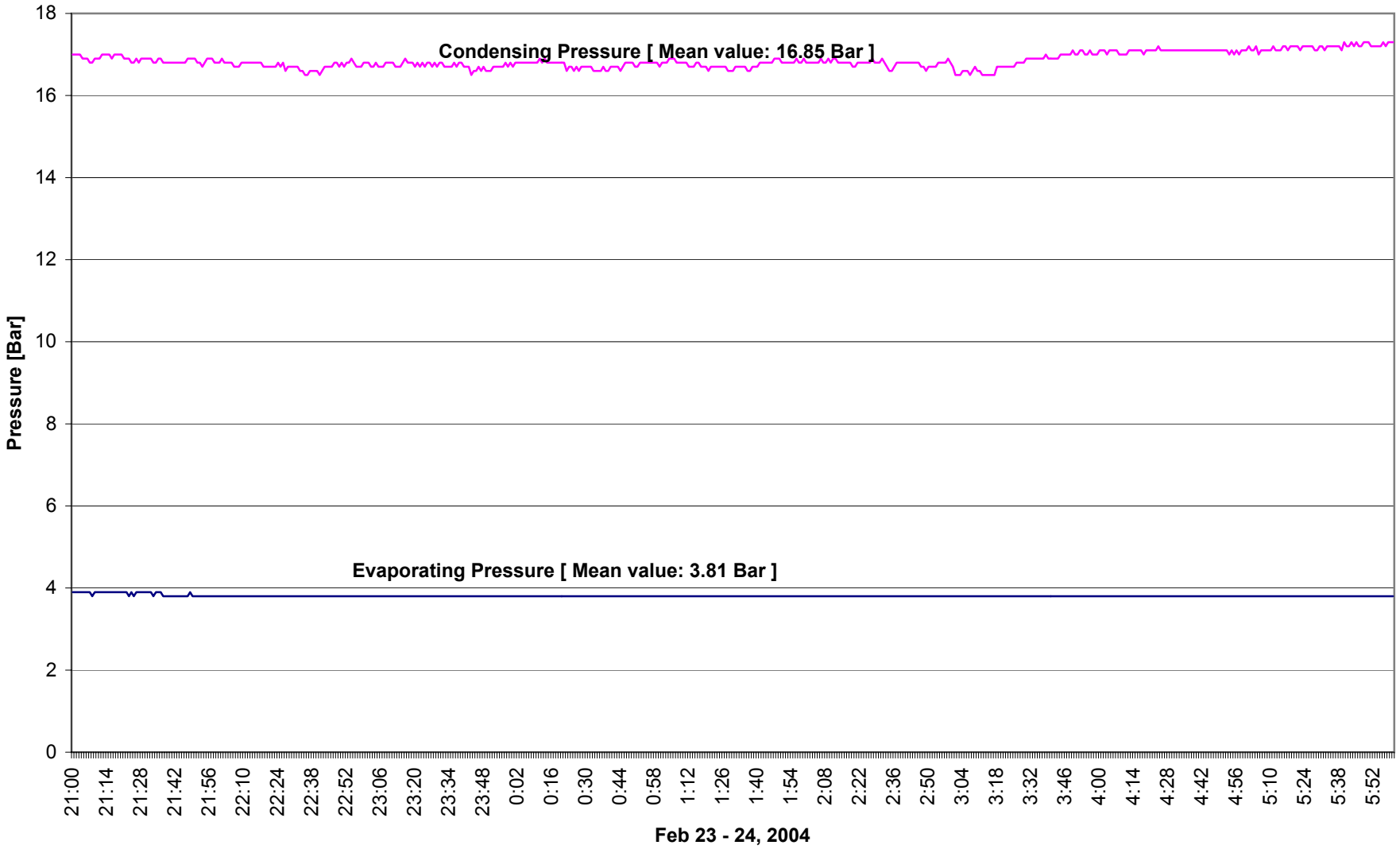


Chart 1C- Carrier Chiller at PCCW: Operating Pressures (Pre- treatment)



Post Treatment Test

April 18-19, 2004

Appendix A

Chart 2A - Carrier Chiller at PCCW: Operating Cooling Capacity, Power Input & COP (Post-treatment)

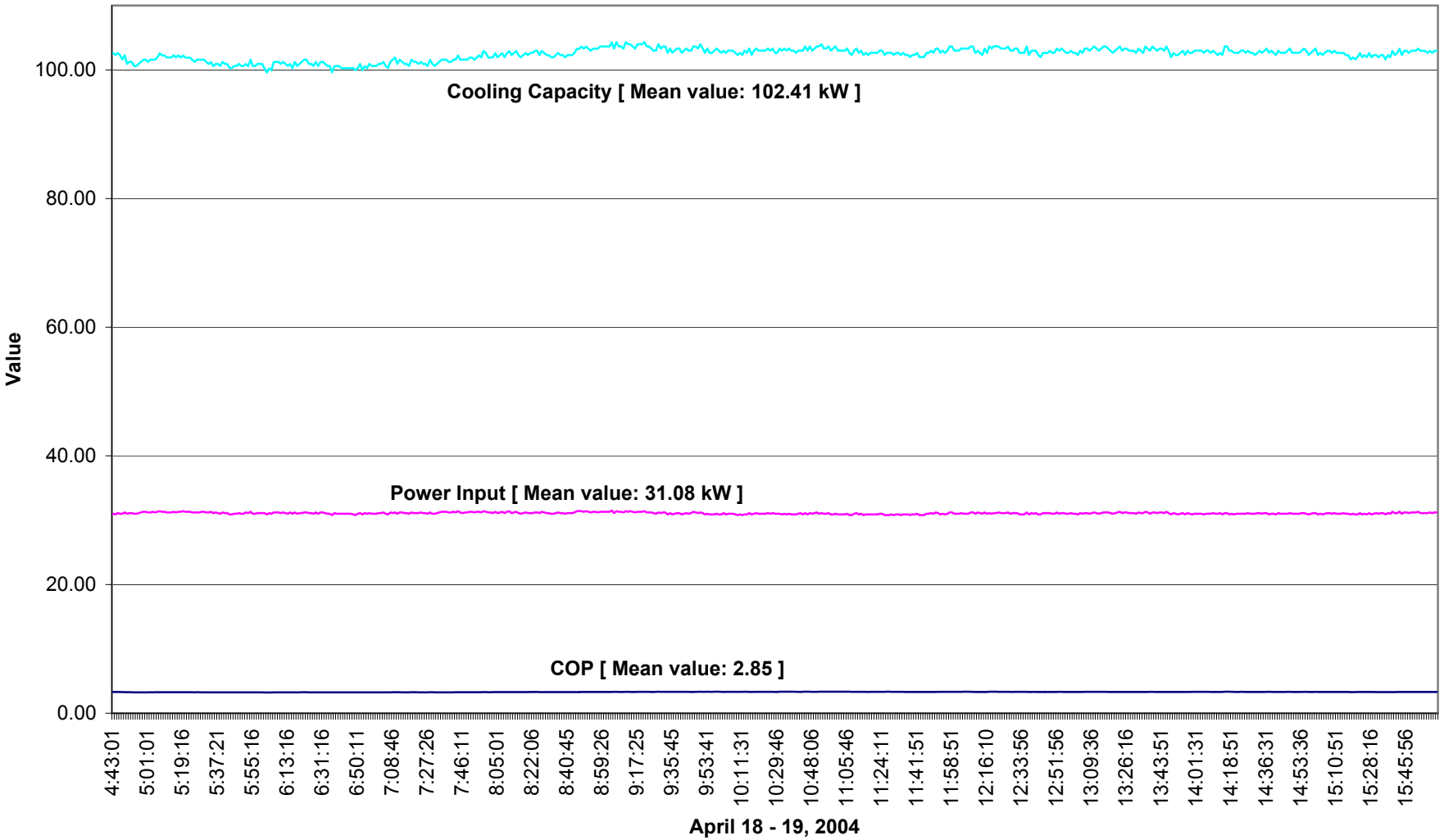


Chart 2B - Carrier Chiller at PCCW: Operating Temperatures (Post- treatment)

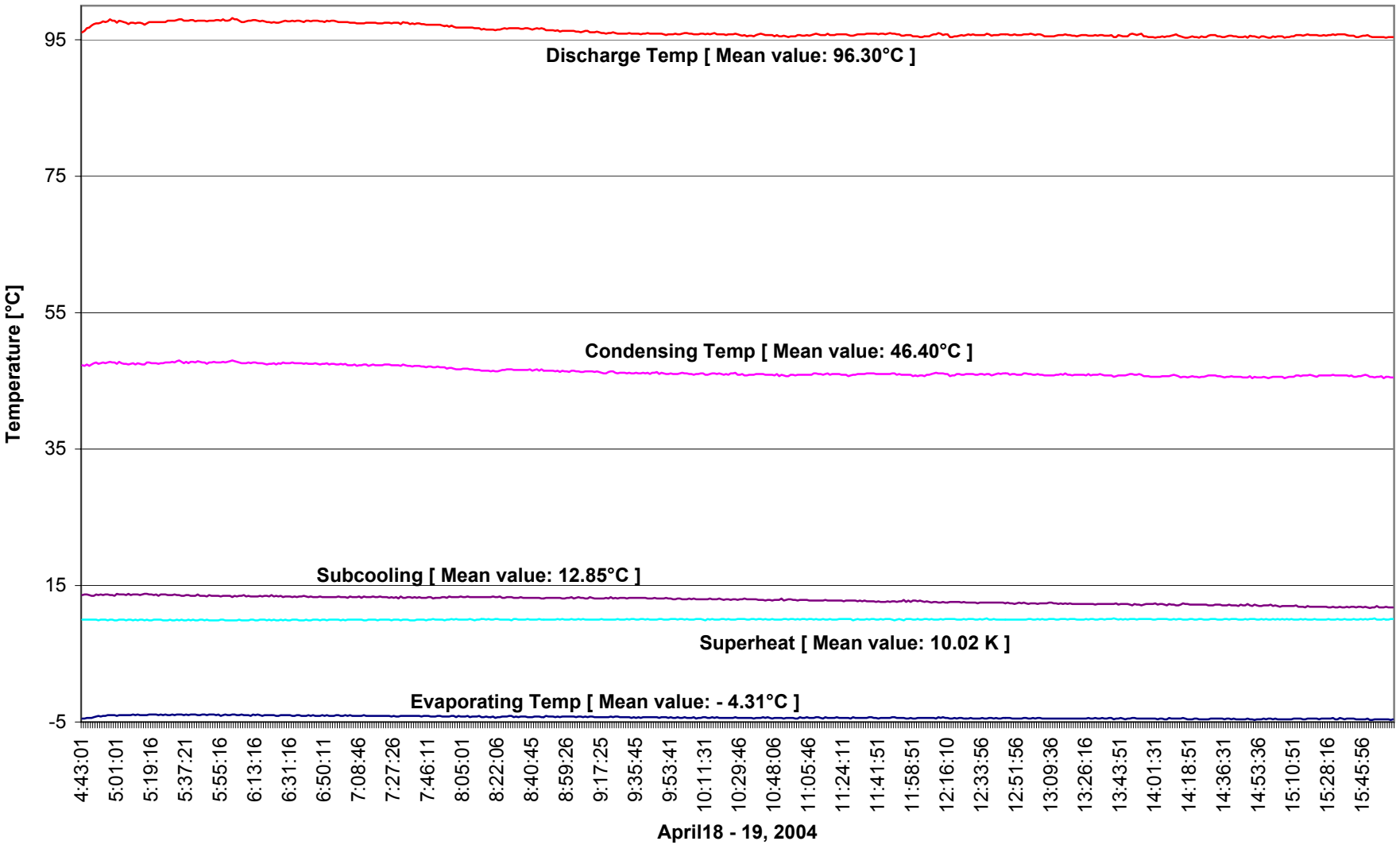
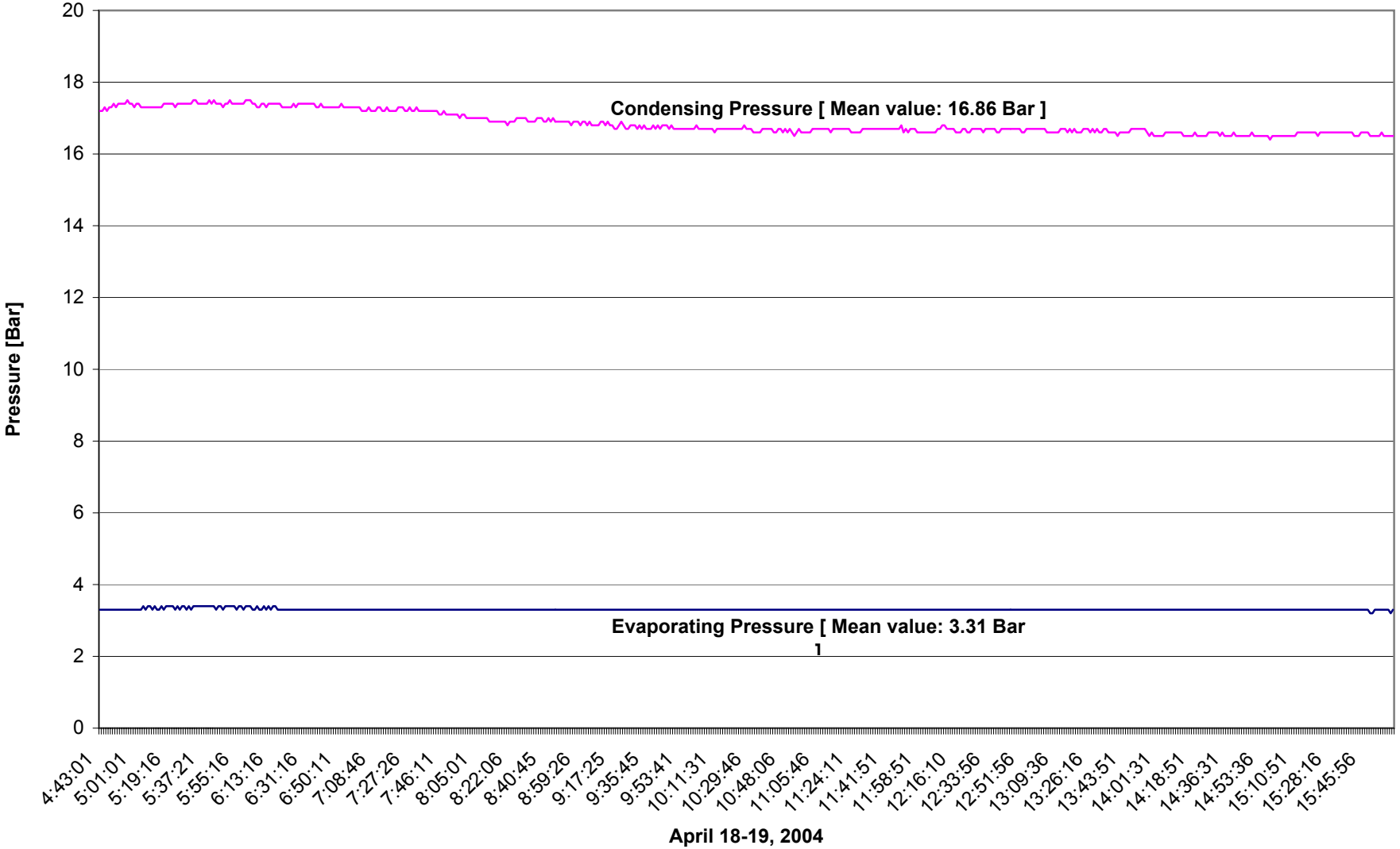


Chart 2C - Carrier Chiller at PCCW: Operating Pressures (Post - treatment)

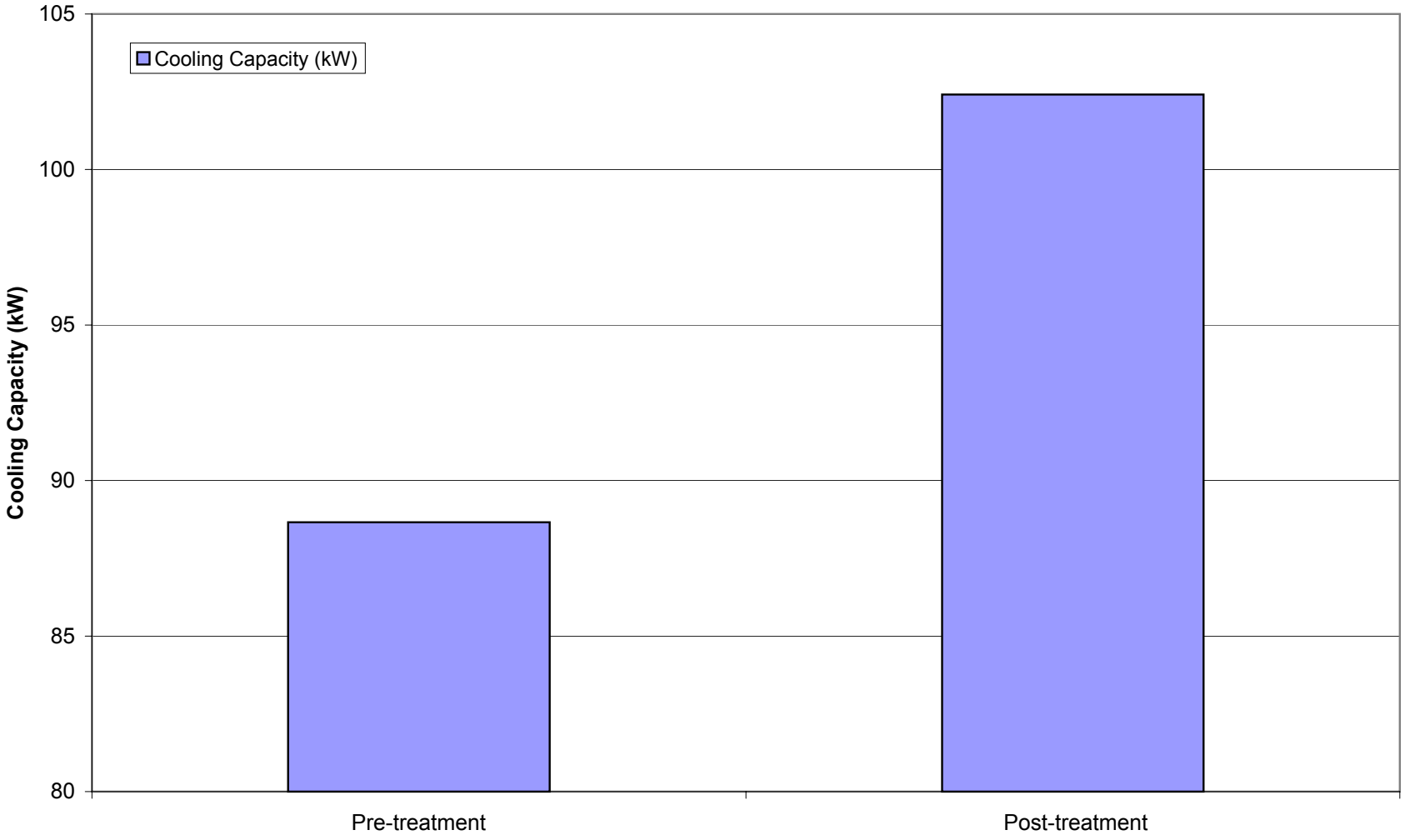


Performance Comparison

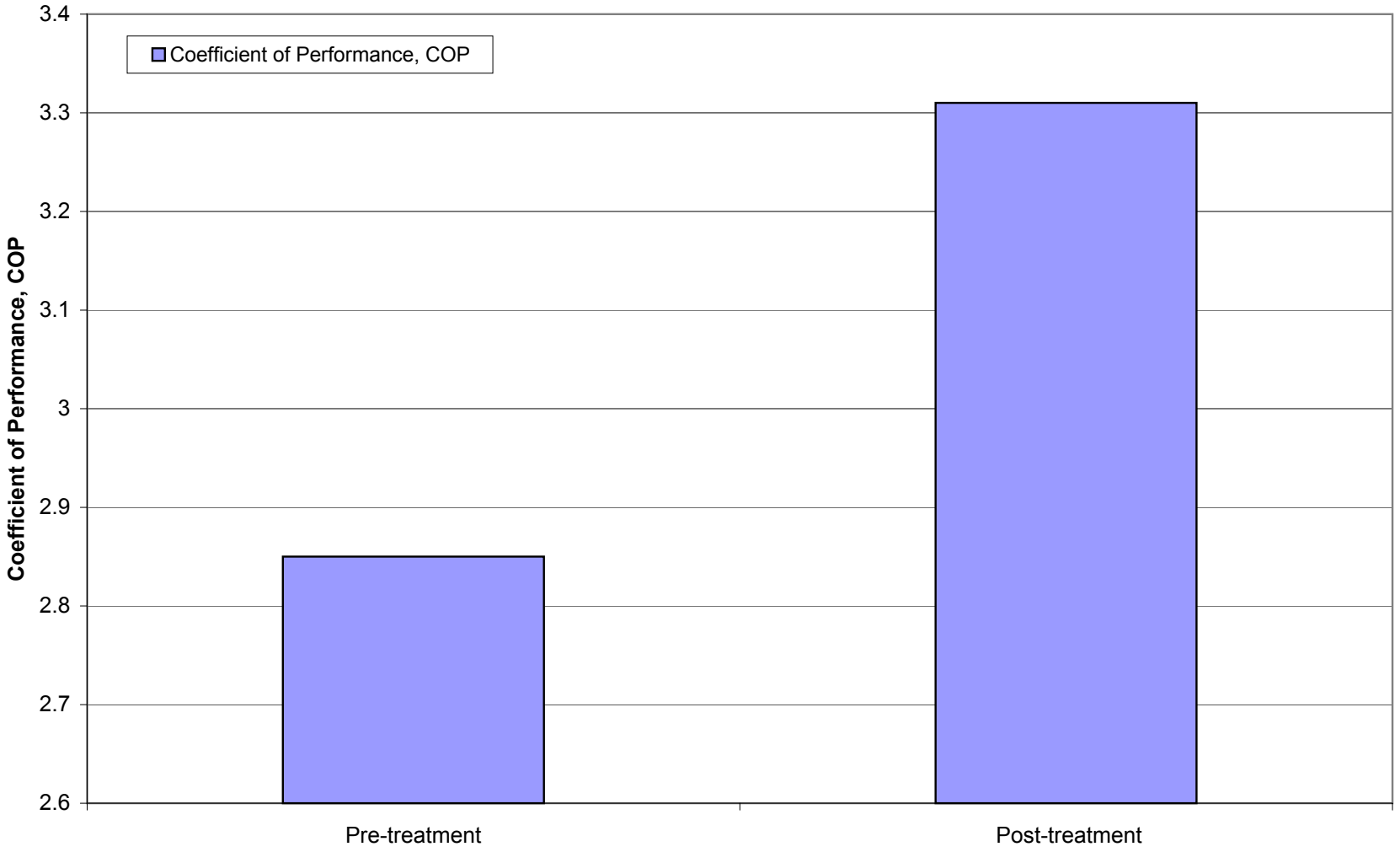
Pre: February 23-24, 2004
&
Post: April 18-19, 2004

Appendix B

Comparison of Cooling Capacity resulting from treatment with PermaFrost



Comparison of COP resulting from treatment with PermaFrost



Comparison of Performance of Chiller resulting from treatment with PermaFrost