

**AN
EVALUATION
OF
THE EFFECTS OF
PERMAFROST TREATMENT
FOR**



**ON
CHILLER 2, A
York YT-D3-E3
Centrifugal Chiller
At
AMP Bourke Place
Melbourne, Victoria
AUSTRALIA**

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March 2004

INTRODUCTION

The aim of this report is to examine the effects of a product known as PermaFrost upon Chiller 2, York YT-D3-E3 centrifugal chiller at AMP Bourke Place, Melbourne, Victoria.

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) Three months after addition of the product.

To measure the performance of the refrigeration system, an “ETM” refrigeration system analyser was used to data log the operating conditions of the system during the testing. For each test, the analyser collected the data on the following operating conditions over a 2 to 3 days period at one minute interval:

- Power input
- Compressor discharge temperature
- Liquid refrigerant temperature at condenser outlet
- Condenser cooling water inlet & outlet temperatures
- Evaporator chilled water inlet & outlet temperatures

The cooling capacity was calculated from the evaporator chilled water inlet and outlet temperature data based on the flow rate of 42.95 L/s obtained from the commissioning record. The coefficient of performance of the chiller was then calculated from the cooling capacity and power input data.

TESTING

The refrigeration system of the chiller was first tested on December 11, 2003 before the product; PermaFrost was introduced into the system and then on March 17, 2004 after the treatment. On both occasions the chiller was chosen as the lead machine in order to obtain data on its performance at full load.

Due to variation in the ambient air temperature, the operating conditions of the chiller fluctuate. An increase in ambient air temperature, resulting in the increase of the temperature of cooling water entering the condenser, will increase the condensing pressure. The increase in condensing pressure will increase the power input and reduce the cooling capacity and hence the COP.

It is normal practice to use the condensing pressure as the “yardstick” for comparing the performance of the refrigeration systems by keeping the condensing pressure constant by maintaining the condenser cooling water inlet temperature as near constant as possible.

On the pre-treatment test, when the chiller was running at full load the average temperature of the cooling water entering the condenser was 21.49°C. On the post-treatment test, when the chiller was running at full load the average temperature of the cooling water entering the condenser was 21.8°C. Hence, there was a slight increase of approximately 1.5% during the post-treatment test.

RESULTS OF TESTING

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

1. Pre-treatment Tests (December 12, 2003)

Chart 1A: Cooling Capacity, Power Input & Coefficient of Performance

Chart 2A: Refrigerant Liquid & Chilled Water Inlet & Outlet Temperatures

Chart 3A: Discharge & Condenser Water Inlet & Outlet Temperatures

2. Post-treatment Tests (March 17, 2004)

Chart 1B: Cooling Capacity, Power Input & Coefficient of Performance

Chart 2B: Refrigerant Liquid & Chilled Water Inlet & Outlet Temperatures

Chart 3B: Discharge & Condenser Water Inlet & Outlet Temperatures

OBSERVATIONS

A comparison of the mean operating conditions for each of the above two tests are summarized in Table 1 in appendix B.

From Table 1, a number of observations can be made about the effects of PermaFrost on the chiller when it was running on **full load**:

- Cooling capacity difference between pre-treatment test and post-treatment test is an insignificant 0.9 %. This could be attributed to a slight difference in the building heat load during the periods of testing.
- Power input decreased by a significant 14.8 % in the post-treatment test. *This indicates the system used less energy to achieve the same cooling capacity.*
- The COP (a ratio of the cooling capacity and power input) increased by 16.3 % in the post-treatment test. *This indicates significant improvement in the overall system performance.*
- The compressor discharge temperatures decreased by 2.4 % in the post-treatment test, *indicating a slight increase in the lubricity of the refrigerant oil in the compressor.*
- The refrigerant liquid temperature leaving the condenser decreased by 2.8 % in the post-treatment test. *This indicates an increase in the subcooling of the liquid entering the evaporator, which is reflected in the increase the system performance.*
- The inlet temperature of the condenser cooling water was 1.4 % higher in the post-treatment test. However, the temperature difference between the condenser cooling water inlet and outlet temperatures decreased by 20.7% indicating a lower rate of heat rejection from the chiller. *This is reflected in the lower power input by the compressor motor.*
- The inlet temperature of the chilled water was 4.4 % lower in the post-treatment test, indicating a slightly lower building heat load.

CONCLUSION

The tests carried out on the chiller indicated a significant overall improvement in the system performance and a marked decrease in the power input.

During the post treatment test there was a slight increase in the inlet temperature of the condenser cooling water. This increase will result in a slight rise of the condenser pressure and temperature. Any increase of the condenser pressure and temperature would in normal circumstances reduce the system performance.

The significant increase in system performance and the marked decrease in power input attributed to the treatment with Permafrost will result in substantial reduction in energy consumption by the chiller.

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

Pre Treatment Test

December 12, 2003

Appendix A

**Chart 1A : AMP Bourke Place - Chiller 2: Cooling Capacity, Power Input & COP at Full Load
[Pre-treatment]**

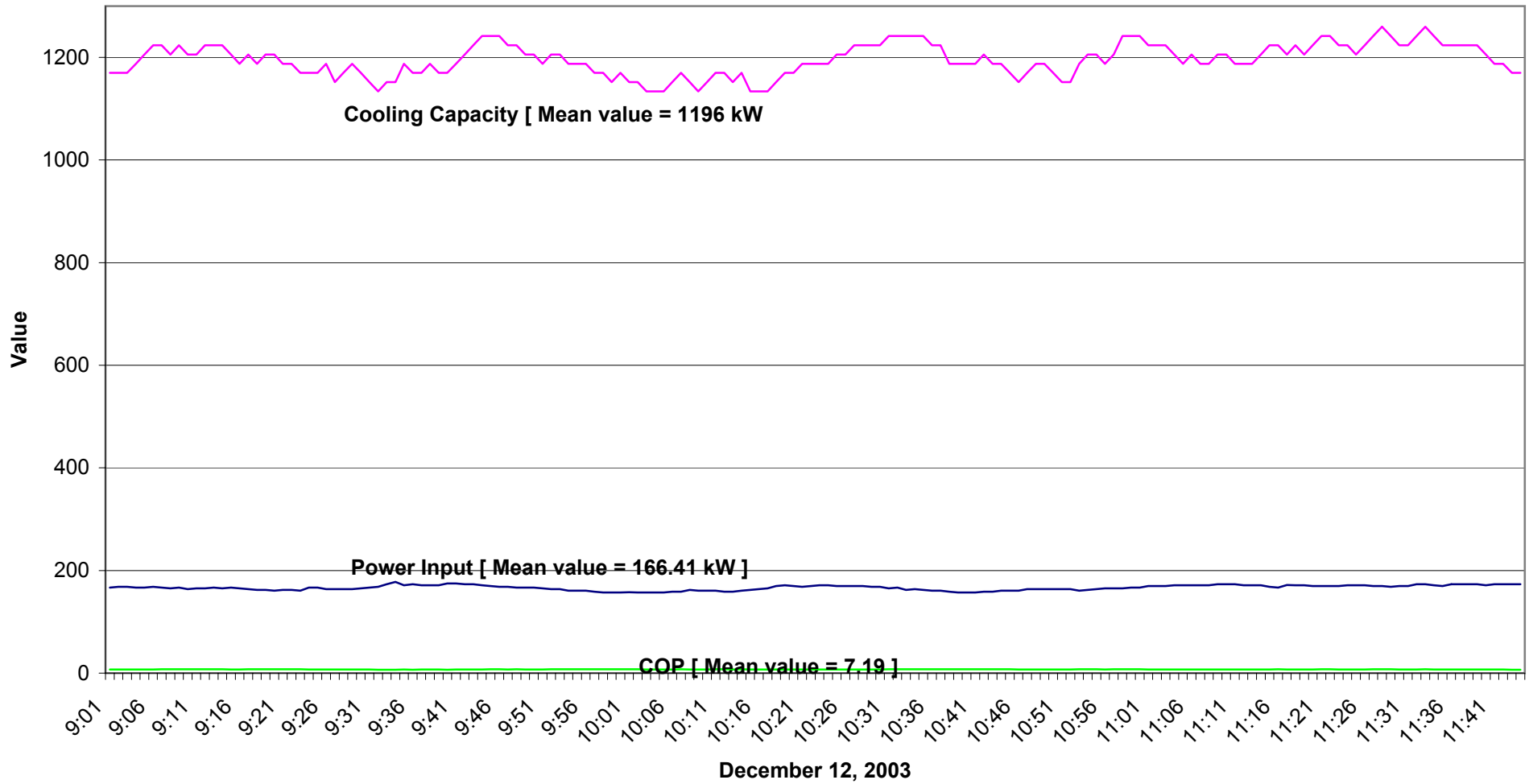


Chart 2A: AMP Bourke Place - Chiller 2: Operating Temperatures at Full Load [Pre-treatment]

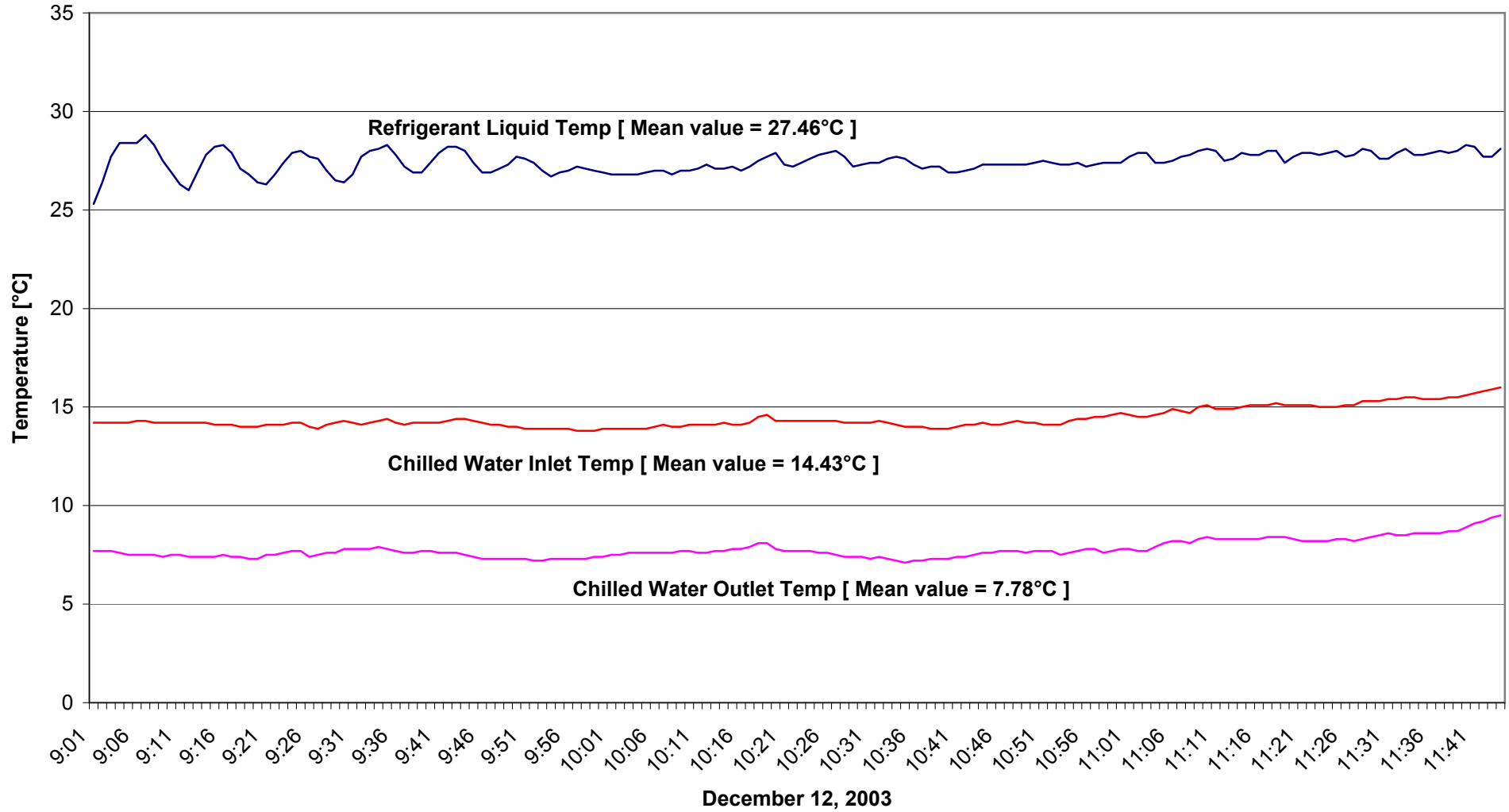
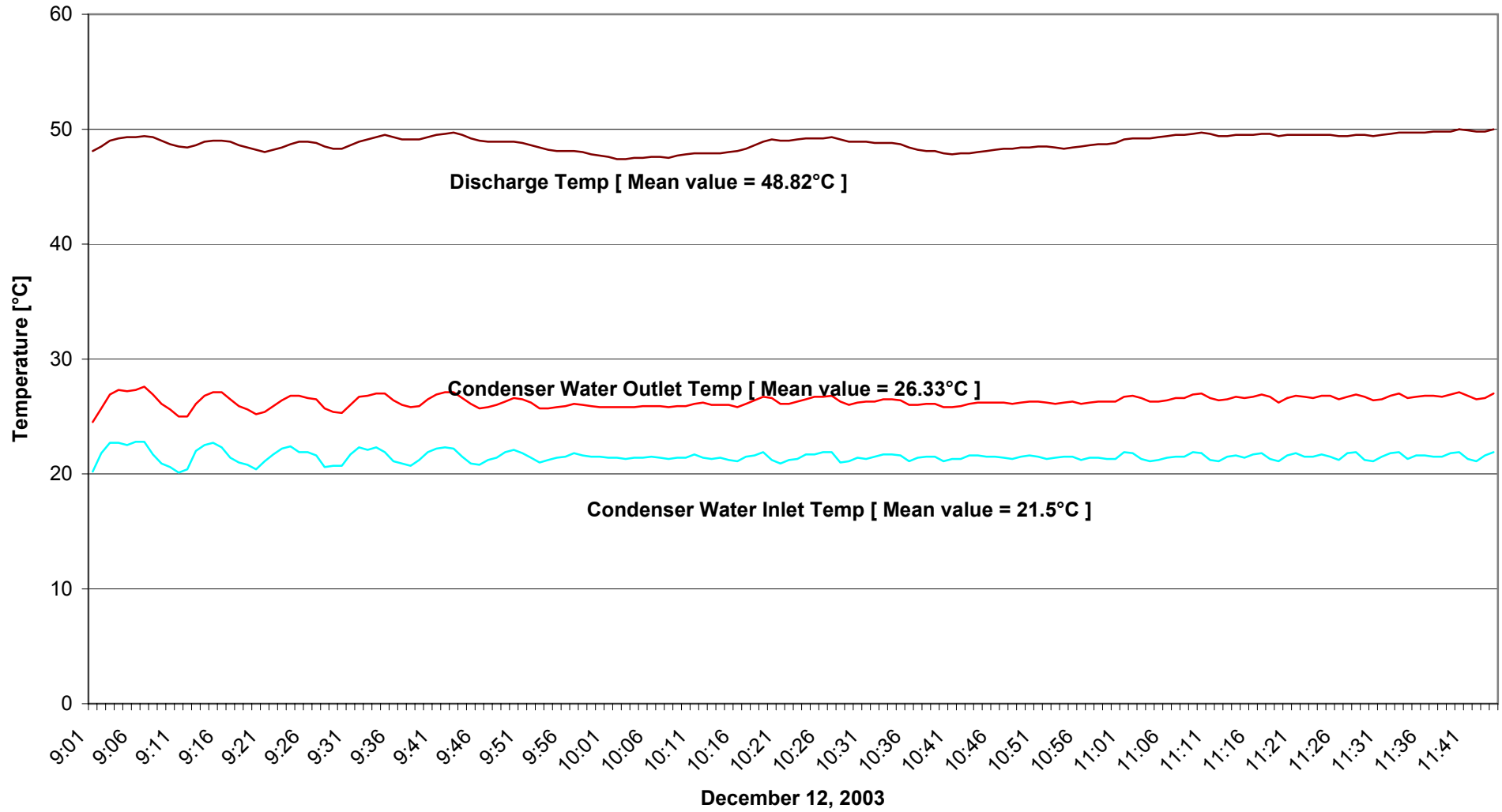


Chart 3A: AMP Bourke Place - Chiller 2: Operating Temperatures at Full Load [Pre-treatment]



Post Treatment Test

March 17, 2004

Appendix A

**Chart 1B : AMP Bourke Place - Chiller 2: Cooling Capacity, Power Input & COP at Full Load
[Post - treatment]**

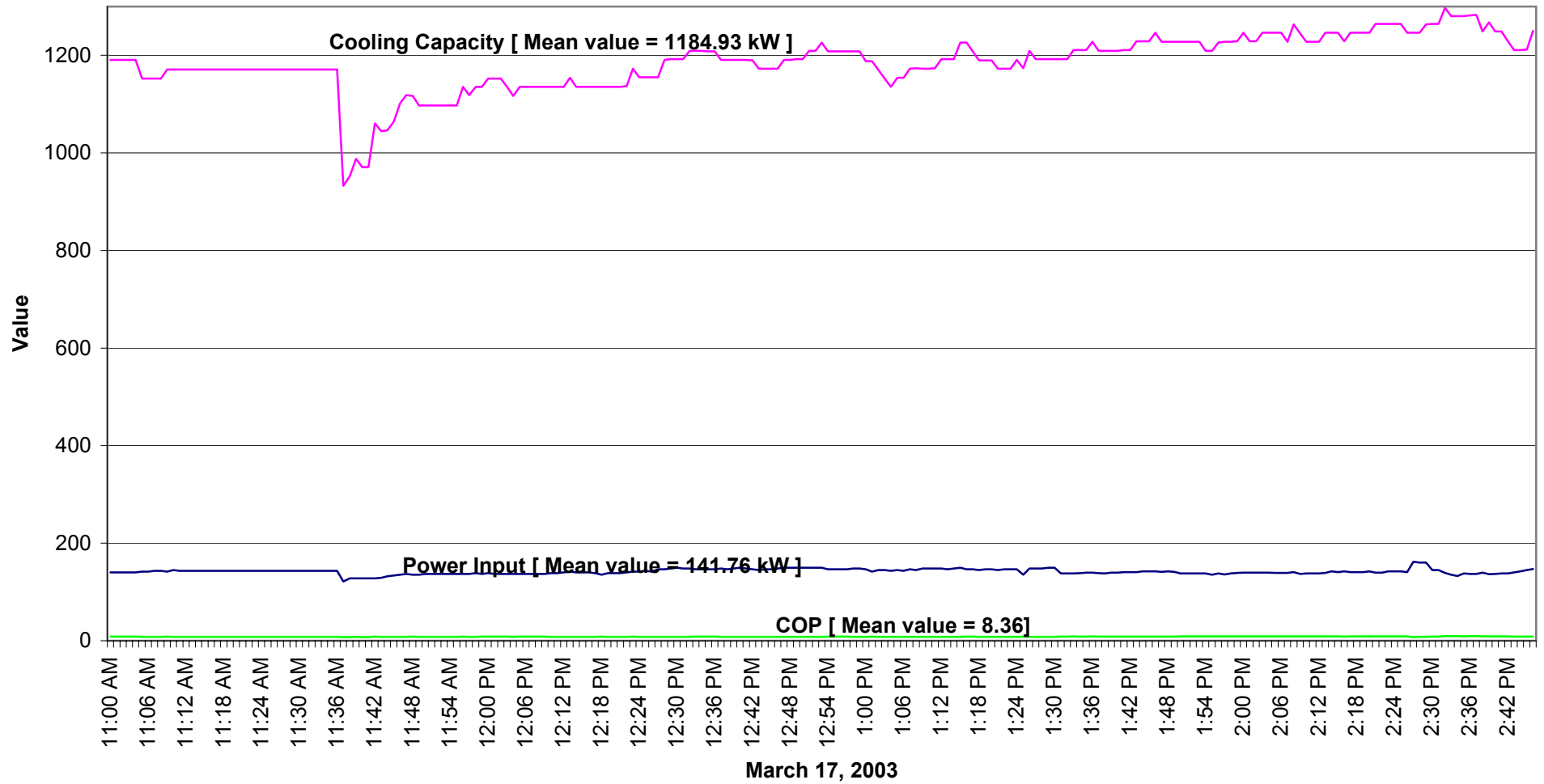


Chart 2B: AMP Bourke Place - Chiller 2: Operating Temperatures at Full Load [Post - treatment]

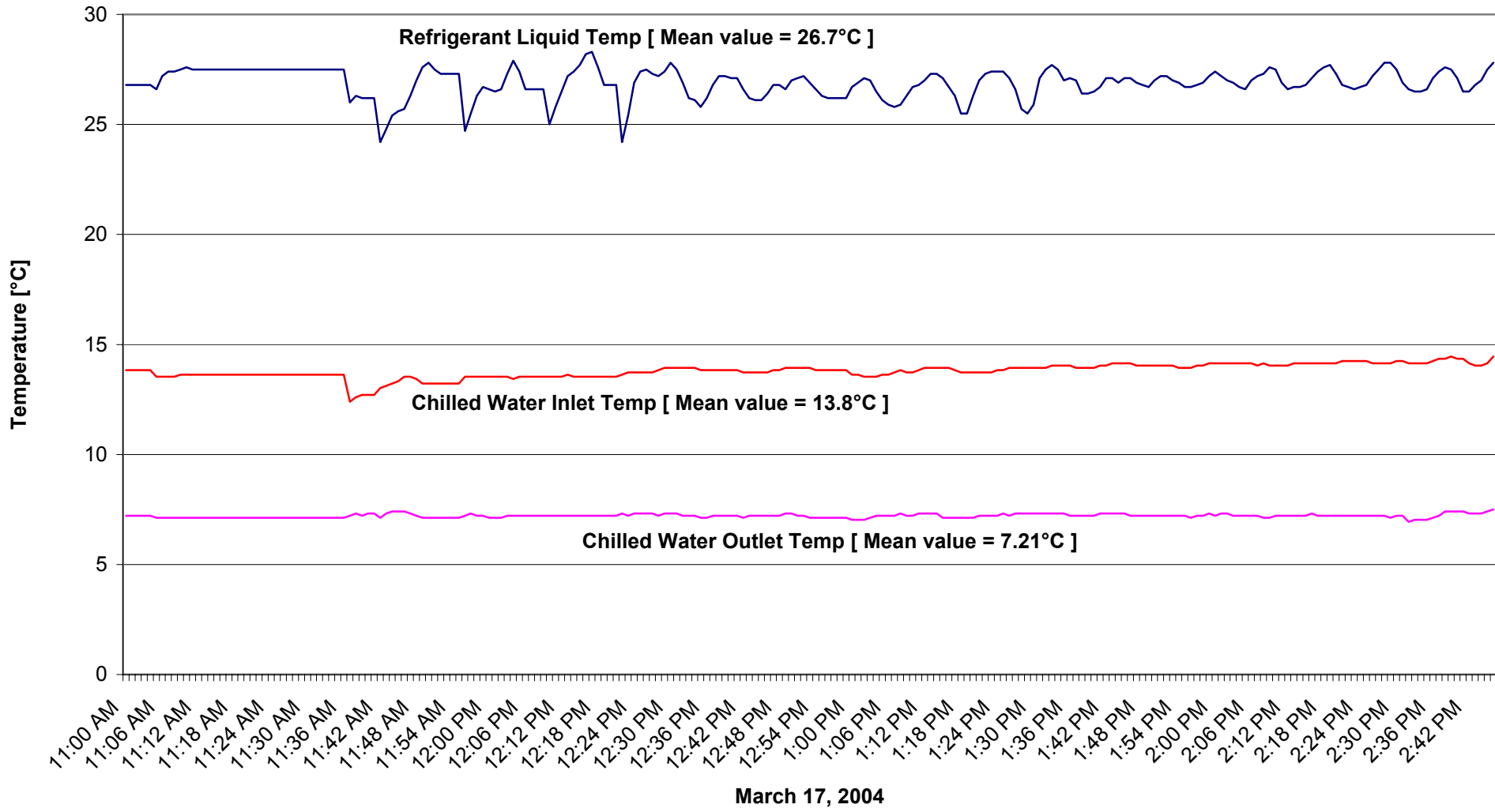
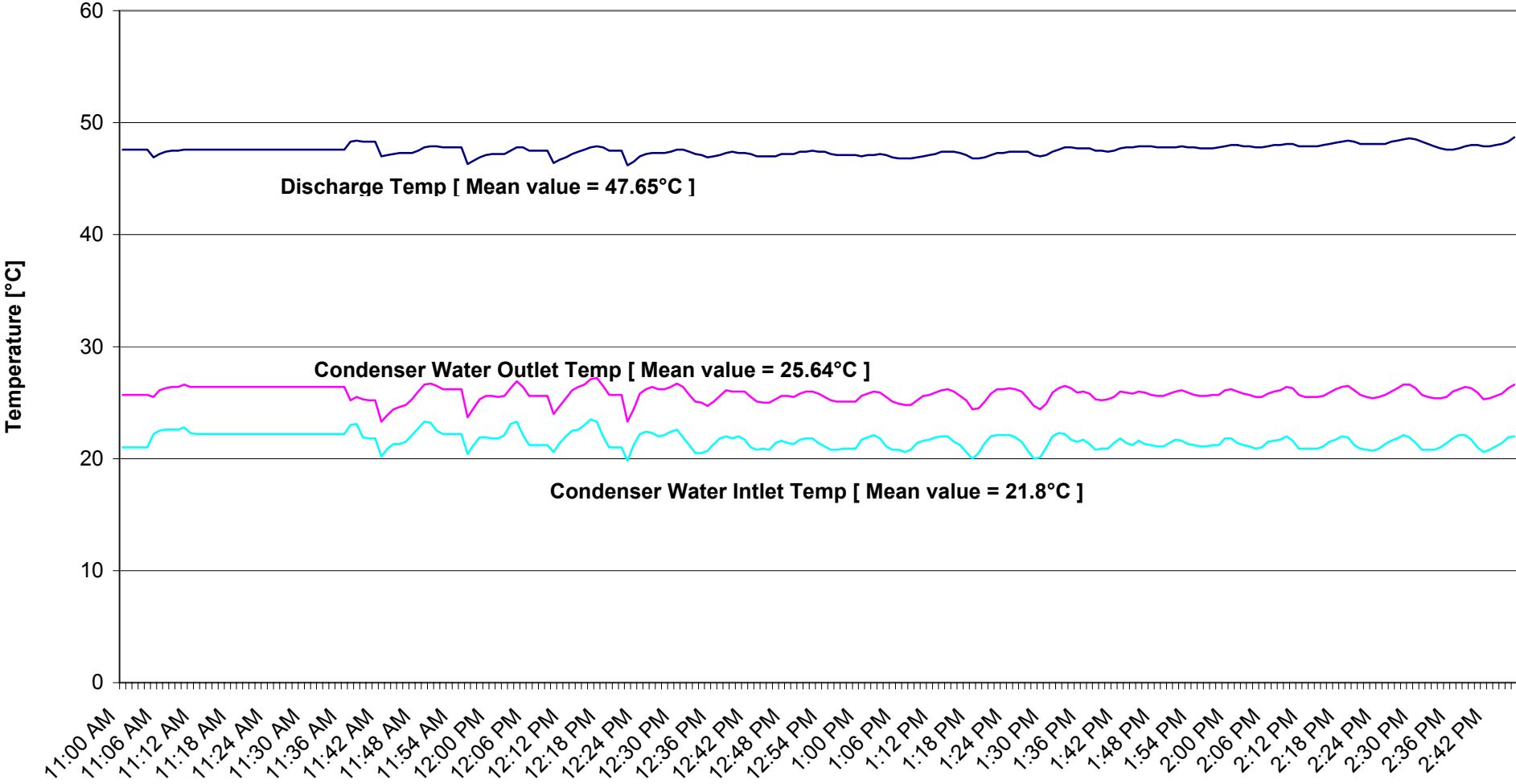


Chart 3B: AMP Bourke Place - Chiller 2: Operating Temperatures at Full Load [Post - treatment]



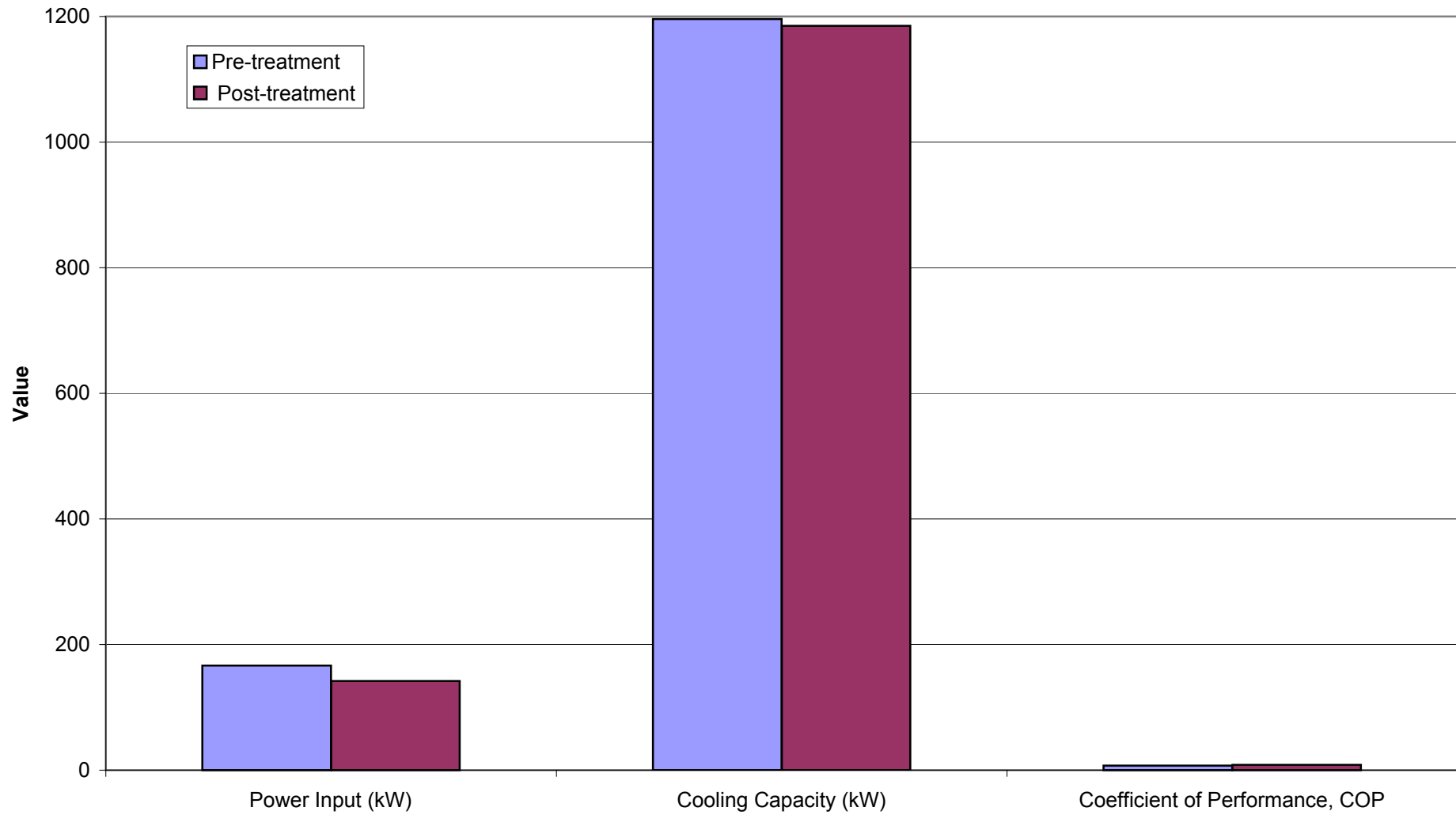
March 17, 2004

Performance Comparison

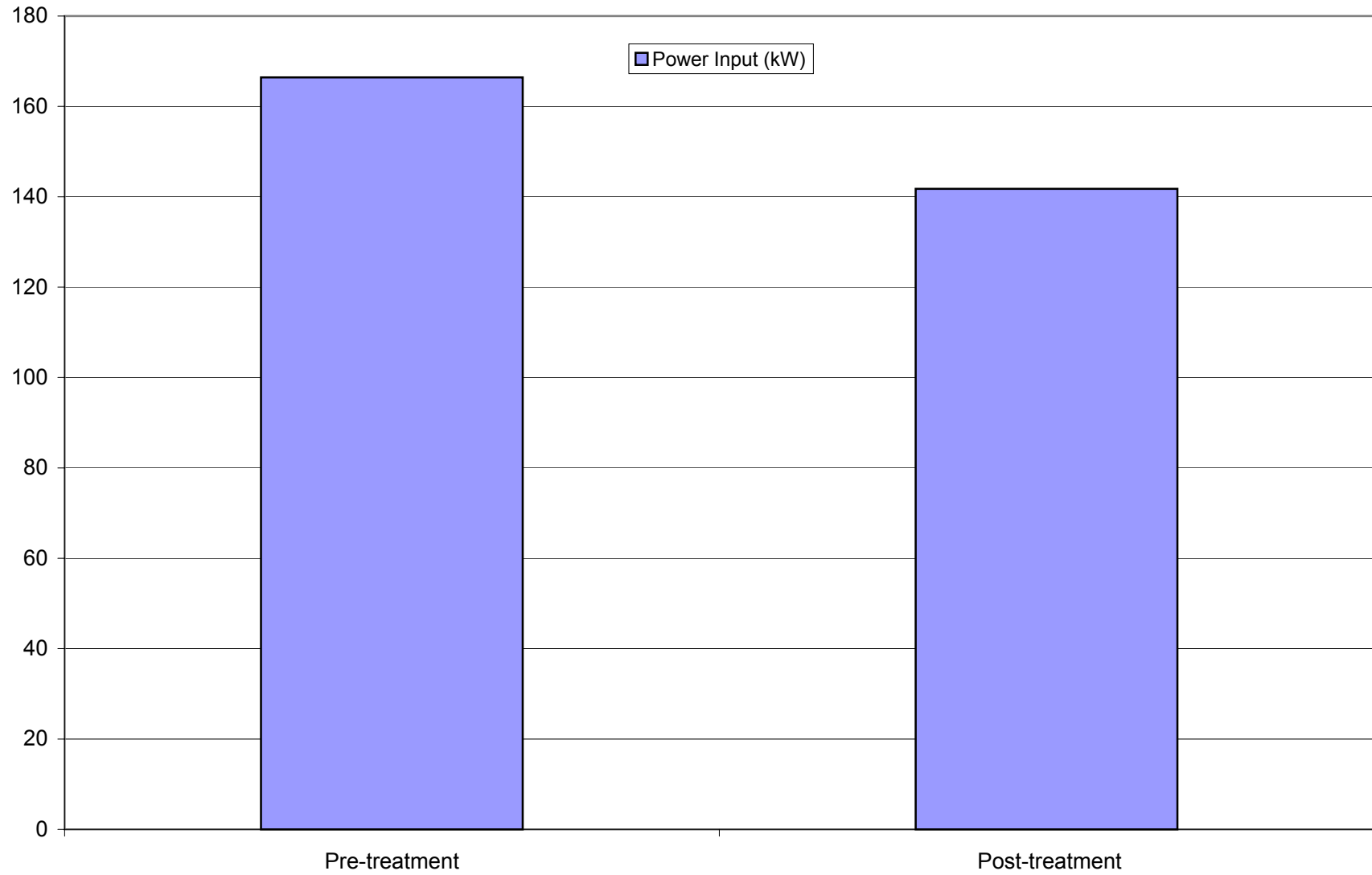
Pre: December 12, 2003
&
Post: March 17, 2004

Appendix B

Comparison of Performance of Chiller 2 at Full Load resulting from treatment with PermaFrost



Comparison of Power Input at Full Load resulting from treatment with PermaFrost



Comparison of COP of Chiller 2B at Full Load resulting from treatment with PermaFrost

