

AN EVALUATION

OF THE EFFECTS OF

**Permafrost**

ON A

YORK CENTRIFUGAL WATER CHILLER

YTDL - E2 - JCL FOR

**MULTIPLEX PROPERTY TRUST**

At



**GOLD FIELD'S HOUSE**

**ALFRED STREET**

**CIRCULAR QUAY**

**SYDNEY, NSW**

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## INTRODUCTION

The aim of this report is to examine the effects of a product known as PermaFrost upon the refrigeration system of the water-cooled, centrifugal York YTDL-E2-JCL water chiller at Goldfields House, Sydney.

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, a data logger was used to datalog the operating conditions of the system during testing. For each test, the analyser collected the data on the following operating conditions over a 4 to 5 hour period at one minute interval:

- Power input
- Chilled water inlet & outlet temperatures
- Condenser cooling water inlet temperature
- Evaporating & condensing temperatures
- Evaporating & condensing pressures

The cooling capacity and the coefficient of performance (COP) were calculated from the data collected. The cooling capacity calculations were based on the temperature difference between the chilled water inlet & outlet temperatures and a flow rate of 53 litres/s. The COP calculations were based on the ratio of cooling capacity to power input.

## **TESTING**

The refrigeration system of the chiller was first tested on January 17, 2005 before the product, PermaFrost was introduced into the system and then on March 8, 2005 after the treatment. On both occasions the compressor was running at full capacity.

On the first test, the average condenser cooling water inlet temperature was 26.65°C. On the final test, the average condenser cooling water inlet temperature was 26.68°C. Hence, there was little difference in the condition of the condenser cooling water inlet temperature during both tests.

## **RESULTS OF TESTING**

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

1. Pre-treatment Test (January 17, 2005)

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

Chart 2A: Evaporator & Condenser Pressures

Chart 3A: Evaporating Temperature and Chilled Water Inlet & Outlet Temperatures

Chart 4A: Condenser Water Inlet and Condensing Temperatures

2. Post-treatment Test (March 8, 2005)

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

Chart 2B: Evaporator & Condenser Pressures

Chart 3B: Evaporating Temperature and Chilled Water Inlet & Outlet Temperatures

Chart 4B: Condenser Water Inlet and Condensing Temperatures

### **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)	959.11	1107.64	15.49
Power Input (kW)	184.85	169.57	-8.27
Coefficient of Performance, COP	5.20	6.53	25.58
Condensing Temperature (°C)	32.87	36.97	12.47
Evaporating Temperature (°C)	4.60	4.14	-10
Chilled Water Inlet Temperature (°C)	12.72	13.52	6.29
Chilled Water Outlet Temperature (°C)	8.40	8.53	1.55
Chilled Water Temperature Difference (K)	4.32	4.99	15.51
Condenser Water Inlet Temperature (°C)	26.65	26.68	0.11
Condensing Pressure (Bar)	0.20	0.37	85
Evaporating Pressure (Bar)	- 0.60	- 0.60	0

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

- Cooling capacity increased by 15.49 % in the post-treatment test. *This indicates a significant improvement in heat transfer in the evaporator.*
- Power input decreased by 8.27 % in the post-treatment test. *This indicates a reduction in power consumption.*
- The COP increased by 25.58 % in the post-treatment test. *This indicates a significant improvement in the overall system performance.*
- There was an increase in the chilled water temperature difference of 15.51 %. This again *indicates a significant improvement in heat transfer in the evaporator.*
- There was an increase in the condensing temperature and pressure of 12.47 % and 85% respectively in spite of a very slight increase of 0.11% in the condenser water inlet temperature.
- The evaporating temperature decreased by 10% but the evaporating pressure remained unchanged.

## **SUMMARY**

The tests carried out on the chiller have clearly demonstrated that treatment with PermaFrost has enhanced its performance by a significant 26 %. This is due to the molecular technology of PermaFrost in depositing its highly activated thermal conductive compounds on the heat transfer surfaces of the evaporator and condenser.

The improvement in the heat transfer in both the evaporator and condenser has resulted in a marked increase of 15 % in the cooling capacity and a decrease of 8 % in the compressor power input.

The decrease in power input and increase in 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 summarized in the bar graphs in Appendix B.

# Pre Treatment Test

January 17, 2005

Appendix A

**Chart 1A - York Centrifugal Chiller at Gold Fields House: Cooling Capacity, Power Input & COP  
[Pre-treatment]**

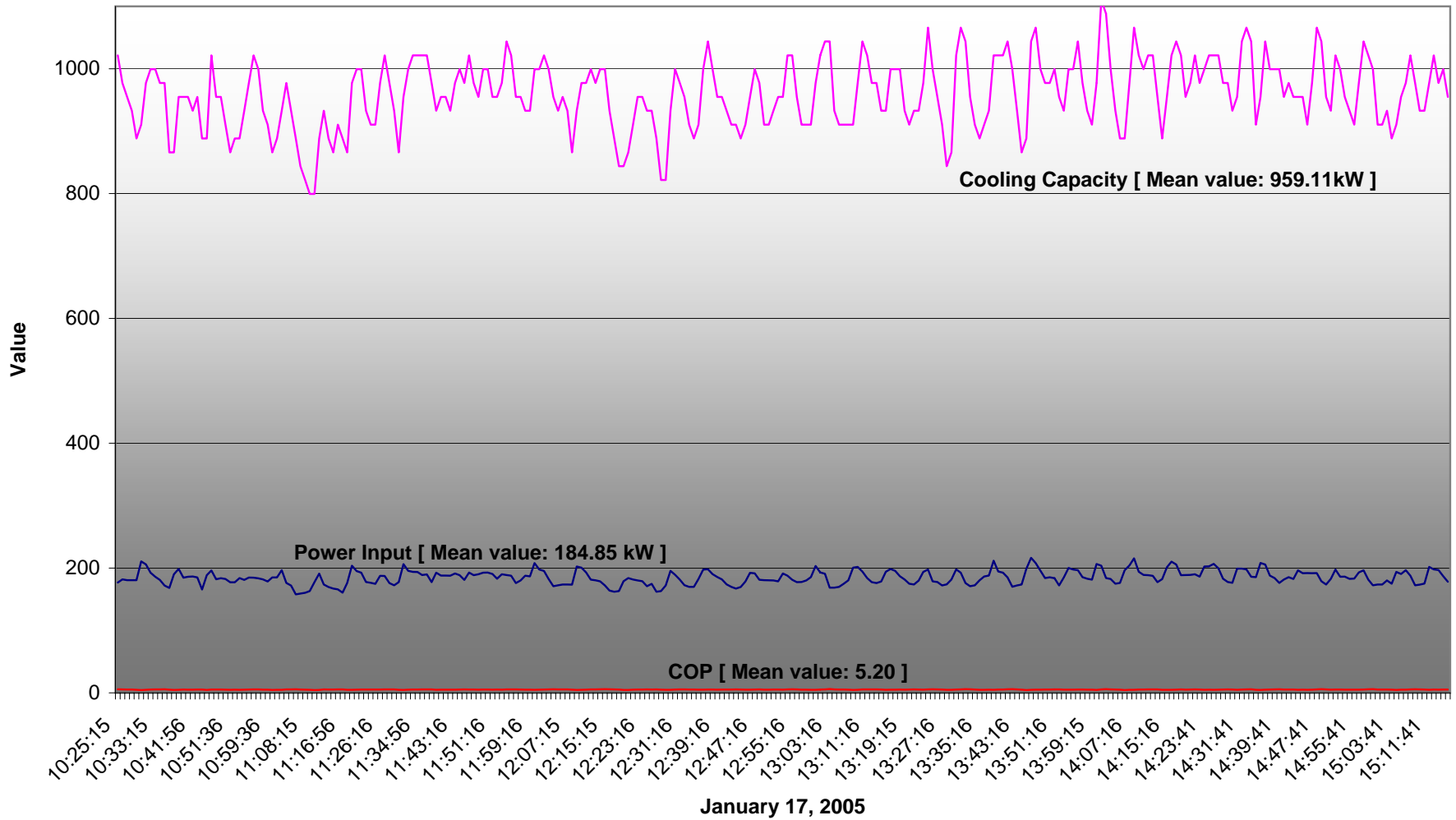
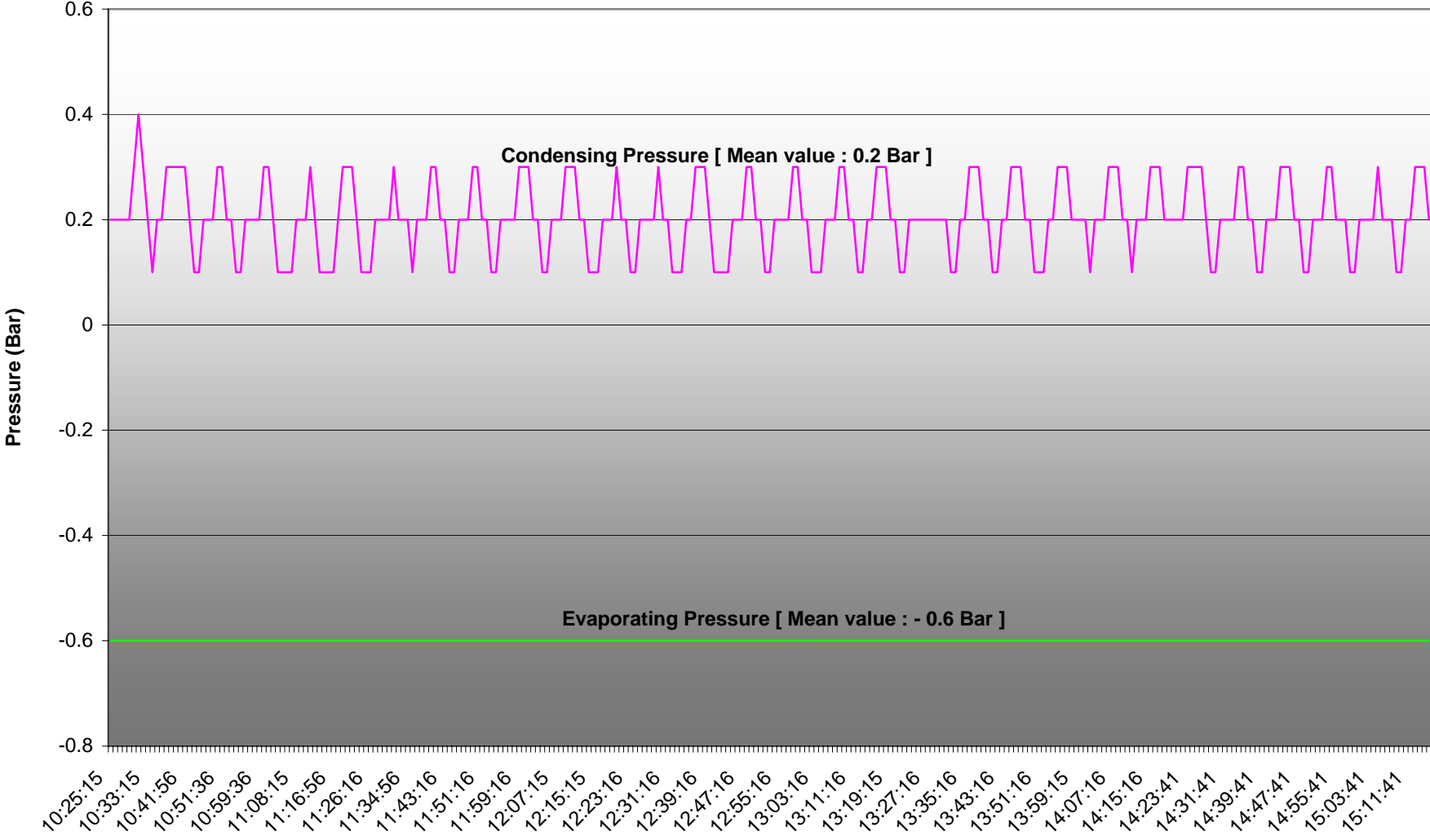
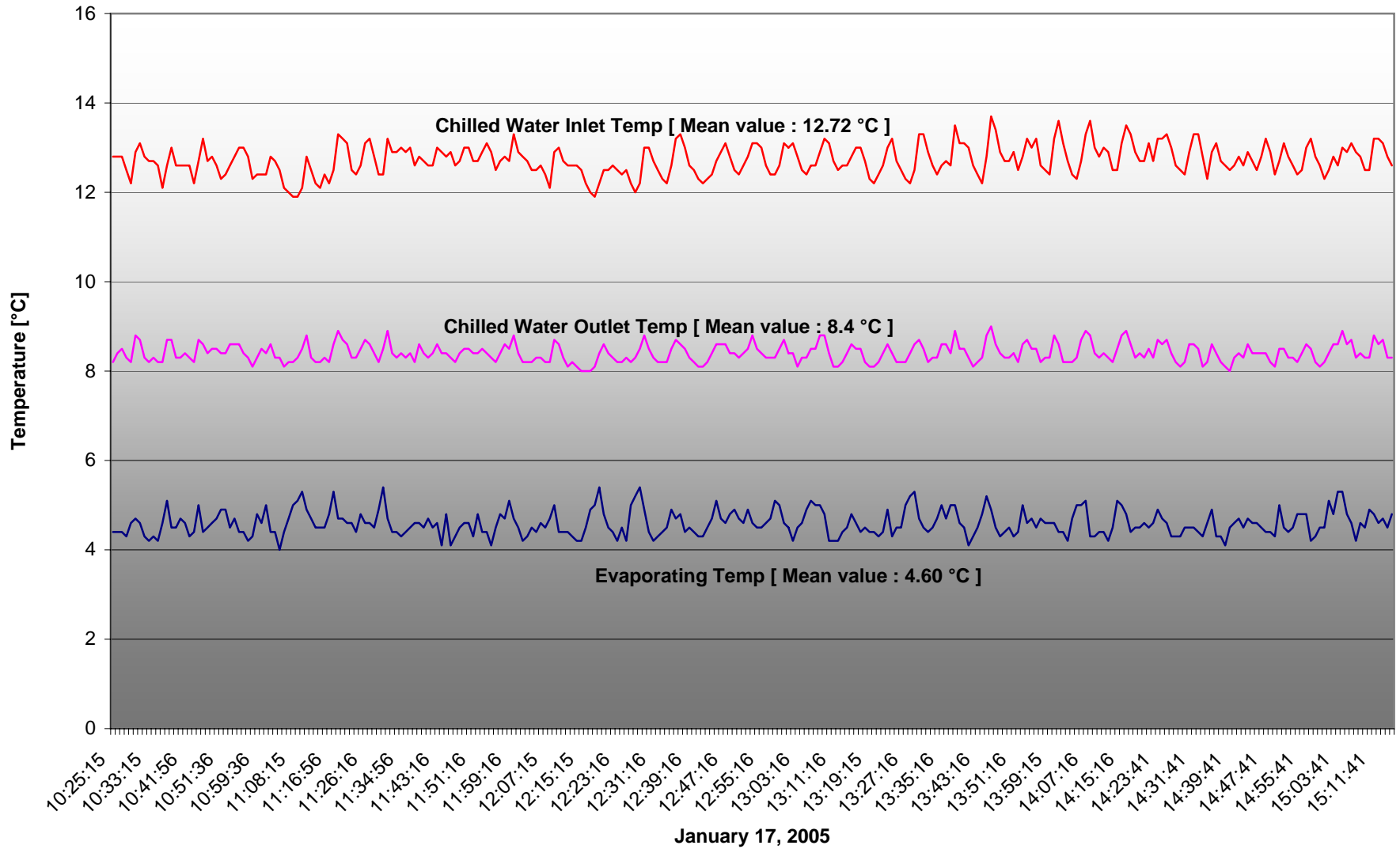


Chart 2A - York Centrifugal Chiller at Gold Fields House: Operating Pressures [Pre-treatment]

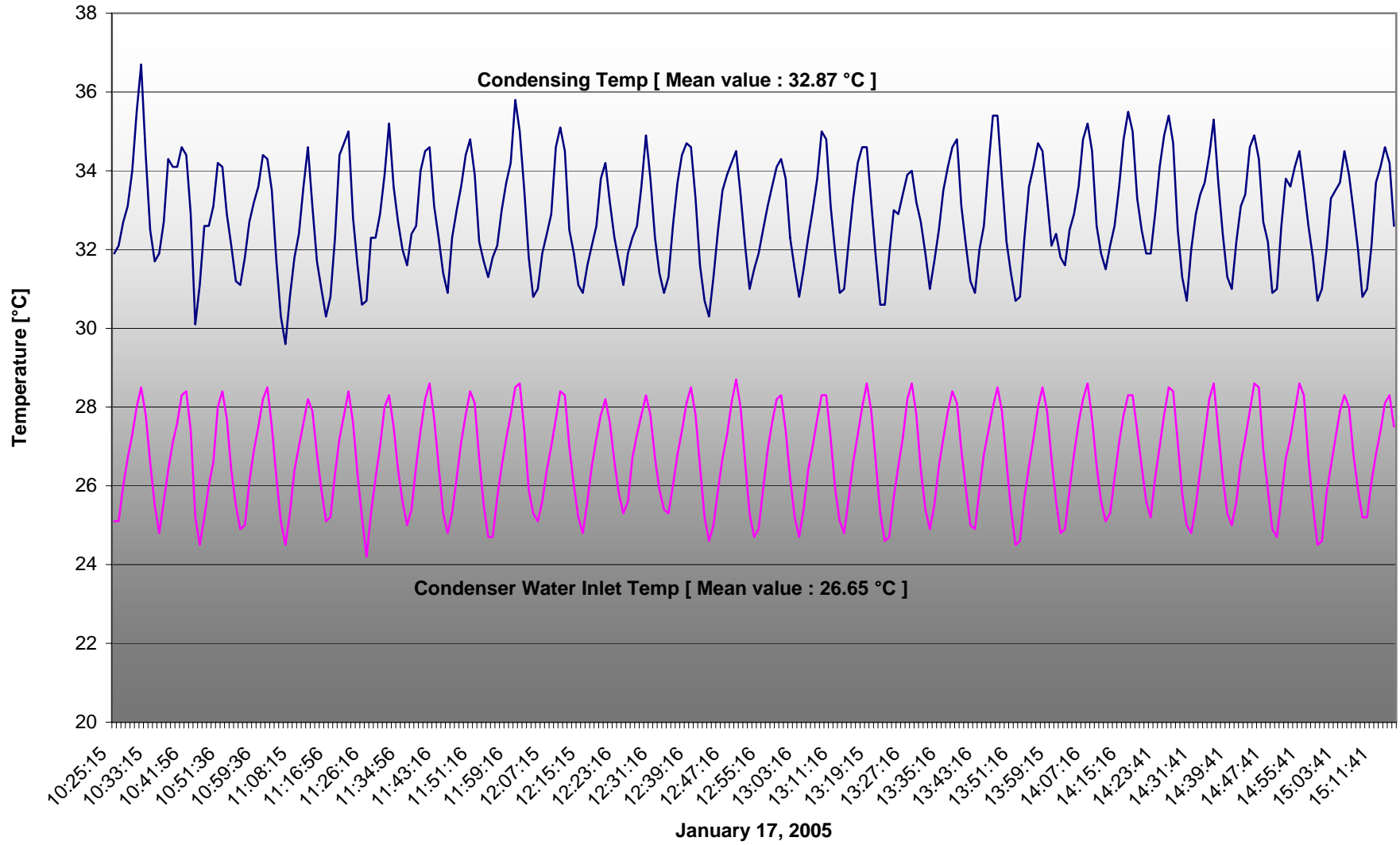


January 11, 2005

**Chart 3A -York Centrifugal Chiller at Gold Fields House: Operating Temperatures [Pre-treatment]**



**Chart 4A -York Centrifugal Chiller at Gold Fields House: Operating Temperatures [Pre-treatment]**

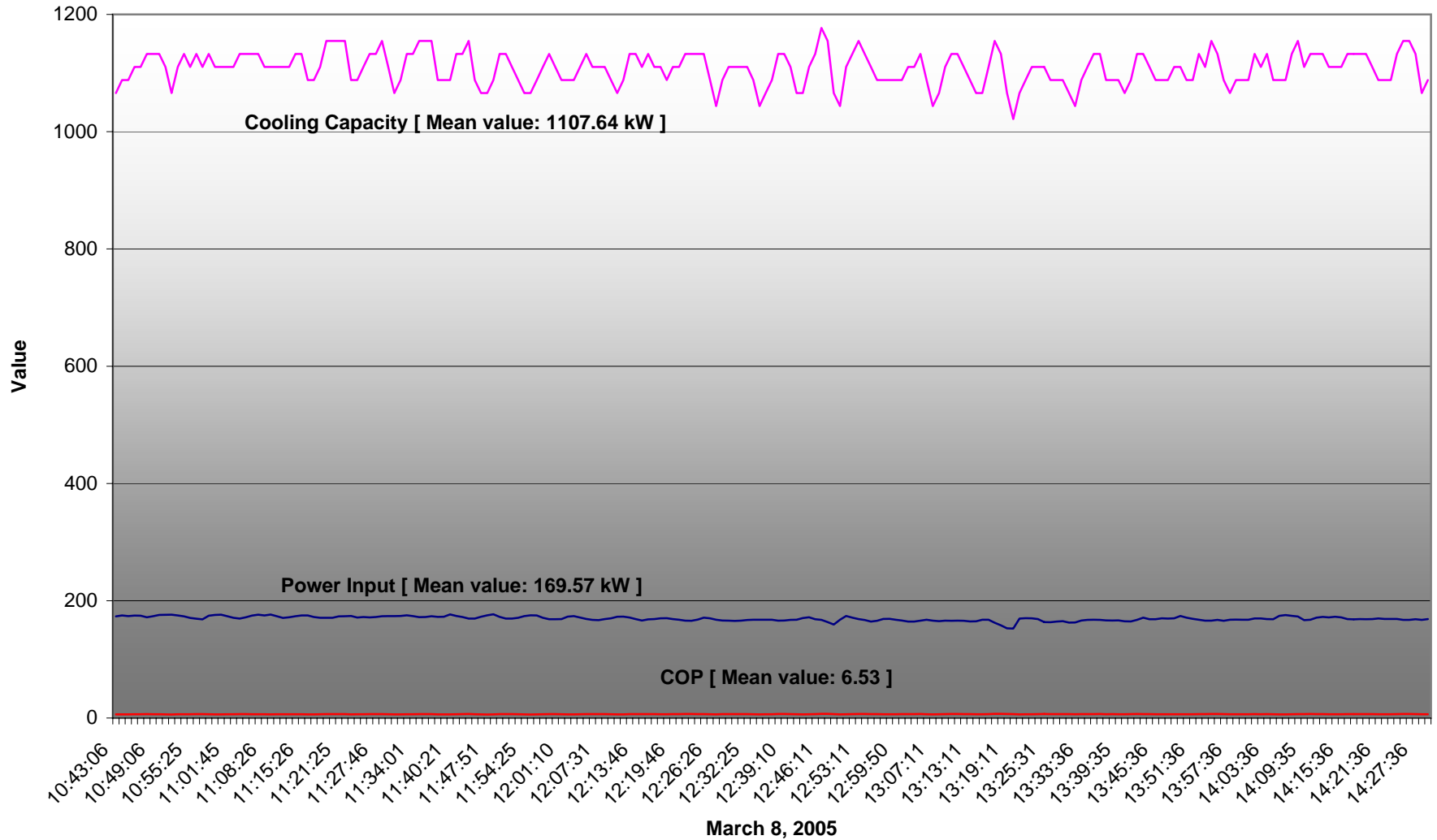


# Post Treatment Test

March 8, 2005

Appendix A

**Chart 1B - York Centrifugal Chiller at Gold Fields House: Cooling Capacity, Power Input & COP  
[Post-treatment]**



**Chart 2B - York Centrifugal Chiller at Gold Fields House: Operating Pressures [Post-treatment]**

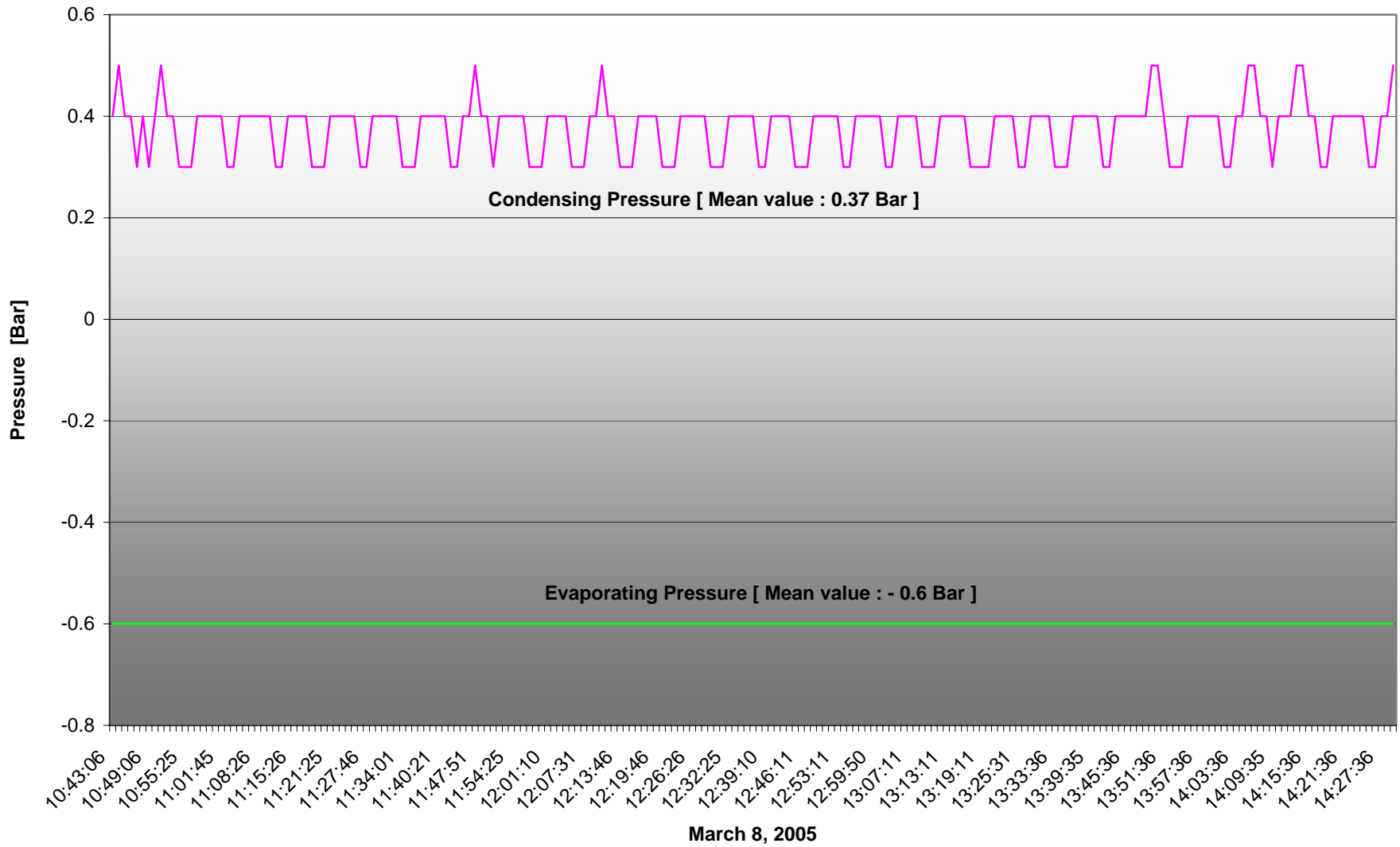
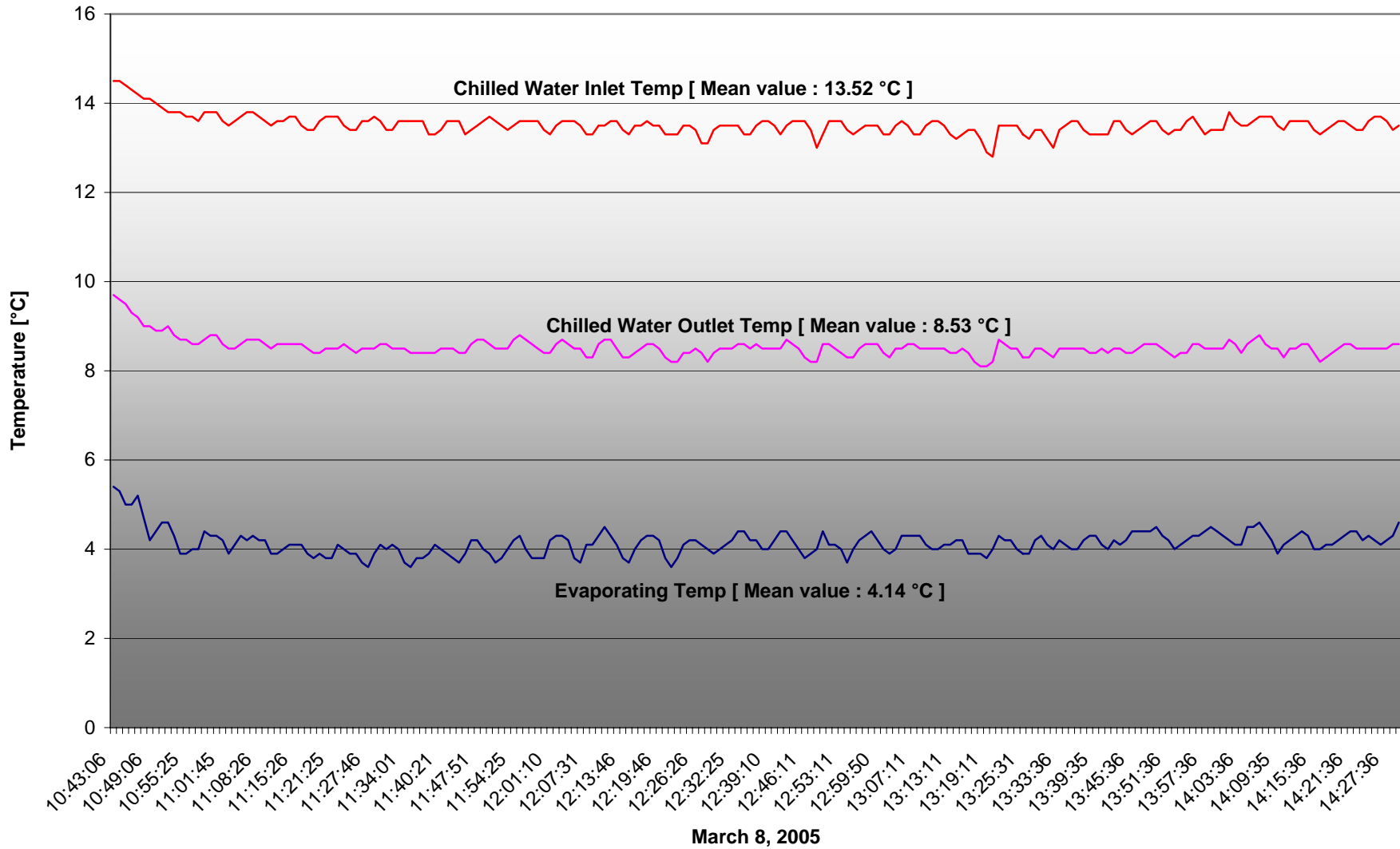
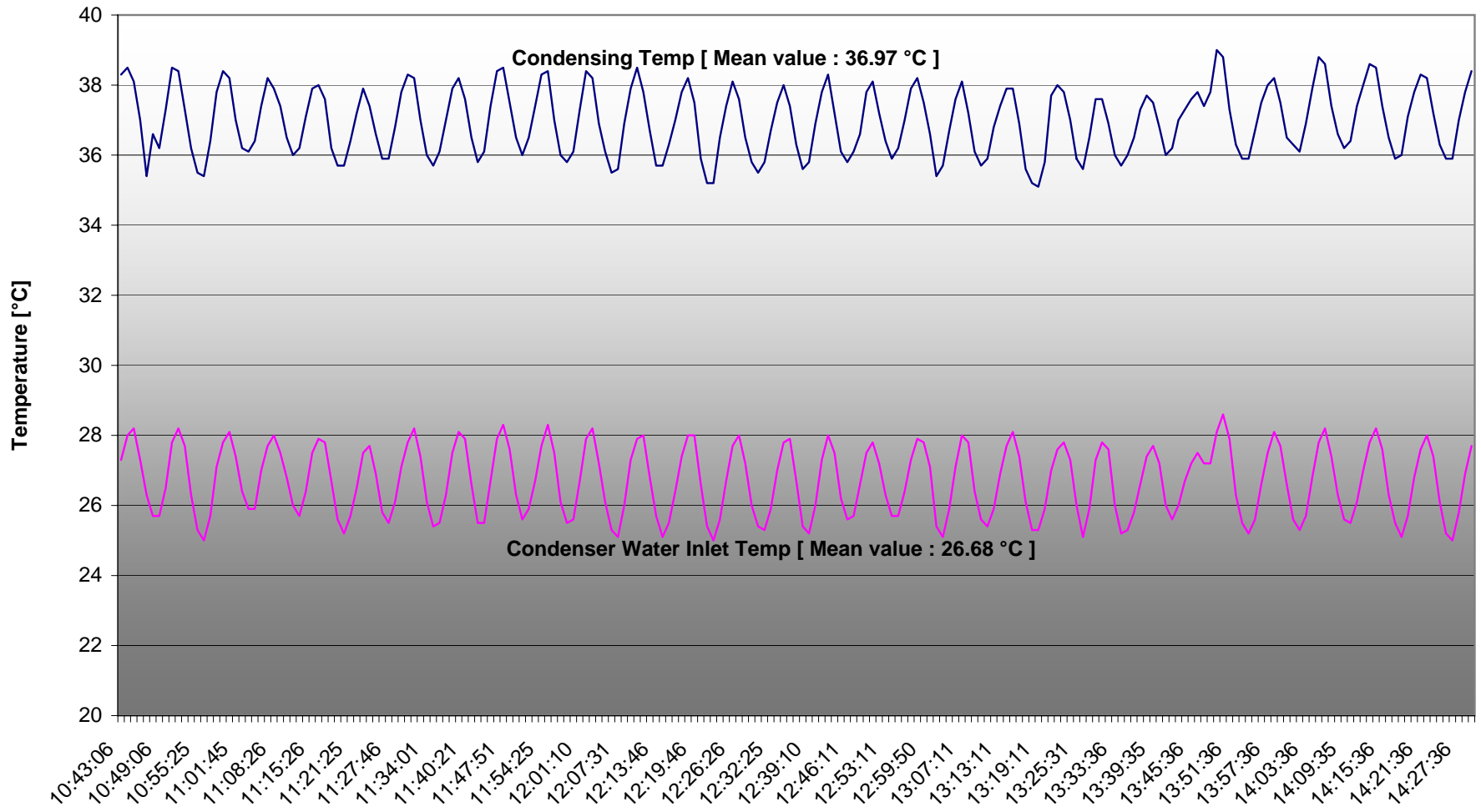


Chart 3B -York Centrifugal Chiller at Gold Fields House: Operating Temperatures [Post-treatment]



**Chart 4B-York Centrifugal Chiller at Gold Fields House: Operating Temperatures [Post-treatment]**



**March 8, 2005**

# Performance Comparison

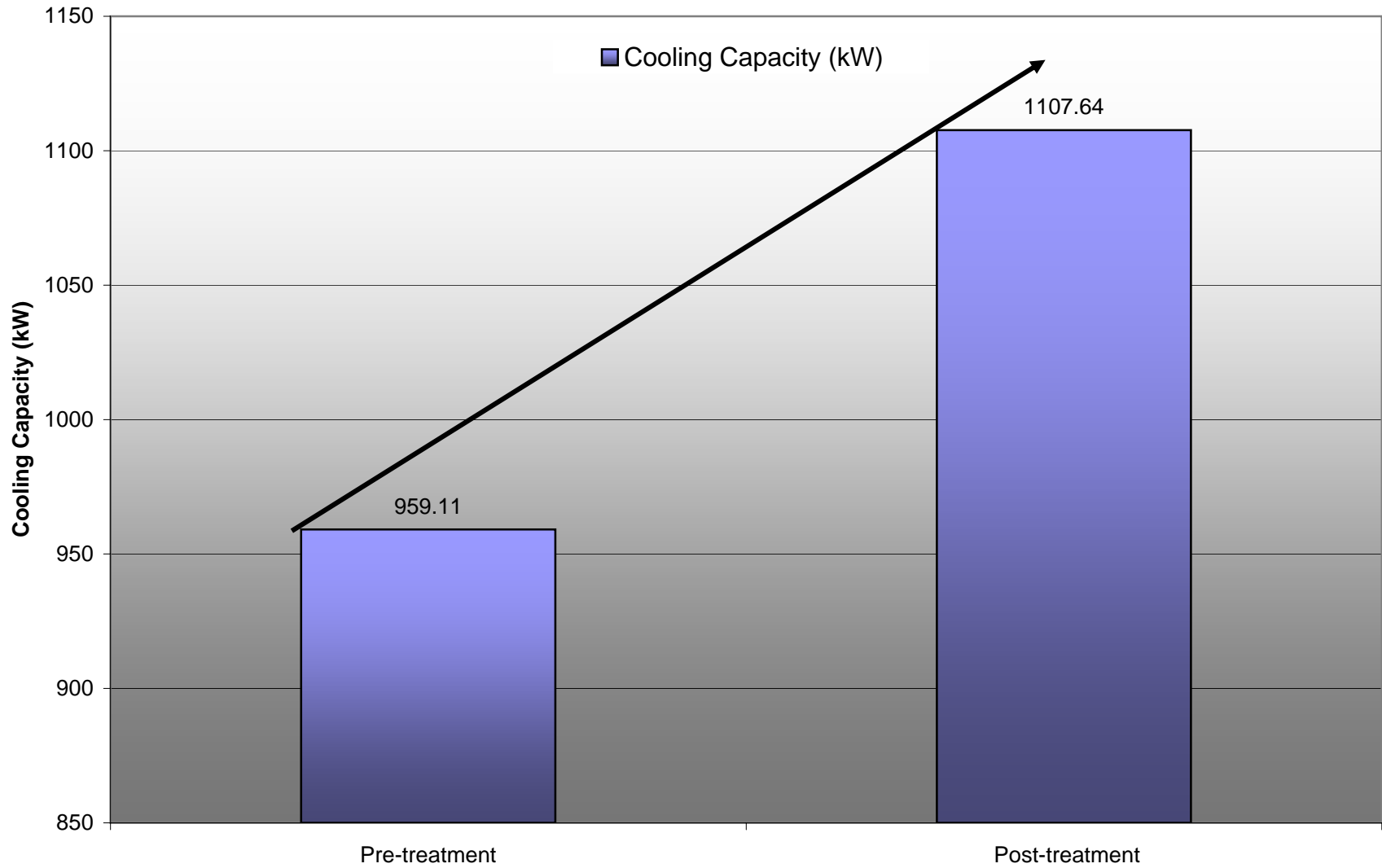
Pre: January 17, 2005

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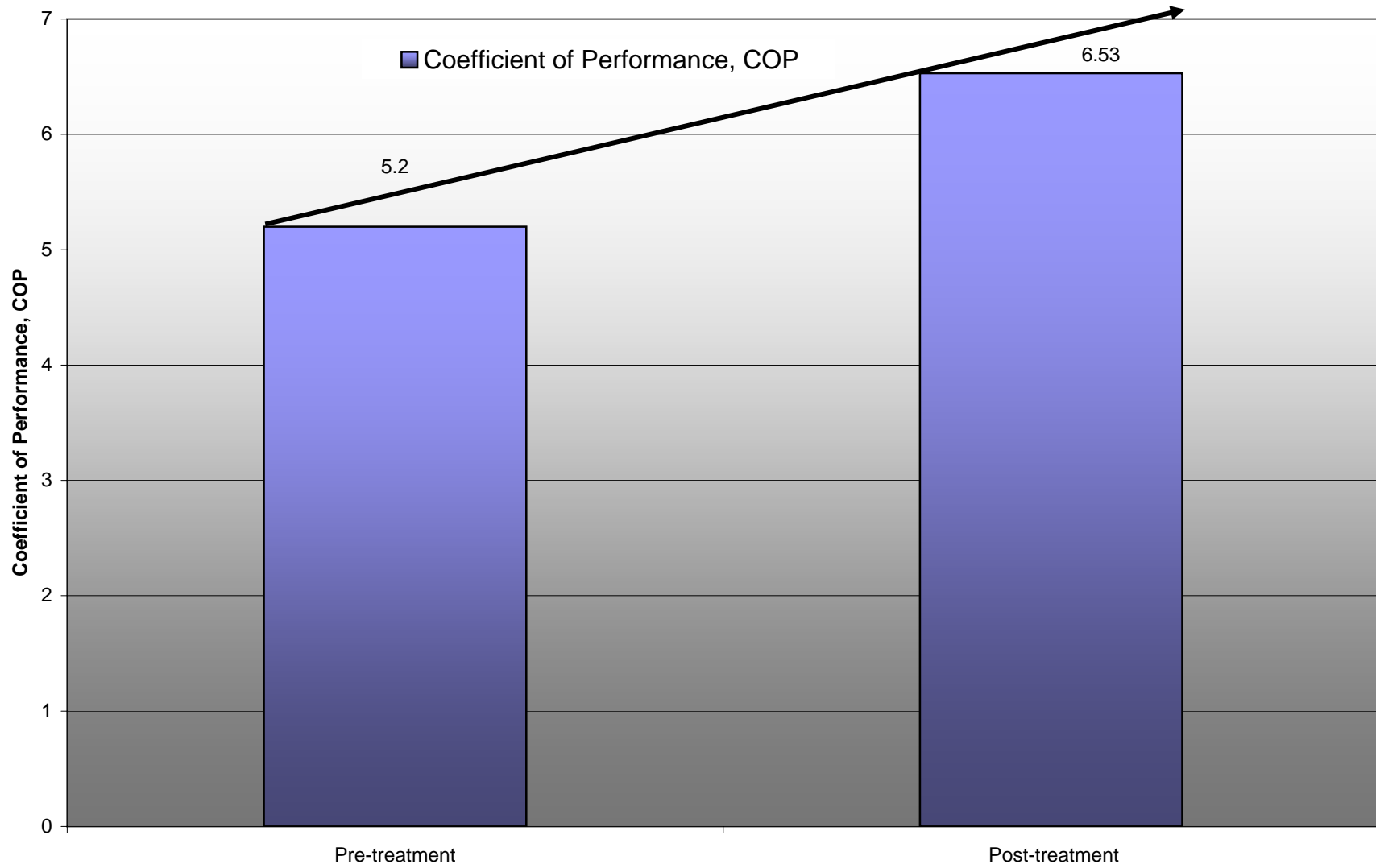
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Appendix B

Comparison of Cooling Capacity resulting from treatment with PermaFrost



Comparison of COP resulting from treatment with PermaFrost



Comparison of Power Input resulting from treatment with PermaFrost

