Guaranteed Energy Savings Performance (GESP) Contract

MINISTRY OF THE ENVIRONMENT & WATER RESOURCES (MEWR) AT THE ENVIRONMENT BUILDING

40 SCOTTS ROAD

PROJECT SHOWCASE:

RETROFIT of CENTRALIZED WATER-COOLED CHILLER PLANT

APRIL, 2013

Contents

- Objective and scope of GESP
- Background of the Environment Building and water-cooled chiller plant
- Overview of water-cooled chiller plant before and after retrofit works
- Case Studies:
  - Performance review of MEWR's water-cooled chiller plant before and after retrofit works
  - High performance of air side distribution system
- Guaranteed chilled water plant system efficiency of **0.60 kW/RT** at **zero tolerance**

Objective and Scope of GESP

- Provision of investment grade energy assessment for water-cooled chiller plant for energy and water conservation
- Design and install capital improvements for water-cooled chiller plant that reduces energy and water consumption and related costs
- Project commissioning
- Measurement and verification of the post-retrofit operations of the improvements
- Guarantee level of system efficiency

The Environment Building
Background of the Water-cooled Chiller Plant

- **Year of completion:** 1984
- **Primary building usage:** Office
- **Total GFA:** 49,021 m^2
- **Total air-conditioned space:** 30,300 m^2
- **Existing chiller plant room** since retrofits in 2006
  - 3 x 500 RT water-cooled chillers in 2005
  - Primary & secondary chilled water pumping system
  - Variable condenser water pumping system
  - Variable speed cooling tower fans
  - Chiller plant room system efficiency of **0.848 kW/RT** (based on energy audit data in 2011)

The Environment Building
Strategy of Achieving Efficient Chiller Plant System

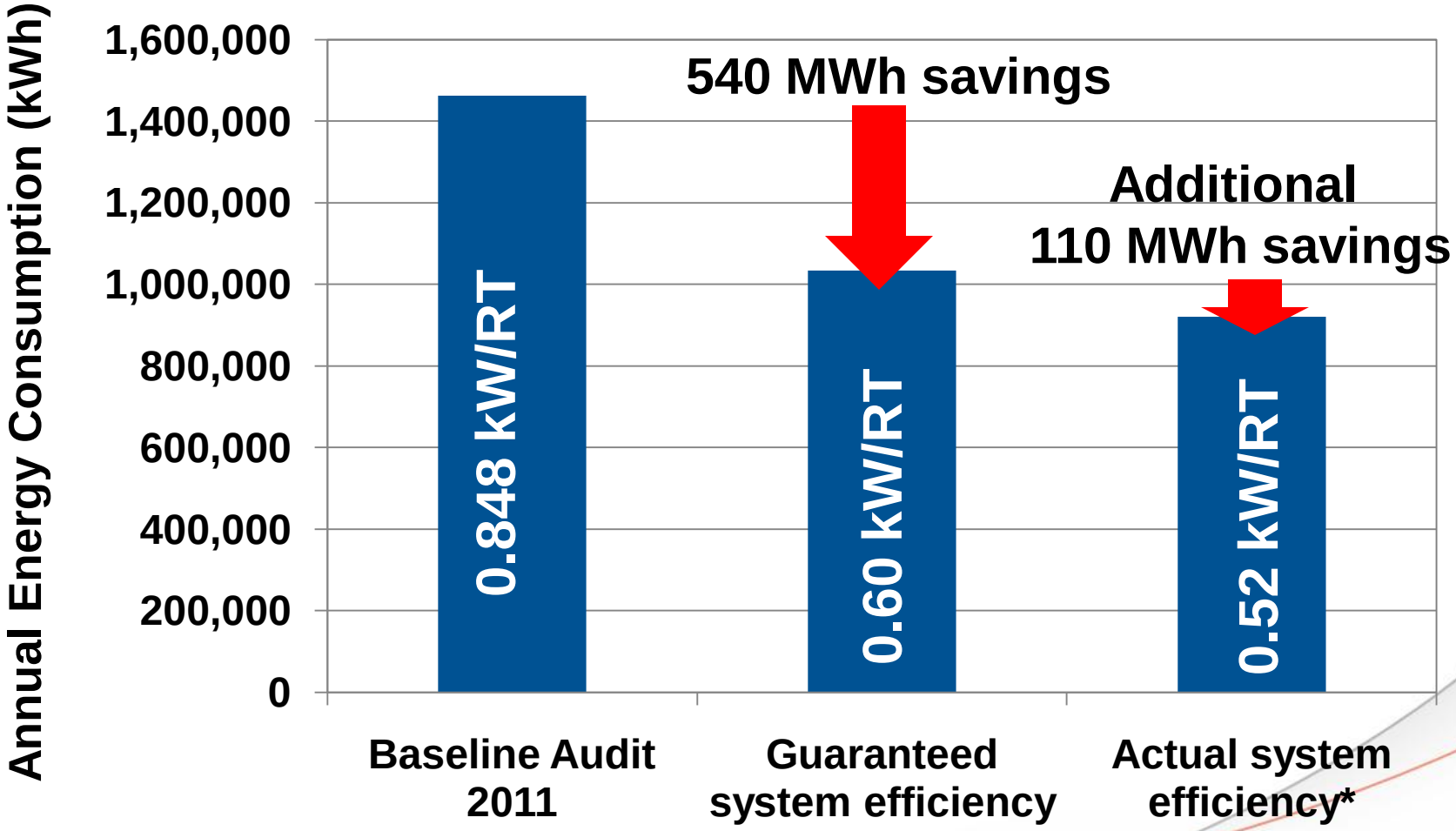
- Use of high efficiency chiller
- Primary only variable chilled water pumping system
- Low pressure chilled water and condenser water distribution system
- Deployment of high accuracy instruments for long term measurement & verification (M&V) of energy efficiency & energy savings
- Optimization of chiller plant control system with web-based system integration solution Tracer™ XT



Add in 1 x 800 RT water-cooled chiller with modified chilled water & condenser water pipe distribution system

Energy Impact

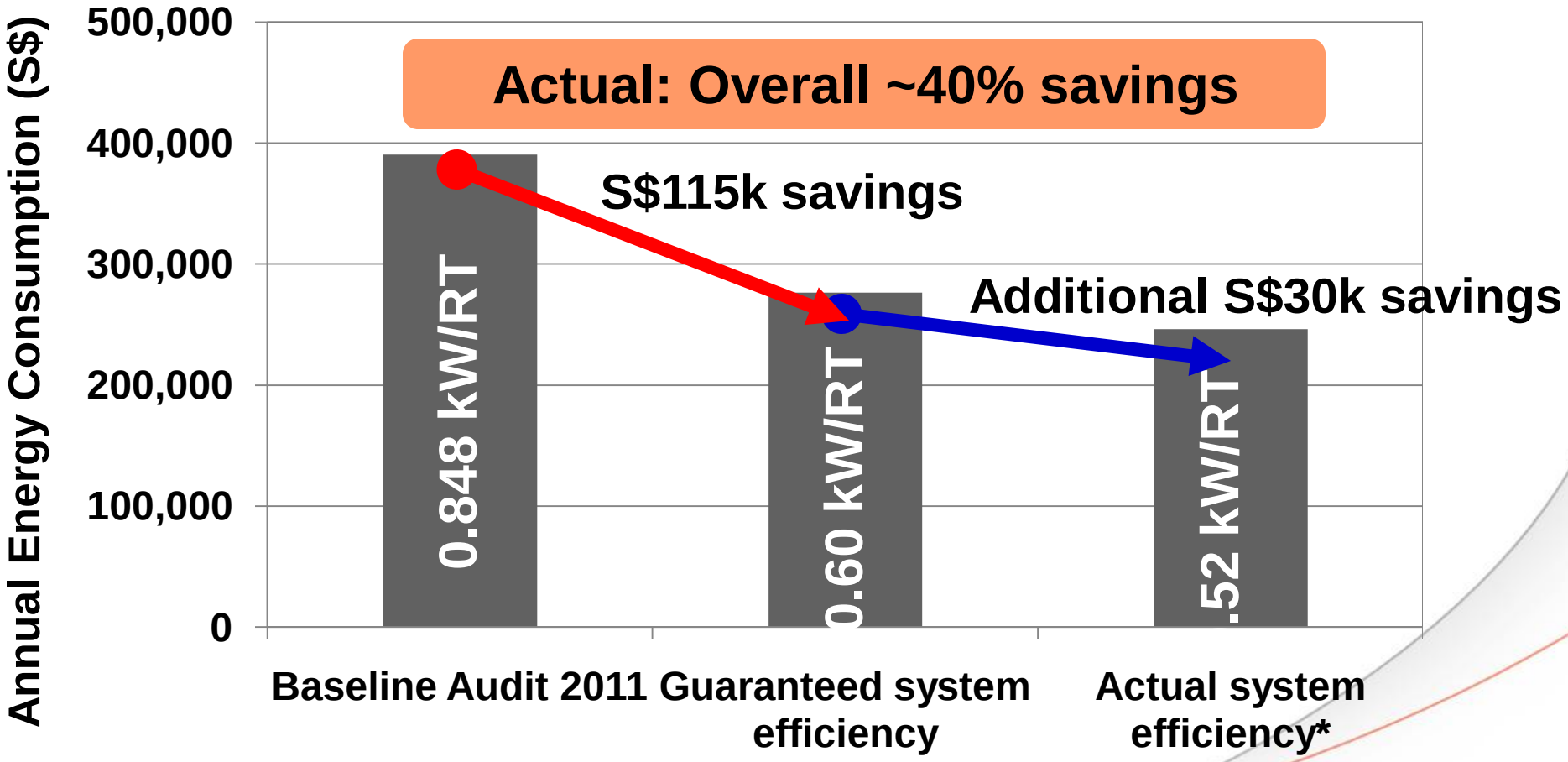
Water-cooled chiller plant only



* *The annual chiller plant energy consumption of actual system efficiency is projected based on latest chiller plant data in Feb & March, 2013*

Financial Impact

Water-cooled chiller plant only



* *Based on latest electricity tariff at S$0.2670 per kWh*

Equivalent Impact

Water-cooled chiller plant only

250,000 kg reduction in CO_2 emission annually







Power for 165 3-room HDB flats

50 cars off the road annually

6,450 trees planted

THE ENVIRONMENT BUILDING

Overview of Water-cooled Chiller Plant before Retrofit Works

June, 2012

June, 2012…

Before retrofit works start



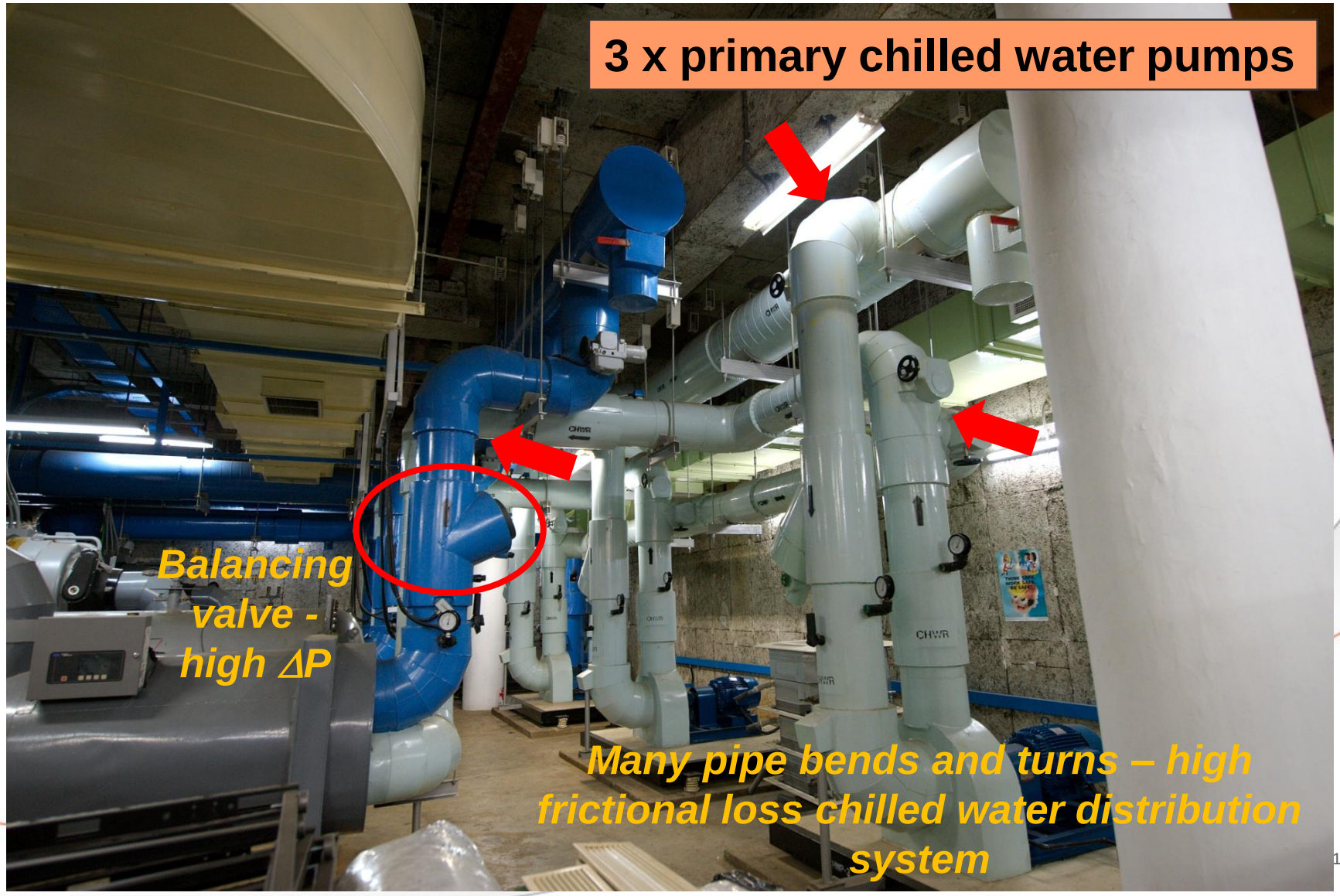


3 x 500 RT water-cooled chillers



June, 2012…

Before retrofit works start



June, 2012…

Before retrofit works start



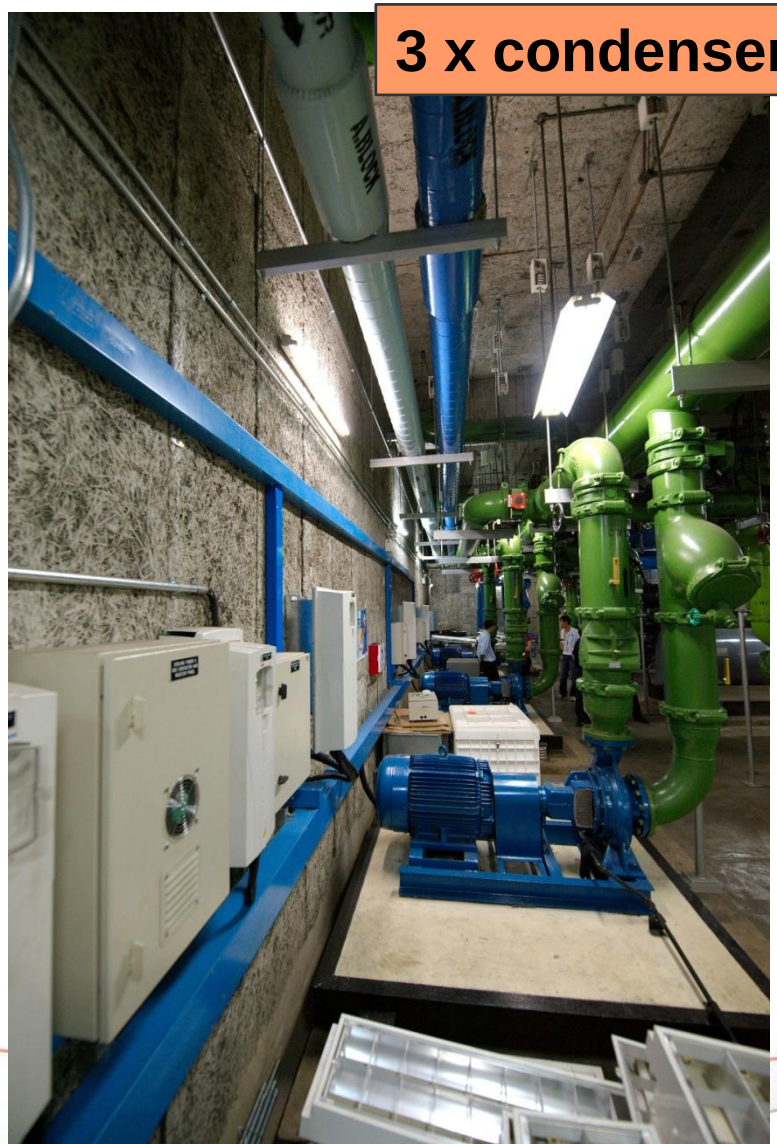
3 x secondary chilled water pumps

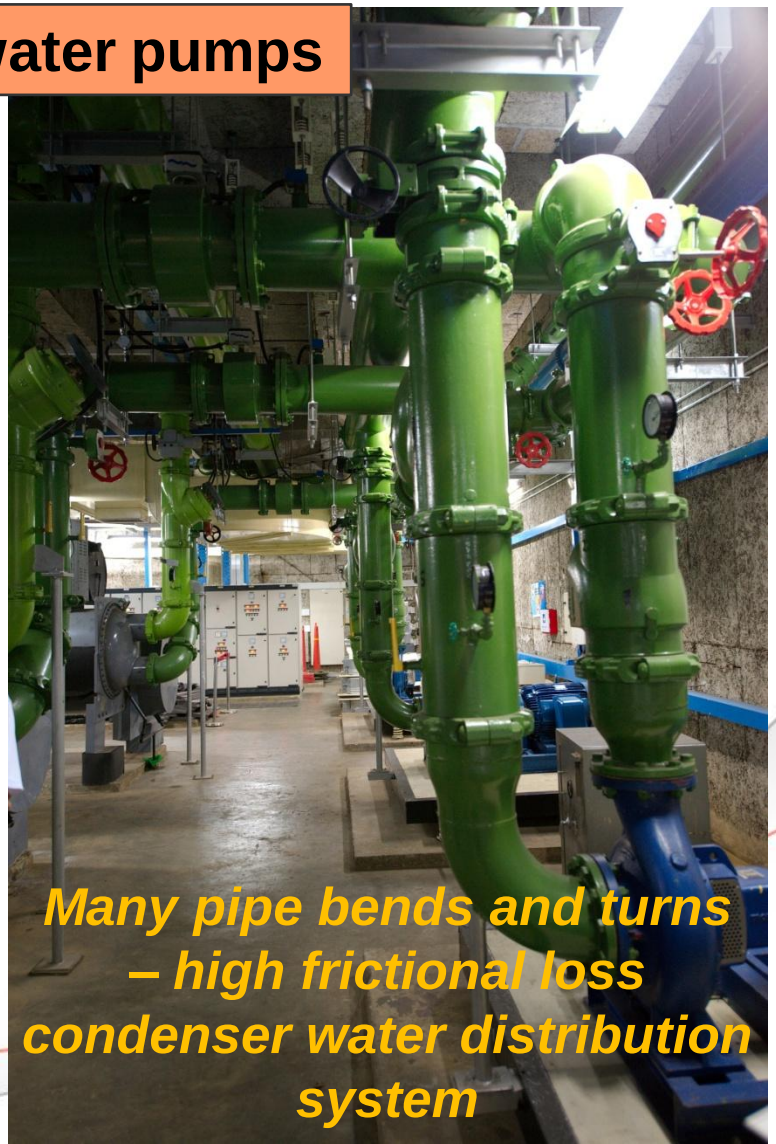


June, 2012…

Before retrofit works start

3 x condenser water pumps





Many pipe bends and turns – high frictional loss condenser water distribution system

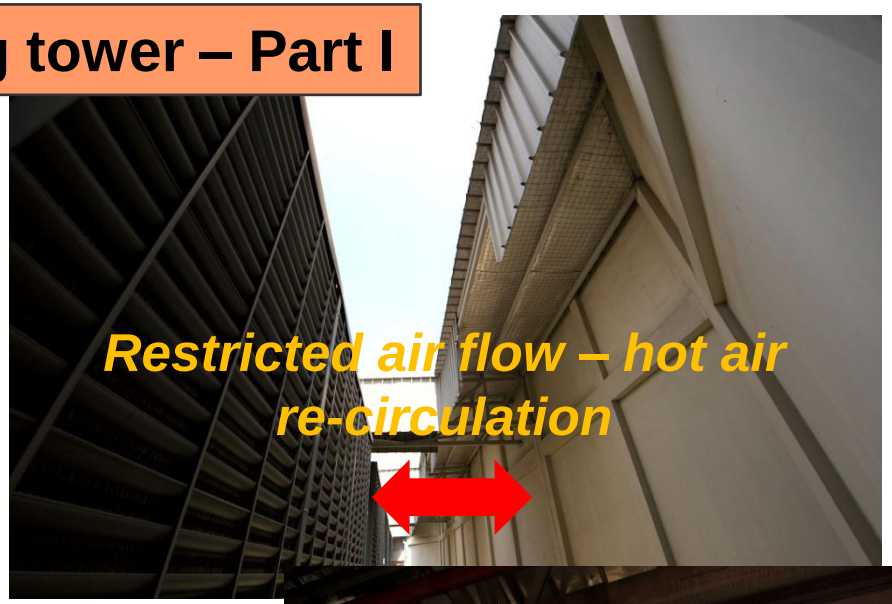
June, 2012…

Before retrofit works start

Hot air & exhaust air

Cooling tower – Part I







June, 2012…

Before retrofit works start

Cooling towers – Part II



4 individual condenser water piping branches for 4 sets of cooling towers

THE ENVIRONMENT BUILDING

Project Works in Progress

July, 2012

July, 2012…

Retrofit works in progress

Delivery & hoisting of new 800 RT water-cooled chiller (Part I)





July, 2012…

Retrofit works in progress

Delivery of new pumps





Delivery & hoisting of new 800 RT water-cooled chiller (Part II)



July, 2012…

Retrofit works in progress







Removal of balancing valves at both chilled water and condenser water sides

THE ENVIRONMENT BUILDING

Completion of Retrofit Works

December, 2012

December, 2012…

Completion of retrofit works

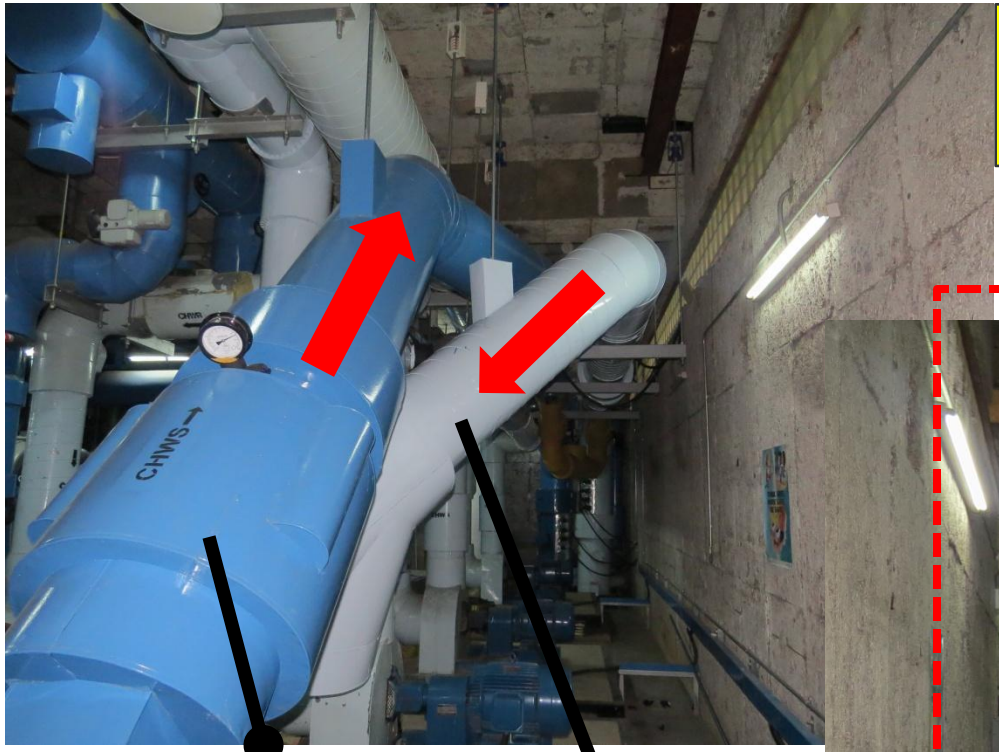


HIGH EFFICIENCY R123 CENTRIFUGAL WATER-COOLED CHILLER

December, 2012…

Completion of retrofit works

PRIMARY VARIABLE PUMPING SYSTEM



CHWS directly being discharged from new CHWP to CHW riser

CHWR from riser directly piped to the new chiller



New CHWP-4

Relocation of old PCHWP-3

December, 2012…

Completion of retrofit works



New staircase platform for easy site access with proper sign labeling

December, 2012…

Completion of retrofit works

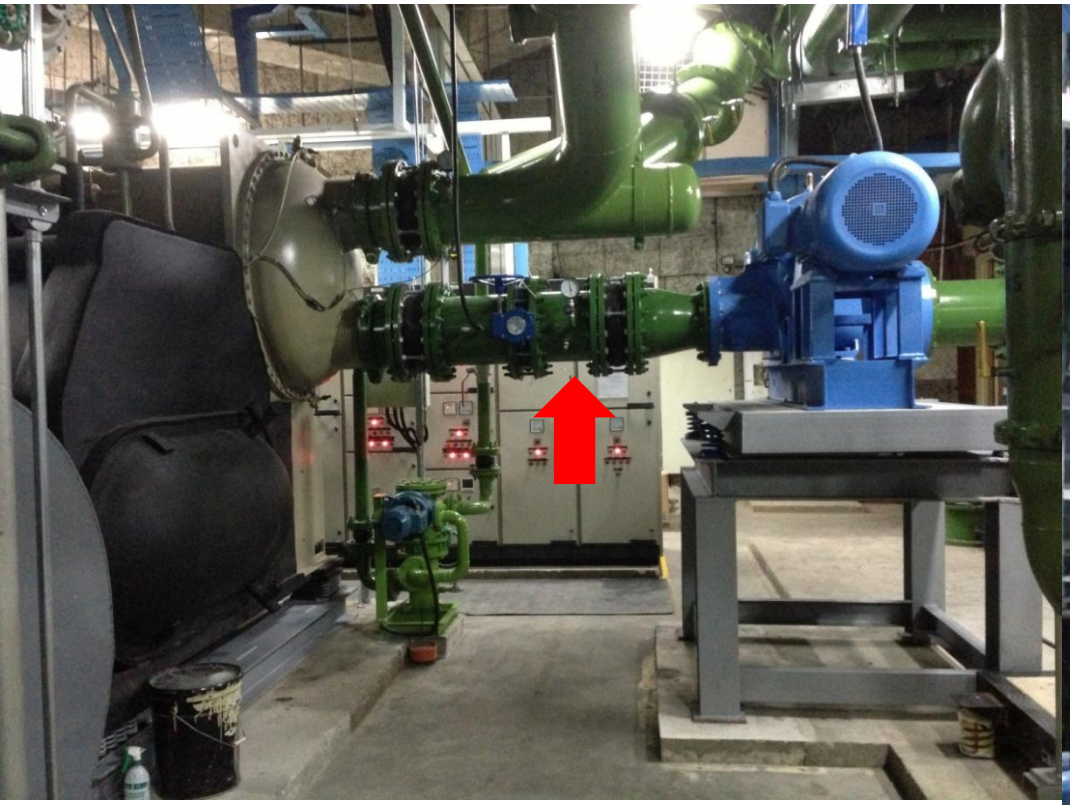


SMOOTHER CW PIPE CONNECTION FOR NEW CWP



December, 2012…

Completion of retrofit works



STRAIGHT CW PIPE CONNECTION TO CHILLER CWS PIPE NOZZLE



December, 2012…

Completion of retrofit works

VSD FOR NEW CHWP





VSD FOR NEW CWP

MAGNETIC FLOW METERS



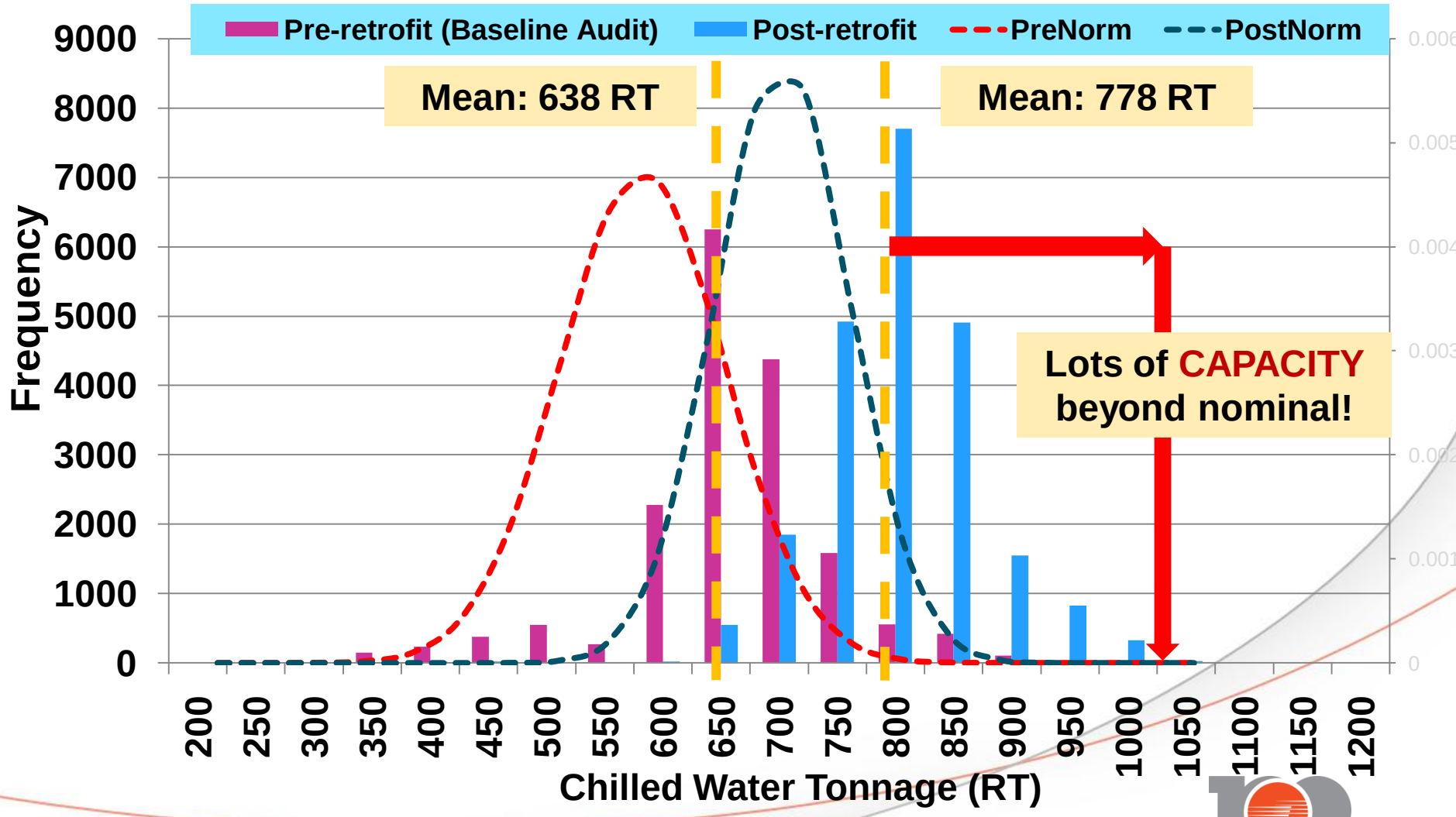
- *At new chiller CHW & CW pipes*
- *At 4 x individual CW header pipes*
- *At existing secondary CHW header pipe*

CASE STUDY #1:

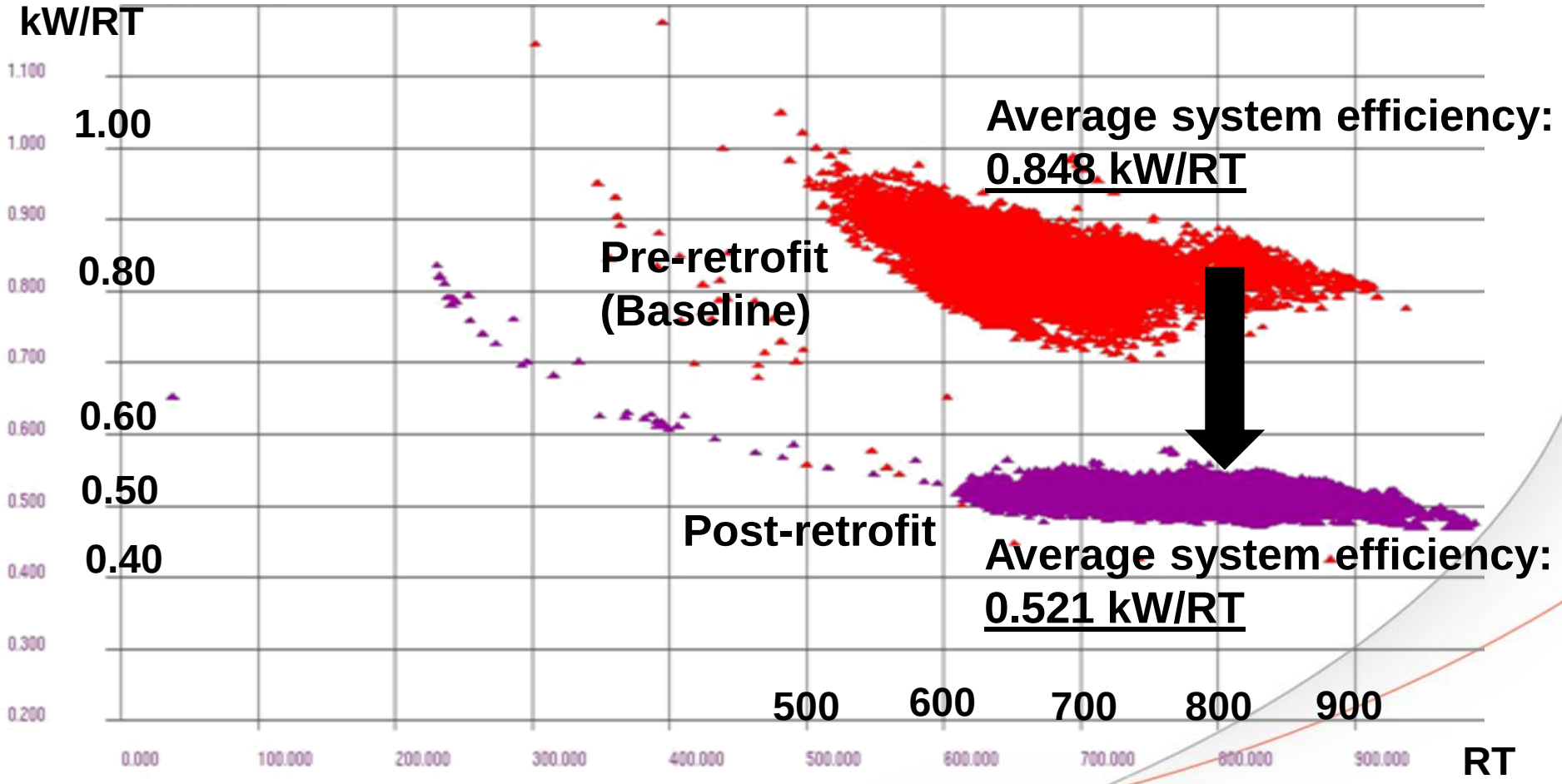
Performance Review of Water-cooled Chiller Plant at

The Environment Building

Measured Chilled Water Tonnage
New Chiller Operating Capacity

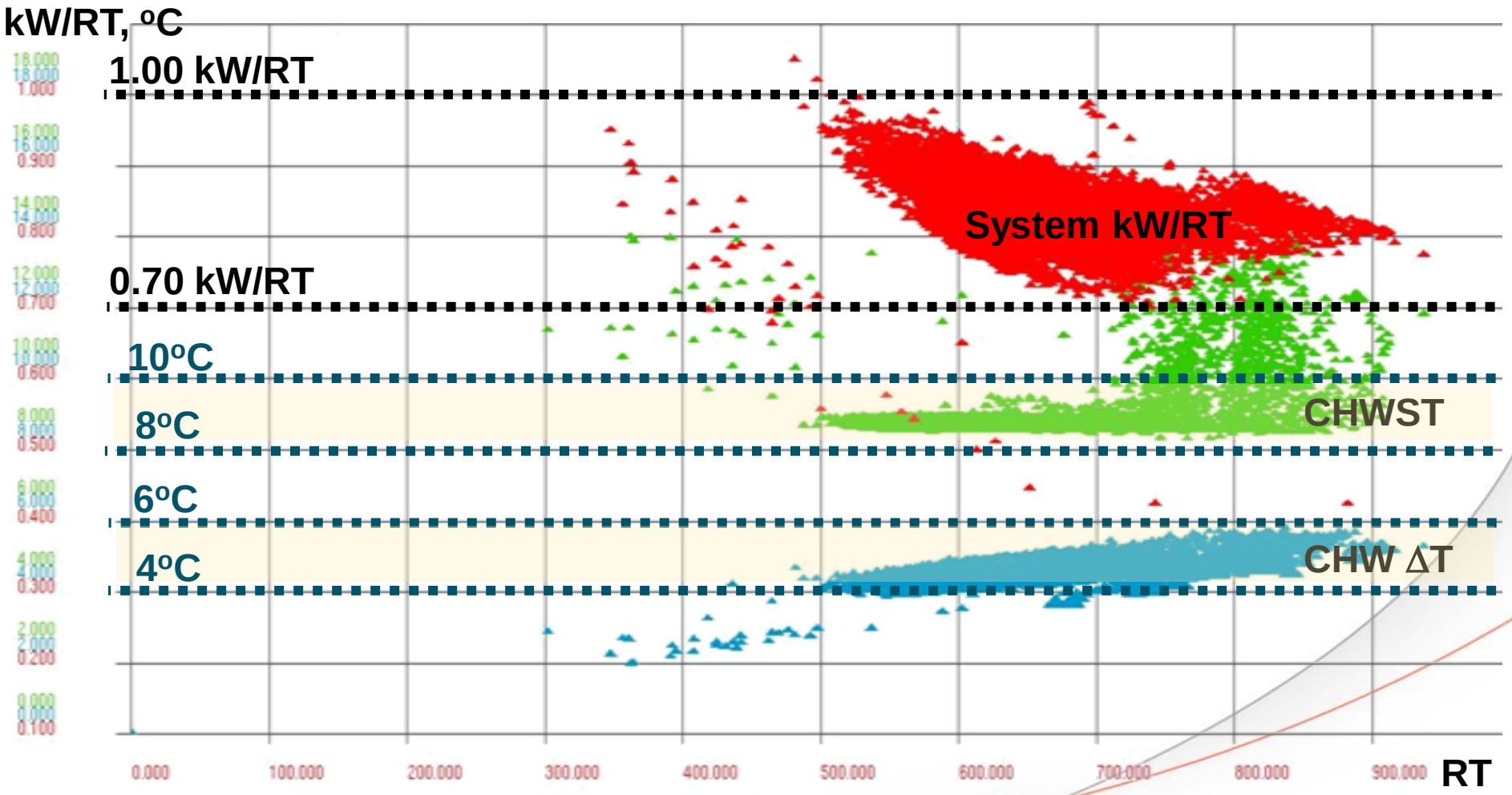


Improvement of System Performance
Total system efficiency



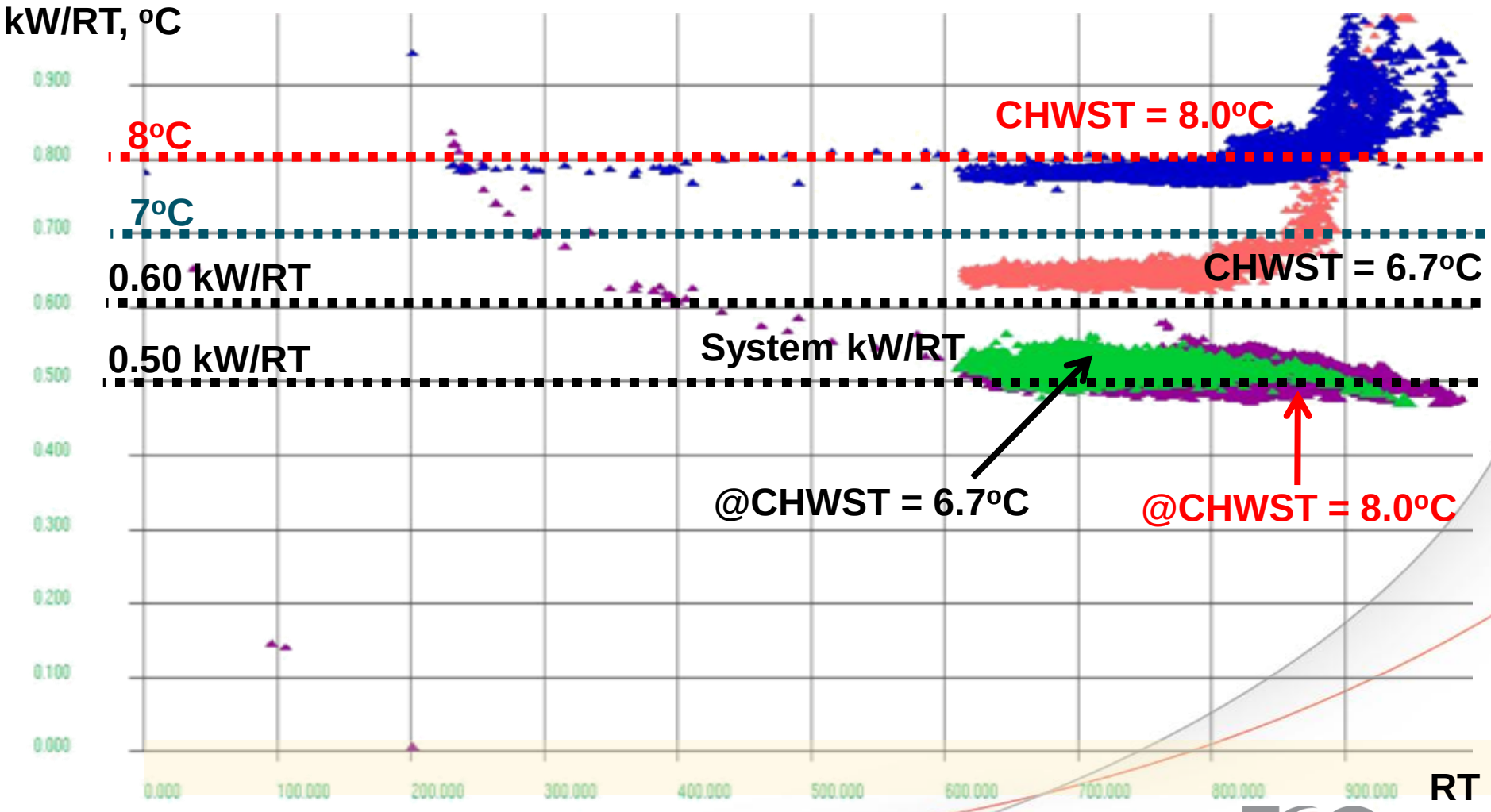
System Efficiency versus CHWS Temperature

Pre-retrofit Baseline Data

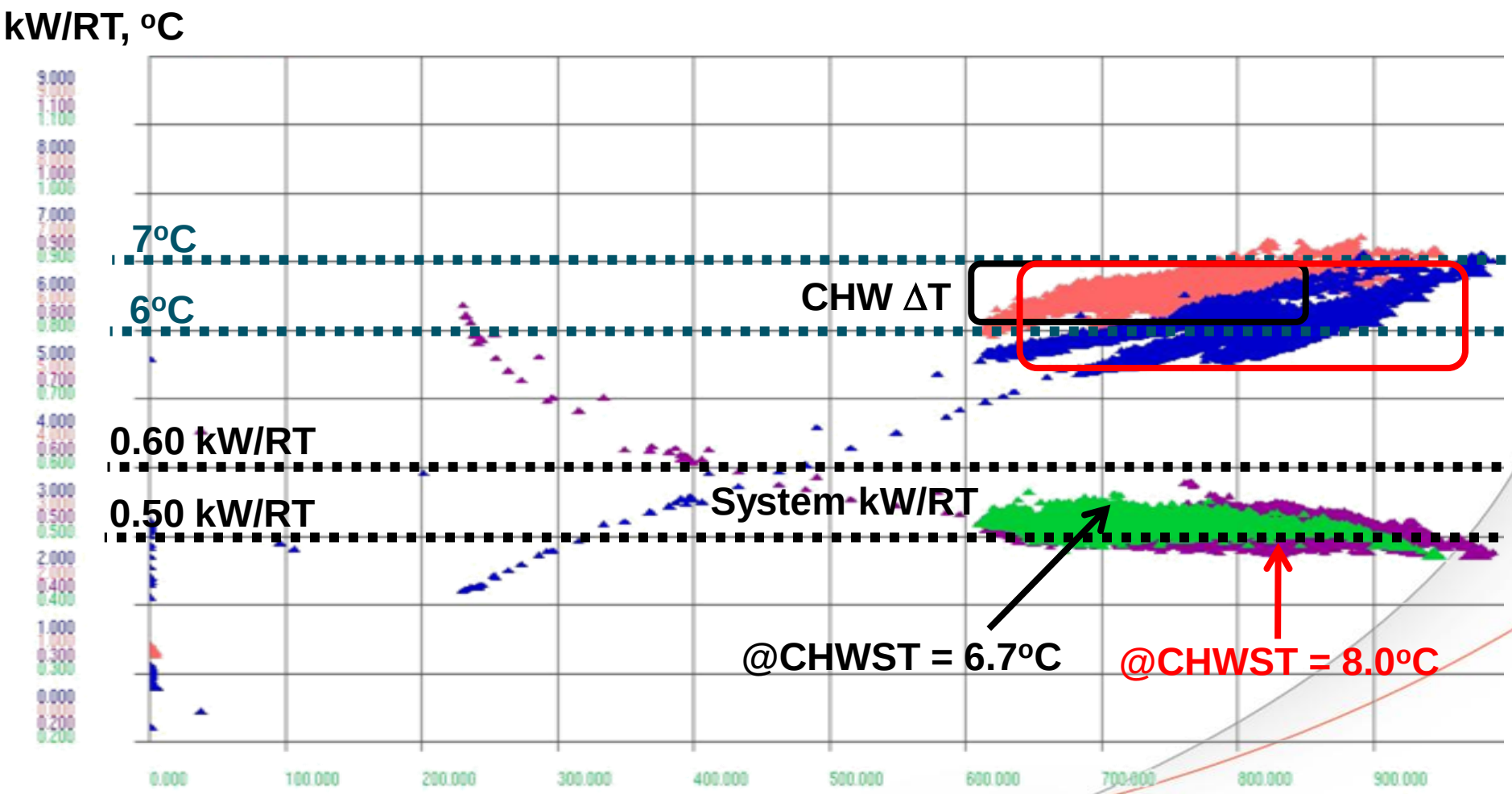


System Efficiency versus CHWS Temperature

Post-retrofit Data

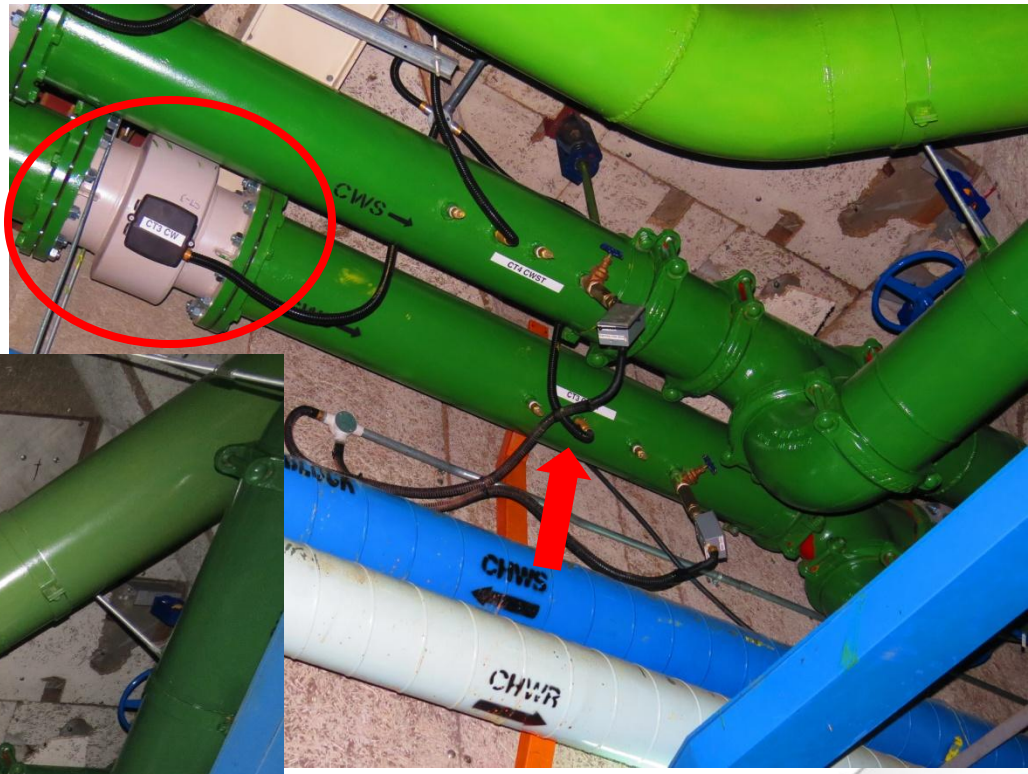


System Efficiency versus CHWS Temperature
Post-retrofit Data



High Accuracy of Instruments
For Measurement & Verification (M&V)

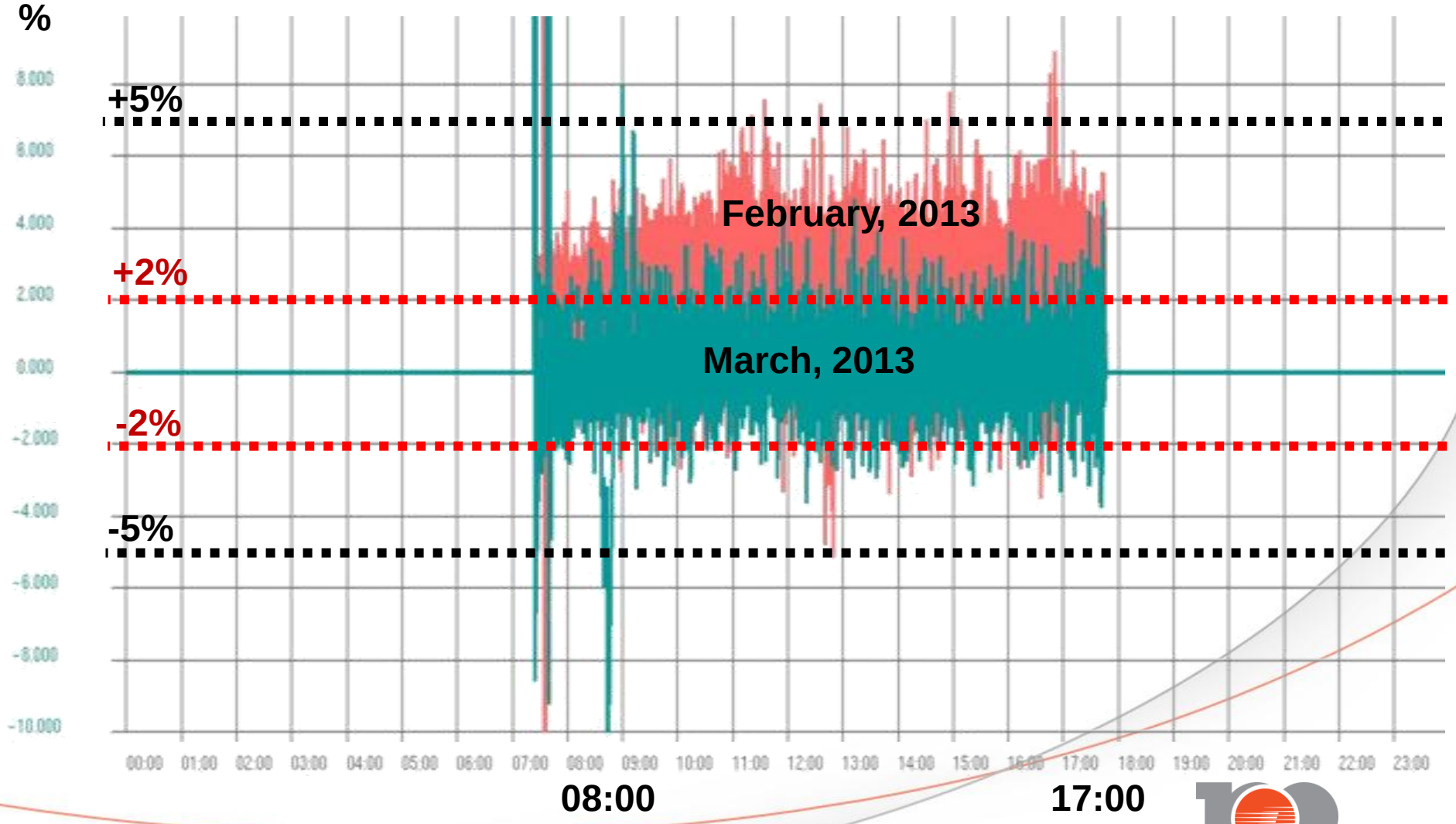
INDIVIDUAL MAGNETIC FLOW METER AT 4 INDIVIDUAL CW HEADER!





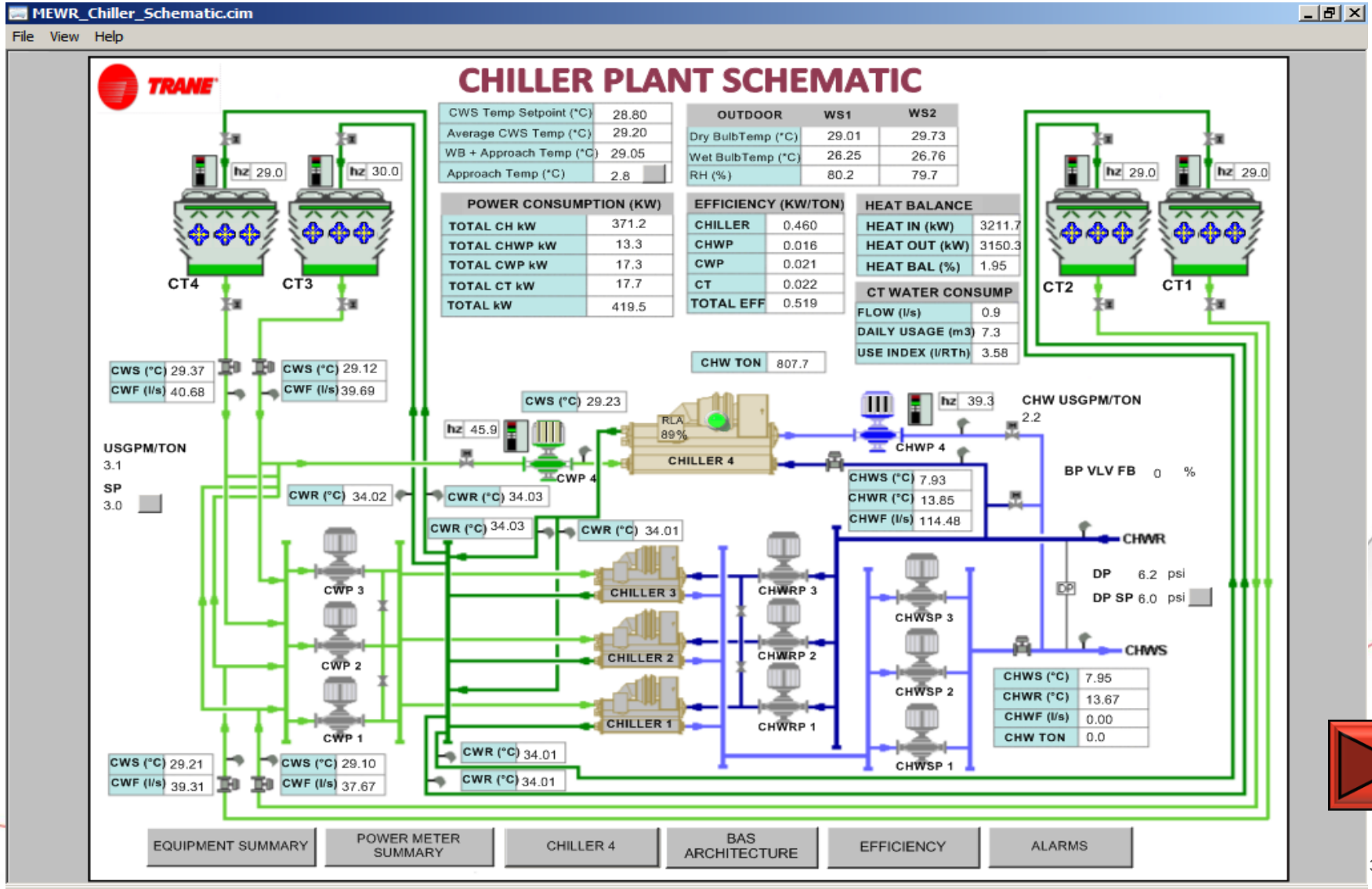
High accuracy temperature sensor at individual CW header with additional spare thermowell

Improvement of System Heat Balance
Within ±5%



Chiller Plant Control System

Web-based system integration solution



Summary

- Improvement of chiller plant system efficiency from **0.848 kW/RT** to below contracted **0.60 kW/RT at 6.7 degC CHWS**
- **Better than 0.521 kW/RT** for actual operating chiller plant system at 8 degC!
- This translates into 30% or more reduction in energy consumption of chiller plant (plus water savings)
- Chiller plant energy consumption saving of approximately 500,000 kWh per year or more
- Further fine tuning will bring us to 0.50 and better



Thank You