


Seasonal HVAC Commissioning – Strategies for year round efficiency

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Performing Buildings – delivered sustainability

Setting up for seasonal tuning

Building tuning plans

Seasonal Tuning for Optimum Performance

Key messages – the way forward

Building tuning imperatives

- If it doesn't perform its just not green – Built performance is what counts
 - **New Buildings:** Measureable return on sustainability investment
 - **Existing Buildings:** Effective strategy for reducing carbon emissions and improving NABERS ratings
- Establishing base year performance and setting up for long term efficient operation and
- Sustainability Engineering/Commissioning IP Development

Maximising long term efficiency

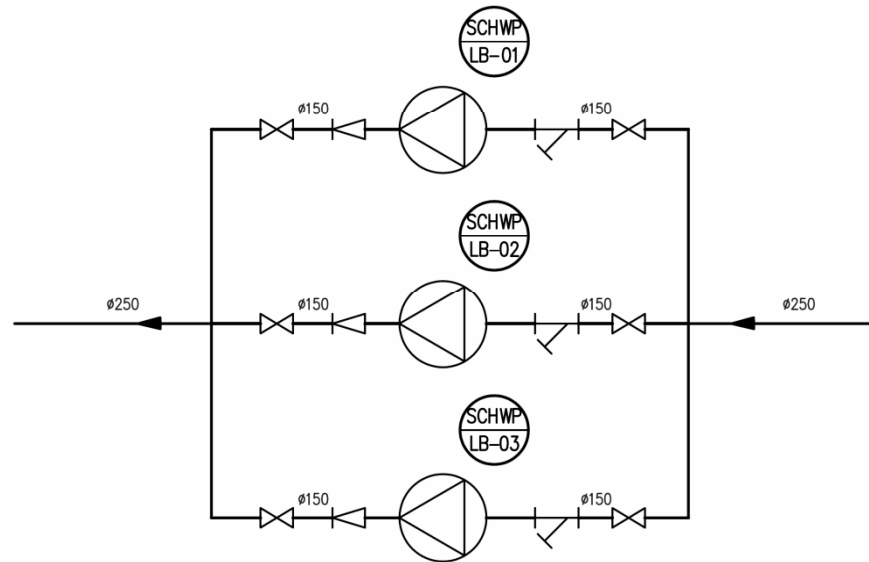
- Managing design complexity
 - *Law of Singularity*
 - *Theoretical vs achievable in practice*
 - *Recognise the Long term maintenance and operation obligations*
- Design, installation and commissioning
 - *Design margins –too little or too much*
 - *Performance issues through poor design and installation details*
 - >>*Embedded energy wastage for the life of the building*
- High efficiency technology
 - *Often not fully exploited through either design or commissioning*
 - *Can be difficult to work with*
- Project delivery models
 - *PC to FC*
 - *Warranted Outcomes*

Prerequisites for Effective Building Tuning

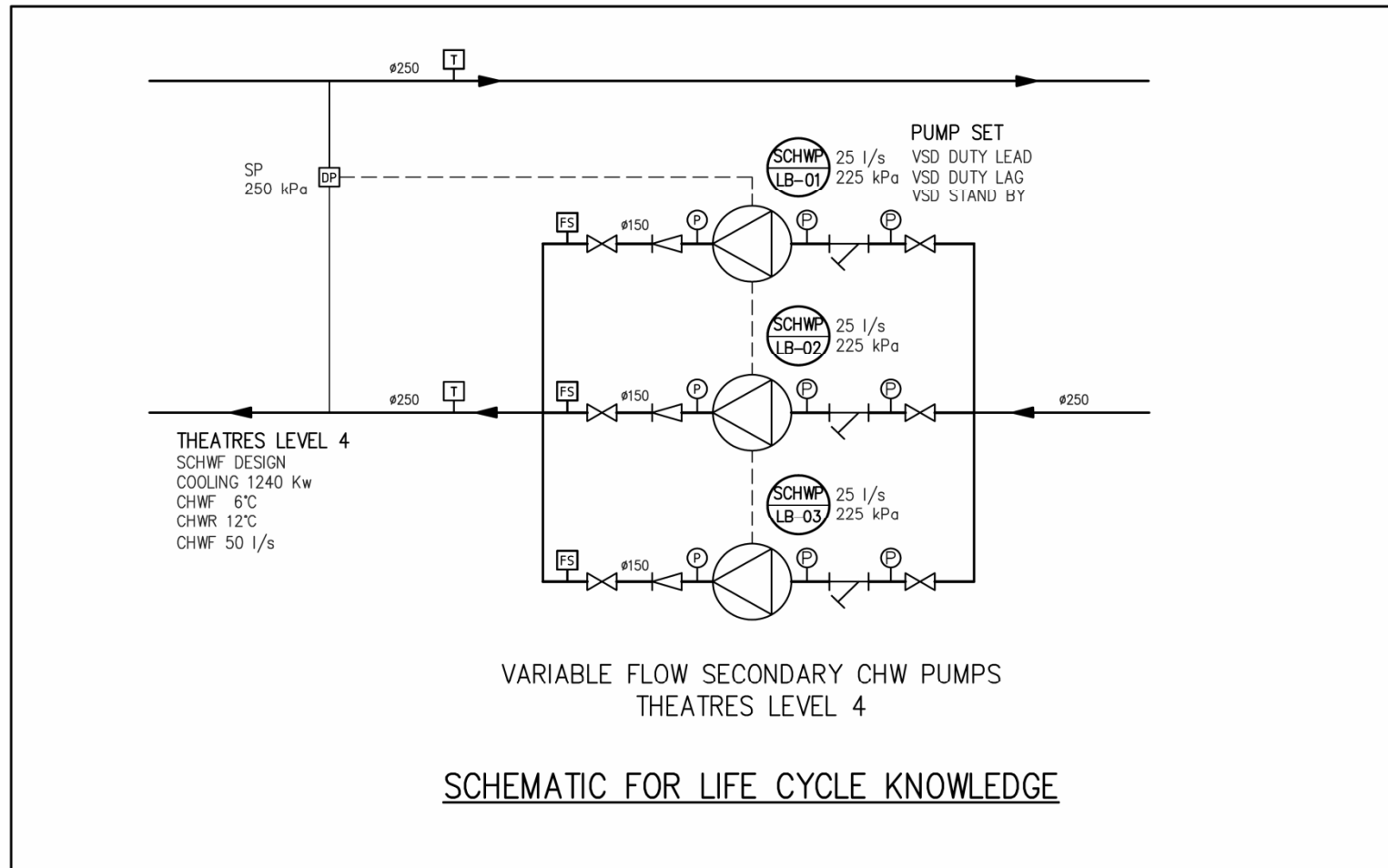
- Documented Design - 101
 - *Design Brief / Criteria,*
 - *Design Schematics*
 - *Control Strategy Functional Descriptions*
 - *Energy Model*
- Building Management Systems
 - *Tunable control systems*
 - *Remote Access*
 - *Trending and Reporting – Standard Reports*
- Energy Management
 - *Energy Model Development Design/Installed/Commissioned*
 - *Energy Meter Tree*
 - *Energy Metering and Reporting Systems*
- Resourced Team

Documented Design – System Schematics

- System Schematics – show the system architecture and sizing
- Design Schematics – convey the design intent



SCHEMATIC FOR TENDER DOCUMENTATION



Functional Descriptions – Real Sustainability IP

- System Schematic
 - System Graphic
 - System Monitoring and Control Variables
- Control Strategy
 - Control Strategy
 - Control Diagrams
- System Energy Limiting Lock-outs
- Failure Modes
 - Plant
 - Out-of-calibration

Functional Descriptions – Real Sustainability IP

- Points List: Physical / Virtual / Set points / Displayed - Alarmed
- HLI vs LLI
- Diagnostic Pages

Energy Monitoring Systems

- Energy Model Report / Design Guide
 - Green Star/NABERS/Operational
 - Major End Use
 - Sensitivity Analysis
- Energy Metering Tree
 - NABERS
 - Energy End Use
- Energy Metering Systems – Single Point of Responsibility
 - Metering Schematic
 - Meters and Interfaces
 - Meter Network capacity and integrity
 - Commissioning and Validation
 - Monitoring and Alarms
 - Trending and NABERS Reporting

Building Tuning Team

- The Team
 - Engineer
 - Facility Manager
 - Head Contractor / Mechanical Contractor / Controls Company/ Other Trade Contractors
 - ICA
 - Independent NABERS Consultant – Client Appointment (?)
- \$\$\$
 - Need to identify provisions in profession fees and tender schedules
 - Provisional sums
- Sub-trade Scope Specifications
 - Controls Specialists
 - Lighting Controls

BUILDING TUNING PLAN

- Scope
- Client Objectives / Design Criteria
- Energy Metering Strategy
 - Key Reports
 - Target Profiles
 - Base Line Profile
 - Time Line
- Seasonal Tuning
 - Scope and Time Line
 - Engineering/Commissioning Review
 - Analysis, actions and outcomes
- Reporting
 - Outcomes
 - Baseline
 - Recommendations

Seasonal Tuning Scope

- Full load operation – Deferred commissioning
- Part load operation
- Normal Hours/After Hours Operation Review
- Central thermal plant staging
- Energy Lockouts
- Optimum start /optimum stop
- Tuning control loops
- Assessing operating characteristics against design intent
- Energy analysis and corrective actions
- NABERS Performance and Reporting
- FD Update

Seasonal Tuning for Optimum Performance

- **VAV Systems**
 - VAV inlet conditions fundamental to good operation / control
 - VAV terminal controller – firmware vs design function description
 - VAV % satisfied control vs supply static control ?
 - VAV calibration – necessary pre-requisite
 - Location of VSD DP control sensors important – especially with Distributed Controls
 - Limiting available static pressure to tenancies
 - requires good system diagnostic pages
 - Combination is best
 - Air flow energy versus supply air temperature optimisation

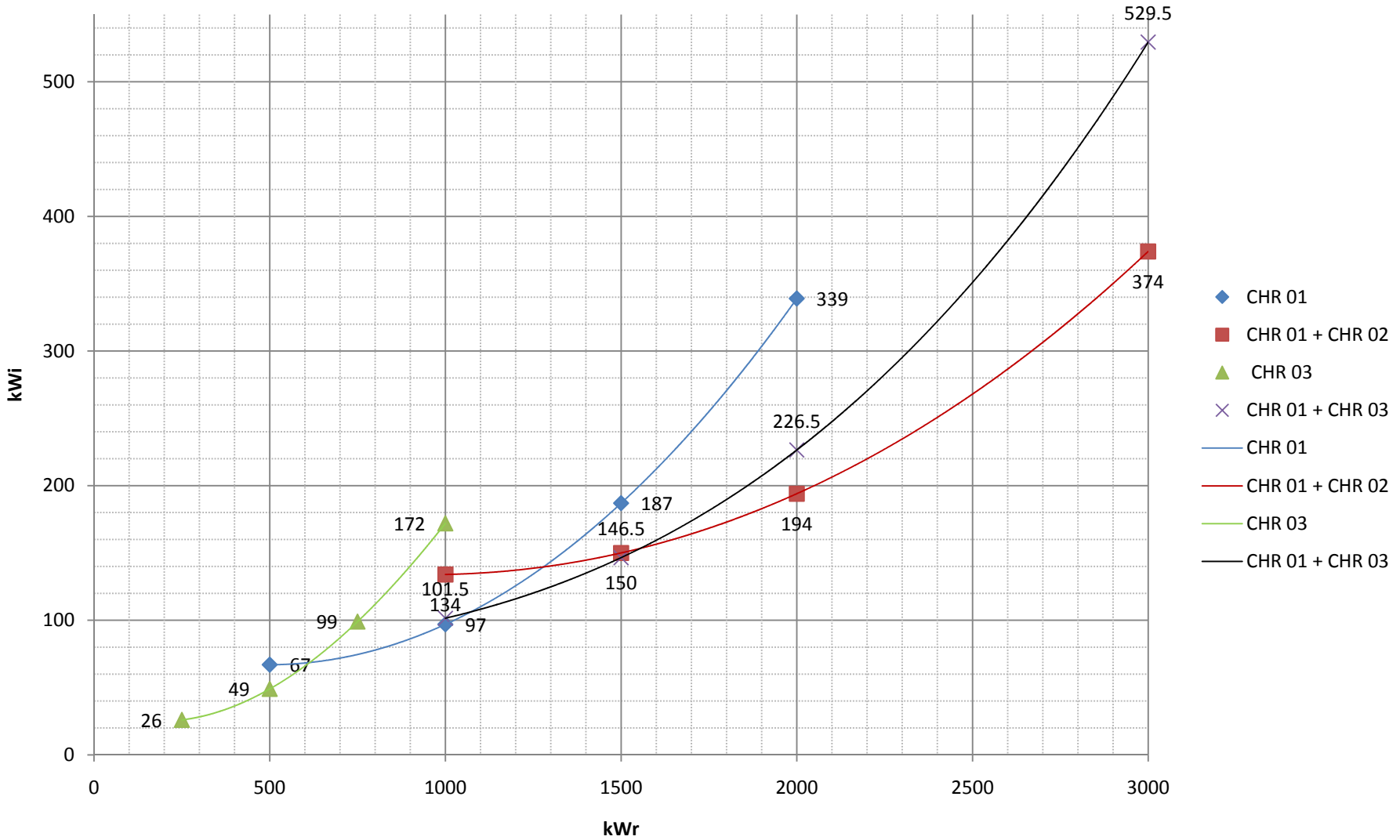
Seasonal Tuning for Optimum Performance

- **Air Handling Systems**
 - **Outside air temperature measurement**
 - **CO₂ /CO Control Strategies – Operation and Limits**
 - **Return Air Fan Control**
 - **Supply Air Fan Tracking**
 - **Static DP Control**
 - **Outside Air Flow Control Maximum vs Minimum**
 - **Minimum turn-down ratios: typically not less than ~ 30 Hz**
 - **Morning Warm-up**
 - **Outside Air Close-off – essential for full outside air systems**
 - **Heat Recovery**

Seasonal Tuning for Optimum Performance

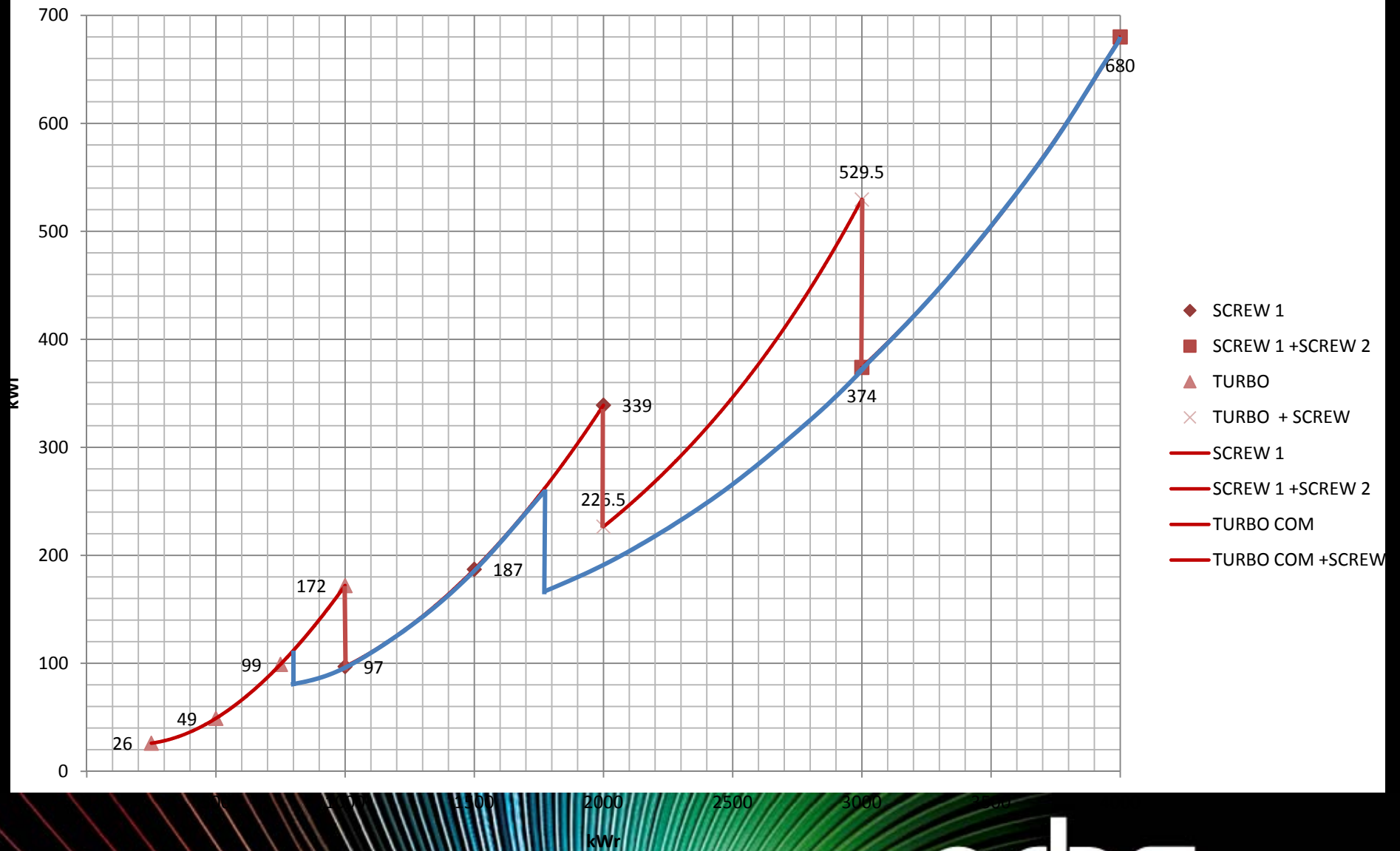
- **Chiller / Condenser Water Systems**
 - **Chilled water system efficiency curve –**
 - important for tuning purposes
 - Design and Off Design
 - **Trend is to capitalize on chiller efficiencies**
 - **Avoid excessive staging**
 - **Electronic flow meters on chillers and variable flow through chillers**
 - **Chiller turn down ratio less than claimed can create significant staging issues : 50% is not 20% !**
 - **Flow and Return Header Design for Primary/Secondary Pumping Systems**

Chiller + CCWP Power Data



- ◆ CHR 01
- CHR 01 + CHR 02
- ▲ CHR 03
- × CHR 01 + CHR 03
- CHR 01
- CHR 01 + CHR 02
- CHR 03
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Chiller + CCWP Power Data



Seasonal Tuning for Optimum Performance

- **Chiller / Condenser Water Systems**
 - **Chilled water system efficiency curve –**
 - important for tuning purposes
 - Design and Off Design
 - **Trend is to capitalize on chiller efficiencies**
 - **Avoid excessive staging and provide adjustable staging variables for each stage in the sequence**
 - **Electronic flow meters on chillers to provide variable flow through chillers**
 - **Chiller turn down ratio often less than claimed can create significant staging issues : 50% is not 20% !**
 - **Flow and Return Header Design for Primary/Secondary Pumping Systems**

Seasonal Tuning for Optimum Performance

- **Chiller / Condenser Water Systems**
 - **Low Delta T Syndrome**
 - **Control Valve Selection**
 - **Chilled Water Supply Temperature Set point**
 - **Primary/Secondary Pumping**
 - **3 Way Control Valves**
 - **Absorption chillers – temperature ranges and time delay (30-45 minutes)**
 - **Condenser water set point control – optimised for chillers and ambient**
 - **Chiller control of condenser water pump**
 - **Use of Proprietary Chiller Control Packages – Technical Support and Validation needs to determined**
 - **HLI vs LLI**

Seasonal Tuning for Optimum Performance

- **Heating Water Systems**
 - **Morning Warm-up Control Strategy**
 - **Condensing Heating Water Units vs Standard Units**
 - **Control valve selection for trim heaters**
 - **Leaving temperature control ability on water heaters**
 - **Matching water heaters to coils**
 - **Low load operation is important – especially for chilled panel systems**

Seasonal Tuning for Optimum Performance

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Seasonal Tuning Process: 1-2 Year Process

First Year : Bedding System Down

- 3-6 months to bed control systems down following PC
- 1-6 months of tenancy fit-outs
- 6-12 months to resolve metering issues - typically

Second Year: NABERS Rating

Base Year

Fine Tuning

Third Year: Transition to Long Term Energy Efficient Operation and Monitoring

KEY MESSAGES

Its not green if it doesn't perform – shifting paradigm focusing on FC and NABERS warranted outcomes

Building Tuning requires information, a tunable building, the right tools and resources

Its not about tuning control loops

Outcomes : Better performing building and valuable IP

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Questions ?

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