CONCEPT

Chiller Plant and VRF Systems: Design, Optimisation and Troubleshooting

22 – 26 March 2027
London - Central London four-star



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Introduction:

Chiller plant and VRF systems often consume far more power than their nameplate kW per ton suggests: chillers run lightly loaded in the wrong combination, low delta-T forces extra machines online, pumps fight bypass valves and VRF outdoor units trip on long or oversized refrigerant runs. This Core Concept course gives plant and building engineers the hydronic, compressor and refrigerant-circuit methods to design, sequence, maintain and troubleshoot centrifugal, screw, scroll and absorption chillers alongside VRF heat pump and heat recovery systems. Participants produce a Chiller Plant Optimisation and Maintenance Plan for a case building.

Course Objectives:

- Compare centrifugal, screw, scroll and absorption chillers and air-cooled versus water-cooled heat rejection for a stated cooling duty
- Lay out primary-secondary and variable primary chilled water configurations with pump heads, decoupler and minimum-flow bypass correctly sized
- Set chiller staging, chilled water supply reset and differential pressure setpoints that lower plant kW per ton across part-load hours
- Size and zone a VRF heat pump or heat recovery system within refrigerant piping length, height and indoor-to-outdoor capacity ratio limits
- Diagnose low delta-T syndrome, centrifugal surge, high head pressure and VRF communication and oil-return faults from trend data
- Build a preventive maintenance, retrofit and optimisation schedule for a chilled water plant and its VRF zones

Target Audience:

- HVAC engineers responsible for chilled water plant selection, hydronic layout and VRF system design reviews
- Facilities engineers responsible for day-to-day chiller plant running, log sheets and energy performance
- District cooling plant engineers responsible for chiller staging, thermal storage use and network delta-T
- Maintenance engineers and supervisors responsible for chiller overhauls, tube cleaning and VRF servicing contracts
- Building automation engineers responsible for plant sequencing logic, setpoints and alarm handling

Course Outline:

Day 1: Refrigeration Cycle Refresher, Refrigerants and Chiller Families

- Vapour-Compression Cycle Refresher: Evaporator Approach, Lift and Condenser Approach
- Refrigerant Selection Factors: Operating Pressure, Glide, Flammability Class and Global Warming Potential
- Centrifugal, Screw and Scroll Compressor Chillers: Capacity Range and Part-Load Curves
- Absorption Chillers: Lithium Bromide Cycle, Heat Source Options and Crystallisation Risk
- Air-Cooled Versus Water-Cooled Chiller Comparison: Dry-Bulb and Wet-Bulb Lift Penalty

Day 2: Chilled Water Plant Hydronics, Pumping and Distribution Layouts

- Constant Primary With Variable Secondary Loop and Decoupler Bridge Arrangement
- Variable Primary Flow Plant: Evaporator Minimum Flow and Bypass Valve Control
- Pump Head Calculation, Pump Curve Reading and Parallel Pump Staging
- Chilled Water Piping: Headers, Balancing Valves, Air Separation and Expansion Tanks
- District Cooling Plant Layouts: Series-Counterflow Chillers and Chilled Water Thermal Storage

Day 3: Plant Sequencing, Efficiency Metrics and VRF System Design

- Chiller Staging Logic: Load, Flow and Kilowatt Based Start and Stop Criteria
- Plant Efficiency Metrics: COP, kW per Refrigeration Ton and Integrated Part Load Value
- Chilled Water Supply Temperature Reset and Differential Pressure Setpoint Reset
- VRF Heat Pump Versus Heat Recovery Architecture With Branch Selector Boxes
- VRF Sizing and Zoning: Diversity Ratio, Piping Length and Height Difference Limits

Day 4: VRF Commissioning, Chiller Faults and Plant Retrofits

- VRF Installation Checks: Brazing Under Nitrogen, Pressure Test, Evacuation and Refrigerant Charge Calculation
- Low Delta-T Syndrome: Coil Valve Leak-By, Fouled Coils and Excess Bypass Flow
- Centrifugal Surge, High Head Pressure and Low Evaporator Pressure Trips
- Condenser Water Treatment Interface: Tube Scaling, Fouling Factor and Eddy Current Tube Testing
- Retrofit Options: Variable Speed Drive Conversion, Refrigerant Change-Out and Chiller Replacement Payback

Day 5: Chiller Plant Room Walkthrough and Optimisation Plan

- Plant Room Walkthrough: Chiller Panels, Approach Temperatures and Log Sheet Checks
- Trend Data Analysis: Hourly Plant kW per Ton, Delta-T and Staging Events
- VRF Fault Case: Communication Errors, Oil Return Failures and Uneven Zone Temperatures
- Preventive Maintenance Task List: Oil Analysis, Vibration Readings and Refrigerant Leak Checks
- Chiller Plant Optimisation and Maintenance Plan Presentation and Peer Review

Skills You Will Gain:

- Chiller Type Selection
- Hydronic Loop Layout
- Chiller Staging Configuration
- Plant Efficiency Benchmarking
- VRF System Sizing
- Refrigerant Circuit Commissioning
- Low Delta-T Diagnosis
- Chiller Retrofit Appraisal

Why Attend This Course:

- Return with a Chiller Plant Optimisation and Maintenance Plan built on case building trend data and plant room checks
- Recover chiller capacity lost to low delta-T, poor staging and fouled condenser tubes without adding machines
- Specify VRF layouts that stay inside manufacturer piping and capacity limits and pass commissioning first time
- Compare chilled water and VRF practice with engineers from offices, hospitals, campuses, malls and district cooling plants

Conclusion:

A chilled water plant and its VRF zones perform only when chillers, pumps, pipework and controls are designed and run as one system. The course moves from the refrigeration cycle, refrigerants and chiller families, through primary-secondary and variable primary hydronics, to staging, kW per ton and part-load metrics and VRF design limits. It then covers commissioning, fault diagnosis and retrofits, before the final day applies them in a plant room walkthrough and a Chiller Plant Optimisation and Maintenance Plan.