Agenda

✓ Packaged Central Plant Product
✓ Capabilities/Value Proposition
✓ Application
✓ Summary
Packaged Plant Product

✓ Engineered Package:
  • Single or Multiple Chillers
  • Boilers and/or Plate & Frame HX
  • Chilled water pumps (N+1)
  • Condenser water pumps (N+1)
  • Hot Water Pumps (N+1)
  • Motor Control Centers
  • Controls: DDC or PLC
  • Fully Air Conditioned Enclosure
    • Optional “Convertible” versions
  • Cooling Tower
  • Tower support structure and piping

✓ Guarantees:
  • Cost ($/ton)
  • System Efficiency (kW/ton)
  • Completion date (months)

Benefit of Packaging: Contract to Require Performance Liquidated Damages (LD’s) for Efficiency, Tons, etc.
Core Design Principles

✓ Highest Energy Efficiency
  ✓ Thermodynamic staging
  ✓ Low condenser water flow
    (1.5 gpm/ton = 20°F ΔT)
  ✓ Low chilled water flow
    (1.0 to 1.6 gpm/ton = 15°F to 24°F ΔT)
  ✓ Variable-primary-flow (ChW)
✓ Equipment serviceability
Design Principles – “Low-Flow” Design

✓ Reduces initial costs
  • Smaller pumps
  • Smaller pipe sizes
  • Smaller switchgear and electrical equipment

✓ Reduces operating costs
  • Less pumping energy
  • Lower connected load
Quantitative Advantages

- **Cost** – Typical installed cost savings of $200-$300 per ton versus field-erected systems
  - Controlled construction environment
  - Repetitive processes
- **Schedule** - can save up to 50% (6 months) versus typical design/bid/construct
- **Industrial Quality**
  - ISO 9001:2000 Certified Manufacturing Processes
  - Standard product designs allow continuous improvement
  - B31.1 Piping
  - Seismic Zone IV – 115MPH – 40 lb/sq ft
Quantitative Advantages

- High System Efficiency
  - Chiller/Pump/Tower Optimization
- Equipment Enclosure
  - Realize use of building space once reserved for mechanical room(s)
- Compact Footprint
- Standardized O&M service and parts
Chiller–Tower Optimization

**Trane was awarded the 2004 SBIC “Best Sustainable Practice” award, recognizing the Trane Chiller-Tower Optimization chiller plant operating system.**

SBIC – Sustainable Buildings Industry Council
Qualitative Advantages

✓ Single-source responsibility
  ✓ Integration
  ✓ One set of submittal, P&ID, PFD documents
✓ Simplified project execution/management
✓ Commissioning
  ✓ Controls certification
✓ Flexibility - customizable to fit specific site conditions
  ✓ Various scope options: compatible with TES, BCHP, and Cogeneration
✓ Portable/Modular/Expandable
  ✓ On-site as missions/needs change
  ✓ Different sites
✓ Guaranteed and predictable performance
Plant Maintenance and Serviceability

✅ Dry room for switchgear and controls
✅ Minimum 5 foot aisle between chillers
✅ Clearance for compressor removal
✅ Overhead monorail hoist (pumps)
✅ Removable end-walls or doors for tube access
✅ Internal catwalks and ladders
✅ Cooling tower catwalk & railing
Total Cost of Ownership

Visible Costs

- Energy Costs
- Equipment Shutdown Costs
- Maintenance Costs
- Legal Costs
- Construction Change Orders
- Performance Problems
- Start-up Delays
- Distribution Piping

Traditional Focus

Hidden Costs

Price/Time

Owner’s Focus
# Project: 2000 Ton Central Plant

## TAS Proposal Number: 2004-I

### Customer Name: Medical Building

### Option 1: Field Erected 2000 ton plant

### Option 2: TAS H-Series with 2 x Long barrel simplex chillers

## Input:

<table>
<thead>
<tr>
<th>Description</th>
<th>Option 1 (MC Estimate)</th>
<th>Option 2 - TAS PCR (actual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Installed Tons:</td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>Planned Full Load:</td>
<td>100%</td>
<td></td>
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<tr>
<td>Running Full Load Tons:</td>
<td>2000</td>
<td></td>
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<tr>
<td>Concrete Slab:</td>
<td>0</td>
<td>26,250</td>
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<tr>
<td>Chillers:</td>
<td>400,000</td>
<td>2,350,000</td>
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<tr>
<td>Cooling Towers:</td>
<td>170,000</td>
<td></td>
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<tr>
<td>Cooling Tower Structure:</td>
<td>48,000</td>
<td>included</td>
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<tr>
<td>Pumps:</td>
<td>96,000</td>
<td>included</td>
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<tr>
<td>Piping/Valves/Instrumentation:</td>
<td>370,000</td>
<td>included</td>
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<tr>
<td>Insulation:</td>
<td>148,000</td>
<td>included</td>
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<td>Controls:</td>
<td>88,000</td>
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<td>Chiller Plant Building:</td>
<td>320,000</td>
<td>included</td>
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<td>Startup:</td>
<td>37,200</td>
<td>included</td>
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<td>Commissioning:</td>
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<td>Electrical:</td>
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<td>included</td>
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<td>Shipping:</td>
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<td>90,000</td>
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<td>Rigging:</td>
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<td>45,000</td>
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<td>Water Treatment:</td>
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<td>Building HVAC:</td>
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<tr>
<td>Refrigerant Monitoring System:</td>
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<td>Field Labor:</td>
<td>170,000</td>
<td>130,000</td>
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<td>Warranty:</td>
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<tr>
<td>Subcontractor Mark-up:</td>
<td>337,230</td>
<td>31,500</td>
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<tr>
<td>General Contractor Mark-up:</td>
<td>435,816</td>
<td>406,163</td>
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<tr>
<td><strong>Construction First Cost:</strong></td>
<td><strong>3,341,245</strong></td>
<td>Actual <strong>3,113,913</strong></td>
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<tr>
<td>$(/ton)</td>
<td>1,671</td>
<td>1,557</td>
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## Performance Input:

<table>
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<tr>
<th>Description</th>
<th>(ESTIMATED)</th>
<th>(ACTUAL)</th>
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<tbody>
<tr>
<td>kw/Ton:</td>
<td>0.85</td>
<td>0.75</td>
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<tr>
<td>Running Load kW:</td>
<td>1,700</td>
<td>1,500</td>
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<td>Connect Load kW:</td>
<td>1,700</td>
<td>1,500</td>
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<tr>
<td>Full Load Hours/Year:</td>
<td>4,117</td>
<td>4,117</td>
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</table>
Net Present Cost Comparison

![Net Present Cost Comparison Diagram]

- **Field Erected**:
  - Equipment
  - Electricity Usage
  - Water Usage
  - Maintenance

- **Packaged**:
  - Equipment
  - Electricity Usage
  - Water Usage
  - Maintenance
# Packaged Plant Product Benefits

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Packaged</th>
<th>Conventional</th>
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<tbody>
<tr>
<td>Energy Efficiency (kW/ton)</td>
<td>.70-.80</td>
<td>.85-1.0+</td>
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<tr>
<td>Eliminates Need for Building</td>
<td>Yes</td>
<td>No</td>
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<td>Installed Capital Cost ($/ton)</td>
<td>950-1500</td>
<td>1600-2200+</td>
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<tr>
<td>Deployment Schedule (mos.)</td>
<td>6-9</td>
<td>18-24</td>
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<tr>
<td>Compactness</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Portability</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Modular Concept</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Constructability</td>
<td>Simple</td>
<td>Complex</td>
</tr>
</tbody>
</table>
Packaged Central Plant Exterior
Packaged Central Plant Interior
Integrated Switchgear

Electrical/Control Dry Room separate from Chillers and Pumps
Pumps and Headers
Typical Package Installation

Installation Statistics:

- 7-Man Crew
- 4 x 10 hour Days
- 4 Days per week

***Plant Installed in 16 Working Days***

Project Information:

- 1,200 tons Installed Now (2 x 600TR Centrifugal Chillers)
- Additional Expansion Planned (2 x Centrifugal Chillers)
- Expansion to be inside shown package and will require less than 10 days to install and require zero plant outage
Receipt, Unloading, and Setting of Modules

- Single Lift
- *Re-Connection* Electrical Bus Duct
- *Re-Connection* Chilled & Cooling Water (8)-Victaulic Couplings
- 75 Ton Crane 1-Day
- 30 Pre-tagged & tested #12 Wires
- *Re-Connection* Controls
- Pump Module
- ASHRAE Ventilation Lighting & Utility Receptacles Built In
- #12 Wires
Cooling Tower Structure & Piping Arrive

Minimal Field Welds: <4
Internal Package & Cooling Tower Structure Major Assembly Complete

Lt Weight Hoist Truck 10 Days
Cooling Tower scheduled for Just-in-Time Delivery and Placement

20 Ton Crane (1 Day)
Cooling Tower Motors & Instruments Wired, Piping Near Completion
1200 Ton Facility Installed
Bossier City, Louisiana

*29 calendar days to install*

*24 weeks from order to chilled water*
1200 Tons – Rincon, California
Screening Options
Screening Options
Screening Options
400 Tons - Stafford, Texas

- Water-Cooled Screw Compressor Chillers
- Replaced Air-Cooled Chiller system
- Delivery to Startup: 9 Days
400 Ton Packaged Plant
400 Ton Packaged Plant
5000 Tons – Houston, Texas

- 5,000 Ton Plant
- Located over an operating Loading Dock
- 0.73 kW/ton Guarantee
- 2 x 2.5 MW Emergency Generators
5000 Tons – Houston, Texas
5000 Ton Packaged Plant – Pompano, Florida
5000 Ton Packaged Plant – Pompano, Florida
5000 Ton Packaged Plant – Pompano, Florida
Data Center Application

- 3 ea. Centrifugal Chillers (3000 Tons) – (55/71 ChW)
- 2 ea. Helical-Rotary Chillers (500 Tons) – (40/58 ChW)
Packaged Plant – Mission Critical
Packaged Plant – Mission Critical
Packaged Plant – Mission Critical
Jumeirah Beach Residence
(www.jbr.ae)

- 60,000 Tons (12 ea. 5,000 Ton Plants)
- 22 million square feet
- 36 Residential Towers
- 4 Hotel Towers
Jumeirah Beach Residence
(www.jbr.ae)
Ammonia Packages
Summary

- Reduced first cost
- High-efficiency plant
  - Lowest Life-cycle cost
- Reliability
- Quality
- Reduced footprint
- Minimal site interference = Maximum Safety
- Shortened construction cycle
- Guaranteed performance
Additional Information

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USACE Engineering and Construction Bulletin #2004-16