

Research, Development, and Demonstration of Packaged Cooling, Heating, and Power Systems for Buildings (BCHP)

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Agenda

Project goal and approach

- ◆ Original plan shared at 2002 Peer Review
- ◆ Re-focused plan after UTC/CTC Strategic Alliance Agreement

Accomplishments Since 2002 Peer Review

- ◆ Characterized waste-heat driven absorption chiller performance and transient response
- ◆ Finalized CHP system control strategy and critical components
- ◆ Integrated microturbine/chiller and mapped power, chilling, and heating performance
- ◆ Identified and mitigated integrated CHP system risks

Next Steps

- ◆ Complete UTRC “Field Trial” and Final Reporting
- ◆ Complete and report new tasks for CHP opportunity and technologies

Conclusions

- ◆ UTC Power is launching PureComfort™ 240

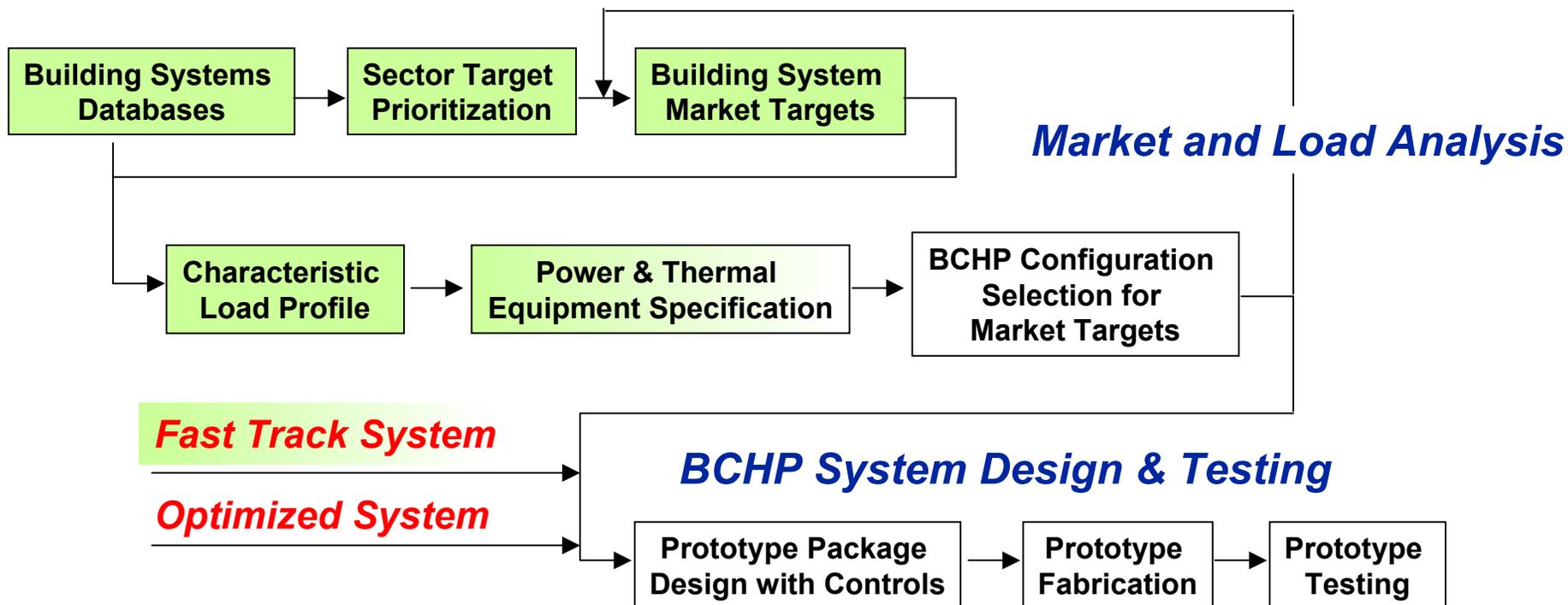
Original Goal and Approach

Goal

- ◆ Develop and demonstrate an “optimum” microturbine CHP system

Approach

- ◆ Guidance from marketplace and “fast track” learning of waste-heat driven absorption chiller
- ◆ Specify, integrate, and test “optimized” microturbine CHP system



Goal

- ◆ Develop and demonstrate an market-driven microturbine/absorption chiller CHP system

Approach

- ◆ Guidance from marketplace never ends
- ◆ Adapt affordable, leading-edge CHP components
- ◆ Integrate 4 CTC C60 microturbines and a Carrier double effect absorption chiller, and demonstrate CHP system performance

CY2002

CY2003

CY2004

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
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Marketplace Assessments

Adapt and Characterize Components

Integrate Sys

System Test

Field Test at UTRC

Commissioned UTC CHP
Validation Test Facility

CHP Opportunities

The October, 28, 2002 news release contained the following:

“The strategic alliance between UTC and Capstone is a long term agreement to integrate, sell, and service microturbine-based combined heat and power solutions for commercial buildings.”

“UTC and Capstone intend to build on key product, technology, and channel strengths of the companies, including those of UTC’s Carrier Corporation – the leading manufacturer of heating, ventilation, and air conditioning systems.”

“The agreement covers North America and most of Europe.”

“As part of the alliance agreement, UTC has committed to purchase a 4.9 percent stake in Capstone.”



CHP system integration of -

4 x C60 Microturbines



Double Effect Carrier Chiller



- can meet many building needs:

Electric Load

- Lighting
- Ventilation
- *Refrigeration*
- *Space Cooling*



Cooling Load

- *Space*
- *Subcooling*

Heating Load

- *Space*
- *Water*

Direct-fired Carrier Chiller Converted for Waste-Heat

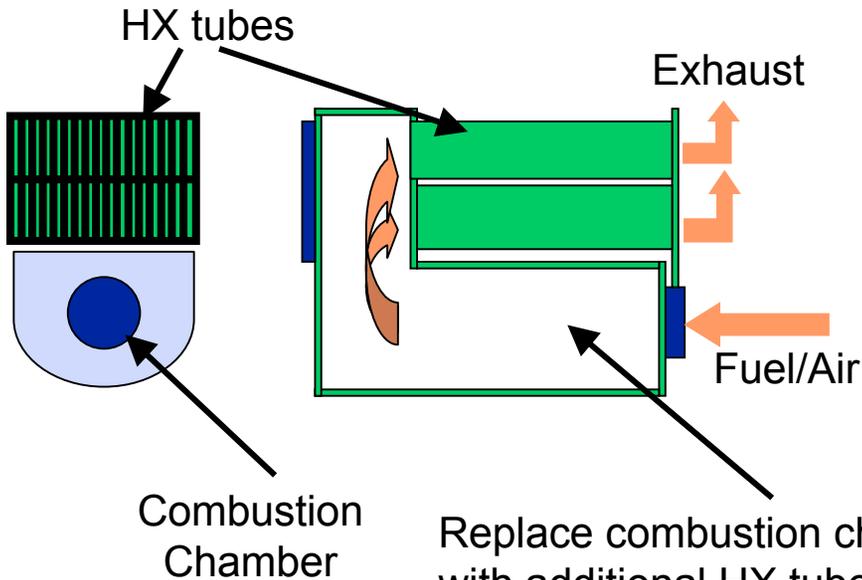
16DN Chiller/Heater



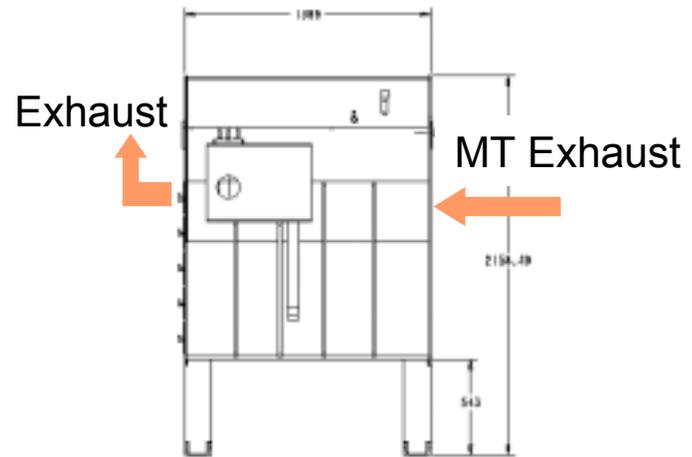
CHP Chiller/Heater



Modified HX



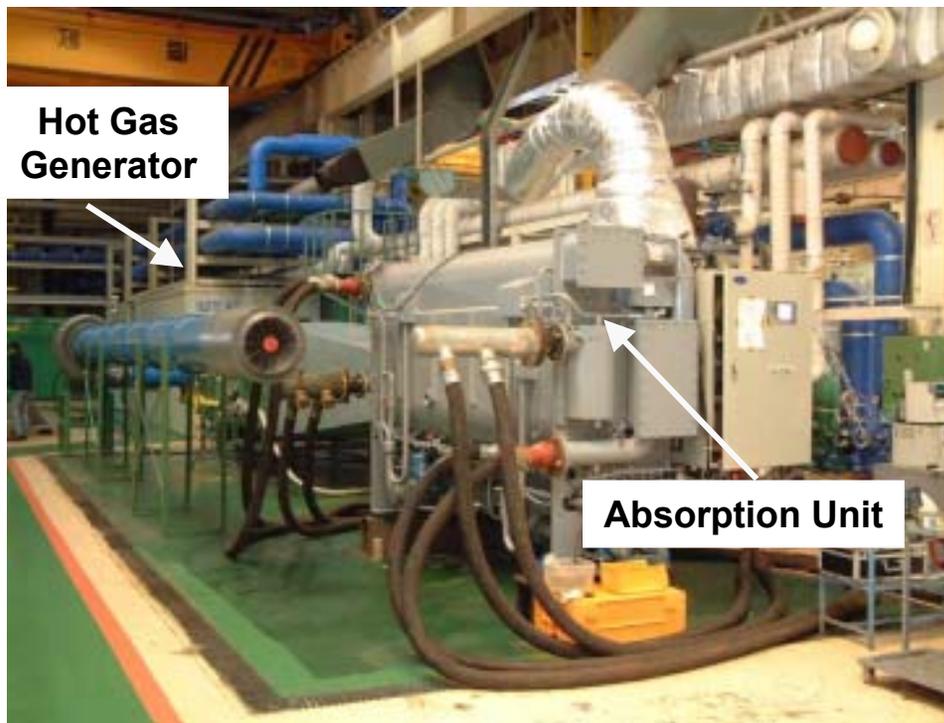
Replace combustion chamber with additional HX tubes



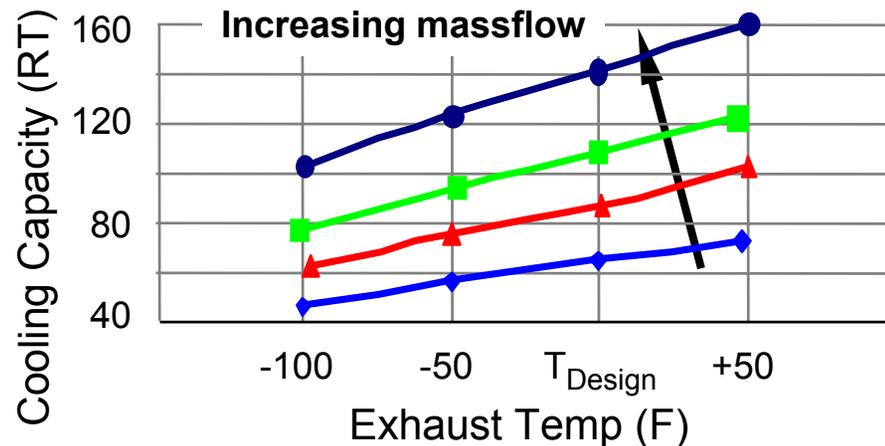
Waste Heat Carrier Chiller Achieves 1.3 COP

Research Center

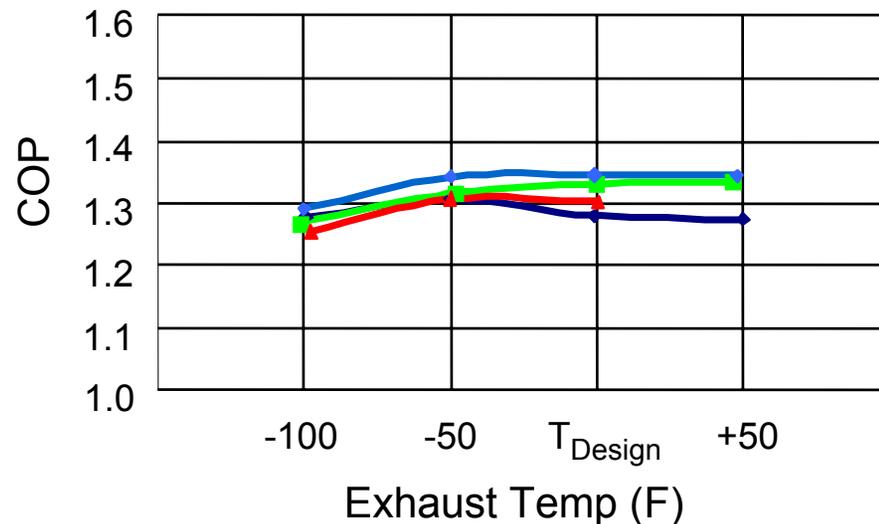
Chiller s/s performance with hot gas generator



Cooling Capacity



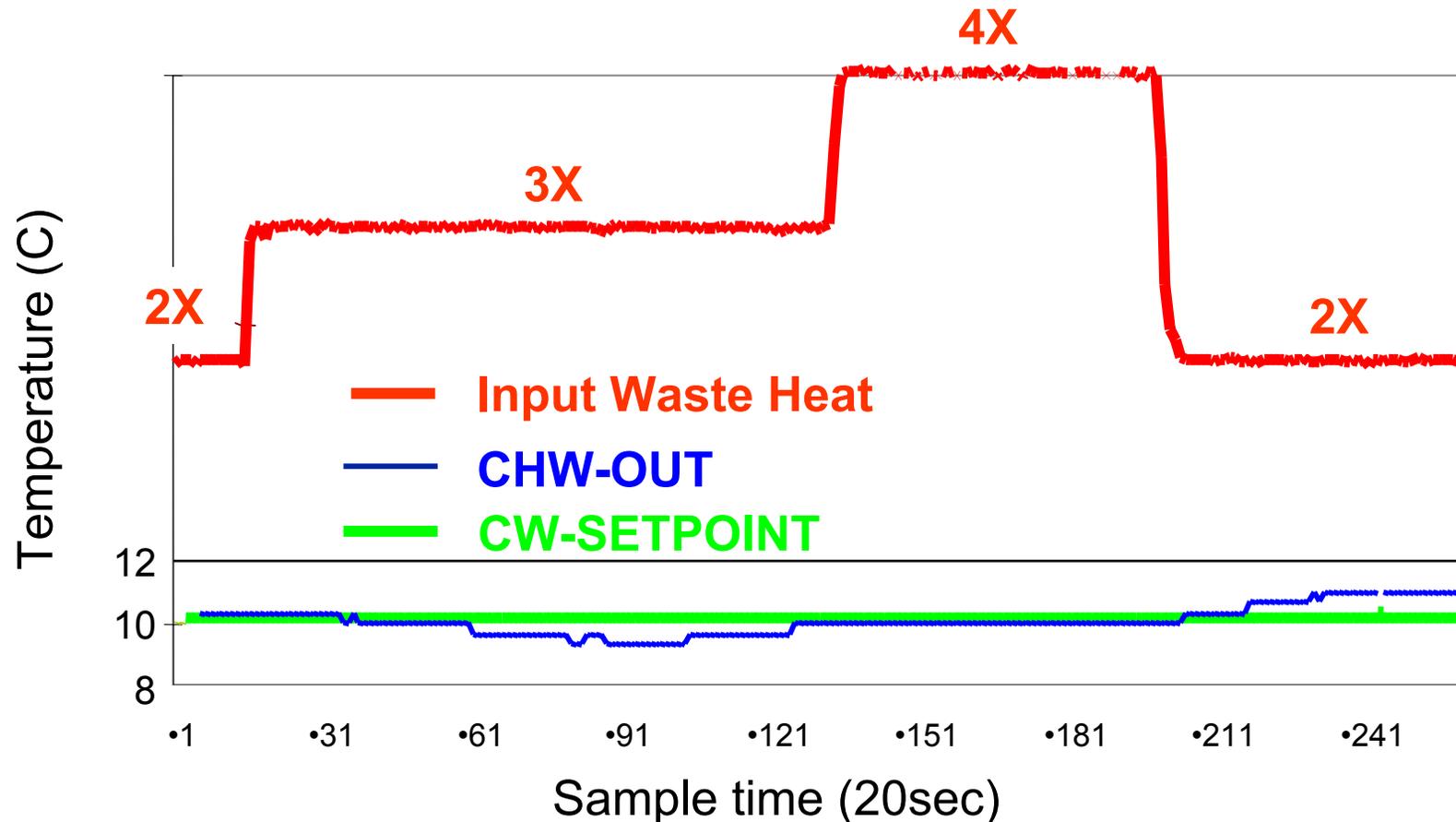
COP



Chilled-Water Set-point Held During Waste Heat Transients

Transient Heat Source Test with hot gas generator

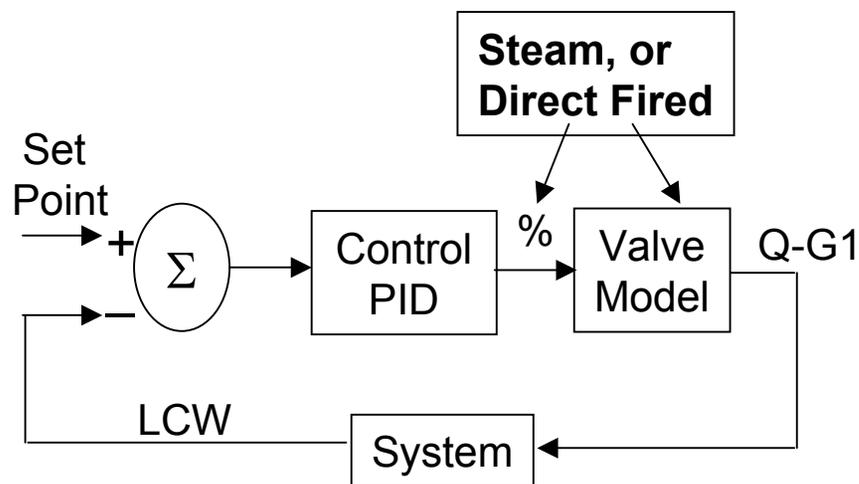
- ◆ Chilled water leaving temperature maintained to within 1.8 F



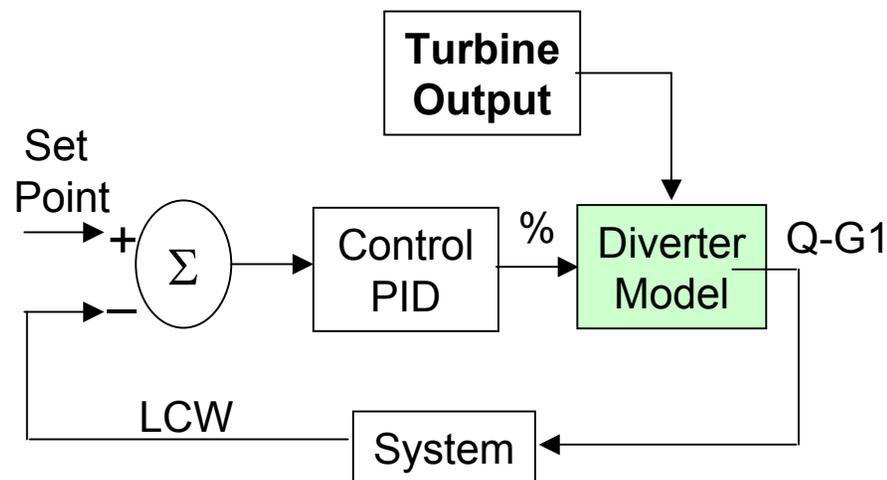
Waste-Heat Damper Used to Control Chiller Output

Substitute diverter valve control for fuel valve control

Existing Product



CHP Product

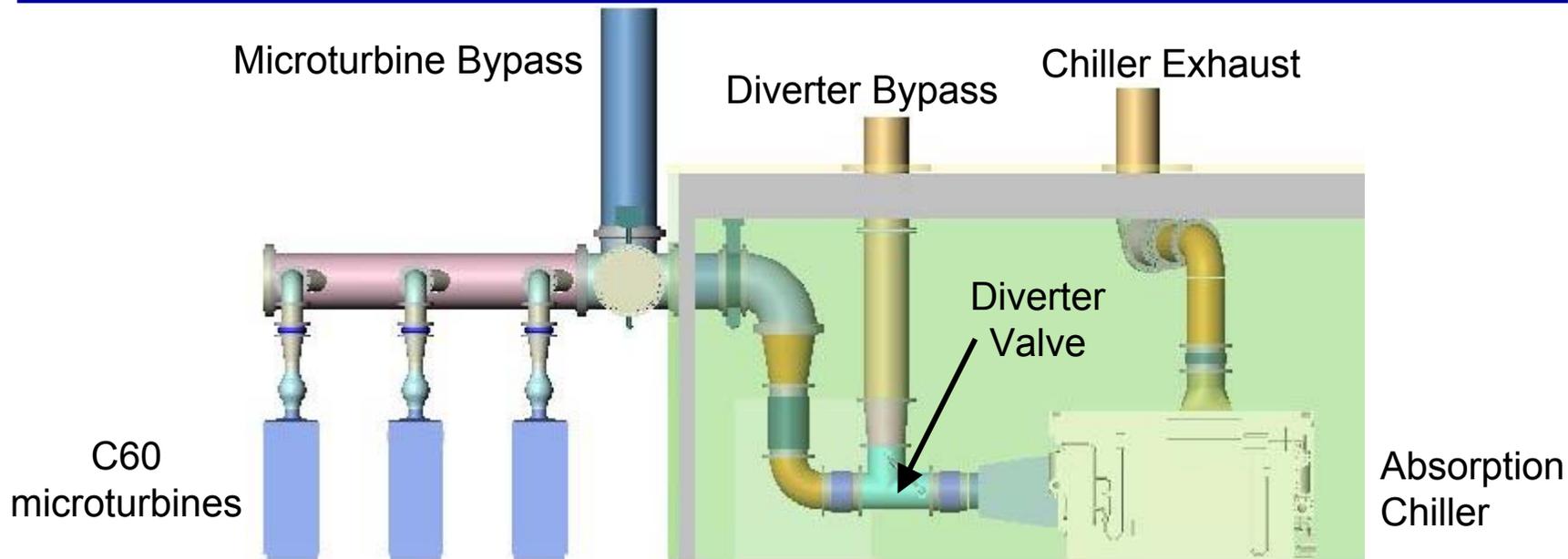


Diverter Valve – used for capacity control

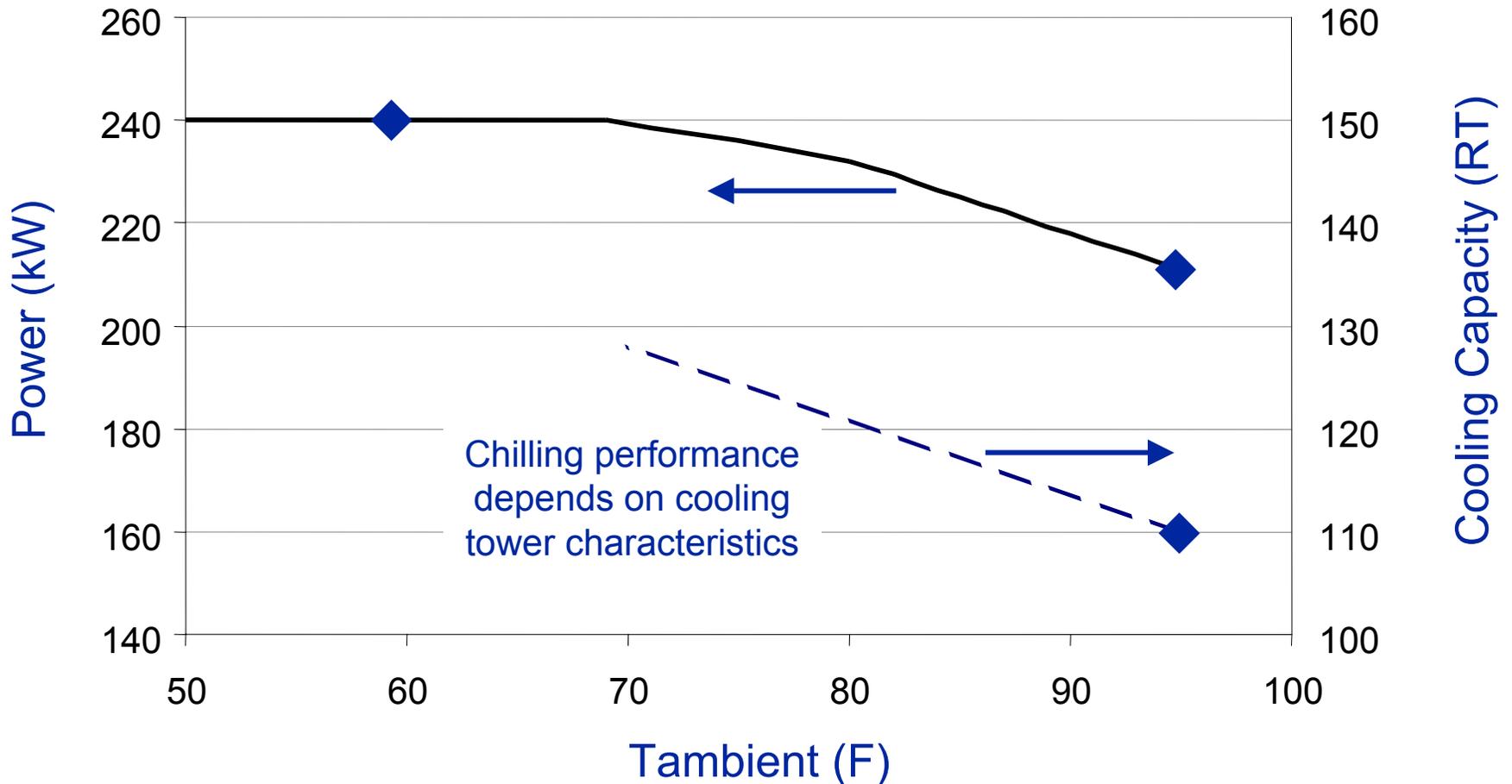
- Air seal blower to insure zero leakage
- Electric actuator used to set position



C60/Absorption Chiller System in CHP Validation Test Facility

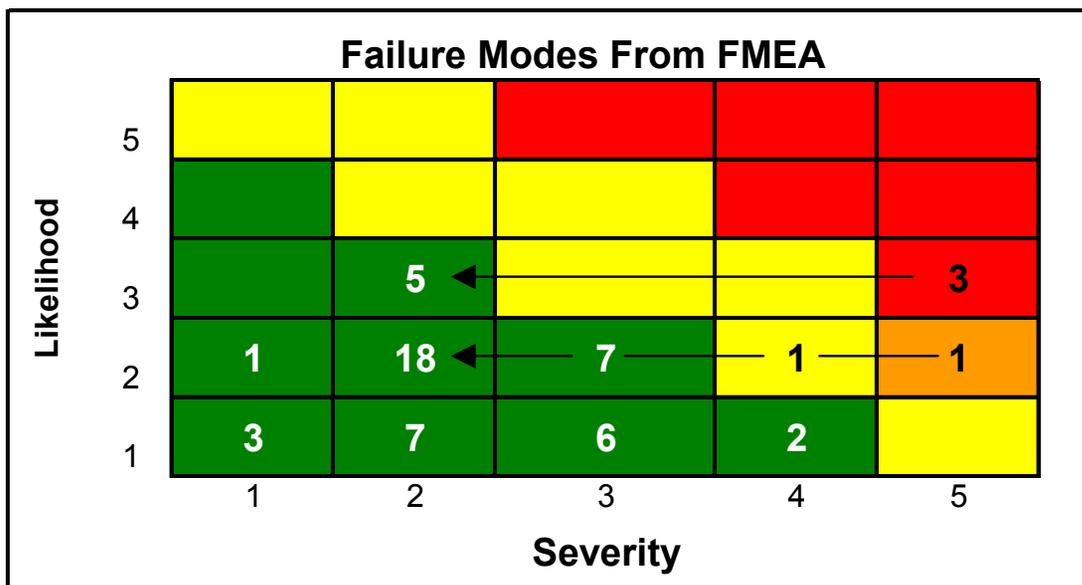


◆ System Rating Points



No residual single point criteria failure modes

- ◆ System controls ensure that highest severity failure modes do not result in health or safety risk
 - For example, must not allow fuel to accumulate in duct
- ◆ Highest Risk Priority Number failure modes driven down by system design, control strategies, or testing.



Complete C60/Chiller CHP System UTRC “Field Test” (Apr 2004)

- ◆ UTRC system is being run as a Field Test
- ◆ Broaden performance map (e.g. “ cold day”)
- ◆ Acquire operational hours

Complete and report US waste heat assessment (Jan 2004)

- ◆ Identify sources, and categorize by quantity, quality, and availability
- ◆ Initiated late in FY03

Complete and report CHP technology options assessments (Feb 2004)

- ◆ Identify options for energy storage and desiccants
- ◆ Assess means to affordably integrate into CHP systems
- ◆ Initiated late in FY03

Re-focused plan has developed technology and demonstrated an integrated microturbine/absorption chiller-heater CHP System

- ◆ System supports commercial building needs for power and space cooling/heating
- ◆ New waste-heat driven, double effect chiller
- ◆ CHP system fuel utilization 70% in cooling mode

Newer tasks are identifying opportunities to recycle or save energy

Together, UTC products and plans have great public benefit

- ◆ Expand customer choice for reliable, affordable electrical and thermal energy
- ◆ Delivers the energy streams with less fuel consumption and pollutants
- ◆ UTC/DOE collaboration is having a direct impact on the marketplace by enabling new CHP products

UTC Power PureComfort™ 240

