Opti-Chill

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Opti-Chill

What is Opti-Chill?

Opti-Chill is a process for the reduction of chilled water plant operating costs.

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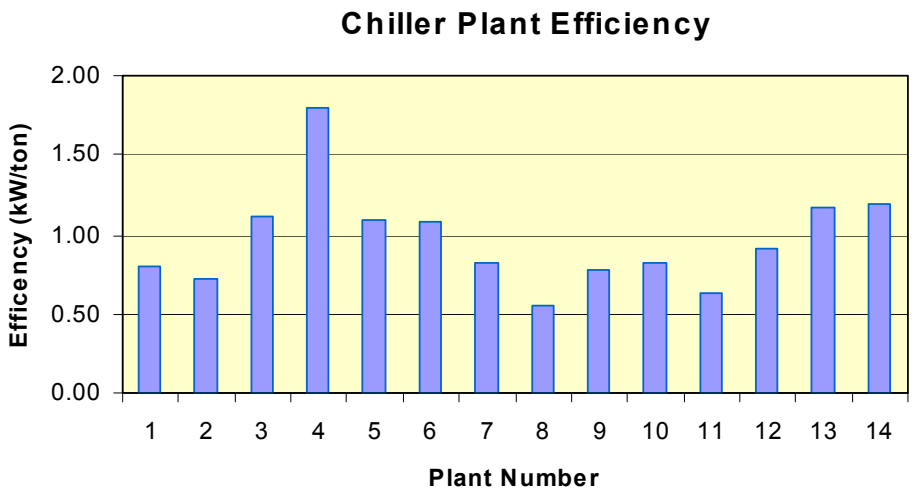
Optimization Potential

- Studies suggest a substantial variation in chilled water plant energy intensity.

0.55 to 1.80 kW/ton



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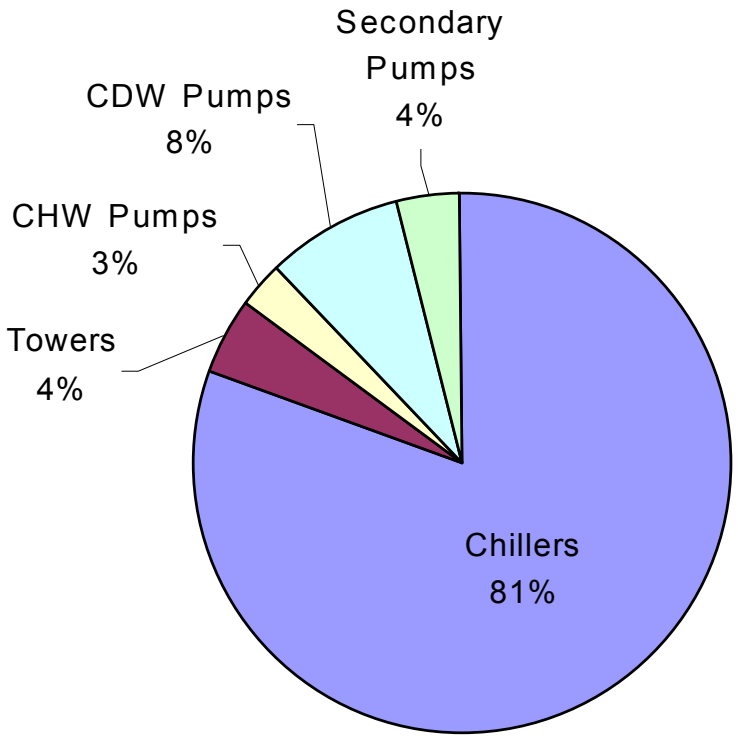
Chilled Water Plant Energy Use



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Efficiency Variables

1. Climatic conditions
2. Cooling load profile
3. Equipment selection & configuration
4. Operating protocols

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Efficiency Measures

- Increasing cooling tower capacity
- Pump impeller trimming
- Variable frequency drives
- High efficiency motors
- Matching sub-loads with chiller system operation (flow/differential temperature)
- Heat recovery

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Efficiency Measures

- Improved piping system layouts
- Chiller & tower performance optimization
- Operating sequence
  - Equipment staging
    - chillers, cooling towers & pumps
  - Set-points
    - chilled & condenser water temperature

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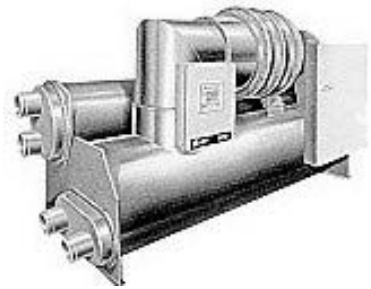
Chiller & Tower Efficiency



- ⇕ Load
- ⇓ CDW Temperature
- ⇑ CDW Flow
- ⇕ Chiller Design

- ⇓ Wet Bulb
- ⇑ CDW Temperature
- ⇕ CDW Flow
- ⇕ Tower Design

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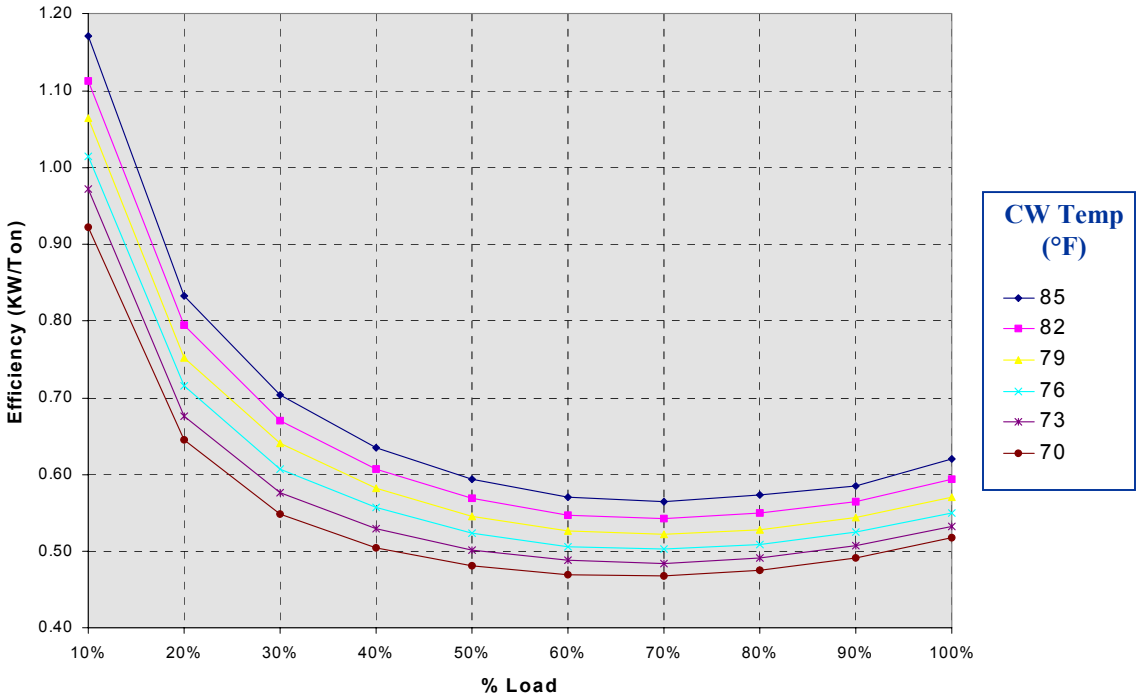
Chiller Efficiency



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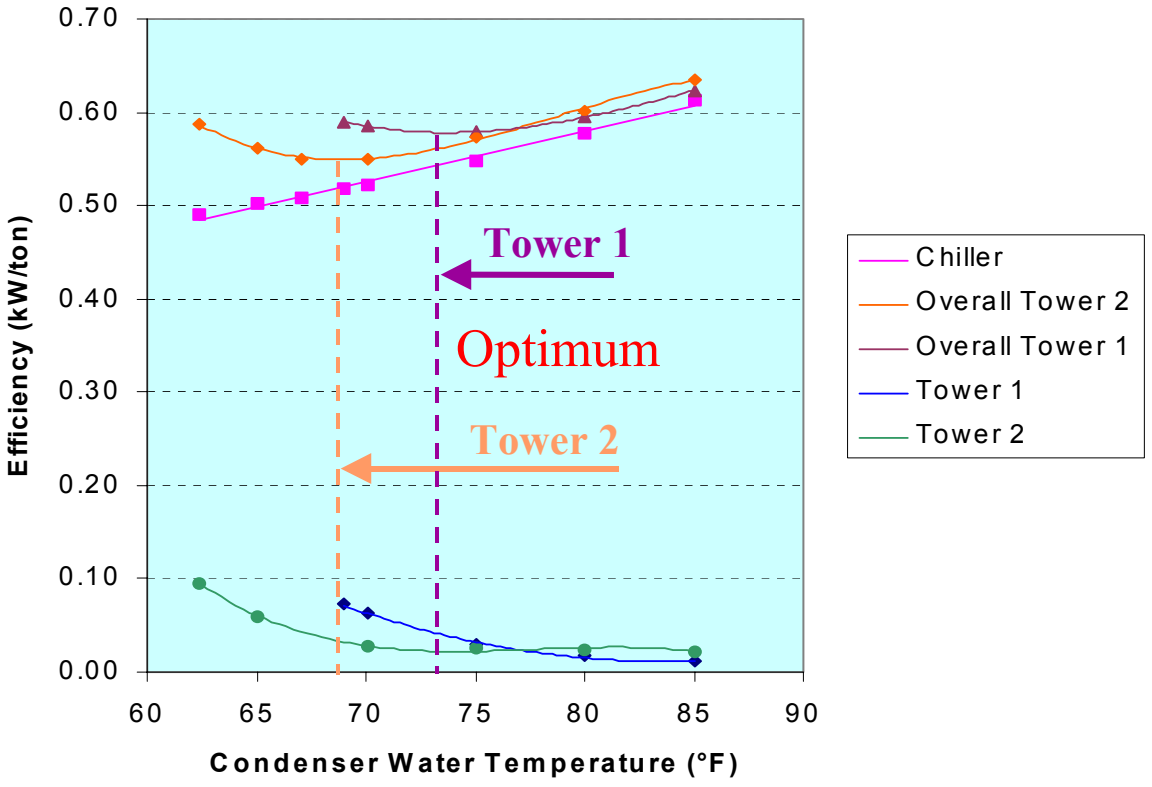
Chiller & Tower Efficiency

- Optimum CW Temperature is a function of tower design



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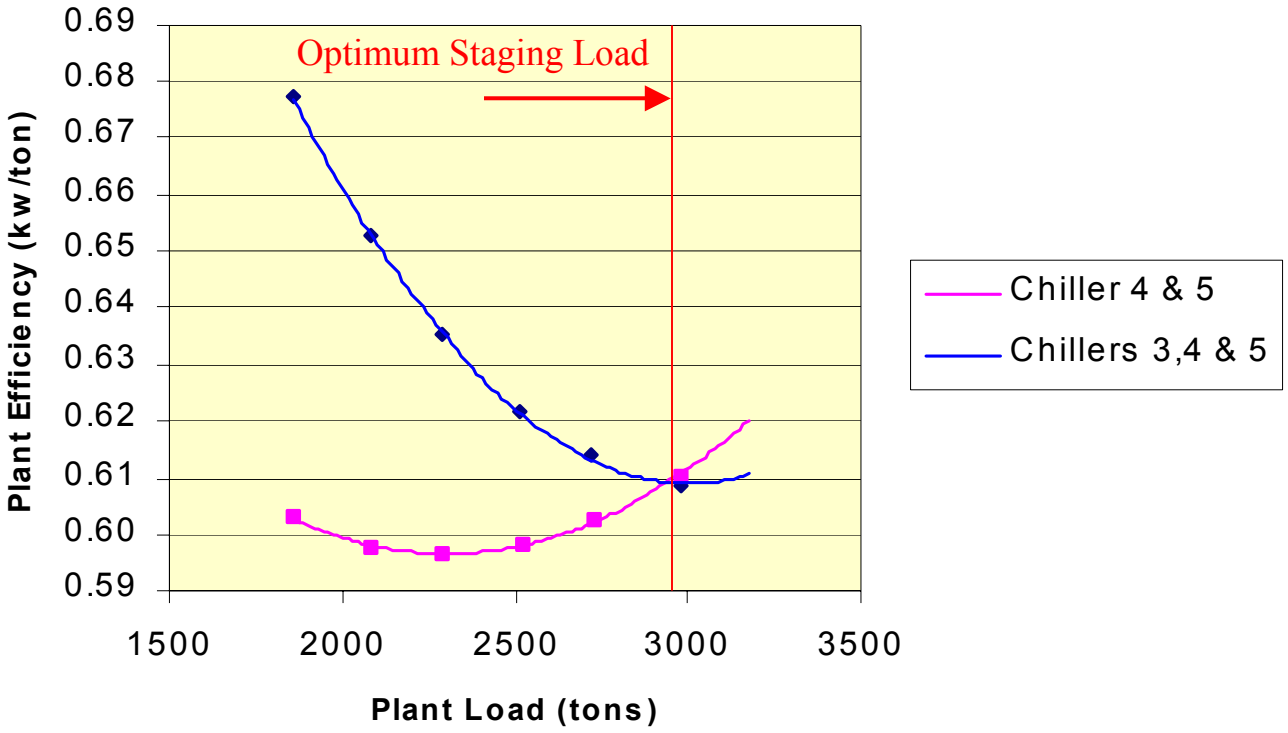
Chiller Sequencing



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Barriers

- Insufficient instrumentation
- Data consolidation and analysis
- Difficulty in determining optimal system conditions
- Quantifying the economics of energy saving measures

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Opti-Chill Process

- Site assessment
- Data collection (FMS & site)
- Bench-marking
- Plant modeling and simulation
- Identification of energy saving measures
- Cost/benefit analysis
- Performance validation

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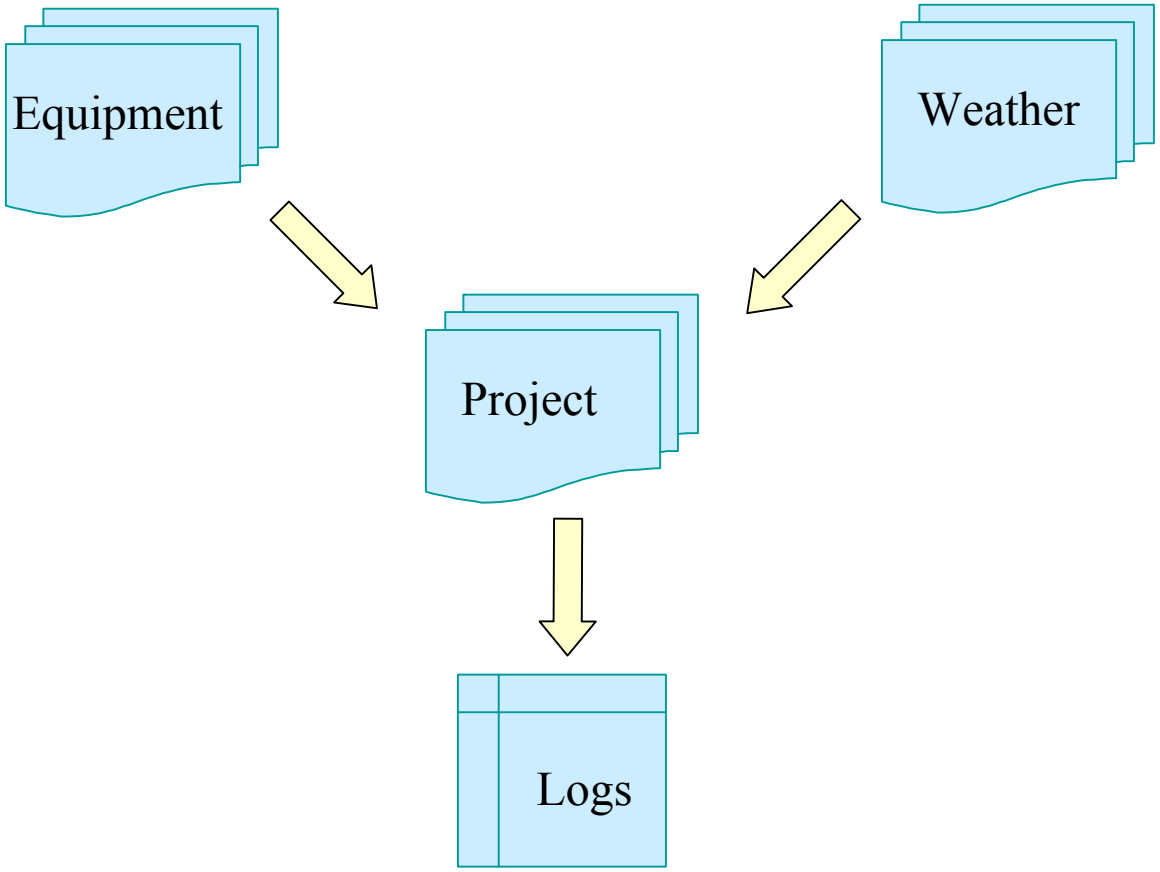
Simulation Model Structure



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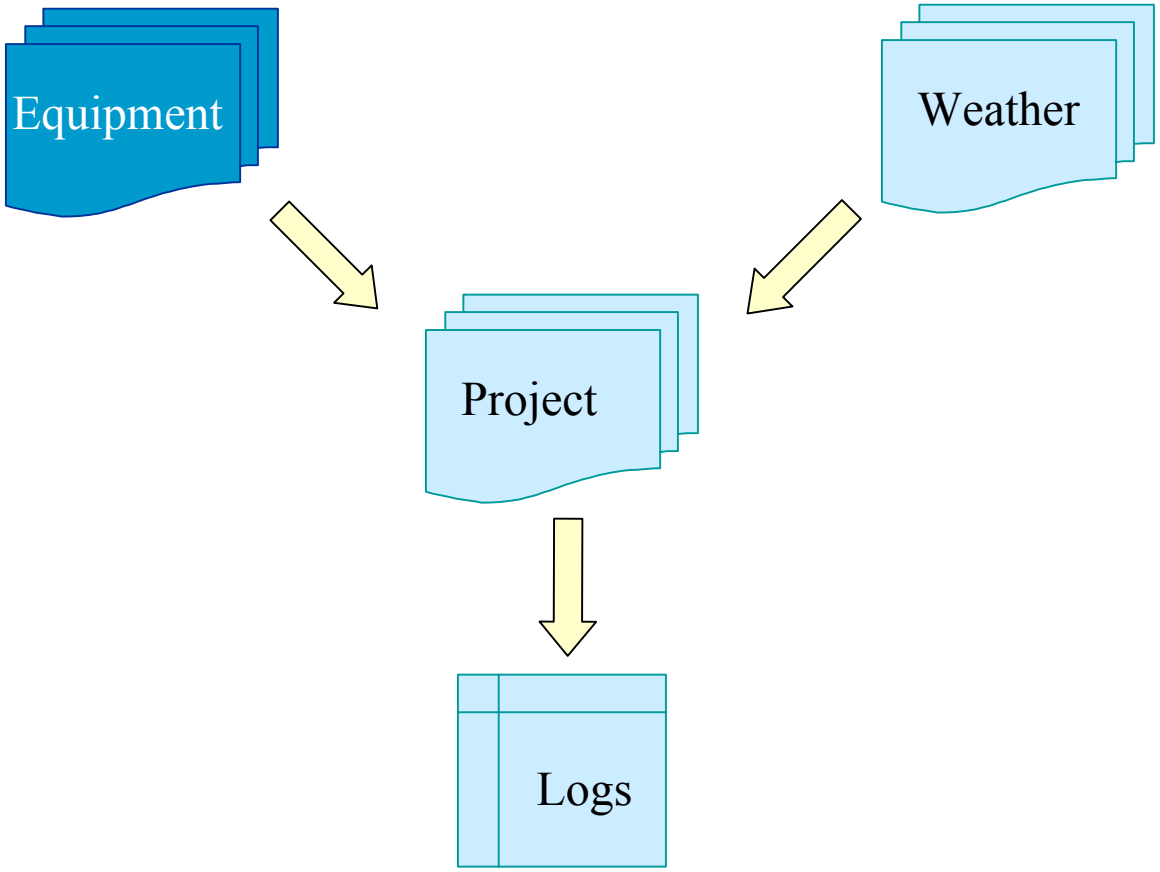
Simulation Model Structure



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Equipment Database

- Tag data :
  - make, model ...
- Component specific data (pump):
  - suction to discharge elevation change
  - suction and discharge diameters
- Performance data (pump):
  - head = f(impeller diameter, flow rate)
  - efficiency = f(impeller diameter, flow rate)

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Equipment Modeling (Pump)

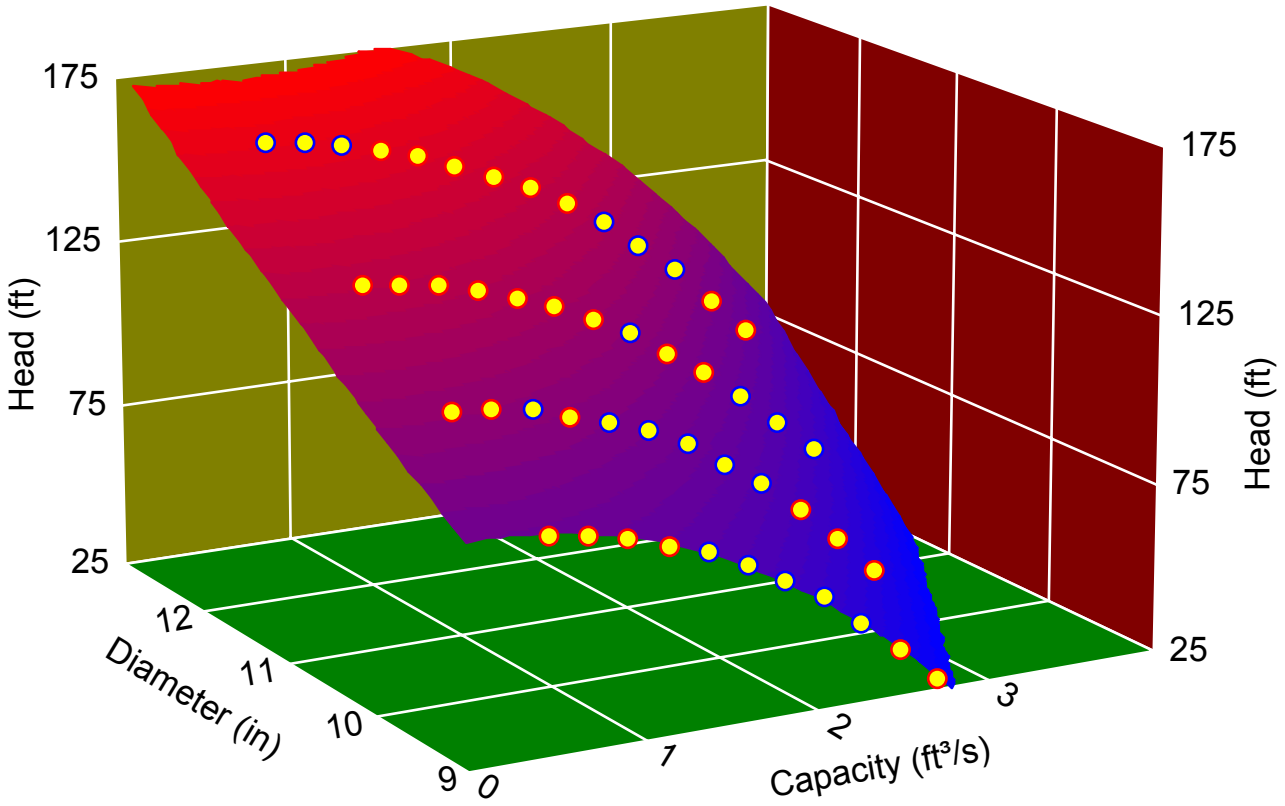
Paco 11-40127 @ 1750 RPM

$z = a+bx+cy+dx^2+ey^2+fxy$

$r^2 = 0.99941175$

a = -27.920 b = -18.083 c = 6.592

d = -9.117 e = 0.732 f = 2.211



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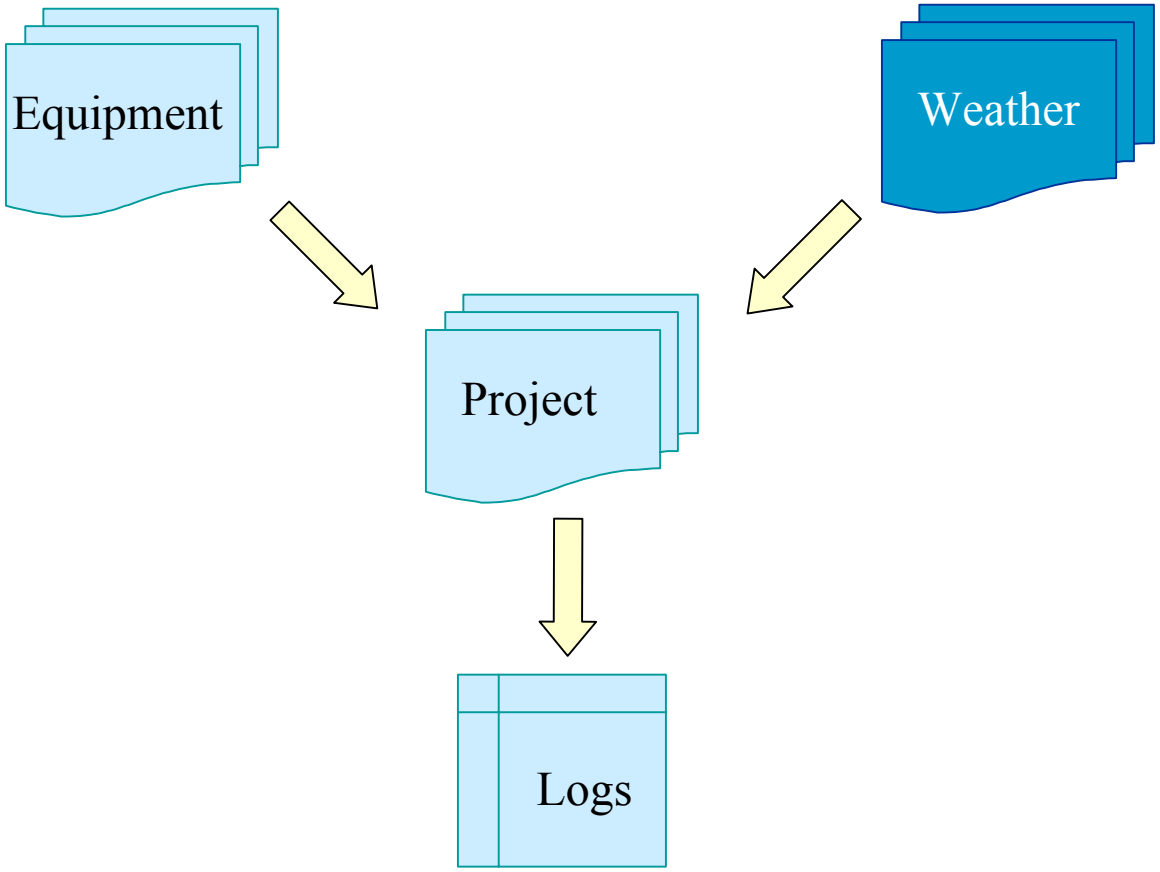
Simulation Model Structure



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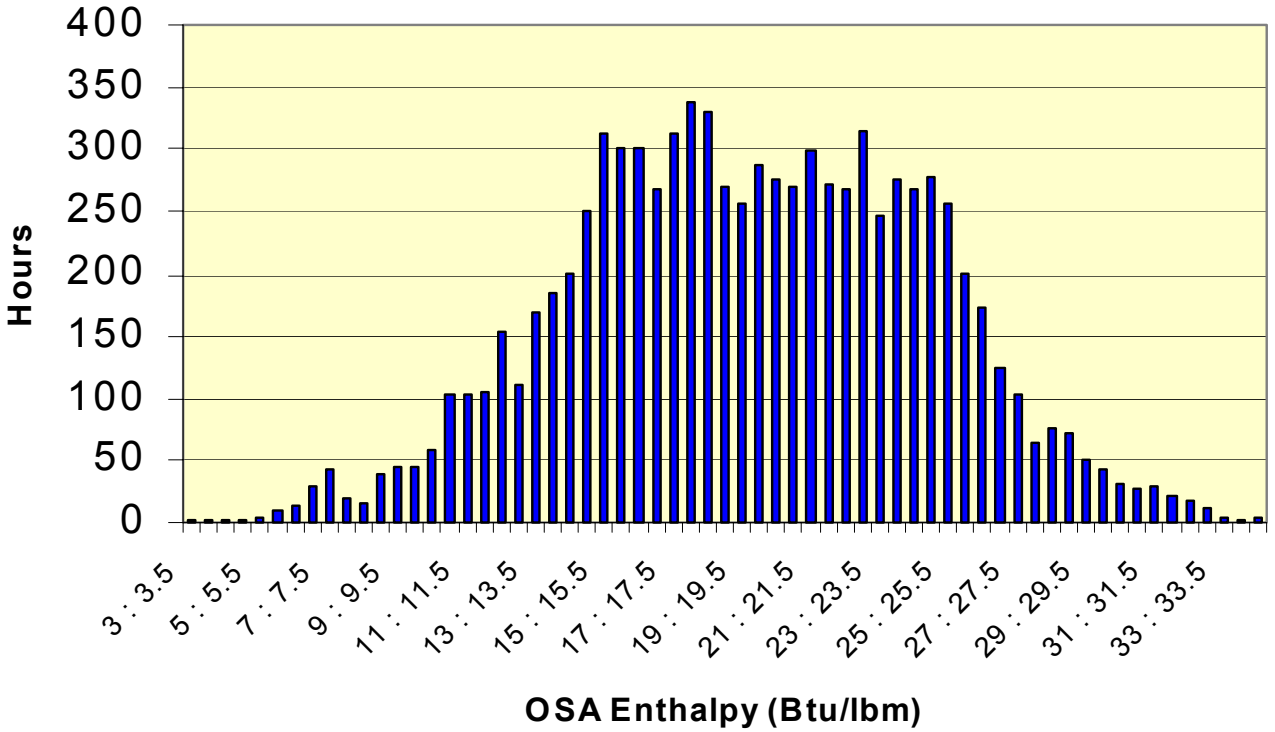
Weather Bin Data



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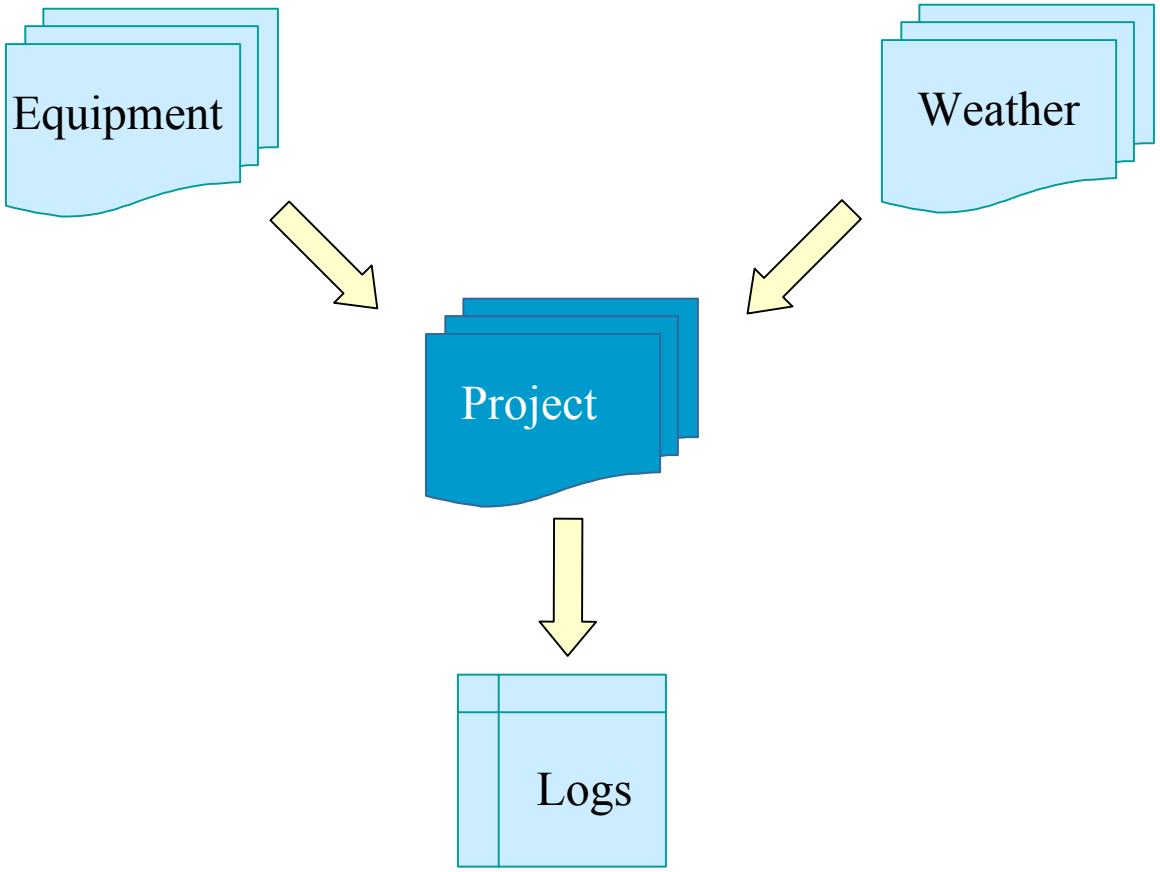
Structure



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Project

- One or more plant systems which must be collectively analyzed due to intersystem operational dependencies.
- Stored in a relational database
  - System configuration
  - User interface

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Project Model

- Configured to:
  - plant configuration
  - equipment operating points
  - sequence of operation
  - local weather data
  - plant cooling load profile
- Generates annual system energy usage forecasts within 5% of actual

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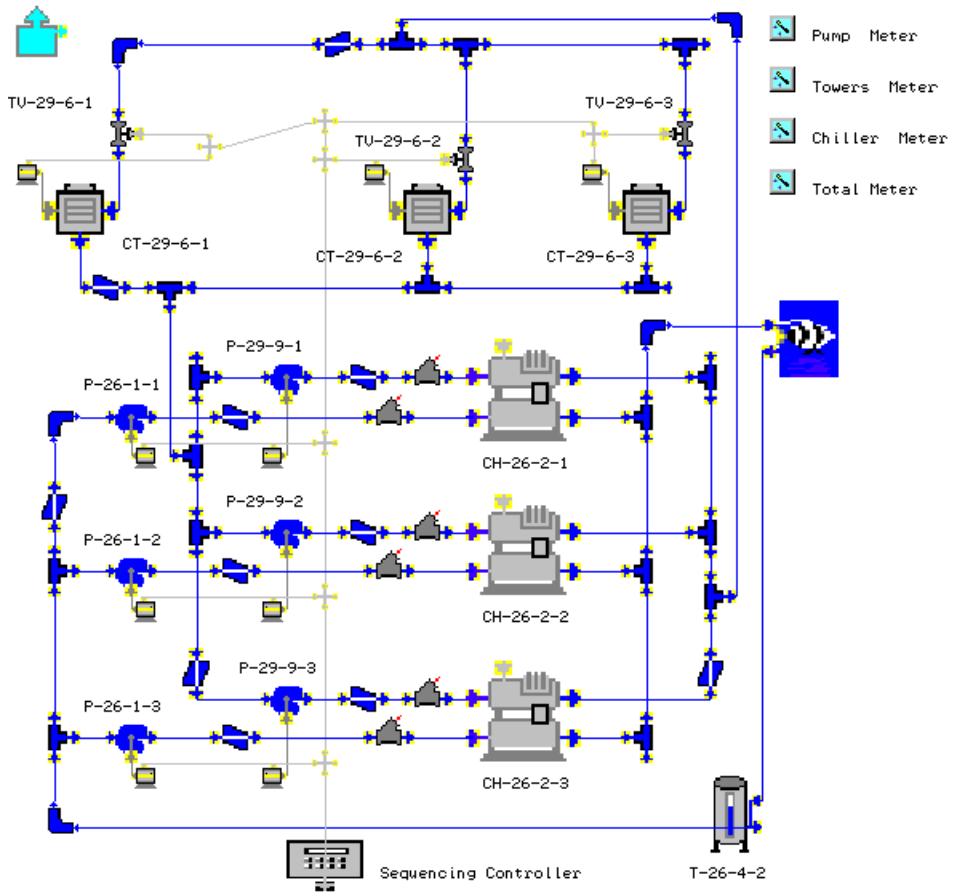
Project Model



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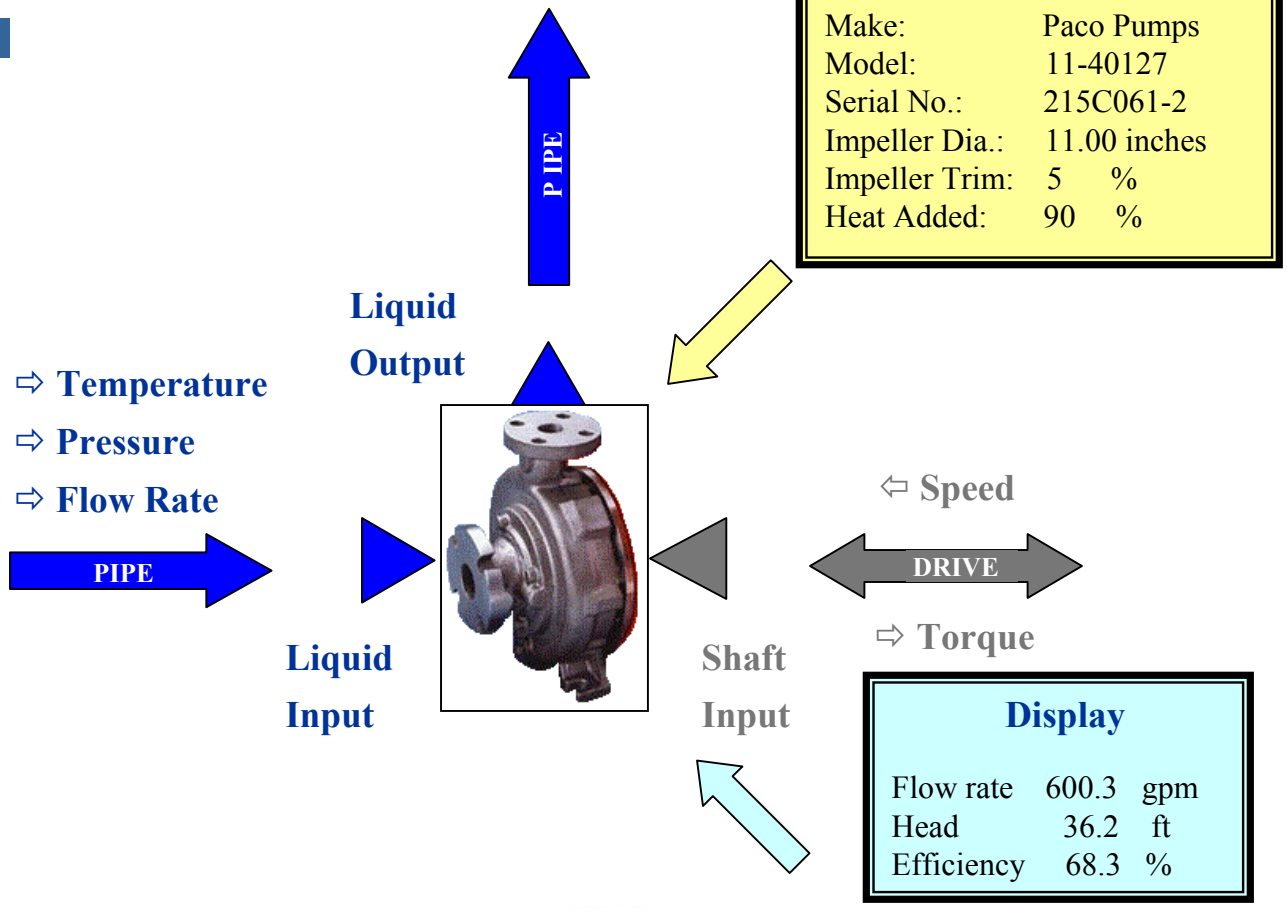
Ports (Pump)



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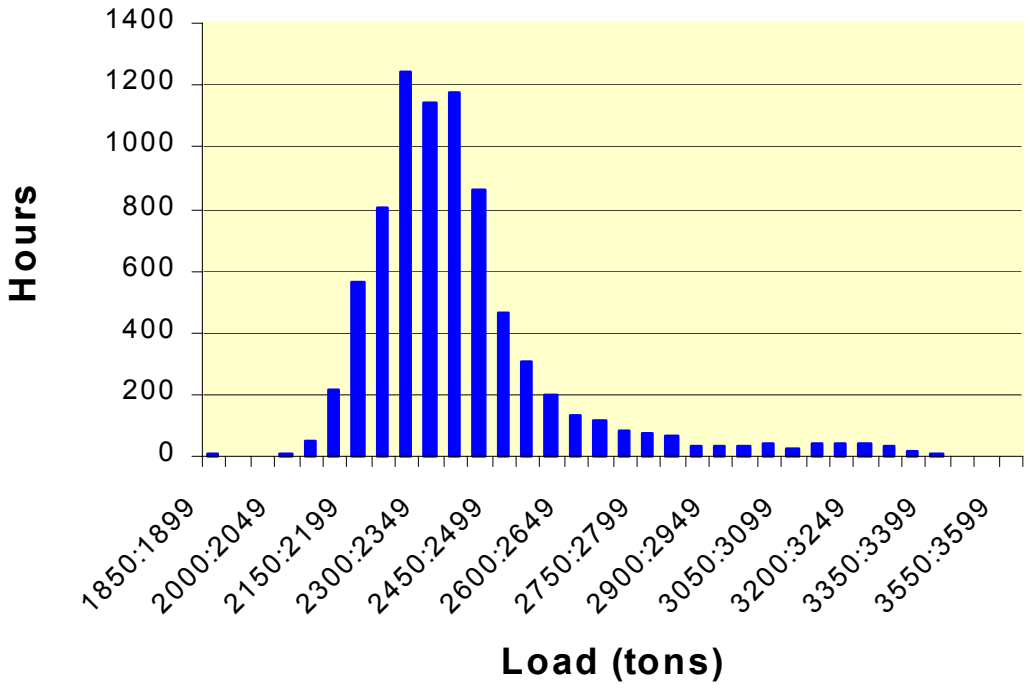
Plant Cooling Load Profile



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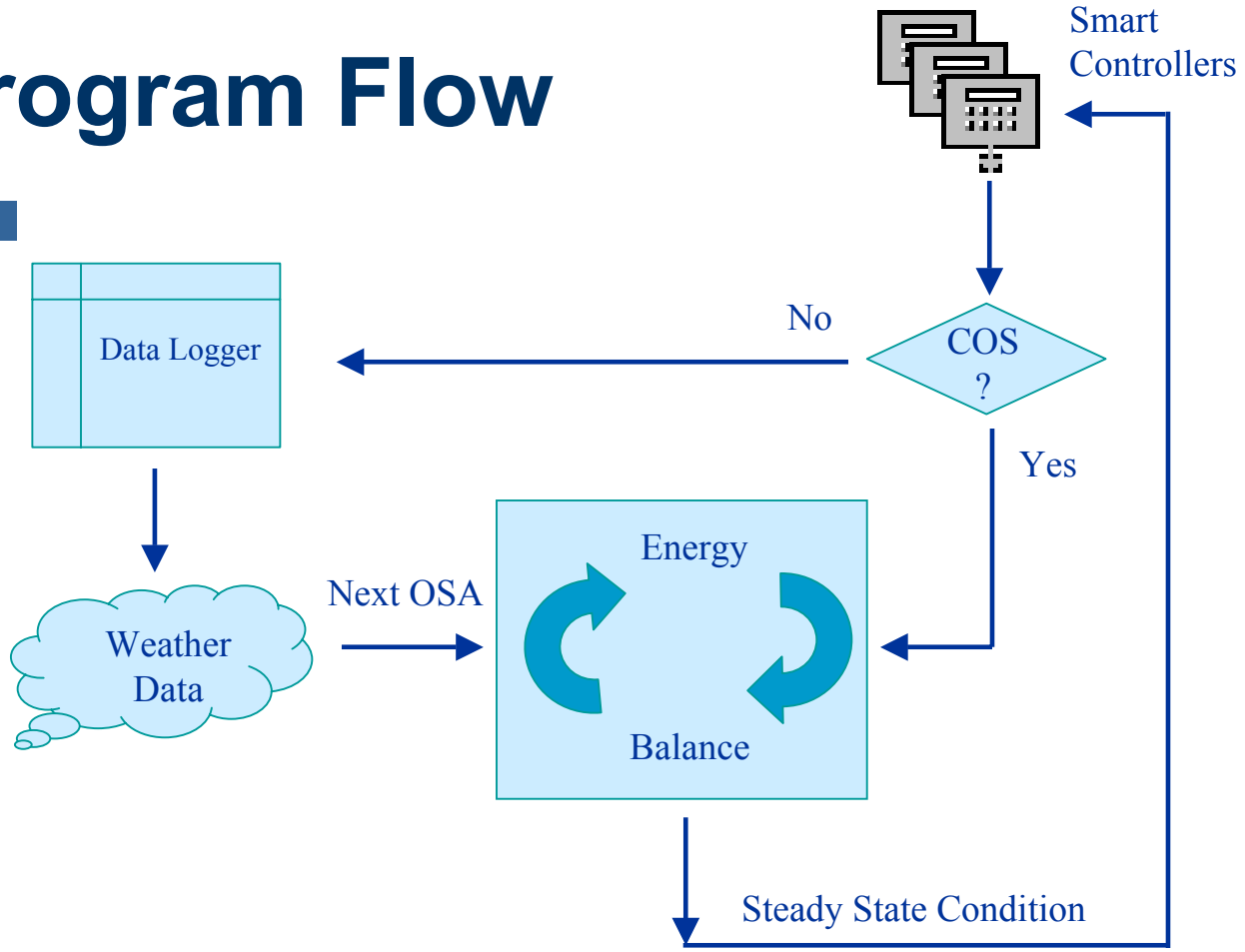
Program Flow



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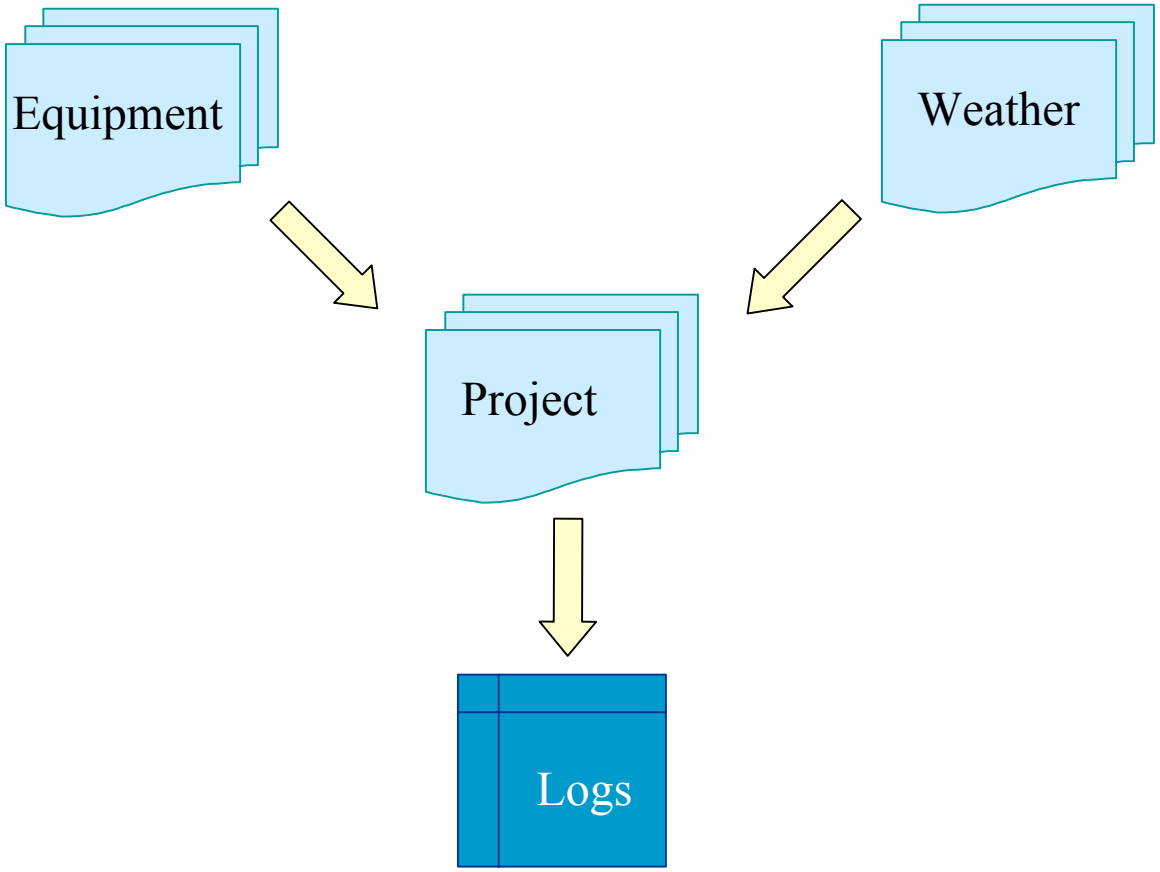
Simulation Model Structure



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Project Logs

- Temporary storage of data generated during simulation model run.
  - Log contains user selected points
    - block port properties
  - Point values logged at each simulation interval steady state condition
  - Logs may be exported to Excel.

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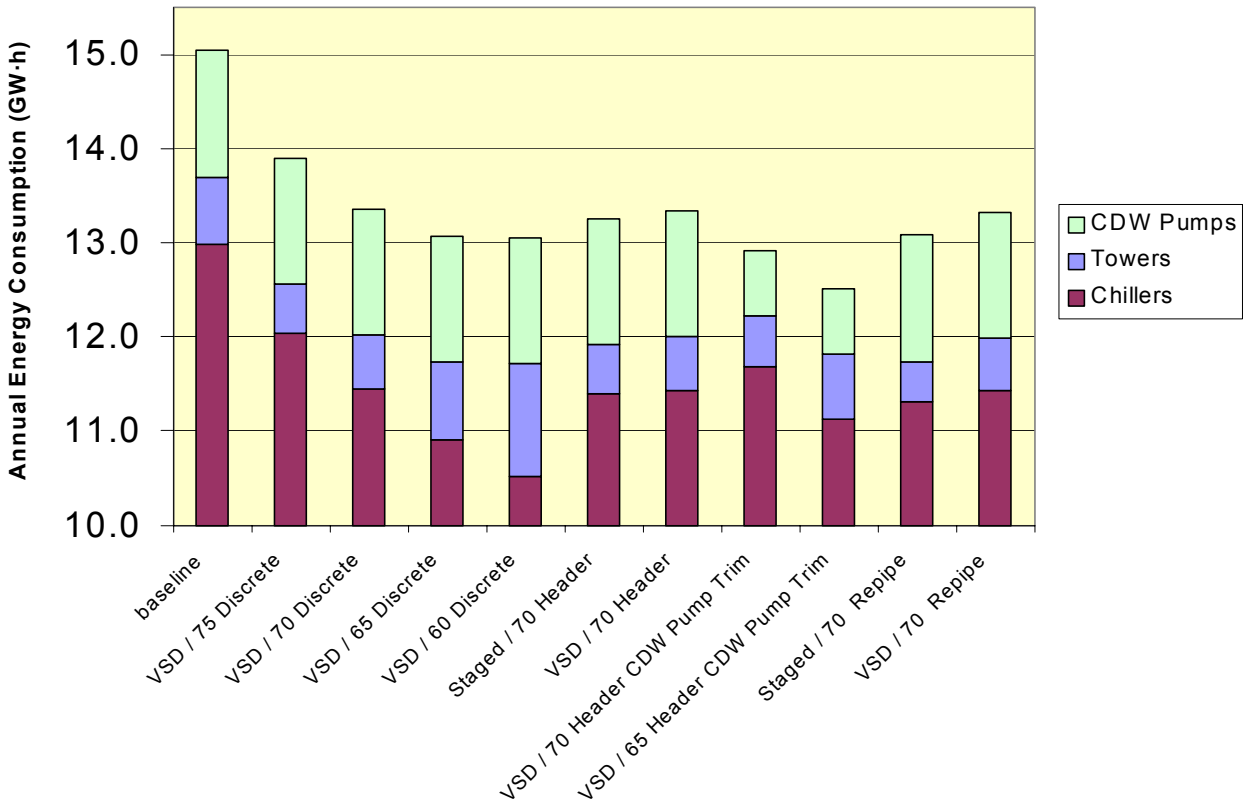
Chilled Water Plant Optimization



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Alliance

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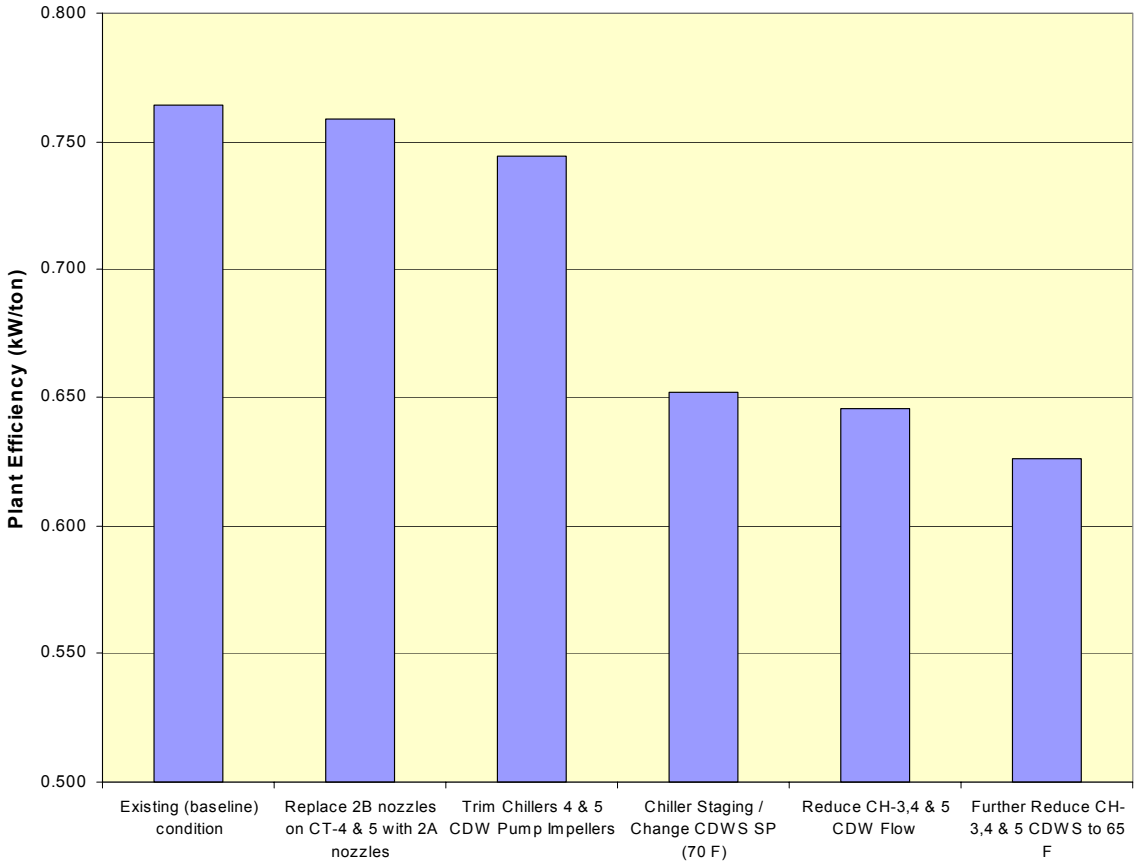
Energy Saving Measures



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Energy Saving Measures

ENERGY CONSERVATION MEASURES			Annual	Energy	Payback	Composite				Plant
	Description	Costs	Savings	KWH/yr	yrs	Costs	$ Savings	Energy	Payback	KW/ton
0	Existing (baseline) condition									0.764
1	Replace 2B nozzles on CT-4 & 5 with 2A nozzles	$7,000	$ 4,467	111,677	1.57	$7,000	$ 4,467	111,677	1.57	0.758
2	Trim Chillers 4 & 5 CDW Pump Impellers	$ 6,000	$ 11,847	296,179	0.51	$ 13,000	$ 16,314	407,856	0.80	0.744
3	Chiller Staging / Change CDWS SP (70 F)	$ 30,000	$ 78,278	1,956,959	0.38	$ 43,000	$ 94,593	2,364,815	0.45	0.652
4	Reduce CH-3,4 & 5 CDW Flow	$ 3,000	$ 5,493	137,316	0.55	$ 46,000	$ 100,085	2,502,131	0.46	0.645
5	Further Reduce CH-3,4 & 5 CDWS to 65 F	$0	$ 16,315	407,880	0	$ 46,000	$ 116,400	2,910,011	0.40	0.626
6	Repipe CT-3,4 & 5 CDWS Header	$ 51,605	$ 3,155	78,875	16.36	$ 97,605	$ 119,555	2,988,886	0.82	0.622
7	Remove Chiller 3 Lakos Separator	$ 35,500	$ 6,055	151,373	5.86	$ 133,105	$ 125,610	3,140,259	1.06	0.615

The Bottom Line

- $116,400 Annual Savings
- 5 Month Pay-back

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OPTI-CHILL Applications

- Central Plant Benchmarking
- Identification and Assessment of Energy Efficiency Opportunities
- Ongoing Validation of Process Efficiency Improvements
- Documentation of Plant Performance

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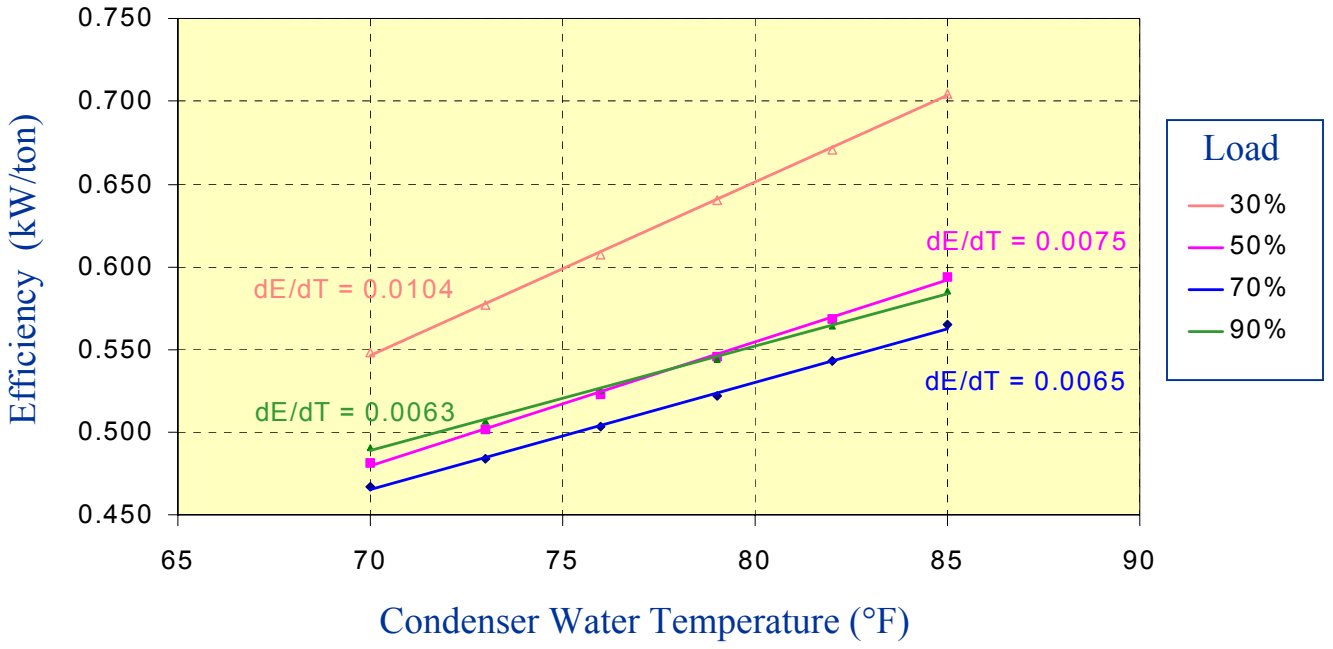
Chiller Efficiency vs. CDW Temperature



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Site Assessment

- Determine scope
- Preliminary estimate of potential savings and costs
- Establish availability of critical site data:
  - Documentation
  - Site load data
  - Instrumentation assessment

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Forecast Weather Data

- ASHRAE WYEC2 data files:
  - one-year period
  - based on a “typical” year
  - representative of long term means
- Hourly dry-bulb and dew-point temperatures.

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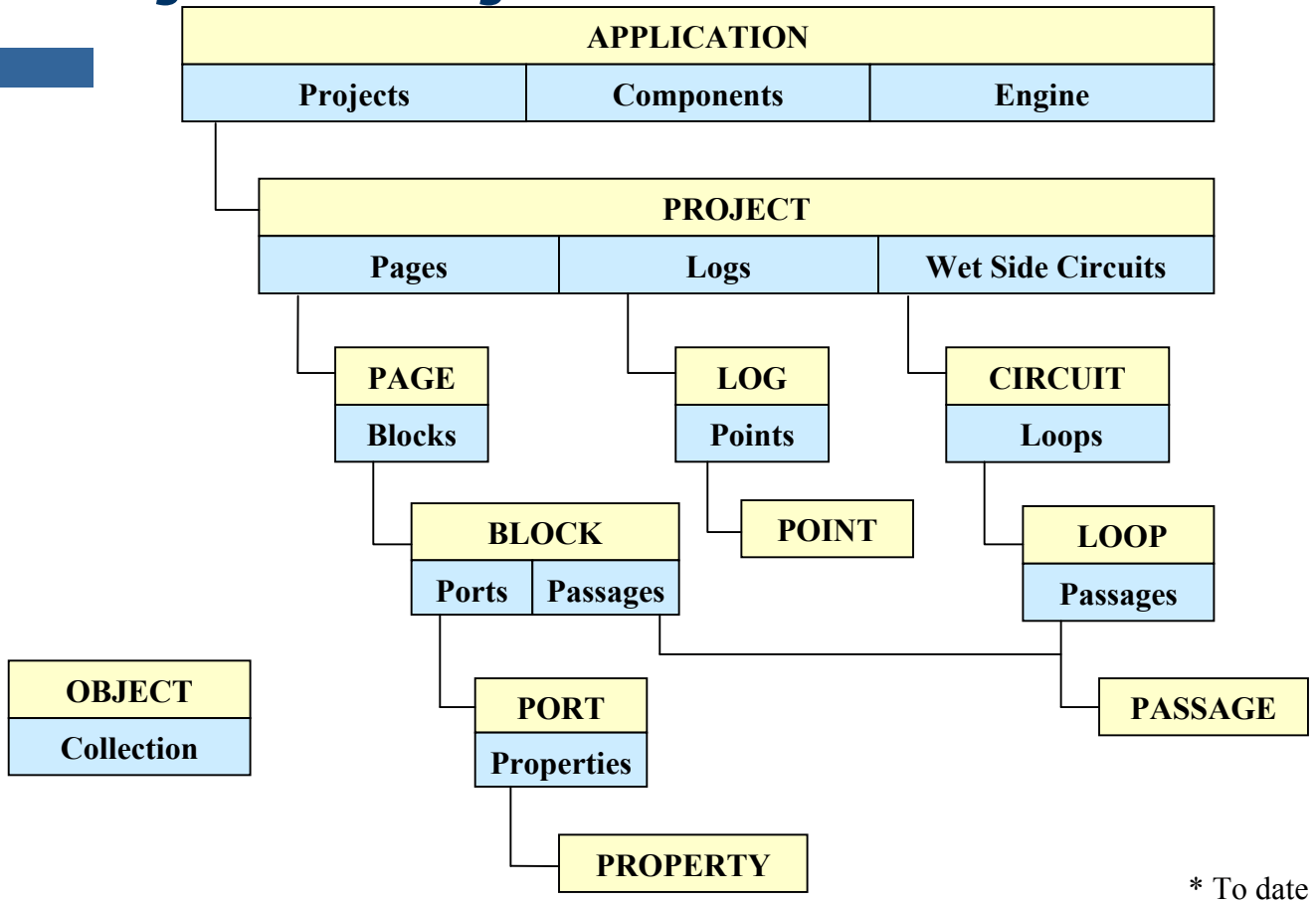
Project Object Structure*



* To date

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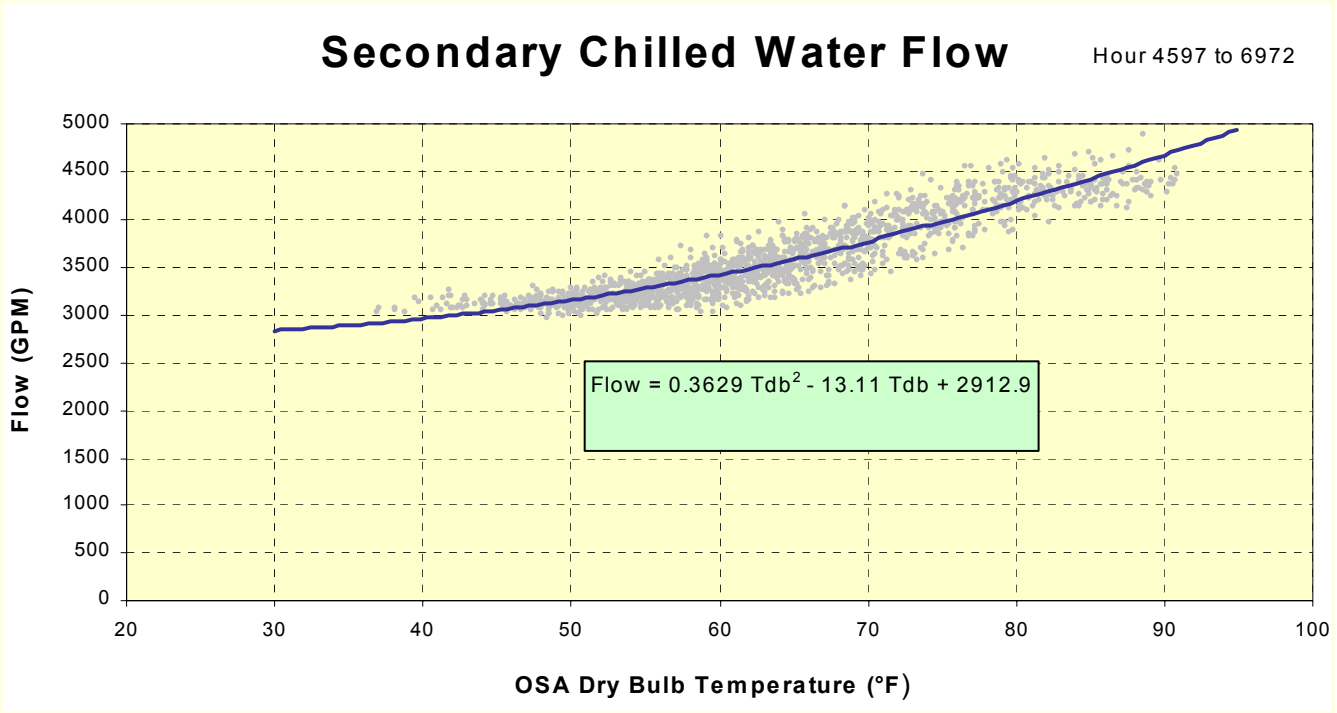
Plant Cooling Load Profile



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