

District Cooling System
Commercial Building Industry



NRG Thermal Corporation Minneapolis, Minnesota, USA Platinum Pipe Award Winner - Correlation to Test/Field Data

Among NRG Thermal's many facilities is the District Cooling System serving downtown Minneapolis, MN. Begun in 1971 as a small chilled water plant for air conditioning, it has grown into one of the country's largest with a total capacity of more than 35,000-tons (123,000 kW) and 80,000 gal/min (18,200 m³/h).

The system includes 5 plants with 18 chillers and multiple distribution loops providing for extensive sectionalizing and bypassing to help assure a 99.98% reliability of chilled water supply. The system was named the "System of the Year" in 1996 by the International District Energy Association.

"In emergencies, [AFT Fathom] allows quick evaluation of sequences and provide[s] reasonable guidance to operation personnel."

To assist in the planning, development and operation, an AFT Fathom model of the system was developed (see Figure 1). Over the years of using the AFT Fathom model, a new plant, 8 chillers and several customers have been added to the system.

Directly related to the benefits of modeling this complex system with AFT Fathom is the high level of accuracy of Fathom's predictions. By investigation, NRG determined they could simplify the modeling of the many customers (buildings) to be represented by a flow control valve. This sets model flow rates to precisely match the actual system flow rates.

To confirm the accuracy of the system model, inlet and differential pressures at 43 buildings were recorded in

15 minute periods over numerous iterations while the system was near peak demand (see Table 1).

The results? With an average inlet pressure at the 43 buildings of 132 psig (900 kPa (g)), the average difference between the actual and Fathom predicted pressures was 2.3 psi (16 kPa), or less than a 2% difference.

NRG Engineering Manager, Slava Prash describes several advantages of using AFT Fathom to model the District Cooling System:

- Very instrumental for planning system development and growth
- Allows evaluating of capacity to be transferred through branches of the manifold for scheduled maintenance or emergency shutdowns and predicts limitations to individual customer loads during such periods
- Ideal optimization tool for planning system lineup for efficient load distribution between cooling plants. Particularly important as some of the plants do not have permanent staff so use of manpower can be optimized as well
- In emergencies, allows quick evaluation of scenarios and provides guidance to operating personnel

NRG is the leading integrated power company in the U.S., built on the strength of the nation's largest and most diverse competitive electric generation portfolio and leading retail electricity platform. A Fortune 200 company, NRG creates value through best in class operations, reliable and efficient electric generation, and a retail platform serving residential and commercial businesses. Working with electricity customers, large and small, NRG continually innovates, embraces and implements sustainable solutions for producing and managing energy.

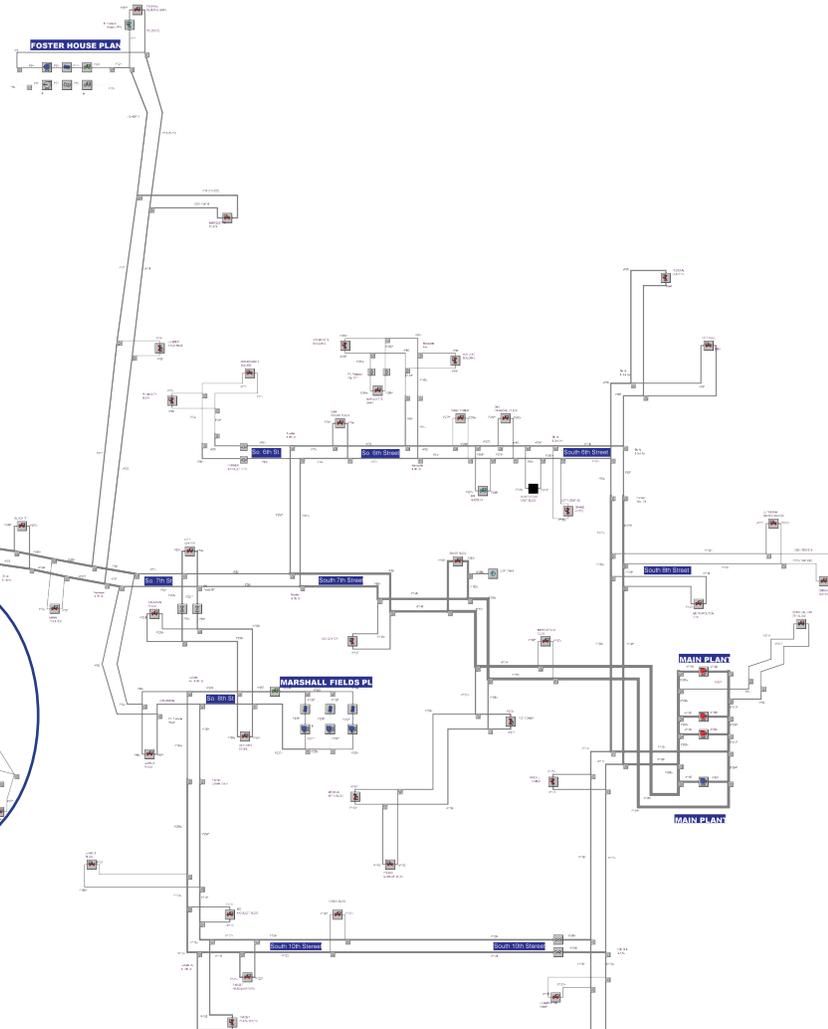
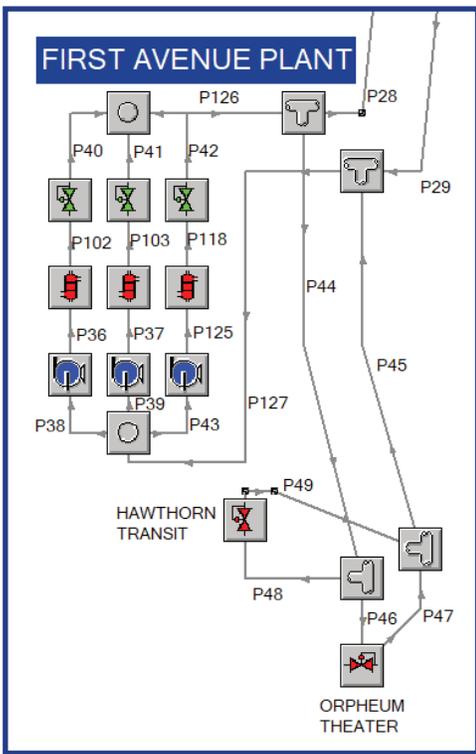


Figure 1 - Minneapolis District Cooling System AFT Fathom model

Inset - detailed view of one of the several chilled water plants and two of the chilled water customers.

Junction	Name	Actual 15-min Average Rounded Readings (standard operations gages/meters)		AFT Fathom Model Output	
		P Inlet psig (kPag)	dP psid (kPa)	P Inlet psig (kPag)	dP psid (kPa)
1	Northstart East Bldg	126 (869)	10 (170)	128 (883)	9.7 (168)
202	Federal Reserve Bank	133 (917)	14 (198)	134 (924)	15 (205)
203	Marquette Plaza	130 (896)	17 (218)	133 (917)	18 (225)
275	Federal Courts	132 (910)	20 (239)	135 (931)	22 (253)
276	City Hall	130 (896)	22 (253)	135 (931)	22 (253)
281	Rand Tower	125 (862)	9 (163)	125 (862)	9.4 (166)
284	510 Marquette Building	126 (869)	7 (150)	125 (862)	6.4 (145)
292	Mann Theater	139 (958)	30 (308)	137 (945)	32 (322)
294	City Center	132 (910)	17 (218)	132 (910)	17 (218)
296	Baker Bldg	146 (1,007)	35 (343)	146 (1,007)	37 (356)
298	Minneapolis Club	138 (951)	38 (363)	140 (965)	40 (377)
301	Craig Hallum [701 Bldg]	149 (1,027)	55 (480)	147 (1,014)	52 (460)
302	Metropolitan Ctr	135 (931)	35 (343)	138 (951)	34 (336)
304	TCF Tower	139 (958)	37 (356)	137 (945)	35 (343)
305	Dayton's Store	134 (924)	18 (225)	133 (917)	17 (218)
310	Orpheum Theater	135 (931)	29 (301)	140 (965)	32 (322)
312	Medical Arts Bldg	138 (951)	32 (322)	136 (938)	31 (315)
313	Young Quinlan Bldg	136 (938)	31 (315)	135 (931)	31 (315)
319	Target Plaza South	129 (889)	13 (191)	129 (889)	13 (191)
322	600 Quebeck	128 (883)	10 (170)	129 (889)	9.7 (168)

Table 1 - A portion of the operating data gathered from the District Cooling System and comparative AFT Fathom predicted values