Nuclear Power Station Service Water Pump NPSH Hydraulic Model Benchmarked Using AFT Fathom™

CASE STUDY

Service Water System
Nuclear Power Industry

Duke Energy
Charlotte, North Carolina, USA
Platinum Pipe Award Winner - Correlation to Test/Field Data

Nuclear Service Water (RN) systems circulate the water that cools the plant's heat exchangers and other components before dissipating the heat into the environment. Because this is a safety-critical system, it is essential to accurately understand how the system works under varying operating conditions, and under Design Basis Accident (DBA) Conditions.

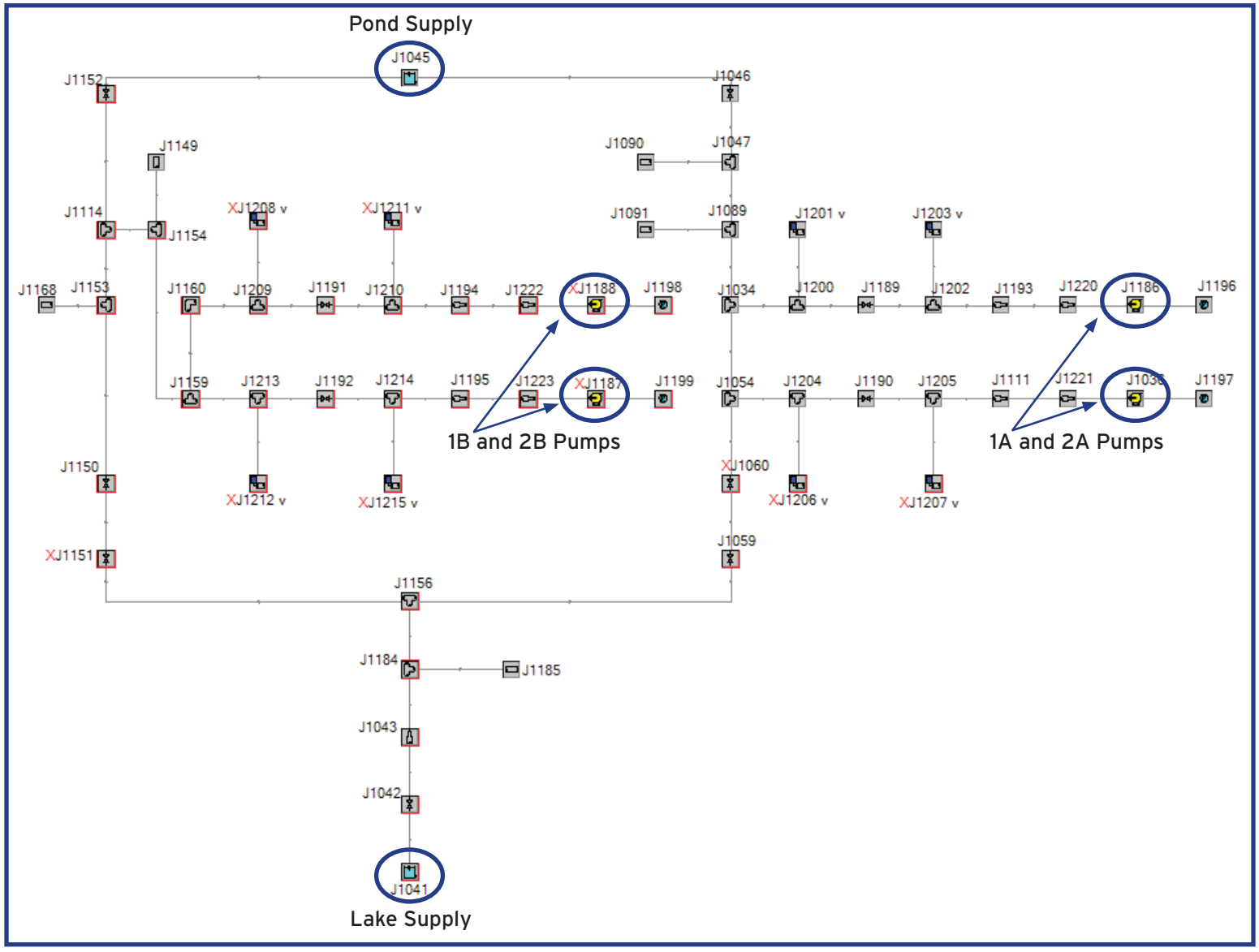
According to Norman Stambaugh, Senior Engineer at Duke Energy, to assure that the RN system can adequately perform its safety function, it must be demonstrated that the RN pump NPSHr can be met under DBA conditions. Over the years, corrosion in the RN pump suction piping has occurred, thus reducing the NPSHa. To analyze this degradation, an AFT Fathom model of the RN pump suction piping was developed and benchmarked. This model not only accounts for the details relating to the piping configuration, but also for the details relating to the roughness and constriction of the piping due to the build-up of corrosion over time. It also provides the ability to input most limiting conditions, such as maximum temperatures and minimum levels for the lake and pond supplies, as well as various amounts of assumed RN strainer fouling.

> "The roughness and scaling factors were... slightly adjusted to obtain a very accurate benchmark to actual test data (0.1 to 0.2 psig)."

Using AFT Fathom, Duke Energy was able to benchmark corroded pipe performance, and accurately model the potential pressure recovery after cleaning the pipes.

McGuire Nuclear Power Station

Duke Energy is one of the largest electric power holding companies in the United States, providing electricity to 7.6 million retail customers in six states. They have approximately 49,500 megawatts of electric generating capacity and natural gas distribution services serving more than 1.6 million customers. Their commercial business owns and operates diverse power generation assets in North America, including a portfolio of renewable energy assets. They are transforming our customers' experience, modernizing our energy grid, generating cleaner energy and expanding our natural gas infrastructure to create a smarter energy future for our customers.



McGuire Nuclear Station RN pump NPSH hydraulic model

Scenario	1A RN Pump Suction Pressure			2A RN Pump Suction Pressure			1B RN Pump Suction Pressure			1B RN Pump Suction Pressure		
	Model Results	Test Results	Delta	Model Results	Test Results	Delta	Model Results	Test Results	Delta	Model Results	Test Results	Delta
BI (all Trains)	-4.06 psig (-0.28 barG)	-3.93 psig (-0.27 barG)	-0.13 psig (-0.01 barG)	-4.57 psig (-0.32 barG)	-5.01 psig (-0.35 barG)	**0.44** psig (0.03 barG)	-3.90 psig (-0.27 barG)	-5.80 psig (-0.40 barG)	**1.90** psig (0.13 barG)	-5.09 psig (-0.35 barG)	-4.27 psig (-0.29 barG)	-0.82 psig (-0.06 barG)
B2 (1A Train)	4.28 psig (0.30 barG)	4.27 psig (0.29 barG)	0.01 psig (6.89 barG)	9.58 psig (0.66 barG)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B3 (1B Train)	N/A	N/A	N/A	N/A	N/A	N/A	-1.50 psig (-0.10 barG)	-1.84 psig (-0.13 barG)	0.34 psig (0.02 barG)	1.61 psig (0.11 barG)	N/A	N/A

Comparison of AFT Fathom model results to test results at McGuire Pump