Refinery Fire Water System Assessment Improves Plant Safety

Comprehensive Hydraulic Capability Study

The Challenge: A U.S. oil refinery experienced a fire which exposed deficient flow and pressure in its fire water distribution system. The vast refinery needed to identify an efficient method of verifying the hydraulic capability of the system and any improvements necessary to ensure the facility's safety. And, it needed to accomplish this without interrupting normal operations.

The Solution: Flowserve accepted the challenge, performing a thorough hydraulic capability study of the plant's fire water distribution system. This included creating a comprehensive hydraulic model of the entire fire water system and gathering field data via wireless technology to validate actual system performance.

After utilizing the validated hydraulic model to analyze several "what-if" scenarios, Flowserve recommended the refinery replace its six existing fire water pumps with three high-capacity vertical units. Flowserve also recommended increasing the diameter of the header pipe around the refinery perimeter. The recommendations were validated by the model, which gave the refinery confirmation that the upgrades would achieve the intended system improvements. The estimated $9.5 million capital project will be completed in phases over the next few years.

An East Coast oil refinery which produces 75 000 bbl/day needed to address concerns expressed by its insurance underwriters regarding the adequacy of the plant's fire water distribution system, despite its compliance with NFPA regulatory codes. The concerns arose after a fire at the facility revealed insufficient flow and pressure in some parts of the system. By working in concert with Flowserve, the refinery confirmed the hydraulic capability of the system was deficient and identified modifications to address the safety concerns of the underwriters.

Hydraulic testing of a hydrant using a Pollard diffuser equipped with a wireless transmitter

The Assessment:

Because the refinery is spread over five square miles, obtaining the topographical measurements and hydraulic data needed to develop an accurate model was a daunting task. Flowserve engineers turned to wireless technology to overcome the challenge. They used hand-held GPS units to map the layout of the system, including hydrant locations and piping runs. NFPA approved Pollard diffusers equipped with omni-directional wireless transmitters were used to log flow and pressure from more than 40 hydrants and pumps within the system. Additionally, wireless sensors recorded pump vibration and bearing temperature data. All of this was accomplished without interrupting normal operations.

Flowserve engineers created an accurate hydraulic model of the plant's fire water distribution system, with over 1800 data points representing pumps, pipe segments and junctions. The accuracy of the model was validated using actual field data collected during the three days of testing. They used the model to analyze the hydraulics of the existing system and to run "what-if" simulations, based on a variety of options which were evaluated against refinery logistics and economic factors.

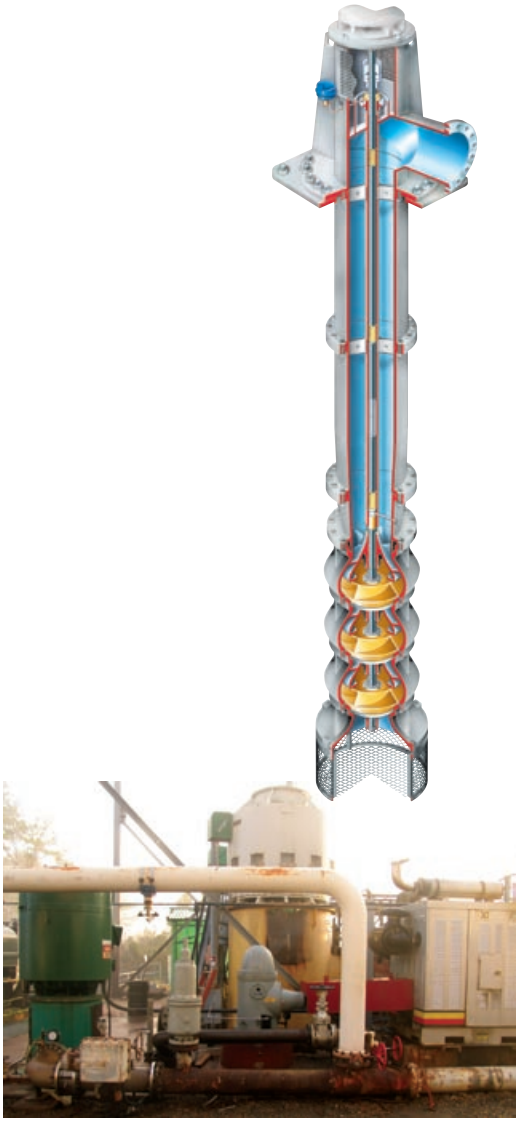
Findings and Recommendations:

After reviewing data from the model, Flowserve determined severe pressure drops and low residual pressure were negatively impacting the performance of the existing system.

Flowserve recommended the refinery add three additional vertical booster pumps to the fire water distribution system: two vertical turbine pumps with diesel drives and one vertical turbine pump with a variable frequency drive. The latter will also serve as a backup pump for the cooling water system for the refinery. The three pumps will deliver water from the nearby bay at flows of 3400 m^3/h (15 000 gpm) and heads to 107 m (352 ft).

Flowserve also recommended the header pipe diameter be increased from 254 mm (10 in) to 610 mm (24 in) and that the piping be extended around the entire perimeter of the facility. The new perimeter piping will provide source water for the complete facility, eliminating dead end runs and minimizing pressure drops within the fire water distribution system.

Section of existing header piping to be upgraded to larger diameter



Existing vertical fire pump

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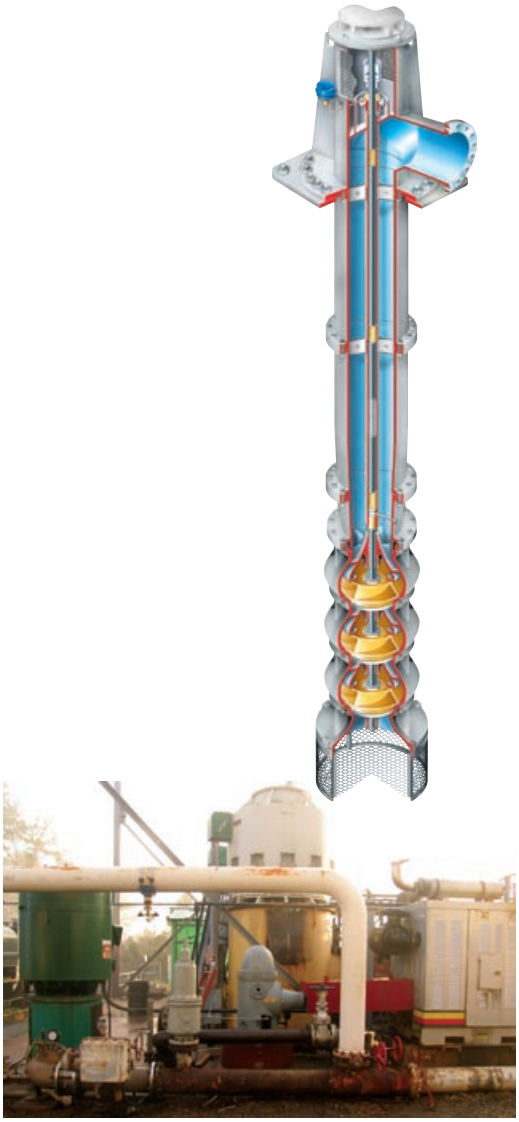

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