Dominion Power

AN *INNOVAS TECHNOLOGIES*® CASE STUDY

Dominion Power, one of the largest producers and transporters of energy in the United States relies on Innovas Technologies, and the Helios Tube Cleaning System® to improve reliability and tube cleaning effectiveness.

Introduction

Upgrading existing tube cleaning systems to improve reliability.

Dominion Power is one of the United States' largest producers and transporters of energy, with a portfolio of approximately 25,700 megawatts of generation and 6,500 miles of electric transmission lines. Dominion serves more than 5 million utility and retail energy customers in 14 states.

Dominion's Mount Storm Power Station is the largest coal-fired power station managed by Dominion Resources. Its 3 units can generate nearly 1,600 megawatts of electricity – as much in one hour as 160 average homes use in one year.

Despite excellent operating processes, during the summer months Mt. Storm's turbines can lose 2-4% of output capacity (20-40 MW) due to condenser tube fouling.

Dominion expressed interest in evaluating possible replacements or upgrades to existing tube cleaning systems in order to recover this lost power generation capacity.

In 2015, Dominion contracted Innovas Technologies to provide optimized performance over a competitor's existing automatic tube cleaning system.

The focus was on Mt Storm's Unit 3B Condenser, and to expand the tube cleaning system from treating one condenser to two condensers.

The existing competitor's ball trap had demonstrated exceptionally high operating pressure drop and a propensity to pin sponge cleaning balls inside it.

Goals

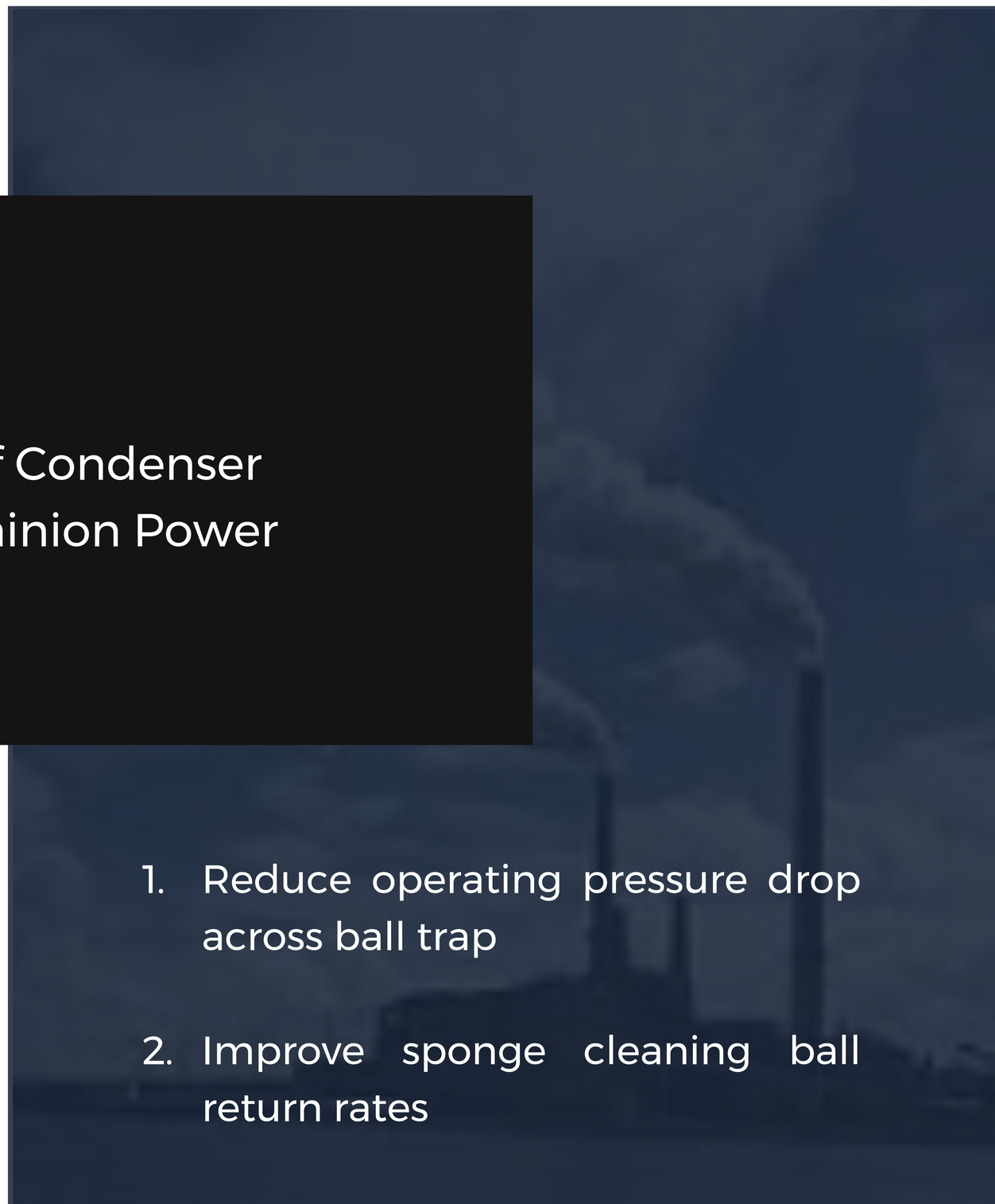
For the project, Innovas Technologies employed “Best Practice” engineering techniques to develop custom ball trap designs and completed performance testing on a 1/6 scale model of the competitor’s 36” ball trap and custom Innovas ball trap designs.

Innovas then performed detailed design and fabrication of two 36” diameter ball traps utilizing the optimal ball trap configuration.

Additionally, Innovas designed and fabricated the necessary piping and PLC digital control systems to expand the tube cleaning system to provide tube fouling prevention for two condensers.

Custom Design & Fabrication

Custom Design & Fabrication of Condenser Tube Cleaning System for Dominion Power



1. Reduce operating pressure drop across ball trap

2. Improve sponge cleaning ball return rates

3. Reduce overall physical footprint of the ball trap

4. Expand the automatic tube cleaning system capability to treat two condensers rather than one

5. Demonstrate reliable & effective tube cleaning system performance for further deployment

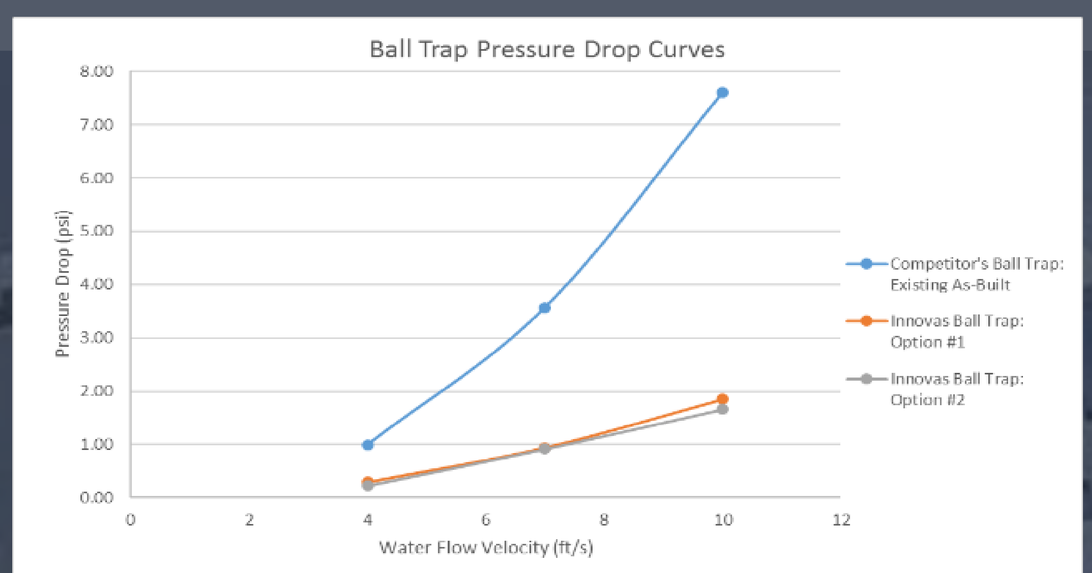
As an essential element of design validation, hydraulic modeling and testing was conducted at the University of Iowa Hydraulic Laboratory (IIHR) in Iowa City, IA, and was supported by IIHR hydraulic engineers and fabrication shop technicians.

Hydraulic Modeling, Testing and Optimization

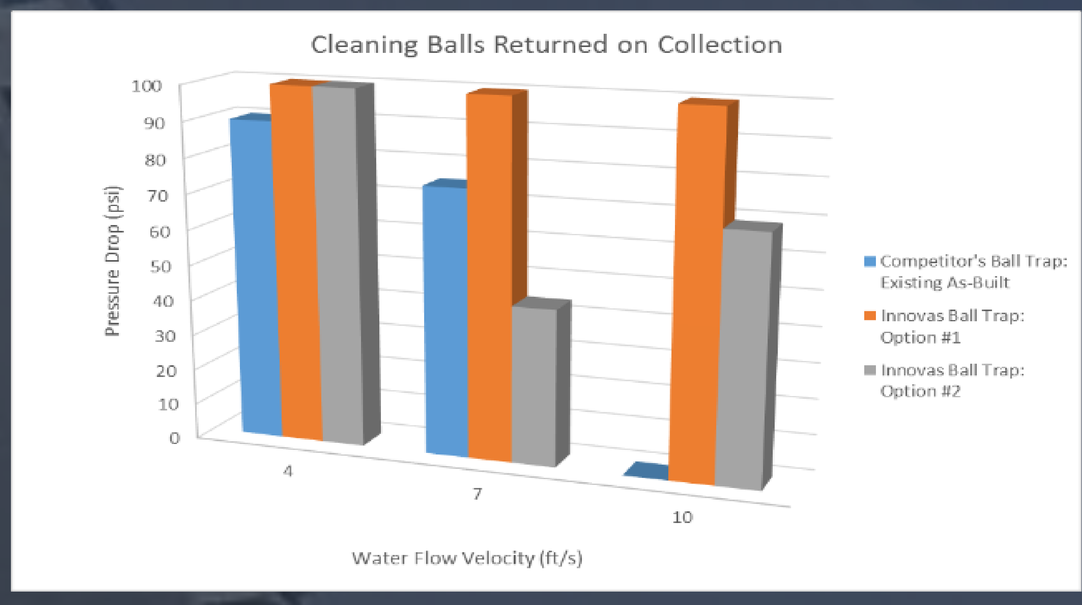
Innovas successfully recreated the field performance of the competitor's existing ball trap, both in terms of clean ball trap pressure drop and in ball return rates. Innovas was also successful in designing a ball trap alternative that provides vastly superior performance in both the clean ball trap pressure drop and ball return rate parameters, as demonstrated in the following charts.

The competitor's existing as-built ball trap exhibited the highest clean ball trap pressure drop at all three fluid velocities. At higher fluid velocity (~10 ft/s) the clean ball trap pressure drop became excessive (>7.5 psi) and would negatively impact cooling water pumping system performance.

The 6" pipe test apparatus at *the* hydraulic lab.



Innovas Ball Traps Demonstrated Significantly Improved Pressure Drop



Innovas Ball Traps Demonstrated Superior Cleaning Ball Return Rates.

The existing as-built design also pinned significant numbers of cleaning balls in several areas, which caused the pressure drop across the ball trap to further increase.

The Innovas **Option 1** ball trap design exhibited good clean ball trap pressure drop across the full range of fluid velocities, with pressure losses lower than published pressure drops for typical industrial y-strainers.

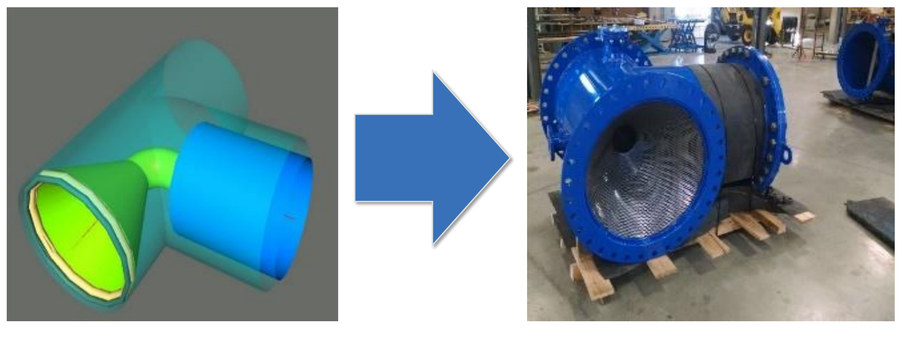
The Option 1 design also returned all cleaning balls on collection, with no pinning across the fluid velocity range.

Innovas Develops Custom Design Options for Testing

The Innovas **Option 2** ball trap design exhibited the lowest clean ball trap pressure drop at all three fluid velocities. However, the Option 2 design also demonstrated the lowest rate of cleaning balls return on collection, with cleaning balls pinning at both the 7 ft/s and 10 ft/s fluid velocities.

With excellent test results in hand, Innovas initiated detailed design of the Option 1 ball trap in the full-scale 36" diameter version for Mt. Storm power station.

Custom Design and Fabrication of 36" Nominal Diameter Ball Traps



Innovas equipment is manufactured in a state-of-the art fabrication facility.

The Innovas Option 1 design demonstrated superior performance in terms of pressure drop and cleaning ball retention and return rates, and did so in a more compact physical package.

Innovas initiated detailed design utilizing 3D CAD tools to turn the test concept into full-size production equipment.

Fabrication of the ball traps and equipment was performed

by ASME certified welders and subjected to verification in accordance with the ASME B31.1 Power Piping Code and Innovas' ISO9001 Certified Quality Management System.

The fabrication of ball traps and associated equipment, including internal and external anti-corrosion coatings, was completed in six weeks and the equipment was shipped ahead of schedule.

Installation & Operation

The installation configuration of the existing condensers required that the two 36" ball traps be installed in a very tight location, with a concrete mezzanine overhead and butterfly valve for isolation immediately downstream of the traps.

By all accounts the installation and fit-up process for Innovas-provided equipment was smooth and straightforward due to precise fabrication tolerances and quality control.

Installed Innovas Ball Trap

Innovas commissioned the tube cleaning systems and field results matched precisely with the hydraulic laboratory performance results.

All cleaning balls were returned without pinning, and a pressure drop of well under 1 psi was measured across the ball traps.

Innovas Ball Traps Ready for Shipping

Innovas vs. Competition

The advantages of the Innovas ball trap design is immediate.

The competitor's old ball trap was inspected in the site's equipment graveyard after removal. Even in a quick visual inspection of the traps the advantages of the Innovas ball trap design are readily apparent.

In the competitor's ball trap extensive areas of the main pipeline were blocked off with solid plates in order to get the cleaning balls routed to the ball exit. The Innovas design achieves perfect ball return rates without occluding the open area for flow in the main pipeline.

Competitor's Ball Trap After Removal

Competitor's Trap Entrance

Innovas Trap Entrance

The Path Forward

The optimized condenser tube cleaning system has been well received at the Mt. Storm facility, with excellent reliability and system performance.

The next level of performance achievement will require use of Innovas' patent-pending design in retrofitting the site's 108" and 120" nominal diameter condenser piping systems to improve power generation output.

The Helios® Cleaning Cycle

The Helios cycle is fully automatic and controlled by a programmable controller.

1. Between cycles, the sponge balls are stored in the Collector and all valves are closed.
2. At programmed intervals, the Controller commands the injection valves to open and pump to start, and the balls are injected into the heat exchanger inlet line.
3. Normal cooling water flow transports the balls through the heat exchanger tubes and into the Ball Trap.
4. The Controller then prompts the collection valves to open and pump to start, and the balls are returned to the Collector, where they are held until the next injection/collection cycle starts.

View the Helios TCS Operation in action at innovastechnologies.com

Prevents scale.

Prevents scale, fouling, biological life and corrosion in heat exchanger tubes.

Reduces maintenance costs.

Reduces maintenance and downtime costs by eliminating manual or chemical tube cleaning.

Extends service life.

Extends the service life of heat transfer equipment.

The Helios Tube Cleaning System®

The Helios Tube Cleaning System® from Innovas improves the energy efficiency of cooling systems.

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See Helios in Action.