Special Applications Series

Heat Rate Awareness

Minimizing Controllable Losses Through Effective Feedwater Heater Level Control

In today's challenging economic and regulatory environment, increasing the efficiency of your power plant is a mission-critical requirement. Taking control of your heat rate can help you use energy more efficiently, minimize fuel costs and boost your bottom line.

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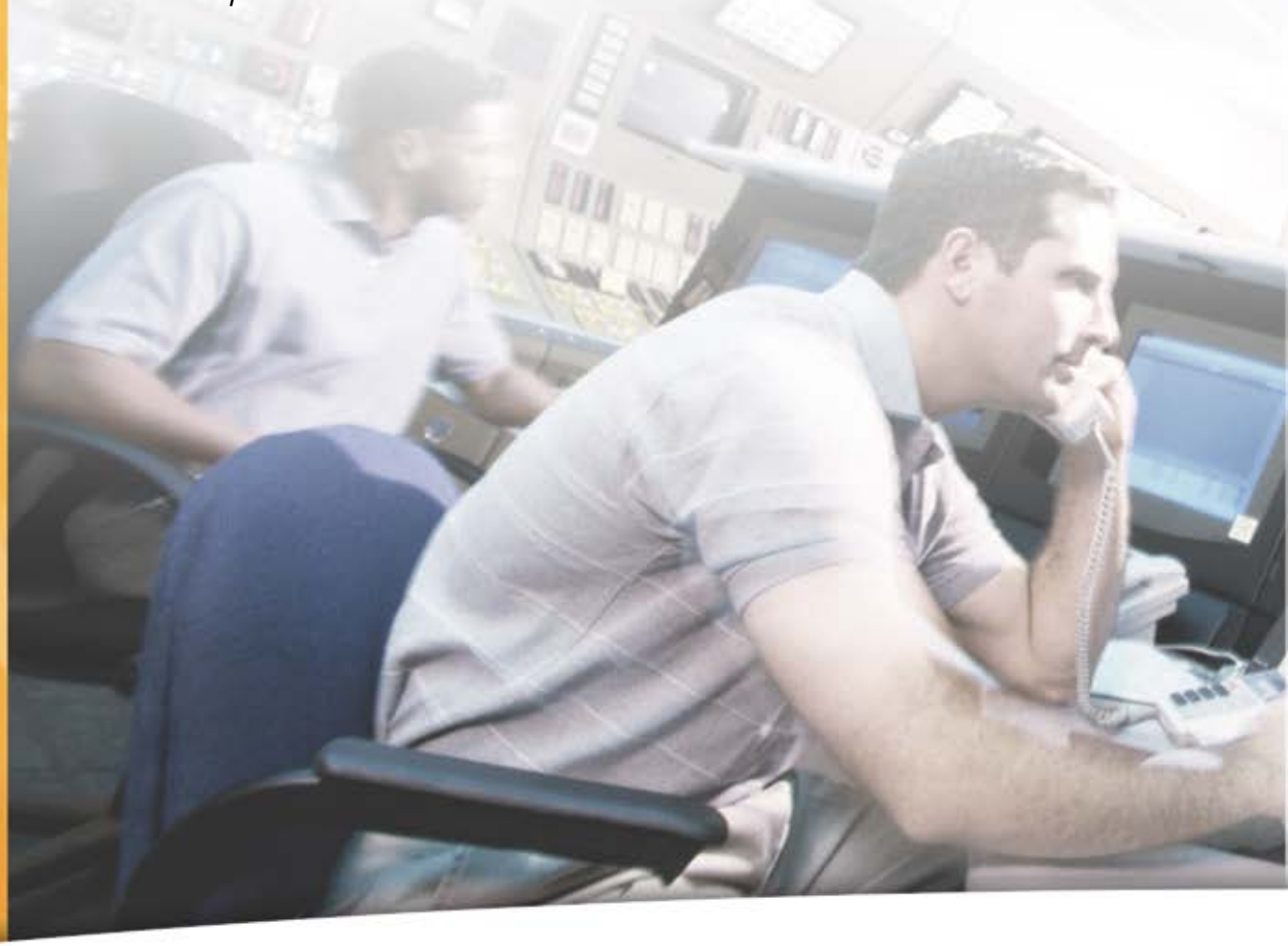
The Heat Rate Imperative

Today's business climate creates numerous challenges for power companies. The Clean Air Act and new climate change protocols have put power plants under increased government regulation. The need to comply with these changing standards while also generating sufficient revenue has made heat rate a key performance indicator for all power plants. Before you can correlate any heat rate technology to a return on investment, you must first understand heat rate, its value to your business and the impact that improved heat rate can provide.

Improving heat rate 1% can generate $500,000 in annual savings for a 500 megawatt power plant*

Fuel Consumes 70%-80% of Production Cost

For most power plant operators, fuel expenditures account for 70% to 80% of production costs. As a plant ages, it becomes even less efficient. To contain fuel costs, operators must maximize the efficiency of their power plants. That's why many companies are now focusing on reducing heat rate as a way to decrease fuel use – and deliver bottom-line results.

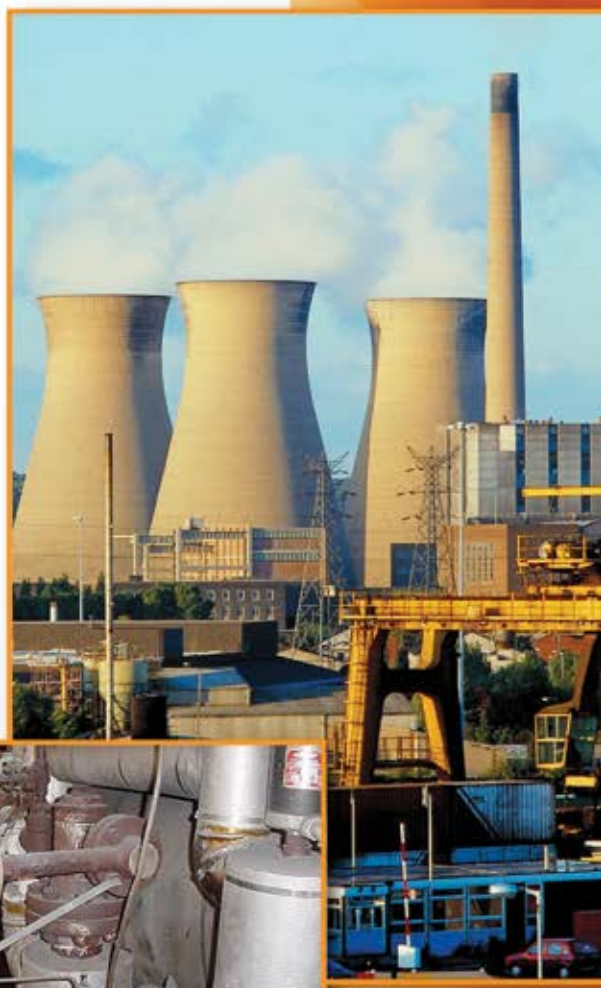


* A 1% improvement in heat rate is worth $500,000 in annual fuel cost savings based on: Fuel cost of $1.25/million Btu, Capacity factor of 85% and Boiler efficiency of 88%.

Causes of Heat Rate Inefficiency and Fuel Cost Acceleration

Most power plants have a life expectancy of 30-40 years with many at or reaching their operational longevity. In addition, these plants often use outdated level technologies that cannot achieve a performance level sufficient to manage controllable losses due to instrument-induced errors:

- **Mechanical or electronic drift due to aging instrumentation, moving parts or intrinsic design.** Torque tube/displacer technology requires calibration between shutdowns to achieve reasonable accuracy and prevent nuisance deviation alarms between multiple level transmitters. In addition, this technology may take too long to respond to rapid level changes due to dampening effects that are fundamental to its principle of operation.
- **Measurement technology that is vulnerable to process conditions.** Shifts in specific gravity and the dielectric constant of media related to variations in process pressure and temperature affect the accuracy of Differential Pressure, Magnetostrictive, RF Capacitance and Torque Tube/Displacer technologies. As a result, these technologies cannot provide accurate level from startup to operational temperatures without applying external correction factors – or can only deliver the specified accuracy at operational temperatures. To compound the issue, calibrations performed on these technologies during a shutdown often require adjustment when the process reaches operating temperature to maintain acceptable control and prevent unnecessary deviation alarms.



Aging level instrumentation combined with instrument-induced errors negatively impacts heat rate and fuel costs.

Effectively Measuring and Controlling Heat Rate at Your Facility

Reducing heat rate drives overall plant performance – and fuel cost savings.

The basic power cycle for a typical steam plant begins at the condenser, where condensed steam from the feedwater heater drains and LP Turbine is routed through each successive stage of feedwater heaters. At the same time, extraction steam from your turbines reaches the appropriate feedwater heaters and the transfer of energy takes place. Maintaining accurate and reliable level controls throughout this cycle is critical to achieve the final feedwater heater temperature that your process requires.

To run your plant at 100% efficiency, the heat rate would need to be 3,412 Btu/kWh. Although this target is not a practical expectation, it is important to note that any increase in heat rate will amplify the amount of fuel needed to generate a given number of kWh of energy.

Cost of Heat Rate Deviation

Even a minor deviation from the target rate can cause a substantial change in the annual fuel cost for your plant. To illustrate this point, let's calculate the increase in annual fuel cost for a plant with a target heat rate of 12,000 Btu/kWh and an actual heat rate of 12,011 Btu/kWh. We will use the following equation and assumptions to calculate the impact of a 1 Btu/kWh deviation.

Cost of Heat Rate for a 1 Btu/kWh Deviation

Change in annual fuel cost ($/year): HRD/BE * FC * CF * UGC * T

- HRD: Heat rate deviation (net unit or turbine cycle)
- BE: Boiler Efficiency = 0.88
- FC: Fuel Cost/1,000,000 Btu = 2.011
- CF: Unit Capacity Factor = 0.85
- UGC: Unit Gross Capacity = 500,000 kW
- T: 8,760 hours/year

Annual Fuel Cost:

(1 Btu/kWh ÷ 0.88)(2.01 ÷ 1,000,000)(0.85)(500,000)(8,760) =
$8,503.64/year for a 1Btu/kWh heat rate deviation.

($8,503.64)(11 heat rate deviation) = **$93,540 increase in annual fuel cost.**

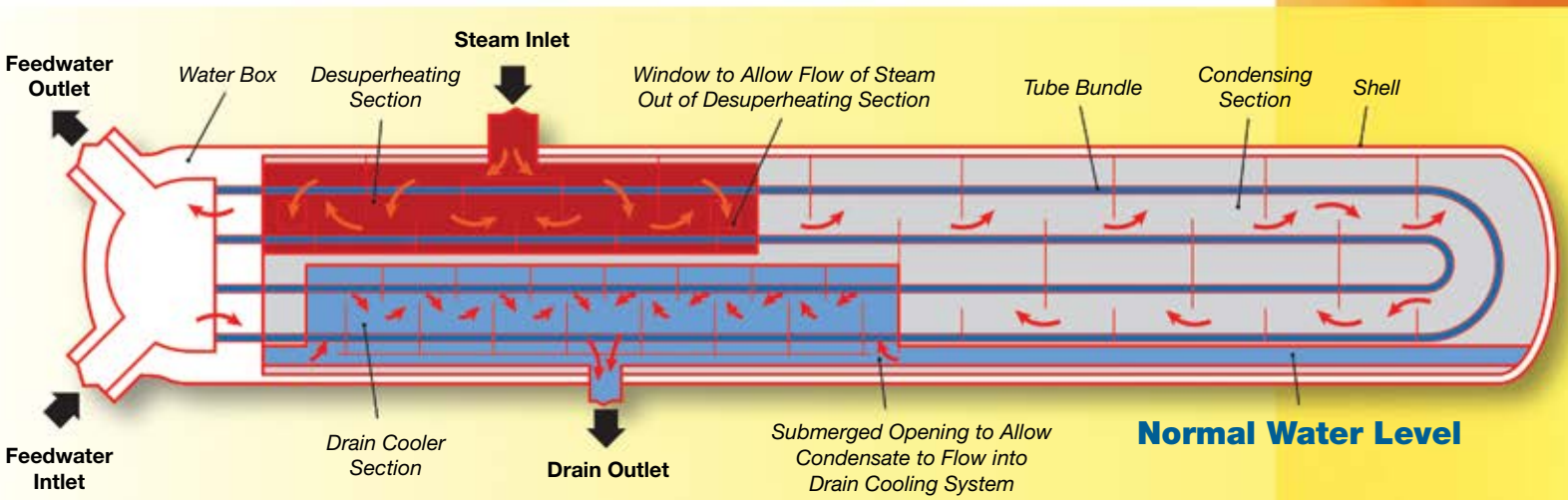
To avoid this unnecessary expense, many companies are now leveraging newer level control technologies to reduce heat rate deviations and fuel costs.

Better Feedwater Heater Level Control Generates Greater Benefits

Maintaining optimum water level is a critical component of maximizing energy transfer and minimizing controllable losses.

Optimizing feedwater heater level control is an effective way to easily improve efficiency (heat rate) and reduce fuel costs. However, a basic familiarity with feedwater operation is critical to understanding how level control can impact your plant.

Feedwater heaters use the heat of condensation to preheat water to the correct temperature for the boiler. During this process, shell and tube heat exchangers allow feedwater to pass through the tube side and extract steam from the turbine to the shell side. The primary benefit of this process is that the feedwater heater decreases the fuel costs by using recovered energy – rather than costly hot gas – to heat the water.



Feedwater Heater Level Control

There are normally six to seven stages of feedwater heating. However, at an approximate capital cost of $1.2 million per feedwater heater, you must achieve optimum heat transfer and improve terminal temperature difference to receive an acceptable long-term return on investment.

With guided wave radar, you can optimize the condensing zone of your feedwater heaters to deliver accurate level control, maximize energy transfer and minimize undue wear and tear. As a result, you can generate the savings that you need to recover this investment.

Proven Portfolio of Heat Rate Control Solutions

The Cornerstone of Heat Rate Reduction

Magnetrol® products provide the highly accurate level control needed to satisfy the most complex applications. Our product portfolio provides a full array of innovative and reliable level measurement solutions for feedwater heaters, including:

- **ECLIPSE® Guided Wave Radar (GWR) Transmitter.**
  Magnetrol's new ECLIPSE Model 706 overshadows current levels of GWR performance. Virtually unaffected by process variations, the 706 gives you a superior degree of accurate and reliable continuous level measurement – without the need for calibration or gravity corrections. By combining superior signal performance, advanced diagnostics and overfill capable probes, the 706 delivers premier level control for a broad range of challenging applications.

- **AURORA® Magnetic Level Indicator(MLI).**
  The AURORA merges the operating system of a conventional float-based MLI with the leading-edge ECLIPSE GWR transmitter. This allows you to measure low dielectric media, high temperature/high pressure process conditions and media with shifting dielectric values accurately and repeatably. The result is a diverse and redundant level-measurement solution in a single-chamber design.

These Magnetrol products provide an effective solution to help make all of your level applications – including feedwater heaters, condenser hotwells, deaerators, cooling towers, air heaters and compressed/instrument air – as efficient as possible.

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Discover How Managing Controllable Losses Can Boost Your Bottom Line

At Magnetrol, we're committed to quality, safety and continuous improvement. Contact us today for a free feedwater heater survey, and put the power of Magnetrol to work for you.

The Heat Rate Expertise You Need

Minimize Your Heat Rate and Total Cost of Ownership with Magnetrol

Finding the right partner – one that understands your process and applications – is vital to your success. That partner is Magnetrol. We combine more than 80 years of experience in level and flow control with a comprehensive range of technologies to deliver the highly effective solutions that allow you to realize a true return on investment. With Magnetrol, you get the best of both worlds. A proven portfolio of level controls – from a company with decades of experience implementing them to satisfy the most complex applications.

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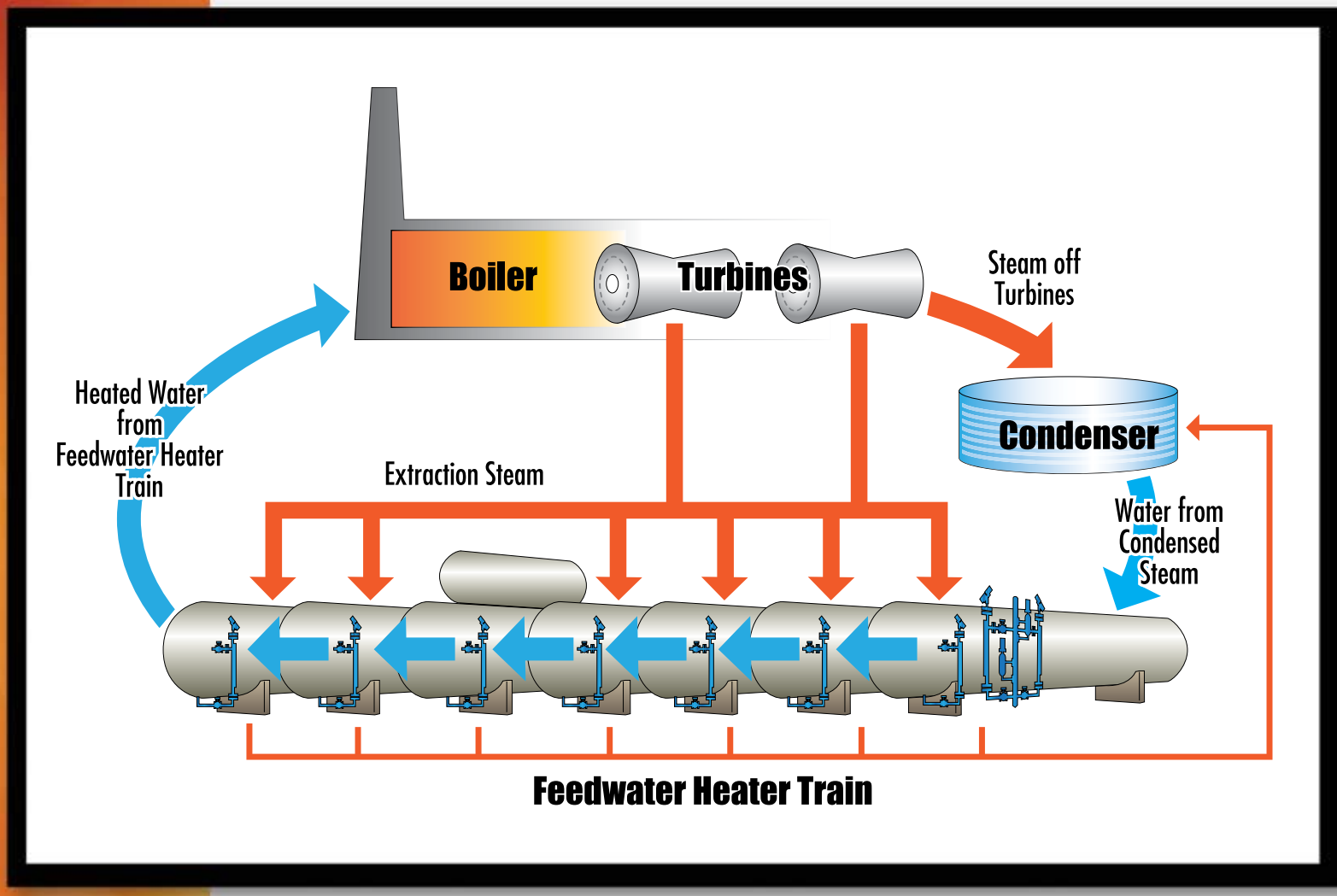
Magnetrol – Your Preferred Partner for Level and Flow Control Solutions

Let Magnetrol help you assess your feedwater heater level control – and minimize controllable losses. Contact Your Magnetrol representative, or connect with us online:

heatrate.magnetrol.com

Power Cycle Overview



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