TILLQUIST

# Optimizing the Steam Generation Cycle and Condensate Recovery Process for Profit

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*Magnetrol® International and Orion Instruments®*

## Objective

To identify key areas in the steam generation cycle, condensate recovery system and waste heat recovery process where cost-effective instrumentation solutions offer a tangible return on investment over the short-term. The goal is to reduce heat rate, environmental impact, fuel and water consumption, water treatment and maintenance costs in commercial and heavy industries where steam generation is essential to the production processes.

## Overview

- Why control?
- Steam generation
  - Boiler/steam drum
  - Deaeration
  - Blowdown
- Condensate and waste heat recovery
  - Cost benefits of condensate recovery
  - Condensate receiver tanks
  - Pump protection
  - Flash tanks and heat exchangers/condensers
- Water chemistry (Chemical storage monitoring)
- Energy management
  - Combustion air, fuel flow & compressed air
- Case Studies

## Why Control?

Although the pulp and paper industry is one of the largest producers of steam outside power generation, the primary metals, petroleum refining, chemical process, and food processing industries also allocate significant portions of their total energy consumption, anywhere from 10% to 60%, to the production of steam. Instrumentation plays an important role in key applications throughout the steam generation cycle. As a consequence, the performance of any level technology relative to instrument induced errors, calibration nuances, and vulnerabilities to process dynamics can have an immediate and adverse impact on fuel consumption while contributing negatively in other aspects of the process be it makeup water requirements, excessive boiler blowdown, energy transfer, etc. Unfortunately, these other aspects of the process indirectly contribute to the inefficient use of fuel and hinder production throughput and product quality. Adding to this burden is the potential for damage to expensive hardware resulting in forced outages, unscheduled, costly maintenance, and production downtime.

> "The U.S. pulp and paper industry—defined as facilities engaged in the manufacture of pulp, paper, and paperboard—consumes over $7 billion worth of purchased fuels and electricity per year. Energy efficiency improvement is an important way to reduce these costs and to increase predictable earnings, especially in times of high energy price volatility."
>
> *Berkeley National Laboratory*
> *Environmental Energy Technologies Division, October 2009.*

It is not an uncommon practice in this day and age to employ a waste heat and/or condensate recovery systems to reduce energy losses and capture valuable condensate. The use of instrumentation technology that cannot adequately or reliably address the control aspects of these processes can inhibit the effectiveness and overall return on investment in these systems and expose hardware to unnecessary damage. Furthermore, processes where electricity consumption and steam generation represent a disproportionate amount of the fuel cost can be plagued with inefficiencies simply due to a technology's shortcomings on critical applications. Of course, this depends on the fuel type as well as other factors. Nonetheless, when properly addressed, these areas have an immediate and positive impact on costs.

An overview of the processes involved, along with the unique instrumentation requirements for each component, offers insight into the significance of maintaining proper level control and protective measures to realize potential savings in steam generation, waste heat and condensate recovery and water treatment systems common in heavy industry.

This paper highlights the individual areas where the application of specific, proven-in-use level control technologies can lower operation and maintenance costs allowing company's to better compete in today's global market. As price is usually a key consideration, severe service applications leverage technologies where the cost benefits are realized over the short- and long-term and are linked directly to efficiency. More consideration is typically given to the front-end cost on applications having the least effect on efficiency of the process; but, in reality, reliable measurement is a key factor in normal operation of the process.

## Steam Generation

Steam generation and condensate recovery systems can vary in complexity depending on the steam end usage and process requirements, e.g., steam for electricity generation or to support a paper mill operation versus that for a small to mid-size specialty chemical process operation. Figure 1 is a simplified diagram depicting a basic steam generation cycle, scalable to virtually any plant requirement whether incorporating a fire tube or larger water tube type boiler. It should suffice to highlight critical areas in the cycle where addressing level control concerns can have a profound impact on efficiency, reliability and maintenance.

At the heart of the system is the boiler/steam drum. Regardless of its size, its primary and peripheral functions are as follows: to provide ample surface area for the efficient separation of water and steam; provide storage capacity to meet immediate boiler feed water requirements; and, to facilitate the introduction of chemicals for treatment purposes as well as the removal (blowdown) of impurities.

A boiler, fire or water tube, presents an extremely dynamic environment with respect to level control regardless of the control strategy—single-, two-, or three-element. The common denominator in each of these strategies is the level measurement itself. Applying a technology that improves on this variable in the equation will most certainly aid in controlling the normal water level (NWL) in the boiler/steam drum, allowing it to better serve its primary function of separating water and steam for improved steam quality. This becomes more important when fluctuations in demand can have dramatic effects on an instrument's performance during "shrink" and "swell" conditions resulting from pressure changes in the boiler/steam drum. In larger-scale steam production such as that required for commercial power generation (water tube boilers), disruptions in boiler/steam drum level control can have adverse affects on the natural circulation of the process and a plant's ability to respond to market demand.

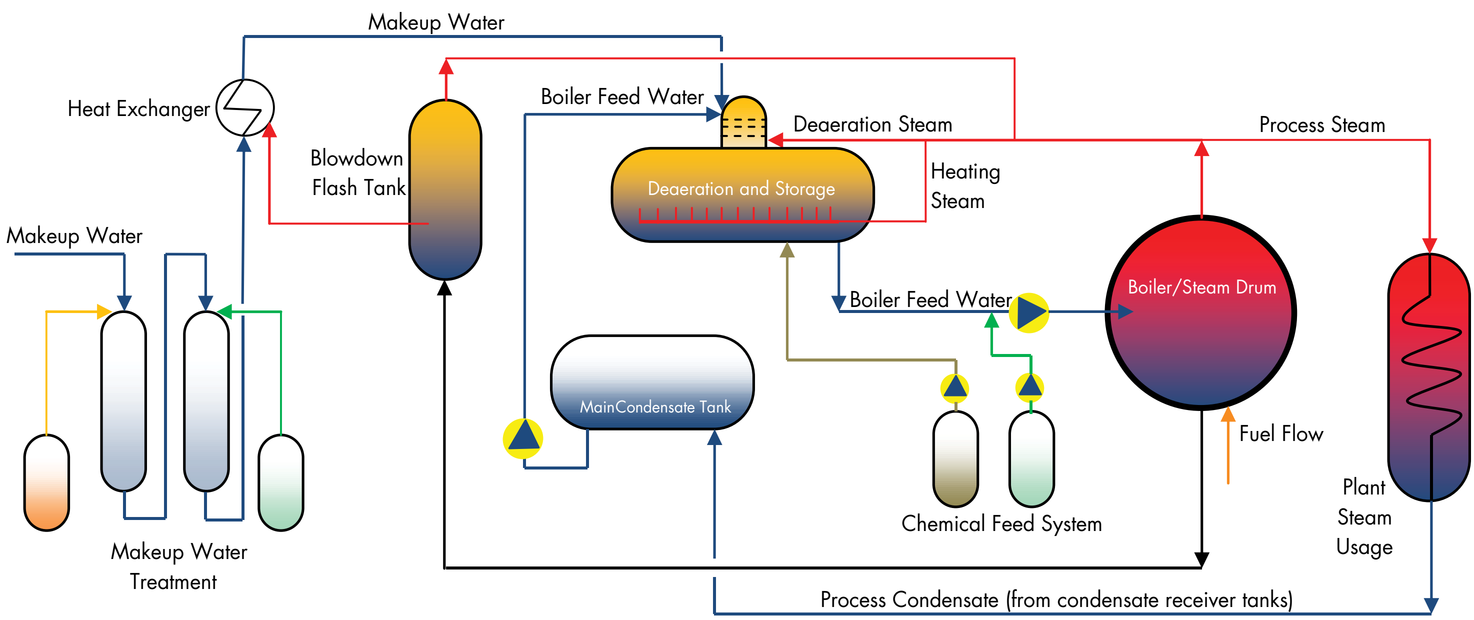
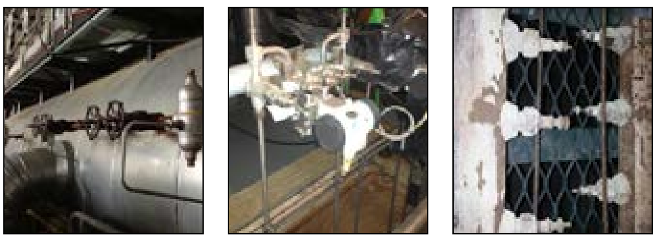



**Figure 1**

Level technologies historically used on boilers rely on inference or buoyancy to determine the level. This in itself leaves them vulnerable to process dynamics (specific gravity, pressure, temperature, etc.) or limits their ability to precisely manage the level for improved fuel economy. Although corrections can be applied to mitigate the effects, the variables that need to be accounted for increase the level control's installation, hardware and calibration complexity, which has the unintended consequence of introducing new avenues for error. Eliminating potential sources of error (including human error) as related to an instrument's fundamental technology is the first step in optimizing boiler/steam drum level control.

A quick peek at various technologies reveals their shortfalls as related to boiler/steam drum level control:

- **Differential Pressure** – a complex system of tubing, condensate pot and transmitter(s) based on inference requiring up to 12 process parameters to properly calibrate. External inputs and corrections are applied to ensure accuracy.
- **Buoyancy (displacer)** – accuracy from startup to operational temperatures is not achievable due to displacer being designed for the specific gravity at operational conditions. Calibration and mechanical wear may introduce errors over time.
- **Buoyancy (mechanical switch for on/off control)** – a low-cost solution for smaller boilers; however, introduction of larger volumes of sub-cooled liquid could affect performance and increase fuel consumption as compared to a continuous type measurement.
- **RF Capacitance** – based on the dielectric constant of the process medium. The dielectric constant of water/condensate changes as a function of temperature, introducing unnecessary errors. Requires in-situ callibration.
- **Conductivity** – high upfront and probe maintenance costs as compared to other technologies. Not a continuous measurement. Resolution is contingent on the proximity of adjacent conductivity probes across the measurement span. Thread galling problematic during repair.

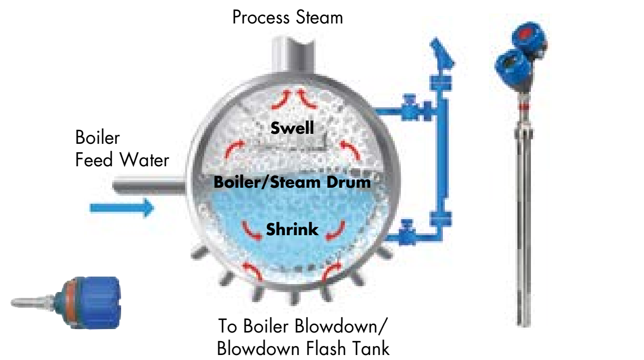


Recurring maintenance, hardware and calibration complexity and vulnerability to process dynamics introduce additional costs and avenues for level measurement errors.

Guided Wave Radar (GWR), on the other hand, is a continuous measurement technology that has the distinct advantage of not being vulnerable to changes in process conditions that affect the aforementioned measurement techniques. Since its performance and accuracy are not contingent on the specific gravity and/or inference, it excels in measuring the actual liquid level in all conditions encountered in the boiler/steam drum. Furthermore, GWR does not require external inputs or calibration to achieve specified performance — accuracy is inherent to the technology. This effectively eliminates the introduction of errors during the calibration process or from external sources, i.e., pressure and temperature. A reduction in the number of variables affecting the measurement provides a high degree of data certainty allowing operators to better maintain the Normal Water Level (NWL) in the boiler/steam drum for optimal water/steam separation and steam quality throughout a variety of process conditions.

## Key benefits of GWR for boiler/steam drum level

- Three-element control strategy: feedwater flow, main steam flow and boiler/steam drum level – actual versus inferred level. Continuous versus discrete indication.
- No calibration or external compensation: data certainty when implementing control strategy during normal operations and "shrink & swell" conditions. Prevents carryover conditions.
- Maintaining NWL in all process conditions improves steam/water separation and overall steam quality.
- Eliminates waste energy due to excessive blowdown to manage level.
- Responsiveness to changes in demand.
- Steam specific process isolation seal for corrosive high temperature/high pressure applications.
- Automatic steam/vapor space compensation.
- Simplified trouble analysis and lower maintenance costs.




**Thermal Dispersion**
Flow Switch for boiler feed water flow and pump protection

**Eclipse® GWR**
Transmitter meets all requirements of ASME Boiler Code Section 1

**Figure 2**

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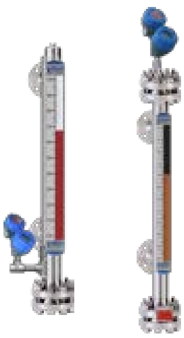
An aside to the discussion on optimizing level control for improved operational efficiency of the boiler/steam drums is the sight/gauge glass requirement delineated in Section 1 of the ASME BPVC.

> **PG–60.1.1** Boilers having a maximum allowable working pressure exceeding 400 psi (3 MPa) shall have two gauge glasses.
>
> Instead of one of the two required gauge glasses, two independent remote water level indicators (two discrete systems that continuously measure, transmit, and display water level) may be provided.
>
> **PG–60.1.1.2** When two independent remote water level indicators are in reliable operation (continuously indicating water level), the one required gauge glass may be shut off, but shall be maintained in the serviceable condition.

Sight gauges serve a very important role as a backup to boiler/steam drum level controls so their presence cannot be understated. However, in continuous service they come with the burden of ongoing, expensive maintenance costs, along with potential safety concerns.

### Common Sight/Gauge Glass Issues

- Steam cuts
- Integral valve failure
- Gasket/seal leakage
- Glass erosion/fatigue



Eliminating one of the two required sight gauges as provided in Section 1 of the ASME BPVC (above) can substantially reduce maintenance costs while allowing the remaining sight gauge to be isolated during day-to-day operation. Oftentimes, the costs associated with repairing sight gauges on boilers/steam drums as well as other applications (heat exchangers/condensers) incorporating these gauges offset the expense of the new instrument. Significantly reducing the number of leak points in comparison to a sight glass/gauge is a welcomed bonus when it comes to the safety of plant personnel.

| | |
|---|---|
| **Repair Kit**<br>Seals/Gaskets<br>Kit with Glass | **$660.00**<br>**$1,600.00** |
| **Shop Time**<br>4 hrs @ $35/hr (est.) | **$140.00** |
| **Installation Time**<br>4 hrs @ $35/hr (est.) | **$140.00** |
| **Vessel/Process Downtime** | **1 Day at $$$** |

## Deaerator & Heat Exchangers

Another key level application, oftentimes overlooked when discussing efficiency is the deaerator and its accompanying storage vessel. The deaerator serves as an "open" type heat exchanger with its primary function being the removal of oxygen and other corrosive gases from the boiler feed water to prevent damage to system hardware. This is accomplished using steam, which can give up about 970 Btu per pound, to support the deaeration process as well as preheat boiler feed water.

> Optimizing the heat exchanger aspects of the deaerator with enhanced level technologies can improve energy transfer. Every 10.8°F (6°C) rise in boiler feedwater amounts to a 1 percent savings in fuel.
>
> Aurora®:
> Magnetic Level Indicator with Integral Guided Wave Radar

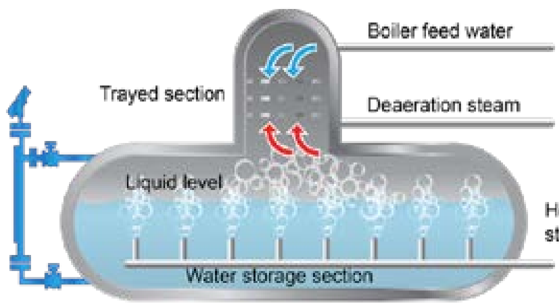



**Figure 3**

Of course, any appreciable gain in boiler feed water achieved through the process reduces the amount of energy (fuel) required at the boiler—every 10.8°F (6°C) rise in boiler feed water amounts to a one percent savings in fuel cost. Inadequate level controls can inhibit the deaeration process (level too high) or reduce/shutdown feed water flow to the boiler (level too low). The former affecting hardware longevity and efficiency while the latter risks production losses and possible damage to pumps.

In addition to the "open" or deaerating feedwater heater, the more common shell and tube heat exchangers/condensers can be found in larger scale steam generation cycles where their costs are offset by gains in thermal efficiency. The effectiveness of a shell and tube heat exchanger in transferring energy is contingent, barring hardware anomalies, on accurate level control. For more information, consult Magnetrol® bulletin 41-296, *Heat Rate and Feedwater Heater Level Control.*

The same attributes making GWR technology uniquely suited for a boiler/steam drum application can also be leveraged on the deaerator and feedwater heaters to provide improvements in thermal efficiency.

## Blowdown Flash & Blowdown Tanks

Maintaining water quality in the boiler within design parameters ensures the highest quality steam possible while minimizing blowdown of the boiler; both of which improve energy and resource management.

Continuous or manual blowdown of the boiler minimizes scale accumulation and corrosion resulting from impurities in the water. The blowdown and blowdown flash tanks provide a means of accommodating liquid and impurities from the boiler with the latter facilitating energy recovery through the use of flash steam. Estimates of up to 49 percent of the energy can be recovered through the use of flash steam routed to heat exchangers or the deaerator to preheat boiler makeup water or support the deaeration process, respectively. Additionally, better level control technology at the boiler side eliminates energy losses resulting from unnecessary blowdown to prevent carryover conditions.

Taking advantage of a specific technology's ability to reliably address the level in either of these vessels, especially the blowdown flash tank, in a plug-and-play type installation and commissioning format (foregoing calibration, external hardware or inputs) is an easy way to ensure optimal performance.

Optimizing boiler, deaerator, heat exchanger/condenser and blowdown usage relative to level control primarily affects fuel economy by better managing the amount of energy required to produce high quality steam for any given task. Seamless response to changes in demand and reducing maintenance associated with the instrumentation or damage to hardware are residual benefits that have their own financial ramifications; hence, should also be considered when implementing any technology. The return on investment time frame can vary depending on the scale of the operation as well as the time spent maintaining aging instrumentation.

## Condensate Recovery

The benefits of any condensate recovery system are well documented in industries relying on steam generation for their processes. Condensate has real value in that every gallon recovered spares the cost of additional makeup water, makeup water treatment and/or wasteful discharge to municipal or other systems. Oftentimes, it is the instrumentation, or lack thereof, that limits the performance of the overall system causing the recovery process to fall short of financial expectations.

Three areas of particular interest relative to efficiency when it comes to level controls are the condensate receiver and main condensate tanks, condensate pumps and associated valves as well as any shell and tube heat exchangers/condensers (Figure 4, next page).

The condensate receiver tanks accept blow-through steam and condensate from various steam process groups throughout a plant. Condensate is later pumped to the main condensate tank where it is stored pending reintroduction into the steam generation cycle. The shell and tube heat exchanger/condenser allows what would otherwise be waste energy to be recovered in the form of flash steam from the receiver tank to preheat makeup water or other process fluids through the heat of condensation. The resulting condensate drains back to the condensate or condensate receiver tank.

The level transmitter on the condensate receiver tank facilitates the automatic management of the condensate level to ensure adequate capacity is available to accommodate (recover) condensate from various plant processes as well as maintaining sufficient headspace in the vessel for the creation of flash steam. Aside from being a critical asset for the plant, the condensate in the condensate receiver tank also protects valves and condensate pump seals from direct exposure to high temperature steam while maintaining a minimum head pressure on the pump. This prevents hardware damage; expensive maintenance and downtime of the receiver tank; and subsequent ripple effects on the steam generation cycle and makeup water requirements. Lastly, the level transmitter provides the control signals for the valves and condensate pump necessary to transfer condensate from the receiver to the main condensate tank, ensuring approximately 15 percent level retention for the aforementioned reasons. At this point, the main condensate tank level transmitters take over to manage boiler feed water supply to service steam generation demand.

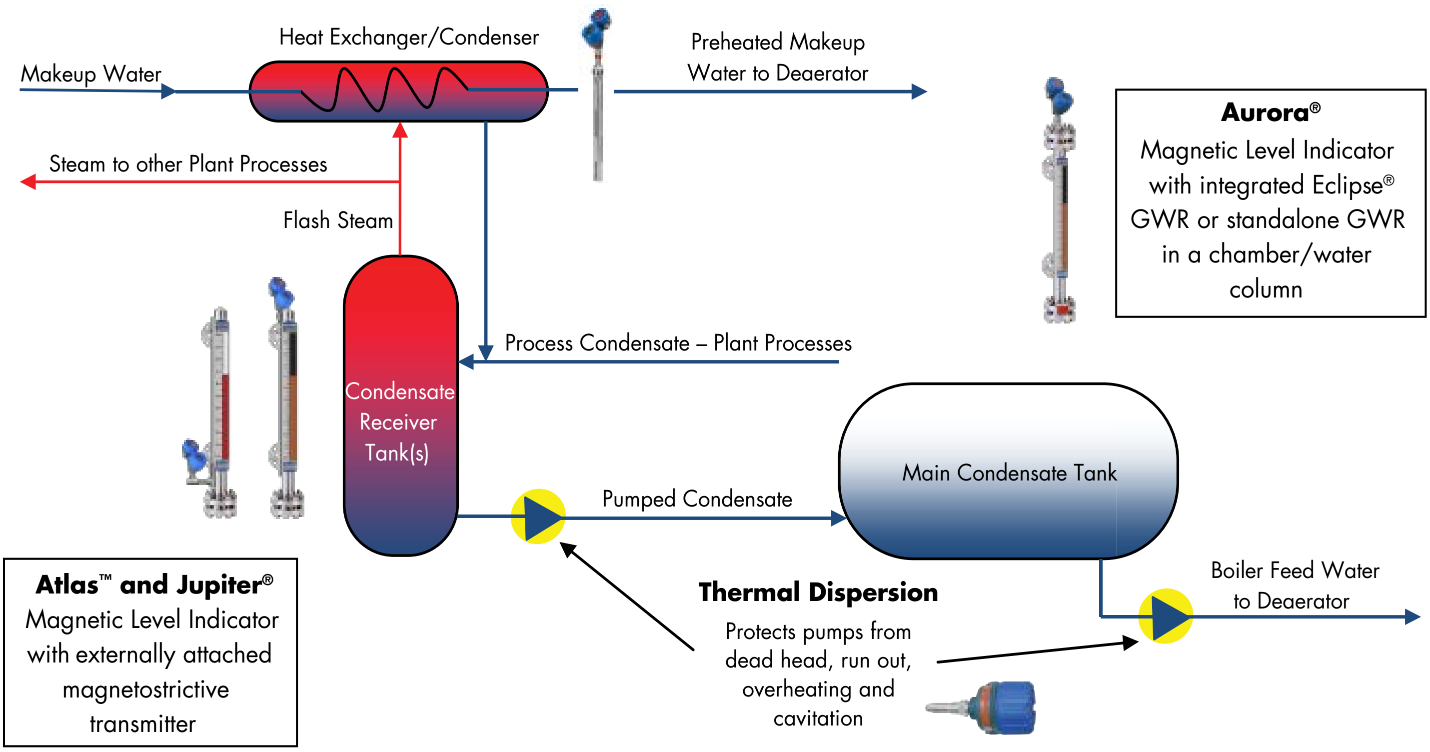



**Figure 4**

## Eliminating Hidden Maintenance Costs

### Condensate Recovery Process Level

- Protect valves & pump seals from exposure to high temperature steam
- Maintain minimum head pressure on condensate pump
- Ensure sufficient headspace for flash steam creation
- Allow capacity to accommodate condensate from various process groups
- Manage boiler feed water supply chain to meet demand

### GWR/MLI Technology Benefits

- Redundant and diverse level technologies
- Unaffected by process conditions
- No calibration required
- No moving parts – eliminates instrument induced errors (GWR)
- Setup wizard and full diagnostics – fast startup and fault isolation
- Designed for high temperature steam applications
- Simplifies instrumentation hardware
- Can be pre-configured for the application

### Case Study

- Pump Seal - $1,000.00
- Labor - two person for ½ day @ $35.00/hr equals $280.00
- Discharged condensate $3.65/1000 gallons
- Condensate receiver out-of-service for maintenance $$$
- 1 to 3 pump seal replacements per week reduced to 1 to 3 per year: “Pulp & Paper Plant”
- Maintenance cost of poor level control: $66K to $200K per year

## Makeup Water Treatment

Makeup water treatment is a critical component of steam generation in that it is the means to resupply the system with water suitable for boiler and other operations that, for whatever reason, was lost in the cycle. Unlike the previous applications discussed in the steam generation cycle, level control for the water treatment process is not necessarily about efficiency, but rather, accuracy, reliability and safety while providing proper inventory management to ensure chemical and makeup water supply meets demand.

Here the focus is on the chemical component of the water treatment since it presents difficulties for level technologies that may work perfectly on non-chemical applications related to the water treatment process or those with limited variations in the contents of the vessel's vapor space. Although important measurements such as ammonia, acid, caustic and other chemical storage tanks are not difficult level applications by any stretch, small nuances in how the vessels are monitored relative to level technology can have a dramatic effect on the day-to-day practicality and reliability of the type of instrument(s) used. Additionally, there are safety considerations when replenishing chemicals as well as short- and long-term maintenance costs, which can be addressed simultaneously with inventory monitoring by implementing a few simple, cost-effective modifications to the instrumentation package.

High-visibility magnetic level indicator with magnetostrictive transmitter supports the offloading of ammonia at a combined cycle power plant

### Key Components to Chemical Storage Monitoring

- Inventory Management (accuracy)
- Resistance to chemical attack (reliability & maintenance)
- Utilize a technology that is unaffected by changes in the vapor space of the vessel (reliability)
- Performance verification (maintenance)
- Visibility during product transfer (safety)

Chemical storage, demineralization and water header tanks come in a variety of shapes and sizes, usually, horizontal or vertical vessels six to ten feet in diameter/height, with the ammonia storage and demineralizer tanks being the largest. It is not uncommon to see some type of level transmitter (ultrasonic being the most prevalent) installed to provide level indication to the control room with a local display at the base of the tank, either in series with the 4–20 mA transmitter output or repeated from the control room. The signal to the control room tracks inventory, acts as a high alarm for overfill protection and establishes the resupply interval. The local display facilitates monitoring the offload of chemicals from the supplier's truck.

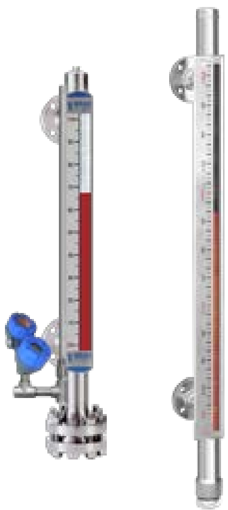
Accuracy, reliability and visibility in dynamic vessel environments and operational scenarios are a level technology's best attributes when addressing chemical storage applications. Cost is always an upfront consideration on these seemingly less complicated measurements. Nonetheless, performance in these two areas can have a measurable impact on the "real" cost of ownership for a plant. There is also a good argument for selecting the appropriate level technology during the Front End Engineering Design (FEED) phase of a project, as this will eliminate potential installation and commissioning issues by taking into consideration the technology in the vessel design — another area of potential savings.

Any number of level technologies can and have been used to address chemical storage. Adhering to the principles of minimizing the number of variables (e.g., vulnerability to process dynamics, calibration, hardware complexity, etc.) that can affect a technology's ability to perform as intended is a key step in reducing the total cost of ownership. Again, Guided Wave (contact) Radar as well as its Through-Air (non-contact) Radar counterpart excel in these areas. Magnetic Level Indicators (MLI) operating in conjunction with either type of radar technology or coupled with a magnetostrictive level transmitter offer redundancy and technology diversity while enhancing visibility for improved safety during resupply operations. There is also the added benefit of redundancy when verifying the primary transmitter's performance during periodic inspections on scheduled outages or while troubleshooting.

This does not imply non-contact ultrasonic level transmitters or other technologies are not up to the task. Simply put, radar is indifferent to the changes in the contents of the vapor space of these vessels occurring throughout the course of the day. Oftentimes, these changes affect a technology causing what can be referred to as nuisance alarms, e.g., intermittent signal loss or when the level indication becomes erratic only to recover about the time a technician arrives on the scene. These types of issues are difficult to isolate due to their intermittent nature and the fact they cannot be linked to an installation, configuration or hardware anomaly.

### Chemical Storage & Water Treatment Level Technologies

- **Radar – Guided Wave (GWR) and Non-Contact** for simplified installation, commissioning and maintenance while tolerant to a changing vapor space
- **Magnetic Level Indicator (MLI)** for improved visibility during resupply; periodic maintenance or performance verification. Can stand alone or work in conjunction with other level transmitters to provide redundancy and technology diversity to critical measurement
- **Magnetostrictive** transmitter coupled with MLI offers an alternative to top-mounted level transmitter technologies while being isolated from vessel contents
- **Ultrasonic (non-contact)** excellent level solution for non-chemical or less critical applications in the water treatment process with limited variations in the vapor space



When discussing the water treatment process supporting any steam cycle, large or small, it is not a one-size-fits-all concept that provides the most benefit as related to performance. For as simple as some of these level applications appear, there is no shortage of instances where they contribute disproportionately to the commissioning and maintenance budgets simply because they cannot accommodate the full breadth of the application dynamics. Opting for a technology-centric versus a one-size-fits-all approach to applications throughout the water treatment process reduces both short- and long-term cost of ownership. This allows for the implementation and realization of the cost benefit of entry-level technologies for less strenuous applications, while minimizing cost on those with variations in the vapor space (e.g., steam, chemical composition, excessive condensation, etc.). All of which can wreck havoc on an instrument's performance as well as a plant's maintenance budget.

## Energy Management

The thrust of this discussion, regardless of the scale of an operation, centers on identifying key areas of the plant where leveraging the attributes of a technology in any given scenario has the most profound effect on efficiency with a quantifiable return on investment falling in the one- to two-year time frame.

As noted earlier, purchased fuel and electricity consumption are areas where any improvements in efficiency drop directly to a company's bottom line. It makes sense that having the ability to monitor the end-use location of fuel throughout a facility as well as the consumption specifics for individual applications — predominately the boiler — can offer insight to potential areas of improvement. A similar statement can be made for electricity consumption; whereby reductions can be realized by simply identifying where the energy is being lost.

In the energy management arena the ability to better monitor combustion air, fuel gas flow and compressed air can help identify losses that over short periods of time can affect a plant's profitability. The two key phrases when discussing instrumentation for the aforementioned are "cost effective" and "return on investment." Without question, any situation can be resolved if enough financial resources are thrown in its direction. The idea is to realize the benefit in the shortest time frame possible at the most reasonable cost. Thermal dispersion mass flow meters meet these criteria.

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## Thermal Dispersion Mass Flow Meter

Thermal mass flow meters are primarily used in air and gas flow measurement applications. The meters consist of a transmitter and probe with temperature sensors (RTDs) located in the pins at the bottom of the probe. The reference sensor measures the process temperature and the other sensor is heated to a specific temperature above the reference. As the flow rate increases, heat gets taken away from the heated sensor. More power is then applied to the heated sensor to maintain the temperature difference. The relationship between power and mass flow rate is established during factory calibration.

**Combustion air flow** measurement to a boiler is important to maintain a stoichiometric ratio with the amount of fuel being supplied. Too little air flow can result in incomplete combustion along with additional carbon monoxide or pollutants depending on the fuel being burned. On the other hand, too much air flow can cool the furnace and waste heat out of the stack. The repeatability of the air measurement is essential to obtaining the most efficient air-fuel ratio (AFR).

- Repeatability of ±0.5% of reading
- Direct mass flow measurement
- Easy to install in an air duct
- No on-site or in-situ calibration

Measuring **fuel gas flow** (natural gas or propane) usage to individual combustion sources compared to the output (steam/hot water) can help optimize boiler efficiency and better manage energy consumption. Knowing individual boiler performance may also assist in operating those offering the best efficiency. Lowering fuel consumption is one of the easiest methods to reduce cost and improve profits.

A key role in energy and facilities management is making **compressed air** systems more reliable and efficient. Valuable resources are wasted when a leak goes unnoticed or cannot be easily isolated.

- Strong signal at low flow rates with high turndown
- Verify calibration in the field
- Easy installation with low pressure drop
- Direct mass flow measurement without the need for pressure or temperature compensation

The Department of Energy estimates that 20–30% of compressor output goes to leaks accounting for thousands of dollars in electrical consumption for wasted air. More extreme cases are the purchase cost of additional/larger compressors to fulfill compressed air needs. The first step to reducing utility costs is to measure the usage. Thermal dispersion technology can be used in branch lines for determining consumption in different sections of the plant or as a relative indication of leakage.

- Easy installation with use of an insertion probe with compression fitting
- Accurate flow measurement under varying pressures
- High turndown and good sensitivity at low flow rates

## Case Study 1*

### Steam System Efficiency Optimized

### J.R. Simplot Fertilizer Plant


**Benefits:**

Total annual project savings: **$335,000** Energy savings: **75,000 MMBtu**

- Improved Boiler Operation
- Recycled Steam
- Increase Condensate Recovery
- Steam Trap Repairs
- Improved Insulation

Project costs: $180,000.00/ROI 6.5 months

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## Case Study 2*

### Improving Steam System Efficiency

### Goodyear Tire Plant

**Benefits:**

Total annual project savings: **$875,000** Energy savings: **93,000 MMBtu**

- Optimize Boiler Operation – tune boilers to reduce excess $O_2$, reduce fuel consumption
- Recover Process Waste Heat – installed heat exchanger to raise makeup water temperature using energy in condensate
- Insulate Process Equipment – lower steam system energy consumption

Total implementation project costs: $180,000/ROI 2.5 months

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## Case Study 3*

### Natural Gas Utility Metering Verification

### VA Medical Center


**Benefits:**

Project savings: **$150,000** (credit applied to account)

- Isolated radio-magnetic interference in utility whole-building natural gas metering system
- Advanced flow metering confirms anomalies in gas consumption over two-month period
- Mass flow measurement optimizes boiler performance and provides secondary confirmation

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## Case Study 4*

### Compressed Air Energy Reduction

### FUJIFILM Hunt Chemicals U.S.A.

FUJIFILM
FUJIFILM Hunt Chemicals U.S.A., Inc.

- Compressed air used in a variety of operations that are critical to maintaining quality in both the process and product
- Assessed compressor energy versus standard cubic feet per minute of air generated and used
- Established a leak detection and repair strategy to reduce compressed air losses that amounts to nearly $10k/year savings

** U.S. Department of Energy*

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## Summary: Process Optimization through Instrumentation

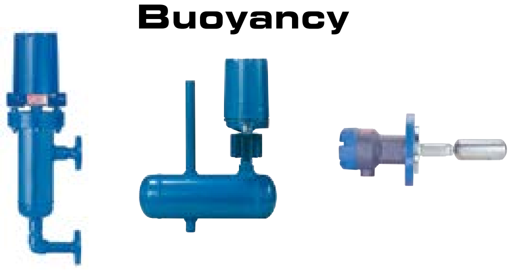
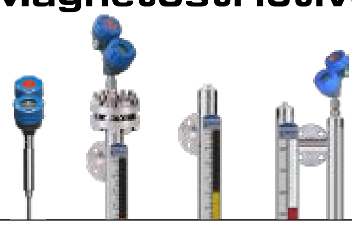
Although plausible, it is rare to identify a single source of inefficiency related to poor level controls that impacts a company's bottom line in the double digit percentile. More so than not, it is these small incremental opportunities for improvement across various aspects of the steam generation cycle, condensate recovery system and waste heat recovery process that ultimately equate to substantial savings.

- Reduced water consumption, treatment, discharge and inventory management
- Improved boiler/steam drum control – energy savings and steam quality
- Reduced fuel consumption – waste heat recovery
- Energy Management – fuel gas, combustion air and compressed air flow
- Hardware protection & maintenance – pumps and pump seals

Oftentimes, the hidden maintenance costs and inefficiencies associated with a technology's vulnerabilities (sustained operation in high pressure and temperature steam environments; chemical exposure; errors due to the complexity of the measurement itself and subsequent calibration requirements) are overshadowed by the day-to-day operation of these processes.

Regardless of the scale of an operation – commercial power generation or small scale boiler system, leveraging the inherent attributes of an instrument's fundamental technology in both the short-term (engineering, upfront cost, installation and commissioning) and long-term (maintenance, day-to-day practicality and energy management) present simple and cost-effective approaches to maximizing the return on investment in the system itself.

## Magnetrol® Instrumentation

| Guided Wave Radar | Non-Contact Radar |
| --- | --- |
|  |  |
| **Ultrasonic** | **Buoyancy** |
|  |  |
| **Thermal Dispersion** | **Magnetic Level Indication/ Magnetostrictive** |
|  |  |

Magnetrol®

See the full product line at:
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