Director's Message

By Brad S. Carlberg, P.E.

Invensys Operations Management– Lake Forest, CA

Honorable Members of PUPID,

Well, it is already the third week of August and it’s summer’s almost over, one more week to Labor Day.

Just like last month, we still need a Director-Elect, and a symposia coordinator. The Director-Elect will train in 2011 and take over as Director for the 2012/2013 biennium. If you can only do it for a single year, then we can look at single terms. In return for the work, you’ll get your ISA Fall Conference registration.

Again this year, I am on the Wireless & Networking Track Committee (this year as chair) for the ISA Automation Week 2011 at the Renaissance Riverview Hotel and the Arthur R. Outlaw Mobile Convention Center in Mobile, Alabama. If you’ve thought about getting involved with a technical conference and/or writing a paper, this is for you. Come on down o the “Redneck Riviera” and see where Mardi Gras started (that’s right, Mobile only loaned Mardi Gras to New Orleans, but had Mardi Gras first!)

I am excited about the “Trends in Process Control & Instrumentation in Pulp & Paper” Panel at the ISA Automation Week 2011 which will be on Tuesday, October 18, at 3:30 - 5:00. Come see the six panelists with over 150 years of cumulative pulp & paper experience and brainstorm about how we can compete with the rest of the world.

Since last May PUPID membership has 26 new and 2 renewing members. The membership has stayed constant since last January with a total of 440. Welcome to all of you new members!

I hope it is an encouragement to you to become more involved with the Division and to enroll more members from the great international pulp & paper community.

Please do not hesitate to contact me at either (251) 454-1200 or brad.carlberg@bsc-engineering.com to discuss how you can help PUPID.

Do feel free to forward the Newsletter to your friends and colleagues who may have an interest in it.
Get a quick overview of the ISA PUPID events for 2011 by going to the Calendar at:
http://www.isa.org/~pupid/2011_PUPID_Calendar.htm

ABTCP 2011-44th Pulp & Paper
International Congress & Exh
Transamerica Expo Center
Sao Paulo, Brasil
http://www.abtcp2011.org.br/ingles/

2011 International Pulp Bleaching
Conference
10/5/2011 to 10/7/2011
Oregon Convention Center Portland, OR
USA
http://www.tappipeers.org/

2012 TAPPI PLACE Conference
5/7/2012 to 5/9/2012
Grand Hyatt Seattle Seattle, WA USA
http://www.tappi.org/content/events/12place

66th Appita Conference & Exhibition
4/15/2012 to 4/18/2012
Melbourne Park Melbourne, Australia
http://www.appita.com/

2011 ISA FALL LEADERS MEETING
SATURDAY, 15 OCT 2011 AND SUNDAY,
16 OCT 2011

ISA AUTOMATION WEEK 2011
MONDAY, 17 OCT 2011 THROUGH
THURSDAY, 20 OCT 2011
ARTHUR R. OUTLAW MOBILE CONVENTION
CENTER
RENAISSANCE MOBILE RIVERVIEW PLAZA
HOTEL
MOBILE, AL
Come meet your leaders & get involved!
While you’re at the ISA Automation Week 2011 come and see the "Trends in Process Control & Instrumentation in Pulp & Paper" Panel. It will be on Tuesday, October 18, at 3:30 - 5:00. Come see the six panelists with over 150 years of cumulative pulp & paper experience and brainstorm about how we can compete with the rest of the world.

Panelist

Bob Barber
Project Engineer at International Paper Co.
Pensacola, Florida Area
foxcis@yahoo.com
Panelist

Ben Blanchette  
Current Americas Pulp & Paper/CWS Business Segment Leader at Honeywell Process Solutions  
Past Sales Consultant at Honeywell  
Sr. Account Manager at Honeywell Process Solutions  
Application Engineer at Honeywell Process Solutions  
Education University of Maine  
Ben.Blanchette@honeywell.com

Panelist

Phil Kelly  
Currently Papermaker at Boise Cascade  
Past Superintendent at Alabama River Newsprint  
Superintendent PM11/PM12 at Champion International  
Process Specialist-Team Leader Paper at Willamette Industries  
Assistant Superintendent PM4 at Georgia-Pacific LLC  
FIT/Engineer at International Paper  
TA/Engineer at Bowater  
Education Lawrence University  
Charleston Southern University  
philkelly@bellsouth.net
Panelist

Davis McAlpine
Current Senior Staff Engineer/E&I Engineering Coordinator at Hargrove Engineers + Constructors
Past Engineer at Kimberly-Clark Corp.
Engineering Technical Leader at Kimberly-Clark
Electrical Engineer at Kimberly-Clark Corp.
Engineer at American Can Corp.
Education University of Alabama
dmcalpine@hargrove-epc.com

Panelist

David W. Peters, P.E.
Currently Principal, Sigma Associates, LLC Consulting Engineers Montrose, Al
Past Brown & Root Mobile, AL
dave.peters@sigma-associates-llc.com
Panelist

Larry E. Wells, P.E.
Independent Paper & Forest Products and Utility Boilers Control Systems Engineering Consultant
Current Contract Engineer at Southern Company
Principal at CCSA, LLC
Past Senior Control Systems Staff Engineer at Georgia Pacific
Principal Control Systems Engineer at BE&K, Jaakko Poyry - Fluor Daniel
Education University of Houston
University of Alabama at Birmingham
Auburn University
ccsallc@bellsouth.net

Session Developer /Moderator

Brad Carlberg, P.E.
Currently Application Engineer - Nuclear Operating Plant Design Department at Invensys Operations Management
Lake Forest, CA

Past
Commissioning Engineer Bechtel International Inc. in UAE
Senior Control & Instrumentation Engineer Bechtel National Inc. in Richland, WA
Consulting Control Systems Engineer BSC Engineering in Daphne, AL
Honeywell IAC as Pulp & Paper Applications Engineer
Instrument Control Services in Pensacola, FL
H.A. Simons Ltd Vancouver, B.C.,
CS Technologies Poughkeepsie, NY

Education Washington State University BSME 1984
brad.carlberg@bsc-engineering.com
WELCOME TO THE 26 NEW ISA PULP & PAPER INDUSTRY DIVISION
MEMBERS SINCE MAY 2011

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<td>Ms. Lakshimi Aravindhran</td>
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<td>Ryan DeHut</td>
<td>Ricardo Alegria Cifuentes</td>
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<td>Patrick W. Hall</td>
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<td>Gustavo E. Hernandez Cardenas</td>
<td>Juan Fernando Ordonez Fajardo</td>
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<td>Ms. Monica S</td>
<td>Adam Thomas</td>
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THANKS TO THE 2 MEMBERS WHO RENEWED THEIR MEMBERSHIPS

Raymond J. Neher, CCST
Dana B. Hill

HERE’S A REMINDER TO THE 40 ISA PULP & PAPER INDUSTRY DIVISION
MEMBERS WHO NEED TO RENEW THEIR MEMBERSHIP

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<td>Prof. Jerker Delsing</td>
<td>Parag Balkrishna Kulkarni</td>
<td>Pritesh S. Rao</td>
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<td>Tim Harshenin</td>
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<td>Chris Hill</td>
<td>Nazly Lorena Ordonez Benavidez</td>
<td>James Andrew White, Jr.</td>
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<td>Peter T. Jessee</td>
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DON’T FORGET TO RENEW!
**Who's Doin' Anything?:**

**AbitibiBowater to Modernize, Reconfigure Iroquois Falls Mill**
AbitibiBowater, Montreal, Que., Canada, this week announced a reconfiguration and capital spending program for its paper mill in Iroquois Falls, Ont., Canada. The investments will improve overall product quality and the mill's competitive position.

The company will be investing C$12 - C$17 million in the thermomechanical pulp (TMP) mill and in PM 8, the larger of the mill's two machines. The pulp mill investment will result in improved pulp quality with the installation of additional pulp cleaning. Paper machine upgrades will result in improved wet-end formation and newsprint quality. Also, chip receiving and chip handling capabilities will be increased to allow the Iroquois Falls facility to operate on 100% externally supplied chips, with the mill's current woodyard and woodroom being phased out.

"Today's announcement is a critical step in improving the competitive position of our Iroquois Falls operation for the foreseeable future," said Michel Maille, VP, Pulp and Paper Operations. "While it has been a good site over the years, this investment is necessary to meet today's market and economic realities."

The increase in chip receiving and handling capability and the closure of the woodroom and wood yard will occur during the first half of 2012. The reconfiguration will result in a workforce reduction of approximately 60 positions, although the company hopes the mill demographics will significantly reduce the number of employees who will be laid off given retirement eligibility over the next couple of years. The pulp mill and paper machine investments will be made over the next 12 to 18 months.

"In addition to improving mill economics, the conversion to 100% externally supplied chips will also provide an outlet for chip residuals from sawmills on the Highway 11 corridor. This will be particularly important as markets for Ontario lumber recover," added Maille.

**Kruger Investing $316 Million for New Tissue Machine at Memphis Mill**
Kruger, Montreal, Que., Canada, reports that its Kruger Products L.P. subsidiary will continue to expand in the North American tissue market by installing a new tissue machine and supporting facilities at its Memphis, Tenn., USA, mill. The $316 million investment will increase the company's production capacity by 18%, or 60,000 metric tpy of additional products to be distributed for the most part in U.S. markets. The expansion project is an integral part of Kruger's long term strategic development plan.

"The proximity of our Memphis Mill to growing U.S. markets will further strengthen our competitive position in North America, which will benefit all our establishments in both Canada and the U.S.,” said Mario Gosselin, COO for Kruger Products L.P. Since the Kruger Co. acquired its tissue mills in 1997, it has made investments of more than C$450 million in its four Canadian mills, including C$230 million to modernize its Crabtree (Quebec) facility.

The investment announced week not only help consolidate position, but will give Kruger Products latitude it needs develop its activities at North American level. The project, which involves tissue machine and state of the art facility to accommodate this new asset, is partly financed by $211 million loan from the Caisse de dépôt et placement du Québec, a Canadian institutional fund manager.

The Kruger Products L.P., a subsidiary of Kruger Inc., has 2,500 employees and operates five mills, four of which are located in Canada and one in the U.S.

**Tembec Reaches Settlement with Matane Workers, to Restart September 11**
Tembec, Montreal, Que., Canada, this week reported that it has reached a settlement with its Matane, Que., high-yield pulp mill employees who have now voted to end the strike. Employees began returning to work gradually on August 22 and operations are expected to resume on September 11. Production at the mill has been suspended since May 10. The settlement covers a seven-year agreement that will expire in October 2016.

The Matane mill employs 143 people, of which 99 are unionized, and ships to customers in North America, Europe, and Asia. It has a production capacity of 250,000 metric tpy.

**DOE Releases New 'Billion-Ton' Study**
The U.S. Department of Energy (DOE), Washington, D.C., USA, this week released a report titled 2011 U.S. Billion-Ton...
**WHO’S DOIN’ ANYTHING?: (CONTINUED)**

*Ton Update: Biomass Supply for a Bioenergy and Bioproducts Industry* that details U.S. biomass feedstock potential nationwide. The report examines the nation's capacity to produce a billion dry tons of biomass resources annually for energy uses without impacting other vital U.S. farm and forest products, such as food, feed, and fiber crops. The study provides industry, policymakers, and the agricultural community with county-level data and includes analyses of current U.S. feedstock capacity and the potential for growth in crops and agricultural products for clean energy applications.

Biomass resources identified in the report could be used to produce clean, renewable biofuels, biopower, or bioproducts. For example, with continued developments in biorefinery capacity and technology, the feedstock resources identified could produce about 85 billion gal of biofuels—enough to replace approximately 30% of the nation's current petroleum consumption. This data will be used by both the public and private sector to grow the bioenergy industry and help achieve President Obama's goals of dramatically expanding renewable energy resources and developing alternative fuels for America's transportation sector.

The report supports conclusion of the original 2005 *Billion-Ton Study* with added in-depth production and costs analyses and sustainability studies. The 2011 report uses more rigorous models and data analysis to test the feasibility of increasing biomass production to help meet the nation's renewable energy needs. The new report also conducts in-depth analyses of land-use changes and competition among food, feed, and energy crops.

The report's findings demonstrate that increases in biomass-derived energy sources can be produced in a sustainable manner through the use of widely-accepted conservation practices, such as no-till farming and crop rotation. In fact, in some cases increased production may contribute to environmental improvements. For example, removing tree portions that are unfit for market in the forest industry can reduce forest fire risk, and planting energy crops on marginal lands can reduce soil erosion. The baseline scenario in the newly released report shows that biomass resources could be increased from a current 473 million dry tons annually to nearly 1.1 billion dry tons by 2030, under a conservative set of assumptions about future increases in crop yield.

**ABB Wins Electrification Order For Pulp Mill In Uruguay**

Zurich, Switzerland - ABB, the leading power and automation technology group, has won an order to supply process electrification and power distribution infrastructure as well as equipment for a new pulp mill in southwestern Uruguay.

The Montes del Plata pulp mill is a joint project of Finnish pulp and paper manufacturer, Stora Enso, and the Chilean forestry company, Arauco. At an estimated cost of $1.9 billion, it is the largest private investment ever made in Uruguay.

The mill is scheduled to begin production in the first quarter of 2013, and will have an annual capacity of 1.3 million metric tons of bleached eucalyptus kraft pulp sourced from Montes del Plata's own forestry plantations. The project includes the pulp mill, a deepwater port and a biomass-based power generation plant to convert waste from pulp production into electricity.

"ABB has delivered and managed large, complex electrification projects for the pulp and paper industry for more than 40 years," said Veli-Matti Reinikkala, head of ABB's Process Automation division. "Our advanced technology can also help customers efficiently tap into local renewable energy sources, ensuring this state-of-the-art mill has a reliable, self-sufficient electrical supply."

ABB will provide power distribution and process electrification for the pulp mill, including the main transformers, 33 kilovolt (kV) power distribution system and control system, smart motor control switchgear, all motors and frequency converters. ABB will also deliver the sectional drive systems for the two pulp dryer machines, including hardware and software engineering, as well as on-site services for customer training, start-up and commissioning.

ABB's Process Automation division delivers industry specific solutions and services for industrial automation and plant electrification. These solutions help customers meet their critical business needs in the areas of energy efficiency, operational profitability, capital productivity, risk management and global responsibility. Available industry specific solutions include process control, instrumentation, analytics, safety, plant optimization, telecommunications, energy management and power distribution.
FPInnovations Leases New Technology To TEXO Consulting & Controls

June 30, 2011

Montreal /PRNewswire/ - FPInnovations and TEXO Consulting and Controls are very pleased to announce that they have signed a new license agreement for the sale of FPInnovations' Recausticizing Control Technology (RCT). RCT is an advanced software which efficiently manages the recausticizing process in kraft pulp mills resulting in reduced energy costs. Potential energy savings are approximately $1 million per year for a typical mill.

"Kraft pulp mills continue to search for additional ways to reduce their chemical cost and energy consumption, and produce more electrical power. The RCT is a simple solution to reduce both energy consumption and operating costs. Its simplicity is revolutionary compared to current recausticizing control systems on the market. We believe this technology will be very attractive to North American, European, Australian and New Zealand markets, which represents our growth market”, stated Mario Leclerc, TEXO Consulting and Controls' Vice-President of Deployment.

The RCT software works in conjunction with a FPInnovations-developed FTNIR Sensor Technology currently sold by FITNIR Analyzers Inc. By combining these two innovative technologies, kraft mills can optimize the efficiency of a key part of their chemical recovery system.

Chris J. Kanters, FPInnovations' National Director of Intellectual Property, Contracts & Licensing stated that "RCT came out of FPInnovations' Chemical Pulping research program. We're very proud of our research team's work which is the result of years of R&D on the Kraft recovery process”. He added, "This technology has already been successfully implemented in five Canadian Member mills."

FPInnovations and TEXO Consulting and Controls have previously signed licence agreements for FPInnovations' Lime Kiln Control and Chlorine Dioxide Generator Control technologies. These agreements, including RCT, support the creation of advanced process control solutions for the whole kraft fiberline.

About FPInnovations
FPInnovations is a not-for-profit world leader that specializes in the creation of scientific solutions in support of the Canadian forest sector's global competitiveness and responds to the priority needs of its industrial and government members. It is ideally positioned to perform research, innovate and deliver state-of-the-art solutions for every area of the sector's value chain, from forestry operations to consumer and industrial products. FPInnovations' staff numbers more than 500. Its research laboratories are located in Québec City, Montréal and Vancouver, and it has technology transfer offices across Canada. For more information about FPInnovations, visit: www.fpinnovations.ca

About TEXO Consulting and Controls Inc.
TEXO specialized in asset optimization using advanced process control applications that are DCS resident. TEXO invests in R&D effort for innovative APC solutions. The ultimate goal is to reduce variability at the kraft digester. APC applications for recausticizing, for brownstock washing and for kraft pulping make it possible for clients who produce pulp and green energy to remain in control of their objectives while becoming more competitive. For more information about Texo Consulting and Controls Inc., visit: www.texo-cc.com

Siemens Wins Order For Complete Electrification And Service Of New $430 Million Paper Mill

June 30, 2011

Atlanta, GA /PRNewswire/ -- Siemens Industry, Inc. today announced it has received a multi-million dollar order from Greenpac Mill LLC, a Cascades Inc. affiliate, to supply the complete electrification and service for a new $430 million green containerboard mill in Niagara Falls, N.Y. This machine will be one of the largest of its kind in North America.

“We are thrilled that Greenpac has selected Siemens for this innovative project,” said Jagannath Rao, president of the Industry Solutions division, Siemens Industry, Inc. "Our energy efficient technology combined with Greenpac's sustainable products will
WHO’S DOIN’ ANYTHING?: (CONTINUED)

meet the needs of its customers at a reduced cost for many years to come.”

Siemens will provide a fully-integrated automation solution and the complete electric power distribution equipment for the new 250,000-square-foot mill, including drives, motors, gear boxes, and stock preparation as well as paper machine equipment and services. The equipment will include medium and low voltage switchgear, power transformers, variable speed drives, and medium and low voltage motion control centers.

Siemens technology offers a unique level of integration into an automation system that reduces the number of human machine interfaces (HMI) and ensures maximum data transparency across all levels. Customer benefits will include optimized process operation and reduced maintenance costs in addition to a shorter project schedule for the customer, increased cost-savings, higher system availability and flexibility, and reduced expenses for configuration and commissioning.

Additionally, the process control system will provide a single view of the entire facility, which will help minimize development, implementation and life cycle costs, and reduce engineering resources. Siemens will provide all main service components for the mill, including engineering, project management, and commissioning and start-up assistance. The order also includes a three-year site support agreement – complete with a 99 percent uptime guarantee – and spare parts and services.

Located adjacent to an existing Norampac facility in Niagara Falls, N.Y., the new, environmentally-friendly Greenpac mill will manufacture a lightweight linerboard made with 100 percent recycled fibers on a single machine that has an annual production capacity of 540,000 short tons. Construction of the mill will begin in July 2011 and is expected to create 108 new jobs in New York. Start-up is scheduled for the summer of 2013.

Siemens Pulp & Paper Technologies is a global provider of solutions, systems, products and services for the pulp and paper industry. For more information about Siemens Pulp & Paper Technologies, visit www.usa.siemens.com/pulpandpaper.

About Siemens:
Siemens Industry, Inc. (SII) is the U.S. affiliate of Siemens' global Industry Sector business—the world's leading supplier of production, transportation and building technology solutions. The company's integrated hardware and software technologies enable comprehensive industry-specific solutions for industrial and infrastructure providers to increase their productivity, sustainability and profitability. The Industry Sector includes six divisions: Building Technologies, Industry Automation, Industry Solutions, Mobility, Drive Technologies and Osram Sylvania. With nearly 204,000 Siemens Industry Sector employees worldwide, the Industry Sector posted a worldwide profit of $4.7 billion on revenues of $47.3 billion in fiscal 2010. www.usa.siemens.com/Industry

A division of Siemens Industry, Inc. (SII), Industry Solutions (IS) is one of the world's leading solution and service providers for industrial and infrastructure facilities comprising the business activities of Siemens VAI Metals Technologies, Water Technologies and Industrial Technologies. Activities include engineering and installation, operation and service for the entire life cycle. Its wide-ranging portfolio of environmental solutions helps industrial companies to use energy, water and equipment efficiently, reduce emissions and comply with environmental guidelines. With nearly 29,000 employees worldwide, Industry Solutions posted worldwide revenues of $8.1 billion in fiscal year 2010. www.usa.siemens.com/industrysolutions.

Metso To Supply Cooking Plant And Fiber Line Upgrade To Phoenix Pulp & Paper In Thailand

May 25, 2011 Helsinki, Finland--(Marketwire) -

Metso Corporation's press release on April 29, 2011 at 10:30 a.m. local time

Metso will supply a cooking plant and a fiber line upgrade to the Khon Kaen mill of Phoenix Pulp & Paper Co. in Thailand. Start-up of the equipment is scheduled for July, 2012. The value of the order is approximately EUR 10 million. The order is included in Paper and Fiber Technology's Q2 2011 orders received.

Metso's delivery will include a two-vessel digester for producing 200,000 tons of eucalyptus pulp per year. The delivery will also include a wash press for the fiber line upgrade. The new cooking system will enable the Khon Kaen mill to increase the
production capacity and utilize the raw material more efficiently. It will also reduce the mill's environmental impact.

Phoenix Pulp & Paper Public Company Limited is a pioneer in pulp products. Founded in 1975, the company is a subsidiary of SCG Paper, one of the leading integrated producers of pulp and paper products in Thailand. Phoenix Pulp & Paper sells its products to customers in Thailand and abroad.

Metso is a global supplier of sustainable technology and services for mining, construction, power generation, automation, recycling and the pulp and paper industries. We have about 28,500 employees in more than 50 countries. www.metso.com

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LIME KILN CONTROL USING ADVANCED REGULATORY CONTROL STRATEGY

MARTIN EMOND AND SERGE NAUD

TOP CONTROL INC.

PRESENTED AT ISA EXPO 2007, 2-4 OCTOBER 2007, RELIANT CENTER, HOUSTON, TEXAS
Lime Kiln Control using Advanced Regulatory Control Strategy
Martin Emond and Serge Naud

- Martin Emond and Serge Naud are process control engineers with Top Control Inc. They specialized in process control optimization, audits, loop tuning and training.
Topics

• Introduction
• Kiln process
• Control strategy
• Conclusion
Introduction

• Lime kiln process
• Great deal of heat required
• Strongly non-linear process
• Benefit of Advance Regulatory Control
Lime Kiln

Lime mud (CaCO₃) flows through the kiln, which consists of three sections: Drying, Heating, and Calcining. The process takes place over a distance of 100 m and takes 3 hours. The kiln operates at temperatures of 110, 315, and 815 Celsius in the drying, heating, and calcining sections, respectively.

CO₂ is released at the wet end, while fuel is added at the dry end. CaO (400 T/d) is produced at the end of the kiln.
Manual Operation

Flow

SP = 815 Deg.C

Fuel

Air

Dry End

Wet End

Kiln

Flow

SP = 815 Deg.C

Fuel

Air

Dry End

Wet End

Kiln

Flow
Energy Balance – Mass Balance

Combustion gases
Fuel
Steam

Heat losses

Chemical reaction

Dry End

Wet End

SP = 815 Deg.C

ID fan

FD fan

Kiln

AT

Fuel

Air

O2

Feed

FC

PT

TT

FV

FV
Kiln Control Strategy

- Dry end control
- Air/Fuel Ratio Control
- ID Fan Control
- Feedforward with Dynamic Compensation

<table>
<thead>
<tr>
<th>CV’s</th>
<th>ID Fan</th>
<th>FD Fan</th>
<th>Feed Rate</th>
<th>Fuel</th>
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<tr>
<td>Feed Flow</td>
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<td>Dry End Temp.</td>
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<tr>
<td>Wet End Temp.</td>
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<td>Pressure</td>
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<td>Fuel Flow</td>
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<tr>
<td>Air Flow</td>
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<tr>
<td>Oxygen Excess</td>
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MV = Manipulated Variable (the controller moves it);
CV = Controlled Variable (the controller tries to control it);
H = Highly correlated, M = Medium correlated, L = Low correlated
Dry end control strategy

- **FC**: Feed Control
- **TC**: Temperature Control
- **PT**: Pressure Control
- **AT**: Air Temperature
- **O2**: Oxygen Concentration
- **Kiln**: Kiln
- **Dry End**: Dry End
- **ID fan**: Induced Draft Fan
- **Wet End**: Wet End
- **Fuel**: Fuel
- **Ratio**: Air/Fuel Ratio
- **SP**: Set Point
- **Rate**: Rate

The diagram illustrates the control strategy for the dry end of a process, focusing on the feed control, oxygen concentration, and temperature control within the kiln and dry end sections.
High Limit zero on override
Air/Fuel Ratio Control Strategy

Operator SP

Feed

ID fan

Wet End

Kiln

Dry End

Fuel SP

Fuel

AC

O2

Σ

+ SP

Ratio

Air

FC

PT

TC

<

High Limit

<

K

Σ

<

0

Rate

Fuel

FD fan

SP
ID Fan Control Strategy
Feedforward with Dynamic Compensation

Operator SP

Feed

Wet End

ID fan

Dry End

Kiln

Fuel SP

Ratio

Air SP

FF Gain + Dynamic Compensation

High Limit

Rate
Other Considerations

- Manage multiple fuel type
  - Fuel/rate relationship and tuning scheduling for every single fuel type
- Start-up conditions
  - From zero production to normal operating zone, the operator take command
- Can production rate be pushed?
  - If Manipulated variable not at limit (ID Fan, FD Fan, Fuel, Feed Rate) and
  - Looking at the signal value that goes to the High Limit zero
Lime Kiln Control Using Advance Regulatory Control Strategy

- Operator SP
- Feed
- ID fan
- TC
- Wet End
- Kiln
- Dry End
- Fuel SP
- Air
- FD fan
- Fuel Ratio
- FF Gain + Dynamic Compensation
- High Limit
- Rate
Conclusion

• Kiln capacity is within process constraints
• Better comprehension of the control strategy for the operators
• The maintenance of this type of control strategy is the most simple due to fact that basic PID controllers are being used and require simple tests to keep them at their best performance
• These simple tests can be easily performed periodically by plant personnel maintenance, operation and engineering in order to validate tuning and feedforward models variation over time.
Thank You!
OPTIMIZING WASTE FUEL BOILER CONTROL WITH MULTIVARIABLE PREDICTIVE CONTROL

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Optimizing Waste Fuel Boiler Control with Multivariable Predictive Control

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KEYWORDS

Multivariable Predictive Control, MPC, Waste Boilers, bark boilers, Hog fuel boilers,

ABSTRACT

Multivariable Predictive Control, MPC, has been used in the continuous process industry for more than a decade. This strategy relies on a model created with test data from the process. The modeling produces a matrix of relationships between the “manipulated variables” and the “control variables” and “constraint variables”

The MPC supervisory control software supplies the DCS, PLC or other regulatory controller with the setpoints for the manipulated variables that will result in the desired control variables and constraint limits. The equations are solved simultaneously on a frequent intervals to provide very tight control of the control variables and constraint limits.

The technique can be applied to many pulp and paper applications including the waste fuel boilers that are an important part of the energy balance at today’s mills. Significant improvements in efficiency have been achieved adjusting the fuel and air flow to the boilers and minimizing the excess O2.

INTRODUCTION

Wood waste is used in paper mills as boiler fuel in far larger quantities today than in previous decades. Because these waste fuel boilers now represent a larger portion of the mill’s energy capacity, the control of waste fuel boilers is critical to matching the steam demand for the pulp mill and paper machines. Just as important, the electrical generation capability of paper mills cannot be managed well without a stable method of control for waste boilers. An overview of the modern paper mill energy users and consumers is shown in Figure 1.

While many paper mills have made large capital investments in boilers to burn waste materials, a growing number of mills are now making the relatively small investments needed to implement “advanced control”. Most waste fuel boilers are installed with standard PID control loops or simple ratio controls for air and fuel. These traditional methods are often not able to keep up with widely fluctuating fuel quality and an inconsistent feedrate from a solids delivery system.
It is understandable that utilities department operators often make the choice to use more expensive, easily controlled fuels when combustion control is difficult. With rising natural gas and oil prices, this is a growing concern. Often the use of the more expensive purchased fuels is the easiest way to operate these boilers within environmental constraints.

**MPC ADVANCED CONTROL**

Multivariable Predictive Control, MPC, has been used in difficult control situations in the refining and chemical industries for more than a decade with very impressive and reliable results. MPC control techniques are being used today for many applications in the pulp and paper mill, such as paper machine cross direction, CD, control for the paper machine, digester control, and lime kiln operations. MPC is improving product quality and operating costs in these applications. It is a control technique well suited for combustion control in waste fuel boiler applications.

MPC projects usually last only a few months from start to finish. The first step is the development of an empirical model of the process to be controlled, in this case a multiple fuel boiler. The model is a matrix of relationships between manipulated variables (the valves, dampers, pumps and motors that can be adjusted) and the control variables (the measurements that are important to the success of the operation). High and low limits on process variables are called “constraints”, and are included in the MPC matrix of control.

Figure 2 shows the addition of the Dynamic Model to the feedback control loop.
The MPC controller uses a set of linear dynamic models, quadratic equations representing the many cause and effect relationships in the process, to predict the effect of future control moves on the controlled and constraint variables. An optimization routine is used to compute a set of future control moves that will minimize any offsets from the desired control values, while simultaneously ensuring that the process constraints are satisfied.

The set of control moves are calculated at each control interval, but only the first calculated move is implemented, by passing a new setpoint to the control blocks in the DCS or PLC. The entire process is repeated at each subsequent control interval. Process measurements are used for feedback to compensate for unmeasured process disturbances. The predictive control technique is shown graphically in Figure 3. At each control interval, the algorithm computes a series of \( m \) future control actions.
This interval, $t+m$, is referred to as the control horizon. The dynamic process models are used to calculate the predicted process response over the prediction horizon of $t+k$ control intervals. The optimization is carried out such that the predicted error for all output variables is minimized across the entire prediction horizon. This is demonstrated in figure 3 below.

The MPC controller regularly calculates the best future setpoints for the control loops in the DCS or PLC. With the constant flow of information from the process, the MPC is able to maintain an optimum control that manual or traditional PID automatic control cannot achieve.

For waste fuel boilers, improved control of the combustion process can be achieved by reducing the level of excess oxygen, which directly translates into improved boiler efficiency. Higher excess oxygen levels indicate more air is flowing through the boiler than is needed to consume the fuel in combustion. The additional air flowing through the boiler results in a measurable heat loss that does not go to steam production.

CONTROL OBJECTIVES FOR WASTE FUEL BOILERS

Waste fuel boilers are increasingly important in mill power plant operations. These boilers have a number of combustion zone configurations such as moving grate, fluidized bed, and pile burning to name a few; however, the boilers typically provide three main functions to the operation:

1. Steam Production (lowers steam costs for the mill)
2. Waste Incineration (reduces solid waste volume)
3. Electricity Generation (lowers or eliminates electrical power costs)

Meeting the steam header pressure demand is of primary concern in a paper mill since low pressure will shut down the paper machine. Depending on the heating value and water content of the waste fuel, it may be necessary to burn supplemental fuel to maintain the boiler steam generation with the
mill pulp and paper production steam demand. Furthermore, some waste fuel boilers operate in ‘batch’ mode, as they require daily waste feed outages to permit removal of the ash created by combustion. Supplemental fuel is needed during these outages as well. Optimal closed-loop control of the boiler throughout these wide operating modes is a challenge.

In Kraft paper mill operations, burning black liquor in the recovery boiler generates green liquor and a significant quantity of steam. Available liquor inventories dictate the steam production from the recovery boiler and, therefore, the recovery boiler is normally operated in a “base-loaded” or static operating mode. Package boilers fired by conventional hydrocarbon fuels such as gas and oil typically operate in a ‘swing’ mode or an “on-demand” basis to maintain the steam header at the desired operating pressure. Advanced control can improve the ability to swing the waste fuel boiler in a more efficient manner and thereby reduce fuel costs associated with the package boilers. Beyond boiler control, additional major energy savings opportunities have been identified and proven throughout the power and recovery area of mills. MPC has been used successfully in all of these operations.

Variability in the heat released by the combustion of the waste fuel often makes control of the waste fuel boiler and the entire steam header very challenging for the plant operators. Waste fuel is a mixture of bark and biomass or sludge treatment operations. The heating value of waste fuel can change dramatically, depending upon the (i) water content and (ii) the proportion of bark to sludge. Northern mills can experience quite severe changes in the waste fuel quality during winter months of operation. Stabilizing the bark boiler operation and improving the overall boiler efficiency can be achieved by improved controls.

Figure 4 Pulp Mill Waste Fuel “Hog Boiler” Diagram
Table 1 provides a realistic example energy balance around a waste fuel boiler in today’s paper mills. The ‘Bone Dry Waste Fuel’ and the ‘Water Content of the Waste Fuel’ combine to give the total mass fed to the boiler (41.3 klbm/hr). For the purposes of this illustrative heat balance, a waste fuel higher heating value (HHV) of 7860 BTU/lbm was used. Bark fuels average around 8500 BTU/klbm\(^1\).

Sludge or biomass typically has lower HHV’s than bark, so as the proportion of sludge or biomass in the waste fuel increases, the HHV decreases. With increasing sludge content, the waste fuel heat release and steam production decrease. Economically, increased sludge processing may reduce landfill or other alternative disposal costs. However, this benefit must be weighed against the resultant loss in steam production and any electricity generation credit.

As the water content of the waste fuel increases (rainstorms or winter conditions), more combustion energy is required for drying the fuel, resulting in less energy available for steam generation. Another negative effect of increased waste fuel water content is a reduction in boiler efficiency. This results from increased stack losses due to improved heat transfer with increased moisture levels. For high water content situations, it may be necessary to burn supplemental fuel (oil, natural gas) to maintain the waste boiler steam output to balance the mill steam production demand.

The overall control objective is to recover as much heat as possible from the flue gas in face of continuously changing waste fuel feed quality. Achieving this objective will result in greater steam production.

The sample heat balance is shown below in Table 1 to illustrate the sensitivity of the waste fuel boiler steam production to (i) the water content and (ii) the sludge content of the feed.

| Table 1 Example Waste Fuel Boiler Heat Balance For A Nominal 110 klbs/h Steam Production at 900 PSIG and 900 DegF |
|---------------------------------------------------------------|-----------------|-----------------|-----------------|
| Bone Dry Waste Fuel (Bark & Sludge) (klbs/hr)                | Base Case       | High Moisture Sludge | MPC Example     |
| Water Content of Waste Fuel (klbs/hr)                        | 15.9            | 15.9              | 15.9            |
| Heat Release of Waste Fuel (MMBTU/hr)                       | 25.4            | 30.8              | 30.8            |
| Energy Release of Waste Fuel (MMBTU/hr)                      | 125             | 125               | 125             |
| Energy Required for Drying (MMBTU/hr)                       | 25              | 30                | 30              |
| Energy available for Steam Generation (MMBTU/hr)             | 100             | 95                | 95              |
| Efficiency (%)                                               | 60              | 60                | 66              |
| Steam Production (klbs/hr)                                   | 108             | 102.6             | 112.8           |

\(^{1}\) Ince, Peter J., 1979, How to Estimate Recoverable Heat Energy in Wood or Bark Fuels, US Department of Agriculture, Forest Service, Forest Products Laboratory
An advanced control scheme can be designed to manipulate the split of under grate air flow to over grate air flow to minimize the excess oxygen (subject to constraints) for changing Waste feed quality. This excess oxygen minimization can be achieved while maintaining steam production at a desired target. The simplified waste fuel boiler schematic has four ‘handles’ or manipulated variables for control.

The waste fuel feeders, the over fire air flow, the under grate air flow and load burner or ‘under grate air preheat’ fuel flow. Actual waste fuel boilers are fitted with multiple waste fuel feeder addition points as well as multiple air injection points, for both the over fire and under grate air flows. Depending on local environmental rules, other control loops may be present to maintain compliance.

**MPC for Waste “Hog Fuel” Boilers**

The heart of an MPC (Multivariable Predictive Control) application is a matrix of dynamic process relationships, which are obtained through controlled plant testing and is conducted in close collaboration with plant operations. Close cooperation between the control engineering team and operations during plant testing and control system commissioning leads to a better understanding of the control objective and ultimately better acceptance by the end user.

The first step in developing an MPC controller is to build a model based on a matrix of control relationships. A series of open loop bump tests on the waste fuel boiler will be done during normal operation, one manipulated variable at a time. Model building software application will enable the control engineer to establish the matrix of cause and effect relationships.

The following matrix in Table 2 shows the process relationships between the controlled objectives (rows) and the manipulated variables (columns), in an ‘open loop’ or manual state of operation. A “+” sign indicates a positive relationship between a pair of variables; likewise a “−” sign indicates a negative relationship exists. For example, a unit increase in the waste fuel feed rate will increase steam production at steady state, reduce excess oxygen and increase the combustion bed level.
Table 2  MPC Matrix of Control

The economic opportunity for an MPC controller strategy is to maximize the efficiency of the boiler operation for changing waste fuel quality (HHV) and load demand on the header. In practice, this is achieved by manipulating the split of over fire air to under grate air to continuously minimize the excess oxygen, subject to a high CO limit. At all times the advanced controller will maximize waste fuel feed while simultaneously minimizing the fuel to the load burners, subject to steam production requirements and other process or environmental constraints.

<table>
<thead>
<tr>
<th></th>
<th>Hog Fuel Feed Rate</th>
<th>Under Grate Air</th>
<th>Over Fire Air</th>
<th>Load Burner Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam Production</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Excess O2</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Bed Level</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Bed Temperature</td>
<td></td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>
MPC BENEFITS

The cost of a well-engineered and executed advanced project is usually recovered in operations savings in less than one calendar year. A typical energy efficiency benefit for MPC on a waste fuel boiler is in the range of 5-15% as illustrated the Heat Balance Table 3.

### Table 3  Steam Production Efficiency improvement with MPC
For A Nominal 110 klbs/h Steam Production at 900 PSIG and 900 DegF

<table>
<thead>
<tr>
<th></th>
<th>Base Case</th>
<th>High Moisture Sludge</th>
<th>MPC Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bone Dry Waste Fuel (Bark &amp; Sludge) (klbs/hr)</strong></td>
<td>15.9</td>
<td>15.9</td>
<td>15.9</td>
</tr>
<tr>
<td><strong>Efficiency (%)</strong></td>
<td>60</td>
<td>60</td>
<td>66</td>
</tr>
<tr>
<td><strong>Steam Production (klbs/hr)</strong></td>
<td>108</td>
<td>102.6</td>
<td>112.8</td>
</tr>
</tbody>
</table>

The third column “MPC Example” shows a boiler efficiency improvement with MPC in operation. For waste fuel boilers, a 1% reduction in excess oxygen improves the overall boiler efficiency by about 3% at constant feed quality and rate. For illustration purposes, it is assumed the excess oxygen could be reduced by 2%. Actual benefits for a given application should be verified on a case-by-case basis and verified by plant trials and analysis.

In this example, the MPC controlled boiler has delivered an additional 10,000 lbs/hr of steam from the same 15,900 lbs/hr of bark and sludge waste. The six percent increase in efficiency means a lower purchased fuel bill for the mill or added income to the mill if it is possible to sell the generated electricity to the grid or direct customers. The cost of the benefits is small compared to the investment in licensing and installing MPC.
ADVANTAGES OF MONITORING THE PERFORMANCE OF INDUSTRIAL PROCESSES

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PRESENTED AT THE 51TH ANNUAL ISA POWID SYMPOSIUM IN 2008
ADVANTAGES OF MONITORING THE PERFORMANCE OF INDUSTRIAL PROCESSES

Martin Emond
Top Control Inc., QC, Canada, and Green Bay, WI, USA

Abstract

A co-generation plant in Eastern Canada automated their operation procedures to improve cost efficiency. Using cost functions, constraints, legal clauses (contract with pulp mills and Hydro-Quebec), and combustible costs, the system minimizes energy costs and selects combustibles, automatically. A consultant designed the strategy and modelled the process and operations. The plant personnel configured the strategies and fine tuned the system with the consultant. Operators, technicians, and managers were trained and actively participated in the system development. All the work was completed within a month. Plant personnel are now totally autonomous: they can modify the system, change priorities, adjust costs, etc. The R.O.I. was less than three months. The system has been used for twelve months without failure, and it has generated excellent benefits.

Keywords

Process Control, Turbine Control, Constraint Control, Desuperheater, Turbine, Split range

1. Introduction

This power house burns primarily bark and in some occasions fossil fuel. Fossil fuel is used when the bark moisture is too high or when the bark quality is poor. This badly affects the heat capacity. The steam generation does not only supply the pulp mill, but also two turbines that generate electricity. The objective is to reach (almost) self-sufficiency.

A new contract with Hydro-Quebec constrains them to buy a maximum of 5 MW; any consumption above this threshold is very costly. The penalty varies according to two rates (H and L), the time of the day, and the day of the week.

In this plant, the steam distribution must be managed such that all steam clients obtain steam in a timely fashion; or else costs are a major concern.

2. The Plant’s Needs and the Approach Chosen

The plant’s managers wanted to be able to master the solution that would be designed by the consultant. That is to say, they wanted to be capable of modifying, refining, and tuning it. They were also concerned about costs.

Furthermore, they wanted to implement a solution that would meet the highest industry standards in terms of % uptime, compatibility with DCS and PLC in place, and communication protocol. Approaches that were considered include model predictive control, fuzzy logic, and advanced regulatory control strategy.
The approach that has been selected is the advanced regulatory control strategy. This approach has many advantages: it requires minimal costs; its robustness is as good as that of the DCS and PLC in place; it uses a proprietary communication protocol; it ensures that the uptime percentage is at maximum; and it involves systems that are well known by the personnel (i.e., the DCS and PLC).

The plant’s personnel was involved in every single step of the solution deployment. As a result, after over a year of operations, the solution is still in place and being used by the operation people. Technicians can maintain tunings of the PID to reflect process model changes over time.

3. The Process

This process consists of three levels of superheated steam pressure (4400kPa, 1140kPa, and 550kPa). The 4400kPa header can feed the two other steam pressure headers through desuperheater valves.

The normal mode of operation is to generate high pressure superheated steam to supply steam to turbine 1 (30 MW); this turbine generates electricity and its exhaust supplies the 550kPa header and turbine 2 (3.3 MW). Similarly, turbine 2 generates electricity and its exhaust supplies the pulp mill.

The two valves on the 550kPa header venting at the atmosphere are only used during start-up procedures.

The five valves 355 A, B, C, D, and E are coordinated by a split range strategy. The first 12.5% of the PIC355 output manipulates both valves 355D and 355E; from 12.51% to 50%, it manipulates valve 355C, which goes to the condenser. The remaining 50% is split evenly between desuperheater valves 355A and 355B.

There are two ways of maintaining the 550kPa pressure: the steam can flow through turbine 1 or through the two desuperheater valves. As an energy stand point, it is much more preferable to let the stream of steam flow through turbine 1. Bypassing turbine 1 reduces the opportunity to produce electrical power. This in turn makes the plant consume more power from Hydro-Quebec, which can lead to a penalty.
However, when the 550kPa drops quickly, the 355 valves A and B compensate for the drop, very quickly. There is approximately a 20% gain of steam that goes through desuperheater valves due to the fact that some water is injected to control the steam temperature. The use of a desuperheater valve is a quick fix, but in the long run, going through turbine 1 is much more efficient in terms of thermodynamics.

The Contract with Hydro-Quebec
The contract stipulates that the plant pays for 5 MW, even if the totality of the 5 MW is not consumed. If the consumption exceeds 5 MW during peak hours, the plant pays a substantial penalty (rate H). If the consumption exceeds 5 MW during off-peak hours, the plant pays the normal rate (rate L). Hence during peak hours, there is a strong incentive to fire a burner, in order to keep the electricity consumption under 5 MW.

However, during off-peak hours, the cost of electrical power is lower than the cost of firing a burner.

The way the contract calculates the purchasing from the Quebec-Hydro, the turbine #2 contribution has a greater weight than turbine #1. This last statement will be a fundamental parameter to take into account in the control strategy.

3. The Right Balance Between the Two Power Sources
If the demand for steam becomes lower than the demand for electrical power, the plant must generate steam to produce specifically electricity. Whenever this situation arises it becomes very cost inefficient, and it is even worse when the heat capacity of the bark is low. When this situation occurs, a burner must be fired to burn fossil fuel in order to compensate for the poor bark quality or the high percentage of moisture.

This plant generates steam for different areas of the paper mill and produces electricity with the left over enthalpy in the steam. Therefore, the 5 MW threshold is critical for the operation efficiency. If the context changes over time, the threshold might have to be modified.

Finally, the planning of shutdowns is complicated since the turbine shutdowns must be synchronized with other areas where they consume steam by the right proportion to stay in balance with the electrical power. Otherwise, they may have to purchase electrical power at a higher cost.
4. The Control Strategy

<table>
<thead>
<tr>
<th>Power Purchasing from Hydro-Quebec</th>
<th>Rate H (Peak Period)</th>
<th>Rate L (Off-Peak Period)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Burner</td>
<td>1 Burner in function</td>
<td>0 Burner in function</td>
</tr>
<tr>
<td>&gt; 5 MW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ignition, decrease purchasing to 5 MW</td>
<td>Decrease purchasing to 5 MW</td>
<td>No ignition, do not decrease purchasing</td>
</tr>
<tr>
<td>Increase purchasing to 5 MW, decrease turbine 2</td>
<td>Increase purchasing to 5 MW, decrease turbine 2</td>
<td>Increase purchasing to 5 MW, decrease turbine 2</td>
</tr>
<tr>
<td>&lt; 5 MW</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Possible scenarios that must be considered in the development of the advanced regulatory control strategy

The control strategy must satisfy all the scenarios included in table 1, and allow flexibility for future contract amendments. (For the sake of simplicity, this part is not shown in the control strategy schematic presented in figure 3.)

Since the calculation of energy costs attributes a greater weight for each MW generated by turbine 2 than for those generated by turbine 1, the control strategy will maximize the usage of turbine 2 first. When turbine 2 saturates, turbine 1 will take over. As shown in figure 3, turbine 2 is mainly governed by the PID of purchasing. Since the bark quality is expected to be good most of the time (in which case no support burner is required), the operating point should require slightly less than 5 MW. However, if the three conditions “(Zero support burner) AND (rate L) AND (Purchasing greater than 5 MW)” are not met, then the PID % Opening of Condenser governs the set point of turbine 2. The third component of the “constraints Turbine 2” box is the availability of the cooling towers. In order for turbine 2 to have some room for increasing its operating conditions, a set point of 33% must be satisfied. Otherwise, turbine 2 will decrease its rate to give back the 33% availability to the cooling towers. In other words, turbine 2 is led by whichever becomes the lowest signal selected by the “constraints Turbine 2” box. If turbine 2 reaches saturation at 3.3 MW and purchasing exceeds 5 MW during peak hours, turbine 1 will increase its production rate in order to keep the energy purchasing below 5 MW.
Overall Control Strategy

- If 0 support burner AND Rate = L AND Purchase > 5 MW Is True then, 1

Figure 3: Control Strategy

- PID % Av. Cool Tower
- PID % Opening of Condenser
- Constraints Turbine 2
- PID Turbine 2

- PID % Sat. Turbine 2
- SWITCH if L, then 50% if H, then PID T2.OUT

- PID 550 kPa ZIC355C2.OUT

- Constraints Turbine 1
- PID Turbine 1

SP=33%

1=Track
0=Un-Track

SP=0%

Low Selector
On the other hand, turbine 1 is mainly governed by the PIC 355 output.

As mentioned earlier, the PIC 355 output consists of a split range. At 50% output of PIC 355, all valves 355 A, B, C, D and E are fully closed. Therefore, turbine 1 will be manipulated such that the PIC 355 output will be kept at 50% as long as rate L is in force.

However, during peak hours (rate H), the PIC 355 output will decrease if the purchasing becomes greater than 5 MW while turbine 2 is at saturation. This implies that steam is produced specifically to generate electrical power. In this situation, the demand for steam does not balance the demand for electricity. Before increasing turbine 1, two constraints must be considered: PID % Saturation of ID Fan (i.e., there must be some room for the manipulation of ID Fan) and PID % Saturation of 4400kPa (i.e., the steam pressure must be ready). Actually, the pressure can go down to 4350kPa before it keeps turbine 1 from increasing its rate.

The ZIC355C2 controls the PIC355 output by manipulating the set point of turbine 1. Therefore, if the PIC 355 output is higher than 50% and turbine 2 is not saturated, then the rate of turbine 1 is increased. That way, turbine 1 will not be bypassed through the two desuperheater valves A and B. If turbine 2 is saturated, it is not worth doing this, because the cost of electrical power is higher for turbine 2, as mentioned previously.

Since the “PID purchasing” is hooked to turbine 2, cranking up turbine 1 to avoid bypassing would result in cutting down turbine 2. Finally, the switch bloc only looks at the rate in force (H or L) and switches between the 50% constant or the output of PID % Sat. of turbine 2, accordingly.

To further refine the strategy, request messages are posted to the HMI (Human Machine Interface) to fire or extinguish the burner. The request messages take into account multiple factors that aim to make the operations as cost effective as possible.

5. Interoperability of the Control Strategy

This control strategy uses very basic functions (such as PID controller, Low select, Logic gate, and fundamental mathematical functions) that can be found in any DCS or PLC on the market. As a result, it is DCS or PLC independent, and the capacity of the DCS or PLC is not a limitation.

6. Results after a Year of Operations

A year later, the strategy is still in place. It is used 90% of the time. (The remaining 10% accounts for special conditions and shutdowns.) Two technicians were involved and trained during the project. In some occasions, the consultant supported them remotely. So, no new software for the client to support, no special gateway for communication and more importantly it has been implemented at the lowest cost possible in their existing DCS and PLC.

About the Author

Martin Emond is a registered professional engineer and author of articles on instrumentation and control. Martin has 19 years of plant experience in several companies and in different fields. He is experienced in solving unusual process control problems. He translates his experience in a very user-friendly manner, in French and English. Martin works for Top Control Inc. He specializes in process control optimization, audits, loop tuning of continuous and batch processes, and training of engineers and technicians.
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**ISA PUPID Calendar**

Get a quick overview of ISA PUPID events for 2002 by going to the Calendar at:  
http://www.isa.org/~pupid/2002_PUPID_Calendar.htm
<table>
<thead>
<tr>
<th>Corner Type</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada Corner</td>
<td>Nothing from anyone there this time!</td>
</tr>
<tr>
<td>Central &amp; South American Corner</td>
<td>Nothing from anyone there this time!</td>
</tr>
<tr>
<td>Far East Corner</td>
<td>Nothing from anyone there this time!</td>
</tr>
<tr>
<td>From the Land of the Midnight Sun</td>
<td>Nothing from anyone there this time!</td>
</tr>
<tr>
<td>European Corner</td>
<td>Nothing from anyone there this time!</td>
</tr>
</tbody>
</table>
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