By Xinsheng Lou, PhD

Time flies. We are quickly approaching the end of 2018 and expecting the advent of the new year.

In this Thanksgiving season, I would like to give thanks for all the support from Power Industry Division (POWID) members and the commitment from the POWID Executive Committee members. Special thanks should go to the POWID 2018 symposium committee for the planning and execution of the 2018 symposium program in the first half of the year. Continuous support from ISA staff and volunteer leadership at the society level is also fully appreciated.

We have been making efforts to extend the division’s technical scope from fossil power and nuclear power to renewable and distributed power, energy storage, and cybersecurity over the past year. We will continue advocating these technologies while we keep working on plant efficiency, emissions, flexibility, availability, reliability, and all the emerging issues affecting power generation and transmission/distribution.

Safety in power plant and power system construction, commissioning, maintenance and operations can never be over-emphasized. There have been fatalities reported in the on-site activities in the power industry worldwide in 2018. In developed countries, safety issues have been addressed more professionally and strictly. More diligence is needed to prioritize safety in the developing countries to enhance the safety training for the workers and improve the safety conditions of the work environment.

I would challenge all the OEMs, construction and EPC companies to review the current work procedures in different phases of the projects - engineering design, manufacturing, product integration, on-site installation and field commissioning and maintenance to make sure that risks to human life are taken very seriously. Risks to human life cannot be simply treated as just one of the KPIs (Key Performance Indicators) for trade-off economic optimization to achieve the most profit. This is what we should consider as automation professionals as well.

I understand that most of us have been following up on the trend of Artificial Intelligence (AI). There has even been a lot of concerns about the future of humans interacting with AI. I personally started using expert systems and artificial neural networks for boiler design and operation monitoring in the mid-1990s when I was in the graduate school. I can see the evolution of the AI algorithms and their impact on the industrial workplace. Nevertheless, I believe that AI technologies should be leveraged with engineering experience to make the power industry better in terms of its safety, efficiency, emissions, flexibility, and economics. I believe that AI will create more advanced digital job opportunities for the automation professionals in the power industry. And we as POWID members are obligated to pass these blessings to the rest of society by practicing as AI technologists with high professionalism and morality.

The 2018 Power Industry Conference Event is still in the works with an exciting new format. The EXCOM members and all the POWID members are invited to make contributions by submitting technical abstracts and volunteering yourselves as leaders to support the conference program planning and execution.

The POWID leaders are always happy to receive inputs and feedback from electric utility users, OEMs, control vendors, universities, government and non-profit organizations on the division, the conference program and the
associated programs. Please be invited to communicate with our division leaders (www.isa.org/powid) if you have any comments – whether positive compliments or constructive criticism.

It is ISA’s consistent goal to make the world a better place with automation technologies. Together we will make ISA POWID the greatest community for us all!

Xinsheng Lou, PhD  
POWID Director 2018/19  
xinsheng.lou@ge.com  
Phone: 1-860-285-4982

**Upcoming ISA Conferences and Events**

**Analysis Division Symposium**

5–9 May 2019  
Galveston, Texas

**49th Annual Fundamentals of Industrial Automation, Instrumentation, and Control Short course**

7–9 May 2019  
ISA Birmingham Section—Birmingham, Alabama

**Process Industry Event**

4–6 November 2019  
Houston, Texas

You can find information on other ISA Events at:  
https://www.isa.org/events-conferences/

Watch the above website for additional details on our upcoming 2019 Power Industry Conference!

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**2018 ISA POWID Symposium Supporters**

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Trend Micro

**Reception Sponsor:**  
AMS

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- SunPort  
- Curtiss-Wright  
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- National Energy Technology Laboratory  
- Bently Nevada, Inc.
It is with mixed feelings that I must say that after 42 plus years in the Power Industry and more than 39 continuous years as a member of ISA and POWID, I am retiring from Southern Company and my ISA related duties on January 31, 2019. I will miss the fellowship and the chance to communicate with you all as the newsletter editor, but I know that even retired I have the same opportunity that you do to contribute articles to the newsletter and hope to be able to do that from time to time. It is comforting to know that I am leaving the newsletter in capable hands as Beth Clarkin did the majority of the work putting together the content for the last edition and all of the work on the content for this edition. Please support her and ISA POWID in the future by contributing articles and reading the newsletters that are produced.

I have been blessed to work with a great group of people over the years and that is the part that I will miss the most. I plan to spend more time with my family and spend more time and effort in serving my Lord and Savior, Jesus Christ. I wish you all His Blessing and hope that you will each get to go on an extended vacation of your own day under His care. If you will allow me to ramble a bit, I would like to share some lessons I have learned over my career.

I worked my way through college working with the public in a lumber yard. I graduated in 1976 at the age of 20 from the Ohio Institute of Technology with a Bachelor of Electronics Engineering Technology. A week later, I joined the Bailey Meter Company in Cleveland, Ohio as an Engineering Cadet where they trained me for three months on electronic and pneumatic instrumentation and control systems. I then moved to Atlanta, Georgia from which I traveled the southeastern U.S. as a Bailey Controls Company (they changed their name) field service representative; that did more to kick start my career in I&C than anything else could have, and it was a true blessing. I would encourage all of those just starting their careers to look for field assignments to gain a lot of experience in a short period of time. I did calibration, troubleshooting, tuning and repair on I&C equipment in a variety of industries during this time and that equipped me to spend seven months as the burner management system startup engineer on a 660-megawatt coal-fired power plant and six months as the boiler control system startup engineer on a 160-megawatt heavy oil-fired power plant.

After four years with Bailey, I left to further my career in engineering and joined BE&K Engineering and Construction in Birmingham, Alabama. There I had an opportunity to serve as the I&C Design lead on Pulp and Paper Industry facilities, mostly associated with their power houses. Shortly after I joined them, I passed the Engineer-in-Training (EIT) exam. Four years later, I took and passed the Professional Engineering Exam and became a P.E. Getting that P.E. license was the second most valuable thing that I did to further my career because it meant that I was truly an Engineer. My biggest accomplishment project-wise at BE&K was serving as the I&C Lead Engineer on a 70-megawatt (thermal) pulverized coal-fired power boiler and a 60-megawatt steam turbine installation at a paper mill in Fernandina Beach, Florida. I spent 17 weeks in the field during the commissioning of that facility.

After over six years with BE&K, an opportunity presented itself to join Southern Company's generation engineering group in Birmingham as a senior I&C engineer. Southern Company was not hiring at that time, so it took six months of discussions with the people who wanted to hire me before I was hired and left BE&K. I desired to join Southern because I enjoyed my time at Bailey working on large central station generation, and BE&K did not do that type of work. Southern would not have been interested in me except for the fact that the two startups that I mentioned that I had done were both Southern Company facilities, and the people at those facilities remembered and recommended me. Another valuable lesson that I want to relay is that it is important to always be courteous and treat everyone that you work with as a respected and valued customer. You never know who you might end up working for some day or who might influence what type of work you end up doing. You also tend to sleep better at night if you treat people right.

Southern provided me many great developmental opportunities for which I am very thankful, and I was able to progress from senior engineer, to engineering group supervisor, to principal engineer and eventually to my position of consulting engineer. Southern also allowed me to participate in ISA conferences and become a member of the ISA POWID executive com-
mittee. I joined ISA while at Bailey because it was recommended to me by a co-worker. I went to BE&K not long after joining ISA and in Birmingham I was able to become active in the local ISA section, which was very involved in technical training. BE&K did not support me traveling to conferences or doing much in the way of outside training, so ISA was very helpful to furthering my career. I also learned that if you write technical papers and offer to present them at these conferences it furthers your growth and makes your company more likely to let you go to those conferences.

As I progressed at Southern, I was also able to represent Southern by participating as a member in the ISA77 standards committee, the NFPA 85 Boiler and Combustion System Hazards technical committees and the ASTM D22.03 stack emissions monitoring technical subcommittee. All of this allowed me to not only increase my technical knowledge but also expanded my technical and social network and allowed me to grow in other ways and become more widely known. My last lesson to share with the early and mid-career people out there is get and stay involved in ISA and other industry groups! I wish you all success and happiness in your careers and life in general.

Sincerely,

Dale Evely, P.E. and ISA Life Fellow
Consulting Engineer, I&C
Southern Company (soon to be retired)
ISA POWID Executive Committee (soon to be retired)

ISA 2018 Annual Leadership Conference

The ISA Leaders Meetings engage a cross-section of ISA volunteer leaders in the policy-setting and decision-making process during 2-4 days of work sessions focused on society business held in a face-to-face setting.

The 2018 ISA Annual Leadership Conference was hosted at Hyatt Regency Montreal in Quebec, Canada on 12 – 15 October, 2018. In the opening session of the ISA Annual Leadership Conference, Mary Ramsey (ISA’s new Executive Director), reaffirmed ISA’s vision, mission statement and values statement and encouraged all leaders to apply these guidelines to the activities of each ISA Section and Division.

In his talk titled “Get More from Your Membership Through Conference Program Development”, Bill Furlow (ISA’s new Business Development Director), shared some new initiatives on re-shaping the technical symposiums by each division. The ISA leaders emphasized that the intention is to enhance the symposiums and their impacts to the industries by consolidating the resources from ISA staff and volunteer leaders.

A Division Roundtable was organized by Kim Belinsky (ISA Divisions and Events Manager), together with the ISA division leaders and ISA section leaders to discuss the roles and responsibilities of the divisions. The following items were voted by six working groups as prioritized division roles: 1) Learn, Educate and Innovate; 2) Have Fun and Create Energy; 3) Create remarkable experiences; 4) Open to Collaboration; 5) Expand to what is possible and find solutions; 6) Make a difference.

Paul Gruhn (ISA President-Elect), hosted a meeting session on “Volunteer Recruiting and Succession Planning”. 

Ashley Weckworth (Director of Chemical Engineering Division and President of Kansas City Section), hosted a session on “Engaging Young Professionals”. POWID has been putting efforts on such work and we will continue to work on volunteer leader recruiting, training and retention.

The 2018 ISA Honors and Awards Gala and Dinner event was hosted on Sunday evening (October 14, 2018) in the same hotel. Newly elected ISA fellows and recipients of the 2018 ISA awards (Technical Presentation, Division Excellence, Section Excellence, Innovation, Enduring Service, Society Service, etc.) were issued certificates in this formal ISA annual event.
ISA POWID Goals for 2018

In 2014, ISA developed and implemented a new model for aligning its vision and mission to strategic goals that, when implemented, will align the needs of key stakeholders with the membership as a whole. In 2017, the Power Industry Division adopted the framework (see figure below) that was established by the vision and completed 80% of the measurable goals.

Areas that have been given a focus for 2018 are:

**Coolest Delivery:**
- To conduct a web cast with technical papers from symposium recommended by POWID EXCOM; and
- To advertise annual symposium with video feedback of prior attendees
- To continue and improve social networking through LinkedIn

**Advocacy:**
- Advocate ISA POWID events via IFAC, IEEE, universities, EPRI, and DOE
- Identify marketing focus for young professionals and engagement in annual symposium
- Continue Student Career Development Forum (SCDF) at annual POWID symposium

**ISA Code of Ethics:**
- Encourage POWID members, in particular EXCOM members to review the ISA Code of Ethics and use it as the guideline in ISA activities and business conduct.
This summary note presents POWID goals and highlights some of the key activities that are taking place within POWID during 2018 in order to deliver value to its membership while also meeting the goals that support ISA’s vision.

## CONTENT

POWID will develop timely, relevant content on important topics to meet the career enhancement and professional development needs of automation within the electric power industry.

### Goal Status

![Goal Status Graph]

<table>
<thead>
<tr>
<th>% Complete</th>
<th>January-April</th>
<th>May-August</th>
<th>September-December</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
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<td>120%</td>
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</tbody>
</table>

- **Expected**
- **Actual**

### OBJECTIVES

**Engage university students and young professionals**

- Identify a candidate for the Robert N. Hubby scholarship prior to annual symposium: **Done**

- Reward a candidate for the achievement award recipient scholarship: **In-Progress**

- Continue Student Career Development Forum at annual symposium: **Done**

- Identify marketing focus for young professionals and engage in annual symposium: **In-Progress**

**Advocate ISA POWID events via IFAC, IEEE and relationships with universities, EPRI, and DOE**

- Invite IFAC TC 6.3 members to participate in POWID meetings and symposium: **In-Progress**

- Invite professionals on power and automation to join ISA and POWID: **Done**

- Nominate candidates for POWID achievement, services and facility awards: **Done**

- Share POWID 2018 Call-For-Papers with IFAC, IEEE, EPRI, DOE and universities: **Done**

<table>
<thead>
<tr>
<th>OBJECTIVES</th>
<th>ACTIONS</th>
<th>STATUS</th>
<th>CATEGORY</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engage university students and young professionals</td>
<td>Identify a candidate for the Robert N. Hubby scholarship prior to annual symposium</td>
<td><strong>Done</strong></td>
<td><strong>3</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reward a candidate for the achievement award recipient scholarship</td>
<td><strong>In-Progress</strong></td>
<td><strong>2</strong></td>
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<tr>
<td></td>
<td>Continue Student Career Development Forum at annual symposium</td>
<td><strong>Done</strong></td>
<td><strong>3</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identify marketing focus for young professionals and engage in annual symposium</td>
<td><strong>In-Progress</strong></td>
<td><strong>2</strong></td>
<td></td>
</tr>
<tr>
<td>Advocate ISA POWID events via IFAC, IEEE and relationships with universities, EPRI, and DOE</td>
<td>Invite IFAC TC 6.3 members to participate in POWID meetings and symposium</td>
<td><strong>In-Progress</strong></td>
<td><strong>2</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Invite professionals on power and automation to join ISA and POWID</td>
<td><strong>Done</strong></td>
<td><strong>3</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nominate candidates for POWID achievement, services and facility awards</td>
<td><strong>Done</strong></td>
<td><strong>3</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Share POWID 2018 Call-For-Papers with IFAC, IEEE, EPRI, DOE and universities</td>
<td><strong>Done</strong></td>
<td><strong>3</strong></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL** 21  
**PERCENT** 88%  

Color Code: **Red**–Below Expectation; **Yellow**–On Schedule; **Green**–Done
POWID will use data to understand trends, make decisions, and develop products and services that align with market needs.

<table>
<thead>
<tr>
<th>OBJECTIVES</th>
<th>ACTIONS</th>
<th>STATUS</th>
<th>CATEGORY</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use feedback to direct changes and continual improvement activities</td>
<td>Use EPRI and ISA data &amp; feedback for POWID to direct annual symposium Marketing by analyzing the Voice of the Customer (VOC)</td>
<td>Done</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Collect feedback of membership and symposium attendees</td>
<td>Use feedback forms during and after annual symposium to collect areas for improvement and areas to continue what works well</td>
<td>Done</td>
<td>3</td>
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<td></td>
<td>Collect feedback from suspended members by email survey</td>
<td>In-Progress</td>
<td>2</td>
<td></td>
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<tr>
<td></td>
<td>Collect feedback from members through member survey</td>
<td>In-Progress</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Track progress on goals aligned to 5 strategic directions</td>
<td>Keep a document with living updates (review once/quarter and provide feedback to Executive Committee)</td>
<td>In-Progress</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Identify and implement method(s) to streamline the process</td>
<td>In-Progress</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Color Code: Red—Below Expectation; Yellow—On Schedule; Green—Done

TOTAL 14

PERCENT 78%
Coolest Delivery

POWID will deliver industry-leading content via multiple platforms in an engaging, easy-to-use, and interactive way.

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**Goal Status**

<table>
<thead>
<tr>
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<th>January-April</th>
<th>May-August</th>
<th>September-December</th>
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</thead>
<tbody>
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<td><strong>% Complete</strong></td>
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<td>120%</td>
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</tbody>
</table>

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**OBJECTIVES**

1. Utilize web-based technologies to deliver content and messaging
   - Conduct a web cast with technical papers from symposium recommended by POWID EXCOM
   - Planning
   - Score: 1
   - Done
   - Score: 3
   - Done
   - Score: 3
   - Done
   - Score: 3

2. Identify a plan to transition to more streamlined delivery of information
   - Scope a plan for transitioning delivery of key information to a virtual platform
   - Planning
   - Score: 2

**Color Code:** Red—Below Expectation; Yellow—On Schedule; Green—Done

**Total Score:** 12

**Percent Complete:** 80%

---

**Actions Table**

<table>
<thead>
<tr>
<th>OBJECTIVES</th>
<th>ACTIONS</th>
<th>STATUS</th>
<th>CATEGORY</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilize web-based technologies to deliver content and messaging</td>
<td>Conduct a web cast with technical papers from symposium recommended by POWID EXCOM</td>
<td>Planning</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Continue using mobile app for annual symposium</td>
<td>Done</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advertise annual symposium with video feedback of prior attendee</td>
<td>Done</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Continue and improve social networking through LinkedIn</td>
<td>Done</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Identify a plan to transition to more streamlined delivery of information</td>
<td>Scope a plan for transitioning delivery of key information to a virtual platform</td>
<td>Planning</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL Score:** 12

**PERCENT Complete:** 80%
Cybersecurity

POWID will utilize ISA’s resources and expertise related to the cybersecurity of automation and control systems used across the electric power industry.

<table>
<thead>
<tr>
<th>OBJECTIVES</th>
<th>ACTIONS</th>
<th>STATUS</th>
<th>CATEGORY</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide a platform for presentation and discussion of the latest industry activities in Cyber Security</td>
<td>Continue track on Cyber Security at POWID 2018</td>
<td>Done</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communicate availability of ISA’s cyber security standards and publications to target market for annual symposium and membership</td>
<td>In-Progress</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>Collaborate with leading industry organizations to addressing cyber security concerns</td>
<td>Identify areas for collaboration on cyber security with EPRI, ISA, OEMs, and other relevant organizations</td>
<td>In-Progress</td>
<td>2.3</td>
<td></td>
</tr>
</tbody>
</table>

Color Code: Red—Below Expectation; Yellow—On Schedule; Green—Done

<table>
<thead>
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<th></th>
<th>TOTAL</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.5</td>
<td>83%</td>
</tr>
</tbody>
</table>

Goal Status

- Expected
- Actual

January-April
- 20%
- 40%
- 60%
- 80%
- 100%

May-August
- 40%
- 60%
- 80%
- 100%
- 120%

September-December
- 60%
- 80%
- 100%
- 120%
Advocacy

POWID will increase understanding and awareness of automation across all age groups, resulting in enhanced proficiency of automation as a profession.

### OVERALL STATUS OF POWID GOALS

For more information on POWID’s goals for 2018, please contact Xinsheng Lou (POWID Director) at xinsheng.lou@ge.com and and Aaron Hussey (POWID Past Director) at aaron.hussey@int-analytics.com.
Welcome once again to Dr. Gooddata country. Last time we got together we completed the equation of the systematic standard uncertainty for compressor efficiency. That equation was:

\[
\frac{\hat{b}_\eta}{b_\eta} = \left[ \left( \frac{\hat{\eta}_c}{\partial P_1} \right)^2 \left( b_{P_1} \right)^2 + \left( \frac{\hat{\eta}_c}{\partial P_2} \right)^2 \left( b_{P_2} \right)^2 + \left( \frac{\hat{\eta}_c}{\partial T_1} \right)^2 \left( b_{T_1} \right)^2 + \left( \frac{\hat{\eta}_c}{\partial T_2} \right)^2 \left( b_{T_2} \right)^2 \right]^{1/2} + \left[ 2 \left( \frac{\hat{\eta}_c}{\partial T_1} \right) \left( \frac{\hat{\eta}_c}{\partial T_2} \right) \left( b'_{T_1} \right) \left( b'_{T_2} \right) \right]
\]

(1)

We also had available a table of the values of the partial derivatives that was completed two articles ago. They were:

\[
\frac{\hat{\eta}}{\partial P_1} = -0.0384
\]

(2)

\[
\frac{\hat{\eta}}{\partial P_2} = +0.00588
\]

(3)

\[
\frac{\hat{\eta}}{\partial T_1} = +0.00340
\]

(4)

\[
\frac{\hat{\eta}}{\partial T_2} = -0.00182
\]

(5)

We also took a hard look at the uncertainties associated with the pressures and temperatures. The overall summary was as shown in the table below:

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYSTEMATIC STD. UNC.</th>
<th>RANDOM STD. UNC.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(P_1)</td>
<td>0.010 psia</td>
<td>0.03 psia</td>
</tr>
<tr>
<td>(P_2)</td>
<td>0.085 psia</td>
<td>0.17 psia</td>
</tr>
<tr>
<td>(T_1)</td>
<td>0.41 R</td>
<td>0.57 R</td>
</tr>
<tr>
<td>(T_2)</td>
<td>0.82 R</td>
<td>0.67 R</td>
</tr>
</tbody>
</table>

However, we needed to take a deeper look at the systematic standard uncertainties for temperature as some of them may have arisen from correlated errors. The deeper look table of the details of the elemental uncertainties that were root-sum-squared to yield the values in the table above are shown in the table below:
Now we need to substitute the parameter levels and their uncertainties into Equation (1) to obtain the systematic standard uncertainty for compressor efficiency. When that is done, we obtain Equation (6) following:

\[
b_\eta = \left[ (-0.0384)^2 (0.010)^2 + (+0.00588)^2 (0.085)^2 + (+0.00340)^2 (0.41)^2 + (-0.00182)^2 (0.82)^2 \right]^{\frac{1}{2}} (6)
\]

\[
= \left[ 0.1474 + 0.2498 + 1.9432 + 2.2273 - 2.08041 \right]^{10^{-3}} = 0.0016
\]

Therefore, the systematic standard uncertainty for efficiency is 0.0016 in efficiency units.

From a previous Dr. Gooddata, we determined that the random standard uncertainty for efficiency was 0.0027.

If we now assume many degrees of freedom, we may calculate the expanded uncertainty in efficiency. It is:

\[
U_{total} = \left[ b_\eta \right]^2 + \left( s_{x,\eta} \right)^2 = \left[ (0.0016)^2 + (0.0027)^2 \right]^{\frac{1}{2}} = 0.00314
\]

(7)

This is the standard uncertainty of the efficiency. The total uncertainty of efficiency, at 95% confidence would then be:

\[
U_{95} = (2) \left[ b_\eta \right]^2 + \left( s_{x,\eta} \right)^2 = (2) \left[ (0.0016)^2 + (0.0027)^2 \right]^{\frac{1}{2}} = 0.0063
\]

(8)

Whoa! Where did that “2” come from in Equation (8) and what’s this “degrees of freedom” comment? That “2” results from the degrees of freedom being over 29 and the applicable Student t being “2” for 95% confidence.

This is the final Dr. Gooddata article. It has been my pleasure to supply these writing. I do hope they have been useful for you all. Remember, use numbers not adjectives. ‘Bye!

**Editor's note:** ISA POWID wants to thank Ron for his contribution of this series of Dr. Goodata articles. You can contact Ron via e-mail if you have any questions. You can locate previous articles in the [POWID newsletter archive](http://www.ourwebsite.com) on our website.
The Best Technical Papers from the 2018 ISA POWID Symposium

During the ISA POWID Symposium and Awards Luncheon in 2018, Awards for the Best Papers for the 2018 POWID Conference were presented. In the last issue, we ran one of two articles that tied for the 2nd Best Paper Award. The other such paper, “Exploring Molten-Salt Reactor Dynamic Behavior and Control Strategies,” was written by Vikram Singh, Alexander M. Wheeler, Ondřej Chvála and Belle R. Upadhyaya. The paper is provided in its entirety in this newsletter for your reading pleasure.

Exploring Molten-Salt Reactor Dynamic Behavior and Control Strategies

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KEYWORDS
Molten-salt reactor, dynamic modeling, fission product poisoning, sensitivity analysis, reactor control, load-following strategy

ABSTRACT

Molten-Salt Reactors (MSRs) are a class of reactors that have recently attracted research and development interest by private industry and public institutions alike. These reactors are considerably different from the current fleet of light-water reactors and outside the experience base of most nuclear engineers. The fluid nature of the fuel leads to new phenomena including delayed temperature and reactivity feedback effects which are specific to each reactor design concept and need to be characterized to determine operability and safety limits. Moreover, the design space under consideration encompasses various fuel-cycles, neutron spectra, and materials. This requires a modeling methodology that can be applied to the breadth of designs under development. Ongoing research efforts at the University of Tennessee have led to a dynamic modeling approach that was verified against experimental data from the Molten-Salt Reactor Experiment. The developed lumped-parameter models are nonlinear and represent the changes in mass, energy, and process parameters in all parts of the reactor plant. The reactivity feedbacks arising from changes in temperature and neutron poison concentrations are also considered. Besides studying response to reactivity perturbations, these models can be used to examine the sensitivity of reactor response to changes in system parameters both in time and frequency domains. This modeling approach has been extended to the two-fluid Molten-Salt Breeder Reactor and is currently being applied to other generalized MSR designs - both thermal and fast reactors - to characterize control strategies. Modeling results suggest that MSRs with sufficient negative feedback exhibit excellent load-following characteristics that can be leveraged to develop control system designs, thus providing a great deal of autonomy.
INTRODUCTION

The growing need to address pollution and climate change has led to a reevaluation of nuclear energy for electricity production. While nuclear energy has long promised less expensive electricity and reduced greenhouse gas emissions, economic and safety-related hurdles have stemmed widespread adoption. Nuclear reactors initially saw accelerated growth but accidents at Three Mile Island, Chernobyl, and Fukushima stoked public fears. These concerns led to stringent safety regulations hurting economic competitiveness. Nonetheless, there are 99 nuclear reactors operating in the United States (as of the writing of this paper) fulfilling ~20% of electricity demand\(^1\). Recent trends in the nuclear industry paint a rosier picture. Novel reactor designs professing solutions to problems faced by the aging fleet of Light-Water Reactors (LWRs) are attracting industry interest. One such design is the Molten-Salt Reactor (MSR).

MSRs are liquid-fueled reactors where a molten carrier salt mixed with fissile material is circulated through the core. The heat generated from fission is deposited through a heat exchanger into a secondary salt. The molten-salt fuel is immune to radiation damage and affords unique advantages such as operation at ambient pressure, possibility of online refueling and reprocessing, inherent passive safety, load-following through reactivity feedback, etc. [1, 2] The advantages offered by MSRs have attracted industry interest with many entrepreneurial ventures in motion as of 2018 [3]. The design space being investigated comprises of various fuel cycles, salt chemistry, and neutron-spectra. Thus, the novelty and broad design space means there is unfamiliarity with the specifics of reactor behavior. The reactor period which is an important parameter for control purposes is strongly dependent on delayed-neutron precursors. However, in MSRs, the circulating fluid fuel leads to a portion of the delayed-neutron precursors decaying outside the core. The remaining precursors are reintroduced into the core after some circulation time causing delayed temperature and reactivity feedback effects [1, 2]. This is further complicated by changes in fuel salt composition with burnup leading to an evolution of dynamics parameters. As a result, new control methods need to be explored.

Developing control strategies is usually accompanied by the development of dynamic models of various levels of complexity that can accurately depict the behavior of the reactor plant during deviations from nominal operation. These models accurately account for the physical phenomena occurring in the plant and output process variables of interest such as power, and various temperatures, pressures, flow rates etc. Moreover, a reactor plant has myriad independent variables that can affect the process behavior. Establishing the range of these variables and the sensitivity of the plant output within these ranges is of paramount importance to reactor safety and operability. Thus, such models can help in isolating parameters of interest for further investigation.

Recent work carried out by the authors resulted in a dynamic modeling approach for MSRs that is applicable to a wide variety of designs while being sufficiently accurate without excessive computational requirements. The models make use of nonlinear point-kinetics for neutronics coupled with a lumped-parameter description of the various components of the reactor plant. This modeling approach was validated against experimental data from the Molten-Salt Reactor Experiment (MSRE) [4]. The MSRE was an 8MW(th) graphite-moderated reactor that was the result of pioneering work in the early 60s at

\(^1\) Nuclear Energy in the U.S. - https://www.nei.org/resources/statistics
Oak Ridge National Laboratory (ORNL). It operated for \( \approx 9000 \) full power hours and demonstrated the viability and, to a certain extent, the long-term operability of MSRs. To this date, it is the only archetypal power-operated MSR for which well-characterized experimental data exists. It serves as the default departure point for all MSR studies. Therefore, the model developed in Ref. [4] was benchmarked against MSRE data both in time and frequency domains. This modeling approach has since been extended to the two-fluid Molten-Salt Breeder Reactor (MSBR) [2].

This paper highlights results from a sensitivity analysis and load-following maneuver performed using the dynamic model of the MSBR. A brief overview of the MSBR and the application of the dynamic model to studying parameter sensitivities and load-following is discussed. Sensitivity plots for selected parameters are presented for both the time and frequency domains and their effect on reactor control discussed. The load-following behavior of the MSBR after accounting for reactivity effects related to Xenon-135 and Samarium-149 poisons, is presented. This is followed by a discussion of the observed dynamic characteristics with recommendations for applicable control strategies. Finally, the main conclusions are listed.

Fig 1. Schematic of the two-fluid molten-salt breeder reactor. (Source: ORNL-4528, 1970 [2]).
MOLTEN-SALT BREEDER REACTOR

The two-fluid MSBR was conceived at ORNL in the late 60s [5]. As the name implies, the MSBR circulates two separate LiF-BeF₂ (FLiBe) salt loops in the core – one carrying ²³³UF₄ (fuel salt), and the other ²³²ThF₄ (fertile/blanket salt). The MSBR was designed specifically to achieve high conversion ratios in the thermal spectrum utilizing the thorium cycle. Thorium occurs on Earth almost entirely as Th-232 which is a fertile isotope capable of absorbing a neutron and transmuting to U-233 – a fissile isotope. Thus, natural thorium needs to be exposed to neutrons to form usable fuel for a nuclear reactor. The two-fluid MSBR accomplishes this by employing a matrix of hexagonal graphite channels designed to keep the fuel salt separate from the fertile salt. This separation greatly simplifies the chemical processing needed to separate bred fissile material. The fertile salt is circulated both through the interstitial spaces of the graphite matrix and in a surrounding under-moderated annular region to increase exposure to neutrons. Each salt loop is circulated through a tube-and-shell heat exchanger where the heat produced from fission and radioactive decay is exchanged with a coolant salt. The coolant salt is just the FLiBe salt without the fissile material. This choice ensures that a leakage in the heat exchanger does not result in salt contamination or deviations in salt chemistry that could interfere with reactor operation. The reactor design is modular with four modules each producing 556 MW(th). The heat from fission is used to convert water into superheated steam in a conventional boiler-reheater system. A schematic of the MSBR is shown in Figure 1.

The details of the modeling methodology adopted here and model validation against experimental data are elaborated in Ref. 4. The details of the MSBR model, that is used here, are given in Ref. 2. The model consists of the reactor core, fuel-salt and blanket-salt heat exchangers, and a constant heat removal system substituted for a boiler-reheater. These components are modeled using lumped-parameter differential equations that track changes in mass and energy as a function of time. The reactivity feedbacks arising from temperature changes in the core and changes in reactor poisons are accounted for in the model. Reactivity perturbations can be introduced through both operator action, that is, movement of control elements, and through internal variations in flow rate, temperatures, heat transfer coefficients, load-demand, etc. The model outputs neutron density, temperatures and flow rates in the various components, and the total reactivity feedback of the system. The reactor power is assumed to be directly proportional to neutron density.

Besides displaying reactor behavior for reactivity perturbations, this dynamic model can be applied to study the dependence of measured outputs such as power, or hot leg and cold leg temperature to fluctuations in input parameters. This model can also be utilized to observe the response of the MSBR system to changes in load-demand. This paper presents results from simulations, not published before, with the aim of exploring the parameter sensitivities and control strategies.

SENSITIVITY ANALYSIS

Sensitivity analysis is a mathematical technique employed to determine how changes observed in the output of a multiple input multiple output system can be apportioned to uncertainties/changes in the various system parameters. The results presented here are from a sensitivity analysis performed using the ‘one-at-a-time’ or OAT approach, where only one input variable is perturbed at a time while setting
all other variables to their nominal values. The resulting changes in system response for power, temperature, and other output state variables can be observed in both time and frequency domains. OAT is the simplest approach to execute but has the drawback of not accounting for correlations between input variables. More sophisticated techniques exist for such analyses which are not presented here.

A reactor plant such as the MSBR can potentially have hundreds of independent parameters. However, not every parameter is equally important with regards to affecting reactor power. Optimizing parameters can be both time consuming and expensive. Having hundreds of parameters only compounds this problem. Hence, sensitivity analysis can greatly simplify plant optimization by sorting parameters according to the magnitude of their effect on process outputs. Furthermore, such analysis can help establish safety margins, inform design and maintenance decisions, and form control strategies.

An ideal version of this analysis would include an exhaustive examination of every independent parameter in the system and various combinations of these parameters. Since the goal here is the demonstration of this modeling technique for studying sensitivities, only a few parameters that have a significant effect on reactor power and are expected to change with burnup are considered. These are: fuel heat capacity, fuel temperature reactivity feedback, mean generation time, and delayed-neutron fraction. The model inputs for the MSBR are borrowed from Ref. [5] which provides these values without quoting associated uncertainties. In the absence of this information, the sensitivity analysis is carried out by perturbing the quantities of interest by fixed amounts about their nominal values.

**RESULTS FROM SENSITIVITY ANALYSIS**

**TIME DOMAIN**

Time domain plots lend themselves to intuitive interpretation. It is also the type of data seen by operators when an event occurs. Figures 2 and 3 show the response of the reactor power, as well as cold leg and hot leg temperatures to a +20 pcm (20x10^{-5} dk/k) reactivity step insertion. The chosen reactivity input is illustrative only and may be introduced by means of control rod movement. The respective input parameters are varied one-at-a-time by ±5%, ±10%, and ±15% about their nominal values.

Fuel-salt in an MSR is well-mixed and hence an intrinsic property such as specific heat capacity evolves with burnup due to fission product accumulation. The mean generation time and delayed-neutron fraction change due to build-up and eventual burning of fissile isotopes such as Pu-239 in LEU-fueled MSRs. Likewise, the fuel temperature feedback coefficient may change for a given reactor configuration with changing isotopic concentrations.

The reactor power changes quickly following a step reactivity insertion, resulting in a prompt jump. This is accompanied by a sharp increase in the hot leg temperature. This temperature increase leads to negative feedback which starts to curtail the initial spike in power. Meanwhile, the cold leg temperature remains unaffected until the “warmer” salt from the initial reactivity perturbation makes its way through the heat exchangers and back into the core. This relatively warmer salt momentarily stabilizes power response leading to secondary and tertiary peaks. This behavior is unique to circulating fuel reactors. Deviations in certain parameters lead to a pronounced difference in the initial peak, whereas other parameters affect
secondary peaks. These features are clearly noticeable in the above figures. However, the MSBR may display heightened sensitivity to changes in parameters for reactivity perturbations of a different frequency.

Fig 2. Power, cold leg, and hot leg temperature response for variations in: (i) fuel salt heat capacity, and (ii) fuel temperature feedback coefficient.
Fig 3. Power, cold leg, and hot leg temperature response for variations in: (i) mean generation time, and (ii) delayed-neutron fraction.
Time domain results showed the differences in the MSBR’s response to a +20 pcm step reactivity insertion due to changes in system parameters. The frequency domain results compare the response of the MSBR to a ±1pcm sinusoidal reactivity insertion for a range of frequencies. With the OAT method in this case, each of the selected parameters is changed by +20%. The ratio of the magnitudes of the perturbed cases and the nominal case are plotted against frequency in Figure 4.

It is observed that the power response of the MSBR is more pronounced for reactivity insertions at certain frequencies. Moreover, each plot shows different characteristic peaks and valleys. In an operating reactor, these characteristic features at different frequencies present an opportunity to determine changes in reactor parameters by measuring power response. For instance, in an LEU-fueled MSR, plutonium...
diversion would certainly change the delayed-neutron fraction. This change can be detected by measuring the reactor response using pre-calibrated instruments to reactivity perturbations of different frequencies. This trait could potentially be leveraged in a safeguarding regime.

LOAD-FOLLOWING

Load-following refers to the mode of operation of a power plant in which it responds to fluctuations in load-demand. This is typically carried out in nuclear power plants (NPP) by moving control rods or by altering recirculation flow rate. The rate of feasible load-following maneuvers in NPPs, however, is limited by the build-up of neutron poisons, most notably Xenon-135 and Samarium-149. These nuclides are produced both directly as fission products and through radioactive decay of other fission products. Both these nuclides are very strong neutron absorbers, and an increase in their concentrations introduces large negative reactivity. Xe-135 is radioactive and decays with a half-life of \( \approx 9.2 \) hours, whereas Sm-149 is stable and its concentration can only be reduced by neutron absorption. Hence, delayed reactivity effects associated with these poisons are the main barrier to load-following [6]. MSRs offer a distinct advantage in this regard as the fuel is a well-mixed fluid. Unlike LWRs where fission products are trapped in fuel pellets, Xe-135 bubbles out of the solution when solubility limits are reached. It is collected using an off-gas system and allowed to decay outside the core. Sm-149 forms a stable compound and remains in solution. It may be separated via online reprocessing. This ability to remove reactor poisons when coupled with strong negative feedback allows some MSR designs to load-follow without controller action.

The load-following ability of the MSBR is discussed in detail in Ref. [2]. For this paper, the MSBR model was expanded to include the effects of Xe-135 and Sm-149 poisons. Standard Bateman equations for time rate of change in the concentration of these nuclides and their parents were implemented [7]. An additional off-gas removal term was used for Xe-135 [8]. Figure 5 shows the uncontrolled response of the MSBR to arbitrary changes in load-demand introduced instantaneously at various times over a period of 12 hours. The flow rates of all the fluids in the system are held constant. Changes in load-demand translate to changes in temperature that are propagated through the fluid loops with negligible time lag dictated by the flow rates. The resulting feedbacks compensate for the variation in load-demand and the power-level moves accordingly. The fuel salt hot leg and cold leg temperatures are observed to vary about a constant average and no safety limits are breached. The associated concentrations of the reactor poisons also change because of the power fluctuations. Xe-135 follows the load-demand profile closely as it is removed through off-gassing, burnup, and radioactive decay. Sm-149, on the other hand, continues to build-up after a reduction in power-level since it is a stable isotope and is not removed through any reprocessing in the model. However, the inherent feedback mechanisms are substantial enough to compensate for the neutrons lost to Sm-149 absorption and rapidly respond to an increase in load-demand.
CONTROL STRATEGY

The load-following capability of the MSBR (and other such MSRs) lends itself to operation with little to no controller intervention. Control rods need only be used to set the average temperature in the core. The load-demand on the system governs the temperature difference across the core. An upper bound should be imposed on the power-level to prevent the cold leg salt from freezing [2]. It is observed, within the implicit limitations of the model, that no rate of change in load-demand is insurmountable by the system feedbacks alone. In other words, the ability of the system to load-follow seems to be restricted only by mechanical and thermodynamic limits of the thermal energy conversion system. With such an innate tendency of the reactor to adhere to load demand, any approach to reactor control should incorporate this behavior. The simplest strategy is to let the reactor follow the load and to utilize control rods to set the desired average temperature in the core. An interesting effect is observed here that is not seen in LWRs. For example, consider an MSR that needs to produce 110% power for some short period.

Fig 5. Load-following maneuver with MSBR.
of time. In this scenario, say the hot leg temperature is close to its safety margin but there is considerable room to vary the cold leg temperature. The operator could then lower a control rod to introduce a small step change in negative reactivity and reduce the average temperature in the core. The load-demand on the system coupled with the negative feedback will set a new temperature difference across the core, allowing the reactor to reach 110% power. Thus, with such temperature constraints, one would lower a control rod to achieve higher power levels in an MSR. This example also goes to illustrate the changes in regulatory framework needed to cover MSRs.

As intermittent renewable energy sources are incorporated into the grid, it has become increasingly desirable and valuable to operate small integral reactors in the load-follow mode. The inherent negative feedback in MSR designs provides a self-regulating feature. This can be further enhanced by supplementing a T-average program as the set point for average fluid temperature control.

**CONCLUDING REMARKS**

Nonlinear dynamic models of molten-salt reactors are developed for different MSR designs. Such models are used for understanding the transient reactor behavior, effects of fission product poisoning, sensitivities of various physics parameters on system response, and for the development of control strategies. The integration of renewal energy sources and traditional energy sources in a power grid requires that nuclear reactors be capable of load-following without inducing economic and physical stresses. The results of the work presented indicate that MSR designs could be tuned to satisfy these requirements. While instrumentation challenges remain, MSRs offer a safer design for nuclear power generation that has potential to be economically competitive. Future work involves the development of instrumentation systems that enhance reactor monitoring, diagnostics, and control thus leading to near autonomous plant operation.

**ACKNOWLEDGMENTS**

This research and development at the University of Tennessee is being funded by a grant from Oak Ridge National Laboratory and by Flibe Energy Corporation. The authors are indebted to these organizations for their generous support.

**REFERENCES**


The Only Tools You Need
A while back your newsletter editor was at one of his company’s generating plants (not to be named) in the southeastern United States and saw a 3D graphic version of an engineering flowchart that says it all; and here it is:

![Engineering Flowchart](image)

This flowchart shares the widespread belief in this part of the country that you can fix just about anything if you have enough WD-40 oil and duct tape.

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POWID Awards Nomination Request to All POWID Members

Each spring, ISA and POWID presents awards and scholarships to individuals and facilities based on nominations from ISA and POWID membership. This is ISA’s and POWID’s way of recognizing outstanding contributions and performance. The awards are quite unique and represent peer recognition across the power automation industry.

Perhaps you also have a deserving colleague or have seen a facility that should be considered for an ISA award. Or perhaps you know a student that should be considered for a scholarship. Please nominate that person, or an exemplary Power Facility for a POWID award as listed below:

- POWID Achievement Award
- POWID Service Award
- POWID Facilities Award
- Robert N. Hubby Academic Scholarship

The Achievement Award recognizes individuals whose efforts have advanced the generation of electrical power. These efforts are exemplified through the individual’s outstanding achievements, original design application, or special contributions toward the development of engineering concepts in the field of instrumentation and controls within the power industry. The recipient of this award selects a deserving college student for an ISA scholarship ($4000).

The Service Award is for outstanding service to POWID. The service of the individual must be noteworthy, exemplary, and exceed the normal duties of the office held. The service is of a nature that advances the stature of the Power Division and/or ISA.

The Facilities Award was created to honor facilities that demonstrate innovative application of control systems or instrumentation technology within the power industry.

The Robert N. Hubby Academic Scholarship is POWID’s most esteemed scholarship and is awarded to a deserving student meeting the rigid technical requirements. Students may apply for the Robert N. Hubby Scholarship ($4000).

Nomination forms for these POWID awards and the Scholarship are available through the POWID website at: https://www.isa.org/division/powid/honors-and-awards/.

Recognize deserving colleagues and facilities by nominating them for an award. Submit questions or forms to the ISA POWID Honors & Awards Coordinator, Don Labbe at Donald.Labbe@Schneider-Electric.com.

If you don’t see a deserving POWID member’s name or an exemplary facility’s name below, then perhaps it’s time for you to nominate those members or facility for an ISA Power Industry Division award.

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Past POWID Achievement Award Recipients:

There are also ISA Fellow Grade, Celebrating Excellence, and other awards that many ISA and POWID members should be considered for. Information on those awards and how to submit nominations for them can be found at: https://www.isa.org/members-corner/isa-honors-and-awards/.

Nominations for POWID Awards and Applications for the Hubby Scholarship are due by February 15, 2019.
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<th>Name</th>
<th>Company/Institution</th>
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</thead>
<tbody>
<tr>
<td>2018</td>
<td>Wayne Marquino</td>
<td>Retired</td>
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<tr>
<td>2018</td>
<td>John Sorge</td>
<td>Southern Company</td>
</tr>
<tr>
<td>2017</td>
<td>Bob Queenan</td>
<td>Curtiss-Wright Scientec</td>
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<td>2017</td>
<td>Mike Skoncey</td>
<td>First Energy</td>
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<tr>
<td>2016</td>
<td>Terri Graham</td>
<td>Hurst Technologies</td>
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<tr>
<td>2015</td>
<td>Don Labbe</td>
<td>Schneider Electric</td>
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<tr>
<td>2013</td>
<td>Cyrus Taft</td>
<td>Taft Engineering</td>
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<tr>
<td>2012</td>
<td>Joseph Weiss</td>
<td>Applied Control Solutions</td>
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<tr>
<td>2011</td>
<td>Robert N. Hubby</td>
<td>ISA and ASME Life Member</td>
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<tr>
<td>2009</td>
<td>Stephen E. “Skip” Wells</td>
<td>Southern Company</td>
</tr>
<tr>
<td>2008</td>
<td>Jim Redmond</td>
<td>Southern California Edison (retired)</td>
</tr>
<tr>
<td>2007</td>
<td>Dan Antonellis</td>
<td>Invensys</td>
</tr>
<tr>
<td>2007</td>
<td>Roger Hull</td>
<td>Emerson Power &amp; Water Solutions</td>
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<tr>
<td>2006</td>
<td>Denny Younie</td>
<td>Wood Group</td>
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<tr>
<td>2005</td>
<td>Wayne Holland</td>
<td>Southern Company</td>
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<tr>
<td>2004</td>
<td>Dale P. Evely</td>
<td>Southern Company</td>
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<tr>
<td>2003</td>
<td>Daniel Lee</td>
<td>ABB Bailey Controls</td>
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<td>2002</td>
<td>Gary Cohee</td>
<td>Applied Control Systems</td>
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<tr>
<td>2001</td>
<td>Rudy Neustadter</td>
<td>Raytheon Nuclear Group (retired)</td>
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<td>2001</td>
<td>Harold Sternberg</td>
<td>ABB Bailey Controls</td>
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<tr>
<td>2000</td>
<td>Dan Antonellis</td>
<td>Invensys-Foxboro</td>
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<tr>
<td>1999</td>
<td>Wayne Holland</td>
<td>Southern Company</td>
</tr>
<tr>
<td>1999</td>
<td>Rudy Neustadter</td>
<td>Raytheon Nuclear Group</td>
</tr>
<tr>
<td>1996</td>
<td>Don Christopher</td>
<td>Houston Lighting &amp; Power</td>
</tr>
<tr>
<td>1994</td>
<td>Bob Hill</td>
<td>Amtek Services, Inc.</td>
</tr>
<tr>
<td>1994</td>
<td>Roger Hull</td>
<td>Emerson</td>
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</tbody>
</table>

### Past POWID Facility Award Recipients:

<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
<th>Location/Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>Linth-Limmern</td>
<td>Switzerland</td>
</tr>
<tr>
<td>2017</td>
<td>Yingcheng</td>
<td>US-China Clean Energy Research Center</td>
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<tr>
<td>2016</td>
<td>Gaston Power Station</td>
<td>Alabama Power</td>
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<tr>
<td>2015</td>
<td>John E. Amos Power Plant</td>
<td>American Electric Power</td>
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<tr>
<td>2014</td>
<td>MWt Chemical Loopping Test Facility</td>
<td>Alstom Power</td>
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<tr>
<td>2012</td>
<td>Weston Unit 4</td>
<td>Wisconsin Public Service</td>
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<tr>
<td>2011</td>
<td>Boiler Simulation</td>
<td>Alstom</td>
</tr>
<tr>
<td>2009</td>
<td>Rutenberg Power Station</td>
<td>Israel Electric</td>
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<tr>
<td>2008</td>
<td>Morgantown Generating Station</td>
<td>Mirant, Mid-Atlantic LLC</td>
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<tr>
<td>2007</td>
<td>Sim Gideon Power Plant</td>
<td>Lower Colorado River Authority</td>
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<tr>
<td>2006</td>
<td>Independence Steam Electric Station</td>
<td>Entergy Incorporated</td>
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<tr>
<td>2005</td>
<td>C. P. Crane</td>
<td>Constellation Energy</td>
</tr>
<tr>
<td>2004</td>
<td>Monticello Steam Electric Station</td>
<td>TXU Energy</td>
</tr>
<tr>
<td>2003</td>
<td>Elrama Power Plant</td>
<td>Reliant Energy</td>
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<tr>
<td>2002</td>
<td>W. A. Parrish Power Plant</td>
<td>Reliant Energy</td>
</tr>
<tr>
<td>2001</td>
<td>J. H. Campbell Plant</td>
<td>Consumers Energy</td>
</tr>
<tr>
<td>2000</td>
<td>Sundance Power Plant</td>
<td>Trans Alta Corporation</td>
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<tr>
<td>1999</td>
<td>Heskett Station</td>
<td>Montana-Dakota Utilities</td>
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<tr>
<td>1997</td>
<td>Mount Storm Power Station</td>
<td>Virginia Electric Power</td>
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<tr>
<td>1996</td>
<td>Gibson Power Station</td>
<td>Cinergy</td>
</tr>
<tr>
<td>1995</td>
<td>T. B. Simon Power Plant</td>
<td>Michigan State University</td>
</tr>
<tr>
<td>1994</td>
<td>Oklaunion Power Station</td>
<td>Central &amp; Southwest</td>
</tr>
<tr>
<td>1993</td>
<td>Gaston Power Station</td>
<td>Alabama Power</td>
</tr>
</tbody>
</table>

### Past Robert N. Hubby Scholarship Recipients:

<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
<th>University/Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>Ivan Petrovic</td>
<td>Cleveland State University</td>
</tr>
<tr>
<td>2014</td>
<td>Breanna Bancheri</td>
<td>Rutgers University</td>
</tr>
<tr>
<td>2012</td>
<td>Simone Van Fermín</td>
<td>Rutgers University</td>
</tr>
<tr>
<td>2010</td>
<td>Michael Adams</td>
<td>Ohio State University</td>
</tr>
<tr>
<td>2008</td>
<td>Sharanya Jaganathan</td>
<td>Pennsylvania State University</td>
</tr>
<tr>
<td>2006</td>
<td>Brandon Cavello</td>
<td>Pennsylvania State University</td>
</tr>
</tbody>
</table>
The Power Industry Division (POWID) would like to welcome all our new POWID members and our new student POWID members. We hope you will take advantage of everything POWID has to offer for your work and your career including the opportunity to network with power industry professional colleagues across the globe. Our primary goal is to provide a means for information exchange among engineers, scientists, technicians, and managers involved in instrumentation, control and automation related to the production of power. POWID is active in developing industry safety and performance standards, working closely with two ISA standards committees—ISA67, Nuclear Power Plant Standards, and ISA77, Fossil Power Plant Standards. The Division also conducts technical training and sponsors awards for power plants and individuals advancing instrumentation and control within the power industry. POWID welcomes your involvement in our division activities. Opportunities are available to provide information for our newsletter and web site, to develop papers for presentation at our annual conference, and to participate in our division’s management structure. It’s a great way to get to know other industry professionals, to gain professional recognition, and to keep informed!

Welcome New and Returning POWID Members

Faraz Ali
Kevin Ammerman
Convergence Controls LLC

Jason Ballard
Techstar, Territory Manager

Pavel Beliaev
Siemens Canada, Control System Lead Engineer

Emmanuel Dana Buedi
Electricity Company of Ghana, Computer Engineer

Vikas Chauhan

Ayoub El Fouih
Trusted Energy Canada, General Manager, PENG

Jeremy Garcia

Mr. Keith Gilbert
Gilbert Consulting Services, Consultant

Lee P Griswold
CCST, Newmont

Daniel Harraka

John Hickman

Manjunath Hiregange

Mahesh Jujgar

Jeff Karnia
Atlantic Power, Power Plant Operator

Isaiah Maphosa
MMI Holdings, Senior IT Systems Engineer (OpSec)

Connor Massie

Leonard Molloy
California Department of Water Resources

Robert Moore
Dow Chemical, Sr. Process Control Technologist

Dr Jatinkumar J Patel
G H Patel College of Eng & Tech, Associate Professor

Abhijeet Patil
OETC, SCADA Engineer

Ryan Perkins

Robert Picou

Ganesh Rakhewar
Nuclear Power Corporation of India Limited, Senior Executive Engineer

Nathan Schiavo
Graybar, Technical Specialist - Industrial Automation

Anthony Snyder
Muscatine Power & Water, Technician

Hala Srour

Mr. Gary Wallace
Engineering Technician

Leon Wardell
Veolia Energy, Instrumentation Tech

Terry Williams
Orlando Utilities Commission, Maintenance Supervisor

Instrument Shop
Welcome New POWID Students

Mohammad Alsurouri
Keegan Anderson
Ms Liliana Araujo Berrocal
Ms Ashritha B L
Ms Priyanka Avinash Bakare
Mr Aravind Bharadwaj
Ms Raksha Bowade
MR Owen Paul Dekker
Jossue Del Real
Mr Carlos Diaz Perez
Mr Oscar Fuentes Amin
Jonathan Gaedchens
Francisco Eduardo Gómez Castro
Addison Jacunski
MR Sean Fergus Kelly
Ms Leah L Lansdowne
Kaleb Lawless
Ms N Leelankitha
Fabrizio Mancino
Rios Miguel
MR Midhun Mohandas
Ms Latha N
Miley Overstreet
MR Parth Mahesk Kumar Patel
Mr Fabio Kempinas Romao
Ms Haripriya S
David Skillstad
Chris R Turcotte

ISA POWID Executive Committee

The ISA Power Industry Division (also known as POWID) is organized within the Industry and Sciences (I&S) Department of ISA to provide a means for information exchange among engineers, scientists, technicians, and management involved in the use of instrumentation and control in the production of electrical power by any means including but not limited to fossil and nuclear fuels.

The POWID Executive Committee (Excom) administers the activities of the division. The Executive Committee normally meets face-to-face once a year at the POWID Annual Conference and conducts conference calls/web meetings as needed throughout the year. For more information about the Excom you can contact the ISA POWID Director - Xinsheng Lou, xinsheng.lou@ge.com or 1-860-285-4982.

ISA77 Committee Update

Hello! POWID Industry members!

Since the last newsletter, several of the ISA77 working groups have held Skype meetings to resolve committee ballot comments. As a result, the Feedwater Control ISA77.42.01, Definitions ISA77.00.01, and Steam Temperature ISA77.44.01 documents have been issued for ISA77 committee ballot. The progress of a few working groups was on hold during the summer months, but work should continue this fall. As a result, the status of new/revision documents are as follows:

- ISA77.13 Turbine Steam Bypass Systems (in revision and still in progress)
- ISA77.14.01 Steam Turbine Controls (in revision and nearly ready to be balloted)
- ISA77.22.01 Power Plant Automation (new document and still in progress)

Please remember that you can find the ISA77 meeting minutes on the ISA77 committee website. You should find both the June and October 2018 ISA77 meeting minutes posted.

 ISA77.13 Turbine Steam Bypass Systems

Membership is the lifeblood of the ISA77 standards committee. ISA77 documents help power plant professionals understand the best-practice in proper system design, implementation, operation, and maintenance which results in plant and operational improvements, reliability, and safety. The working group meetings provide opportunities for members to interact with their peers via Skype meetings to build consensus and learn about the latest trends in various plant systems. If you have an interest in joining the ISA77 committee or any of its working groups or have any questions about ISA77, then please don’t hesitate to contact Daniel Lee (dan.lee@us.abb.com).

Daniel Lee
ISA 77 Chair

ISA67 Nuclear Power Plant Standards Committee Update

By: Daniel Steik
ISA67 Committee Chair
Idaho National Laboratory

ISA67 is organized to be the focal point in ISA for documenting through standards publications: criteria, standards, practices, and procedures related to instrumentation and controls in nuclear power generating stations and associated industries. The ISA67 committee is responsible for all ISA nuclear plant instrumentation and control standards. Currently, we address transmitter installation, sensing lines, leak detection instrumentation, setpoints and uncertainty calculations, and performance monitoring. The committee holds physical meetings every summer during the ISA POWID Symposium and virtual meetings as appropriate throughout the year.

We are always open to new ideas and input from those with a stake in Nuclear Power Plant Standards. Please consider getting involved today! More information about the ISA67 Committee and its activities can be found at the ISA67 committee website.