

## **Minutes of CSS Technical Committee on Smart Grids meeting, Dec. 13, 2011, Orlando Florida**

**Draft; comments and corrections to Tariq Samad, tariq.samad@honeywell.com**

### **Introduction**

Massoud Amin called the meeting to order shortly after 4:30 p.m. local time. Attendees were asked to introduce themselves [a list of recorded meeting participants appears at the end of these minutes]. Amin thanked Eyad Abed for submitting minutes from the last meeting, held at the American Control Conference in San Francisco, June 29 – July 1, 2011.

### **Smart grids content in recent and upcoming conferences**

Both the 2011 IFAC World Congress, Milan, and the IEEE CDC-ECC 2011 featured plenary addresses and invited/regular sessions on smart grids.

The IFAC Symposium on Power Plant and Power Systems Control will take place in Toulouse, France, Sept. 2012. It's still not too late to submit contributions. <http://www.pppsc2012.org/>.

### **Approval of minutes from previous TC-SG meeting**

The minutes from the meeting of the TC during the 2011 American Control Conference, prepared by Eyad Abed, were approved (motion: Michael Polis; second: Alireza Seyedi).

### **Smart grid vision project for CSS**

Anuradha Annaswamy gave an update on the smart grid vision project for control systems currently ongoing. The project has been initiated by IEEE Standards Association. The objective is to create a document that describes a long-term vision—over a 30 – 50 year horizon—for smart grids from a control perspective. The vision document would include forward-looking use cases and discussions of enabling technologies. We should consider future scenarios that are radical departures from today's grid (for example: the future grid could comprise a conglomeration of millions of microgrids; consumers may not pay for power but for reliability). At the same time, the visions articulated should be plausible and not “science fiction.” A roadmap and reference architectures would also be included. A single “consensus” view is not required; multiple possibilities can be presented. The target audience includes researchers and funding agencies. The report will be peer reviewed and available on IEEE Xplore.

A kickoff meeting for the project was held on Nov. 20, 2011 in Atlanta, hosted by GE. Twenty leading researchers attended. Presentations on industrial and European perspectives and on various aspects of the smart grid (renewable integration, transmission and distribution, market mechanisms, consumer end-use) were given. The group developed an outline for the report. Main sections are Current Practice, Drivers for Change, Scenarios, and Enabling Technologies.

Anyone interested in participating should contact Annaswamy, Amin, or Tariq Samad.

Four other IEEE societies are engaged in parallel activities; outlines from some of them were also reviewed. We plan to complete the document by August/September 2012 with initial drafts due by March/April. The final report will probably be 100 – 150 pages. IEEE will make available a copy editor for consistency, proofing, etc., and also provide support for artwork and figures.

Jakob Stoustrup remarked that many communities are pursuing smart grids. Controls is central to this emerging domain and we can justifiably claim to be the most important component. Amin agreed, stating that “smart grid is a controls problem” and mentioning his article in the European Journal of Control that emphasizes this in the beginning.

### **Action item 1 from the previous TC-SG meeting: White paper**

Two action items from the previous meeting were discussed. First, we had highlighted the need to prepare a white paper (or multiple white papers) for funding agencies globally. It was agreed that this white paper (or these white papers) could be based on the vision document and that therefore white paper preparation should be deferred until we have made further progress on the document.

Samad remarked that different regions of the world are pursuing smart grids and the priorities are not the same everywhere. For example, in the U.S. efficiency is probably the key driver, in Europe renewables integration is top-of-mind, and in Japan the topic of most interest seems to be microgrids. Region-specific emphases could be placed in a cover letter to go with the vision document and/or we could tailor executive summary versions for different audiences.

### ***The Future of the Electric Grid***

The discussion then turned to the recently published report from MIT titled *The Future of the Electric Grid* [<http://web.mit.edu/mitei/research/studies/the-electric-grid-2011.shtml>]. Amro Farid was involved in the preparation of the report and gave an overview of it. He noted that the report is American-centric although perspectives from other parts of the world have been included. The report is broad-ranging and includes discussion of policy matters as well. Farid's contribution to the report was mostly regarding the integration of large-scale renewables.

Samad read the major recommendations of the report from its executive summary. Farid remarked that the report authors recognized that the audience for the report was diverse and went well beyond engineers and academics. The report had been organized accordingly. In particular, media outlets for policy makers would probably not get further than the executive summary, hence the nontechnical and generic wording of the recommendations. The controls community should be encouraged to go deeper—there is considerable more detailed discussion in the report that is relevant for control scientists and engineers.

Sean Meyn remarked that in his view real-time markets today are a disaster. We cannot impose real-time prices to residential consumers without the science to back it up—*pace* a recommendation of the MIT report. Meyn clarified that his concern did not extend to commercial and industrial consumers. Real-time pricing is one tool to deal with power system challenges such as volatility of renewable energy; alternative tools are also available.

### **Action item 2: Workshops and publications**

This was the second of the two action items from the last TC-SG meeting. Annaswamy said that the 2012 American Control Conference (Montréal, June 27 – 29) will include a workshop on smart grid markets that she has organized by. The conference will also include a semi-plenary lecture by Marija Ilic on smart grids.

Aranya Chakraborty briefly previewed an upcoming (January) volume that he and Ilic have co-edited, titled *Control and Optimization Methods for Electric Smart Grids*, Springer. The book consists of 18 chapters. <http://www.springer.com/engineering/robotics/book/978-1-4614-1604-3>

Stoustrup mentioned another Springer volume, *Smart Power Grids 2011* (Ali Keyhani and Muhammad Marwali, editors), that has recently been published in Springer's Power Systems series. Stoustrup has contributed a chapter to the volume. <http://www.springer.com/engineering/energy+technology/book/978-3-642-21577-3>

Amin mentioned the monthly *IEEE Smart Grid Newsletter*, for which he serves as chairman. The newsletter publishes 4 articles per month and is distributed across IEEE and beyond—in the first two weeks of November 2011, the newsletter website received 5,200 visits from 100+ countries. Subscriptions are available free of charge at <http://smartgrid.ieee.org/publications/smart-grid-newsletter>. Articles are solicited. Submissions should be 800 – 1,000 words in length and should not have mathematical content. Manuscripts are reviewed within one week.

At Amin's request, Abed revisited a suggestion he had made in the previous TC-SG meeting, to hold an interactive workshop. IEEE can support such an event, which could provide a forum for people around the world to participate. Annaswamy suggested that the idea could be expanded to a virtual conference. Stoustrup remarked that he was general chair of a recent virtual conference, which featured participants from 5 continents who gave enthusiastic evaluations. The organizers intend to hold such conferences triennially.

Samad mentioned that CSS has an irregular webinar series and we could use that vehicle to give virtual seminars on smart grids.

Farid noted that the European Union has funded a network of excellence on smart grids with about 30 research institutions as partners. The network organized a full conference that was entirely virtual. We could learn from that experience.

Amin suggested that we form a subcommittee to review/recommend options for innovative delivery of smart grid content. The subcommittee should report back to the TC-SG at its next meeting in Montréal. Volunteers for serving on the subcommittee were solicited; Rajeev Verma, Seyedi, and Chakraborty offered their services.

Amin reminded the attendees that the TC-SG has a Linked-In subgroup that can be used to continue the discussion on this and other topics. [The subgroup can be joined by visiting [http://www.linkedin.com/groups?gid=3723696&trk=myg\\_ugrp\\_ovr](http://www.linkedin.com/groups?gid=3723696&trk=myg_ugrp_ovr).]

Stoustrup said that he will propose to the organizing committee of the virtual conference series he is involved with to make the next conference on smart grids (2013). He will work with the subcommittee as appropriate.

### **Hot topics for the controls community related to smart grids**

Amin suggested that the TC should articulate important topics in smart grids that the controls community can address. He asked for suggestions from those present and said that he would initiate a discussion over e-mail as well. The following “hot topics” were offered:

- Seyedi: Integrating controls and communications.
- Ian Hiskens: Modeling of power systems integrated with communications processes.
- Amin: Repertoire of controls for smart grid—a bird’s eye view.
- Samad: Closed-loop pricing and electricity use.

### **CDC-ECC 2011 workshop on smart grids**

Eugene Feinberg asked if anyone in the group knew who the organizers were for a workshop on smart grids that was originally planned for CDC-ECC but was ultimately cancelled. No one present knew. [Note: Per the CDC-ECC workshop chair, the organizer was Ganesh K. Venayagamoorthy, ganeshv@mst.edu.]

### **Attendees’ interests in smart grids**

Samad suggested that the meeting participants each talk briefly about their interest in smart grids.

Nicanor Quijano: In Colombia, 86% of electricity comes from hydro, so communication, control, and market issues are different than in most other countries. Their work is focusing on distributed generation and how it will impact power companies. Four universities are collaborating.

There was a Colombian Control Conference held recently; Kameshwar Poolla talked about smart grids. The IEEE Power and Energy Society also organized a workshop.

Edgar Sanchez: Power generation is mainly from oil and is dominated by a few large power companies. There is a very big wind farm in the southern part of the country but very little solar generation. A Latin America smart grid conference is in planning stages.

Eduardo Camacho: We should define what control technologies can be applied to smart grids and how we can penetrate the smart grid space. Many other societies and organizations are focusing on smart grids and have formed smart grid committees. In many cases dynamics issues are being ignored. Can we participate in these committees and correct such shortcomings?

Seyedi: The interdisciplinary nature of smart grids means that we should contact other committees (power systems, communications, signal processing). Everyone is thinking about the problem from their point of view. We can help bring the different parties together. We should pursue more collaborations with similar societies.

A few suggestions were offered to follow up on this remark:

- When we prepare an NSF white paper we should submit it to both Engineering and CISE directorates. These NSF directorates have worked together on cyberphysical systems and could also jointly pursue smart grids.
- CSS also has a technical committee on Power Generation; we could partner with them.
- The vision documents of the IEEE societies involved could serve as common ground. We could hold a symposium to share perspectives. The final goal is the same for all societies.

Participant from Japan (name not recorded): The recent tsunami and the Fukushima Daichi incident have changed the power system landscape in Japan. Nuclear power is now a problem. Interest has increased in renewables. NEDO, the Japanese funding agency, could be a good target for our white paper.

In response to a question by Amin on integrating the 50 and 60 Hz grids in the country, the Japanese participant remarked that there was currently a DC interconnect between the grids with limitations on power transfer.

Sorin Bengea: United Technologies Research Center is working on an integrated design framework for smart grids and smart buildings; there is synergy between these two areas that needs to be exploited.

Verma: Eaton works on universal power supplies and microgrids. Rajiv is interested in related challenges and market opportunities.

Paul Flikkema: Background is in sensor networks and is here to learn. Renewable integration is extremely important. Interested in sensor-based control based on forecasting and nowcasting for wind and solar.

Zihua Qu: Agree that consumer response is an important issue. Also distributed optimization and distributed control. Would also like to suggest that we can look at topics that are not traditional for us, e.g., cybersecurity—utilizing computational resources to enhance security rather than to make systems more vulnerable. The University of Central Florida would be pleased to host a workshop in Orlando in wintertime!

Eugene Feinberg: Several IEEE societies are organizing smart grid conferences, which tend to be narrowly focused. IEEE should consider holding one large conference on smart grids. There is also smart grid interest in INFORMS, the operations research society. We could do something together with them.

Stony Brook Univ. is very active in the area and holds a regional conference on energy every year. Eugene has chaired the conference's program committee. The next conference will be in Nov. 2012 in New York City. The TC-SG can organize something in conjunction with that.

Abed: We haven't talked about data too much. Data visualization is very important and control decisions are often made based on visualizations. We need to understand human behavior. For example, how does consensus arise in the power system context if individuals make their own decisions? Game-theoretic issues are involved. We should seek open areas for research from a fundamental controls perspective.

Annaswamy: It is hard to get access to real data in order to validate research. Some sort of consortium including researchers and industry stakeholders could be considered to address this problem; this consortium could have ownership of data supplied by industry.

Alessandra Parisio: Her group at Univ. Sannio (Italy) is working on a high-level central controller for microgrids based on a model-predictive control scheme. Industrial facilities that own distributed generation and renewable energy sources are interested in testing the algorithm. Parisio spent time in Athens and tried the algorithm on experimental microgrids. Good forecasts are important—prices, renewables, demand. There will be an international symposium on power electronics and electrical drives in June 2012; trying to organize an invited session on smart grids.

Amro: We really need access to real data in order to validate our solutions and to be increasingly pertinent to the electric power industry. Suggestion: We should come out with a uniform position on the importance of access to real data, how it would be beneficial to industry, and how it would lead to cooperation; this is reiterated many times in the MIT study and is lacking today. But access to real data is a highly charged issue from enterprise and national security points of view—we'll need to address these challenges.

Roland Malhamé: We have not discussed business models for smart grids. Real-time markets may not be appropriate for individual consumers; we should think of other schemes for the residential sector. For example, agreements with rate incentives between utilities and homes could allow utilities to control certain loads. Storage will be very important; there are vast amounts of natural (thermal) storage dispersed in the system.

When we deal with customers we're talking about huge numbers. A scheme whereby you're controlling such loads one by one is not workable. We need approaches that are as decentralized as possible but coordinated through an optimization mechanism. All of this will only work if there is a business model that allows it.

The topic of storage elicited comments from other attendees. Stoustrup remarked that his group had won a large smart grid project last year in Denmark, worth more than \$20M. They are looking at how storage can help with intermittencies of renewable generation and at the interchange between electrical and thermal storage.

Amro said that storage is one of the most important issues at Masdar. They are interested in the topic beyond the typical applications to solar intermittency, reliability, and load balancing. In particular, they are interested in the connection of storage with demand-side resources and water. The emphasis on water is very specific to the region. They are interested in co-generation of water. Masdar is the only post-graduate institution in the region and the only institution devoted to sustainability, so research in these areas is a high priority.

## **Conclusion**

The meeting was adjourned shortly after 6 p.m. local time.

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