



IEEE JOINT TASK FORCE ON QUADRENNIAL ENERGY REVIEW

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Dear Bill:

The IEEE Joint Task Force on Quadrennial Energy Review (QER) is pleased to respond to your request. This letter provides our initial reaction and seeks clarification for some of the topics listed in your April 29 letter.

We have recruited leaders from our membership to develop initial responses for your priority issues and plan on having these initial responses completed by your June deadline. We believe that a lot can be accomplished in this time frame, although not all questions can be answered. Indeed, some of these issues are rather open-ended research questions that are active areas of research, while some are basic issues that are in development as the electric power system adopts new technologies and as institutions of the electric power system evolve and change.

Our responses will be developed from recent work by IEEE members and IEEE Societies. Our objective is to evaluate the IEEE pool of information (reports, guides, standards, papers) and compile it into an easily comprehensible format for the QER team. Each section will consist of a white paper with appendices including IEEE reference materials. The 2014 National Energy Policy Recommendations (NEPR)¹ that address many of your questions at a policy level are examples of the work of IEEE on these issues. Part of our initial response included here is based on that effort.

We will work on all seven (7) areas described below in parallel. However, if we get into a crunch, the focus will be to deliver drafts for first four (4) topics by the end of June. In any case, we will continue working on our documents based on your feedback with a plan to deliver final results by the end of August.

Our initial reaction and questions are summarized below.

- 1. Effects of renewable intermittency on the electric power grid and the potential role of storage in addressing these effects (and other applications of storage).***

High levels of variable and uncertain renewable generation will require increased electric system flexibility from other resources, to enable electricity supply-demand balance. This flexibility can come from a portfolio of supply- and demand-side options, such as flexible conventional generation, storage, new transmission, more responsive

¹ <http://www.ieeeusa.org/POLICY/positions/IEEE-USA-NEPR-2014.pdf>

loads, and changes in power system operations. An important aspect of managing supply-demand balance is forecasting both renewable resources and load, particularly as load patterns have been changing, e.g. growth in data centers that have ten times the load density of other types of utility loads.

Many believe that large-scale, grid-level energy storage must be developed and deployed if intermittent sources of electric power (such as wind and photovoltaics) are to reach full potential. However, this is not a foregone conclusion. The technical role and economics of energy storage in a future that relies significantly on wind and photovoltaics has not been fully explored with solid quantitative analysis. Until less expensive storage becomes available, other more cost effective solutions for addressing the variable nature of renewable energy sources must be explored (e.g. natural gas generation, spinning reserve). When it becomes available, energy storage could complement variable generation and reduce fossil plant usage.

2. Skilled workforce issues.

IEEE has been heavily involved in researching and understanding this issue. IEEE-PES developed an in-depth report on this in April 2009². The NEPR devotes a whole section, *Energy Sector Jobs, Workforce Requirements and the Economy*, to this issue.

3. Utility and other energy company business case issues related to microgrids and distributed generation (DG), including rooftop photovoltaics.

This could be a very broad topic and some more specificity would help in better focusing our response to your needs. Business models of the energy industry have evolved substantially since restructuring and the adoption of new technologies and grid configurations such as distributed energy resources (DER) and microgrids along with energy efficiency programs and demand response. In addition, consumer interest in increased resiliency and differentiated levels of service are creating new opportunities and challenges.

Some believe that microgrids will be the grid of the future and that there will be no need for the T&D grid while others believe that there is no business case for large proliferation of microgrids. One needs to consider that grid started as a microgrid and that interconnected grids were originally created to improve reliability and service, which was followed by use of the grid for market transactions. In reality, neither the microgrids nor the traditional system may fulfill all the consumer needs. Microgrids and traditional grids may need to work synergistically to form hybrid grids. The business case will depend on benefits achieved by microgrids, including required level of service, and continued decrease in pricing of technologies such as PV panels and storage.

Some of the key success factors in the integration of intermittent renewable and converter-based DGs in microgrids require proper controls and automatic dispatch, including smart inverters. IEEE has been working on integration standards and tools to facilitate the integration of renewables into the grid.

Are there any specific business issues that are of particular importance for the QER?

² http://www.ieee-pes.org/images/pdf/US_Power_&_Energy_Collaborative_Action_Plan_April_2009_Adobe72.pdf

4. *The implications and importance of aging infrastructure and the options for addressing these challenges, including asset management.*

The initial reaction to this issue is that the age of the infrastructure *per se* should not be the only focus of concern because, in general, it is not the main cause of outages or other customer inconveniences. We propose instead to refocus this question on the holistic asset management approach addressing grid resiliency including relative risks and economics of maintenance, repair and replacement or retirement for the various elements of the physical infrastructure.

A holistic asset management approach requires viewing the entire fleet of capital equipment as critical strategic assets impacted by key inter-related areas in support for business goals: Aging Infrastructure (including condition monitoring and assessment tools), Grid Hardening (weather related response, physical vulnerability and cyber security), and System Capabilities and Characteristics (including improving reliability metrics such as SAIDI and SAIFI). Integrating asset management approach structured around these focal areas and interacting with spending and resource decisions is needed to best achieve optimal cost-effective solutions.

We also propose to discuss physical- and cyber- vulnerability in this context. While it is not possible to predict when and where future events will occur, it is possible to identify the substations and lines in the system that, as a result of their location, configuration and electrical characteristics, pose the greatest risk for large-scale outages.

5. *The technical implications for the grid (bulk and local distribution) of electric vehicle (EV) integration - and the timing you see as necessary to avoid having the grid status slow down any potential progress.*

The adoption of new end use technologies and in particular electrification of the transportation sector is an important topic within IEEE and is the subject of a major initiative³. We expect to contribute substantially in this area. The NEPR addresses this broadly in the section titled “*Transforming Transportation By Diversifying Energy Source*” and concludes that “*The electric infrastructure already in place is sufficient to permit on the order of 75 percent reduction in the dependence on liquid fuels, through greater penetration of plug-in electric vehicles (PEV), including all electric and plug-in hybrid electric vehicles.*” A more extensive discussion of transmission and distribution system impacts is included in the energy policy addendum, “*Breaking Our Dependence on Oil by Transforming Transportation*”⁴.

6. *Recommendations for metrics for addressing Smart Grid issues, especially to help policy-makers determine the importance and necessity of protocols.*

IEEE is deeply involved in the Smart Grid effort at all levels, including development of standards that provide benefits such as supporting interoperability and best practices. IEEE has already taken initiatives to highlight issues pertaining to the benefits of Smart Grid technologies. Therefore, we have been investigating the relative merits of different metrics for evaluating the value of smart grid technologies.

³ <http://electricvehicle.ieee.org/>

⁴ <http://www.ieeeusa.org/policy/positions/Transportation0512.pdf>



We intend to identify benefits of standard protocols to support interoperability among Smart Grid components. However, we need some clarification of this question: Are there any particular issues you are concerned about in the context of the importance and necessity of protocols?

7. *Insights on creating one or multiple "report cards" on the condition and performance of the electric grid. We envision this addressing: efficiency, reliability, cyber and physical security, safety, and other factors you may recommend, even in draft form*

This request is indeed something we have been discussing recently. Our colleagues at ASCE have periodically issued report cards on the USA infrastructure (www.infrastructurereportcard.org) and we are not in agreement with their 2013 evaluation of the electric sector. We will discuss this challenge and see how we might respond.

As indicated above please let us know if we are on the right track and would appreciate some clarification to more fully understand these issues and questions and focus our responses. Consequently we are requesting a meeting at your convenience. Our proposal is to meet during the week of June 16.

In addition, as discussed, we would very much appreciate your participation at the Late Breaking News Super Session on general topics of impacts of energy policy on the power industry at the IEEE PES General Meeting in Washington DC, planned for July 29th.

Sincerely, on behalf of the IEEE Joint Task Force on Quadrennial Energy Review (QER)

Veronika Rabl

IEEE-USA Energy Policy Committee, Chair

Damir Novosel

IEEE Power & Energy Society, President-Elect