National Electrical Manufacturers Association

Representing Electrical and Medical
Imaging Equipment Manufacturers
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Office of Electricity Delivery and Energy Reliability
Room 8H033
U.S. Department of Energy
1000 Independence Avenue SW
Washington, DC 20585

RE: Smart Grid RFI: Addressing Policy and Logistical Challenges
September 17, 2010 Federal Register Notice

The National Electrical Manufacturers Association (NEMA) submits the enclosed comments regarding the referenced subject.

NEMA is the trade association of choice for the electrical manufacturing industry. Founded in 1926 and headquartered near Washington, D.C., its approximately 400 member companies manufacture products used in the generation, transmission and distribution, control and end-use of electricity. NEMA members serve a domestic market of $100 billion and export $20 billion.

Thank you for the opportunity to offer these comments.

Very truly yours,

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Setting Standards for Excellence

National Electrical Manufacturers Association

Introduction

The National Electrical Manufacturers Association (NEMA) is a trade association through which the electro-industry develops and promotes positions on standards and government regulations, and members acquire information on industry and market economics. On behalf of the member companies of NEMA, we would like to submit our comments in the following areas of the DOE Request for Information dated September 17, 2010 on "Addressing Policy and Logistical Challenges to Smart Grid Implementation;"

- The definition of "Smart Grid" for policymaking purposes
- Barriers to the deployment of grid infrastructure
- Reliability and Cybersecurity
- Priority Areas for Federally Funded Research
- Smart Grid Testing and Certification

The definition of Smart Grid

A definition for the term "Smart Grid" has been part of the discussion ever since the term was used in the Energy Independence and Security Act (EISA) of 2007. For the purpose of any policymaking activities, a Smart Grid should be defined as:

> *Any collection of devices, systems, applications, or technologies that can be used to enable the features, goals, and objectives for the modernization of the electric grid as described in Title XIII of the Energy Independence and Security Act of 2007.*

Ultimately EISA is the guide by which the full cadre of federal agencies and the entire electrical industry conduct their affairs relative to Smart Grid. Attempting to capture a definition in any greater level of detail is simply impossible.

Barriers to Smart Grid Deployment in Transmission Corridors

The legal construct of siting a transmission corridor is a complex mix of federal, state, and local statutes, regulations, guidance, and ordinances, with input from end-use consumers. A report by the National Commission on Energy Policy concludes that policymakers must seek out "new and innovative siting procedures" that clearly illustrate the costs and benefits of a given project or risk facing the same determined opposition that has slowed or killed proposals for new energy projects over the past three decades."

According to all projections, U.S. energy demand is growing dramatically. The nation needs a huge investment in coal, natural gas, nuclear, wind, and other projects, as well as the systems to deliver them, in order to meet projected demands. The Obama administration has stated their desire to harness renewable energy (wind, sun, earth, tides, etc.) but connecting renewable energy sources to the electrical grid is problematic. The ideal situation would be to transmit the maximum amount of power through existing corridors, but existing infrastructure simply cannot accommodate this surge. New corridors need to be constructed.

The process of siting transmission corridors is itself a barrier – it can take years of skillful navigation and cost millions of dollars. By its very nature, approval is an arduous, multi-year process. A national siting policy significantly increases the likelihood of using clean, renewable energy by encompassing a single process to plan, permit, and pay for transmission lines.

Plotting a course through the daunting matrix of federal agency approvals is tedious and time consuming. Each approval process may initiate critical adjustments to planning, cost allocation, and siting. The applicant must decide if it is ready and willing to pay for new transmission corridors. Actions by federal agencies, interstate planning authorities, or court challenges can drive a circular process lasting years. The U.S. manufacturing base has the technology to create and maintain transmission corridors, but the siting process remains the major holdup. While smaller projects are often approved in a reasonable period, larger projects that span long distances and affect multiple communities can easily become bogged down and, in some cases, take years to obtain final approval.

With all of these obstacles, it becomes evident why approval for siting a transmission corridor is such a long-lived process and in many cases is unsuccessful. Indeed, approximately 15 percent of projects involving the siting of corridors for high-voltage transmission lines are canceled. For projects that receive approval, the full timeline from the initial approval to finishing out construction lasts on average more than a decade, with the actual construction process taking up less than one-third of the total timeline.

What are the problems with transmission line projects?

- The Edison Electric Institute has identified more than 100 independent utility transmission projects value at more than $50 million each in 2010. These projects are at various stages of review and completion, with a handful close to completion, but most still mired in daunting review processes spanning nearly a decade and involving dozens of state, regional, and federal review organizations.
- Along the way, public opposition has stalled many projects, and the sheer burden of review compliance and years-long waiting period has prompted some utilities to cancel projects to cut losses associated with high review process costs.
- The glacial pace at which transmission projects are completed is constraining the amount of renewable generation capacity that can be integrated into the nation's power grid and limiting the effectiveness and benefit of a smarter grid in terms of enhanced reliability and reduced congestion.
- Transmission lines are the linchpin that connects electricity from generation sites to our homes and businesses.

- The process for obtaining approval for siting a transmission line corridor is seemingly one of the most difficult tasks in the universe to accomplish as it is governed by a complex web of federal, regional, state, and local regulatory requirements.
- Among the requirements, utilities must conduct in-depth environmental impact statement (EIS) that assesses the project's effects on the local area can take years to complete. Should any changes be made to a corridor's proposed siting, a new EIS must be created, which pushes the timeline even further into the future.

The NIMBY (Not in My Backyard) Challenge

A vast variety of constituencies have interests when it comes to transmitting energy. Energy entrepreneurs, transmission developers, public utilities, state legislatures, and federal regulators are all engaged in the ultimate goal of moving renewable energy. Proponents and opponents of new transmission corridors agree that load growth, construction permits, wildlife protection, property rights, and other concerns must all be addressed before lines can be built. After obtaining all federal approvals, the final challenge is crossing non-federal land. State properties and private land issues can lead to purchased rights, eminent domain, and court challenges. Because of this, building interstate and interregional transmission facilities can take years.

"Not In My Back Yard" intersests (NIMBYs) block energy projects by organizing local opposition, changing zoning laws, opposing permits, filing lawsuits, and bleeding projects dry of their financing. NIMBY-ism is also a significant roadblock to the siting process, as local community groups and environmental advocacy organizations often protest to the construction of new high-voltage transmission lines and towers. These groups are often successful in delaying construction (or having it canceled outright) by issuing challenges on several fronts, including: public protests; objecting to findings in the environmental impact statement (EIS); and lawsuits.

Legislative Activity

Congress in EPACT gave the Federal Energy Regulatory Commission "backstop authority" to site interstate electric transmission lines if states fail to act on an application within a year or impose crippling conditions. The new energy statute also authorized the Energy, Agriculture, Commerce, Defense and Interior departments to designate "energy corridors" in the West. In 2009, the U.S. Court of Appeals for the Fourth Circuit ruled that federal law does not apply to a state's authority to make decisions on major interstate transmission lines within its borders. The U.S. Supreme Court declined to hear an appeal, generating uncertainty over FERC's authority to override a state's denial of a siting permit.

The American Clean Energy Leadership Act of 2009 (S. 1462).

On June 17, 2009, the Senate Energy and Natural Resources Committee voted 15-8 to report a bill, entitled "The American Clean Energy Leadership Act of 2009" (S. 1462). Section 121 addresses changes to transmission siting:

- Requires FERC to coordinate development of an interconnection-wide plan that achieves the policy goals, from plans developed by current planning entities; FERC must promulgate a rule to embody the policy goals and develop a schedule to implement those policies within one year of enactment.

- Transmission planning entities shall develop regional plans and submit them to FERC within 24 months. The commission will encourage joint submissions and submission of interconnection-wide plans. FERC may require modification of submitted plans to ensure conformance to planning principles and to reconcile inconsistencies.
- FERC shall periodically evaluate whether projects in the interconnection-wide plan are being developed, and if not take actions, in accordance with other provisions of law, to address identified obstacles.
- Make recommendations to Congress for further actions or authority needed to ensure development of timely projects.
- Update the plan every three years.
- Allows states one year from time of filing of a proposal to site a high priority national transmission project.
- Gives FERC jurisdiction over siting when states have either been unable to site the facility or have denied the application. Jurisdiction in over facilities 345 kilovolts and above that are included in the transmission plan.
- Gives Department of the Interior lead agency status for development of records of decision on public lands.
- FERC must establish, by rule, appropriate methodologies for allocation of costs of high priority national transmission projects.
- Such methodologies derived from the cost allocation must be just and reasonable and not unduly discriminatory or preferential.

The American Clean Energy and Security Act (HR 2454)

Passed by the House of Representatives on June 26, 2009, Section 151 of the American Clean Energy and Security Act (HR 2454) addresses changes to transmission policy:

- Amends the Federal Power Act to establish a federal policy for transmission planning that calls for regional electric grid planning that facilitates the deployment of renewable and other zero-carbon and low-carbon energy sources for generating electricity to reduce GHG emissions while ensuring reliability, reducing congestion, ensuring cyber-security, minimizing environmental harm, and providing for cost-effective electricity services throughout the United States.
- Directs FERC to: (1) adopt, within a year, national electricity grid planning principles derived from such policy to be applied in transmission planning that may implicate interstate transmission of electricity; (2) encourage regional planning entities to cooperate and coordinate across regions and harmonize regional electric grid planning with planning in adjacent or overlapping jurisdictions; (3) seek to ensure that planning is consistent with the national electricity grid planning principles; (4) require regional planning entities to submit initial regional electric grid plans within 18 months of FERC promulgating such principles and to update such plans every three years; and (5) report to Congress within three years on the results of the initial regional grid planning process.

- Authorizes FERC to issue a certificate of public convenience and necessity in states in the Western Interconnection for the construction or modification of a transmission facility that meets certain criteria.
- Requires FERC to lead efforts to coordinate environmental reviews and approvals for proposed projects in states in the Western Interconnection and requires the Department of the Interior to assume such lead with respect to federal land.

Activities within the Federal Energy Regulatory Commission (FERC)

On June 17, 2010, FERC issued a notice of proposed rulemaking (RM10-23-000) on transmission planning and cost allocation. The notice was the latest in a series of steps taken by FERC to enhance the efficiency and effectiveness of wholesale energy markets by proposing reforms to the rules under which public utilities plan, and recover the costs, for transmission expansion. Changes driven by customer needs, emerging technologies, and new entry dictate that the Commission continually evaluate the rules governing transmission services and wholesale market operations.

The proposed revisions to transmission planning and cost allocation are responsive to such changes, and build upon work started three years ago in Order No. 890, which created a framework for an open and transparent planning process that enables stakeholders, including independent transmission developers and those seeking to use technologies in new ways, to propose alternative solutions for consideration in the planning process. Last fall, Commission Staff completed a series of conferences held around the country to review how well those rules are meeting the needs of our Nation, and to collect input as to how the Commission can improve upon the regional planning processes.

A significant aspect of the June proposal is the proposal to require that transmission planning take into account public policy mandates, such as renewable portfolio and efficiency standards at the state level. These policy-driven mandates are leading to significant changes in the resources used to serve customers. By proposing to incorporate public policy mandates into the transmission planning process, FERC seeks to ensure that these legal requirements are met in a way that is fair and efficient to transmission customers.

Another significant aspect of FERC's proposal relates to the allocation of transmission costs. By proposing to tie cost allocation to the regional transmission planning processes, we seek to facilitate the transition from planning to implementation in a way that again builds on existing processes. The touchstone of the proposal is the cost causation principle, ensuring that only those consumers benefiting from transmission facilities are charged for associated costs. The FERC proposal does not impose a uniform method for allocating the costs of transmission, nor does it dictate how benefits are to be derived or evaluated. Rather, the proposal allows each region the first opportunity to develop cost allocation mechanisms and identify for itself how the benefits of transmission facilities are to be determined.

For many regions of the country, the pressing need for reforms on issues of transmission planning and cost allocation is being driven by a shift in the type of generation resources being developed in response to state renewable portfolio standards. However, the challenges facing the integration of renewable energy resources are not limited to the build out of transmission. The variability of certain renewable resources poses new operational challenges that can be managed not only with conventional generation resources, but also with such complementary technologies as electricity storage and demand response. There is also significant technological innovation that will impact the use and operation of the electric grid including the smart grid and electric vehicles.

Policy Recommendations on Transmission Siting

The United States needs a clear national policy that increases the generation and use of clean, renewable energy. Renewable energy resources must be secured and transmitted as part of our national electricity supply portfolio. Federal authority over transmission planning, siting, and cost allocation will significantly increase the likelihood that needed facilities will be constructed in a timely manner.

With this in mind, NEMA remains a strong proponent of a national siting policy. It is essential to meeting our nation's goal of reducing reliance on carbon-emitting sources of electric energy. NEMA supports legislation that designates FERC as the lead agency for conducting environmental reviews. A clear nationwide transmission line siting process would streamline current practices, facilitate construction, create domestic jobs, and expedite transmission corridors that deliver clean and renewable energy.

Reliability and Cybersecurity

NEMA's interest in cybersecurity is driven in part by the seven major findings described by the Department of Energy in their *Metrics for Measuring Progress Toward the Implementation of the Smart Grid* publication:

- Enable active participation by consumers
- Accommodate all generation and storage options
- Enable new products, services, and markets
- Provide power quality for the range of needs in a digital economy
- Optimize asset utilization and operating efficiency
- Anticipate and responds to system disturbances in a self-healing manner
- Operate resiliently against physical and cyber attack and natural disasters

In applying these findings, the objectives for electrical manufacturers for cybersecurity in Smart Grid are twofold: the risk to business operations from security breaches; and the risk to product development and marketing as the federal government adopts preventive measures.

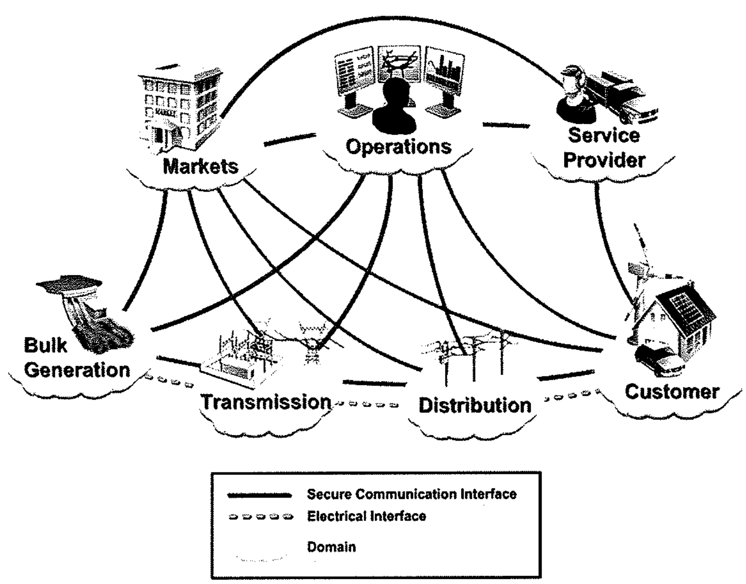
A breach in cybersecurity would have a couple of immediate effects: first, utility service interruptions (including their potential disruptions to business, commerce, and other activities); and second, the unavoidable scramble to patch the breach. This could involve countless hours of research and development staff time, contractors and consultants, etc. which would be a considerable financial burden on the utilities and manufacturers alike. The implementation of those patches would involve potential changes to the manufacturing process, deployment of patches to the installed base, product recalls, rebates and many other expensive options, not to mention the potential for lawsuits, both valid and frivolous, based on the potential outages described above.

An additional interest of the manufacturers is standardizing on common approaches to cybersecurity across utility areas of control as well as state boundaries. It is critical to invest the time and resources upfront to select the optimal architecture, minimize risks, and attain a reasonable balance between costs and security. Additionally, there exists a need for states to work together in order to provide utilities with a uniform security implementation approach. If public utility commissions do not lead with a common approach, then it will be very difficult for utility companies, manufacturers, the National Institute of Standards and Technology (NIST), and Standards Development Organizations (SDOs) to coordinate their security standards development efforts increasing the level of difficulty for manufacturers to provide interoperable solutions. The corresponding drop in interoperability could also lead to a lower quality of service to electricity customers.

Definitions

In order to foster an understanding of this cybersecurity discussion, the following terms will be used in the context as described:

Domain – A domain is an area of operational responsibility within the Smart Grid architecture. For the purpose of this document, the domain considerations will follow those of the Conceptual Model of the Smart Grid as crafted by NIST, where each of the "clouds" in the diagram represents a grid *domain*:



Layer – A layer is the application of a security measure in the cybersecurity architecture. For example, the first layer of security is the physical connection to a device in the Smart Grid. Another layer could be a log-in server to authenticate any user that is trying to issue commands to Smart Grid devices. Encryption is yet another layer, and so on. Having a *layered security architecture* implies that multiple security measures could be applied to any connection to the Smart Grid.

Segment – The electric grid is a collection of contiguous, interconnected physical devices from the point where electricity is generated to the point of use. A *segment* of the grid is any set of elements for which the electricity supply can be controlled as a unit. This may be a single building such as an office high-rise, a group of related buildings such as an educational or industrial campus, or a collection of buildings or homes such as a military base or a residential neighborhood.

Standards Development

Hardware. Hardware-based standards for cybersecurity must be designed appropriately for the operating environment including the method of deployment, administration, and any operational considerations (such as weather for outdoor devices). They must also integrate with widely-accepted management systems and practices associated with the electrical industry.
Software. As with hardware-based standards, software solutions in cybersecurity need to be compatible with widely-accepted management systems and practices. Both interoperability and sustainability need to be factored into the features of any standards developed or adopted for software systems.
Transport. Limitations of the communications associated with the electric grid need to be part of the design criteria for cybersecurity standards. Unlike the Internet, the electric grid was not designed as a communications network and therefore cannot support heavy message loads; long-haul distances with limited access to bandwidth will be the norm in many cases.
Operational Sustainability. For the development of any standard in the cybersecurity arena, the concept of how that standard will be supported after deployment needs to be considered. In a distributed operating environment with literally millions of nodes (such as the electric grid), manual maintenance is not a viable option. The application of a security standard as a component of a larger security architecture needs to permit remote administration.

Legislative Actions

Cybersecurity Design. The NEMA member companies agree that first and foremost, security must be part of the design consideration for any smart grid component (and its corresponding interactions with other grid elements) from its inception. At the same time, designing and building the entire grid to the highest security standards would simply make it too costly to undertake any form of national modernization project – cybersecurity measures should therefore be deployed judiciously, taking into account segmentation and layering.
Incentives. The fast path to widespread adoption of cybersecurity measures will naturally include incentives. Any legislation dealing with the Smart Grid, cybersecurity, and energy

policy in general needs to target incentives for utilities and manufacturers in areas like adoption of best practices and implementation of cybersecurity measures. Given its importance to the process, research and development should be specifically targeted for incentive programs.
Funding Standardization. Building on the success of the NIST programs for standardization in the Smart Grid, legislative actions should continue to provide funding for government agencies, non-government organizations, standards development organizations (SDOs), and individual companies involved in the development, promulgation, and conformity assessment of standards and technologies for cybersecurity in the Smart Grid.
Legislative Restraint. With the variety of cybersecurity technologies that are now available, it would be easy to become over prescriptive when developing legislation associated with cybersecurity. Laws should be crafted to reflect national priorities and objectives for cybersecurity programs but not constrain innovations by focusing on individual solutions or technologies.

Regulatory Actions

Applying Standards. Combining the intent of the legislative recommendations, regulatory actions should focus on applying the standards that are endorsed by governmental agencies (such as the Department of Homeland Security and the National Institute of Standards and Technology) to achieve the cybersecurity objectives in legislative policy. Rulemaking should be aimed at enabling interoperability through the application of standards and whenever possible, should examine the issues associated with backward compatibility.
Implementation. Regulatory agencies must carefully weigh issues associated with voluntary versus mandatory implementation of a security measure. They should consider the life expectancy of the current installed base of equipment and technology, and consider graduated schedules for adoption when appropriate in order to avoid stranding utility company investments before their useful life has been expended. Rulemaking should be geared to help utilities move faster to replace legacy systems that do not meet emerging Smart Grid standards. Utility companies should be scrutinized for filings that include statements like "where technically or economically feasible" to avoid a business-as-usual posture for the adoption of Smart Grid technologies.
Segmentation. In order to control the cost of deployment, regulators need to consider the overall security architecture in their rulemaking decisions. As with the electric grid itself, the ability to isolate security issues and insulate core grid functionality from their effects is equally important as the strength of the security measure.
Layering. As with segmentation, the aspect of security layering needs to be considered during rulemaking. Individual security measures should not be considered in a vacuum, but rather in the context of how they contribute to the overall security architecture of the system. It would be important to define rules and guidelines for the levels of layered security required as a function of the criticality of a device, its functions, the impact on the surrounding segments of the grid, etc.

RESEARCH RECOMMENDATIONS

Adaptive Optimal Power Flow

Real-time adaptation to a variety of disruption contingencies is a common reliability challenge encountered in electrical grid systems. A typical contingency is a failure of one of the transmission links in the grid that may cascade to a massive gridlock because of network effects.

Unfortunately, there is no cost-effective real-time solution to the adaptation of large-scale electrical grids to contingent scenarios. A common approach is to pre-program transmission and generation schedules to make them robust with respect to most common worst case contingency scenarios. In particular, the North American Electric Reliability Corporation (NERC) simulates such type of planning for a few major failure contingency families. While the aforementioned robust scheduling is not a real-time solution, it is also nearly impossible to compute numerically in large-scale grid networks (tens of thousands of links) for a fairly comprehensive yet common family of contingency scenarios such as N-1-1 which is part of the NERC nearest future requirements. Current research suggests that advances in event-driven adaptive Optimal Power Flow (OPF) planning could lead to transformational breakthroughs in real-time adaptation of electrical power grids to disruption contingencies. Adaptive OPF is an extension to the commonly used variety of large-scale OPF algorithms that employ recent advances in stochastic programming, implying adaptability to contingency situations while making sure the base case planning is robust, so that adaptation is feasible.

The breakthroughs required for a solution to real-time adaptation of electrical power grids to disruption contingencies will not be realized with incremental evolutionary improvements in existing technologies as most of them are based upon pre-programmed scheduling involving first generation of OPF algorithms. Rather, they will be realized only with fundamental research to understand the underlying obstacles, which will in turn enable the development of novel concepts that incorporate a revolutionary new event-driven adaptive OPF scheduling technique.

NEMA recommends that the DOE solicit research proposals that would examine adaptive OPF scheduling techniques. Criteria for such a basic research solicitation would include the ability to address adaptability of short-term (1-2 hour) transmission & generation schedules in real-time (1-10 min), for a comprehensive family of contingency scenarios such as N-1-1 (as defined by NERC) in a large-scale (~10 000 links) electrical grid.

High Temperature Conductor Systems Evaluation

The Evaluation of High Temperature Conductor and Connector Systems is a common design challenge encountered in electrical systems. To maximize the transmission capacity of an overhead line, existing and future transmission conductors will need to operate at higher temperatures. Recently, high-temperature connectors have been developed to meet these needs.

These connectors have been designed for aluminum conductor steel reinforced (ACSR), aluminum conductor steel supported (ACSS) and high-temperature low-sag conductors that operate well above 1000C and often beyond 1500C. These connectors were designed to have a larger connector size and longer connection, to counter the effects of high-temperature on the connector components. They were not tested vigorously to the extreme conditions that are encountered in the field and they were not developed based on proven models. Long term tests on traditional compression fittings at high-temperatures have revealed that fittings will lose their compressive strength over time from thermal cycling. Compression fittings have a defined life expectancy due to the aging of the material of the components. In additional to the material, the design of a fitting also plays a major role in determining its longevity. Detailed information on the performance of these connections can have a significant impact on applying ACSS and other conductors in the power system to take advantage of the larger potential power flow capacity of these conductors.

Unfortunately, there is no commonly available solution to the Evaluation of High Temperature Conductor and Connector Systems. Heat cycle testing of commonly available conductor/connector combinations using ANSI C119.4 has been used for many years, but the heat cycle test has not been used to evaluate high temperature conductor and connector systems. Current research suggests that advances in the ANSI C119.4 heat cycle testing could lead to transformational breakthroughs to the Evaluation of High Temperature Conductor and Connector Systems. Most of the research done to date has involved individual conductor manufacturers working with individual connector manufacturers, and this data has not been made publicly available.

The breakthroughs required for a solution to the Evaluation of High Temperature Conductor and Connector System will not be realized with incremental evolutionary improvements in existing technologies. Rather, they will be realized only with fundamental research to understand the underlying obstacles, which will in turn enable the development of novel Evaluation Techniques for High Temperature Conductor and Connector System concepts that incorporate a revolutionary new heat cycle testing.

NEMA recommends that the DOE solicit research proposals that would examine heat cycle testing for high temperature conductor and connector systems. Criteria for such a basic research solicitation would include the ability to address the following:

1. A test to evaluate the long term performance of high-temperature connectors,
2. A guide to operate an overhead line reliably within given limits, and
3. A methodology to improve on connector designs.

Advance Energy Storage Testing Facilities

There are manufacturing infrastructure needs for building the full energy storage systems that are beyond just developing the battery energy storage technology. Practical testing facilities for the completed systems are required. Small scale testing is not enough to uncover the operational problems with large systems. Manufacturers of the complete systems need the facilities to test systems for both development and production validation. We suggest the DOE solicit projects for the development and installation of large energy storage test systems than can support the development of the full system demonstrating its "grid-connection" capability and the appropriate operation of the various functions, and to also support the production testing to support the manufacturing of these large systems.

Power Electronics Assisted Switch (PEAS)

There is huge potential for energy saving in the distribution system. Much of the saving can be achieved by optimized voltage and var control. The degree of optimality is dependent on the operation constraints of mechanical switches that limit the number of switching in a day. PEAS can remove the operation constraints and offer unprecedented switching flexibility, thus allowing better energy loss optimization. NEMA recommends that the DOE solicit research proposals for developing PEAS technology and demonstrating it in field pilot.

Smart Integration Module (SIM)

The voltage regulation and var compensation capability in a distribution system is the primary determinant of the operation efficiency and reliability. Traditional capacitor banks and voltage regulators offer optimization capability to some degree. But a power electronics-enabled transformer module, when coupled with distributed energy storage, could drastically change the way distribution system and, by extension, the transmission system is operated. A smart integration module (SIM) provides a modular and universal integration point for distributed generation, distributed energy storage and provides power factor correction, power quality improvement, dynamic real power balancing. When SIM is widely adopted on distribution systems, the real time dependence and coupling of the distribution system on the transmission system and the generation system will be less and loss, which will allow the transmission system to be operated in adaptive, rather than defensive, fashion. Study has shown that defensive operation (such as N-1) increases the scheduling cost by several percentage points. Adaptive operation will enable the operators to gain this huge saving. SIM will allow the operator to do it without sacrificing service reliability. NEMA recommends that the DOE solicit research proposals for developing SIM technology and demonstrating it in pilot.

Dynamic Real Power Compensation (DRPC)

The concept of reactive power compensation is familiar to many. But the concept of dynamic real power compensation is not. The two enabling technologies for dynamic real power compensation: voltage source converters and large scale fast response battery storage have come a long way in recent years in terms of technology maturity and manufacturing cost. Dynamic power compensation technology, if widely adopted, can change the landscape for power system stability. The fast response of real power compensation means the system are more flexible and can operate in much large operating range, and withstand much greater disturbance without fear of causing a black-out. This speed will provide more economical scheduling of the resources. NEMA recommends that the DOE solicit research proposals for developing DRPC technology and demonstrating it in pilot.

Grid Friendly Appliance Controller (GFAC)

Demand response based on time of use price or real time price can help the system run more efficiently. Appliances can also help the system to improve stability and reduce the risk of blackout by responding, under emergency situations, to system stress signals, such as low voltage and frequency. Controllers will need to be developed that will detect system stress from local measurements and respond quickly by ramping down or up consumption in an intelligent manner to be additional stabilizer for the system. NEMA recommends that the DOE solicit research proposals for developing GFAC technology (controller as well as coordination strategy) and demonstrating it in pilot.

Adaptive Protection Coordination (APC)

With the penetration of distribution generation into the electric distribution system, power flow patterns and fault currents at any given node will change in a way not predictable in the planning stage of the system. To ensure the system is well protected and maintain normal operation, protection and control strategies and settings will have to be changed adaptively (in real time). NEMA recommends that the DOE solicit research proposals for developing APC technology and demonstrating it in pilot.

Smart Grid Testing and Certification

Activities Related to the NIST Smart Grid Interoperability Panel (SGIP)

NEMA and its members are heavily engaged in the activities of the NIST Smart Grid Interoperability Panel, including the Testing and Certification Committee (SGIP-TCC). In our opinion, the work of this panel to create a framework for testing and certification is invaluable, and we would urge the U.S. Department of Energy to reference this work in any testing and certification policy.

The nature of the TCC framework provides an adequate means for any entity, whether it's a third-party certifier or a first-party self-certification to ensure the interoperability of the products. Limiting the ability to self-certify, or creating a separate set of rules that govern a third-party process would seriously limit the industry's ability to deploy innovative solutions on a timely basis.