DOE EAC Electricity Adequacy Report
Transmission Chapter DRAFT– September 18, 2008

NOTE: The purpose of this document is to seed discussion at the September 25-26, 2008 meeting of the DOE Electricity Advisory Committee (EAC). It does not represent the views of all members of the DOE EAC. Dissents received by publication of this draft document are included at the end.

1. NATIONAL GOAL: A ROBUST INTERSTATE ELECTRIC TRANSMISSION NETWORK THAT ENABLES OUR ELECTRICITY FUTURE

The United States needs a national vision and policy to develop a robust interstate electric transmission system analogous to that of President Dwight Eisenhower when he enabled the development of a national interstate highway system over 50 years ago. Broad-scale planning historically has not been used for electric transmission because meeting larger, national needs was not the intent of the original lines. Now, power delivery has evolved from local generation resources serving local demand, to larger, more remote resources serving metropolitan areas, to today's system that enables regional resources to serve regional load. A new, high-volume transmission system integrated as an overlay is needed to draw together our existing "patchwork" system and to support national energy priorities.

Transmission upgrades have traditionally served as the solution of last resort planned on a "just-in-time" basis. This has resulted in a system ill-equipped to meet future energy needs. While generation has been added to meet the growing demand, investment in transmission has lagged. Additionally, a grid once designed to meet local customer needs is now required to meet the needs of wholesale markets that have evolved since the Energy Policy Act of 1992 and the US Federal Energy Regulatory Commission (FERC) created opportunities for consumer access to remotely located resources. Aging infrastructure, retiring generation, continuing load growth, a lack of long-term grid overlay-focused planning, and the addition of new generation have severely stressed the existing grid.

Electric transmission now faces a new challenge with the rapid development of generation and technologies designed to reduce the electric industry’s climate change impacts. These technologies - including wind, solar, biomass, geothermal, clean coal, and nuclear - all need the same transmission system to enter the electricity marketplace and serve customers. The nature of these new resources, both from a natural resource and political view, will typically require that their locations are far from the large population centers where the electricity is needed. This gap must be filled with transmission. Similar to the rapid expansion of electricity in the mid-20th Century, the US electric industry again faces the challenge of facilitating the integration of new resources while at the same time addressing the continued need for reliability and meeting the growing demands of customers and supporting the economy. Add to this the expectation of further demand growth due to electrification of transportation elements and industrial processes offset some by demand response and energy efficiency gains as we comprehend climate change impact. What is on the horizon cannot be viewed as a simple extrapolation of today.

Electricity must also remain reasonably priced for consumers of all income levels. Failure to keep electricity rates reasonable will have a damaging impact on the quality of life for many Americans. New and upgraded transmission can add to consumer costs, but transmission is only a small part of the energy bill, typically much less that 10%. In fact, new and upgraded transmission adding a tiny fraction to the energy bill can actually facilitate lower consumer costs with greater interregional market reach for energy supply, broader demand-side impact over multiple regions, and better energy delivery efficiencies overall.

Many important national issues, including energy security and climate change, can be addressed through the development of a robust interstate transmission system. The benefits of a robust grid include:

- Access to newer generation technology and the ability to share the benefits of demand response and smart grid initiatives across broad regions.
- Improved system resource adequacy requirements, by allowing greater sharing of resources and less dependence on local generation and constrained fuel supplies.
- Enhanced system reliability, security, and efficiency.
- Robust market competition that will benefit customers by eliminating bottlenecks in the US transmission grid.
- Lower and more stable rates for consumers over the long term with increased access to lower cost resources and the diverse portfolio of energy sources made available through transmission.

The greatest impediments of a robust interstate transmission grid are: (i) lack of long-range and visionary interregional planning, (ii) fragmented, uncertain, local and lengthy siting processes, and (iii) fragmented and uncertain cost allocation mechanisms for interstate transmission. Interstate transmission is a national good not unlike our interstate highway system. Federal support and guidance is essential to build collaboration across the diverse stakeholder groups and encourage the right solutions to what has become a national priority. National solutions require federal leadership. It is recognized that a vision does not become reality overnight, but vision provides leadership and direction. President Eisenhower's vision of the interstate is a prime example.

Overall Recommendation:

- DOE and FERC should actively support the development of an overall interstate transmission vision for the nation consistent with national energy priorities, and support the elimination of impediments to its development.

2. BROADER PROACTIVE INTERREGIONAL PLANNING EFFORTS NEEDED

From a societal perspective, there must be an integrated and interregional view of the electric grid that includes everything from the fuel source to consumer habits. This integrated and interregional view must transcend the interconnection queues, demand-side guesswork, regional seams, and "just in time" short-term transmission development. Population centers tend not to move and tend to have predictable growth. Locations and types of supply as well as demand options can be assumed in a broad sense by learned planners. If long-range plans are coupled with short-range certainties, lower transmission development costs can be the result. Did our interstate highway system start as two-lane roads with costly upgrades every few years, or did we take the visionary, long-range view? We have lost the art of true long-range macro planning in favor of the "just in time" incremental micro planning that serves short-term needs and is more costly to consumers in the long run.

Since the siting and construction of transmission infrastructure can take several years to complete, long-range interregional planning is critical. Planning facilities that can flexibly accommodate multiple future scenarios is paramount and should be employed on a broad scale. Planning must be carefully integrated on a long-term basis that far exceeds anything previously considered. Diversity of fuel sources, demand options and diversity of transmission solutions must be thoroughly examined, and planning must occur with a greater geographic scope and longer timeframe than ever before. Adapting to today's energy landscape requires a fundamental shift in the way that the transmission system is planned and built.

Confounding the planners' extrapolation of today will be society's response to climate change. The trend toward electrified transportation and pressure on industrial sectors to reduce greenhouse gas emissions could result in a tremendous demand on transmission infrastructure. These new electrification initiatives can have a profound impact on our grid if we do not plan and stay ahead of these initiatives. Efficiencies and demand-side options will help, but will not create significantly less need for transmission for the foreseeable future. The need to integrate renewable energy and other low-carbon generation sources makes it even more important for transmission planning to be conducted on an interregional basis.

Areas with high quality renewable energy resources, such as wind, solar, and geothermal energy, tend to be located at significant distances from population centers. Other low and zero-carbon resources, such as nuclear power plants and carbon capture and storage (CCS) coal plants are also likely to be located at significant distances from load centers. As a result, robust interregional transmission infrastructure will be required to move electricity from the regions where it is produced to regions where it will be used. Greater use of non-dispatchable generation technologies will also increase the importance of regional transmission planning, as the ability to move electricity from region to region will help system operators balance energy supply with demand across wider areas.

The localized or single-region planning mechanisms of the past and present are inadequate for the challenges of tomorrow. There will always be a need for local planning, similar to the need for state and local roads, but extra-high voltage (EHV) transmission, at voltages 345,000 Volts (345 kV) and above, can act as a superhighway crossing multiple jurisdictional boundaries. Planning for EHV transmission must start at the regional level and quickly become multi-regional in nature, stretching across vast portions of the continent to build a robust transmission overlay, restoring reliability while allowing large percentages of the population access to the clean energy sources they need. State-focused approaches to planning alone, stopping at state or jurisdictional system boundaries, will not achieve the renewable objectives of our nation, nor will they preserve our electric grid reliability.

The electric grid is a complex, interrelated network, and changing any part of the grid has widespread effects throughout the system. As the August 2003 blackout demonstrated, reliability in a broad region of the Eastern US and parts of Canada can depend on the reliability of a small number of transmission lines hundreds of miles away in Ohio. Similarly, electricity customers in the Northeast US can face significantly higher electricity prices because of transmission constraints several states away. The planning process for transmission lines that impact consumers, regulators, transmission dependent utilities (TDUs), and other market participants across a wide area should involve those parties across the affected region. Current planning within regions or local planning areas is robust, but interregional planning is lacking and transmission development between regions nearly non-existent.

For example, the "lake effect" phenomenon, a power flow problem around the eastern Great Lakes, has been around for decades. This was a contributor to the spreading of the 2003 blackout in the Eastern US, but has yet to be resolved. Certainly system controls, procedures, and compliance with mandatory reliability standards were put in place to mitigate the effects, but relatively little transmission investments have been made over the decades to mitigate this issue. This area is governed by three regional transmission organizations (RTOs) and the operator in Ontario, Canada. RTOs (and ISOs or independent system operators) are planning for reliable operation within their footprint, but they are not planning across regions as well.

Planning processes also need to incorporate the many purposes that transmission lines serve within an interstate network. Benefits for EHV transmission are very difficult to assign or classify to specific entities or categories. EHV transmission allows load growth to be served, reduces energy costs by allowing access to lower cost generation, increases reliability, and diversifies the generation portfolio. For example, TDUs frequently must pay market-based prices, but often are unable to bring power into their system from any company other than their traditional supplier because adequate transmission access is not available. Many separate "reliability" from "economic" planning, but that distinction for EHV transmission is untenable because these facilities improve both economics and reliability over the lives of the assets. Many use regional or jurisdictional boundaries as the limitation for EHV transmission benefits. Such delineations can yield fractured planning processes with pointed solutions, causing a dearth of investment across boundaries and creating lower voltage, less efficient solutions.

Longer range transmission planning, with consideration for 20- or even 30-year time frames instead of five- to ten-year ranges, will be critical to building new infrastructure. Today, most jurisdictions tend to justify projects on very strict reliability or economic assessments within each entity's area for short time horizons. The result is typically lower voltage, less efficient, least-cost solutions. Project validation needs to evolve to consider EHV transmission upgrades, in addition to appropriate lower voltage upgrades, that would provide sustainable, efficient, and long-term benefits over broad regions. Higher voltage transmission lines are more cost effective and more environmentally benign than lower voltage lines (as fewer lines are needed). The current process of planning small, incremental projects to meet narrowly defined needs leads to the construction of a transmission system that is highly sub-optimal. While consumers could save near-term costs by building lower voltage lines today and rebuilding them in the future as needs grow, this is more costly in the long run and harms community and landowner relationships.

Rights-of-way (ROWs) are precious, and we should make the best use of them, minimizing impacts. Higher voltage transmission should be used for interstate and interregional needs. Planning processes that are longer term should yield higher voltage transmission for interstate and interregional use. Interstate transmission should be at least 345 kV or higher, including complementary HVDC (High Voltage Direct Current) connections. These high-capacity lines enable the most prudent use of scarce corridors, and can be effectively linked to form the greater long-term interstate transmission vision. The highest voltage transmission in the country is 765kV. One 765kV line with 200 foot right-of-way width is equal in capacity to two to three 500kV lines (each with 200 foot right-of-way) and equal to numerous 345kV lines. HVDC transmission is most useful for long distance application (greater than approximately 500 miles without intermediate interconnection potential after being built), and interconnecting large systems with no synchronous connections, such as the Western interconnection, the Eastern interconnection, and the Texas grid. The benefits of an EHV overlay can yield focused upgrades of existing lines within existing corridors and cause the retirement of older assets, recovering their rights-of way. For example, today our interstate highway system has changed the role of US and state routes, with locally focused roadway upgrades and some roadway retirements.

Fortunately, some efforts have begun to successfully address the need for interregional planning. FERC Order No. 890 requires all transmission providers to participate in open, transparent regional planning processes that address economic as well as reliability needs. In the Eastern US, the Joint Coordinated System Plan is currently examining transmission infrastructure build-out plans that will facilitate the integration of a large amount of wind energy. In the Western US, the Western Governors Association and the DOE are leading the Western Renewable Energy Zones transmission planning process. Ultimately, these and other planning entities must work collaboratively to develop a long-range plan to move the plan from concept to implementation, and must encourage all stakeholders to be involved, such as regulatory bodies, legislators, government administrators, TDUs, and other interested parties.

Key Recommendations:

- DOE and FERC should encourage broader-scale, collaborative interregional transmission planning efforts with longer-term planning horizons among current planning authorities.
- DOE should periodically develop an interregional transmission plan coordinating among the plans already developed to ensure consistency with national energy priorities and provide official authorization with feedback to current planning authorities.
- DOE should initiate a comprehensive study on the grid planning impacts of our changing energy future with respect to supply and demand options, and with a close look at electrification of transportation elements and industrial processes. These results should be input into interregional planning efforts by current planning authorities.
- FERC should lessen the short-term delineations among EHV transmission rate-based projects between economic and reliability projects and recognize the overarching economic, reliability and energy security benefits of interstate transmission over the lives of the assets.

3. SITING OF INTERSTATE TRANSMISSION FACILITIES MUST BE IMPROVED

A more efficient transmission regulatory framework with clear delineations between federal and state jurisdictions will foster a stronger interstate transmission grid, therefore stronger wholesale competition in the electric industry. At the federal level, the FERC relies on wholesale competition to protect American consumers. Tenets of the Energy Policy Act of 2005 confirm that wholesale competition remains a national policy. Proper infrastructure expansion – facilitated through regulatory reform – will bring about the robust environment in which healthy wholesale markets will help mitigate many of the energy problems facing the nation today. However, reluctance by some states to site transmission beneficial to their neighbors renders new EHV transmission construction difficult, if not impossible. And the national interest electric transmission corridor (NIETC) provision of the Energy Policy Act of 2005, even though now narrowly applied to only two parts of the country, is currently under fire.

Currently, states and the federal government both have some jurisdiction over all transmission lines. RTOs have planning and scheduling authority over some, but not all, parts of the country. When proposals take transmission projects across federal lands, additional agencies, such as the various divisions of the Department of the Interior, also become players. States today retain central authority for the siting of transmission facilities. In addition, the North American Electric Reliability Corporation (NERC) and its Regional Entities (REs), through delegated authority from FERC, enforce compliance with standards that focus on maintaining reliability of the transmission grid. It is this broad spectrum of interested parties - and the nature of interstate transmission crossing jurisdictional boundaries - that complicates and impedes the siting process.

A further complication is that each state has its own siting rules and processes, which are rarely consistent with each other. In addition, each state views the benefits of transmission differently, especially regional benefits. The institutional arrangements for siting are not set up to deal properly with interstate transmission lines, and thus no structure exists that aligns with the national priorities inherently tied to transmission development. As demonstrated by the federal experiences regulating natural gas, electric transmission difficulties may best be handled under a regional, inter-regional, or, ideally, a national approach to balance the needs of the regions and the nation with the rights and needs citizens.

As a case in point, the 90-mile Jacksons Ferry-Wyoming 765 kV line energized by American Electric Power (AEP) in Virginia and West Virginia in 2006 was 16 years in the making. Almost 14 years were spent on siting, with just over two years devoted to construction. AEP spent $50 million on the project before the first spade of earth was turned. A portion of the siting problems that plagued the project were simply the function of an interstate effort. Virginia had one set of rules requiring compliance; West Virginia had another set. Several federal agencies also were involved due to the proposed path of the project, and each of those agencies had yet another set of criteria to meet. Each set of rules and regulations was reasonable independently; they simply didn't mesh. When the project was revised to comply with requirements in one jurisdiction, filings needed to be amended in each of the other jurisdictions, and the processes would start over. This mode of repetition and indecision is not only time consuming, but also very inefficient and, ultimately, more costly to consumers.

EHV transmission lines are used, in general, to transfer large quantities of electric power long distances and provide the backbone for the Eastern and Western interconnections and Texas today. Lines of this magnitude already are used in the 48 contiguous states. With this in mind, these high voltage lines primarily facilitate interstate commerce, and may fall best within the jurisdiction of a regional, inter-regional, or, ideally, a national (FERC) approach. Only with the recognition of the multi-state benefits of EHV transmission and the willingness to work collaboratively on siting will this impediment be overcome.

Key Recommendations:

- Provide siting authority to a regional, inter-regional or, ideally, a national authority such as FERC (similar to interstate natural gas pipelines) for interstate transmission facilities, with a participative and streamlined process established for states and other federal agencies.
- Despite recent opposition, DOE should consider designating more National Interest Electric Transmission Corridors (NIETCs).
- FERC should exercise its authority to issue permits for construction of transmission within NIETCs as appropriate.
- If multi-state collaborative organizations are established for siting, encourage the development of a consistent framework for evaluating and siting interstate transmission facilities at their level.
- If the actions lead only to revisions of the NIETC provisions of the Energy Policy Act of 2005, these provisions need to extend beyond relief of today's congestion and must address the reliability of the grid, the energy security of our nation, and access to renewable energy sources.

4. COST ALLOCATION & RECOVERY MUST BE MADE MORE CERTAIN

Transmission expansion has the ability to open new and diverse supply options, thus reducing consumer susceptibility to price spikes due to fuel cost increases, potential carbon impacts, and congestion. Transmission constitutes much less than 10% of the average US residential customer bill, but could have a significant impact on lowering the total cost of delivered energy. In other words, reduction in energy production costs could offset the cost of transmission expansion. Despite this, regulators and consumers alike remain concerned about the impact transmission projects will have on electricity rates.

Determining who pays for transmission that benefits many users across a wide area, for a variety of purposes and over a long time period, is perhaps the most significant barrier to transmission development. Methodologies for allocating costs to end users have a profound effect on the justification and authorization of transmission projects, particularly large scale EHV projects. There is a free rider issue where the beneficiaries of transmission have an incentive to avoid paying their share. Where RTOs have a role, they most often determine cost allocation methods while in other regions this task is delegated to individual states and utilities. The lack of regional agreements not only complicates the planning and justification of inter-jurisdictional projects, but also creates a higher level of uncertainty and risk for investors. Regulatory and political risks remain significant disincentives to project consummation, especially as the construction of large-scale projects can extend over a number of years with large capital investment.

The inherent nature of EHV transmission means benefits are provided across wide areas not limited by jurisdictional boundaries. For these particular types of projects, it is difficult, if not impossible, to accurately determine particular beneficiaries. In addition, benefits are often categorized into "reliability" or "economic" benefits, and the allocation methodologies frequently differ between these categories. There needs to be recognition that interstate transmission projects are multi-faceted, and attempting to assign costs for these types of projects to any particular group will always be met with objection causing unneeded delays. In some jurisdictions, costs for EHV transmission are shared across all companies in the footprint based on load ratio share. In this way, major backbone infrastructure can be planned based on the needs of the entire region. This promotes projects that are designed for maximum benefits to multiple stakeholders, and minimizes the cost impact to any individual customer group. This approach removes the ever-contentious rate cases that continually occur under a "beneficiary pays" or "participant funding" approach.

RTOs as well as state and federal policy makers should be engaged to encourage a shared approach for cost allocation for interstate transmission facilities. An approach that enables regional and interregional planning will naturally encourage the design of transmission projects with widespread benefits. At the consumer level, sharing costs as broadly as possible reduces the rate impact while enabling the robust infrastructure that also provides economic benefits through reduced congestion and lower energy production costs. With clear, established cost allocation methodologies, approval processes become much more efficient and the associated risk of uncertainty is minimized. This will encourage the adoption of prudent interstate transmission projects and the investment needed to build them. Without clear cost allocation, transmission is not encouraged. In cases where a potential line crosses over dissimilar cost allocation mechanisms, the project is delayed perhaps two years to determine the project and who pays. While incentives enabled by the Energy Policy Act of 2005 and FERC Order No. 679 have helped backbone transmission investment, cost allocation has proven to be the largest impediment to any transmission development, especially across dissimilar cost allocation areas.

In addition to cost allocation, rate design has a profound effect on decisions to build high-voltage transmission. Timely recovery of transmission investment is a vital component in attracting sufficient investment, particularly in the construction of EHV transmission projects with time lines that can extend multiple years. However, recovery of FERC-approved transmission costs is not necessarily guaranteed at the state level. This gap creates a risk of trapped costs, which is a deterrent to investment. Pass-through rates (state-approved mechanisms to allow automatic recovery of FERC-approved investments) help to bridge this gap and provide the certainty needed to stimulate major transmission investment. Reconciliation of federal and state cost recovery mechanisms will go far toward encouraging the construction of the EHV lines required by our nation.

Key Recommendations:

- FERC should provide leadership for developing the parameters of broad cost allocation under its rate-making authority for EHV transmission.
- Federal encouragement is needed for pass-through recovery of FERC-approved transmission investments at the state level.
- DOE and FERC should inform regulators and consumers on the need for transmission to stabilize electricity costs, and provide evidence through broad analyses.

5. MORE THAN NEW WIRES: GRID OPERATIONS AND MANAGEMENT SHOULD BE ENHANCED

The construction of a robust interstate transmission network is the most important solution to the challenges of electric grid reliability, load growth, transmission congestion, and the integration of renewable and other low-carbon generation. However, a number of steps can also be taken to operate the grid more efficiently and effectively. While grid operation has a number of challenges, there are solutions available that should be developed in conjunction with transmission expansion.

The existing grid is aging and it use is changing. The grid was largely developed from the 1950s through the mid-1970s with an aim to serve local utility needs. While some components last a long time (many decades) with good maintenance, others do not last as long and need to be replaced. Consumer load has also changed from "dumb" devices, to a digital world that is not forgiving for even the slightest service deviation. More "reactive" power is also being drawn from the grid for our motorized society crowding out the ability to transmit "real" power long distances and increasing the possibility of a "voltage collapse" blackout.

Renewable energy is growing, with much of the development far from population centers. Optimization of these resources as well as the operation of the grid is needed now more than ever. Historically, dispatching of resources was dependent on the demand and the most cost effective generating plants that were nearby. In addition dispatching of resources today is limited by congestion, weather (for renewable energy) and other factors. Much higher renewable electricity penetration will require an efficient and responsive fleet of traditional resources, new energy storage devices, and demand response to fill the gaps created by the inherent variability of renewable resources. Potential operating restrictions on the existing traditional generation fleet to achieve air or water quality improvements may impact the viability of those resources to help integrate renewables, and could lead to major operational issues. In addition, the growing complexities and higher use of the grid, the long distances to renewable energy, and the continued addition of power electronics and computers needed to control the grid will be even more operationally challenging than today.

Better wide area controls are needed for the grid. Much capability of the existing grid is a result of well-engineered controls and communication systems. Without them, the capacity of the grid to transfer significant amounts of power while still meeting reliability criteria would be much diminished. But more sophisticated detection and precise control action is needed. This includes situational awareness for the people operating the system to determine the correct automatic control actions and their timing. This can be facilitated by accelerating the work underway on precise time synchronized measurements on an interconnection-wide basis – also known as the North American SynchroPhasor Initiative (NASPI). These phasor measurement units (PMUs) are often described as "diagnostic MRI" for the electric grid.

Today's grid is operated in a manner that is not unlike driving down the interstate at 65 mph while opening and quickly closing your eyes every few seconds. This is enabled by today's supervisory control and data acquisition systems or SCADA. PMUs offer the driver the "eyes wide open" advantage while driving down the interstate. PMUs need work, but the concept should be further developed to provide automatic control of a modern grid by quickly adapting the power system to serious loss of transmission, generation or load. The benefits are better reliability and greater capability of the grid to move power, as well as possibly preventing or mitigating the effects of a widespread blackout.

To make better use of renewable energy and share other resources, including demand response, a wider geographic scope for energy "balancing areas" make it easier to reliably operate the electric grid. More opportunity for excess generation in one region to be offset by shortfalls in generation in another region would be the result. However, the benefit of larger balancing areas is generally more pronounced for wind energy, as total wind output is less variable over larger geographic regions. More flexible dispatch, shorter-term dispatch schedules (down to five or ten minutes), better energy storage capability, and demand response over larger geographic regions can enable even more renewable generation and provide less need for additional capacity. Solutions can take many forms, including consolidation of existing control areas into larger ones as is the case in some RTOs, or "virtual" consolidation through coordination agreements. But these solutions require interstate transmission as well. Also, NERC reliability standards will need to be reviewed to make sure any changes to "balancing areas" maintain high standards of reliability.

Changing the grid operations picture is the concept of smart grid, which enables demand response and other resources as significant potential for electric load to be dispatched as generators are dispatched today. Plug-in hybrid electric vehicles attached to the grid using smart grid technology also have significant potential to provide demand-side flexibility in the future, although the penetration of the transportation sector this represents would also increase electric load. Other energy storage technologies may also become cost-effective sources of system flexibility in the future.

New products and services could allow more efficient use of existing transmission infrastructure. The US electric grid is highly congested in some areas. As congestion moves around depending on outage conditions, seasonal variation, and other factors, opportunities exist for transmission customers to use spare transmission capacity outside of congested times. Recent FERC rules put in place conditional firm transmission and generation redispatch services to address transmission constraints. It is also possible to dynamically rate transmission lines for ambient weather conditions, allowing more electricity to be transmitted over the line when temperatures are lower than at peak summer days, although they require transmission operators to know more about the system than is generally the case today. Making such options available to transmission customers, including variable output renewable energy generation sources, can allow more efficient use of the existing infrastructure and significantly reduce the cost of reliably integrating new generation.

Other devices can also help in the controllability of the grid. For example, flexible AC transmission systems (FACTS) can provide control and voltage support to improve grid throughput. In addition, the use of HVDC to complement the AC network we have today can also be used to control the network, provide more connectivity across the three US grids, and mitigate the spread on blackouts.

Building upon lessons learned, a number of operational actions were recommended in the US-Canada Power System Outage Task Force Report on the 2003 Blackout. These recommendations are at various stages of development and the DOE is encouraged to review the status of each of them carefully, assess what else must be done, and determine how the DOE can help advance them. In addition, in Europe, they have successfully integrated over 50GW of wind. We can learn from their lessons learned as they deal with the variability of wind resources.

Key Recommendations:

- DOE should expand research into: (i) wide-area monitoring and control initiatives, (ii) network integration of renewable resources, and (iii) control center enhancements needed for our grid and energy future.
- FERC should encourage coordination/consolidation of balancing authorities or allow "virtual" coordination/consolidation to improve integration of variable resources and further the benefits of smart grid technologies and demand response. Reliability standards should be reviewed before any changes to balancing authorities are considered.
- FERC should encourage development of tools for improved generation dispatch and system flexibility for our grid and energy future.
- DOE should assess the implementation of the recommendations of the 2003 blackout report and direct actions if not implemented successfully.

6. CONTINUE MANDATED RELIABILITY COMPLIANCE

The Energy Policy Act of 2005 enabled FERC to mandate compliance with reliability standards. Congress largely acted on this issue as a result of the 2003 blackout in the Eastern US. This area is very important to our energy security and FERC, NERC, and the REs have done an admirable job to develop and enforce these standards. Utilities responsible for compliance are responding to their lead.

Key Recommendation:

- FERC, NERC, and REs should continue efforts to refine and enforce reliability compliance standards.

7. TECHNOLOGICAL INNOVATION SHOULD CONTINUE TO BE SUPPORTED

In transmission, R&D efforts are needed in three broad areas: (i) achieving more effective use of rights-of-way, (ii) application of improved system and equipment controls and diagnostics for the increasing grid complexity for our changing energy future, and (iii) advancing smart grid concepts to facilitate self-healing of the grid and demand response options. As aging transmission facilities are upgraded and replaced, and as new facilities are designed and built, these efforts will ensure utilization of technology solutions that maximize the capability and reliability of the transmission network. But leadership is needed. The industry is highly fragmented with over 500 transmission owners and over 3000 distribution owners, and R&D totals less than 1% of revenues.

Costs to develop and implement a new technology can be substantial. And, if the project proves successful, little or no benefit commensurate with risk might flow to its owners. FERC has encouraged development of advanced technology through incentives under the Energy Policy Act of 2005. However, these incentives are subject to the same regulatory barriers, where the investment in these technologies may be trapped at the state level, and cost recovery or its timing is not assured. Considering the risks involved, utilities are reluctant to make the necessary investments. Investment will occur only when regulatory policy provides reasonably certain cost recovery and a reasonable rate of return commensurate with risk.

Timely introduction of novel technologies can only be accomplished in the industry with leadership and direct involvement of the DOE in collaboration with entities such as Electric Power Research Institute (EPRI). Elements of such a futuristic grid have been articulated through various industry initiatives, including DOE Smart Grid, EPRI IntelliGrid and National Energy Technology Laboratory (NETL) Modern Grid. However, the current Office of Electricity Delivery and Energy Reliability R&D budget is far lower than any other energy research area. An increase in R&D funding from the DOE is needed to further grid modernization efforts. If our economy depends on our energy future, and a robust and technologically advanced interstate grid will enable our energy future, then funding levels need to reflect federal leadership.

DOE's prior commitments to partner with the industry in demonstrating advanced technologies can serve as a model for the new collaboration. With input from the industry, DOE can build an R&D portfolio, formulate an R&D roadmap, provide seed funding and engage willing participants in joint efforts to develop/demonstrate new technologies for the benefit of the industry and its stakeholders.

Key Recommendations:

- DOE should increase federal funding for transmission R&D and provide leadership at the federal level. Participation by national labs should also be increased.
- FERC should continue its policies related to technology development per the Energy Policy Act of 2005 and particularly encourage "first adopters."
- DOE should collaborate with EPRI to leverage R&D resources.

8. BARRIERS TO FINANCING AND CONSTRUCTION OF TRANSMISSION SHOULD BE LOWERED

Perhaps more so than at any point in the electric industry's history, new entrants stand poised to have a significant impact on the country's infrastructure. While there have been less than a dozen new regulated utilities formed over the past 40 years, interest in the transmission sector is exceptionally high. In addition, a number of companies are exploring opportunities in the merchant transmission business, in which their investment would be at risk and their return not capped. Most of these potential new entrants are drawn to the electric delivery business because of obvious need for capital and the fact that a "21st Century Grid" will require new thinking, new technologies, and new business approaches, which help level the playing field with traditional utilities and provide multiple avenues for growth.

In recent years, tens of billions of dollars of equity have been raised by infrastructure funds looking for opportunities to deploy the capital in regulated or unregulated projects. These new players have lower return expectations than traditional private equity funds, and their time horizons for holding investments may be longer. In addition, commercial and investment banks have favored lending to utility projects, as they provide greater cash flow certainty during a period of economic unease.

While many observers view this heightened sense of interest as proof that new companies and new capital will be flowing into the industry over the coming years, the reality is much less sanguine. In actuality, there are very few success cases. While in some instances it is clear that the potential new entrant made mistakes, there are also numerous unforeseen hurdles that prevent transactions. Some utilities fight bitter political battles at the state level to stop transactions, and while regulators rightfully look to ensure cost savings and synergies are shared by customers, they often overreach to the point that the economics no longer make sense. In new regulated and deregulated transmission projects, new entrants will take timetables and regulatory procedures at face value, failing to understand that interveners, inter-regulatory strife, and a myriad of legal options by opponents can extend the implementation time of these projects by years.

Today most incumbent electric utilities have the right of first refusal to construct, or arrange for construction of, any transmission project within their service territory. Reliability projects are generally completed expeditiously because they are required to meet NERC criteria or to "keep the lights on." Concerns frequently are expressed by TDUs and consumer advocates that incumbent utilities can continue to exercise transmission and/or generation market power by delaying "economic" projects through the request for repeated feasibility and cost-benefit studies and other delaying tactics. States and RTOs should be encouraged to develop expedited timelines whereby utilities must commit to either constructing or contracting for the construction of economic projects, and beginning construction of approved projects that will benefit consumers.

Seams are the borders between RTOs, as well as between utility control areas. Coordinating transmission projects across such seams is increasingly important to bring renewable energy to customer loads, as well as to improve grid robustness and the acquisition of lower cost electricity. Often, however, there is no mechanism for approval, cost allocation, and/or selection of owners for projects that cross these seams. RTO boards of directors should be encouraged to develop processes for dealing with these types of projects and facilitate independent transmission company participation and utility partnerships in "bidding" for construction rights. In addition, several states have created transmission authorities to stimulate the construction of high voltage transmission lines (e.g., Wyoming, Kansas).

While increased participation is encouraged, it is equally important to avoid complications to system operations and jeopardizing reliability that could arise with a larger number of owners. Expanding transmission infrastructure with increased participants and jointly-owned transmission facilities must be accompanied with sound agreements for operation, maintenance, restoration, and reliability compliance. However, incumbent utilities should not be looked upon as operator, maintainer, and restorer of last resort with reliability compliance responsibilities without compensation.

While the public, national and state policy-makers, and utility executives must become more engaged in defining our nation's energy priorities (e.g., reduced dependence on imported oil and natural gas, minimization of greenhouse gas emissions, responsible mix of generation types, enhanced reliability of the grid system, maintaining reasonable prices), immediate benefits on many of the above dimensions can accrue from a more robust high voltage electric transmission system. Resolution of impediments to the construction and integration of such transmission infrastructures into the present and envisioned regional and national grids is imperative.

Key Recommendations:

- DOE and FERC should support reduced barriers for transmission investors and new transmission ownership structures, while ensuring that reliability is not jeopardized.
- FERC should encourage states and RTOs to expedite construction of approved projects and deal with potential delays.
- FERC should promote the development of seams agreements between RTOs and other jurisdictional authorities for planning and allocating costs of interstate transmission facilities.
- FERC should encourage sound agreements for operations, maintenance, restoration and reliability compliance where fragmented ownership prevails.

DISSENT:

Some members of the DOE EAC have reported serious reservations about the approach in this chapter. They will be sending detailed recommendations prior to the September 25-26, 2008 DOE EAC meeting or will respond at the meeting. They do not agree that there is an urgent need to build a massive new, interstate transmission system based on a non-existent federal energy policy that overrides state policies and permitting jurisdiction, and passes all costs on to ratepayers, regardless of state determinations of need, lower-cost, or more environmentally benign alternatives. There is a need for additional federal assistance in state and regional planning efforts, more timely permitting by federal land use agencies, and focused transmission to meet state (and, perhaps in the future, federal) renewable portfolio standards. They hope the final product will take this more nuanced approach.

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