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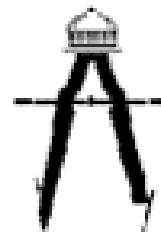
Reliable Electric Power Transmission and Distribution
under National Restructuring

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ABOUT THE AUTHOR

Brian Coombe is a senior electrical engineering major and student of the Schreyer Honors College at The Pennsylvania State University, University Park, PA. This paper is the product of work done through the Washington Internships for Students of Engineering (WISE) program in the summer of 1999. His internship was sponsored by the Institute of Electrical and Electronics Engineers (IEEE).

WISE PROGRAM

The Washington Internships for Students of Engineering is a ten-week summer program for outstanding engineering students who have completed their junior year of undergraduate study and display evidence of leadership skills and interest in public policy. The students spend the summer in Washington, DC learning how engineers are specially equipped to influence public policy as it relates to scientific or technical fields. Frequent meetings with government and private offices expose the interns to a variety of public policy issues. Each student researches an issue through literature surveys and interviews with experts and completes a policy paper for their sponsoring society. For more information about the WISE program, contact WISE, Attn.: Anne Hickox, 400 Commonwealth Dr., Warrendale, PA 15096-0001 or on the Internet: <http://www.wise-intern.org>.

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ABSTRACT

Electric utility restructuring is an extremely complex process, which can have effects on the reliability of our nation's electric transmission and distribution systems. Legislation enacting retail competition must ensure their continued reliability through standards, research, and a self-regulating reliability organization.

EXECUTIVE SUMMARY

Electric power is the most capital intensive and fourth-largest industry in the United States. Our nation relies on reliable electric power for safety, national security, and economy. The vertically integrated, regulated electric utility structure has worked to preserve and increase the reliability of these systems for over thirty years. Utilities have also worked to improve reliability; utility companies formed the North American Electric Reliability Council in 1968 to improve the reliability of our interconnected transmission grids through standards and coordination. Additionally, research to improve reliability has taken place both at the utility level and through the Electric Power Research Institute.

Recent and proposed legislation has prompted retail competition in 16 states, with the other 34 considering restructuring legislation. The current administration has proposed a national electric competition plan that would mandate retail competition in all 50 states by 2003; this plan is currently in legislation in both the House and the Senate. The plan proposes to increase reliability, but many of the specifics are not laid out.

Some of the negative effects of state restructuring initiatives have recently been observed, as outages due to reduced maintenance expenses have manifested in recent months. Opponents of restructuring cite the possibility of the increase of similar events; proponents see these events as a hurdle to be overcome in the new regulatory process.

Participants in the issue include the 3000 electric utility companies nationwide, their representative organizations, the various trade and professional organizations that represent their employees, the Department of Energy, specifically the Federal Energy Regulatory Commission, Congress, and the state public utility commissions, and consumer protection and interest groups.

Policies to maintain and improve reliability under this restructuring fall into three basic categories: standards, planning and oversight, and research. Policy alternatives are

evaluated on their effectiveness, efficiency, equity, flexibility, and feasibility. The policy alternatives evaluated are:

- Require Utility Mergers to Contain a Reliability Plan
- Creation of a Self-Regulating Reliability Organization
- Creation of A Standards Body
- Establishment of New FERC Requirements for ISOs
- Continuation of DOE Power Research and EPRI Funding

This paper recommends the creation of the North American Electric Reliability Organization as the self-regulating reliability organization, continued funding of EPRI research with public benefit funds, and creation of new IEEE voluntary standards to ensure the reliability of the new restructured electric transmission and distribution systems.

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ISSUE DEFINITION

The Importance of Reliable Electric Power

Our nation relies on electricity. Every home, factory, hospital, university, and office needs electricity to function. Reliable electric power has been a given in the last 25 years, thanks to the efforts of utilities and government. Every American is affected by the electric system; we require our electricity to work each day without question.

Since a blackout in 1965 left 30 million without power for several days, electric utility companies have worked to improve the reliability of our nation's electric system and prevent such large-scale disruptions of electric service¹. While our electric system has performed well, with few outages in the past years, current policy issues are increasing the potential for reduced reliability.

Sixteen states have currently passed legislation to deregulate the electric utilities within them, and the other 34 have legislation pending. Bills exist in both the House and the Senate, which will mandate nationwide deregulation by 2003. These changes in policy, not technology, have led to the issue of reliability, particularly with the transmission and distribution systems. The performance of transmission and distribution systems is vital to the consumer of electric power.

The opening of the generation market forces electric power companies to allow anyone access to the transmission and distribution grids. These changes will require the use of new standards in interconnection and transmission. Additionally, the North American Electric Reliability Council (NERC), a voluntary electric utility member organization, will not have the authority and influence it once had in a deregulated market.

The behavior of the formerly vertically integrated utility companies will also have a measured affect on reliability. As the owners of the transmission and distribution systems reduce costs in order to compete in a restructured market, the maintenance of these systems and research required for their improvement must continue in order to ensure future reliability.

Who Is Affected

Failure of a transmission line or a distribution transformer can affect anyone in our nation. We've all experienced loss of electricity in our lifetimes, whether for a few minutes or a few hours. Hopefully, our experience was only an inconvenience, but for some, loss of electricity can mean much more.

Industrial plants and commercial office buildings are particularly affected adversely by power outages. The median critical service loss duration for industrial plants (the amount of time without power that it will take to shut down a plant process) is ten seconds. The average plant restart time after a complete shutdown is 17.4 hoursⁱⁱ

Commercial office buildings are also vulnerable to losses in electric service. 74% of commercial offices consider an outage of one hour a "critical service loss". Costs for these outages are high; it is estimated that it costs a firm an average of \$17.99 for each kilowatt-hour of power not delivered. Industrial plants lose about \$11 on average for each kilowatt-hour not delivered. Since industrial plants are much larger consumers of power (many use over 1000 kilowatts, so an interruption in service of an hour would amount to the loss of megawatt-hours), they are often greater harmed financially by such lossesⁱⁱⁱ.

Economic and Social Consequences

The economic costs of unreliable power are so high that they escape estimation. Social consequences are high as well.

BACKGROUND

The Electric Utility Industry: Role and Policy History

It is estimated that public utilities make up the fourth largest industry in the United States, with revenues exceeding \$200 billion annually. The electricity sector is the most capital-intensive industry in our nation, with current assets of close to \$700 billion. Utilities have been regulated by the Securities and Exchange Commission (SEC) since the passing of the Public Utility Holding Company Act of 1935 (PUCHA). This

legislation broke up large monopolies that had formed and established regional suppliers of electricity, which were regulated on the state level by Public Utility Commissions (PUCs). Interstate electric commerce was regulated by the Federal Power Commission, which is now known as the Federal Energy Regulatory Commission (FERC). FERC is under the Department of Energy, and has control over interstate power transmission and mergers^{iv}.

Electric utility companies fall into four basic categories: private or investor owned, municipal, federally owned, and cooperatives. Private utilities are owned by investors and seek to make a profit by selling electricity. It is estimated that there are 223 private utilities currently operating in the United States. Municipal utilities are owned by state and local governments and make up the largest segment of utilities with 1,874 operating. There are currently 16 federally owned utilities; federal utilities cannot make a profit by law and usually sell electricity wholesale to other utilities. The Tennessee Valley Authority (TVA) is an example of a federal utility. Cooperatives, or co-ops, are customer-owned providers of electricity that exist in areas that do not have municipal or investor-owned electric service. Co-ops usually exist in rural areas, as it is not profitable for other utilities to provide service to areas with few customers and long distribution runs. Cooperatives must pass all profits back to the customer; they are very similar to credit unions^v.

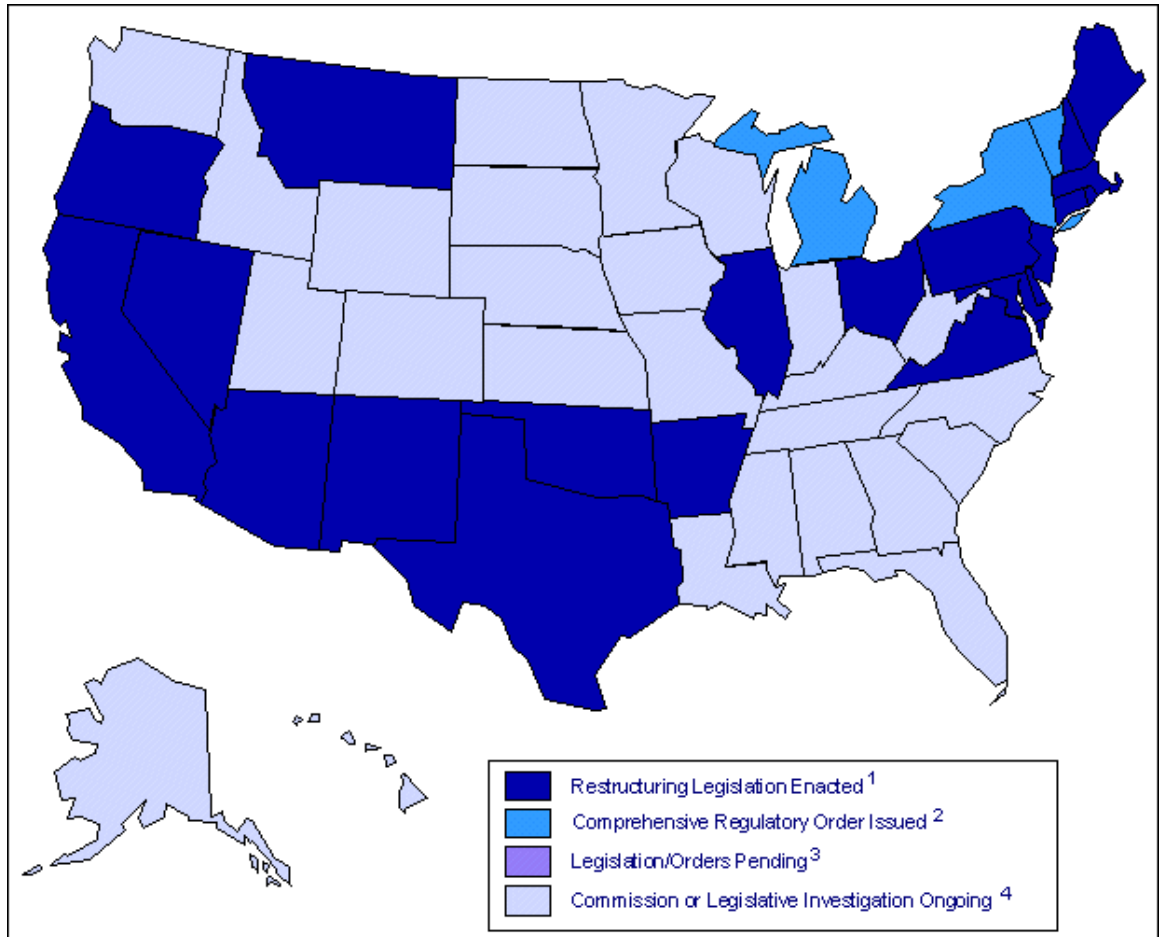
Historically, the majority of electric utilities participated in generation, transmission, and distribution. Generation is the creation of low-voltage electricity from a primary fuel source, such as nuclear fission or coal burning. Transmission involves the high-voltage conversion and transfer of the power produced at the generating facility to distribution centers located in the areas served by the utility. This network of high voltage transmission lines is known as the “grid”. Distribution is the conversion of this high-voltage power from the transmission lines to lower voltage lines serving neighborhoods, office buildings, and industrial complexes. These three segments of the electric power industry have always been vertically integrated; the only exception has been the federally owned utilities, who generate power and transmit it to other utilities’ grids in wholesale transaction^{vi}.

Path to Deregulation

With the oil embargo of the early 1970s and the fear of a natural gas shortage, President Carter proposed the National Energy Act in an effort to reduce our national dependence on fossil fuel energy sources. The Public Utilities Regulatory Policy Act (PURPA), signed into law November 9, 1978 as part of the National Energy Act, required utilities to purchase power from non-utility generating companies that used renewable energy sources or cogeneration. Cogeneration is the secondary use of steam, primarily produced for heat or industrial use, to generate electricity. These facilities, once certified by FERC and the PUC in that state, was classified as a Qualifying Facility QF. With the passing of PURPA, FERC required utilities to purchase power produced by the QF at its avoided cost (the price the utility would have to pay to produce that same power in its plant or buy from another utility). Many states set this avoided cost, and required utilities to purchase unneeded power at high prices from QFs to promote the renewable technologies^{vii}.

Technologies introduced in the 1980s, along with the increased availability of natural gas, brought the gas turbine into use. Gas turbines are smaller and more efficient than conventional fossil fuel, hydroelectric, and nuclear generation technologies. The Energy Policy Act (EPACT), passed in 1992, allowed generators other than QFs to produce and sell power wholesale to the utilities. These were known as Exempt Wholesale Generators (EWGs). Utilities were not required to purchase power from the EWGs, but it was usually cheaper for the utility to buy additional power wholesale than to add increased generation capacity^{viii}.

PURPA and EPACT gave state governments the authority to pass additional deregulation legislation. To date, 16 states are implementing electricity restructuring, with the other 34 states currently addressing reform^{ix}. Close to 4,000 QFs are in operation in the United States today, and 144 EWGs have entered the market since 1992^x. See Figure 1 on next page for a map of the states enacting retail competition.



Current Deregulation Policymaking

On March 25, 1998, President Clinton unveiled the Department of Energy's Comprehensive Electricity Competition Plan. This plan mandates that all consumers, nationwide, would be able to choose their electricity supplier by January 1, 2003, ensuring competition in every state. The plan intends to save a typical family of four \$230 per year in direct energy costs (lower electricity bills), as well as \$128 in indirect costs saved on items produced with cheaper electricity^{xi}

This Plan has been proposed in both the Senate and the House. S.1047, The Comprehensive Electricity Competition Act, was proposed May 13, 1999 by Senator Frank Murkowski, (R-Alaska), Chairman of the Senate Energy and Natural Resources Committee by request of the Department of Energy. H.R. 1828, also titled the Comprehensive Electricity Competition Act, was introduced May 17, 1999 by

Congressman Tom Bliley, (R-Virginia), Chairman of the House Committee on Commerce.

Deregulation's Effects on Reliability

Blackouts and power shortages seen in states with electric competition brought the reliability issue to public attention. The largest blackouts experienced after deregulation occurred on the West Coast Trees growing under transmission lines had not been trimmed, resulting in three 500 kilovolt line sections from Columbia River hydroelectric generating facilities to load centers in Portland, Salem, and Eugene, Oregon being snapped on August 10. This overloaded lower-voltage lines, causing cascading faults to occur and isolating several grids. The blackout resulted as the grids were overloaded, continuing until the lines could be repaired^{xii}.

The utility company responsible for maintaining the right-of-way claimed it was unable to keep up with the tree growth, due to monetary cutbacks and layoffs, which resulted from competition. Compounding the problem was the failure of protection and control equipment. This equipment was not engineered for the complex grids used in California and Oregon, two deregulated states with many smaller generators competing for customers.

While blackouts are the most severe consequence of reliability problems, wholesale price spikes are another problem that can indirectly affect consumers. During the week of June 21, 1998, a combination of factors occurred that drove wholesale prices up to extremely high levels. Wholesale prices are historically around \$30 per megawatt-hour (a unit of electrical energy - a 100 watt light bulb burning for 1 hour uses 100 watt-hours, often abbreviated as Wh) in the Midwest in June; some transactions peaked as high as \$7000/MWh on June 25. Power companies were forced to purchase this power at these high prices or curtail their customers; while no customers experienced blackouts, utilities lost several million dollars that week alone. Utilities were not the only entities affected; many large industrial companies, such as Steel Dynamics, purchase power in "real-time" contracts which tie their retail prices to current wholesale ones^{xiii}.

This surge in prices was again related to deregulation issues. Supply was reduced at a time when demand was particularly high. Storms had knocked out several key transmission lines and power plants, and the deregulation-trimmed maintenance crews of the utilities could not respond fast enough to make necessary repairs. An improvement in weather, plus adequate time to repair the lines, had brought prices back to normal in the next week^{xiv}.

Participants in the Issue

The Clinton Administration's Comprehensive Electricity Competition Plan recognizes reliability as an important deregulation issue. The March 18, 1998 press release reads:

Reliability and competition can – and must – go hand in hand. To ensure reliability in the new market we propose to build upon the industry's tradition of self-regulation by requiring key market participants to join in an organization which would establish reliability standards and enforce those standards subject to the oversight of the Federal Energy Regulatory Commission^{xv}.

The Department of Energy, in the Comprehensive Electricity Competition Plan, recommends the FERC-approved formation of an entity to prescribe and enforce mandatory standards to ensure reliability. FERC will be given the authority to review all standards enforced by this organization and ensure that they are in the public interest and reflect the proper level of reliability^{xvi}

A similar organization to what the Department of Energy recommended is in existence today. NERC was formed by electric utilities in 1968 in response to a blackout that left 30 million customers without electricity^{xvii}. NERC has proposed the creation of a new organization, known as the North American Electric Reliability Organization (NAERO), which is independently governed and funded. This organization could fulfill the role proposed by the DOE.

In the report "RELIABLE POWER: Renewing the North American Electric Reliability Oversight System", the organization states:

Stakeholder representatives should be heavily represented in standing committees of the board and thus have the opportunity to participate in setting reliability standards. In this manner, we struck a balance between the public interest in impartial judgment by the

board and the need to involve those with the most knowledge and experience if reliability standards are to be sound and command respect^{xviii}.

Senator Murkowski states:

I have no doubt that if we promote competition, consumers and our economy will benefit significantly. The transition to market competition raises a host of very thorny problems which we will have to address. There may be consensus that these and other issues must be addressed, but there is no consensus as to how we should address them. That is why I believe that the best way to promote competition is by deregulating, streamlining, and empowering the States^{xix}.

Many organizations feel that the federal deregulation legislation may hurt consumers. John Bosworth of the AARP is concerned that “states are not prepared to implement retail wheeling (the selling of generated electricity)”^{xx}

The International Brotherhood of Electrical Workers (IBEW), the nation’s largest electrical worker’s union, has various concerns involving deregulation and reliability. IBEW’s President, John Barry, states:

...claiming that federally mandated electric utility deregulation is needed to improve the reliability of the nation’s electrical grid is patently absurd... We have seen the examples of what happens to reliability when qualified workers are not there to maintain the system. Utilities believe that to be competitive, they must cut costs. Maintenance programs are slashed along with workers, so that when storms occur, getting customers back online becomes quite a chore. Our electricity system is already the most reliable in the country, and we’re determined to keep it that way^{xxi}

The technical issues present in reliable power delivery are numerous and create difficulties when analyzing reliability concerns. The Institute of Electrical and Electronics Engineers (IEEE)-USA notes that “the most critical issue to solve in restructuring the electric utility industry is reliability” in the 1997 IEEE-USA Technology Policy Symposium Summary. The cosponsoring IEEE-USA Technology Policy Council and Energy Policy Council state that “better ways to operate transmission and distribution, not generation, offer the major technological challenges.”^{xxii}

KEY CONFLICTS AND CONCERNS

Liberty vs. Government Control

Electric utilities have always been considered a natural monopoly, and therefore have remained under tight government control. The development of smaller-scale, cheaper generation technologies has led to the current legislation on retail competition. While generation may become a retail entity, transmission and distribution will remain regulated monopolies. The issue hinges on the level of regulation and control the federal and state governments will have over utilities which transmit and distribute electricity^{xxiii}.

Treating electricity as a commodity, which is traded and exchanged over the transmission systems before ultimately reaching the distribution systems is an oversimplification. As stated by the Congressional Research Service:

the need for (transmission) system coordination tempers the desire for direct, bilateral competition in the electricity debate, resulting in the proposed segmented industry of competitive generation, but regulated, natural monopoly transmission and distribution. The question is what balance between competition and control the new market should embody^{xxiv}.

The reliability “umbrella” organization discussed in current legislation is a constraint that may measure the amount of government control involved with reliability. Proposed legislation mirroring the Clinton administration’s plan for restructuring calls for this organization to be made up of utilities and private generating companies, and will be overseen and authorized by the Federal Energy Regulatory Commission. This is similar to the current reliability organization, the North American Electric Reliability Council, and will continue to keep the federal government a step away from the reliability concern. Other proposals currently in legislation also provide for a reliability council. The Administration’s proposal also provides for an Electricity Outage Investigation Board to be established within the Department of Energy^{xxv}.

Private Property vs. Common Good

Transmission lines are currently owned and maintained by a multitude of utilities. A transmission line that connects two distribution networks may be (and often is) owned by a third utility that oversees its operation and maintenance. Many utilities can own and oversee small parts of a large transmission system. While these systems are currently owned by utilities, they are indeed a common good. The effective operation and

maintenance of the transmission grid is essential to efficient, economical, and reliable electric power generation and distribution^{xxvi}.

Current legislation proposes that independent system operators (ISO's) be responsible for the transmission systems. These ISO's will be government-regulated utility organizations who do not generate power and exist solely to provide balanced control and maintenance of the transmission grids. This would remove the ownership of the transmission lines from the utilities, and make them indeed common goods^{xxvii}.

Distribution systems are currently owned by local utilities. These systems convert the high-voltage power from the transmission systems to lower industrial and commercial voltages and deliver it to local customers. Current proposals mandate the continued ownership of the distribution systems by the utilities, with full regulation from state public utility commissions. The distribution systems are indeed a common good as well, but they are also profit-generating entities for utilities, as utilities will charge customers for access to the local distribution system if they choose another generating company to purchase power from (known as carrier costs). Since carrier costs will make up a significant portion of revenues for utilities, who have invested in the existing infrastructure, the distribution systems will most likely remain regulated, utility-owned entities^{xxviii}.

Environment vs. Profit

While deregulation of generation has raised significant environmental concerns, the impacts of the restructured transmission and distribution systems upon the environment are not as inherently obvious. As of 1995, there are over 621,000 overhead miles of transmission lines in the continental United States, along with an additional number of miles of lower voltage distribution lines^{xxix}. Transmission line owners may eventually foresee the need to add additional transmission capacity as our nation requires increased electrification. Current legislation does not restrict transmission operators from adding transmission lines; these lines require clearing of forests for up to ten feet on each side of the line, and can often disrupt ecosystems. Sufficient evidence has not been found regarding the hazards of high-voltage power, but many are concerned with the effects of

electromagnetic radiation that results from high voltage power transmission. Installation of additional transmission lines near populated areas may result in conflicts with residents over possible effects of these lines^{xxx}

Big Government Vs. Local Government

The issue of regulation once again hedges on whether or not the federal government should require national electric competition and enforce reliability standards. Some legislation prefers state reliability enforcement by state Public Utility Commissions, while others dictate federal reliability enforcement. Interstate transmission systems and competition cloud the issue, as power producers in one state may sell power to a distributor in another state (regulated by a separate state PUC) via interstate transmission lines. The national transmission grid is not a homogeneous entity as well, state and local politics often dictate the presence and locations of transmission lines. Texas, for example, is completely isolated from the national transmission grid due to state political issues^{xxxi}

Public action groups also feel that the federal government should not be involved in deregulation at all; they prefer that deregulation legislation take place only at the state level.

Majority vs. Minority

Rural and remote customers are the minority in the electric power industry. Most rural customers are served by cooperatives, customer-owned and -financed power companies that are built in areas where for-profit companies do not see any profit possibility. Since these cooperatives are non-profit organizations, which intend to provide service at the lowest prices, they could possibly be affected adversely by retail competition. These cooperatives actually see the current legislation as a benefit. Glenn English, chief executive officer of the National Rural Electric Cooperative Association, predicts

“Consumers will increasingly turn to cooperatives for energy services if the electric utility industry abandons its long-held obligation to serve all customers”^{xxxii}

With both the majority, investor-owned and municipal utilities, and the minority, rural coops, seeing competition as an advantage, the conflicts between minorities and majorities on this issue seem nonexistent.

Centralization vs. Decentralization

Historically, NERC has been the centralized body dealing with reliability. NERC oversees ten regionally reliability councils; these councils were designed with the geography and specifics of the transmission grids in mind (Texas and Florida, two states which are isolated from other grids, have their own councils under NERC). Reliability standards devised by NERC have always been enforced by the FERC. With current legislation, this may change. NERC may no longer be the centralized reliability organization; this could lead to more centralization if the new reliability organization does not oversee the smaller regional councils^{xxxiii}.

Another key issue is centralized power research. The Electric Power Research Institute (EPRI) is one example of centralized research; EPRI is a non-profit corporation that conducts scientific research in electric power technologies. Many of the research products of EPRI directly improve the reliability of transmission and distribution systems. Critics of restructuring claim that centralized power research, such as that performed at EPRI, will be lost in a competitive environment as utilities will have to cut back research funding in order to compete with non-utility generators. This lack of centralized research could have a major impact on the future of electrical system reliability^{xxxiv}.

Costs, Safety, and Liability

The costs of an electrical outage, as well as the associated safety issues, are evident and very high. One only needs to look at the previous example of the New York City blackout to realize the costs and safety issues.

The liability issue is not clear. A power company is not currently liable for any costs or damages due to outages; but the City of New York recently sued Consolidated Edison after several outages during the summer 1999 heat wave. The general consensus is that power providers can be held to a contract to deliver power, with exceptions due to “Acts of God”. The question remains to be debated in the courts.

POLICY ALTERNATIVES

Require Utility Mergers to Contain a Reliability Plan

The International Brotherhood of Electrical Workers (IBEW), the nation’s largest electrical workers union, has proposed that any companies applying to the Federal Trade Commission (FTC) for the approval of a merger must provide a reliability plan. This plan must contain boilerplate language committing to maintain or improve reliability and quality of service^{xxxv}.

This proposal is not very specific, and leads to concerns regarding the FTC’s ability to judge the merits of a proposal on reliability. Alternatively, the FERC could act on behalf of the FTC and certify the reliability plan.

Effectiveness

This could be an effective solution to long-term issues with reliability. Future mergers and acquisitions are more likely to occur as transmission and distribution companies compete with generators for customers in the deregulated environment. This alternative is qualitative in nature, as the issue of how to measure the effectiveness of the reliability plan is not spelled out.

This alternative is also dependent on some assumptions. If the reliability plan is included in the merger proposal, who will enforce it if the merger does take place?

Alternatively, is the reliability plan legally binding? Could mergers occur, with reliability plans, that allow for *less* reliable service than before the merger?

Efficiency

The economic and social benefit of this alternative is the continuation of reliable and dependable electric service. The benefits of reliable service and the consequences of power failures, both economic and social, have been proven and are almost immeasurable. The issue is really if this alternative will provide this benefit, and how much of this benefit it will actually produce (alternatively, what interruptions in electric service it can prevent).

The economic consequences are debatable. Ideally, mergers occur in the free market should benefit the consumer; what is the government's role in these mergers could be an issue. Recently, several mergers in the telephone industry (which underwent deregulation in the 1980s) resulted in one large company, Bell Atlantic, controlling the jurisdiction of what was four Baby Bells. Many consumer federations and action groups are protesting the results of this merger. Similar situations could occur with utility mergers.

Equity

The costs of the reliability plan will be initially distributed among the merger participants, and then eventually passed to the consumer in terms of rates. In theory, the consumer directly benefits from the reliability plan's implementation, with the result being continuous electric service.

Risks include liability and affects of the plan. The consumer experiences the risk of losing reliable electric service, while the merger participants may be liable under law for any part of the reliability plan.

Flexibility

This policy lacks flexibility in several areas. Once a merger is approved, how it will adhere to the reliability plan is not detailed. Additionally, a merger is either approved or not approved based on the reliability plan; no incentives exist for far exceeding the standards set for approval.

Feasibility

This policy is very difficult to implement. Interagency cooperation, such as between the FERC and the FTC, may be required to approve reliability plans. Feedback, especially from organizations such as the IEEE, must be necessary to ensure that the reliability plans being approved merit such actions.

This proposal, while supported by the largest electrical workers union, will be opposed by their employers, electric utility companies. Utilities will not be likely to support this, since it requires expenditure of revenues to formulate and implement the reliability plan. The FTC (and the current partisan Congress) may even feel it has no place certifying any reliability plan in a merger. Engineering societies, whose members are both users of electricity and employees of power companies, will be in a difficult position.

Creation of a Self-Regulating Reliability Organization

The Comprehensive Electric Competition Plan, proposed by the current administration, outlines for the formation of a self-regulating reliability organization. This organization would develop and enforce reliability standards for all electric power producers, transmitters, and distributors. NERC has proposed to form a new organization, the North American Electric Reliability Organization (NAERO). The key difference is that the FERC currently enforces any NERC standards, where NAERO will have the jurisdiction to develop and enforce any reliability standards. NERC was a

voluntary organization, but NAERO will require mandatory compliance in a restructured system.

Key elements will exist in NAERO's operation, which include binding agreements between NAERO and regional reliability councils. NAERO will not be mandated if the Comprehensive Electric Competition Plan legislation is not passed.

Effectiveness

Creation of a self-regulating reliability organization, with the power to enforce any policies, will both qualitatively and quantitatively improve transmission and distribution system reliability. This policy will be beneficial in the long-term; but short term issues may be a problem. The creation of the organization, and the associated learning curve involved, may cause the inability to deal with coming reliability issues in the next few months and years.

Efficiency

This policy will have a significant economic impact on consumers if it is able to prevent electrical failures. It is unknown whether the costs of the formation of this organization will be born by the utilities, as in the past, or if the government will sponsor it, but the costs associated with a single electrical failure can easily justify the operating costs of this organization.

Equity

This policy could have the power to affect smaller companies in a negative manner. If the larger utilities make up the organization, issues that may affect the smaller utilities and their customers could be created. Distribution of costs among the utilities, whether equal for each or proportional to the size, could create inequity if the transmission and distribution companies are required to fund the newly created

organization. Since the organization may also have jurisdiction over Canada, international issues may be raised.

Flexibility

This policy lacks flexibility, as no exit strategies or “safety net” exist if the self-regulating reliability organization proves to be ineffective. This alternative is flexible with regards to state and local authority, as the regional reliability councils will remain under the governing body.

Feasibility

This policy will be relatively easy to implement. Current proposals in legislation provide for it, and NERC has proceeded to form NAERO in an attempt to meet the criteria for the organization.

Creation of A Standards Body

Alternative to the creation of a Self-Regulating Reliability Organization is the formation of a new standards body that will develop but not enforce reliability and quality of service standards. This standards body may not even require creation if new entrants to the power market continue to participate in and adhere to NERC standards. If the current legislation is not passed, however, separate federal measures may be needed to oversee reliability in the states currently undergoing deregulation. These measures could include the creation of such a body, similar to NERC, with enforcement overseen by the FERC.

Effectiveness

Given the use of voluntary standards, such as those formulated by the IEEE, this standards body could be an effective producer of new, voluntary standards that are

needed under deregulation. This would be a long-term solution, as the standards body would require time to be formed and formulate standards. The effectiveness of the standards developed would be determined by the FERC enforcement.

Efficiency

This alternative will cost very little to implement, but the costs the companies will have to bear to adhere to the standards developed will be difficult to measure. This alternative is slightly less economically efficient in terms of free market, as the FERC enforcement of these standards would be required.

Equity

Once again, the issue of how the utilities will be represented in the standards body may be a problem. Smaller utilities and regional cooperatives may see this policy as having the possibility of harming them, if they are not represented and standards that are developed are detrimental to them. The formation of NAERO is supported by the American Public Power Association (APPA), Canadian Electricity Association (CEA), Edison Electric Institute (EEI), Electric Power Supply Association (EPSA), Electricity Consumers Resource Council (ELCON), Enron Corp., and the National Rural Electric Cooperative Association (NRECA).

Flexibility

This policy is very flexible, for the standards body itself—it's size, makeup, etc.—can be flexible as well. Reversibility of this policy is questionable, however. Current standards are voluntarily met or enforced by FERC, so this body would not be as drastic as a change for the utilities as the formulation of a self-regulating reliability organization.

Feasibility

Since a similar body (NERC) is in existence, the creation of this body would be relatively easy. NERC could easily assume the role of this body, or a new body similar to NERC could be formed

Establishment of New FERC Requirements for ISOs

Current legislation, as well as FERC Order 888, provides for the formation of Independent System Operators (ISOs). These ISOs would be utility companies that own and operate the regional transmission systems. These utilities would still be allowed to compete for wholesale and retail generation sales in the deregulated market. Many feel that this is incomplete, and the ISO should be a separate corporate entity that is responsible only for operation and maintenance of the transmission systems alone, with no role in generating power. Utilities that only operate distribution systems would still be allowed to sell generated power. The FERC would be required to oversee all operation and pricing involved with the ISO.

Effectiveness

Transmission line operators that compete in the generation market for customers may sacrifice transmission-line maintenance costs in attempts to produce power at lower prices in retail competition. Legally removing generation from transmission within corporations and separating transmission as a business could effectively protect consumers from outages caused by poor attention to transmission facilities. This would be a long term solution.

Efficiency

This may not be an efficient policy, for the corporations owning the transmission lines must profit from their use only. The economic viability of this option is undetermined.

Equity

This is an equitable alternative for those benefiting from transmission lines, namely utility users which purchase wholesale power and the consumers they sell it to. This policy is not equitable for owners of transmission lines, since they would have to sell off their generating facilities under this plan.

Flexibility

This alternative is not very flexible, and is completely irreversible. Any transmission line operator that sells off its generating facilities would be left without them as a source of revenue.

Feasibility

This plan would require major legislation to implement. It is a long-term solution, but the effectiveness of the incentives and their level and distribution would need to be closely monitored.

Continuation of DOE Power Research and EPRI Funding

Some utilities have proposed a consumption tax for electric power. Customers would pay a small, flat tax per unit of power used. This tax would support existing power research. This policy is very controversial, as many utilities claim that they will

be unable to fund electric power research in a competitive environment. The Electric Power Research Institute (EPRI), is currently funded by many utilities. Alternatively, many also contend that federally funded Department of Energy Research should continue even in a deregulated environment^{xxxvi}.

Effectiveness

The continued research and technical innovations that support the transmission and distribution infrastructure are necessary to maintain and improve their reliability. Past research innovations have been very effective in improving reliability.

Efficiency

Conservative estimates yield a \$50 billion customer benefit from EPRI research alone. This is more than a tenfold return-on-investment (ROI) for utility companies. Thus, power research is extremely efficient and can support reliability with small investments.

Equity

This policy would benefit all consumers, even beyond reliability. Power research has the ability to bring electricity to the poor, improve energy efficiency, and reduce the output of greenhouse gases. The only question is on the distribution of funding. Smaller utilities that conduct power research may lose out if their research is not funded.

Flexibility

This alternative is flexible in that the levels of funding and who is funded can be adjusted easily. Additionally, if the benefits of research are not seen, funding can be reduced or removed.

Feasibility

This plan is feasible under existing legislation. The continued use of public benefit funds for this research is part of the Comprehensive Electricity Competition Plan.

RECCOMENDATIONS

Electric utility restructuring at the state level and currently proposed national restructuring legislation creates the need for new standards and regulation in issues involving reliability and quality of service of our nation's electrical transmission and distribution systems. Both the current regulatory legislation and standards affecting reliability of these systems are not equipped to deal with the transitory issues which will be seen as the country moves to deregulating electric utilities.

The policy alternatives devised to mitigate this problem fall under three areas: reliability standards, reliability planning and oversight, and reliability research. A combination alternatives emphasizing these three key areas is the best method for maintaining and improving the reliability of the transmission and distribution system. The combination of alternatives recommended is:

- Creation of NAERO as a self-regulating reliability organization, sanctioned by the FERC
- Development and adoption of new IEEE standards in the power transmission and distribution areas
- Continued funding of power research in government and industry

Creation of NAERO and Sanctioning by the FERC

NERC has existed for over thirty years, and has undoubtedly improved the reliability of the electrical grid in the United States, Canada, and Mexico. NERC has taken a proactive role in the restructuring, by conducting reliability assessments for the next ten years as well as formulating a strategic plan for the creation of NAERO, the next-

generation reliability organization. NAERO will be created in the next year; the issue is whether or not the FERC would sanction NAERO under the current proposed legislation. No other reliability organization of similar history, size, or scope exists in the United States today. NAERO is the clear choice for the oversight and planning of our transmission and distribution system reliability.

Development and Adoption of IEEE Standards

The Institute of Electrical and Electronics Engineers is the largest technical professional society in the world. Many people responsible for the development and operation of electrical transmission and distribution systems are IEEE members, and the IEEE is a respected body in industry and government. Power professionals have relied on voluntary standards since the creation of the first electrical networks, and the IEEE Standards Committee has both a working group on Reliability and a working group on Power Systems Engineering with many subdivisions. Historically the Power Systems Engineering group has developed standards for distribution and transmission. The IEEE Standards Committee would be in the best position to develop new voluntary standards for reliability.

Funding of Power Research through both Industry and Government

The positive effects of funding power research have been proven and will continue. Disaster mitigation, transmission and distribution planning, failure analysis, maintenance planning, and other technical subjects continue to see improvements as a result of this research.

The deregulation of the long-distance telephone market and the airlines has resulted in the reduction or disappearance of basic research. The common example has been the disappearance of Bell Labs in telecommunications research. Regulators and congress must ensure that the same difficulties do not fall on the power industry.

CONCLUSION

The complexity of the nation's electrical transmission and distribution systems and the difficulty to forecast natural disasters and other events that affect reliability make analysis extremely difficult. Legislators and regulators must continue to support industry coordination, standards, and research to preserve our nation's strongest asset under national restructuring.

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