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Update on the Impact of Electricity Market Competition in the USA on the Nuclear Industry

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The move to deregulate electricity markets in the United States has accelerated to almost fever pitch. In 1996, the Federal Energy Regulatory Commission (FERC) required all interstate public electricity utilities to permit third parties access to regulated utilities' transmission systems. In late December 1999, FERC took deregulation one step further, by issuing a rule requiring utilities to submit proposals for participation in Regional Transmission Organisations (RTOs). All fifty states, plus the District of Columbia, have investigated the feasibility of retail competition, and forty-six are moving forward, albeit with varying degrees of intensity.[1]

In such a rapidly changing environment, the nuclear industry must work to remain competitive with other forms of electricity generation. The industry's ability to do so in the new millennium, in both the short term and the long term, is dependent upon several different factors. An evaluation of these challenges forms the substance of this paper.

Federal Regulatory Background

The passage of the Energy Policy Act of 1992 and the subsequent issuance in 1996 of FERC Orders 888 and 889 marked the real starting point for deregulation of electricity supply in the United States. The Energy Policy Act gave FERC the power to require electricity utilities to provide access to their transmission grids for wholesale electricity transactions. Relying on that authority, FERC promulgated Order 888,[2] which mandates open access to interstate transmission lines at the wholesale level. Utilities were required to file open access transmission tariffs, describing the terms under which they will provide access to their systems for point-to-point and network transmission services.

Utilities also were required to provide ancillary services to all third parties on a non-discriminatory basis. Such services include scheduling, system control, dispatch, and voltage control. For utilities not subject to the jurisdiction of the FERC (those who do not transmit electricity in interstate commerce), Order 888 contains a "reciprocity requirement". Under this requirement, any customer who purchases transmission services through an open access tariff (including those not subject to FERC control) is required to provide similar open access services to the transmission seller. Further, Order 888 requires functional unbundling of electricity services. Utilities must separate, both physically and organisationally, their generation and transmission services in order to prevent the controlling utility from discriminating in favour of transmitting its own power.

FERC Order 889 adopted a code of conduct to govern the mechanics of functional unbundling.[3] First, the order requires physical separation of generation and transmission personnel within the same corporate family. Generation employees are not allowed in the transmission control room and cannot be given any preferential access to information regarding operation of the utility's transmission system. Second, the order recommends, but does not require, the creation of Independent System Operators (ISOs) to manage transmission activities. Utilities would relinquish control over their transmission systems to an independent operator to ensure fairness in access, but ownership of the transmission facilities would remain with the utility. Finally, Order 889 requires that utilities implement Open Access Same-Time Information Systems (OASIS). These internet based systems allow utilities searching for transmission services to view each provider's availability and cost information in real time, and to make nearly instantaneous reservations for access.

In its most significant electricity restructuring initiative since Orders 888 and 889, in December 1999 FERC promulgated Order 2000.[4] That order requires utilities to submit plans for participation in an RTO. As with an ISO, by participating in an RTO utilities relinquish control over their transmission systems to an independent authority, whose job is to ensure fair access to wholesale transmission services. FERC believes that RTOs will benefit consumers of electricity in the USA through the lower electricity rates that FERC believes will result from a wider choice of services and service providers. FERC has predicted that significant cost savings — as much as US$2.4 billion a year — are likely to result from the introduction of RTOs. As FERC Chairman James Hoecher has stated, the goals of RTOs are simple: increased "competition, efficiency and reliability".

Order 2000 does not prescribe the form or operation of the RTO. Rather, the FERC will permit various types of RTOs to be established. For example, they may take the form of ISOs as described above; they may be "for profit" companies that both control and operate the transmission assets (generally known as "Transcos"); they could be a combination of the ISO and Transco models; or they could take another form not yet determined by the industry. All RTOs, however, must have four specific characteristics and must perform eight minimum functions.

The four characteristics of an RTO are:
- independence,
- scope and regional configuration,
- operational authority,
- short-term reliability.

Of these, FERC has stated that independence is the "bedrock principle" of RTOs. Generally, independence means that an RTO must be operated without the influence of market participants, including any entity that sells or brokers electrical energy, or provides transmission or ancillary services to the RTO, unless such entities have no economic or commercial interests that would affect the RTO.

The eight minimum functions that an RTO must perform are:
- tariff administration and design,
- congestion management,

- parallel path flows,
- ancillary services,
- OASIS operation,
- market monitoring,
- planning and expansion,
- inter-regional co-ordination.

In Order 2000, the FERC also encourages RTOs to examine new transmission pricing approaches, such as single system rates or congestion pricing. According to Order 2000, all public electricity utilities that own, operate or control interstate transmission facilities must file by 15 October 2000 a proposal for an RTO, or alternatively a detailed description of why the utility has not yet joined an RTO and any future plans for participation. The RTOs must be operational by 15 December 2001.

As a result of deregulation, many utilities remain concerned that much of the large capital expenditure for plants and equipment which they made relying on the old regulatory scheme will be unrecoverable under the new interstate open access regime. FERC's position on recovery of these "stranded costs", therefore, significantly influences how states are restructuring the electricity utility industry at the retail level. Some early estimates indicated that stranded costs could be as high as US$200 billion, larger than the bailout of Savings and Loan institutions in the 1980s, although that number has moderated as most deregulation plans allow for stranded cost recovery.[5]

The standard for cost recovery, adopted by FERC and many states as well, is to allow recovery of costs that are "legitimate, prudent and verifiable".[6] The vagueness of this standard has made it difficult for utilities to predict whether they will be able to recover their costs. Possible solutions include transmission surcharges and securitisation of stranded costs through the issuance of utility bonds. However, the decision as to recovery methods for stranded costs at the retail level is left primarily to individual states.

Federal Legislative Initiatives

For the last five years various members of the US Congress have been formulating proposals for restructuring the electricity utility market. At present there are several bills pending before the Congress, including a bill submitted by the Clinton Administration. While no action on any of these proposals is expected during 2000, as it is an election year, common themes emerge from the various pieces of legislation:

- Repeal of the Public Utilities Holding Company Act.
- Allowance for stranded cost recovery.
- Repeal or suspension of the "Qualifying Facility" provisions of the Public Utility Regulatory Policy Act.
- Standards for service reliability.
- Consumer protection.
- Provision for ISOs or RTOs.

The Clinton Administration's plan imposes retail competition by 1 January 2003, but would permit states to opt out, encourages FERC to set up RTOs, requires prior FERC approval for any merger between electricity utilities, grants FERC jurisdiction over electricity reliability issues and standards, and allows the government owned electricity authorities (such as the Tennessee

Valley Authority (TVA)) to participate in the competitive market.[7] Additionally, a measure introduced by Senator Frank Murkowski, Chairman of the Senate Energy and Natural Resources Committee, would permit any utility holding nuclear assets to petition FERC for additional transmission surcharges to cover decommissioning costs associated with nuclear plants. A measure introduced by Representative Joseph Barton of Texas would exempt nuclear decommissioning trust funds from taxation upon transfer of ownership of any nuclear plant.

Federal restructuring legislative proposals in previous years have tried to bring about comprehensive restructuring of the electricity utility industry. More recently, however, proposals have begun to coalesce around narrower provisions, addressing primarily the reliability of the electrical power grid. A rapid reduction in the amount of capacity available nationwide has led to more frequent brownouts and even rolling blackouts during peak power usage periods during the summer months.

Capacity-driven power outages in locations such as Silicon Valley have painfully demonstrated the significant financial implications of reduced reliability of the grid. Whereas electricity grid reliability was expected, in fact taken for granted, during the era of franchise monopolies, reduced reliability and the potential for unexpected blackouts has surfaced as an undesirable by-product of electricity restructuring. The most recent federal legislative proposals have targeted the reduction in grid reliability through mechanisms to control and enforce criteria for grid reliability on a national scale.

State Competition Initiatives

As previously noted, 45 states and the District of Columbia are investigating, are in the process of implementing, or have already implemented retail competition. Five already have competition in place, namely California, Massachusetts, New Jersey, New York and Rhode Island. Seventeen states have scheduled a competition phase-in. Only two states, Colorado and Idaho, have decided not to pursue restructuring, citing low electricity rates and the potential for significant rate increases as the primary reason. Low rates are also the primary reason for the "wait-and-see" approach that a few other states have taken.

Other reasons that some states have been slow to act include:

- Availability and cost of different fuels and means of generation.
- Environmental concerns.
- The effect upon state and local tax bases.
- The effect on energy assistance programmes for low-income households.

While no two states have restructuring initiatives which are exactly alike, there are several common elements to many of the plans that are currently under review or have already been adopted. These are:

- Phase-in of competition over several years.
- Reliability standards.
- Recovery of stranded costs.
- Control of market power either through forced divestiture or through ISOs/RTOs.
- Temporary rate freezes.

Stranded cost recovery is usually through either a transmission access fee or through some form of debt securitisation. Several states list the extent to which the burden of stranded costs should be placed upon utility shareholders as one of the remaining issues for study.[8]

NRC's Regulatory Position

The Nuclear Regulatory Commission (NRC) has taken significant regulatory action in response to electricity restructuring. These actions address financial assurance, decommissioning funding, anti-trust issues, foreign ownership limitations, and the licence transfer process. For instance, the NRC has issued a new rule covering decommissioning funding. The NRC has also published new guidance on financial assurance for operations, but has not yet changed the regulations governing financial qualification because it believes that dramatic changes are not necessary. Rather, the NRC believes that "economic deregulation does not preclude adequate protection of public health and safety", and "[the NRC's] regulatory framework is generally sufficient, at this time, to address the restructurings and reorganisations that will likely arise as a result of electricity utility deregulation".[9]

Last year, the NRC revised its regulations concerning financial assurance requirements for decommissioning in light of ongoing electricity utility restructuring efforts.[10] In addition, the NRC Staff revised the guidance on estimating decommissioning costs to reflect significantly lower estimates. For example, under the new guidance, the estimated cost to decommission a large PWR was reduced from about US$500 million to about US$300 million.[11]

The NRC has now adopted a rule which allows licensees to use their customers' contractual obligations to demonstrate decommissioning funding assurance. Such obligations can be used if the electricity purchaser (contractor) is required to pay the decommissioning obligations specified in its contracts "notwithstanding the operational status either of the licensed power reactor to which the contract(s) pertains or *force majeure* provisions". All decommissioning proceeds from the contracts must be deposited in an external sinking fund.[12] The NRC suggested that captive insurers (i.e. those owned by licensees or their parent companies) might provide insurance to guarantee the availability of decommissioning funds.

The new decommissioning funding rule allows licensees to use parent company or self-guarantees of decommissioning funding to cover all or a portion of its decommissioning costs, whereas the previous version of the regulation did not allow utility licensees to use these methods, nor did it allow non-utility licensees to use them in conjunction with other methods.[13] Moreover, the NRC will now allow licensees to use methods not specified in the regulations, so long as the methods provide, as determined by the NRC on a case-by-case basis, "assurance of decommissioning funding equivalent to that provided by the mechanisms specified in [the regulations]".[14] The NRC has not yet had an opportunity to elaborate on what methods are "equivalent" to the specified methods.

For licensees without the benefit of cost-of-service rate regulation or non-bypassable decommissioning charges, the NRC's new decommissioning funding rule did not significantly increase flexibility for providing decommissioning funding. The NRC recognises that the requirements are

burdensome for licensees without the benefit of mandatory charges or contractual guarantees to cover decommissioning costs.

The NRC has recognised that deregulation is prompting a significant number of operating licence transfers as plants are sold or new entities are formed to operate plants previously operated by utility licensees. In response to these changes, the NRC has streamlined its procedures for conducting public hearings on licence transfers by promulgating a new hearing procedure in its rules of practice.[15] Further, to help facilitate licence transfers, the NRC has eliminated anti-trust reviews during licence transfers[16] and clarified its interpretation on limitations of foreign ownership of nuclear power plants to allow significant foreign investment in nuclear power plants.

The Effect of Restructuring on the Nuclear Industry

The effects of restructuring will be felt in the nuclear industry during the short and the long run, as the industry struggles to reduce costs sufficiently to be competitive with existing and new fossil generation. Costs within the fossil generation sector are not likely to remain stable either, and it is this potential for change that may, in fact, increase the prominence of nuclear power in the future.

Competitiveness in the Short Run — Further Reducing Costs
Many of the early predictions surrounding electricity restructuring projected the rapid demise of nuclear power. Some analysts believed the costs of nuclear power were prohibitively high, and that fossil generation stations would eventually drive nuclear plants out of business in a competitive marketplace. In 1997, I noted that the actual cost of producing electricity was the determining factor in whether existing nuclear plants would continue to run in the deregulated environment, rather than the overall cost of the facility.[17] This is because most state deregulation plans include recovery of stranded construction and decommissioning costs, making the capital investments surrounding construction and eventual decommissioning irrelevant.

Since those costs are already accounted for, the competitiveness of an existing nuclear station is judged by comparing its production cost plus the estimated cost of any unexpected capital repairs to that of an existing fossil station. Many times this comparison favours nuclear power. In 1998, the cost of producing electricity at a nuclear site averaged 2.31 cents/kWh, with individual plants as low as 1.15 cents/kWh. In fact, this compares quite favourably to 2.12 cents/kWh for coal generation, 3.55 cents/kWh for natural gas, and 3.87 cents/kWh for oil.[18]

Many utilities understand the potential of existing nuclear power plants, as evidenced by recent corporate transactions. Indeed, large utilities in possession of significant nuclear assets are buying plants from other, smaller companies. For instance, PECO and Unicom (the parent company of Commonwealth Edison) announced a merger bringing 19 nuclear plants under their combined control; AmerGen (which includes PECO and British Energy) recently acquired four nuclear power generation stations; Conectiv sold its nuclear interests to PSE&G Power and PECO; and First Energy purchased two nuclear units from Duquesne Light Company.

Other utilities with significant nuclear assets are pursuing re-licensing of the nuclear power plants that they already own. Two nuclear power stations, Baltimore Gas & Electric's Calvert Cliffs and Duke Power's Oconee, have already received approval from the NRC for additional operating periods of 20 years, in addition to their initial licence period of 40 years. Based on the success of these two applicants, many other utilities have joined the queue to pursue licence renewal for an additional 20 years for their own nuclear power plants. For example, the trade press indicates that Florida Power & Light intends to re-license Turkey Point, and Carolina Power & Light intends to re-license Robinson-2 and Brunswick.[19]

The key to nuclear competitiveness in the emerging energy market is to keep costs as low as possible without compromising safety and without increasing the risk of an unexpected outage. Safety concerns, real or perceived, can lead to increased NRC scrutiny, and outages reduce overall revenue, thus increasing the cost of generation per kWh. Several different strategies have arisen for cutting costs. They include:

- better outage planning to reduce time off-line;
- sharing expertise/outsourcing;
- new fuel technologies and/or storage options;
- a focus on excellence.

With the reductions in staffing that many utilities in the United States have seen in the past several years, outage personnel must be able to perform multiple functions quickly and correctly. Because the staff required to operate a nuclear power plant is large, even after the aforementioned reductions, time during which a nuclear plant does not produce electricity can become very expensive.

Many utilities, therefore, now develop more detailed and thorough outage plans, in order to reduce the amount of time that the plant is not generating power.[20] One utility provides every employee with a copy of the entire outage schedule, as well as daily progress reports in order that employees know exactly what will be expected of them. Crews managing work are given greater flexibility to make their own decisions. Thus, work is done faster as management approval is not necessary for every issue that arises. Another utility provides business and financial training through a local university to all its managers at the plant. A more highly trained and informed staff are better able to make cost-effective decisions that result in getting the plant up and running again in a much shorter time.

The wide variance seen in cost per kWh between individual nuclear plants indicates, in part, a gap in terms of effective nuclear plant management. Organisations that have been successful in nuclear management have found profitable methods for disseminating information, and those in need of such information have been willing to negotiate to obtain it, whether in the form of nuclear management companies, mergers and acquisitions, or training contracts between utilities. Whatever the format of the information sharing, the ultimate goal is to reduce production costs by taking advantage of the economies of scale that present themselves and by managing plants more effectively.[21]

Consolidation of nuclear ownership/control is the primary means by which these advantages are achieved. Consolidation allows larger owners to take

advantage of the expertise of their employees throughout a larger system. Rather than having a nuclear support division to assist one plant, or even two or three, the same personnel can assist multiple plants, reducing the overall cost per kWh of the support division. Moreover, those choosing to acquire control over a nuclear plant are invariably those who have been able to effectively and competitively reduce costs and increase performance with their own plants.

An interesting side note is whether transfer of ownership to a new entity will in any way affect the eligibility of the plant to receive stranded cost assistance, as many states are still forming deregulation plans. It could be argued that a voluntary choice to acquire ownership waives the argument of reliance on the old regulatory scheme that justifies stranded cost recovery. If so, the option of a nuclear management company may be the better alternative. Rather than transferring title to a new entity, a utility retains ownership of the plant but turns over management decision-making regarding the plant to an operating company.

Such outsourcing activity allows the management company to take advantage of economies of scale (in terms of personnel), and thus allows the utility to negotiate a lower price, thus reducing production costs. Furthermore, the utility will be better able to quantify its production costs, allowing more informed business decisions concerning the plant. Other opportunities for outsourcing to reduce costs in the short-term, as well as the long-term, include outsourcing of information technology, human resources, and customer services (e.g. billing and call centre operations).

Fuel technologies and new spent fuel storage options also have the potential to reduce production costs for nuclear plants. Higher burnup fuel assemblies can allow longer cycle lengths, which reduces the percentage of time devoted to refuelling outages and thereby offers the opportunity for increased capacity factors. Less expensive options for spent fuel storage can further reduce overall operating costs for nuclear power. As nuclear power plants continue to operate, and the Department of Energy (DOE) continually fails to meet its obligation to take spent fuel, the cost of storing the increasing quantity of spent fuel becomes an ever more significant part of the cost of nuclear generation.

More creative methods of using available space in spent fuel pools offers some relief from this increased cost. For those nuclear power plants with no additional pool storage space, less expensive dual purpose storage options for dry storage of spent fuel become ever more important for holding down the cost of nuclear generation. The primary challenge associated with newer technologies, however, is their reliability.[22] Failures can result in long outages, and may necessitate expensive repairs. Plant owners and operators may find themselves in a catch-22, where newer technologies are not well tested and hence not attractive, because no-one wants to experiment with unproven technology, while continuing to implement existing technologies will result in higher, and therefore less competitive, overall generation costs. Moreover, in a world of ever tightening purse strings, the availability of federal research funding for nuclear power generation and related technologies is no longer something that can be relied upon.

A private spent fuel storage facility, currently under review by the NRC, may provide a more cost-effective alternative for additional storage of spent fuel. Rather than building a large number of small, separate spent fuel storage facilities at any number of nuclear power plants, the private facility could provide a single, more efficient option for the temporary storage of spent fuel until the DOE meets its legal obligation to take the spent fuel, whether for federal storage or for disposal in the proposed deep geologic repository currently under investigation at Yucca Mountain, Nevada. Although the private temporary spent fuel storage site will not be ready until late 2001 at the earliest, those utilities reaching their spent fuel storage capacity limits may have an additional option for spent fuel storage.

Underlying all of the attempts to reduce nuclear power generation costs, however, is the absolute necessity of safety, which is a thread that runs throughout the nuclear industry and, of course, the public.[23] While cost reductions and safety may appear, at first glance, to be opposing forces, this is not the case. It has been repeatedly demonstrated that those nuclear power plants that have the lowest cost per kilowatt-hour are typically rated among the safest and best performing plants in the country. A fundamental commitment to excellence is the method used to achieve concurrently both operational safety and cost-efficiency. An informed, well-trained, and dedicated staff is perhaps the most effective way to guarantee both goals. Plants with safety problems typically suffer from both inefficiency and poor management. Such plants are ripe for acquisition by another company, or, in the alternative, for outsourcing to a nuclear management company. The resulting change in management vision and culture offers the potential to unlock the full economic value of what has been, heretofore, a poorly performing nuclear generation asset.

Nuclear Competitiveness Over the Long Run — Existing Plants

The long-term viability of existing nuclear generation assets will still be determined by a comparison of the production costs for the nuclear plants versus the production costs for fossil plants, as stranded costs of construction and decommissioning will be paid for through provisions in the restructuring plans.[24] Unfortunately, long-term production costs for existing nuclear units involve more than operational costs. Nuclear plants are not without their own potential capital costs, such as those involved with steam generator replacement, which may be required for the long-term operation envisioned in licence renewal applications. Large capital investments may be necessary to keep nuclear plants running into the middle of the twenty-first century. These capital costs, along with fuel prices and environmental concerns, will play a key role in determining the relative costs of nuclear and fossil power.

The question of whether to close existing nuclear plants and to replace them with new fossil generation (most likely in the form of natural gas-fired combustion turbines) turns on a comparison of the production costs for the nuclear plants versus the production costs plus construction costs for a new fossil plant. As with the decision on whether to operate existing nuclear plants versus existing fossil plants, comparison of the capital costs for licence renewal versus construction of a new fossil plant, as well as environmental concerns and fuel cost comparisons, will be determinative factors.

While both traditional fossil generation and nuclear generation make use of non-renewable fuel sources, there is a sizeable gap between their respective

price per kWh. A long term uncertainty, however, is how the relative price of each fuel, on a per unit basis, will change over time. Fuel pricing and technological advancement will play a key role in this dynamic. Of particular importance is the large number of natural gas-based facilities currently under construction or already in operation. A developing shortage of natural gas, whether of actual reserves or the transmission capacity to transfer those reserves, will affect this entire sector of the industry very quickly, as fuel purchases are constantly necessary.

In contrast, the supply of uranium is more than sufficient to supply the existing set of nuclear power plants. If anything, the drive to reduce costs as a result of restructuring can be expected to put pressure on uranium enrichment and nuclear fuel fabrication vendors to further enhance efficiency and reduce profit margins. Restructuring has increased the need for high burnup, high performance nuclear fuel products, and offers the opportunity for vendors to develop new products with a real market in a restructured electrical power industry. The vulnerability of the natural gas plants to fuel cost volatility may make the fuel cost of nuclear power more predictable and hence an attractive option in the longer run, as costs per kWh may vary greatly in fossil generation.

As previously discussed, development and implementation of newer technologies may be more difficult in the competitive environment. To the extent that nuclear utilities can implement cost-saving or production-increasing technologies, production cost can be further reduced. Current designs for natural gas combustion turbines may have reached a physical limit, thus reducing opportunities for further technological advancement. For example, first stage combustion turbine fan blades are constructed using nickel alloys, whose melting point is around 2650°F (1450°C). Many high efficiency combustion turbines already use extensive cooling systems to maintain temperatures around 2400°F (1300°C). Thus, greater energy extraction from natural gas combustion turbines is limited, as exceeding the melting point for nickel will cause catastrophic failure and require first stage replacement. Such repairs can be in excess of US$2.5 million, not including revenue losses resulting from time off-line. In contrast, new technological solutions may be available for nuclear units as research questions and opportunities still abound.[25]

Changing environmental requirements may also contribute to a resurgence of nuclear power. Combustion of fossil fuels releases a host of air pollutants, including carbon dioxide, nitrogen oxides and sulphur dioxide into the atmosphere. As Clean Air Act restrictions on SO_2 and NO_X intensify, the control technologies will drive the cost per kWh of fossil energy higher. Installation of control equipment represents a large capital investment, so much so that older plants may choose to shut down rather than modernise. Control technologies decrease unit efficiency by using lower burn temperatures (to control NO_X) and lower flow rates (to avoid overloading SO_2 scrubbers).

Assuming that nuclear production costs do not change significantly, stricter environmental standards for traditional air pollutants favour the nuclear power industry. Further, the growing concern over carbon dioxide and the potential need for regulation of CO_2 emissions may strongly encourage the continued use of nuclear power. The Kyoto Protocol requires the United States to reduce

its CO_2 emissions to a level 7% lower than the levels that existed in 1990. Fossil energy will either have to make significant efficiency strides while maintaining compliance with other traditional pollutant standards, or other energy sources will be necessary. If the Kyoto Protocol is actually implemented in the USA, it is unlikely that the demand for nuclear power will decrease.

The Potential for New Plants in the Competitive Environment
Not surprisingly, the potential for new nuclear generation is almost entirely dependent upon finding a way to reduce the capital costs associated with construction. While small reductions in cost may be enough to make nuclear power plants profitable over a forty-year time horizon, utility investors think in terms of shorter investment horizons. Short-term results are the primary criterion on which the performance of companies are now typically judged, and any investment in nuclear generation is not likely to affect those short-term results in a favourable manner.

Without significant reductions in up-front capital costs, or significant increases in the cost of competing fossil power, new nuclear units are unlikely. However, new nuclear power plant technologies being developed for an advanced generation of plants, including gas-cooled plants using gas turbines instead of stream generators and stream turbines, offer the potential for economically competitive nuclear power plants in a restructured electricity utility industry. The commercial implementation of such nuclear power plants in the USA is still some time in the future, although at least now it is being considered.

Conclusion

Restructuring of the electrical power industry in the USA is well underway. FERC further accelerated the effort in December 1999 with its Order 2000 that requires utilities to submit plans for participation in an RTO. The individual states are proceeding with implementing restructuring on a scale and at a pace that is appropriate to each state's individual circumstances. Federal legislation may well end up addressing only the issue of electrical grid reliability, and leaving the broader issues of restructuring to the discretion of the individual states.

Nuclear power has fared quite well in restructured electrical power markets. Whereas many critics predicted most, if not all, nuclear power plants would be unable to compete in a restructured marketplace, in fact many nuclear power plants rank among the lowest cost electrical power producers in the USA. To remain competitive, the remaining plants must continue to keep down production costs in both the short-term and the long-term, including both fuel costs and capital investments, such as steam generator replacement, necessary to facilitate operation for the time periods envisioned by a 20-year licence renewal.

Besides corporate consolidations and the indirect benefits from the pressures placed upon fossil fuel power generation costs due to either increased fuel costs or increased environmental compliance costs, the nuclear industry must continue to pursue other cost saving measures to maintain competitiveness. As discussed, these include better outage planning, sharing of expertise and outsourcing services, new fuel technologies and spent fuel storage options.

This must be done while maintaining a commitment to excellence. If successful, a bright future for nuclear power will mean a bright future for utilities, nuclear fuel cycle vendors and other companies who play an important role in maintaining nuclear power as a cost-competitive means of electrical power generation in the United States.

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