SOME THOUGHTS ON ACTIONS-POLICIES AND THEIR RESULTS

by George Silvestri

Winston Churchill made the observation, "Those who fail to learn history, are doomed to repeat it."

We can look at past actions/policies, whatever the endeavor, and obtain an insight into the advisability and consequences of current and future decisions. Those past actions/ policies may have had favorable results, or they may have had disastrous unintended consequences no matter how commendable the intentions were. Whatever the results, they provide a basis for evaluating current policies and initiatives.

The unintended consequences of specific actions and policies relate to all of the organizations that are involved to some degree with electrical power activities. The organizations involved include the electric suppliers, the legislative branch of government, the executive branch, the judiciary branch and the regulatory agencies (federal, state and local). The intent of this writing is not to cast aspersions on the individual agencies but to obtain insight into the consequences of their decisions.

I will cite specific legislation, policies and agencies in the paragraphs that follow in the hope that we will profit from the consequences of particular actions. In addition, I will cite particular events that are relevant to the topic.

PURPA

In 1978, as a reaction to the rapid increases in electrical power cost, triggered by OPEC 's oil price increases, a law was passed by the United States Congress. This law, Public Utility Regulatory Policies Act (PURPA), was part of the National Energy Act. This law created a market for non-utility electric power producers and forced electric utilities to buy power from these producers at the "avoided cost" rate, which was the cost the electric utility would incur were it to generate or purchase from another source.

There were a number of various responses to the legislation. Some came under the umbrella of Independent Power Producers, others as Merchant Plants and still others as cogeneration (dual purpose-supplying both heat and electricity) plants as well as other single purpose plants and just called Non-Utility Generators, NUGs. The price of natural gas was low so many of these non-utility entities installed combustion turbines. While the cost of coal was lower than natural gas, the capital cost of combustion turbines was also lower than conventional steam plants.

The "avoided cost" rate was often set at the highest avoided cost rate which occurred at the time of the highest electrical demand and which was incurred with units with the poorest thermal efficiency and/or the units with the highest fuel cost. At periods of lower system

demand, the utility still had to purchase the electricity from the NUG even though the utility could generate or purchase electricity at a lower price than the NUG could supply. When natural gas prices increased to more conventional levels, the price of electricity from the NUGs became even greater, yet the conventional electrical suppliers had to buy power from them 7/24 ad infinitum.

The cost disparity became so large that many electric utilities acquired (bought out) the NUGs and shut down these uneconomical plants. In other instances electrical utilities in New England purchased combustion turbines when natural gas prices were low, in an effort to contain electric costs. However, when the natural gas prices subsequently increased, the utilities were in the untenable position in which the power cost from the combustion turbines was greater than the allowable price that could be charged to consumers. Despite a tight power supply at that time, the utilities shut the combustion turbines down as they were subsidizing the electric users, and the regulatory agencies refused to provide rate relief.

MAKING THE RIGHT DECISION

With changes in fuel costs, fuel options, interest rates, environmental policy and allowable rates of return, the selection of generating options by electricity suppliers is no simple process. At times, what appears to be a viable generation option becomes a poor choice in a comparatively short time period. To illustrate this I have selected some events in the past 30 years as noted below.

CYCLING STEAM PLANTS

There is always the tendency to confuse short term trends in the factors (cost of capital, cost of fuel and operating and maintenance cost) that comprise the total cost of power with a truly long term trend. Sometimes these short term trends can persist for years. For example, in the late 1960s and the early 1970s, because of the high cost of capital and low fuel costs, a number of utilities built cycling steam plants that had lower capital costs but also lower thermal efficiency. The lower capital costs resulted from plants that had lower operating pressures and temperatures (1800 pounds per square inch, psi, steam pressure and steam temperatures of 950 F) and eliminating, in part, other plant equipment that contributed to the plant's thermal efficiency. Most plants previously had operating steam conditions of 2400 psi and 1000 F. The difference in thermal efficiency of the two types of plants was as high as 10 %.

These lower efficiency steam plants were also expected to be more tolerant of cycling operation. That is, the plant would cycle, operating during the daytime hours when electrical demand was high but shutting down overnight and/or on weekends when demand was low. It was projected that these cycling plants would go through startup/shutdown cycles about 300 times a year. This turned out to be an incorrect assumption because of

changes in the factors that comprise the total cost of electricity. Moreover, subsequent analysis and operating experience revealed that the conventional steam units could operate in a cycling mode just as well as the less efficient units with lower steam conditions.

To cite an example of what happened in many instances, bear with me as I cite the experience with a steam turbine that my employer, Westinghouse Power Generating Business Unit, supplied for the Encina Station of San Diego Gas and Electric Company. This 300,000 KW unit was expected to operate in an on/off mode for 300 times a year. During the first year of operation, this unit did experience about 300 on/off cycles. But in the second year the unit only experienced about 30 on/off cycles and was shut down the remainder of the time. Rapid increases in the cost of natural gas made the unit uneconomical to operate.

Yet the rationale for these cycling units was low fuel cost and high capital cost. Moreover, interest rates dropped to more traditional levels thereby removing the justification of high cost capital. It would be easy to blame the utilities for adopting such a generating strategy. In retrospect what seemed to be a long range trend had adverse consequences despite the electric utilities objective of reducing generating costs, coupled with the concurrence of the regulatory agencies.

An insightful observation was made in a technical paper in a British engineering publication. I have paraphrased it slightly and had cited it in some of the technical reports that I wrote when actively employed. The observation is as follows: ***It is a human trait to ascribe to the unknown competitor all of the hopeful virtues and to ascribe to the established technology all of the known drawbacks***.

My observations (from over 40 years of employment in a sector of the electric power industry) are that this human trait has been exhibited on numerous occasions with unfortunate consequences. Furthermore, none of the stakeholders involved in one aspect or another of the supply of electricity has been immune to this failing with undesirable consequences.

COURT DECISIONS

When Exelon Generation was involved in the process of getting a 20 year license extension (for the Oyster Creek Nuclear Generating Station) from the Nuclear Regulatory Commission (NRC), the New Jersey Department of Environmental Protection (DEP) opposed the granting of the license extension. The DEP maintained that the thermal discharges from the plant were an environment hazard and would require the installation of a wet cooling tower. The NRC and the plant owner maintained that the Environmental Impact Study justified the granting of the extension without a cooling tower. The DEP filed a suit under the Utility Water Act. The owners maintained that the granting of the license was supported by the cost benefit analysis of the plant with and without a cooling

tower. The trial judge ruled that since the Utility Water Act did not mention cost-benefit analysis, the DEP's contentions were valid. The ruling was appealed. The US Supreme Court overruled the trial judge, noting that cost-benefit analysis was used in the deliberations of many government agencies and was a legitimate procedure in evaluating various alternatives. Moreover, cost-benefit analysis is employed by a host of enterprises in the selection of alternative concepts and projects.

WHO'S IN CHARGE, THE LEGISLATURE OR THE REGULATORS?

When legislation is enacted, the language is often vague and imprecise. The legislatures rely on the regulatory agencies to develop the specifics. Specific examples in the environmental area are the acronyms ALARA (As Low As Reasonably Achievable), BAT (Best Achievable Technology) and NSPS (New Source Performance Standards) that are employed in the regulatory process. What do Reasonably Achievable and Best Available Technology really mean? Are they in the eye of the beholder?

There have been instances where electric utilities have contemplated upgrades of plant equipment which would increase plant output as well as reducing environmental pollution per unit of output. The US EPA has established limits on the pollutants, which if exceeded would require that the plant be subject to the New Source Performance Standards, NSPS, the same as for a completely new plant. This has acted as a deterrent to utilities in upgrading plants. Consequently, the older more heavily polluting plants remain operational rather than increasing output through upgrades and producing less pollution per unit of output to avoid the imposition of NSPS.

NUCLEAR ENERGY

As originally constituted the Atomic Energy Commission (AEC) besides meeting the needs of our military establishment, had responsibility for the promotion of nuclear power and the regulation of the nuclear industry, a potential conflict of interest. As a result the agency was broken up into two separate entities, the new AEC and the Nuclear Regulatory Commission (NRC). The new AEC operated research facilities and laboratories devoted to both civilian and military uses. The NRC became the regulatory arm of the nuclear industry.

The AEC, prior to its breakup, provided support to utilities for building nuclear power plants under what was known as the Power Demonstration Reactor Program. The Yankee Rowe and Dresden 1 plants and a host of smaller nuclear plants were built under this initiative.

Based on this experience, manufacturers began offering large-scale reactors to the nation's electric utilities in 1963. Utilities ordered hundreds of reactors during the next ten years. A number of factors led to a diminution and eventually cessation in orders for new nuclear

plants. The major factor was the energy crisis, which was precipitated by the OPEC members. It resulted in a drastic reduction in the rate of increase of power consumption from an average of about 7 % per year to 1 % to 1 ½ % per year, followed by cancellations of many projected nuclear plants (about 100) or the stretch-out of the completion dates for the plants.

There are numerous examples of stretch-out of the completion dates for nuclear plants. The Limerick nuclear station is one example of stretch-out. The PA PUC discouraged the stretch-out option. However, the PUC did allow PECO to complete Limerick 1 but with a cap on rates. PECO was encouraged to cancel Limerick 2. PECO responded by offering an alternative, accepting a cap on the Limerick 2 capital cost that could be included in the rate base, while still completing the unit. Construction was completed and the capital cost came in lower than the cap agreed to by PECO and the PA PUC. In retrospect, this was the more correct decision.

THREE MILE ISLAND (TMI) AND ITS IMPACT

On March 20, 1979 Unit 2 at Three Mile Island sustained an accident that led to overheating of the reactor core. Even though the accident resulted in no deaths or injuries to plant workers or members of the nearby community, it brought about sweeping changes involving emergency response planning, reactor operator training, human factors engineering, radiation protection and many other areas of nuclear power plant operations. NRC regulations and oversight became broader and more robust, and management of the plants was scrutinized more carefully.

The Kemeny Commission, set up to investigate the March 1979 accident at the TMI nuclear power plant, recommended that the nuclear power industry establish a program that specified appropriate safety standards and to set up an agency for systematic gathering, review and analysis of operating experience at all nuclear plants. In response the nuclear industry established two organizations in December 1979; Institute of Nuclear Power Operations (INPO) and the Nuclear Energy Institute (NEI).

INPO's mission is to promote the highest levels of safety and reliability (to promote excellence) in the operation of nuclear electric generating plants. The Nuclear Energy Institute, NEI, is the policy organization of the nuclear energy and technology industry and participates in both the national and global-making process. In this regard the NEI's objective is to support policies that promote the beneficial uses of nuclear energy and technology in the United States and around the world.

In addition to these organizations, at the behest of Congress and the regulatory agencies, the electric power industry, in the late 1960s, set up it own research and development organization, the Electric Power Research Institute, EPRI. I had the privilege of being

loaned (from my employer, Westinghouse Electric Corp.) to EPRI in the October 1973 through October 1974 time frame to assist in developing their technology programs.

It was recently announced that INPO will join the NRC in overseeing the construction of two new nuclear reactor units at Plant Vogtle in Georgia. Inspection teams from INPO will assess Vogtle's operation independently of the NRC.

The design electrical rating net capacity for nuclear plants was in the low 60% range for several years, reflecting the need to correct deficiencies and upgrade plant systems to conform to NRC requirements. INPO's efforts and a substantial reduction in downtime for refueling outages (from 2 to 3 months to slightly over 1 month along with greater time periods between refuelings) as well as improved planning and maintenance resulted in a steadily increasing net capacity factor from about 70% in 1998 and reached an outstanding level of about 90% since 2000.

MAINTAINING THE VIABILITY OF NUCLEAR POWER

Plant Operating License Extensions

The NRC, recognizing the advantages of and the need for nuclear power, developed a number of initiatives. Based on the Atomic Energy Act, the NRC issued licenses for commercial power reactors to operate up to 40 years and allowed these licenses to be renewed for up to another 20 years. The first electric utility to apply for a 20 year license extension in April 1998 was Baltimore Gas and Electric Co., owner and operator of Calvert Cliff 1 and 2. The NRC issued the license in March 2000. A typical application is processed in 30 months, if there is a hearing, and 22 months, if there is no hearing.

The applicant must demonstrate that it meets the requirements which ensure safe operation and comply with environmental standards as well during the additional 20 years of plant operation. Fifty five (55) life extensions have been granted out of a total of 104 generating units. Another 9 units are in the final stages of the review process and applications have been filed for an additional 20 units.

Increased Licensed Power Operation of Existing Plants

The second NRC initiative relates to increased licensed output, up-rates, for existing nuclear plants. Eighteen (18) nuclear units have been approved for up-rates with the increases ranging from about 2% to 13 %. Power up-rates for an additional 6 units are under consideration and range between 13 % and 16 %.

Certification of New Reactor Designs

The third NRC initiative relates to a program for the certification of new reactor designs, building on the operating experience with currently operating plants. All sectors of the populace (plant designers, plant owners and their suppliers, intervenors, public interest groups and government agencies) are given the opportunity to testify at the hearings for or against the certification. If after completion of the hearings, a reactor design is certified, challenges will not be allowed regarding the safety and viability of the certified design. However, when a decision is made to build a new plant using the certified reactor design, hearings must be held regarding the environmental suitability of the site where the certified design is to be built.

Two reactor designs have been certified and six (6) other designs are at various stages of the certification process. One of the certified designs, two generating units, has been designated for the Vogtle site and was discussed in the section on INPO.

Why So Much Discussion of Nuclear Energy?

Considerable material in this write-up has been devoted to nuclear power. The nuclear option is sustainable, a claim that can be challenged when applied to other so called "green" technologies. Can an energy option be sustainable when it requires the continual infusion of tax payer monies and produces massive government deficits? We have experienced the devaluation of the US currency which has resulted in increased crude oil prices and increased gasoline prices.

Nuclear power is a green technology, i.e. a minimal carbon footprint, whether or not one agrees with the proposition that anthropological (human) activity is responsible for global warming. More recently, the term climate change has replaced global warming in the discussion.

I believe in climate change. The earth's climate has been changing for thousands of years, alternating between cold and warm periods. The proposition that the warming period between the 1970s and the late 1990s was due to human activity has not been proven despite assertions by Al Gore and others. That assertion has been rejected by a sizeable segment (numbering in the tens of thousands) of the scientific and technical community but has received little or no coverage in the popular news media. Moreover, since 1999 the earth has been cooling and is about 1 degree cooler than 1998. This is fact and not my opinion.

But enough of opinions and that debate for now, I will return to actual events.

Nuclear power has been given minimal support by the current administration. This assertion is reinforced by the allocation of monies for the various energy options in the recently enacted Energy Legislation. Nuclear energy was allocated only $ 18 billion for loan guarantees to build new plants. Note, loan guarantees, not tax credits. About $ 200 billion has been allocated to green technologies. The builders of solar cell plants and wind

farms are getting a tax credit of 30% of the plant cost or can get a tax credit of 1.5 cents for every kilowatt of electricity that is produced. The loan guarantees for the initial nuclear plants will cost the tax payers little or no money. In the event that there are some costs incurred by the government (tax payers), as soon as the plants come on-line, the government will be the first entity to get reimbursed.

The cost of a solar cell plant has been reported to be from $6400 per kilowatt to $7500 per kilowatt. Projected new nuclear plant costs have been estimated to be below those levels and without any tax credits. A 1,100,000 kilowatt wind farm would require 300,000 acres of land and would have the tax credits noted earlier. A 1,100,000 nuclear unit similar to one of the units at PECO's Limerick Station will occupy less than 1 square mile of land, and not require tax credits.

There has been minimal concern by proponents regarding the unavailability of solar and wind power when electrical demand occurs and its consequences for the economy. Do we just tell consumers to just suckit up? Or to put it less graphically, just accept it when there is insufficient electricity. These passive sources of energy are available only when the natural forces, wind and sun, are present. It is no accident that thriving economies have moved away from heavy reliance on passive sources of energy

FREE MARKETS OR GOVERNMENT TAX CREDITS

I will once again relate to my own experience with a laudable goal, reducing energy consumption, and the consequences of government intervention.

In the late spring of 1975, my family and I moved into a larger house. The house was a two story bi-level. We subsequently discovered that the house layout was such that the air conditioning did not effectively cool the upper floor in hot or humid weather when we were entertaining friends, while the lower floor was uncomfortably cold. In winter, while the comfort level could be maintained on the upper floor but with excessive fuel bills, the lower floor was intolerably cold.

One of my first corrective actions was to add more insulation to the attic and during the 1976 winter I installed insulation batts on half of the attic floor. Then I took down the wall paneling of the first floor family room and discovered that the outside wall, composed of cinder block, had no insulation but did have furring strips to which the paneling was secured. I purchased and installed polystyrene slabs between the furring strips and reinstalled the paneling. Looking further, I found that a small storage area under the landing at the front door entrance had large gaps in the outside wall that allowed air to enter the house. I sealed the gaps with wood and insulation.

I undertook these actions because I determined, based on my engineering education and experience as well as common sense, that they would be cost effective in improving the

comfort index in my home. Moreover, the winterizing was cost effective without the inducements of tax deductions or tax credits.

My younger brother, who was in the heating and air conditioning business and had a bilevel house, told me that he installed a folding door between the upstairs and downstairs of his house. The door disrupted the adverse air circulation pattern between the upstairs and downstairs and improved the comfort index in the house. Our door, purchased and installed during the summer of 1977, cost considerably more than my brother had expected.

President Carter had proposed a program to reduce energy consumption and dependence on foreign oil. The legislation gave tax deductions for weatherization of homes. The insulation industry counseled against this, maintaining that it would stimulate short term demand, which would not be sustainable, and would increase cost. The legislation was enacted. In the fall of 1977, when I went to buy additional insulation batts for the attic, the price had doubled. You connect the dots.

I also contracted to have additional insulation blown into the space between the asbestos siding and the existing insulation in the second floor walls. Insulation was also blown in between the ceiling of the garage, which was unheated, and the floor of the second story. All of these actions improved the comfort index of the upper floor but the lower floor was still uncomfortably cold in the winter. We concluded that ducting changes were needed for the first floor and window replacement probably would be beneficial for the second floor. At that time the management of my division of the Westinghouse Electric Corp. announced its intention to move the activity out of Pennsylvania, and I determined that further enhancements to the comfort index were not cost effective.

Currently, a tax credit, not a tax deduction, of 15% is given to individuals that have energy saving systems installed in their homes. This has induced homeowners to contract for a variety of services and products that are expected to reduce energy consumption. This freebie (?) has created an unsustainable demand with unforeseen consequences, in my opinion, similar to what resulted from President Carter's winterization program and its accompanying costs.

My response to this current program is that if these actions are so desirable and beneficial to the consumer, then the free market, if allowed, can also do this without incurring the monstrous national debt that is being created. What may not be denied is that the government program (states have gotten into the act) has contributed to the massive federal deficit with unpleasant consequences for the value of the US currency. I have more trust in 300 million consumers in a free market than the collective judgment of the politicians and civil servants who support these tax credits, even if they were to number one (1) million.

HOPEFUL VIRTUES AND REALITY

On page 3 I quoted an observation from a British engineering publication and for your convenience it is reproduced below.

It is a human trait to ascribe to the unknown competitor all of the hopeful virtues and to ascribe to the established technology all of the known drawbacks.

Combustion Turbines and Combined Cycles

Many claims have been made for combustion turbines over the years when compared to conventional steam power plants: (1) Reduced or no thermal discharges to bodies of water, (2) Potentially superior thermal efficiency, (3) Lower plant capital cost, and (4) More effective use of natural gas, a more environmentally benign fuel.

The combustion turbine has experienced a number of boom and bust cycles over the years. A major deterrent to combustion turbine usage is the volatility in the price and supply of natural gas. This volatility occurred in the late 1960s, in the early 1970s and the 2000s when the natural gas prices have been especially volatile and unpredictable. Refer to the experience of New England utilities, page 3, with combustion turbines and the experience with Cycling Steam Plants fueled with natural gas, page 3.

To improve the thermal efficiency of combustion turbine applications, they were coupled with steam turbines, combined cycles, in which the combustion turbine exhaust gas was discharged to a Heat Recovery Steam Generator (HRSG) to produce steam. The steam from the HRSG was sent to a steam turbine to generate additional electricity.

The successful bidders for the HRSG contracts employed design that minimized cost and which revealed an unawareness of the known drawbacks (of their designs), drawbacks that the conventional steam generator manufacturers were aware of. Consequently, reliability problems have been experienced with the HRSGs. The end result was increased down time and the attendant need for expensive replacement power as well as the costs of repairs. This is an ongoing reliability issue.

This is a classic example of excessive reliance on the hopeful virtues and potential possibilities. The ignorance of known drawbacks has been a costly lesson.

Wind Farms

So many excessive claims have been for wind turbines. Some proponents have declared that wind energy is free. Is it? There are raw materials that must be processed and then fabricated into components. In the eastern US many of the potential and existing sites are on hillsides and mountain ridges. For the mountain sites accessibility is difficult, especially when design deficiencies are encountered. Gear box failures are a generic issue and corrective measures are hampered by the lack of easy accessibility to the sites and the

difficulty of getting cranes to the site to make the repairs or install more reliable, replacement components.

Land availability should be a concern. A 1,100,000 KW wind farm, the same output as one nuclear unit at the PECO Limerick plant, would require 300,000 acres of land. So where do we site the wind farms? Offshore has been suggested as a siting option. Breezes at the seashore may be seaward or landward or may change direction during the day. The difficulties with maintenance and repair are more intractable than with mountain sites. Positioning a shipboard crane is more difficult because of water currents and tides as well as inclement weather. There are navigation safety concerns related to oceangoing vessels and pleasure craft.

I contend that there are no hard, reliable cost figures for wind farms. The economics have been distorted by tax credits and other government subsidies.

The potential power obtainable at a given wind farm site has been overstated by reliance on information from solitary wind turbines or small size wind farms. The multiplicity of wind turbines at a site alters the magnitude of the air velocity and the wind patterns as compared to what was present before the wind turbines were installed. The end result is a shortfall in the projected power output at a site. The aforementioned comments are based on the behavior of fluids as noted in the branch of physics known as Fluid Dynamics.

Proponents of wind power cite the installation of additional wind turbines as proof of their benefits. A closer examination of the issue reveals that legislative mandates as well as tax policy have been the impetus for many existing and planned installations

THERE IS NO MAGIC BULLET TO SOLVE OUR ENERGY ISSUES.

Solar Power Plants

The capital costs of Solar Power installations have been estimated to range from $6400 per kilowatt to $7500 per kilowatt by owners and suppliers. See page 7. The tax credits will reduce the cost. But what about the other costs as noted on pages 8 and 9?

The supporters of wind farms and solar power plants dismiss the concerns about unavailability of these energy sources when the wind is not blowing or is blowing too hard or too slow and the sun is not shining or is shining with insufficient intensity or from the needed angle relative to the panels. They would use combustion turbines to make up the deficiency. So, we would install combustion turbines which would not be in use most of the time. Moreover, combustion turbines present a number of issues as noted in a previous section.

The atmosphere carries dust and debris and seashore installations are subject to ocean spray and salt, some of which are tightly adherent. Provision for washing is needed. Whose water supply is to be appropriated?. This is an especially contentious issue when the solar plant is in a desert area (land area is not a constraint). Water supply is a valid concern.

PAY NOW OR PAY LATER

The Public Utility Commissions of many states denied the electric utilities requests for incorporation, into the rate base, of Interest During Construction (IDC) during the 1980 and 1990s, at a time when the cost of capital was over 20%. In that time period my employer moved our operation to Florida. The high interest rates for consumers loans resulted in a lower sale price for my Pennsylvania house. In addition, the interest rate on the loan for my Florida house was in excess of 16 %.

The public utility commissions opted for a short term strategy, cap electric rates and defer the increase in rates to the future. Because there was no income stream to cover the costs of the interest on loans for the plant construction, the utilities were forced to borrow money to cover the interest costs on previous loans. There was a compounding of interest costs and the cost of the plants..

Now many of the electric rate caps are expiring or soon will be. The utilities are accused of price gouging because of the large increases in electric rates but which are attributable to the decision not to allow Interest During Constriction. The legislatures are attempting for force the utilities to charge rates that are less than the utilities are entitled to when they accepted the caps. Are or are not the utilities being treated fairly?

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