SASKATCHEWAN ELECTRICAL

energy options

Position Statement Report
October 31, 1991

REVIEW PANEL

- *Dr. Roy Billinton (Chairman)*
- *Ann Coxworth*
- *Chief Roland Crowe*
- *Russ Pratt*
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October 31, 1991

George D. Hill, Q.C.
President, SaskPower
2025 Victoria Avenue
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Dear Mr. Hill:

Please find attached the Position Statement Report from the Electrical Energy Options Review Panel. The final report, including supporting documentation, will be submitted to you on November 15, 1991.

Respectfully submitted,

Dr. Roy Billinton, Chairman

Ms. Ann Coxworth

Ms. Vicki Dutton

Chief Roland Crowe

Mr. Russ Pratt

RLB/dkm

Enclosure

ELECTRICAL ENERGY OPTIONS REVIEW PANEL
POSITION STATEMENT REPORT

Introduction

The Electrical Energy Options Review Panel was appointed on November 27, 1990, by SaskPower. The Terms of Reference given to the Panel by the corporation outline the scope of the review process and can be summarized into the following objectives.

1) Obtain, through open public meetings, the views of people throughout Saskatchewan on how future demand for electricity could be altered or met.

2) Report to SaskPower on what they heard from Saskatchewan people and to document, using findings from public meetings, tours and research, the possible viable energy options that could be used to meet SaskPower's future energy requirements.

Immediately after being appointed, the Panel undertook a tour of a number of SaskPower's generating facilities. This tour gave the Panel a fundamental understanding of electrical generation from coal-fired thermal and hydro plants. In order to gain an understanding of electrical generation using other options, the Panel toured generating facilities in other jurisdictions. These included nuclear plants, wind farms, solar research centers, biomass and cogeneration facilities. In addition, the Panel visited several organizations who deal primarily with conservation and related technologies.

The Panel, over a six-month period, held 26 days of public meetings in communities as far north as Stony Rapids and as far south as Estevan. In total, the Panel received 27 written briefs and heard 150 presentations from individuals, organizations and business representatives.

Based on these activities, the Panel has prepared a position statement which reflects its opinion on electrical energy options available to SaskPower and the Province of Saskatchewan.

This short report contains the executive summary and position statement. The complete report, including supporting documentation, will be available for submission in the near future.

Executive Summary

After completing an intensive hearing process, conducting selected site visits, examining written material and holding many discussions, the Panel has come to the conclusion that in addition to the analysis and selection of demand side initiatives and supply side options, there are several studies and actions which should be taken by SaskPower and the Government of Saskatchewan in order to meet Saskatchewan's future electrical energy requirements. These recommendations are summarized below, together with a brief statement on electrical generation options.

1. SaskPower should undertake a complete study of the current levels of efficiency in the use of electricity in all sectors of the Saskatchewan economy. This study should include a comparison of these levels with what is possible using currently available technology.

2. SaskPower should undertake a complete economic analysis of the potential for demand side management initiatives and should put in place immediately those which are cost-effective in terms of avoiding the need for additional generating capacity.

3. The Government of Saskatchewan should proceed immediately to establish an independent tribunal which will provide an arbitrator function between SaskPower and independent power producers. SaskPower and the independent tribunal should develop a highly visible framework, which includes an avoided cost policy, to facilitate the incorporation of a limited amount of non-utility generation and cogeneration in Saskatchewan's electrical energy system.

4. Saskatchewan has a wide range of possible electrical energy supply options. These include biomass, coal, hydro, natural gas, nuclear and wind facilities. Each of these options has limitations and conditions which constrain its use.

5. The Government of Saskatchewan should conduct a broad and thorough public review of nuclear power generation in Saskatchewan including short- and long-term nuclear waste disposal.

6. There is some potential for the generation of electrical energy in Saskatchewan using wind power. SaskPower should conduct a thorough study of wind regimes in Saskatchewan and make this information available to potential independent power producers.

7. SaskPower should closely monitor developments in the economic generation of electrical energy using solar radiation and create a plan for evaluating these developments in a Saskatchewan context.

8. SaskPower should closely monitor developments in advanced technologies such as fuel cells, magnetohydrodynamics, stored energy systems, batteries, fusion and hydrogen in order to properly assess their possible future implementation in Saskatchewan.

Position Statement

Introduction

Electrical energy supply in Saskatchewan has evolved over the past century from a few isolated generating facilities to a complex fully integrated system. Electrical energy consumers connected to the SaskPower system enjoy high quality supply at an affordable cost. This is an important factor in the economic and social well-being of the province and its residents. It is important therefore to clearly appreciate that the basic function of SaskPower is to meet the electric energy needs of Saskatchewan in an environmentally responsible manner, at an acceptable standard of reliability and at the lowest possible long-term cost. Given the present trends in industrial development and lifestyles in Saskatchewan, it is expected that in addition to demand side management, energy conservation, purchases from independent power producers and plant-life extensions, new generating capacity will be required to meet increasing electric power and energy requirements and to replace retiring generating facilities and purchase agreements. These trends, however, should not be assumed to be fixed and it should be appreciated that this is a time of considerable change both locally and globally. The uncertainty associated with future economic directions and objectives coupled with personal attitudes towards energy utilization and conservation dictate that high priority be given to flexibility in the system and that SaskPower be in a position to respond to change.

Electrical Energy Demand Side Options

Energy Conservation and Efficiency

This is a dynamic area of application within the electrical energy industry. The technology for improving the efficiency of electrical energy utilization is developing rapidly. Attitudes towards demand side management (DSM) are evolving quickly as utilities throughout the industrialized world gain experience in this area. The Panel heard widespread support and enthusiasm during the hearings for demand side initiatives and their potential application in Saskatchewan. The Panel also concluded that

SaskPower is not seen to be taking full advantage of possible options to reduce both power and energy demands. SaskPower is not seen by the public at large to be particularly receptive or responsive to public concerns in this area. The Panel believes that the potential for economically feasible conservation and efficiency improvement in Saskatchewan should be carefully and exhaustively evaluated. In the absence of such a study, it is difficult to predict the extent to which conservation and efficiency improvements will impact upon future electric power and energy requirements. Some indications can, however, be drawn from similar activities in other parts of North America and some of these are referred to in the technical section of the final report.

The Panel suggests that SaskPower conduct a thorough review of demand side programs in other jurisdictions and their relevance to Saskatchewan. A comprehensive survey of present levels of efficiency in all areas of electrical energy utilization is required in order to estimate the potential for improvement with current available technologies. The Panel recommends that those DSM initiatives which are economically attractive should be implemented as soon as possible. SaskPower should perform a detailed economic analysis of each demand side management initiative in order to ensure that true costs and benefits are fully understood and that the initiative will not in itself increase the rates charged to its customers any more than that which would be realized by other alternatives.

The potential for demand side management including conservation and efficiency applications depends to a large extent on how the public at large perceive the need for and value of limiting electrical energy use. Conservation and efficiency gains are based in part on technological improvements, which require associated funding, and also on behavioral changes, which require recognition of the need for change. SaskPower has an important role to play in electrical energy education of the public at large and also of specific segments such as the commercial, industrial and educational sectors. SaskPower should establish a highly visible and functional department to perform these functions.

Electrical Energy Supply Options

Non-Utility Generation and Cogeneration of Electrical Energy in Saskatchewan

At the present time, all the electrical energy supplied to the grid connected Saskatchewan system comes from generating facilities owned and operated by SaskPower. In many jurisdictions, a significant component of the overall system electrical energy requirements is provided by non-utility generation and cogeneration facilities. These facilities provide a measure of flexibility and diversity in electrical energy supply and facilitate the orderly, economic and efficient use of natural resources. Non-utility generators can be defined as those facilities owned and operated by electricity producers other than SaskPower and include possible private and municipal utilities and independent power producers. A cogeneration facility is normally directly associated with an industry in which a significant requirement for electrical energy is coupled with a large demand for process heat, usually in the form of steam. The opportunities for cogeneration are therefore directly related to the facilities residing within the system. Saskatchewan has several industries which provide all or part of their electrical energy needs by cogeneration. These facilities do not, however, supply additional energy to the grid connected system. They do, however, decrease the total demand for electrical energy from the system.

The Panel believes that the Government of Saskatchewan should adopt a policy that will facilitate the production of electrical energy by non-utility generation and cogeneration facilities in parallel with SaskPower. In order to perform this function, however, the role of SaskPower as the agency responsible for meeting the electrical energy needs of Saskatchewan, at an acceptable standard of reliability and at the lowest long-term cost must be clearly retained. At the present time, SaskPower does not appear to be particularly receptive to possible inclusion in the provincial electrical energy supply of energy generated by non-utility generation or cogeneration facilities. This may or may not be true but the perception very definitely exists. This may be due to the fact that all dialogue on this issue is done directly between SaskPower and the potential independent producer and

there is no unbiased third party involvement. This is not the case in other provinces where regulatory bodies or energy commissions created by government legislation provide an arbitrator function in regard to perceived differences between generated energy costs and worth.

The Government of Saskatchewan should proceed immediately to establish procedures whereby independent power proposals and cogeneration alternatives can receive and be seen to receive proper scrutiny and consideration as viable provincial electrical energy sources. These procedures should ensure that all generation facilities added to the electrical energy system further the orderly, economic, environmentally responsible and efficient use of Saskatchewan's natural resources.

The most contentious issue in non-utility generation is the price paid by the utility for the electrical energy supplied to the system. In most jurisdictions, this is determined through a public hearing process by an independent tribunal. This opportunity does not exist in Saskatchewan at this time. The Panel recommends that such a tribunal be established. The pricing policy should be based on the philosophy that the rates to electric utility customers should not increase beyond those which would be incurred without the addition of the independent power facility, and that consumers should be indifferent, in terms of both power quality and cost, as to who actually generates electricity.

A small non-utility generation project may have a number of highly visible socioeconomic benefits associated with it for the locale concerned. These benefits should not be a consideration in the determination of acceptable energy purchase rates. The Panel believes that any such benefits can be more appropriately recognized by applying direct government actions in the form of taxes and grants rather than by increasing electricity rates to the general consumer.

The Panel appreciates that benefits may accrue to society when electrical energy is generated by renewable energy sources rather than by non-renewable sources. These potential benefits should not restrict the possible development of non-renewable energy projects that meet the

environmental standards set by the province. It should be clearly understood that selecting specific energy resources for preferential treatment could result in choosing options that would otherwise be uneconomical, thereby resulting in increases in electricity costs to all consumers.

Any policies regarding financial support for the development of renewable energy sources should be established by the Government of Saskatchewan rather than by SaskPower. The government may therefore choose to put in place an energy policy which provides subsidies or tax relief for renewable energy developments. A clear framework of provincial and national energy policies and environmental legislation would assist SaskPower to effectively incorporate renewable energy sources in its planning strategy. The proposed independent tribunal could provide the forum for discussion of the implications of such government policy decisions on electrical energy rates in Saskatchewan.

The Panel believes that an independent power producer should receive fair value for both the electrical energy and capacity provided to SaskPower. In broadest terms, this is commonly referred to as avoided cost, although there are many interpretations of the correct way to calculate this value. SaskPower should proceed immediately to prepare for public scrutiny an avoided cost policy and price schedule which can be used by potential non-utility generators and cogenerators in their financial planning and decision making.

The mandate of SaskPower imposes the obligation to deliver reliable electrical energy to the consumer in a cost-effective manner. In order to ensure that SaskPower has the opportunity to provide the required reliability of supply, it may be necessary to limit the energy provided by non-utility generators . The Panel recommends that a limit of 125 MW be placed initially on non-utility generation. This should be reviewed by SaskPower and the proposed tribunal as soon as relevant operating data are obtained. It may be found necessary to subdivide the allocated power generation into small and large independent power producer segments with different contracts and constraints.

SaskPower should also develop a standard contract applicable to all non-utility generation . Contracts for external power production should be long-term to provide energy stability and therefore the Panel suggests that all contracts be for at least 20 years.

Electrical Energy Supply Sources

Saskatchewan has a wide range of available electrical energy supply options and should take full advantage of the economic benefits associated with its natural resources while acting in an environmentally responsible manner. In principle, all the available options for the generation of electrical energy could be developed either by SaskPower or by independent power producers. Imposing a limit on the non-utility generation components will restrict the independent production to relatively small capacity components which utilize natural resources such as small hydro, wood waste, peat, natural gas and the wind. Economic evaluation of a particular option cannot be done using simplistic cost/kw of power or cost/kW.h of energy values. This is a complex system planning task in which the contribution of the particular option must be examined in a total system context. The Panel believes that certain options are both technically viable and appear to be economically attractive. The Panel has not conducted a detailed economic analysis of each option, many of which are extremely site specific. The actual costs and the system benefits associated with a particular generation facility must therefore be determined by SaskPower when considering that option.

Coal

Saskatchewan has abundant reserves of low cost, low sulphur coal and should attempt to take advantage of this resource in an environmentally responsible manner. This cannot be done using conventional coal technologies for generating electricity and therefore "clean coal" technologies should be utilized. These technologies, such as pressurized fluidized bed combustion (PFBD) and integrated gasification combined cycle (IGCC) facilities are not totally clean in the sense of making zero contribution to carbon dioxide (CO_2) levels in the atmosphere. They are, however, a considerable improvement on conventional coal technologies and should be regarded as viable options for Saskatchewan. In view of the

possible support by the federal government for a clean coal facility in Saskatchewan, this option looks attractive from many viewpoints. In addition to new sources of generation, clean coal technologies offer the possibility of plant life extensions and modifications resulting in decreases in CO_2 production at other coal-fired plants.

Hydro

Saskatchewan has the potential to generate additional energy from a number of hydro sites throughout the province. Some of these are possibly environmentally acceptable and economically attractive. These should be considered as viable options in meeting future electrical energy requirements. The negative reaction to building hydroelectric generating stations on the Churchill River, displayed in the 1978 report by the Churchill River Board of Inquiry, and the adverse aspects associated with the Rafferty-Alameda dams should not automatically rule out building further dams or hydroelectric plants in the province. Each potential hydroelectric site should be examined on its own merits both in terms of impact and environmental effects. Hydro power, given sufficient flow, has the potential of being the cheapest source of emission free electrical energy and should not be discarded without detailed and balanced scrutiny. Hydro power may also provide the opportunity for independent power production, particularly in northern communities provided that these communities have input into the justification and creation of the project.

Natural Gas

The present price of natural gas makes it an attractive option for SaskPower electrical energy generation and for independent power production. The basic philosophy in both Saskatchewan and Alberta has been to use natural gas for the generation of electrical energy at peaking plants rather than for base load production. Gas turbines are excellent options for peaking capacity due to short construction lead times, excellent load following capabilities and adequate unit sizes to meet peak demands. High gas costs in the past and relative instability in future gas prices coupled with the realization that this is a non-renewable resource have

restricted the use of natural gas as a fuel for base load power generation. It is interesting to note that this philosophy does not seem to be adhered to in some other locations or situations. In California, it is expected that natural gas will be the basic fuel for large amounts of base load generation over at least the next decade. The utilization of natural gas will allow California utilities to limit the burning of coal and reduce their dependance on nuclear power plants.

Natural gas is also a preferred fuel at the present time for many non-utility generators due to minimal environmental impacts, low generating unit capital costs, short construction times and high availability at relatively low cost. It is rather anomalous that the two producing provinces should restrict their own use of a natural resource while selling this resource to other jurisdictions to use in applications not considered suitable by the producing jurisdictions. The use of natural gas in Saskatchewan for non-dispatchable power production by non-utility generation is contrary to the basic philosophy adopted by SaskPower. This contradiction in philosophy should be reconciled by SaskPower and the proposed tribunal before proceeding to purchase electrical energy from an independent power producer using natural gas.

The Panel further suggests that SaskPower review its basic philosophy on the use of natural gas for the generation of electrical energy and seriously examine the option of using this resource for both base load and peaking capacity.

Nuclear

This is undoubtedly the most contentious option for electrical energy generation in Saskatchewan. It is, however, a viable option which should be considered when planning Saskatchewan's electrical energy future. The proposed CANDU 3 technology offers a nuclear generating unit which is sized to permit reasonable integration in the SaskPower system. The CANDU 3 is, however, a prototype unit for which there is no technical or economic history. These factors must therefore be carefully assessed when considering its possible implementation in the SaskPower system.

It should be clearly appreciated that there are widely held and deeply felt concerns about nuclear safety, waste disposal and other issues which must be recognized and addressed. Past CANDU performance and the proposed development in the CANDU 3 technology suggest that all the relevant technical concerns can be basically satisfied. Extensive research is presently being conducted by Atomic Energy of Canada Ltd. on deep waste disposal and definitive criteria and procedures should be available for examination and discussion in the near future. Deep waste disposal will ultimately have to satisfy an intensive and public environmental review process before it can be considered to be acceptable.

There are, however, some fundamental philosophical objections to nuclear power generation which are held by a significant proportion of the general public. These concerns are much broader than the generation of electrical energy within Saskatchewan. They initiate with the mining of uranium in Saskatchewan and its utilization in various forms throughout the world. The construction of nuclear generating stations in countries considered to be relatively unstable and unpredictable is seen as a distinct threat to the global environment. The utilization of nuclear plant fuel in the creation of weapons which could reside in the hands of dictators, terrorists or irresponsible governments is seen as more than a distinct possibility and therefore something that cannot be allowed to happen. It can be argued that the presence of a CANDU 3 nuclear generating station in Saskatchewan will not affect the global nuclear power situation and the nuclear weapon scene. This, however, will not likely mitigate the deep rooted objections to nuclear power production held by a segment of the population. The utilization of nuclear power generation in Saskatchewan in the form of a CANDU 3 generating unit is a viable option. Objections to nuclear power must, however, be viewed in a broader context than the simple generation of electrical energy and treated in this way when making societal choices. The Panel recommends that the Government of Saskatchewan conduct a broad public review of nuclear power generation in Saskatchewan including short- and long-term waste disposal.

Biomass

Biomass sources in Saskatchewan include, but are not limited to, wood, peat and municipal solid wastes. Biomass may provide the opportunity for independent power production in northern locations where wood waste and related forest residues occur. The generating facilities at these locations will be small capacity installations directly associated with local forestry activities. It is not expected that SaskPower will utilize these resources due to the availability of lower cost alternatives, but could possibly purchase electrical energy from non-utility generators or cogenerators using these resources. Their utilization therefore becomes a question of economics and the provision of an equitable process for considering these options.

Wind

This is a popular option, at least in the eyes of the general public, for electrical energy generation. It has not been utilized extensively at this time by any electric power utility in Canada although some utilities have trial facilities. There is some potential in this area for future electrical energy generation in Saskatchewan and SaskPower should make a definite commitment to fully examining this potential. Wind power economics are directly related to available wind energy, wind system capacity factors, equipment availability and maintenance requirements. Electrical energy production from the wind is therefore very site specific. Some important information can be extracted from experience and research in other jurisdictions such as California but research and experience in the Saskatchewan environment is required.

Initial studies indicate that there may be only a limited number of economic wind power sites in Saskatchewan. This point can be illustrated using data provided by Environment Canada (see technical section of the final report). The maximum average power output as a percentage of the installed wind turbine capacity is approximately 26 percent at Swift Current, 16 percent at Saskatoon and 7 percent at Hudson Bay. The data used to obtain these values are, however, incomplete and therefore before drawing any firm

conclusions regarding wind power potential in Saskatchewan, the Panel recommends that SaskPower initiate a detailed study of wind regimes at a number of potentially suitable locations.

Energy generated by wind power could be supplied to the system either by an independent power producer or by SaskPower. It appears that the most cost-effective use of wind power is in the form of suitably located wind farms, which in essence are operated and controlled in a similar manner as a basic power plant with a number of small units. Modern wind turbines are complex pieces of equipment, requiring expert maintenance, located approximately 30 meters above ground level. They do not appear to be economically viable as single units located on farms scattered throughout the province. The bulk of the wind farms located in North America are in California. Most of these are privately owned and sell energy to the regional utility. It appears, however, that electric power utilities are now actively involved in owning and operating wind farms in addition to purchasing wind energy from non-utility generators. Wind is very definitely a non-dispatchable energy source and its random nature makes it difficult to assign a capacity or power credit in addition to an energy credit. It may therefore be necessary at some point in the future, due to system reliability considerations, to limit the wind power penetration in the system capacity composition. Initially, however, the Panel recommends that SaskPower proceed to collect appropriate wind data at specific locations in the province and proceed to make this information available to potential independent power producers. SaskPower should also actively monitor the research and development being conducted on wind turbines.

Solar

Solar radiation offers the potential of an unlimited source of energy with little danger of environmental damage. At the present time, solar radiation for grid connected electrical energy generation must be considered as a developing technology which cannot be economically utilized in Saskatchewan. As with wind power, solar energy can be economically and technically viable at remote locations where grid connected supply is not

available or not economically feasible. Two basic technologies for producing electricity from solar radiation are presently in the development and demonstration stages. Photovoltaic devices convert sunlight directly into electricity while solar-thermal devices use solar energy to vaporize a working fluid which is then used to drive a turbine coupled to an electric alternator. Photovoltaics are not a viable alternative for grid connected electrical generation in Saskatchewan at the present time due to high costs and a lack of proven development in northern locations. Solar radiation has, however, considerable potential for the future. The Panel recommends that SaskPower actively monitor the research and development being done on the application of solar radiation in electrical energy generation.

Geothermal

Geothermal energy is not a viable option for generation of electricity in Saskatchewan as the maximum obtainable temperature is far less than that considered suitable for the commercial generation of electrical energy.

Oil

Electrical energy generated by oil-fired boilers is not a viable option for Saskatchewan. The costs and availability of oil compared to other alternatives makes it extremely unlikely that this resource will be used to generate electrical energy at other than remote locations.

Purchases from Interconnected Systems

The electrical energy supply system in Saskatchewan is interconnected with the systems in Manitoba, Alberta and North Dakota and therefore topologically is in a position to purchase both electric power and energy. These purchases can be made in a number of ways, such as economy interchange, seasonal diversity exchanges, firm capacity purchases and basic reserve sharing. SaskPower has already taken excellent advantage of these opportunities and should continue to do so when the purchase or exchange is economically advantageous and satisfies the system reliability

constraints. The Panel does not believe, however, that power and energy purchases from other jurisdictions should be used to simply avoid building similar facilities within Saskatchewan. As an example, purchasing power from hydroelectric facilities in Manitoba while stating that the construction of dams in Saskatchewan is environmentally unacceptable is not considered to constitute valid acceptance of environmental responsibility.

Developing Technologies

There are a number of technologies which are in various stages of research and development. It can be suggested that clean coal technologies, wind power and solar energy are also in this category. These energy conversion systems are, however, in actual utilization and also in active research and development phases. There are some relatively new technologies, such as compressed air energy storage which offer potential for future utilization but which require extensive study before considering their application in Saskatchewan. There are a number of exciting technologies being studied and developed which have tremendous potential but are clearly not economically or technically viable for utilization in Saskatchewan within at least the next decade. These are as follows.

- Fuel cells, including phosphoric acid fuel cells, molten carbonate fuel cells and solid oxide fuel cells.
- Magnetohydrodynamics.
- Stored energy systems including stored energy in CO_2 and electric batteries.
- Nuclear batteries.
- Nuclear fusion.
- Hydrogen utilization.

The Panel recommends that SaskPower establish a specific body within their organization to observe, monitor and help educate the public on developing technologies for electrical energy production and utilization.

Conclusions

There is no single alternative on either the demand or supply side that will satisfy the electrical energy needs of the Province of Saskatchewan. The Panel firmly believes that SaskPower needs a well-balanced mix of many demand and supply alternatives in order to fulfill its mandate to satisfy the system load requirement as economically as possible, in an environmentally responsible manner, and with a reasonable assurance of continuity and quality. This includes realistic, practical and economically justified conservation and efficiency measures together with economic and reliable supply additions.

In order to facilitate the philosophy that all generation facilities added to the SaskPower system further the orderly, economic and efficient use of Saskatchewan's natural resources, the Government of Saskatchewan should establish an independent tribunal to provide the interface between external sources of electrical energy supply, SaskPower and the government.

As a Crown corporation, SaskPower has the potential to be used by government as a tool for public policy. The Panel clearly appreciates that decisions made on demand and supply side alternatives can have considerable impact on society in the form of employment and economic development. The Panel believes that it is inappropriate for SaskPower to be placed in the position of formulating provincial social policy. Socioeconomic benefits should be recognized by the Government of Saskatchewan and facilitated in the form of taxes and grants rather than by increasing electricity rates to the general consumer.

Glossary of Terms

Base Load

The minimum continuous load over a given period of time.

Base Load Generating Station

A generating station which is normally operated to supply all or part of the base load of a system and which consequently operates at full output whenever available. Base-load generating units tend to be large units with low operating costs.

CANDU

A Canadian-designed nuclear reactor. The name stands for "CANadian Deuterium Uranium" steam generating system. All nuclear generating stations produce steam from atomic fission to drive turbines and make electricity. CANDU uses deuterium, "heavy water," rather than ordinary light water, as an essential component of the reactor. CANDU also uses natural rather than enriched uranium as fuel.

Capacity

The greatest amount of power that can be supplied by a generating unit, power station, or entire provincial grid system.

Capacity Purchase

Refers to the purchase of capacity from an interconnected utility or a non-utility generator.

Carbon Dioxide (CO_2)

A gas resulting from the burning of organic materials.

Coal

A fossil fuel composed mostly of carbon, with traces of hydrogen, nitrogen, sulphur and other elements. It was formed from remains of trees and plants alive millions of years ago.

Coal–Fired Plants

Coal-fired plants are power stations which burn coal to generate electricity.

Cogeneration

The production of electricity along with useful steam or hot gases. The steam or gases are used for industrial purposes.

Combined Cycle

Combined cycle involves generating electricity using a gas turbine, and diverting the exhaust gases into a waste-heat boiler to produce steam. This steam can then drive another generator, producing additional electricity.

Conservation

Refers to all methods of reducing the demand for electrical energy.

Demand

The amount of electricity required at a point in time.

Demand Side Management

DSM programs are undertaken to influence the amount and timing of customers' use of electricity, in order to reduce peak demand and overall consumption.

Dispatchability

The ability to vary or control the output of a generating unit.

Economy Interchange

Refers to the purchase of energy from an interconnected utility in order to effect a savings in the cost of generation when the receiving party has adequate generating capability available to carry its own load.

Efficiency

Refers to the amount of electrical energy used to provide a specific level of service. Improving energy efficiency in electric motor use, for example, implies producing a given level of mechanical power output with a lower electrical energy input.

Energy

The amount of electric power consumed over a certain period of time, usually measured in kilowatt-hours.

Energy Source

The primary source that provides the power that is converted to electricity. Energy sources include coal, petroleum and petroleum products, gas, water, uranium, wind, sunlight, geothermal and other sources.

Gigawatt (GW)

One billion watts.

Gigawatt Hour (GW.h)

A unit of bulk energy. A million kilowatt-hours. A billion watt hours.

Grid

Grid is a network of transmission lines and interconnections.

Independent Generation

Generation owned or operated by producers other than a utility. These producers usually have generating plants for the purpose of supplying electric power required in their own industrial and commercial operations. The term also covers private plants whose sole purpose is the sale of electricity to a utility.

Kilowatt (kw)

Kilowatt - 1,000 watts.

Kilowatt–Hours (kW.h)

When a 100 watt bulb burns for 10 hours, it consumes one kilowatt-hour (kW.h) of energy. A typical household may consume an average 600 to 800 kW.h per month.

Megawatt (MW)

Megawatt - 1,000,000 watts.

Non–Utility Generation

Describes electricity produced by an enterprise which is not a power utility. It may be used to supply the producer's own needs, and/or sold to a utility.

Nuclear power

Nuclear power plants use a controlled nuclear reaction to generate electricity.

Peak Demand

The maximum amount of power required at a particular point during a period of time, for example, daily peak.

Peaking Capacity

Peaking capacity is provided by generating stations which are usually operated to provide electricity during peak demand periods.

Power

The rate at which electric energy is delivered. It is expressed in kilowatts, megawatts, and other units of power.

Reserve Sharing

Utilities maintain a generation capacity reserve or margin to allow for unusual peak demands, equipment failures and regular maintenance. Interconnected utilities can share this reserve capacity, thereby allowing the deferral or displacement of generation additions on either or both systems. Reserve sharing also provides the mutual benefits associated with service reliability, conservation of natural resources and capital, and economy of operation.

Seasonal Diversity Exchange

An arrangement that allows a summer peaking utility (for example, Basin Electric in North Dakota) to draw capacity and energy from a winter peaking utility (for example, SaskPower) in the summer period. The winter peaking utility then draws it back in the winter. This arrangement results in lower capacity requirements for both utilities.

Thermal Generating Station

An electric generating station where the turbine is driven by gases or steam produced by burning fuels (such as coal, oil, gas, wood or refuse) or by nuclear processes.

Transmission Line

A line used for the transmission of electric power at high voltage. Transmission lines may be constructed overhead, underwater or underground. Lines of voltage less than 115 kilovolts are usually considered to be sub-transmission or distribution.

Transmission System

Lines, transformers, switches, etc. used to transport electricity in bulk from sources of supply to other principal parts of the system. Transmission is generally at voltages of 115 kilovolts and above.

Wind Farm

A group of wind turbines used to harvest wind energy for electrical generation.

Saskatchewan Electrical Energy Options Review Panel

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