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Northern York Region Electricity Supply Study

Submission to the Ontario Energy Board

September 30, 2005

EXECUTIVE SUMMARY

I. Introduction

As a result of the rapid growth of York Region, the electricity supply infrastructure in the area has been approaching, and in some cases exceeding, its planned capability. The Ontario Power Authority (OPA) has developed a recommendation on the best way to meet the growing need for power, and is submitting this report to the Ontario Energy Board in response to a letter of direction received on July 25, 2005.

The focus for this study was limited to the most urgent areas of need: the communities served by Armitage Transformer Station (TS), including the northern portion of York Region and Bradford West Gwillimbury in Simcoe County (referred to as "Northern York Region"). The process used to develop this recommendation included extensive consultation, technical and financial analysis of the options, as well as a procurement process. The OPA's goal is to recommend a long-term solution that is technically feasible, timely, and cost effective, while considering its impact on communities.

II. Load Forecast and Conservation & Demand Management

The forecast for load growth at Armitage TS is 3.25% per year for the next 10 years before adjustment for conservation and demand management. The total demand has been adjusted down by 5% in 2007 to account for the effect of existing conservation and demand management programs. While there are some shortcomings in the Northern York Region forecast, the OPA considers the forecast sufficient for this initiative.

Recognizing the important role that conservation and demand management will play in Northern York Region, the OPA has initiated a procurement process for a target of 20 MW of demand response. The OPA has further adjusted the load forecast to incorporate this. There are also a number of province-wide conservation initiatives being developed, and given the urgent need in Northern York Region, the OPA would like to pilot such projects in the area.

III. System Capability and Need

Presently at Armitage TS there is transformation capability of 317 MW and the capacity to serve up to 16 feeder lines. The planning limits for the transformers have been exceeded since 2002, and there is a need for four new feeders and no positions are available. As a result, a new transformer station is required immediately, which will provide 150 MW of new capacity and eight feeder positions. By the end of the study horizon, factoring in the existing 53 MW shortfall, 173 MW of new transformation capacity will be required as well as eight new feeders in addition to the current need for four. Therefore, as a result of the need for both transformation capability and feeders beyond what a single transformer station can provide, as well as the need to provide feeders geographically close to the new and growing loads, the solution will require two transformer stations within the study horizon.

The main source of bulk electricity supply to the area is a 230 kV double-circuit line from Claireville TS in Vaughan travelling 35 km northeast to Holland Junction. From there, a line tap travels 8 km southeast to Armitage TS. The thermal capability of the line is limited by the line tap to 470 MW. Voltage collapse on the line limits the ability to supply the area to 375 MW.

After demand response is factored in, there is a need for at least an additional 140 MW of new bulk supply to Northern York Region. This can be supplied either by new local generation providing supply to the area or new system generation transmitted into the area through upgraded transmission capability.

IV. Distribution & Transformation

The preferred site for the first new transformer station is in the vicinity of Holland Junction. Connecting to the existing 230 kV line at this point avoids using up the limited capability of the line tap. Additionally, the site is closer to the supply at Claireville and provides a location for new capacitor banks, both of which reduce the risk of voltage collapse. The location does not provide added diversity of supply, but with proper switching could be served from either the north or south.

The preferred site for the second new transformer station depends on the bulk supply option. If the bulk supply is met through new generation servicing the area, then the preferred site is in Aurora. This station would be located in an industrial area and would require less than two kilometres of upgraded transmission lines along the existing Buttonville-Armitage right-of-way. This location does not provide a new source of power to the area, but can be connected to the local generator in a manner that would provide a diversity of supply.

If the bulk supply requirement were to be met through upgraded transmission facilities, the preferred location for the second transformer station would be in Gormley on the existing Buttonville-Armitage right-of-way. This option would provide diversity of supply to the area, but would require 10 km of upgraded transmission line.

V. Bulk Supply

One proposal to meet the need for bulk supply through new transmission is to upgrade the 22 km line from Buttonville TS to Armitage TS with a double-circuit 230 kV line. As a variation on this proposal, the OPA has considered upgrading the line from Buttonville TS only as far as Gormley, approximately 10 km. This option, at a cost of $23 million, has the benefit of being $27 million cheaper in transmission costs, assuming all overhead, but with added distribution costs of $9 million. If the entire line is undergrounded, the transmission cost will rise to $67 million. This option does not provide the same level of diversity as the Buttonville-Armitage option.

Local generation with a firm capacity of at least 200 MW to 350 MW can also meet the bulk supply need. As well, this option would provide diversity of supply and maintain continuous load supply to the area after the loss of the transmission line from Claireville. Local generation can be best provided by a gas-fuelled simple cycle generator, which would provide peaking power to both Northern York Region and the rest of the Ontario system.

When the options of new local generation and new system generation with upgraded transmission capability are compared, the new local generation option is less costly by approximately $40 million (net present value) and is generally more acceptable to the community. Local generation would also provide much needed relief to the autotransformers at Claireville TS.

The OPA believes that the bulk supply bottleneck for Northern York Region can be best addressed through generation installed locally.

VI. Recommendations

Immediate action for summer 2006 is focused on increasing the amount of static capacitors at Armitage TS and implementing as much of the planned demand response as possible. In conjunction with this, the OPA recommends proceeding with the construction of a new transformer station in the vicinity of Holland Junction, along with static capacitors at this station.

To provide the longer term relief to the supply bottleneck, the preferred solution is to provide local generation, required to be in service by 2011. However, the existing level of security of supply to Northern York Region is below the Independent Electricity System Operator's guideline. As such, the OPA will endeavour to acquire the recommended generation resources as early as 2008 in order to improve the security of supply.

Along with the development of local generation, there will be a need for another transformer station. This is also required by 2011, but may be deferred by successful conservation and demand management initiatives. For the local generation solution, the preferred site for a new transformer station has already been identified and is in northern Aurora, a short distance from Armitage TS.

If no generation procurement contract is concluded, the OPA recommends supplying the area from new system resources via an upgraded line from Buttonville to Gormley and a new transformer station in the vicinity of Gormley.

VII. Regulatory Approvals Required

The OPA will apply to the OEB for recovery of its costs under a local generating contract, if and when the OPA has entered into such a contract following a successful procurement process. In order to quickly procure demand response in York Region, the OPA intends to act under the Ministerial direction contained in a letter dated June 15, 2005 to contract for "250 MW or more of demand side management and/or demand response initiatives across the province." In acting under the authority of this directive, no OEB approval of the costs related to such contracts will be required.

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1 INTRODUCTION

The Independent Electricity System Operator ("the IESO") in its 2003 *10-Year Outlook* stated that transmission reinforcements were required to accommodate the high growth rates in York Region. The year after Parkway Transformer Station (TS) and a line to Richmond Hill Junction were built to improve the supply to the southern portion of York Region, the *10-Year Outlook* noted that northern York Region still had a supply issue. The Local Distribution Companies (LDCs) in York Region along with Hydro One Networks Inc. ("Hydro One") recommended rebuilding the existing line between Parkway TS and Armitage TS to meet this northern need. In October 2004, Hydro One completed a Draft Environmental Study Report for the proposal. The Minister of the Environment received requests to "bump-up" the transmission project proposal to require an individual environmental assessment. In March 2005, Hydro One withdrew its proposal.

1.1 Ontario Energy Board Letter of Direction

On July 25, 2005, the Ontario Energy Board ("the OEB") issued a letter of direction to the Ontario Power Authority ("the OPA") requesting two opinions with regard to the York Region electricity supply. The first opinion is on the need for new supply in York Region and the second is on the optimal way to service this need, with specific reference to four supply options previously identified to the OEB. Those four options are:

1. *The Transmission Option*, which consists of rebuilding the line between Parkway Transformer Station (TS) in Markham and Armitage TS in Newmarket;

2. *The Buttonville Option*, which involves building a 230/44 kV TS at the site of the existing Buttonville TS and constructing the necessary distribution feeder lines;

3. *The Holland Junction Option*, which consists of building a 230/44 kV TS at the Holland Marsh Junction; and,

4. *The Supply/Demand Reduction Option*, which involves the OPA contracting with generators and/or consumers for new supply, capacity, or demand reduction.

The OEB has also authorized the OPA to consider alternatives to options 1-3 provided they are acceptable to the implementing transmitter and/or distributor.

The OEB has requested that the OPA present a recommendation to them by September 30, 2005. At this time they will determine which options, if any, are necessary and may initiate a subsequent regulatory process to direct or authorize the preferred option. The letter of direction in its entirety can be found on the OEB website.

This document contains the OPA's recommendation to the OEB. It is designed to be a standalone report, supported by the eight exhibits it references. These exhibits provide greater detail and substantive technical analysis corresponding to the information presented in the main document.

1.2 Overview of York Region

York Region is a rapidly growing community with an estimated population of 900,000 in 2005. While the southern portion of York Region had its electricity infrastructure upgraded in 2004, the northern portion has continued to grow without improvements since 1990. The OPA in its study of York Region identified the most urgent need to be in the northern part of the region, confirming Hydro One and the IESO's earlier findings. The longer term supply need of southern York Region will be the subject of a future planning study by the OPA. Thus, the focus of this study is northern York Region.

Figure 1-1 shows the boundary of the area of focus for this study, which corresponds approximately to the service area of Armitage TS. The area of focus for this study includes six York Region municipalities that are served by Armitage TS, along with Bradford West Gwillimbury in Simcoe County. The York municipalities are Aurora, East Gwillimbury, Georgina, King, Newmarket, Whitchurch-Stouffville, and along with Bradford West Gwillimbury are collectively referred to as "Northern York Region".

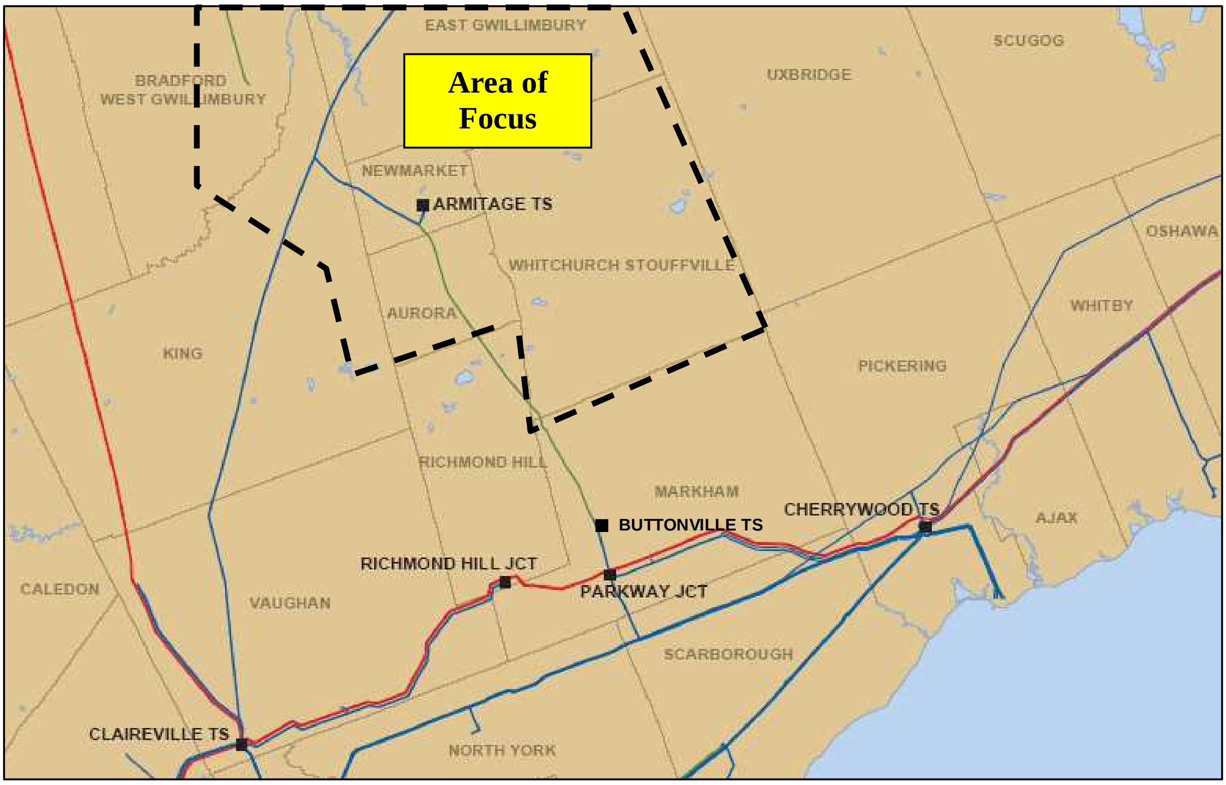

Figure 1-1: Area of Focus for York Region Supply Study

1.3 Planning Considerations

The OEB has asked the OPA to assess the need in York Region and recommend a preferred option to meet this need. The OPA's goal is to recommend a solution that is technically feasible, timely, and cost effective while considering its impact on communities. It is also important that this solution provides supply to the area of focus for the long-term, rather than temporarily addressing the immediate need.

The OPA has engaged the affected communities and local utilities in the process by receiving advice, feedback, and comment with respect to the identification, definition and evaluation of electricity supply and demand response options. As part of its consultation, the OPA arranged discussions of issues with various stakeholders with diverse perspectives. This was done to facilitate a mutual appreciation of differing viewpoints and allow the interested public to participate in the deliberation process used by the OPA to produce a recommendation.

1.4 Process Overview

The OPA initiated three parallel streams of work: a consultation process, a technical and financial analysis, and a procurement process. These converged and became an integrated process focused on finding a suitable solution. Details of the scope and approach of the consultation process are described below. A description of the technical and financial analysis and procurement discussion follows later in the document.

1.4.1 Planning meetings with key stakeholder groups

In March 2005, the OPA met with key staff and elected officials in York Region and Bradford West Gwillimbury. Calls and meetings were also arranged with public interest groups as well as with utilities in the area to explain the mandate of the OPA with respect to this project, coordinate communications with impacted stakeholders, and solicit advice and feedback regarding the scope and process for the consultation.

1.4.2 Public meetings

In May 2005, the OPA organized two large public meetings to solicit feedback on the scope and process of the consultation, raise awareness of the issues facing York Region, and articulate the OPA's mandate with respect to meeting the electricity supply needs of the region. On May 4, 2005, the first public meeting was held in Richmond Hill with more than 700 people in attendance. Later in the month, at the request of northern residents and elected officials, a second public meeting was held in Newmarket with approximately 80 people in attendance. Notices for the meetings were placed in many of the community newspapers including Italian and Chinese language newspapers and the Toronto Star. The meetings consisted of two short presentations followed by a question and answer period. Exhibit A contains the meeting summary outlining the questions and issues raised during these meetings.

1.4.3 Working group

A working group was formed in June 2005, consisting of municipal government staff, residents, school board representatives, business community representatives, and public interest group representatives. A group of advisors was identified from both the affected utilities and relevant government ministries to be involved in the working group's deliberations. Five full-day sessions were conducted, providing the group with information about the different aspects of the planning process, the needs assessment, and options identification and evaluation. The working group and advisors provided valuable advice and feedback on the planning process. The OPA wishes to thank all participants in the working group sessions for their contributions in time, experience, and insight, including the observers who took the time to attend and contribute. For a list of organizations and individuals represented, the terms of reference, and the code of conduct for the working group, see Exhibit A.

1.4.4 Elected officials forum

Through consultation with elected officials, the OPA identified a need to keep elected officials informed in a more formal forum than by conference call. The OPA requested that each municipality send two elected officials to represent their community and invited area MPPs to meetings established specifically for elected officials in the region. Three forums were conducted to update elected officials about working group deliberations and provided an opportunity to solicit their advice and feedback.

1.4.5 Media

Media were invited to attend the first public meeting in order to raise awareness of the OPA's involvement in the planning exercise and to engage the community in the consultation. There was extensive media coverage at public meetings and several news articles covering the different stages of the working group deliberations.

1.4.6 Observers

In order to ensure that the consultation was as open and transparent as possible, the general public was invited to all working group sessions and elected officials meetings as observers. They were given the opportunity to ask questions and provide comments at specific times during the meetings. Observers' comments were recorded in meeting summaries along with comments from participants.

1.4.7 Website and written comments

A project webpage was setup early on in the consultation to allow for the posting of documents. This provided an opportunity for the broader public to be kept informed of the process and provide written comments. The OPA responded to questions from the public.

1.4.8 Briefing on draft recommendation

On September 14, 2005, after the release of the draft recommendations to the public, the OPA organized a final public open house to provide an opportunity for the general public to ask questions and provide comments to the OPA. Approximately 200 people attended the open house. The feedback received on the draft recommendation was reviewed and the report was updated. All feedback received on the draft report is included as part of Exhibit A.

2 LOAD FORECAST AND CONSERVATION & DEMAND MANAGEMENT

2.1 Load Forecast

In order to properly assess the needs of Northern York Region and determine an appropriate study horizon, a load forecast of electricity demand was needed. Electricity usage is driven by a number of variables, including but not limited to economic activity, demographic growth, the price of electricity, energy conservation, and weather effects. Therefore, the task of forecasting electricity demand is complex and must incorporate a number of different considerations. The forecasts for Northern York Region are based on several approaches. One approach used is trend analysis, which looks at historical consumption levels and extrapolates into the future. The second is end-use analysis, which considers actual devices consuming power. Finally, the third approach is macro-economic analysis, which considers the level of economic activity and growth along with their impact on electricity use.

2.1.1 Summary

Armitage TS serves three local distribution companies (LDCs): Aurora Hydro Connections Limited ("Aurora Hydro"), Newmarket Hydro Limited ("Newmarket Hydro"), and Hydro One's LDC.[1] Each LDC's share of the peak load at Armitage TS is shown in Figure 2-1. The peak load provides the most relevant value for forecasting in this case, since it is this amount of electricity that the system must be capable of reliably delivering.

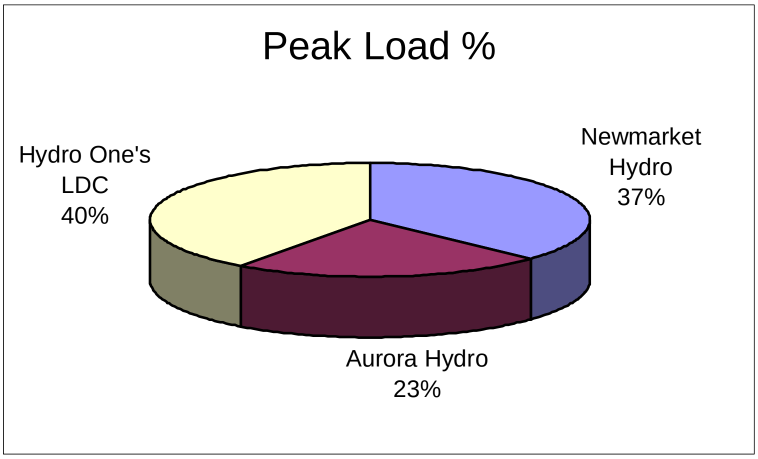

Figure 2-1: Peak Load at Armitage TS by LDC

[1] Barrie Hydro serves most of Bradford West Gwillimbury; however, the Barrie Hydro service territory in Bradford West Gwillimbury is embedded in Hydro One's distribution system, and as a result is aggregated and represented as Hydro One distribution load.

Individual forecasts were developed by each LDC and then combined to reflect the total load forecast for Armitage TS. It is forecast that load in Aurora could grow by 3% per year for the next 10 years, in Newmarket by 3.5% per year, and in Hydro One's LDC service areas by 2% per year. Combining these, the total forecast annual growth at Armitage TS is slightly over 3%, before adjusting for any new conservation and demand management (CDM). More detail on exact load forecast values is available in Exhibit B.

Figure 2-2 shows the load forecast for Armitage TS. The dashed line is the most recent forecast at Armitage. The solid line is a revised forecast to incorporate the effects of existing CDM initiatives, which are discussed in more detail in Section 2.2.3.

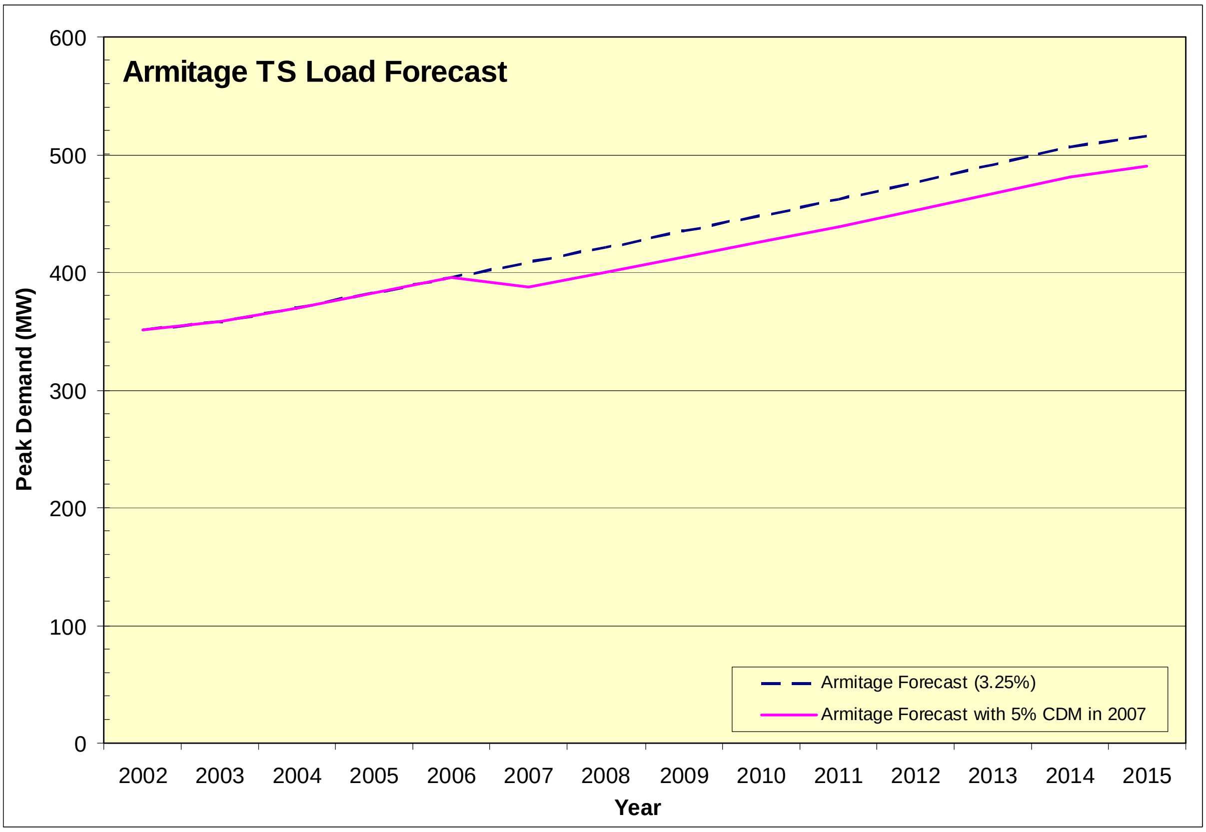

Figure 2-2: Armitage TS Load Forecast

During the OPA consultation, a representative from East Gwillimbury brought to Hydro One's attention a new housing development that had not been identified in their local area forecast. Hydro One reviewed their forecast with this new development and found that the summer peak increased by approximately 0.5 MW. Hydro One recommended no change to the forecast because this increment is small relative to other forecast uncertainties.

2.1.2 Analysis

The quality of the Armitage TS forecasts is limited by two main factors, the effects of future electricity prices on demand and the uncertainty of future weather effects.

Trend analysis is based on “average” weather patterns and is achieved through the technique of weather normalization. This is performed to avoid any distortion of the average long-term trend by historical extreme weather events. Any extreme or prolonged heat waves will have the effect of increasing the load above the historical trend, and therefore represents risk in the forecast. Historical Ontario data from the IESO shows increases of up to 12% in demand during summer peaks as a result of extremely hot weather. Given the need to meet electricity demand during extreme weather, this factor has the effect of increasing the urgency of the supply situation by several years.

The effects of the changing price of electricity also represent uncertainty in the forecast. Both the future energy price and the impact of that price on demand are unknowns representing risk. It is most likely, however, that the price of electricity will rise in the future, resulting in downward pressure on demand, extending the need date by some time.

These two shortcomings in the forecasts are offsetting in their impact, reducing the potential inaccuracy. The forecasts are also subject to ordinary uncertainties, such as unexpectedly high or low levels of population growth or economic activity. These ordinary uncertainties are generally dealt with by placing uncertainty bands around forecasts when they are used for decision making. Only a profound change in economic or population growth would undermine the forecasts and such a risk appears low.

2.1.3 Conclusion

The load forecasts for Northern York Region have been validated by Armitage TS actual loads during the recent extreme weather in the summer of 2005. It may be possible to improve the forecasts slightly, but it is unlikely that such an effort will affect the outcome of the decisions required for the area. A number of the constraints to supplying Northern York Region were reached in 2002, and others will be reached in the very near future. York Region has demonstrated rapid growth in the past decade and this is not likely to decline significantly in the next five to ten years. As a result, it is the current level of area load that drives the existing urgent needs, whereas the rate of future load growth forecasts are secondary drivers affecting later periods in this study. The OPA considers the forecast sufficient for this initiative.

2.2 Conservation & Demand Management

Conservation and demand management (CDM) incorporates two separate but related concepts. First, it includes conservation, which is a general reduction in consumption, usually through changing usage patterns or improvements in technology such as compact fluorescent light bulbs. This is depicted in Figure 2-3 by the dashed line. Secondly, it includes demand response, which shifts electrical loads from peak to off-peak hours. Figure 2-3 illustrates how this shift helps keep demand within the load meeting capability of a system. If the red cross-hatched periods are moved to other times when demand is lower, such as the striped area, then the existing infrastructure remains capable of meeting the demand.

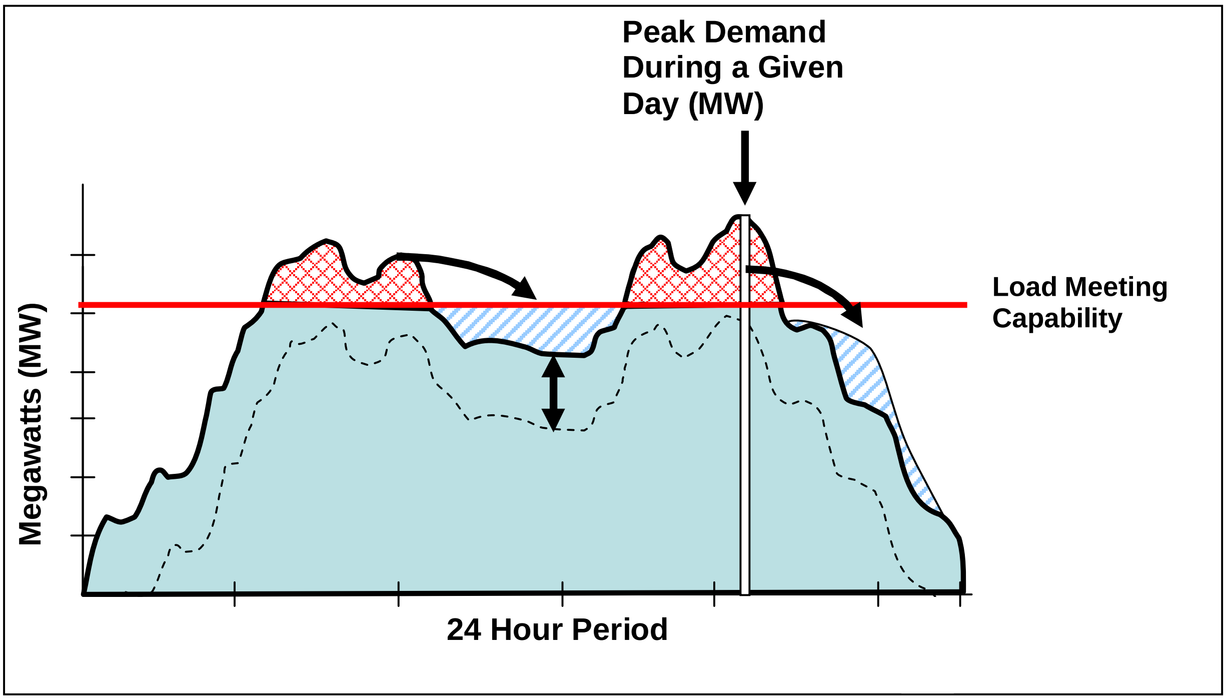

Figure 2-3: Impact of Demand Management on Load Meeting Capability

The working group believes that CDM has an important role to play in addressing the electricity supply problems in Northern York Region; the OPA agrees with this assessment. Both the Working Group and the OPA recognize that while CDM will play a critical role in the integrated solution to the supply problem, it is not sufficient to address all the constraints.

2.2.1 Overview of Request for Expressions of Interest (RFI)

The OPA issued a request for expressions of interest (RFI) for demand response in Northern York Region. The purpose of the RFI was to gauge the level of interest for demand response (DR) projects, one aspect of CDM. A requirement of this RFI was for a demand response of at least one MW, which could be verified through random audits. Existing LDC programs were disqualified and any proposal had to be able to respond to high prices and directives from the IESO.

The OPA is prepared to provide support payments for demand response; however, the options have to be cost-competitive and derive a significant portion of their value or revenues from the consumers benefiting from the reductions or the sale of services to the wholesale market.

2.2.2 Response to RFI

Individual responses to an RFI, along with any information that could prejudice potential RFI respondents are commercially sensitive and therefore confidential. In order to ensure that this report to the OEB is made public in its entirety, it is necessary to omit any specific discussion of the RFI responses. The underlying OPA analysis of the supply situation does take into consideration the actual responses to RFI, even though the details cannot be shared here.

The number and quality of responses received demonstrate a strong interest in DR projects in Northern York Region.

There were response(s) offering standby generation to offset peak demands. It would be required to run during peak periods in anticipation of the loss of a single transmission line to the area, likely for several hours each summer day. This generation, typically diesel, may have difficulty meeting emissions limits when run for non-emergency purposes. The Ministry of the Environment’s current practice when issuing Certificates of Approval for diesel generators prohibits their use on smog days for non-emergency purposes, and therefore severely restricts their ability to meet the identified need in Northern York Region. It will be up to individual developers to permit their projects so that they can meet the identified need. Therefore, if there is technology to reduce the emissions sufficiently or if the generators are converted to cleaner fuels, they may be used to provide DR in Northern York Region.

There were also respondent(s) willing to act as aggregators to control loads within Northern York Region during peak periods. This type of project involves a third-party aggregator signing up consumers to have their load cut in a verifiable manner in the event of a high-demand day. A typical example of such a program would be an air conditioner load cycling regime where people signed up for the program may have their air conditioners cycled off periodically during times of peak demand. This may have little-to-no impact on users since air conditioners normally only run a portion of the time, but can provide valuable megawatts of relief to the system if enough users are involved. The main concern with this type of demand response initiative is that there is very little recent experience in Ontario; however, there is experience in neighbouring jurisdictions which may aide in finding proponents with proven track records.

The OPA is prepared to take its procurement to the next stage through a request for proposals (RFP) that is substantially similar to the RFI. While the RFI's purpose is to gauge the level of interest in a project, the RFP's purpose is to find the best proponents for a project and negotiate contracts. This RFP process will not be exclusive to those who responded to the RFI so others who have DR proposals for Northern York Region may submit them as well. The OPA has set a target of 20 MW of economic demand response in Northern York Region, with as much as possible ready by summer 2006. The OPA intends to develop this DR as part of a government directive to acquire 250 MW of demand response provincially.

2.2.3 Province-Wide Conservation & Demand Management

The Government of Ontario has an initiative to reduce peak electricity demand growth by 5% province-wide. Each of the local distribution companies has undertaken numerous initiatives with funding approved by the OEB to help achieve this target.

On April 6, 2005, the OEB announced that $160 million had been allocated to this initiative province-wide, with Aurora Hydro and Newmarket Hydro spending over $2 million on this initiative, and Hydro One spending close to $40 million across the province. This money is being spent on improvements to distribution networks, new pilot Smart Meters, alternate forms of generation, and more efficient lighting, heating, and appliances.

The existing Local Distribution Companies' CDM programs are not necessarily targeted specifically towards the peak hours and days where demand response is most critical. As well, future funding for these programs is uncertain, and there is no requirement that they produce verifiable savings. While conservation measures will have an impact on reducing demand, the need in Northern York Region is for *peak* demand reduction particularly in the summer, for which the most benefit can be had through targeted programs.

Any CDM initiatives undertaken by the OPA in response to the specific needs of Northern York Region will be designed to complement and supplement the provincial initiative to ensure there is no duplication, and to focus on the specific needs of the area.

2.2.4 Other CDM opportunities

There are a number of other initiatives in the pipeline for Ontario, such as low income housing and institutional buildings electricity efficiency improvement programs, appliance upgrade and exchange programs, EnergyStar for New Homes, and a customized incentive program modelled after California's 20/20 program.

The EnergyStar for New Homes program is a means of recognizing houses that have been built with higher energy efficiency standards. Houses qualify if they are either 30% more efficient than outlined in the 1993 National Model Energy Code, or 15% more efficient than any state energy code. Owners of EnergyStar homes pay less on their utility bills while reducing energy demand, and can qualify for special Energy Efficient Mortgages.

A customized incentive program, based on California's 20/20 program for reducing demand, will also be explored. The 20/20 program provided a 20% rebate on energy costs during summer months to customers who reduced their electricity usage by 20% or more, for a combined savings of at least 40% on their bill.

Although these initiatives are province-wide, given the urgent need in Northern York Region, the area is an ideal candidate for pilot projects and early implementation; to this end the OPA will take advantage of the opportunity in York Region. The success of these programs will depend heavily on the cooperation of LDCs and committed support at the community level.

Smart Meters, a government initiative to install time-of-use electricity meters also has potential to reduce peak demand in Northern York Region. Although the initiative is outside the mandate of the Ontario Power Authority, the OPA supports the view that Northern York Region is a logical place to pilot this program.

2.3 Adjusted Load Forecast

The Armitage TS load forecast has been further adjusted to reflect the target of 20 MW demand response (approximately 5%) through the OPA procurement process. In Figure 2-4, the blue dashed line shows the baseline forecast, the pink solid line shows the baseline forecast adjusted for existing CDM programs, and the green dotted line shows this adjusted forecast further modified to reflect the target of 20 MW of DR.

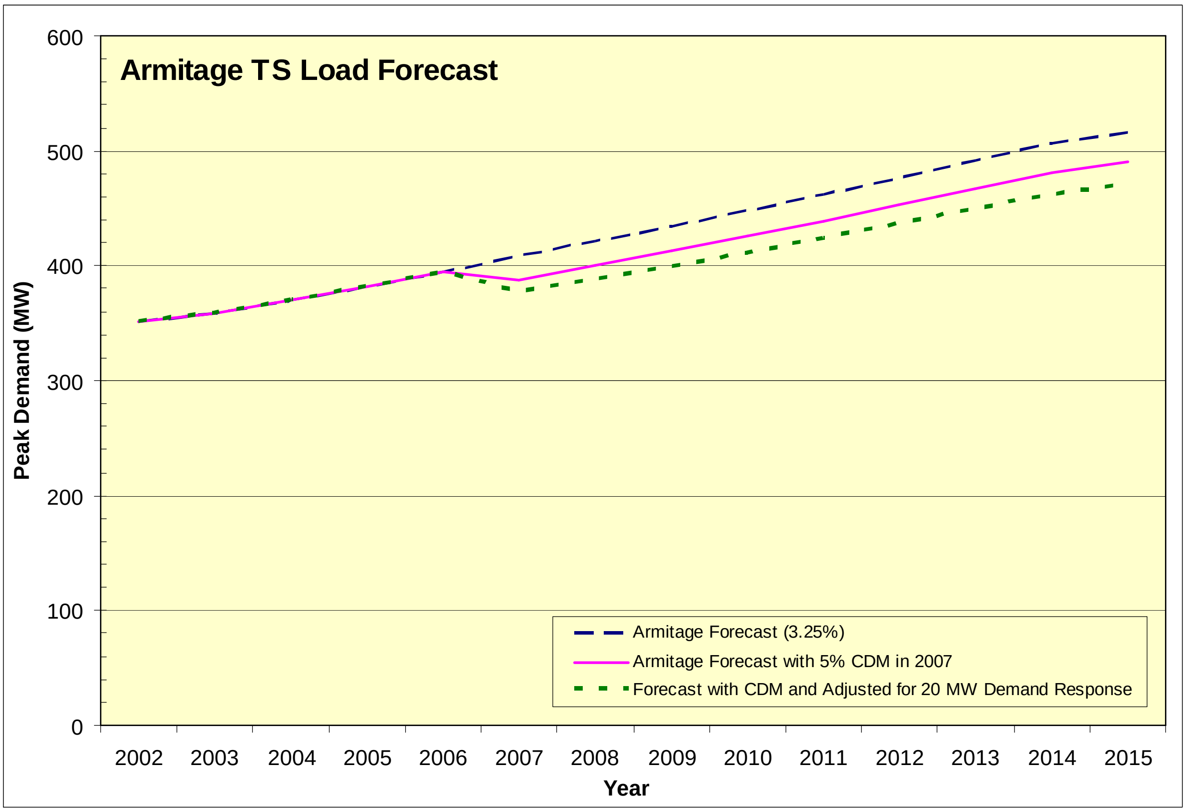

Figure 2-4: Load Forecast at Armitage TS Adjusted for CDM

The OPA and affected LDCs will monitor the effectiveness of CDM on a regular basis and revise the load forecast accordingly.

3 SYSTEM CAPABILITY AND NEED

3.1 Reliable Electricity Supply

A reliable electricity supply must consider and prepare for the impact of equipment outages before they occur. Failure of the electricity delivery system can happen in fractions of a second following equipment outages. Thus, safe and reliable operation of such a system requires that failure events be anticipated and boundaries established to ensure the system can automatically settle into a safe operating mode following a failure.

This is further complicated because electricity cannot be stored in meaningful quantities, and the supply and demand must be balanced nearly instantaneously taking into consideration the numerous reasons why circuits[2] fail, such as ice storms, lightning strikes, and equipment failure. As well, station equipment and lines occasionally require planned outages for routine maintenance or repairs. It is important that supply is not interrupted every time such an incident or outage occurs; therefore, the bulk supply capability is based on the event that one of the circuits is out of service; in other words, when each circuit is running at half its capability, the line is at capacity. Any increase in load beyond that point would exceed the capability of a single circuit and can therefore no longer supply the load reliably or meet the IESO Supply Deliverability Guidelines. In such a case if a circuit were to fail, then the total load would exceed the capability of the remaining circuit and some load would have to be disconnected automatically to avoid an interruption of the entire load.

For the purposes of discussion in the following sections, the system delivering electricity to supply the load area in Northern York Region is divided into two major components, namely:

- Transformation and distribution facilities which transform or step-down high voltage electricity into lower voltages suitable to feed into the LDCs' distribution networks, and,

- Bulk supply facilities consisting of generation resources and high voltage transmission lines into the area.

[2] A "circuit" consists of three wires or conductors carrying 3-phase power. A transmission "line" can be a tower line consisting of either a single circuit or multiple circuits. The line supplying Northern York Region is a 2-circuit tower line, on one set of towers.

A reliable electricity supply system delivering electricity to a major load center such as Northern York Region should meet the following performance requirements, which are included in the OPA planning considerations:

1. With all elements of the supply infrastructure in service to supply the area load, the equipment must operate within its normal limits. The voltages on the transmission and distribution lines must be within acceptable ranges.

2. With all transmission elements in service pre-contingency, the loss of a transmission element, which would also result in the loss of the connected transformers, should not result in the interruption of area load. All the remaining elements must be within their applicable ratings and the voltages on the transmission and distribution lines must be within the acceptable ranges. This requirement is in conformance with the IESO's Supply Deliverability Guidelines, which state in part:

    > *For loads between 250 MW and 500 MW: with all transmission elements in service pre-contingency, any single element contingency should not result in an interruption of supply to a load level greater than 250 MW.*

    Additionally, in an area with local generation, it is customary to assume that for technical or commercial reasons the largest generator in the area is unavailable in determining the supply need for the area.

3. A diverse bulk supply source, either in the form of local generation or a high voltage transmission line transporting generation into the area, is available to supply as much area load as possible in the event of the loss of the existing main bulk supply facilities.

    For a major load centre such as Northern York Region, it is important to include supply security or diversity as part of the planning considerations. This is consistent with IESO's Supply Deliverability Guidelines, which state in part:

    > *With all transmission elements in service, for any double circuit contingency that results in a supply interruption of between 250 MW and 500 MW, all load should be restored by switching operations within a typical period of 30 minutes.*

4. The distribution feeders must be capable of delivering electricity reliably to the customers within the acceptable voltage range with minimum electrical losses. Where practical, customer loads can be connected to adjacent feeders to minimize prolonged interruption in the event of planned or unplanned outage of a feeder.

These planning principles are considered good utility practice and are adopted by utilities worldwide.

3.2 Transformation & Distribution

3.2.1 Existing capability

There are presently two transformer stations at Armitage TS, and these can be thought of as "Armitage 1" and "Armitage 2". They are relatively independent, but have some support systems in common. The connection arrangement and supply capability of each station on the site is similar to other stations in Ontario, with each station having two transformers, one connected to each incoming supply line. In the event of a loss of a transformer, the remaining one is capable of supplying the total load supplied by that station.

Transformers have variable capacities depending on the duration at which they must run. For planning purposes the capacity that a transformer can provide for ten days continuously, known as the "10-day limited time rating", is used. Ten days is the assumed time for replacing a failed transformer. The effective planning transformation capacity at Armitage TS is 317 MW, on the assumption that one transformer from each station is out of service as a result of a failure of either incoming 230 kV circuit from Claireville TS.

In addition to having a limited transformation capacity, each transformer station is capable of supplying eight distribution feeder lines for a combined capacity of 16 feeders. Feeder lines run from the transformer station to houses, buildings, and factories in the area supplying them with power. Each feeder has a limited capacity determined by the rating of the conductors and voltage regulation. Ideally, these feeders need to be as short as possible to reduce losses.[3]. All 16 feeders running from Armitage TS, six of which are allocated to Newmarket Hydro, three to

[3] When electricity travels along distribution and transmission lines, some power dissipates as heat into the environment, resulting in losses.

Aurora Hydro and seven to Hydro One's LDC, are fully utilized. The combined capability of these feeders matches the transformation capacity at Armitage TS. The station is pictured in Figure 3-1.

Figure 3-1: Armitage Transformer Station

3.2.2 Bottleneck

The transformers at Armitage TS have been subjected to loading beyond planning capacity since 2002. There are, however, two reasons why this has not resulted in power interruptions in Northern York Region. The first reasons is that the system is designed to allow for a single contingency to occur at any time. Unless this contingency occurs during one of the periods where the planning transformation capacity is exceeded, there is no service interruption. As the load continues to grow in Northern York Region, the period in which the transformers are loaded beyond this capacity will continue to grow as well, which will increase both the duration of exposure to this risk and the amount of load exposed to this risk. The second reason why this has not resulted in service interruptions is that transformers are capable of running beyond their 10-day limited time rating for very short periods of time if necessary.

The loading on the Armitage transformers was 347 MW on June 27, 2005 (based on 30-minute averages), about 10% above the planning limit of 317 MW. This is graphed in Figure 3-2 to highlight the already existing need for additional transformation capability.

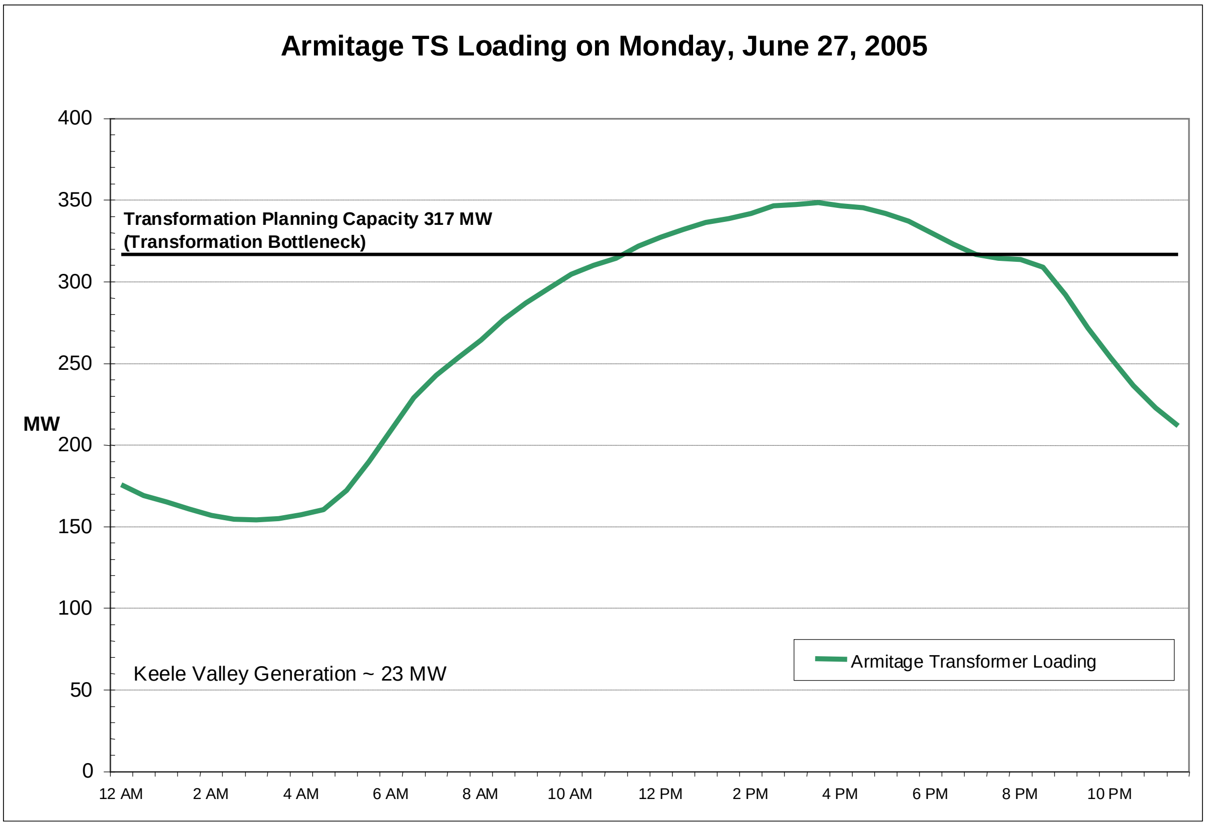

Figure 3-2: Loading on the Armitage Transformers on Monday, June 27, 2005

In addition to the need for new transformation capability, there is a shortage of feeder lines. Presently, Hydro One's LDC requires one new feeder, Aurora Hydro requires two new feeders, and Newmarket Hydro needs one new feeder to effectively serve their loads. Armitage TS is unable to meet this existing need for four new feeders or any future feeder requirements. Service is presently being provided through a suboptimal feeder configuration, but this solution is not sustainable and it will become impossible to connect new loads. Based on the load forecast and assumed feeder loads of 15 to 20 megawatts, at least eight new feeders will be required over the next 10 years, in addition to the currently required four.

3.2.3 Need

Because additional transformation capability and feeders have been required since 2002, one new transformer station is required immediately. The standard transformer station design has a capacity of 150 MW. It is highly desirable to use standard transformer sizes since this optimizes repair time which is critical in the event of a failure.

The actual peak load in the Armitage TS service area was 370 MW. With a transformer planning capacity of 317 MW, this represents an existing shortfall of 53 MW. Between 2005 and 2015, the end of the study horizon, the load is forecast to grow by about 140 MW. This value considers the impact of existing CDM programs, but not the OPA demand response initiative. After the 20 MW of DR is factored in, the growth is only 120 MW. When this is added to the existing shortfall, there is a need for 173 MW of new transformation capacity in Northern York Region. Additionally, there is a need for up to 12 new feeders in the next 10 years, while a single transformer station can only handle eight. Therefore, as a result of the need for both transformation capability and feeders beyond what a single transformer station can provide, as well as the need to provide feeders geographically close to the new and growing loads, the solution will require a second transformer station within the study horizon.

3.3 Bulk Supply

3.3.1 Existing capability

The facilities providing bulk electricity supply to Northern York Region comprise:

- System-wide generation from a diverse mix of generation resources to supply loads across the province, including Northern York Region,
- The 230 kV transmission corridor, running northbound from Claireville TS in Vaughan to Minden TS, consists of two 230 kV circuits running 55 km from Claireville TS to Brown Hill TS supplying both Armitage TS and Brown Hill TS. At Holland Junction in King Township, an eight kilometre line tap runs from these two circuits southeast to Armitage TS. This is depicted in Figure 3-3. More detail about the transmission lines and transformer stations is available in Exhibit C.

- Keele Valley generation plant, located in Vaughan and connected to a 44 kV feeder into Armitage TS, has a maximum output of approximately 30 MW. However, as discussed in Section 3.1, the planning principle adopted by the OPA is to assume that the largest generating unit in the study area, in this case Keele Valley, is unavailable.

3.3.2 Bottleneck

The bulk supply bottleneck limits the amount of electricity that can be transported into Northern York Region to service the area load. The first constraint, the thermal capability of the Claireville line, is restricted by the line tap running between Holland Junction and Armitage TS. It is capable of supplying an area load of 470 MW during the summer months. The second constraint, voltage collapse[4] on the line, limits the capability to supply the area load to about 375 MW.

The thermal constraint on the line tap arises in 2010 based on the load forecast. The risk of voltage collapse is forecast to occur in 2008. The voltage collapse problem is particularly acute for Northern York Region because the load is primarily served by Claireville TS, which is located at a considerable distance away.

3.3.3 Supply security or diversity considerations

For the loss of the 35 km section of the double-circuit tower line between Claireville TS and Holland Junction, the remaining transmission line from Minden TS is expected to be capable of providing an emergency supply of approximately 150 MW to Northern York Region. This would require line loops, switches or breakers to provide isolation capability. Even with this capability this still does not fully meet the guideline for restoration of all load within 30 minutes.

The supply security or diversity issues can be remedied by means of either installing local generation or building new transmission into the area to supply part of the area load.

[4] Voltage collapse is a failure of a heavily loaded transmission system resulting from an uncontrollable decline in voltage. This may be triggered by load increases or loss of supply and can occur within seconds.

3.3.4 Need

After the 20 MW of DR is factored into the load forecast, there is a need for 140 MW of new bulk supply to serve Northern York Region. This can be supplied two ways:

1. New local generation providing supply to the area, or,

2. New system generation transmitted into Northern York Region through upgraded transmission capability.

3.4 Summary

The map in Figure 3-3 shows the two bottlenecks currently affecting Northern York Region.

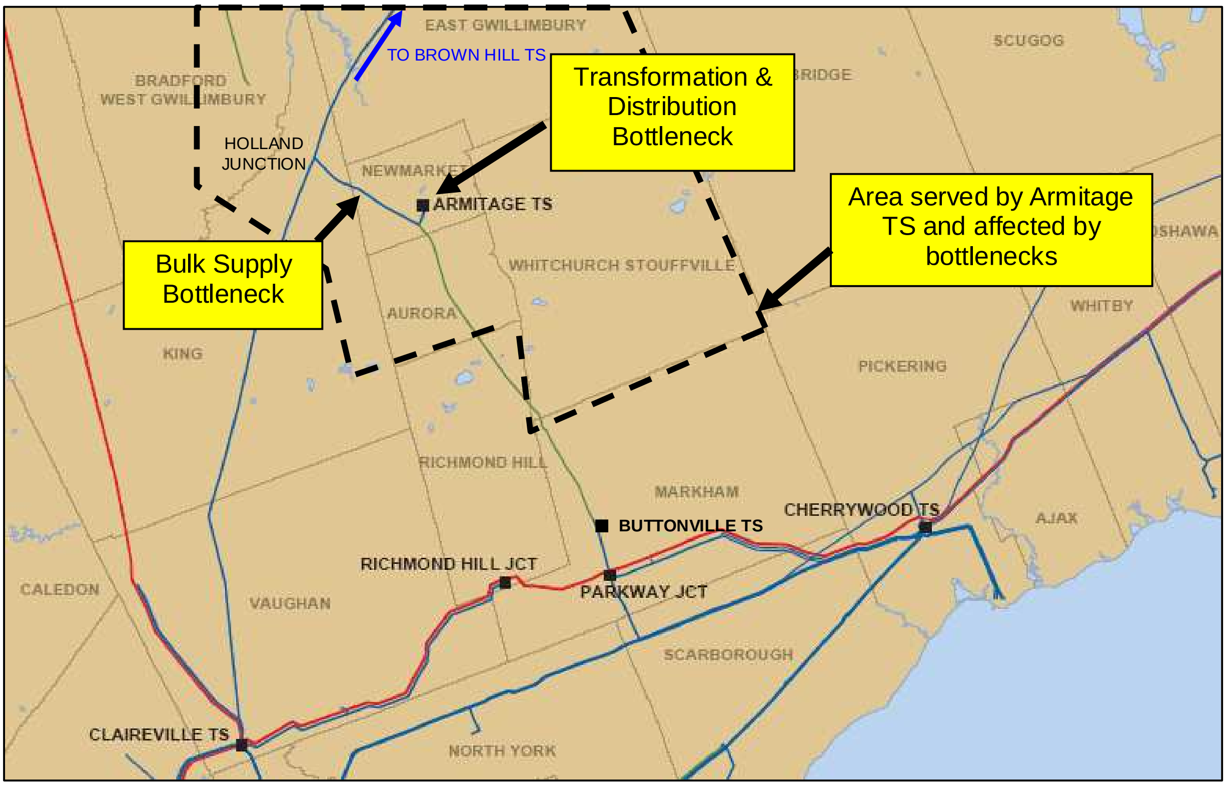

Figure 3-3: Bottlenecks to Armitage Supply Area

Figure 3-4 shows a timeline of each of the bottlenecks at Armitage TS. Note that the transformation and distribution bottleneck has already been encountered, and with no action beyond CDM, the bulk supply bottleneck may be reached as soon as 2008. As well, there is already a security of supply issue that needs to be addressed.

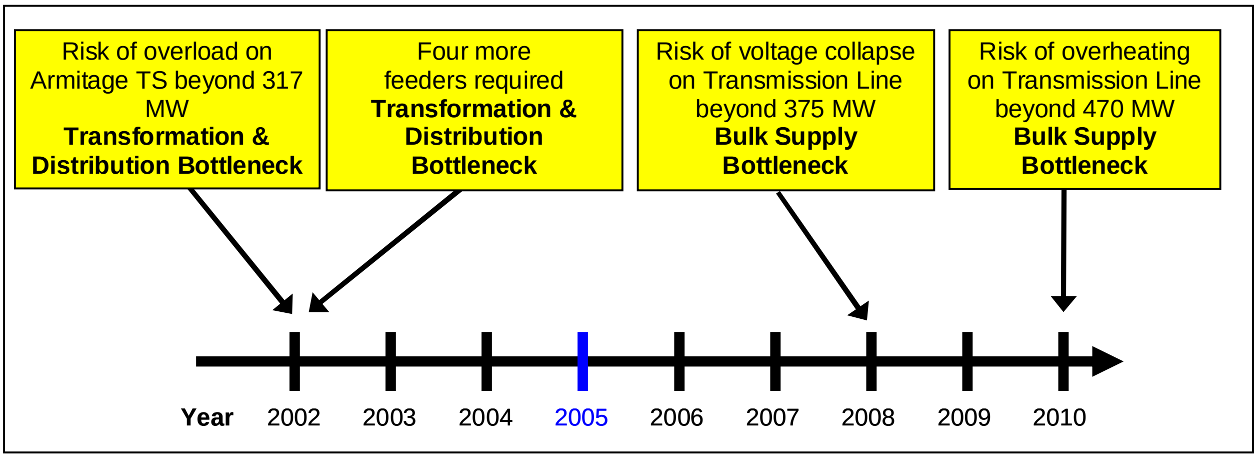

Figure 3-4: Timeline of Bottlenecks to Armitage TS Service Area

4 DISTRIBUTION & TRANSFORMATION

4.1 Planning Considerations

Distribution and transformation have been grouped together because both bottlenecks are related and must be addressed jointly, typically by the same remedy: a new transformer station. The location of the TS is critical for a number of reasons. First, it should be central to the loads it serves to minimize the losses along feeder lines as well as the cost of running those feeders. Second, there must be an adequate supply of high voltage power to a transformer station to ensure it can run to its capacity. Presently, Northern York Region requires one new transformer station. It will require an additional transformer station near the end of the period if the area continues to grow at the forecast rate. A number of locations for transformer stations were considered and several are discussed in greater detail below and illustrated in Figure 4-1. See Exhibit F for complete details on the distribution and transformation options.

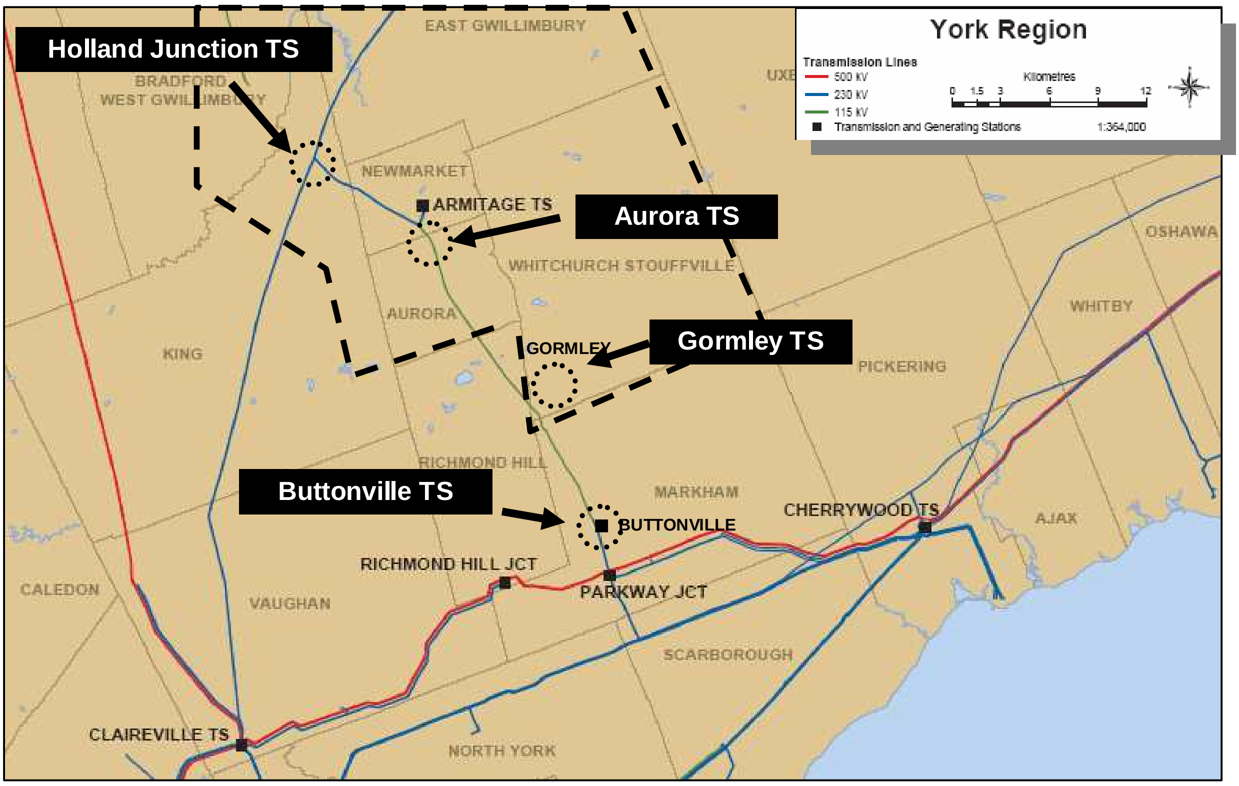

Figure 4-1: Map Showing Potential Transformer Station Locations

4.2 Transformer Station Options

4.2.1 Buttonville TS

This is Option 2 as identified in the letter of direction from the OEB. The option consists of building a 230/44 kV transformer station at the site of the existing Buttonville TS and running 44 kV feeder lines to Aurora, Newmarket, and Whitchurch-Stouffville. The existing Buttonville TS provides transformation down to 28kV distribution voltage used in southern York Region. A second Buttonville transformer station would provide transformation down to the 44kV voltage used in Northern York Region. The second station would be supplied from Parkway TS using the existing 230 kV line that feeds the existing station. Most of the feeders from the second station on the site would be quite long as most of the load served would be in Newmarket and Aurora.

There are three advantages to this option. The first is that there is space at the existing Buttonville site for an additional transformer station and no new site would have to be developed. The second advantage is that there is an existing and adequate 230 kV supply available on the site. The third advantage is that the available 230 kV supply is independent of the 230 kV transmission lines supplying Armitage TS, resulting in increased supply diversity for Northern York Region.

There are several significant disadvantages to this option, all relating to the length of the feeders that would be required to supply the load. These were highlighted in a report submitted to the OEB by the local distribution utilities titled *Collective Response to the OEB Direction of June 28, 2005* (“Collective Response”). The first disadvantage is the capital cost of building the required distribution system distant from the load. Their estimate for the capital cost is a relatively high $47 to $57 million depending on the routing of the feeder lines. There are also significant distribution losses associated with this option because of the long feeders. The secondary losses were estimated to be 9 MW above the typical losses for a more conventional station and feeder arrangement. Finally, the reliability provided by the arrangement will be suboptimal because the long feeders are more exposed to the elements and more likely to be disrupted by lightning and other factors.

This option is not favoured as either the first or second station for serving the need of Northern York Region.

4.2.2 Holland Junction TS

Construction of a transformer station at Holland Junction is OEB Option 3. This is the location where the line tap to Armitage TS intersects the line from Claireville to Minden, as pictured in Figure 4-2.

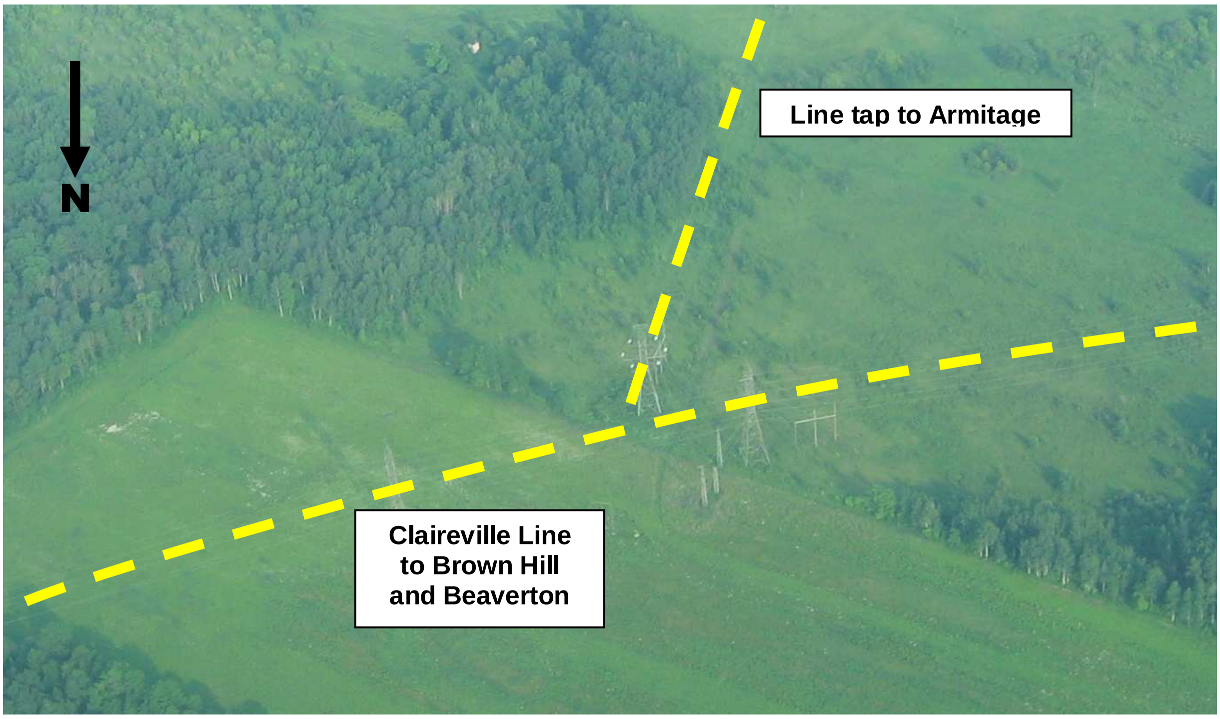

Figure 4-2: Holland Junction

The new station would be constructed somewhere in the vicinity of the tap. The precise location will depend on road access, the availability of suitable land and the availability of routes for feeders leaving the station. To minimize the environmental impact of a new station, the station could potentially be constructed along the existing right-of-way (ROW), as a "right-of-way station", similar to the arrangement at Brown Hill TS shown in Figure 4-3. A key purpose for the Holland Junction TS would be to off-load Armitage TS through load transfers to the new station. Another purpose would be to provide new feeders required to serve existing and growing loads in the northern portion of York Region, King Township and the Bradford area.

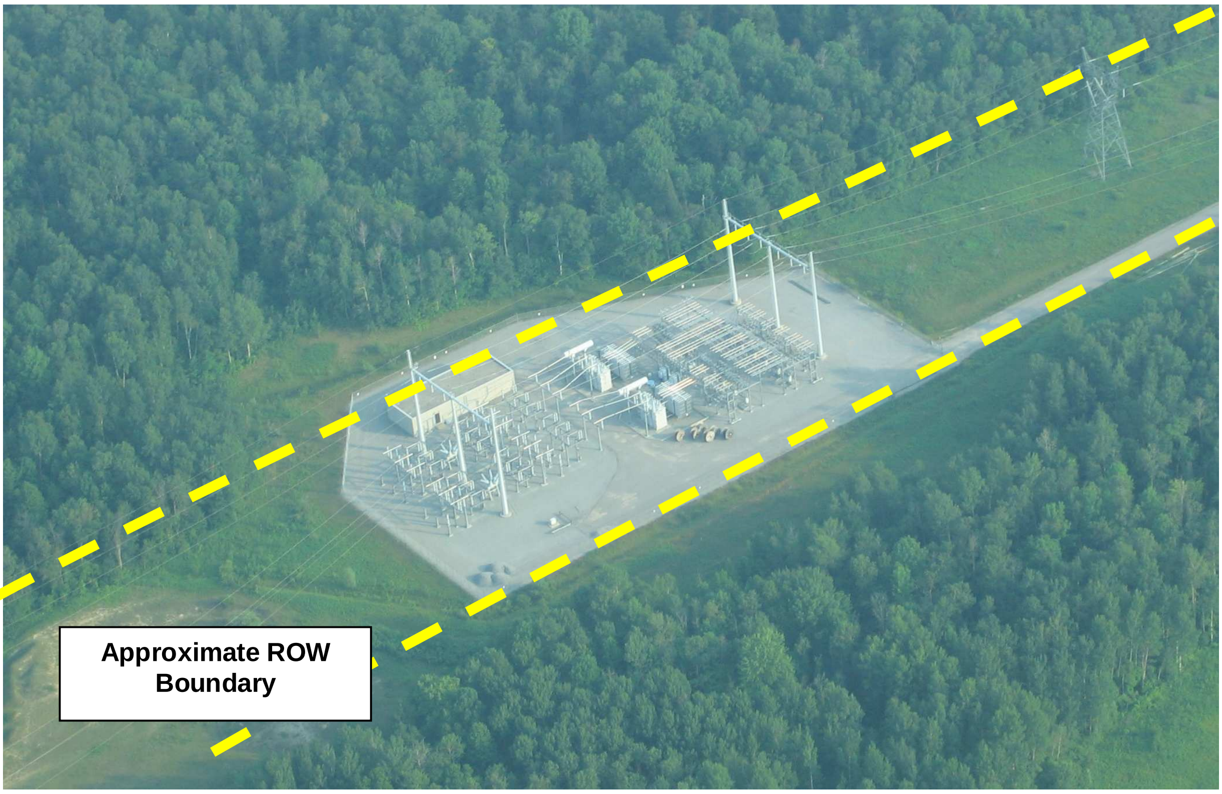

Figure 4-3: Brown Hill Transformer Station

There are several advantages to the Holland Junction TS option. The first is the availability of a site beneath the existing transmission lines allowing the station to be built quickly. The second advantage is the fact that the station would connect to the existing 230 kV Claireville to Minden lines at a point "upstream" of the eight kilometre line tap to Armitage TS. Connecting to the 230 kV lines at this point avoids using up the capability of the line tap and results in a shorter line length to the station from the main supply point at Claireville TS. This will reduce the effects of voltage drop at the station, therefore lessening the risk of voltage collapse. The station is centrally located to growing loads and offers reasonable feeder lengths and losses. A final and very important advantage of providing this station is that it enhances the load meeting capability of the existing 230 kV lines by offering an ideal location for new capacitor banks that will support the line voltage.

There are some disadvantages associated with the Holland Junction option. One being that it does not provide a new route for the additional power to Northern York Region, and therefore does not contribute significantly to diversity of supply. It does, however, offer a degree of diversity by virtue of its strategic location. Depending on switching capability, the station can be independent of the Armitage TS line tap and can be supplied from either the north or south should a major transmission line failure occur.

This option is an attractive first step because it can be constructed quickly, offering a wide range of benefits that provide value in both the short and long term.

4.2.3 Aurora TS

Aurora TS was one of the elements considered in the 2003 plan to provide new capacity to Northern York Region. At that time, the plan was to supply such a station using a 230 kV line from Buttonville TS in the south. In the current plan, Aurora TS would be supplied from the north by a short 230 kV line. This station would be built in an industrial area adjacent to the existing Buttonville-Armitage right-of-way, about two kilometres south of Armitage TS. Line taps of approximately 1.6 kilometres would have to be constructed along the route of the existing Buttonville-Armitage ROW replacing the old line. The station would supply industrial and other loads in Aurora as well as other loads to the east.

Aurora TS would be built to provide both transformation capacity in Northern York Region and new distribution feeders in its geographic area at a future date when the capacity and feeders are required.

The approximate site of this proposed station is shown in Figure 4-4.

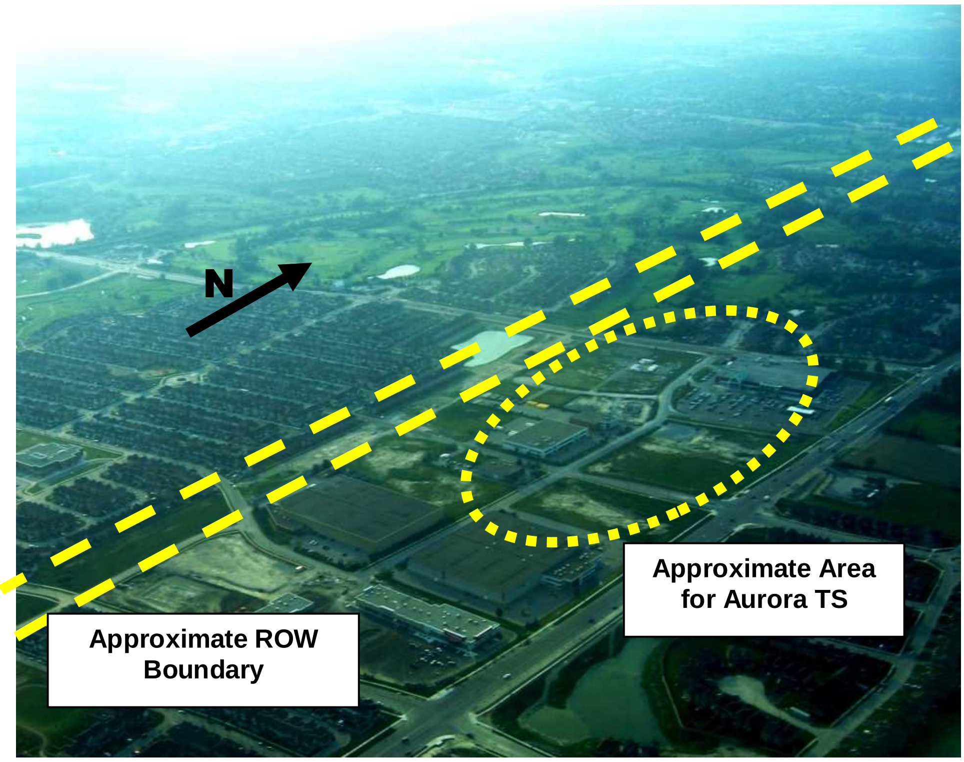

Figure 4-4: Approximate Area of Proposed Aurora TS

The Aurora TS option has a number of advantages. It would be ideally situated to supply new and growing loads through short feeders. Another advantage is the moderate cost because of the short 230 kV lines and feeders. Finally, Aurora TS would provide another opportunity to install capacitor banks for voltage support in Northern York Region.

This option also has several disadvantages. The first disadvantage relates to providing a bulk supply to the station. As an immediate option this station would require the completion of a 230 kV supply line that would require additional time to complete. As a longer term option, this requirement for additional time is not an issue. The second disadvantage is that the 230 kV supply to this station would not be independent of the supply lines to Armitage TS, and the station would not in itself offer significant additional diversity to the Northern York Region supply. This can be mitigated, however, by ensuring that the local generation is connected in a manner to offer diversity of supply to the area.

This option is an attractive second step because it avoids the high costs associated with long 230 kV transmission lines and provides a wide range of benefits.

4.2.4 Gormley TS

Gormley TS is an alternative to Aurora TS and would be built if local generation cannot be provided in Northern York Region. Gormley TS would be located somewhere in the Stouffville Side Road area and supplied by a 230 kV transmission line from Buttonville TS. The location of this station is a compromise that would minimize the high cost of building a 230 kV line from Buttonville by locating the station as far south as possible while also being far enough north to be reasonably close to the load that it would serve. Gormley TS would serve industrial and other loads in Aurora as well as other loads to the east. Figure 4-1 shows the approximate location of Gormley TS. No site has been identified for this proposed station, but it would be adjacent to or on the existing Buttonville-Armitage right-of-way. Approximately 10 km of double-circuit 230 kV line would have to be built to supply the station.

Since a relatively long transmission line would have to be built to Gormley TS, the anticipated time delays involved in constructing a line make Gormley TS unsuitable as a short term alternative. It is, however, a useful option if local generation cannot be provided and Aurora TS cannot be built.

There are several advantages to the Gormley TS option. The first advantage is that Gormley TS would be supplied from Buttonville by a line that is independent of the existing 230 kV line supplying Armitage TS. This would enhance the diversity of supply to Northern York Region by offering an alternative means of supplying some of the load should major transmission line problems occur. A second advantage is the station's southerly location that would reduce the cost of providing transmission lines to supply the load.

Similarly, there are disadvantages to the Gormley TS option. The first is the cost of having to provide 230 kV transmission lines. The second is that the station location is further away from the load area, thus resulting in increased feeder lengths and feeder losses. The third disadvantage is that the southern portion of this line would pass through communities that have previously expressed concern about such a line.

This option is not the preferred second step because of transmission line cost and the need for a slightly more expensive distribution network than required for an Aurora TS.

4.3 Immediate Solutions

There is an urgent need for new distribution facilities to serve Northern York Region. Since 2002 there has been a shortage of feeder positions at the existing transformer station at Armitage, and a shortage of transformation capability putting the region at increasing risk of service interruption.

Over the long term two transformer stations will be required to provide a reliable supply to Northern York Region. One must be provided immediately to relieve the existing Armitage TS loading and one will be required towards the end of the study period to provide future geographic coverage and transformation capacity.

All three options other than Gormley TS are available as short term measures to provide relief to Armitage TS. These are the Aurora TS, Buttonville TS, and Holland Junction TS options, all of which can be implemented relatively quickly. Gormley TS has a long implementation time and as such is more suitable for the longer term. It also requires a relatively long transmission line that would not be consistent with a long term plan of providing additional supply using local generation.

The immediate solution requires that an option be chosen for a new transformer station that can be completed quickly. The parameters involved in that decision were highlighted in Section 4.2 where each option was described in detail.

Based on the information from the consultation process, the Holland Junction site is the preferred location for a new transformer station to serve Northern York Region. The Holland Junction option is preferable to Aurora TS because it does not require a supply line, and therefore can be constructed more quickly. Holland Junction TS is also situated closer to Claireville TS, which reduces the risk of voltage collapse. The Holland Junction TS option is superior to the Buttonville option in almost all areas including capital cost, distribution feeder losses, and reliability. The only area where Buttonville TS is stronger is in the near term diversity of supply. That advantage will be reduced in the future if local generation is provided in the area and it is connected in a manner that enhances bulk supply diversity. The Buttonville option is not favoured by Hydro One, Newmarket Hydro and Aurora Hydro.

Residents of King Township have expressed some concern with regard to locating a new transformer station in their municipality. The primary concern related to the appearance and impact of new roadside wood pole feeders near the transformer station. It is possible to mitigate the impact of new feeders by careful design of those facilities. There was also concern expressed about the use of agricultural land for infrastructure, and for this reason the OPA suggests that this station should be built on the existing ROW to the extent that this is practical.

4.4 Longer Term Solutions

The Aurora TS and Gormley TS options are best suited as longer term solutions. If growth for Northern York Region materializes as forecast, and CDM comes in on target, there will be a need for another transformer station near the end of the 10 year study period. The exact timing of this will depend on growth and on the need to provide capacity and new feeders in the areas where load is growing. Because geographic coverage must be provided it will likely be necessary to provide a second transformer station on that basis, even before the first new transformer is fully loaded.

The choice of whether Aurora TS or Gormley TS will be more suitable as a long term solution will be driven by the success of providing local generation in sufficient quantity in Northern York Region. Aurora TS is preferable from a cost perspective and also provides the reduced losses and enhanced reliability offered by a station situated close to the load that it serves. Although preferable, Aurora TS cannot be constructed as a second station connected to Claireville TS unless the required local generation is successfully implemented. Gormley TS is less attractive but remains the best option should local generation not become available.

The Aurora TS option is preferred as the long term solution due to its lower cost, lower losses, better reliability and consistency with the overall supply plan for Northern York Region.

5 BULK SUPPLY OPTIONS

5.1 Planning Considerations

Traditionally bulk supply to a region was provided either by augmenting transmission capability to enable transmission of electricity from system-wide generation resources, or by building local generation. At the present time the Ontario system is in need of new generation due to the aging nuclear units and the coal phase out. Furthermore, peak demand in Northern York Region occurs at the same time as the provincial generators are at capacity serving the entire province. As a result, local generation is not competing against transmission alone, but rather against transmission plus new system generation.

The need for bulk supply to serve Northern York Region can be met in two ways, either through new local generation or new system generation with upgraded transmission capability into Northern York Region.

5.2 Transmission

The Ontario power grid, developed over the last century, is an integrated transmission system consisting of facilities at 500 kV and 230 kV. There is also a 115 kV transmission network, used as radial supply in southern Ontario due to its limited capability in bulk electricity transmission.

Efficient and reliable transmission of bulk electricity is enhanced by:

1. A high voltage transmission grid that connects major centres in the province, and,

2. Redundancy and alternative routes that provide both reliability and flexibility.

Higher transmission voltages provide better capability to transport electricity over longer distances. Meanwhile, the shorter the required transmission distance, the higher the reliability performance since shorter transmission lines have lower exposures to external elements (*e.g.* lightning). In addition, higher transmission voltages and shorter transmission distance both contribute to reducing transmission losses. A comprehensive set of design, operating, and planning procedures and standards are included in the Ontario electricity market rules, the

Transmission System Code of the Ontario Energy Board, NERC reliability standards, and NPCC operating and planning policies.

5.2.1 Methods of increasing transmission capability

Increase in the transmission capability can be achieved by,

- building a new transmission line on an existing right-of-way;
- building a new transmission line on a new right-of-way;
- upgrading an existing line by replacing the conductors and towers if required; or,
- rebuilding an existing 230 kV double circuit line into a four-circuit line.

The cost of a transmission line increases as the transmission distance increases. The cost of 230 kV underground cables is considerably higher than that of overhead 230 kV lines. Building new lines on new rights-of-way require right-of-way acquisition.

With respect to consolidating and rebuilding on existing rights-of-way, it is important to note that converting a double circuit 230 kV line that is currently in operation for load supply into a four-circuit 230 kV line is very costly. In addition to the high cost of a four-circuit line compared to a double circuit 230 kV line, there are significant costs incurred during the construction stage since temporary by-pass line sections have to be constructed to maintain existing load supply. The temporary by-passes are then dismantled after the new line is placed in service. This methodology would apply to the rebuilding of the Claireville to Armitage corridor.

Similarly high costs are incurred in consolidating and rebuilding the existing 115 kV line that is currently supplying a 115 kV transformer station. In addition to the required bypasses, there are additional costs in either replacing the existing 115 kV transformer station with a 230 kV station, or adding 230/115 kV transformation facilities. These additional capital costs are estimated to be in the $10 million to $20 million range. This would apply to the Essa-Barrie-Armitage corridor.

A number of transmission options including those proposed by the working group involving new rights-of-way and different transmission technologies were evaluated and are discussed in Exhibit D. The two transmission options with the shortest lengths to Northern York Region are described in more detail below and pictured in Figure 5-1. One uses an existing corridor and the other runs from Parkway TS to Armitage TS along Highway 404. The one along Highway 404 represents the general issues and implications of building transmission lines alongside 400-series highways.

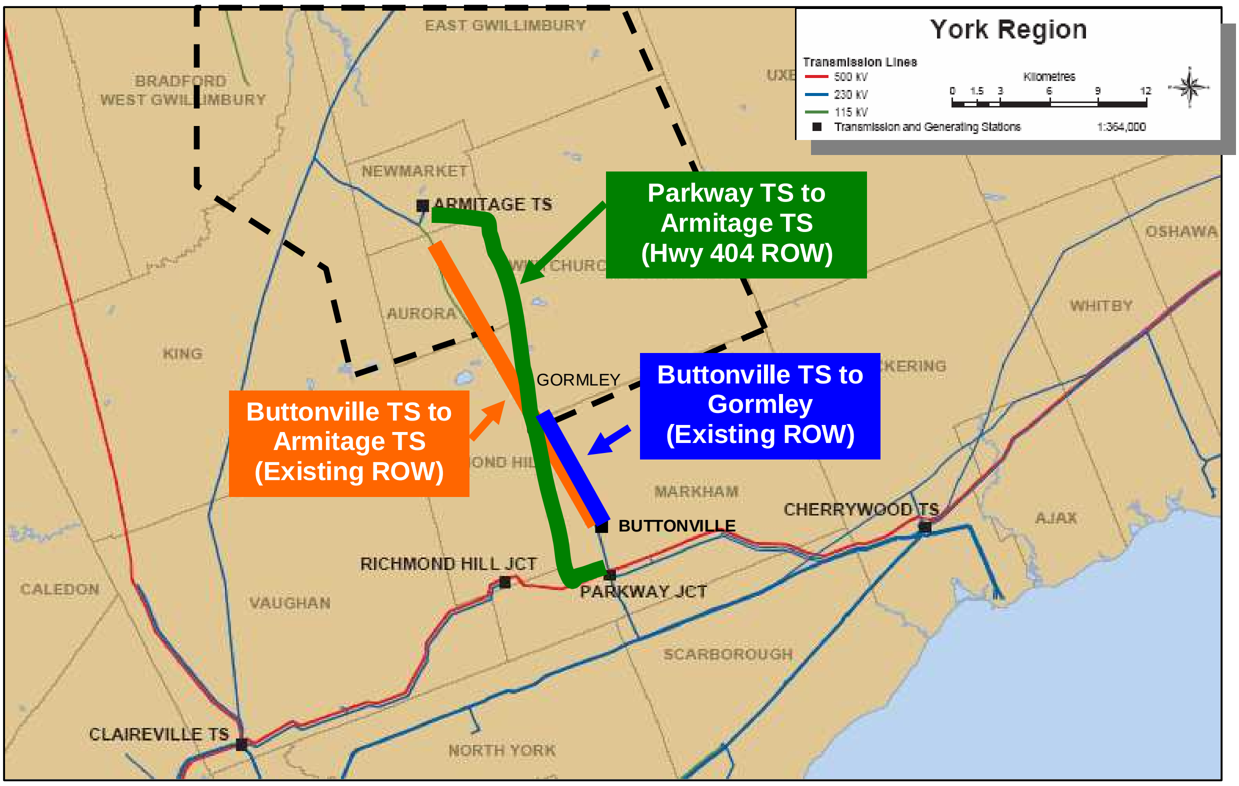

Figure 5-1: Proposed Transmission Routes

5.2.2 Transmission in York Region

Bulk electricity transmission supplying York Region consists of 230 kV transmission lines originating from four major 500/230 kV transformer stations located in northern Greater Toronto Area (GTA): Claireville TS, Richview TS, Cherrywood TS and the newly built Parkway TS. These 230 kV transmission lines transport bulk electricity to nearby load areas in York Region where a number of 230/44/28 kV transformer stations step down the voltages to distribution levels at 44 kV or 28 kV. From there, local distribution companies deliver electricity to their customers via distribution feeders ranging in length from about 20-25 km depending on the distribution voltages.

Since the transmission infrastructure supplying the York Region is based entirely on 230 kV voltage class, the optimum choice of voltage class for new transmission lines is 230 kV. This will optimize efficiency and effectiveness in integrating the existing 230 kV transmission facilities with new ones. Using other voltage classes such as 500 kV or 115 kV would require additional 500/230 kV or 230/115 kV transformation facilities, which have significant cost increases for the 500 kV, and higher transmission losses and lower reliability performance for the 115 kV.

Some Working Group members expressed the view that overhead transmission lines have negative socioeconomic impacts on communities. Most agreed that lines running through non-built up areas were tolerable, while a few indicated concerns about the use of rural land to provide infrastructure for built-up areas. The OPA has noted this view and taken it into consideration, along with the requirement that infrastructure is necessary for growing communities, and usually best placed in existing infrastructure corridors to minimize the impact. As such, the analysis of the transmission options begins with the existing corridors into Northern York Region.

5.2.3 Existing transmission corridors into Northern York Region

There are three existing transmission corridors into Northern York Region, two from the south and one from the north. The first corridor runs north from Parkway TS to Buttonville TS to Armitage TS in Newmarket. The Parkway-Buttonville section, about 3 km in length, consists of a two-circuit 230 kV line supplying Buttonville TS. The Buttonville-Armitage section consists of a single-circuit 115 kV line with the northern portion being used as a 44 kV feeder supplying Whitchurch-Stouffville. The southern portion is being used as a 28 kV feeder to supply Markham. This corridor is about 22 km in length and is wide enough for consolidation by dismantling and replacing the existing 115 kV line with a 230 kV two-circuit line from Buttonville TS to Newmarket.

The second corridor, which currently provides electricity supply to Armitage TS, runs north from Claireville TS to Holland Junction (35 km) and a line tap (8 km) runs from Holland Junction to Armitage TS in Newmarket for a total length of about 43 km.

The third corridor consists of a 115 kV line running east from Essa TS to supply the 115 kV transformer station Barrie TS 11 km away. The line continues in the southeast direction toward Holland Junction in King Township. The section between Barrie TS to Holland Junction is about 36 km and is currently used as a 44kV feeder from Barrie TS as a backup supply for Southern Bradford. The corridor continues in the southeast direction consisting of 8 km of the 230 kV line tap to Armitage TS. The total length of this corridor is about 55 km.

5.2.4 Buttonville TS to Armitage TS

One option to reinforce supply to the north is to upgrade the existing double-circuit 230 kV line from Parkway TS to Buttonville TS and replace the existing 115 kV line from Buttonville TS to Armitage TS with a double-circuit 230 kV line. This 115 kV line is currently used as 44 kV and 28 kV distribution feeders supplying Whitchurch-Stouffville and Markham respectively.

Another transmission option involves upgrading just the line section from Buttonville TS to Armitage TS without changing the line section from Parkway TS to Buttonville TS since its capability is sufficient to meet the identified needs in Northern York Region.

This proposal is to replace the existing 115 kV line running from Buttonville TS to Armitage TS with a double-circuit 230 kV line. This provides Northern York Region with a diversity of supply by connecting a significant portion of the area load to a second source from the transmission grid. The estimated capital cost of this transmission option, assuming overhead line construction, is $50 million.

The community, through the Working Group, expressed considerable concern about this option. Concerns were expressed primarily with regard to its impact on property values, electromagnetic field levels and aesthetics. A discussion ensued about appropriate mitigation measures, and there was a strong view that the line should be buried, at least through urban areas, if not completely. Partially undergrounding the line, for 14 km, would increase the capital cost estimate from $50 million to about $112 million.

5.2.5 Buttonville TS to Gormley

As a variation on the Buttonville TS to Armitage TS transmission option, the OPA has also considered the Buttonville TS to Gormley option, which has similar characteristics except with a much shorter transmission line length of only 10 km compared to 22 km for the Buttonville to Armitage option. The transmission line would end at or near Gormley where a 230/44 kV transformer station would be built to supply Northern York Region. This option has been reviewed and accepted by the three area LDCs, but as a less preferred option because it would involve longer feeders and additional distribution capital costs estimated in the range of $7 million to $9 million more than the Buttonville-Armitage option.

The estimated capital cost of this transmission option assuming overhead construction is $23 million. Assuming 5 km through developed area would be underground, the capital cost estimate would increase to $44 million. If the entire line consists of underground cable, the capital cost estimate would rise to $67 million.

From the overall capital cost viewpoint, the Buttonville-Gormley option is lower by $27 million in transmission costs, assuming overhead line, but higher by up to $9 million in distribution compared to the Buttonville-Armitage option. It does not provide for the same level of diversity, as it does not provide a back up source of power in case of interruption to Armitage.

5.2.6 Highway 404 from Buttonville TS to Armitage TS

One of the alternative rights-of-way proposed by the Working Group was to run from Parkway TS to Armitage TS along Highway 404. This has the benefit over the existing right-of-way in that it minimizes routing near residential neighbourhoods and schools. There are, however, a number of uncertainties and risks associated with using this right-of-way, which are common to the issues surrounding the use of 400-series provincial highway ROWs for transmission lines.

First, routing the line to and from Highway 404 poses considerable difficulty. At the south end, moving from Parkway TS to 404 could be done above ground along an existing right-of-way across the top of the GTA; however, this seriously limits the potential use of that right-of-way in the future since there is only space allowance for one additional line which could otherwise run across the entire GTA. In the alternative, the line could be undergrounded to 404, but this adds significant cost, and also has the potential to interfere with overhead lines, particularly with regard to maintenance access.

Second, given the proximity of 404 to Buttonville Airport, the line would most likely have to be undergrounded in the vicinity of the airport to comply with regulations, adding further cost to the option.

The third and most serious issue is the use of the highway right-of-way itself. The Ministry of Transportation (MTO) representative, in his presentation to the Working Group, indicated that there is no available space along the existing right-of-way to allow for a transmission corridor. Therefore, using the highway corridor would require widening it by expropriating adjacent lands, adding to the cost, uncertainty, and construction time. It is essentially the same as acquiring a new right-of-way that is not parallel to a 400-series highway. Given the risks and capital costs associated with this route, the need for at least partial undergrounding, and the difficulty in getting the line to and from Highway 404, the OPA does not consider that it is a viable option to pursue.

5.3 Local Generation

As discussed in Section 3.1, the performance requirements for supplying Northern York Region include (a) continuous load supply after the first contingency loss of a critical element, and (b) supply security requiring a diverse bulk supply source in the event of loss of the existing main bulk supply from Claireville TS. Local generation is a bulk supply option that can meet these requirements.

To meet performance requirement (a), local generation with a minimum firm capacity of either 60 MW connected to the 44 kV distribution network, or 140 MW connected to the 230 kV transmission network is required. To meet performance requirement (b), local generation with an installed capacity in the range of 200 MW to 350 MW is required. The range captures considerations of security of load supply as well as flexibility for generator proponents to optimize their generation technologies and designs to encourage a future competitive bidding process to attract local generation in Northern York Region. More detail on generation is available in Exhibit E.

5.3.1 Overview of Request for Expressions of Interest (RFI)

Recognizing that generation may provide a solution to the supply problem in Northern York Region, the OPA issued a Request for Expressions of Interest (RFI) for new generation facilities in Northern York Region on May 2, 2005. Given the nature of the problem in the region, the RFI required that generation be firm capacity to ensure it is available at peak periods when it is most needed. Firm capacity is defined as the capacity of a generating plant with the single largest generating unit unavailable. For generators connected to the 44 kV distribution network, the requirement was a minimum 60 MW of firm capacity and for those on the 230 kV transmission network, it was 140 MW. The generator operator is expected to maximize its revenues from the sale of energy-related services and products.

The only specification with regard to fuel type was that it must not be coal; however, other requirements would have eliminated certain fuel types. For instance, wind cannot provide firm capacity without a storage mechanism since there is no guarantee of having wind power available at peak load periods. Other small renewable projects such as solar would be captured as part of CDM. Lastly, there was a preference indicated in the RFI for generation that could be in-service by December 1, 2006.

5.3.2 Response to RFI

Individual responses to an RFI, along with any information that could prejudice potential RFI respondents, are commercially sensitive and therefore confidential. In order to ensure that this evidence to the OEB is made public in its entirety, it is necessary to omit any specific discussion of the RFI responses. The underlying OPA analysis of the supply situation does take into consideration the actual responses to the RFI, even though the details cannot be shared here.

A number of companies with proven track records in generation responded to the RFI with proposals. There were sufficient responses that met screening criteria to provide assurance that there is sufficient interest in building generation in the affected area. Some respondent(s) proposed combined cycle gas generation while other(s) proposed simple cycle.

5.3.3 Types of generation

As part of the generation mix for supplying electricity demand, three types of generation are needed:

1. Baseload generation to supply the continuous requirements of the area;

2. Intermediate generation to ramp up early in the day and shut down in the evening to supply additional daytime loads; and,

3. Peaking generation to start rapidly to meet the few peak hours of a peak day or, to provide immediate capacity support in the event of system contingencies.

Generally speaking, combined cycle gas generation is suited to intermediate duty while simple cycle is more suited to peaking.[5] Combined cycle generation typically has a higher capital cost but a lower operating cost than simple cycle on a $/MWh basis. As a result, it is designed to run more often than simple cycle, and is more efficient when running. Additionally, a combined cycle generator produces lower emissions per megawatt-hour than simple cycle.

Either generator can alleviate the Northern York Region bulk supply bottleneck, and either must be running before a contingency, not after one occurs. If a transmission line fails and the generator is not already running, then voltage collapse will be quick and an interruption to the entire area will occur. Either type of generator must run during peak load periods when a single transmission line cannot carry the area load.

Since the issuance of the generation RFI, further studies by the OPA and input from the Working Group and interested parties have modified a number of requirements in the original RFI. They are:

- Assuming the implementation of the CDM/transformation/distribution options in 2006, the resulting need date for generation can be delayed beyond 2006. However, an early in-

[5] In a simple cycle generator, burning gas is used to spin a turbine which produces electricity and waste heat. In a combined cycle generator, the waste heat is captured and used to spin a steam turbine to produce additional electricity.

service date would still be beneficial in view of the need for additional generating resources for the system in the 2008 to 2011 time frame.

- There is a requirement for the generating units in Northern York Region to be in-service and operating during peak load periods. In times when the units are not operating, they may be called upon to be in-service quickly (*i.e*., in minutes) in the event of system outages or the need to support system voltages.

A study performed by London Economics for the OPA, included as Exhibit G, has confirmed that there is a need in Ontario for peaking generation and elaborated on the range of needs. In locating peaking resources, consideration must be given to the incremental costs for major cost categories such as land, mitigation, fuel supply, as well as the potential for lower economies of scale if a smaller generator is required. For gas generation, the availability of an adequate gas supply will differentiate the cost of generation in one location versus another.

A practical combined cycle generating plant would have to be within the 300-350 MW range to meet the minimum firm capacity requirements of Northern York Region, much larger than would be required to provide a local solution for continuous load supply after the first contingency loss. However, this high range does provide benefits to load supply security in Northern York Region. Simple cycle plants can meet both the minimum requirements, and maintain reasonable maximum size limits. Individual generator unit sizes of less than 50 MW have advantages in reducing total plant size because the loss of one generator is less significant than with larger generator unit sizes. From a technical standpoint, a 230 kV-connected simple cycle generating plant with a maximum size in the range of 200 MW to 250 MW would provide a practical solution to the bulk supply bottleneck, but with fewer benefits on load supply security than a larger combined cycle plant.

5.4 Local Generation vs. System Generation & Transmission

The supply bottleneck can be addressed by one of two ways: new local generation or additional transmission to deliver new system generation to the area. In either case new generation will be required to meet the demands of new load. Determining whether new local generation or new system generation along with upgraded transmission facilities is a more suitable approach depends on the cost of providing transmission to bring new system generation into York Region, and the incremental cost of providing generation locally in York Region.

5.4.1 Economic analysis

Whether building a local generator, or a system generator plus a transmission line, the cost of building the generator is constant. Only the incremental generator costs associated with location and the transmission costs varies between the two. As a result, to compare the economics of the two bulk supply options, incremental location costs and transmission costs were compared. The full report analysing the economics of the two options can be found in Exhibit H. The main distinction factored into the comparison between locating a generator locally versus at the most economical location on the system is the fuel delivery cost. This incremental cost is less for a simple cycle generator than a combined cycle generator since the former is expected to run considerably fewer hours and is smaller, therefore using less fuel. In either case, the incremental fuel cost has the effect of increasing the marginal cost of the unit, reducing the number of hours it is run.

This additional fuel cost to local generation is offset by reduced transmission losses associated with generating power at the most economical location and transmitting it to the local area. Once these costs are accounted for, the difference between the net present value of a new local generator and the net present value of a new system generator and transmission line can be calculated to determine the difference in cost between the options. In this case, the most economical local generator is $40 million to $80 million cheaper than the shortest length transmission option, with the lower end corresponding to an all overhead transmission line and the higher end corresponding to an all underground cable. The economic analysis tends to favour local generation over system generation plus transmission.

5.4.2 Other considerations

Although the economic analysis favours local generation, there are a number of other factors to be considered. One key factor is the availability of gas supply. In this case, because Northern York Region is a summer peaking area, when gas is less in demand, gas supply in the region at peak times is available. Additionally, through the extensive stakeholdering process described in Section 1.4, the OPA identified a greater community acceptance of generation over upgraded transmission facilities. Lastly, local generation provides the benefits of relieving the loading on the four 500/230 kV autotransformers at Claireville TS. Assuming 200 MW of generation would be installed, it would reduce the loading of each autotransformer by approximately 20 MW.

5.5 Conclusion

The OPA believes that the bulk supply bottleneck can be best addressed through generation installed locally. In the event that no successful procurement contract for local generation is concluded, the OPA recommends supplying Northern York Region with system resources and additional transmission facilities. The most suitable option for this case is to upgrade the line from Buttonville TS to Gormley with a double-circuit 230 kV line and build a transformer station at Gormley.

6 RECOMMENDATIONS

6.1 Overview

The OPA has adopted a two-phase integrated solution to meet the growing needs in Northern York Region. The purpose of Phase I is to take immediate actions that will address the supply shortfalls that have been in place since 2002. The intention of Phase II is to provide a solution that will continue to meet the growing needs in Northern York Region. This can be done in one of two ways—through the construction of local generation or the upgrade of transmission capability to the region to bring in system generation that must be installed elsewhere.

One of the key benefits of a two-phase solution is that Phase I provides sufficient time for either generation development or the implementation of a transmission solution to Northern York Region. If one solution proves unworkable, there is still an opportunity to pursue the other.

6.2 Phase I for Northern York Region

Immediate action for the summer of 2006 is to increase the amount of static capacitors at Armitage TS and implement as much of the planned demand response as possible. In conjunction with this, the OPA recommendation is to proceed with the construction of a new transformer station at Holland Junction, along with static capacitors at this station. When complete, this station and the capacitor installations will meet the urgent need providing enough time to develop a solution to address the ongoing load growth. In addition to recommending building new transformation facilities and the required feeders, the OPA will acquire as much DR as economically justifiable and will encourage conservation programs in the region. The effects of this CDM should be monitored at least on an annual basis and the load forecasts updated accordingly to provide better information for the timing of the Phase II recommendation.

6.3 Phase II for Northern York Region

The preferred Phase II solution is to provide local generation within Northern York Region.

One suggestion put forward during a working group session was to have "decision points" and reconsider at the last possible opportunity whether or not generation is still needed and should go ahead or if the load growth has tapered sufficiently through effective CDM or otherwise to eliminate this need. While the suggestion has merit, in the context of a province with a need for peaking generation and the already significant needs of Northern York Region, the risk of developing stranded assets is minimal. Consistent with this, the sooner the generator is available to support the capacity needs in the province, the better. To relieve the supply bottleneck, generation is required to be in service by 2011. However, to provide security of supply to Northern York Region and to augment the bulk supply in accordance with this Phase II recommendation, the OPA will undertake a procurement process to acquire the recommended generation resources in Northern York Region as early as 2008. The timeline will be sufficient to allow proponents to develop quality proposals and for the OPA to ensure a fair and competitive process.

Building new generation requires environmental and/or other regulatory approvals. Although the responses to the RFI for local generation have demonstrated interest in developing generation in Northern York Region, there is nevertheless a risk that this development will not occur. In such a case, the OPA recommends supplying Northern York Region from system resources via a transmission solution. This also requires environmental and/or other regulatory approvals.

Along with the development of either local generation or transmission plus system generation will be the need for another transformer station. This is also required by 2011, but may be deferred by successful conservation and demand management initiatives. Depending on whether the local generation or transmission approach is followed, an appropriate location for this transformer station should be sited and protected for future use. For the local generation solution, the preferred site for a new transformer station has already been identified and is in Aurora, a short distance from Armitage TS. For the transmission solution, the preferred location is in the vicinity of Gormley.

6.4 Responses to OEB

The OPA submits that

1. In Northern York Region

   a. Experience with actual transformer loading at Armitage TS during summer 2005 has demonstrated a shortfall of approximately 53 MW of transformation capacity

   b. In the next 10 years the load forecast shows that there will be a need for an additional 140 MW of bulk supply.

2. As part of a two-phase solution, Phase I involves immediately

   a. Pursuing a target of 20 MW of demand response in addition to the aggressive pursuit of as much CDM as is economic in accordance with OEB Option 4,

   b. Building a new transformer station at Holland Junction in accordance with OEB Option 3, and

   c. Adding static capacitors to the new station at Holland Junction as well as at the existing Armitage TS to improve voltage stability.

3. Phase II involves

   a. Procuring local peaking generation in accordance with OEB option 4 to be online no later than 2011 but preferably earlier, by 2008 if possible, and constructing a transformer station in Aurora by 2011 or later if the need is deferred by CDM, or,

   b. In the alternative if no generation procurement contract is concluded, developing new transmission facilities from Buttonville to supply Northern York Region with system resources and building a new transformer station in the vicinity of Gormley by 2011, or later if the need is deferred by CDM.

7 REGULATORY APPROVALS REQUIRED

The OEB, in its letter dated July 25, 2005, stated that it may determine, once it has reviewed the OPA's evidence, that one or more of the options recommended by the OPA are necessary. If so, the OEB states that "there will be a subsequent regulatory process to direct or authorize the preferred option". The letter notes the OEB's power to order that a transmission or distribution option be implemented. It also addresses the power of the OEB to approve the recovery by the OPA of its costs under contracts to procure supply, capacity or demand response prior to an OEB approved Integrated Power System Plan and procurement process being in place.

The OPA will be guided by whatever process the OEB adopts with respect to the OPA's proposals for transformer stations and static capacitors. With respect to the procurement of local peaking generation proposed by the OPA, the OPA will apply to the OEB for recovery of its costs under this contract, if and when the OPA has entered into such a contract following a successful procurement process. Any such contract that the OPA enters into will be subject to obtaining the necessary approval from the OEB.

The procurement of demand response is part of the OPA's Phase I recommendation and so is on a faster time-line than the procurement of generation. The OPA intends to act under the Minister's direction contained in his letter to the OPA dated June 15, 2005 to contract for "250 MW or more of demand side management and/or demand response initiatives across the province" in procuring demand response in York Region. In acting under the authority of this directive, no OEB approval of the costs related to such contracts will be required.