The Management of Minimum Load Conditions

BACKGROUND

The management of minimum load conditions is required when Ontario's electricity production from typical baseload facilities such as nuclear units, other energy sources that cannot be stored (must run hydroelectric units), and other non-dispatchable generation (i.e. wind, solar) is greater than the market demand. This condition typically occurs on a "global" basis although this condition can also occur in localized areas in the province if associated with limited transmission or transfer capabilities.

The phasing out of coal and the general reduction in the proportion of manoeuvrable generation in Ontario's supply mix is resulting in a change in the flexibility and manoeuvrability of the fleet of resources utilized by system operators in balancing the energy needs of the province. With a supply mix consisting of nuclear units, increasing amounts of embedded and renewable resources as well as conservation, a larger baseload generation mix will exist in Ontario than what is seen today. As baseload/non-dispatchable generation will form a large percentage of the total generation mix in Ontario, we expect that during hours of low demand and transmission constraints, the IESO will have to look to manoeuvring this, otherwise non-dispatchable, generation in order to manage minimum load conditions. The principles of this paper will cover the sharing of dispatch between nuclear, spilling water and non-dispatchable resources (i.e. wind generation), as these will have the largest impact during these periods of concern. Other embedded generation, such as biomass, need to be considered to the extent it impacts the available options for minimum load management. The review will also take into account secondary issues that may exacerbate the minimum load conditions.

In the past and on several occasions of late, the IESO has dispatched nuclear units to manage minimum load conditions. In other instances generators have chosen to reduce supply on their own accord during conditions of anticipated low loads. Given the expected frequency, magnitude and duration of minimum load conditions expected in future years the IESO has initiated a review of the management of low load periods. The review will help guide the IESO's development of a policy regarding the principals for minimum load management. The IESO's review will be based on the following criteria:

1. Operability and Reliability
2. Implications to the Environment
3. Allocative Efficiencies

Although the IESO has articulated some of its thinking in these areas, stakeholder input is being sought to ensure the accuracy and appropriateness of the review and subsequent policy.

OPERABILITY AND RELIABILITY

Nuclear – Nuclear generators are classified as dispatchable. While this classification enables manoeuvrability from nuclear units, there are reliability concerns around dispatching off a nuclear generator or manoeuvring a generator at a high frequency. There is a possibility that over time, if not during a single move, the nuclear units may be damaged and unable to supply baseload generation. Furthermore, excessive manoeuvring of a nuclear unit may decrease the overall life of the unit, thus the long term reliability of the resource.

Although some manoeuvring is possible some nuclear facilities have regulatory requirements that restrict the online manoeuvrability and this can lead to the need for complete shutdown and associated implications. Implications relating to market impacts are discussed in later sections. The operability impact relates to the generic return to service timeframe of a nuclear unit after shutdown, which is up to 72 hours or more. With nuclear generation representing a majority of Ontario's generation and baseload generation, this minimum down time can be a reliability concern to the IESO and moving one of these units needs to be evaluated against potential losses to other generation. In addition, the minimum down time may result in higher costs to consumers. These costs will generally be in the form of higher on-peak electricity prices when nuclear generation is removed from service.

Hydro - Hydro generators can have safety implications which may limit spilling or result in spilling delays. Once spilling, hydro generators can have minimum spill times which limit the IESO's ability to load follow (lose 5 minute dispatch capability). Hydro units may not be able to respond quickly enough to help alleviate the surplus conditions. Once in spill, the hydro generator may spill as much as needed

(with no equipment concerns) so long as the spillways are sufficient and there are no regulatory concerns. Over the last few years, water flow regulations (i.e. elevation requirements) have been tightening.

Non-dispatchable Renewable Generation (Wind as an example) - Today, the IESO has limited control over the dispatch of wind generation except to call the generator to go offline for reliability purposes. If the renewable generator is a market participant, the IESO can dispatch them off, while if they are not a market participant, the IESO can order them to disconnect for reliability concerns. When the reliability concern no longer exists, these wind generators can come back online as long as the wind is blowing. There are no known equipment limitations that we are aware of, at this time, with taking most renewable resources offline.

IMPLICATIONS TO THE ENVIRONMENT

Nuclear - When nuclear units are manoeuvred, there are market participant stated concerns with potential violations of thermal emission constraints with the plant's cooling system.

Hydro - If the spill is delayed, the water will back up and may reach an environmental limit and the hydro unit will be forced to flow. Some flooding concerns may exist during certain times of the year due to icing conditions downstream of spillways.

Non-dispatchable Renewable Generation (Wind as an example) - There are no known implications to the environment as a result of dispatching down wind generation.

In addition to these issues, loss of nuclear or hydro generation for prolonged periods of time may result in other, more environmentally unfriendly (i.e. green house gas emitting) generation to be committed. As an example, a 72 hour shutdown of a nuclear unit may result in gas/coal unit commitments in future hours.

ALLOCATIVE EFFICIENCIES

More Expensive Energy

While dispatching down nuclear units may be efficient from a static, single hour perspective, it may be inefficient when considered dynamically over multiple hours. During the period of shutdown, the nuclear unit will be unavailable for dispatch and other, more expensive generation will be dispatched, likely resulting in a much higher real-time price. Alternately, dispatching off an alternate, more flexible source would only be for the hours specified, not impacting the market price and guarantee programs (Spare Generation On-Line (SGOL), Day Ahead Generation Commitment Guarantees (DAGCG)) for extended lengths of time.

Examples of secondary issues include:

Commissioning Units

The existing Market Rules have commissioning generating units classified as self-schedulers. This indicates that a commissioning unit will be permitted to be generating while nuclear generation is manoeuvred and hydro generation is spilled. Due to the potential reliability concerns noted earlier, it may not always be appropriate to have these units commissioning while baseload is being manoeuvred. A long term view, however, needs to be considered as incomplete commissioning may delay a much needed resource in the weeks/months to come. As an example, delaying a commissioning unit in the spring to avoid a nuclear reduction or wind/hydro spill may cause the need for emergency control actions due to shortages in a high demand period where the commissioning unit would have otherwise been available.

Real-Time and Day Ahead Guarantees

Real-time and day ahead guarantees such as spare generation online and generator cost guarantees (SGOL and GCG respectively) were put in place to enhance and support reliability, meaning there would be generation online when there are expected shortages. Today's procedures have more expensive generation coming online while baseload generation, such as nuclear and hydro, are manoeuvring down or spilling. Without an optimized solution, the myopic nature of these programs is

having the reverse affect than what was originally envisaged. These actions are, arguably, now creating negative impacts to the nuclear fleet, as intermediate generators with minimum run time constraints extend into low load period operations.

MOVING FORWARD

It is the IESO's current thinking that in order to manage minimum load periods appropriately and maximize the penetration of renewable resources on the system, changes to the current policies are required. Based on the operability/reliability, environmental and market impacts discussed in this paper, the IESO is undertaking a policy review that addresses local or global minimum load periods and the resources to be dispatched down or curtailed based on the facilities that make the most sense from the perspective of these 3 principles. Depending on the scenario, this could mean nuclear shutdowns for long term surpluses and/or renewable reductions for short term scenarios.