## ISSUE 19: NODE LOSS FACTORS

**Date Raised**
Late 2002.

**Description**
The node loss factor represents the increase in total system losses (or line losses) when an extra one MW is injected at that node. The node loss factor is used to calculate the node penalty factor [PF = 1.0/(1 – loss factor)]. In both the predispatch and real-time constrained sequences, the node penalty factors are used in the objective function formulation where they adjust offer and bid prices during the dispatch calculation to account for the losses.

These loss factors are fixed quantities established by the IMO, and may be reviewed and revised by the IMO from time to time. The factors are generally positive for over-generated areas and negative for under-generated areas. The magnitude of the loss factors depends on the degree of over/under generation and the electric distance between the node and the load centre (reference bus).

Nodes with positive loss factors (over-generated) would have penalty factors greater than one. The prices of dispatchable resources at these nodes will be adjusted (multiplied by the penalty factors) to a higher value. They have to offer/bid lower prices than dispatchable resources at nodes with negative loss factors in order to be dispatched.

The loss factors for dispatchable loads are all set to zero to facilitate appropriate treatment of the non-dispatchable portion of their consumption.

**Background**
In the original design of the Dispatch Scheduling and Optimisation (DSO) program, the loss factors and the penalty factors were calculated in each Network Constrained Dispatch (NCD)/ Network Security Assessment (NSA) iteration (i.e. every time constraints are linearized – about 4 times in each run of each constrained sequence). During market testing, it was noted that, due to the change in loss factors, erratic dispatches are produced. Some dispatchable resources at a station are dispatched up while other resources with the same offers at the same station are dispatched down between intervals. Dispatch instability during periods of shortfalls or near shortfalls in market sources of operating reserve were being experienced. As well, some market participants desired predictable (preferably fixed) penalty factors to enable them to formulate offers so as to achieve specific dispatch of their resources.

Prior to market launch, the Market Rules were amended to allow the use of fixed loss factors. Identified as a temporary solution, the use of fixed loss factors has been continued. They have been updated only a few times since market opening.

**Why a Pricing Issue**

The true loss factors within the power system change continuously. They depend on system configuration, outages and load and generation patterns. Loss factor magnitude will change and for some nodes the sign of the loss factors may change from positive to negative or visa versa, particularly as flows on the underlying transmission paths reverse.

The use of fixed loss factor in the dispatch process potentially produces less efficient (higher cost to market) dispatch.

The IMO-controlled grid is physically dispatched to meet actual losses in real-time. The main impact of using a fixed set of penalty factors is the possibility that the dispatch could have been adjusted to further reduce total losses. This results in increased CMSC payments to some market participants. The original formulation, although theoretically correct, provides the potential for only a very small reduction in losses[1] (in the order of tens of MW, or about 0.1 % of loads). Given the uncertainties in the load forecast, the inability of generators to be 100% compliant in following their dispatch instructions, and the approximations in the DSO modelling, it is anticipated that this loss minimisation is unlikely to be achieved in practice.

**Impacts of Issue**

*Market Impact*

The use of fixed loss factors impacts the principles of efficiency and transparency. The use of incorrect loss factors results in potentially inefficient dispatches with higher total cost to the market.

[1] Transmission losses across the entire IMO-controlled grid are typically 2% to 3% of total system load. Assuming a system load of 20000 MW, these total system losses would amount to 400 MW to 600 MW. IMO simulations of selected peak-load conditions similar to those experienced in summer of 2001 showed losses in the range of 700 to 850 MW, corresponding to 3.1% to 3.3% of load. However, only a fraction of the total losses can be influenced by re-dispatching generation. (e.g. reducing 1100 MW of purchases from Michigan and New York by scheduling an equivalent amount of generation in central Ontario results in a change in losses of 30 MW, for a 2200 MW re-dispatch.). In addition, the lowest cost dispatch often does not coincide with minimal losses. A generator that increases losses may be offering at a low enough price to overcome the cost of the extra losses.

The IMO staff set these loss factors based on offline studies. Using loss/penalty factors calculated by the DSO based on existing system conditions would make the dispatch process more transparent.

*Participant Impact*
[to be developed]

*IMO Processes and Procedures Impact*
Minor changes to the DSO to calculate and use a more frequent update of the loss/penalty factors.

**Related Issues**
018: Pricing and allocating line losses
002: Publishing nodal price data
016: Historical analysis of nodal prices