AIP All Island Project

SEM TRADING AND SETTLEMENT CODE

Proposed
MSP Software Parameters
for the
First Trading Year

CONSULTATION PAPER

9 August 2007

AIP/SEM/07/439

Background

The SEM Trading and Settlement Code (TSC) was commenced on 3rd July 2007, when the Framework Agreement was signed by the original signatories.

The TSC specifies that the Market Operator shall make a report to the Regulatory Authorities proposing five parameters relating to the operation of the MSP Software at least four months before the start of each Year[1]. The parameters concerned are:

1. The Over-Generation MSP Constraint Cost;

2. The Under-Generation MSP Constraint Cost;

3. The Aggregate Interconnector Ramp Rate MSP Constraint Cost;

4. The Energy Limit MSP Constraint Cost;

5. The Tie-Breaking Adder.

The Regulatory Authorities have now received the Market Operator's report which is included in this paper as appendix 1. In addition, the Market Operator proposes that the value for the Tie-Breaking Adder shall be 0.001. The Market Operator's proposed value for the Tie-Breaking Adder may need review dependent upon the Regulatory Authorities' determination of the value for the Market Price Cap. This is because there is a limitation on the maximum number of significant digits that can be handled by parts of the central systems and the total number of significant digits in the Market Price Cap and the Tie-Breaking Adder together cannot exceed this limit.

The purpose of this consultation is to seek views from participants on the Market Operator's proposals. The Regulatory Authorities welcome all comments on the Market Operator's proposed value for the Tie-Breaking Adder and the proposals set out in Appendix 1 of this paper. Comments should be sent, preferably in electronic form, to:

Philip Newsome,
Commission for Energy Regulation,
The Exchange,
Belgard Square North,
Dublin 24
pnewsome@cer.ie

The closing date for comments is Thursday 6th September 2007.

[1] See TSC paragraph N.25.

Next Steps

The Regulatory Authorities will provide all comments received to the Market Operator and will seek its responses to those comments. On the basis of that information and the comments on the consultation, the Regulatory Authorities will reach their decision on the values that should be used for the parameters concerned for the First Trading Year. It is intended that all comments and the Market Operator's responses will be published and it is therefore preferred that any comments received are not indicated to be confidential. Any party that wishes any part of its comments to be kept confidential should clearly indicate which parts of the comments are confidential. Once the Regulatory Authorities have provided their decisions to the Market Operator, the approved values will be provided to the Market Operator and published in accordance with paragraph N.27 of the TSC.

Appendix 1

SMO Market Operations

Introduction

The core algorithm of the market attempts to optimise for a non-linear mixed integer constrained objective with non-linear constraints. Occasionally the mathematical problem posed may be infeasible (i.e. there is no solution that satisfies all the constraints). In these cases rather than return no answer it is customary in numerical solutions to produce an answer where some of the constraints have been breached slightly. To achieve this slack variables are introduced with suitably chosen coefficients that make it only possible for these variables to be only used in the cases of infeasibility. In addition the setting of these coefficients can prioritise the order in which constraints will be breached for a given situation.

The methodology proposed below has been used combined with data that has been supplied in market trial to estimate the correct value of these coefficients. The SMO proposes these values of coefficients as reasonable proxies for what is likely to be required in live operation.

Calculation of Rounded Values to Enter in UUC
These values are based on those in Part G but are converted in to rounded values

Entered values:

Over generation penalty =	73
Under generation penalty =	73
Interconnector ramp penalty =	292
Energy limit penalty =	38

The following are the values for the RA's to publish (in which factor in an additional factor of 5 applied by the UUC))

Over generation penalty =	**365**	***× maximum daily bid price***
Under generation penalty =	**365**	***× maximum daily bid price***
Interconnector ramp penalty =	**1460**	***× maximum daily bid price***
Energy limit penalty =	**190**	***× maximum daily bid price***

How the UUC Handles Penalties

The UUC includes 20 price-quantity pairs for each constraint that can be violated. For each step a price and quantity is set by the operator. The prices must increase between the steps that are used and the quantities must increase (being cumulative). However, the price of the last bid step used is multiplied by a factor equal to 5 times Max(0.1, greatest bid price for the day). Regardless of what bid quantity is set for the final step, the UUC internally imposes no limit on the quantity that can be scheduled from the final step.

The proposed methodology for setting the penalties is to use just one bid step and enter a relatively low penalty factor in the cost field. This factor effectively sets the penalty used internally to be that factor multiplied by 5 and multiplied again by the greatest bid price during the day (assuming that bid price exceeds 0.1). This approach results in penalty values that vary from day to day. E.g.

- Set first bid step price to be 100, and first bid step quantity to be zero (this is allowed only for the last bid step used). Ignore all other steps.
- Suppose the maximum bid price for the day is 875.

- The effective penalty will be 5 × 100× 875 = 4375, the quantity of violation allowed will be infinite.

The specific penalty functions are:

- The cost of under-generation. The quantity scheduled is the amount by which the generation requirement exceeds scheduled generation. The penalty cost applies each trading period on a per MW rate of violation.
- The cost of over-generation. The quantity scheduled is the amount by which scheduled generation exceeds the generation requirement. The penalty cost applies each trading period on a per MW rate of violation.
- The cost of violating interconnector ramp limits. A single ramp rate applies for the Moyle Interconnector. This can be violated in either direction, i.e. increasing or decreasing flow between trading periods beyond the allowed ramp rate. The penalty cost applies each trading period on a per MW rate of violation.
- The cost of violating energy/reservoir limits.   This penalty applies to the MWh (not MW) violation of energy limits, maximum reservoir levels and minimum reservoir levels.

Relationships between Penalties

Setting penalties is not arbitrary. If the penalties are set incorrectly then constraints could be violated simply because it is cheap to do so rather than because there is no feasible solution. In other words we do not want penalties used for purely "economic" reasons.

Under-Generation

The under-generation penalty will be economic to use if it is cheaper to not supply demand than to generate. Thus the penalty must at least cover the maximum per MW cost that could be incurred in a single trading period by generating. This cost is assumed to correspond to starting the most expensive possible unit and running it for that one period. We set this cost based on the following assumed levels:

- For the contribution of start up costs we use the highest value of (start up cost / minimum stable generation) for any generator. This is used to cover the possibility that the generator starts and then runs at its lowest possible level, so that the per MW start up cost is maximised. We use the full start up cost if the unit has zero minimum stable generation. The result is MAXSU.
- For no load cost a similar approach is used but with the no load cost replacing the start up cost. The result is MAXNL.
- For the incremental bid cost, an estimate of the maximum bid must be used. This is assumed to be the market price cap. The result is MAXBID.
- An additional safety margin factor SMF1 is applied.

This defines the maximum avoidable cost as MCAUG = (MAXSU+MAXNL+MAXBID) ×SMF1.

In addition, the penalty for under-generation must exceed the market price cap (MCAP).

So the minimum value of the under-generation penalty is OGP = Max(MCAUG, MCAP]

Over-Generation

Over-generation tends to be associated with very low prices. It might therefore be thought that a relatively low penalty might discourage over-generation for economic reasons. This is not true. The worst case scenario is that over-generation is incurred for a single trading period so as to avoid turning a generating unit off for one period and then back on for the next period. By leaving the unit on a minimum loading we can avoid a start up, and may be able to back off a second unit further. Hence MCAUG determine above will be a good upper bound estimate of the avoided cost.

The under generation penalty must also exceed the absolute value of the Market Price Floor (MFLOOR) which could be negative.

So the minimum value of the over-generation penalty is the maximum cost avoided for under generation, MCAOG = MCAUG

The minimum value of the over-generation penalty is UGP =Max(MCAOG, abs(MFLOOR)]

I.e. the penalty for over-generation should match that for under-generation assuming MFLOOR is not the critical factor.

Interconnector Ramp Limits

1 MW of violation of a ramp rate allows a different level of flow through the remainder of the optimisation time horizon. Thus violating the ramp rate from the start of day level to the first period level by 1 MW actually allows 1 MW more to be flowed for all 60 periods. The implication of this is that the penalty for ramp violations need to be significantly higher the penalty on under and over generation. The scaling factor used is IRCLF, which should ideally be greater than 60.

What is the biggest cost change that could stem from a ramp rate violation? Conceptually it could take us from over-generation to under-generation for all 60 periods.

But if we are in over-generation, we have an energy shortage, and we would only violate an interconnector ramp limit to increase imports but the cost of this must be no more than the cost of over-generation else we would not increase imports. If we are in under-generation, we have an energy surplus, and we would only violate an interconnector ramp limit to increase exports but would only do this if this cost no more than the reduction in the under-generation penalty cost.

Hence the basic cost unit for the ramp limit penalty is max(OGP,UGP) × IRLCF.

Setting IRLCF to a value higher than 60 (e.g. 62) should ensure that if MCAUG and MCAOG have been set appropriately then interconnector ramp limits will not be violated until after over-generation or under-generation has occurred.

In practice the Moyle Interconnector has a ramp limit of 10 MW/minute or 300 MW over a trading period. As the Interconnector only has a range of flows of around 480 MW, it could ramp from one extreme to the other in 2 trading periods. Consequently, the scaling factor may only need to be 2 rather than 60. However, as there is always the possibility of the interconnector’s ramp limit changing, a value of 4 trading periods is considered a safer margin, and is the value used in determining the recommended parameters.

Energy/Reservoir Limits

These limits are applied on a MWh basis. Hence to accumulate 1 MWh of energy limit penalty, we need to accumulate 2 MW of over-generation or (in the case of minimum reservoir limits) under-generation. Hence the Energy Limit scaling factor ELSF only needs to be more than 0.5.

Hence the basic cost unit for the energy limit penalty is max(OGP, UGP) × ELSF.

Energy Limit vs Interconnector Ramp Violations

We set ELSF to be 5.2 and IRLCF=4 . The value of ELSF=5.2 gives some safety margin above the minimum value required. A safety margin is already factored in to IRLCF =4. The logic for setting the interconnector ramp penalty is far more conservative than that for the energy limit, and consequently setting each factor to near its minimum value will almost certainly always result in the energy limit being violated before the interconnector ramp limit (assuming there is a choice).

This is probably a desirable solution as it will result in the Moyle Interconnector being scheduled ex ante to always be within its technical limits. If an energy limit is violated ex ante this does not matter so much as this is not a schedule requiring settlement. In ex post schedules the interconnector ramp limit should not be an issue because it should already be factored into modified interconnector user nominations.

Penalties to Enter into the UUC

To convert the above penalties into a form applicable for METHOD1 we must divide the calculated penalties by 5 times the maximum expected bid for the day.

All of the equations above have been derived based on some assumed maximum bid price where the aim has been to over estimate that cost for certainty. We set MAXBID = MCAP.

However at this point we want to consider the fact that what ever value gets entered into the UUC screens will be scaled by 5 times the actual maximum bid on a day. This will not necessarily be our assumed MAXBID. An undesirable scenario would be one where we converted the above penalties based on MAXBID, only to find that the maximum bid for an actual day is so low by comparison that the penalty is insufficient to stop economic violations (e.g. because of high start up costs). To avoid this, we must assume a MINMAXBID value, representing the minimum value expected for the maximum bid on any given day.

For each penalty function we use one bid step with quantity of zero and a price of:

- Under generation = UGP/5MINMAXBID
- Over generation = UGP/5MINMAXBID
- Interconnector Ramp = IRP/5MINMAXBID
- Energy Limit = ELP/5MINMAXBID