“Straw Man” On Zonal Contingency Reserve

Step 1: Initial Congestion Clearing for Energy Schedules

a) Import all nodal injections and withdrawals from the “balanced schedules” for a Scheduling Coordinators (SCs) into the nodal transmission system model (i.e. power flow base case) to forecast actual flows on all lines and transformers.

b) Run through full nodal analysis to determine the least cost method of clearing all congestion (i.e. relieving all overloads). This means that the RTO will start into the inc and dec markets, using up the lowest priced options (which makes them unavailable later).

Step 2: Determining Zonal MSSCs

a) Determine the generation (i.e. net injections) at each node.

b) Using the defined zonal boundaries, determine which zone each generation node is located in.

c) Find the total generation loss for each predefined contingencies (single contingencies and reasonably likely multiple contingencies).

d) Using the defined zonal boundaries, the largest total generation loss in each zone becomes that zone’s MSSC. (This assumes that there are no defined contingencies that cause generation loss in more than one zone.)

Step 3: Assigning Contingency Reserve Responsibility back to SCs based on Contributions to Zonal MSSCs

a) Contingency reserve responsibility for each generator is based on:

a.1 Scheduled output in relation to the MSSC of its zone

a.2 Number of other generators within that zone that “share” that impact on the MSSC.

b) See the “Contingency Obligation” spreadsheet.

Step 4: Selecting Contingency Reserve from Zonal Markets

a) Generators bid contingency reserve into the zone they reside in.

b) Contingency reserve bids are for capacity only; must be “price takers” for any energy delivered.

c) The RTO must select enough contingency reserves to respond to the MSSC in each zone (plus some safety factor?). This does NOT mean that the contingency reserve to meet a zone's MSSC must reside in that zone.

d) Contingency reserves can be "shared" amongst zones.

d.1 The flow changes (to what was already forecast on the basis of the SC "balanced schedules") on lines and transformers connecting zones to each other (i.e. inter-zonal elements) are taken into account.

d.2 If these flow changes result in additional congestion (i.e. the flow changes increase flow across any inter-zonal element beyond its limit), then the inc/dec costs of clearing this congestion ARE included in the contingency reserve cost.

d.3 Any additional congestion inside the zones is ignored.

e) The RTO selects the least cost combination of contingency reserves across all zones that meet the RTO's reliability goal (see c). Least cost includes the cost of the contingency reserve capacity (is this marginal pricing?) and the cost of any resulting congestion clearing.

f) See the "AncMarket" spreadsheet.

f.1 Because the SC "balanced schedules" might not be truly "least cost" (in the sense that there may be inc bids, dec bids, and uncongested transmission that could be consummated to immediately lower overall costs), the spreadsheet optimization tries to minimize redispatch (by minimizing the inc/dec dollars changing hands) as well as contingency reserve costs. This is still an issue that RTO West needs to address.

f.2 Depending on the market bids, it's quite possible to have many "solutions" that are equally good. The spreadsheet shows just one of these. The RTO would want to add more criteria to improve the selection, perhaps including a preference for "self-provision" based on which SCs have obligations.

Step 5: Congestion Clearing for the Selected Contingency Reserves Using the Nodal Model.

a) The RTO-selected contingency reserves are moved back into the nodal model.

b) Again (as in Step 2: c), the total generation loss for each predefined contingencies (single contingencies and reasonably likely multiple contingencies) is modeled.

c) The range of possibilities to make up for each generation loss with the RTO-selected contingency reserves is explored. Congestion clearing costs (which now include both the inter-zonal and intra-zonal) are tracked.

d) After exploring all the generation loss contingencies and reserve response possibilities, the RTO identifies the least cost alternative for clearing congestion that allows the RTO-selected contingency reserves to cover all of the generation loss contingencies (one at a time).

d.1 The inter-zonal portion of the congestion clearing costs (that are less than what was calculated in Step 4) are added to the capacity costs of the RTO-selected contingency reserves to be assigned back to those with contingency reserve obligations. I have no idea how to do this yet.

d.2 The intra-zonal congestion clearing costs, along with any increase in inter-zonal costs, are absorbed by the RTO.

Step 6: The RTO Commits to Congestion Clearing for Both Energy and Contingency Reserves.

a) Congestion clearing for contingency reserve responses must be done in advance.

b) Congestion clearing for contingency reserve responses will result in physical “room” across lines and transformers.

c) Establish preliminary nodal pricing at each bus.

c.1 Is this marginal price, or is this some sort of average price?

c.2 Is this pricing based on just the congestion clearing for “balanced schedules” in Step 1? Or does it include the congestion clearing for contingency reserves too?