Dynamic Transfers

Preliminary Formulation of Software Function for Transmission Reservation

Provided in Support of 2009-2011 Stakeholder Process to Consider Expansion of Dynamic Transfer Services in ISO Tariff

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Comments in this stakeholder process have asked for additional information concerning how the separation of energy schedules and transmission capacity may be implemented in the ISO's market software, through the addition of a bid component for transmission capacity that may exceed the awarded energy schedule. The ISO has had preliminary discussions with its software vendor concerning the software formulation for including this bid component in the market co-optimization, and offers the following description. The principles describing this market function are first reviewed in the section on "Dynamic Transfer Capacity". This is followed by the description of the optimization's objective function in the "Optimization Changes" section, and then by a description of the changes in constraints in the "Existing Physical Inter-Tie Constraints" and "Proposed Physical Inter-Tie Constraints" sections. It must be recognized that refinements in the formulation of the market optimization may occur during implementation of any new software feature.

Dynamic Transfer Capacity

1. The aim of the transmission capacity is to reserve transmission capacity for the dynamic schedules in the DAM, HASP, and STUC and not in RTD process.
2. The Transmission capacity will be modeled as a capacity commodity for which the market participant owning the dynamic resource can submit an economic bid.
3. The range of the economic bid for this commodity can be more than the range of the energy bid submitted for the dynamic resource but less than the registered physical capacity.
4. The Transmission capacity bid will be tied to the Energy bid on the dynamic resource or in other words participants can not submit a transmission capacity bid in the forward and real time market without a corresponding energy bid.
5. The transmission capacity bid will be a single segment bid
6. The transmission capacity can not be self-scheduled by the participants.
7. Like the other Ancillary Service commodity the transmission capacity will have a senior market dependency or in other words if there are transmission capacity procured in the DAM process those will be protected in the RTM process by using appropriate penalty and will be re-optimized based on the real time bid.
8. The transmission capacity will not be subjected to buy back.
9. There will not be any regional or system requirement defined for the transmission capacity.
10. The Inter-tie constraints will be enhanced to accommodate the newly defined transmission capacity.
11. The existing mechanism for enable/disable of a commodity for participating in the market will be expanded for the transmission capacity commodity.

12. In the real time the Transmission capacity will be cleared by the HASP/STUC/RTPD. In RTD the inter-tie limit will not be reduced by this cleared amount unlike the other ancillary service.
13. The transmission capacity is directional and does not provide counter flow capability similar to other ancillary services. So basically the import and export direction transmission capacity do not net with each other.
14. The resource capacity constraints will be modified to include the Transmission capacity.
15. The resource ramping constraints for energy will not be limited by the transmission capacity awards (simplified ramping)
16. The transmission capacity will not be subjected to pro-rata processing that is applied to energy for hourly ties.
17. The transmission capacity can not be associated with a wheeling transaction
18. The transmission capacity can not be awarded as a block transaction
19. The transmission capacity award is calculated differently that the other ancillary services i.e. when the others are considered incremental relative to energy other ancillary service the transmission capacity is considered absolute relative to zero.

Optimization Changes

1) The cost of the transmission capacity will be added to the objective function. The sign will be negative in other words it will be treated as an income contrary to other ancillary services that are treated as expenses.

   Objective Function = (Other Terms) - (TC – EN) TC $_{bid}$

           TC: Transmission Capacity variable of Dynamic Resource
           EN: Energy variable of Dynamic Resource
           TC $_{bid:}$ Bid price of the Transmission Capacity.

2) The resource capacity constraints will be modified. The appropriate limit (Economic, regulating or operating) will be applied.
3) The Inter-tie Constraints will be modified as illustrated. For the sake of brevity the physical constraints are listed below. The full constraints involving convergence bidding in IFM are affected analogously.

Existing Physical Inter-Tie Constraints

$$\max\left\{0, En_{Imp}^{t} - En_{Exp}^{t}\right\} + Reg_{Imp}^{Up;t} + Reg_{Exp}^{Dn;t} + Res_{Imp}^{t} + NRes_{Imp}^{t} \leq F_{Imp}^{OTC}; \quad t \in T$$

Each of these constraints is equivalent to the following two linear constraints:

$$En_{Imp}^{t} - En_{Exp}^{t} + Reg_{Imp}^{Up;t} + Reg_{Exp}^{Dn;t} + Res_{Imp}^{t} + NRes_{Imp}^{t} \leq F_{Imp}^{OTC}; \quad t \in T$$

$$Reg_{Imp}^{Up;t} + Reg_{Exp}^{Dn;t} + Res_{Imp}^{t} + NRes_{Imp}^{t} \leq F_{Imp}^{OTC}; \quad t \in T$$

The inter-tie transmission constraints in export directions are posted in a similar way:

$$\max\left\{0, En_{Exp}^{t} - En_{Imp}^{t}\right\} + Reg_{Exp}^{Up;t} + Reg_{Imp}^{Dn;t} + Res_{Exp}^{t} + NRes_{Exp}^{t} \leq F_{Exp}^{OTC}; \quad t \in T$$

This constraint can be split into two equivalent linear constraints:

$$En_{Exp}^{t} - En_{Imp}^{t} + Reg_{Exp}^{Up;t} + Reg_{Imp}^{Dn;t} + Res_{Exp}^{t} + NRes_{Exp}^{t} \leq F_{Exp}^{OTC}; \quad t \in T$$

$$Reg_{Exp}^{Up;t} + Reg_{Imp}^{Dn;t} + Res_{Exp}^{t} + NRes_{Exp}^{t} \leq F_{Exp}^{OTC}; \quad t \in T$$

Proposed Physical Inter-Tie Constraints

$$\max\left\{0, En_{Imp}^{t} - En_{Exp}^{t}\right\} + Reg_{Imp}^{Up;t} + Reg_{Exp}^{Dn;t} + Res_{Imp}^{t} + NRes_{Imp}^{t} + (TC_{Imp}^{t} - En_{Imp}^{t}) \leq F_{Imp}^{OTC}; \quad t \in T$$

Each of these constraints is equivalent to the following two linear constraints:

$$En_{Imp}^{t} - En_{Exp}^{t} + Reg_{Imp}^{Up;t} + Reg_{Exp}^{Dn;t} + Res_{Imp}^{t} + NRes_{Imp}^{t} + (TC_{Imp}^{t} - En_{Imp}^{t}) \leq F_{Imp}^{OTC}; \quad t \in T$$

$$Reg_{Imp}^{Up;t} + Reg_{Exp}^{Dn;t} + Res_{Imp}^{t} + NRes_{Imp}^{t} + (TC_{Imp}^{t} - En_{Imp}^{t}) \leq F_{Imp}^{OTC}; \quad t \in T$$
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The inter-tie transmission constraints in export directions are posted in a similar way:

$$\max\left\{0, En_{Exp}^{t} - En_{Imp}^{t}\right\} + Reg_{Exp}^{Up;t} + Reg_{Imp}^{Dn;t} + Res_{Exp}^{t} + NRes_{Exp}^{t} + (TC_{Exp}^{t} - En_{Exp}^{t}) \leq F_{Exp}^{OTC}; \quad t \in T$$

This constraint can be split into two equivalent linear constraints:

$$En_{Exp}^{t} - En_{Imp}^{t} + Reg_{Exp}^{Up;t} + Reg_{Imp}^{Dn;t} + Res_{Exp}^{t} + NRes_{Exp}^{t} + (TC_{Exp}^{t} - En_{Exp}^{t}) \leq F_{Exp}^{OTC}; \quad t \in T$$

$$Reg_{Exp}^{Up;t} + Reg_{Imp}^{Dn;t} + Res_{Exp}^{t} + NRes_{Exp}^{t} + (TC_{Exp}^{t} - En_{Exp}^{t}) \leq F_{Exp}^{OTC}; \quad t \in T$$

Where:

En_{Imp}^{t}	is total energy import
$Reg_{Imp}^{Up;t}$	is total Regulation Up import
$Reg_{Imp}^{Dn;t}$	is total Regulation Down import
Res_{Imp}^{t}	is total Spinning Reserve import
$NRes_{Imp}^{t}$	is total Non-Spinning Reserve import
TC_{Imp}^{t}	is total Transmission Capacity import
En_{Exp}^{t}	is total energy export
$Reg_{Exp}^{Up;t}$	is total Regulation Up export
$Reg_{Exp}^{Dn;t}$	is total Regulation Down export
Res_{Exp}^{t}	is total Spinning Reserve export
$NRes_{Exp}^{t}$	is total Non-Spinning Reserve export
TC_{Exp}^{t}	is total Transmission Capacity export
F_{Imp}^{OTC}	is inter-tie OTC in import direction
F_{Exp}^{OTC}	is inter-tie OTC in export direction