Market Settlements - Advanced

Energy Market Module
Agenda

- Energy Market
  - Energy
  - Marginal Losses
  - Congestion
Supplying Participant Load

• Supply and load will balance for each hour
  – Participants in the PJM Day-Ahead Energy Market can use their own generation, bilateral contracts, virtual bids and spot market purchases to supply their load serving obligation in any hour.
    • Will automatically balance because of Spot Market purchase or sale
  – Participants in the PJM Real-Time Energy Market can use their own generation, bilateral contracts and spot market purchases to supply their load serving obligation in any hour.
    • No virtual bids
    • Will automatically balance because of Spot Market purchase or sale
spot market energy interchange

- a measure of the “imbalance” in a market participant’s resources and loads
- defines a participant’s “net position” (i.e. buyer or seller) relative to the pjm spot energy market
- net interchange = load - resources

resources

load

- generator 1: 100 mw
- generator 2: 200 mw
- load: 400 mw
- export: 50 mw
- import: 300 mw

spot market interchange = 450 - 600 = -150

(net seller to spot market)

positive net interchange = buyer from spot market
negative net interchange = seller to spot market

calculated hourly for each participant
Day-Ahead Spot Market Energy Calculation

Day-Ahead Load MWh

Day-Ahead DEC Bid MWh

Day-Ahead Sale Transaction MWh

Day-Ahead INC Offer MWh

Day-Ahead Purchase Transaction MWh

Day-Ahead Spot Market Energy

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Day-Ahead Spot Market Energy

System Energy Price will be the same for all participants at all buses!

Buyer Charges

Seller Charges

(typically a credit to the seller)

System Energy Price Component of Day-Ahead LMP
Balancing Spot Market Energy Calculation*

Real-Time Load MWh - Losses + 
Real-Time Sale Transaction MWh - 
Real-Time Spot Market Energy

Real-Time Generation MWh + 
Real-Time Purchase Transaction MWh - 

* Net metered interchange (minus SE losses) used from Power Meter
Balancing Spot Market Energy

Buyer Deviation = Real-Time Spot Market Energy - Day-Ahead Spot Energy Purchase

Buyer Charge → Real-Time System Energy Price Component of LMP


Seller Charge (negative) → Real-Time System Energy Price Component of LMP

System Energy Price will be the same for all participants at all buses!
Spot Market Interchange Review - Net Buyer

LSE Net Buyer of 10 MW
S.M. Energy Charge = 10 MW ($25) = $250

Prices shown are System Energy Price component of LMP

Load: 45 MW
Generation: 35 MW

SMI = 10 MW
Spot Market Interchange Review - Net Seller

Load: 20 MW @ $35
Generation: 20 MW @ $35

Load: 10 MW @ $35
Generation: 40 MW @ $35

Load: 15 MW @ $35
Generation: 30 MW @ $35

Prices shown are **System Energy Price** component of LMP

Load = 45 MW
Generation = 90 MW

Net Seller of 45 MW
S.M. Energy Charge = -45 MW ($35) = -$1575

SMI = -45 MW
**Business Example - Day-Ahead Spot Market Energy**

<table>
<thead>
<tr>
<th>Energy Market Withdrawals</th>
<th>Energy Market Injections</th>
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<tbody>
<tr>
<td>200 MW (DA Demand)</td>
<td>100 MW (Schedule Purchase)</td>
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<td>10 MW (DEC Bid)</td>
<td>110 MW (Gen 1 Day-Ahead Schedule)</td>
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<td>10 MW (INC Offer)</td>
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<td>0 MW (Gen 2 Day-Ahead Schedule)</td>
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<td>210 MW</td>
<td>220 MW</td>
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\[ 210 \text{ MW} - 220 \text{ MW} = -10 \text{ MW} \times $10.00 = -$100 \text{ Charge} \]

(Note that charge is negative)

**Day-Ahead System Energy Price**
## Business Example - Balancing Spot Market Energy

<table>
<thead>
<tr>
<th>Energy Market Withdrawals</th>
<th>Energy Market Injections</th>
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<tr>
<td>220 MW (RT Load excluding losses)</td>
<td>100 MW (Schedule Purchase)</td>
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<td>110 MW (Gen 1 actual generation)</td>
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<td>37 MW (Gen 2 actual generation)</td>
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<td>220 MW</td>
<td>247 MW</td>
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</table>

220 MW – 247 MW = -27 MW

-27 MW – (-10 MW) = -17 MW ($11.75) = - $199.75 Charge

(Note that charge is negative)
Exercises 1 & 2

• Exercise 1 shows the participants Day-Ahead position
• Exercise 2 shows the participants Real-Time position

Day-Ahead

- Generator 1
  100 MW
  @LMP = $10

- Generator 2
  200 MW
  @LMP = $10

- 400 MW Load
  @LMP = $10

- Export = 100 MW
  LMP = $10 (Source)

- InSchedule Purchase at Zone = 20 MW
  @ 10 (Sink)

- DEC bid 50 MW
  @ LMP = $10

Real-Time

- Generator 1
  200 MW
  @LMP = $15

- Generator 2
  300 MW
  @LMP = $15

- Export = 100 MW
  LMP = $15 (Source)

- InSchedule Purchase at Zone = 20 MW
  @ 15 (Sink)

- 500 MW Load
  @LMP = $15

- Actual Operations

LMPs shown are Day-Ahead System Energy Price component of LMP

05/24/2017
Exercise 1

Calculate the Day-Ahead Net Interchange and Spot Market Energy charge for the participant shown below:

Day-Ahead
Net Interchange = ?

Day-Ahead
Spot Market Charge = ?

LMPs shown are Day-Ahead System Energy Price component of LMP
**Exercise 1 - Answer**

Calculate the Day-Ahead Net Interchange and Spot Market Energy charge for the participant shown below:

- **Day-Ahead Net Interchange =** 550 MW - 320 MW = 230 MW
- **Day-Ahead Spot Market Charge =** (230 MW)($10) = $2300 Charge

"Load" = 400 + 50 + 100 = 550 MW
"Gen" = 100 + 200 + 20 = 320 MW

LMPs shown are Day-Ahead System Energy Price component of LMP
Exercise 2

Calculate the Balancing Spot Net Interchange and Spot Market Energy charge for the participant shown below:

Generator 1
200 MW
@LMP = $15

500 MW Load
@LMP = $15

Generator 2
300 MW
@LMP = $15

Export = 100 MW
LMP = $15 (Source)

InSchedule Purchase at Zone = 20 MW @ 15 (Sink)

Actual Operations

Real-Time Net Interchange = ?
Balancing Net Interchange = ?
Balancing Spot Market Charge = ?

LMPs shown are Day-Ahead System Energy Price component of LMP
Exercise 2 - *Answer*

Calculate the Balancing Net Interchange and Spot Market Energy charge for the participant shown below:

- **Real-Time Net Interchange =**
  \[ 600 - 520 = 80 \text{ MW} \]

- **Balancing Net Interchange =**
  \[ 80 \text{ MW} - 230 \text{ MW} = -150 \text{ MW} \]

- **Balancing Spot Market Charge =**
  \[ -150 \text{ MW} \times \$15/\text{MWh} = -\$2,250 \]

LMPs shown are Day-Ahead System Energy Price component of LMP.
## Supporting Calculations

**DA Spot Market Energy Charge** (1200.01) = DA Net Interchange (3000.28)  
* DA PJM Energy Price (3000.01)

**Bal Net Interchange** (3000.30) = RT Net Interchange (3000.29)  
- DA Net Interchange (3000.28)

**Bal Spot Market Energy Charge** (1205.01) = Bal Net Interchange (3000.30)  
* RT PJM Energy Price (3000.02)
### MSRS - Day-Ahead Daily Energy Transactions

#### Supporting Calculations

**Day-Ahead Net Interchange** = SUM (all MWh values) for each hour, excluding transactions whose Up to Congestion flag = Y

#### Table (Con't.)

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#### Possible Transaction Type Values:
- Demand, Decrement, Load Response, Generation, Increment, Internal Bilateral, Import, Export, Wheel In, Wheel Out, Total DA Net Interchange

#### Hours 3 through 23 Hidden Due to Space Considerations
MSRS - Real-Time Daily Energy Transactions

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Supporting Calculations
Real-Time Net Interchange = SUM (all MWh values) for each hour

Hours 3 through 23 Hidden Due to Space Considerations
**MSRS - Real-Time Daily Energy Transactions**

**Possible Transaction Type Values:** Internal Bilateral, Retail Load Responsibility, Wholesale Load Responsibility, Generation Responsibility, Import, Export, Wheel In, Wheel Out, Adjusted Net Metered Interchange, Power Meter Allocated EHV Losses, De-rated Losses, Default Supplier Load, Total RT Net Interchange

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*RRLs and WLRs do not include losses for spot market interchange!*
**MSRS - Load InSchedule With and Without Losses**

Report displays the load MWh with and without losses for each load InSchedule (WLRs and RLRs) applicable to the customer account.

### Possible Transaction Type Values:
- Wholesale Load Responsibility
- Retail Load Responsibility

### Possible Status Values:
- Load with Losses
- Load without Losses

---

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Agenda

• Energy Market
  – Energy
  – Marginal Losses
  – Congestion
**Losses**

- Transmission losses refer to the loss of energy in the transmission of electricity from generation resources to load, which is dissipated as heat through transformers, transmission lines, and other transmission facilities.

- Only the losses incurred on facilities included in the PJM network model and, therefore, reflected in the PJM State Estimator are included in the PJM settlements for transmission losses.
Losses Billing

Settlement for losses reflected in LMP calculation

• **Implicit Loss Charge**
  - Day-ahead and balancing locational net loss bill calculated hourly
    • Represents the marginal loss price difference between a participants injections and withdrawals
    • Calculated using the *Loss Price* component of LMP

• **Explicit Loss Charge**
  - Calculated using source and sink of transaction using Loss Price component of LMP
Implicit vs Explicit Loss Calculations

- **$ Scheduled Load Loss Charge**
- **$ Scheduled Generation Loss Credit**

**Internal Bilateral Transaction**
- **Generation Sells To Load**

**$ Actual Generation Loss Credit**
- **Gen** credited Losses at A
- **Gen** charged Losses at B

**$ Actual Load Loss Charge**
- **Load** credited Losses at C
- **Load** charged Losses at D
- **Load** as buyer in the internal bilateral transaction pays explicit losses C - B
Calculation of Locational Net Loss Bill (Implicit Losses)

Locational Net Loss Bill is the difference in Loss Price components of LMP between a participant’s “load” and “generation”

Net Loss Bill (Implicit Loss Charge): **Load Loss Charges** - **Generation Loss Credits**

Load Loss Charges*
- Load: Load Bus MWh x *Loss Price Component* of Load Bus LMP
- Energy Sales: Sale MWh x *Loss Price Component* of Source LMP
- Decrement Bids: Dec Bid MWh x *Loss Price Component* of Bus LMP

Generation Loss Credits*
- Generation: Generation Bus MWh x *Loss Price Component* of Generation Bus LMP
- Energy Purchases: Purchase MWh x *Loss Price Component* of Sink LMP
- Increment Offers: Inc Offer MWh x *Loss Price Component* of Bus LMP

* deviations are used for balancing market calculations
Day-Ahead Explicit Losses Charge

Day-Ahead Transaction MWh *

(Loss Price Component of Day-ahead Sink LMP – Loss Price Component of Day-ahead Source LMP)

- Transmission customer pays losses for external transactions
- Buyer pays losses for internal transactions (network customer)
- Explicit loss charges are not included in the net loss bill calculations
Balancing Explicit Loss Charge

Real-Time Transaction MWh – Day-Ahead Transaction MWh *

\[ (\text{Loss Price Component of Real-time Sink LMP} - \text{Loss Price Component of Real-time Source LMP}) \]

- Transmission customer pays losses for external transactions
- Buyer pays losses for internal transactions (network customer)
- Explicit loss charges are not included in the net loss bill calculations
• Buyer pays explicit congestion and losses across the path (Sink – Source) \(B\) – \(A\).

• Generator credited implicit congestion and losses at the generator bus \(A\).

• Generator (as the seller) is charged implicit congestion and losses at the source \(A\).

• Load (as the buyer) is credited implicit congestion and losses at the sink \(B\).

• Load is charged implicit congestion and losses at the load bus \(B\).
## 9 Supporting Calculations

DA Implicit Loss Charge (1220.01) = DA Loss Withdrawal Charge (1220.11) - DA Loss Injection Credit (1220.12)

Bal Implicit Loss Charge (1225.01) = Bal Loss Withdrawal Charge (1225.11) - Bal Loss Injection Credit (1225.12)
### Implicit Congestion and Loss Charge Details

**Customer Account:** PJM Interconnection  
**Report Creation Timestamp (EPT):** 10/9/2012 15:55  
**Start Date:** 2/5/2012  
**End Date:** 2/5/2012

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<th>PNODE ID</th>
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### Table (Con't.)

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MSRS - Implicit Congestion and Loss Charge Details

The Description document for Implicit Congestion and Loss Charge Details shows the supporting calculations located in the CSV and XML files.

9 Supporting Calculations

- DA Congestion Withdrawal Charge (from Congestion Charge Summary) = \( \text{SUM} \) (PNODE DA Congestion Price * DA Congestion Withdrawal Energy) for all PNODEs
- DA Congestion Injection Credit (from Congestion Charge Summary) = \( \text{SUM} \) (PNODE DA Congestion Price * DA Congestion Injection Energy) for all PNODEs
- DA Loss Withdrawal Charge (from Loss Charge Summary) = \( \text{SUM} \) (PNODE DA Loss Price * DA Loss Withdrawal Energy) for all PNODEs
- DA Loss Injection Credit (from Loss Charge Summary) = \( \text{SUM} \) (PNODE DA Loss Price * DA Loss Injection Energy) for all PNODEs
- Bal Congestion Injection Energy Deviation = RT Congestion Injection Energy - DA Congestion Injection Energy
- Bal Loss Injection Energy Deviation = RT Loss Injection Energy - DA Loss Injection Energy
- Bal Congestion Withdrawal Charge (from Congestion Charge Summary) = \( \text{SUM} \) (PNODE RT Congestion Price * Bal Congestion Withdrawal Energy Deviation) for all PNODEs
- Bal Congestion Injection Credit (from Congestion Charge Summary) = \( \text{SUM} \) (PNODE RT Congestion Price * Bal Congestion Injection Energy Deviation) for all PNODEs
- Bal Loss Withdrawal Charge (from Loss Charge Summary) = \( \text{SUM} \) (PNODE RT Loss Price * Bal Loss Withdrawal Energy Deviation) for all PNODEs
- Bal Loss Injection Credit (from Loss Charge Summary) = \( \text{SUM} \) (PNODE RT Loss Price ($/MWh) * Bal Loss Injection Energy Deviation (MWh)) for all PNODEs
### MSRS - Explicit Loss Charges

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<th>C</th>
<th>D</th>
<th>E</th>
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### 9 Supporting Calculations

**DA Explicit Loss Charge (1220.13)** = DA Transaction MWh (3000.72) * (DA Sink Loss Price (3000.16) - DA Source Loss Price (3000.17))

**Bal Transaction Deviation (3000.74)** = RT Transaction MWh (3000.73) - DA Transaction MWh (3000.72)

**Bal Explicit Loss Charge (1225.13)** = Bal Transaction Deviation (3000.74) * (RT Sink Loss Price (3000.19) - RT Source Loss Price (3000.20))
Loss Surplus

• More money collected from load than is paid to generation
  – Results in a loss surplus
  – Distributed to Transmission Users based on ratio shares of real-time load (without losses) + exports (paying for transmission service)
### 9 Supporting Calculations

Transmission Loss Credit (2220.01) = Total PJM Loss Revenues (2220.11) * \((\text{RT Load (3000.38)} + \text{Firm RT Exports (2220.13)} + \text{Reduced Non-Firm Exports (2220.16)}) / \text{Total PJM RT Load plus Reduced Exports (2220.17)})\)
Agenda

• Energy Market
  – Energy
  – Marginal Losses
  – Congestion
Transmission Congestion Charges

Implicit

• Charge incurred from moving generation to load across a constrained system

• Associated with price differences in congestion component of LMP between generation and purchases, netted against its load and sales

Explicit

• Associated with price differences in congestion component of LMP between the source and sink of a transaction
Transmission Congestion Charges

Day-Ahead Charge Calculations

- Locational Net Congestion Bill
  - Implicit Congestion Charge
- Explicit Congestion Charge
  - Associated with internal and external transactions

Balancing Charge Calculations

- Locational Net Congestion Bill
  - Implicit Congestion Charge
- Explicit Congestion Charge
  - Associated with internal and external transactions

Calculations utilize the **Congestion Price** component of LMP
Calculation of Locational Net Congestion Bill (Implicit Congestion)

Locational Net Congestion Bill (Implicit Congestion Charge):
- Load Congestion Charges - Generation Congestion Credits

Load Congestion Charges*:
- Load: Load Bus MWh x Congestion Price Component of Load Bus LMP
- Energy Sales: Sale MWh x Congestion Price Component of Source LMP
- Decrement Bids: Dec Bid MWh x Congestion Price Component of Bus LMP

Generation Congestion Credits*:
- Generation: Gen Bus MWh x Congestion Price Component of Gen Bus LMP
- Energy Purchases: Purchase MWh x Congestion Price Component of Sink LMP
- Increment Offers: Offer Bid MWh x Congestion Price Component of Bus LMP

*deviations are used for balancing market calculations
Day-ahead Explicit Congestion Charge

Transaction MWh *

(Congestion Price Component of Day-ahead Sink LMP – Congestion Price Component of Day-ahead Source LMP)

- Transmission customer pays congestion for external transactions
- Buyer pays congestion for internal transactions (network customer)
Balancing Explicit Congestion Charge

Transaction MWh Deviation *

(Congestion Price Component of Real-time Sink LMP – Congestion Price Component of Real-time Source LMP)

- Transmission customer pays congestion for external transactions
- Buyer pays congestion for internal transactions (network customer)
# MSRS - Transmission Congestion Charge Summary

Transmission Congestion Charge Summary
Customer Account: PJM Interconnection
Report Creation Timestamp (EPT): ############

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| Customer ID | Customer Code | EPT Hour Ending | GMT Hour Ending | DA Congestion Withdrawal Energy (MWh) | DA Congestion Withdrawal Charge ($) | DA Congestion Injection Energy (MWh) | DA Congestion Injection Credit ($) | DA Implicit Congestion Charge ($) | DA Explicit Congestion Charge ($) | Bal Congestion Withdrawal Energy Deviation (MWh) | Bal Congestion Withdrawal Charge ($) | Bal Congestion Injection Energy Deviation (MWh) | Bal Congestion Injection Credit ($) | Bal Implicit Congestion Charge ($) | Bal Explicit Congestion Charge ($) |
|-------------|---------------|----------------|----------------|----------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|----------------------------------------|-----------------------------------------|----------------------------------------|----------------------------------------|-----------------------------------|-----------------------------------|
| 88888 DEK   | 07/05/2012 01 | 07/05/2012 05  | 0              | 0                                      | 150                                | -54                                | 54                                | -56.91                            | 178.214167                            | -21.39                                  | 100                                    | -45                                    | 23.61                              | 12                                  |
| 88888 DEK   | 07/05/2012 02 | 07/05/2012 06  | 0              | 0                                      | 300                                | -6                                 | 6                                 | 15.56                             | 178.126667                            | -146.06                                | 50                                    | -24                                    | -122.06                             | -7.55                               |
| 88888 DEK   | 07/05/2012 03 | 07/05/2012 07  | 0              | 0                                      | 350                                | -10.5                              | 10.5                              | 4.67                              | 253.075333                            | -1122.71                               | 0                                     | 0                                     | -1122.71                            | -12.78                              |
| 88888 DEK   | 07/05/2012 04 | 07/05/2012 08  | 0              | 0                                      | 350                                | -7                                 | 7                                 | 1.5                               | 253.176833                            | -704.18                                | 0                                     | 0                                     | -704.18                             | -7.01                               |
| 88888 DEK   | 07/05/2012 05 | 07/05/2012 09  | 0              | 0                                      | 350                                | -7                                 | 7                                 | -13.93                            | 253.088167                            | -661.39                                | 0                                     | 0                                     | -661.39                             | -9.28                               |

## 9 Supporting Calculations

DA Implicit Congestion Charge (1210.01) = DA Congestion Withdrawal Charge (1210.11) - DA Congestion Injection Credit (1210.12)

Bal Implicit Congestion Charge (1215.01) = Bal Congestion Withdrawal Charge (1215.11) - Bal Congestion Injection Credit (1215.12)
## Implicit Congestion and Loss Charge Details

### Customer Account: PJM Interconnection

**Report Creation Timestamp (EPT):** 10/9/2012 15:55

**Start Date:** 2/5/2012

| Customer ID | Customer Code | EPT Hour Ending | GMT Hour Ending | PNODE Name | PNODE ID | DA Congestion Price ($/MWh) | DA Congestion Withdrawal Energy (MWh) | DA Congestion Injection Energy (MWh) | RT Congestion Price ($/MWh) | RT Congestion Withdrawal Energy (MWh) | RT Congestion Injection Energy (MWh) | Bal Congestion Price ($/MWh) | Bal Congestion Withdrawal Energy Deviation (MWh) | Bal Congestion Injection Energy Deviation (MWh) |
|-------------|---------------|-----------------|-----------------|------------|----------|----------------------------|-----------------------------------------|-------------------------------------|-------------------------------|---------------------------------------------|--------------------------------------|------------------------------------------------|-------------------------------------------------|
| 88888 DEK  | DEK           | 02/05/2012 01   | 02/05/2012 01   | DEK EXT LMP | 99999999 | -0.36                      | 0                                        | 0                                   | -0.36                         | 0                                           | 0                                      | -350                                         | -0.35                                            |
| 88888 DEK  | DEK           | 02/05/2012 02   | 02/05/2012 02   | DEK EXT LMP | 99999999 | 0.02                       | 0                                        | 0                                   | 0.02                          | 0                                           | 0                                      | 300                                          | 0.02                                             |
| 88888 DEK  | DEK           | 02/05/2012 03   | 02/05/2012 03   | DONEXT LMP  | 99999999 | -0.03                      | 0                                        | 0                                   | -0.03                         | 0                                           | 0                                      | 350                                          | 0.03                                             |
| 88888 DEK  | DEK           | 02/05/2012 04   | 02/05/2012 04   | DONEXT LMP  | 99999999 | 0.00                       | 0                                        | 0                                   | 0.00                          | 0                                           | 0                                      | 0                                             | 0.00                                              |
| 88888 DEK  | DEK           | 02/05/2012 05   | 02/05/2012 05   | OUTTHERE EXT | 99999999 | 0.88                       | 0                                        | 0                                   | 0.88                          | 0                                           | 0                                      | 178.075333                                    | 0.88                                             |
| 88888 DEK  | DEK           | 02/05/2012 06   | 02/05/2012 06   | OUTTHERE EXT | 99999999 | 0.82                       | 0                                        | 0                                   | 0.82                          | 0                                           | 0                                      | 178.126667                                    | 0.82                                             |
| 88888 DEK  | DEK           | 02/05/2012 07   | 02/05/2012 07   | DONEXT LMP  | 99999999 | 0.03                       | 0                                        | 0                                   | 0.03                          | 0                                           | 0                                      | 178.135333                                    | 0.03                                             |
| 88888 DEK  | DEK           | 02/05/2012 08   | 02/05/2012 08   | DONEXT LMP  | 99999999 | 0.41                       | 0                                        | 0                                   | 0.41                          | 0                                           | 0                                      | 350                                          | 0.41                                             |

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MSRS - Implicit Congestion and Loss Charge Details

9 Supporting Calculations

DA Congestion Withdrawal Charge (from Congestion Charge Summary) = SUM (PNODE DA Congestion Price * DA Congestion Withdrawal Energy) for all PNODEs

DA Congestion Injection Credit (from Congestion Charge Summary) = SUM (PNODE DA Congestion Price * DA Congestion Injection Energy) for all PNODEs

DA Loss Withdrawal Charge (from Loss Charge Summary) = SUM (PNODE DA Loss Price * DA Loss Withdrawal Energy) for all PNODEs

DA Loss Injection Credit (from Loss Charge Summary) = SUM (PNODE DA Loss Price * DA Loss Injection Energy) for all PNODEs


Bal Congestion Injection Energy Deviation = RT Congestion Injection Energy - DA Congestion Injection Energy


Bal Loss Injection Energy Deviation = RT Loss Injection Energy - DA Loss Injection Energy

Bal Congestion Withdrawal Charge (from Congestion Charge Summary) = SUM (PNODE RT Congestion Price * Bal Congestion Withdrawal Energy Deviation) for all PNODEs

Bal Congestion Injection Credit (from Congestion Charge Summary) = SUM (PNODE RT Congestion Price * Bal Congestion Injection Energy Deviation) for all PNODEs

Bal Loss Withdrawal Charge (from Loss Charge Summary) = SUM (PNODE RT Loss Price * Bal Loss Withdrawal Energy Deviation) for all PNODEs

Bal Loss Injection Credit (from Loss Charge Summary) = SUM (PNODE RT Loss Price ($/MWh) * Bal Loss Injection Energy Deviation (MWh)) for all PNODEs
## MSRS - Explicit Congestion Charges

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Explicit Congestion Charges (DESC)

9 Supporting Calculations

DA Explicit Congestion Charge (1210.13) = DA Transaction MWh (3000.72) * (DA Sink Congestion Price (3000.07) - DA Source Congestion Price (3000.08))

Bal Transaction Deviation (3000.74) = RT Transaction MWh (3000.73) - DA Transaction MWh (3000.72)

Bal Explicit Congestion Charge (1215.13) = Bal Transaction Deviation (3000.74) * (RT Sink Congestion Price (3000.10) - RT Source Congestion Price (3000.11))
Exercise 3 - Questions

Day-Ahead Market
DA System Energy Price = $10

Load: 20 MW
DALP = $1; DACP = $15

Gen: 10 MW
DALP = $1; DACP = $0

Gen: 5 MW
DALP = $2; DACP = $15

Load: 15 MW
DALP = $2; DACP = $20

Gen: 20 MW
DALP = $2; DACP = $5

DEC Bid 10 MW
DALP = $2; DACP = $5

Export = 20 MW
Source DALP = $1; DACP = $10
Sink DALP = $3; DACP = $20

Hint:
Spot Market Charges = SMI * DA System Energy Price
Implicit Congestion = Load Charges – Generator Credits using DACP
Explicit Congestion = Schedule MW (Sink DACP - Source DACP)
Implicit Losses = Load Charges – Generator Credits using DALP
Explicit Losses = Schedule MW (Sink DALP – Source DALP)

SMI = 30 MW (Net buyer)
**Exercise 3 - Answers**

**Day-Ahead Market**
- DA System Energy Price = $10

- **DA Spot Market Charges:**
  - 30 MW * $10 = $300

- **DA Implicit Congestion:**
  - ($300+$300+$50) - ($0+$75+$100) = $475

- **DA Explicit Congestion:**
  - 20 ($20-$10) = $200

- **DA Implicit Losses:**
  - ($20+$30+$20) – ($10+$10+(-$20)) = $70

- **DA Explicit Losses:**
  - 20 ($3-$1) = $40

**Load:**
- **20 MW**
  - DALP = $1; DACP = $15

- **15 MW**
  - DALP = $2; DACP = $20

- **10 MW**
  - DALP = $1; DACP = $0

- **5 MW**
  - DALP = $2; DACP = $15

- **DEC Bid 10 MW**
  - DALP = $2; DACP = $5

**Export:**
- **20 MW**
  - Source DALP = $1; DACP = $10
  - Sink DALP = $3; DACP = $20

**Load:**
- **20 MW**
  - DALP = $1; DACP = $15

**Generation:**
- **20 MW**
  - DALP = $2; DACP = $5

- **5 MW**
  - DALP = $2; DACP = $15

- **10 MW**
  - DALP = $1; DACP = $0

**SMI = 30 MW (Net buyer)
Exercise 4 - Questions

SMI = 10 MW (Net Buyer)

Load: 30 MW
RTLP = $1.5; RTCP = $5

Gen: 10 MW
RTLP = $1; RTCP = $0

Gen: 20 MW
RTLP = $2; RTCP = $20

Gen: 20 MW
RTLP = $1; RTCP = $10

DEC Bid 0 MW
RTLP = $2; RTCP = $5

Hint:
Calculate Deviations from DA
Spot Market Charges = SMI (deviation) * “RT System Energy Price”
Implicit Congestion = Load Charges – Generator Credits using RTCP (based on deviations from DA schedules)
Explicit Congestion = Transaction deviations (Sink RTCP - Source RTCP)
Implicit Losses = Load Charges – Generator Credits using RTLP (based on deviations from DA schedules)
Explicit Losses = Transaction deviations (Sink RTLP – Source RTLP)

Balancing Market
RT System Energy Price = $20

Calculate Balancing Market . . .
• Spot Market Charges
• Implicit Congestion
• Explicit Congestion
• Implicit Losses
• Explicit Losses

Load: 30 MW
RTLP = $2; RTCP = $20

Source RTLP = $1; RTCP = $15
Sink RTLP = $3; RTCP = $28

Export = 0 MW

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Exercise 4 - Answers

SMI = 10 MW (Net Buyer)

LSE

Load: 30 MW
RTLP = $1.5; RTCP = $5

Gen: 10 MW
RTLP = $1; RTCP = $0

Gen: 20 MW
RTLP = $1; RTCP = $10

Gen: 20 MW
RTLP = $0.5; RTCP = $15

DEC Bid 0 MW
RTLP = $2; RTCP = $5

Load: 30 MW
RTLP = $2; RTCP = $20

Export = 0 MW
Source RTLP = $1; RTCP = $15
Sink RTLP = $3; RTCP = $28

Balancing Market
RT System Energy Price = $20

Balancing Spot Market Charges:
(10 MW – 30 MW) * $20 = ($400)

Balancing Implicit Congestion:
($50+$300-$50) - ($0+$150+$0) = $150

Balancing Explicit Congestion:
-20 ($28-$15) = ($260)

Balancing Implicit Losses:
($15+$30-$20) – ($0+$15+$0) = $10

Balancing Explicit Losses:
-20 ($3-$1) = ($40)
Questions?

PJM Client Management & Services
Telephone: (610) 666-8980
Toll Free Telephone: (866) 400-8980
Website: www.pjm.com

The Member Community is PJM’s self-service portal for members to search for answers to their questions or to track and/or open cases with Client Management & Services