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Integrated Marketplace: TCR Bid Activity

Integrated Marketplace Training Team
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501.614.3200

Agenda

• Introduction
• TCR Overview
• Market Clearing
• Risk and Exposure
• Negative Implications
• Positive Implications
• MP Activity: Observation vs. Expectation
• One Last Point...
• Wrap-Up
Training Administration Details

- Attendees should have registered for this training through the LMS.
- To receive credit for attending this training:
  - You must have registered in the LMS.
  - If you are not registered, send your name via WebEx Chat to the facilitator.
  - If you do not have an LMS account, you will need to create one.
- This training is **not** eligible for NERC CEH credits.
- This training does **not** include a knowledge assessment.
Common Acronyms

- ACP – Auction Clearing Price
- ARR – Auction Revenue Right
- CEH – Continuing Education Hours
- DA – Day Ahead
- EIS – Energy Imbalance Service
- LIP – Location Imbalance Pricing
- LMP – Locational Marginal Price
- LMS – Learning Management System
- LSE – Load Serving Entity
- MCC – Marginal Congestion Component
- MEC – Marginal Energy Component
- MLC – Marginal Loss Component
- MP – Market Participant
- RMS – Request Management System
- SF – Shift Factor
- SL – Settlement Location
- SMT – Structured Market Trials
- TCR – Transmission Congestion Rights
- ToU – Time of Use
- TSR – Transmission Service Request

Purpose of this Training

Problem

Phase 2 Annual Auction showed unexpected results, including high revenue inadequacy

Solution

SPP Staff Solution: Found and solved Logic Error in pre-run

Market Participant (MP) Solution: Must participate realistically to get realistic results
Training Objectives

• Describe how Transmission Congestion Rights (TCR) Market Clearing works.

• Identify the behaviors that enable Market Participants (MPs) to limit risks and manage exposure.

• Compare MP activity during TCR Market Trials to expected MP activity post TCR Market Go-Live.

• Identify the key dates for the Phase 2 Re-Run of the Annual Auction.

Section 2

TCR OVERVIEW
Understanding Congestion

No Congestion:
• Same prices
• Net revenue = $0

Congestion and Pricing

No Congestion:
• Same prices
• Net revenue = $0

*All Prices = LMP
**Congestion and Pricing (cont’d.)**

**Binding Constraint:**
- Prices separate

**Example:**

<table>
<thead>
<tr>
<th>MP</th>
<th>Settled</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEN₁</td>
<td>$20 \times -100\text{MW} = -$2,000</td>
</tr>
<tr>
<td>GEN₂</td>
<td>$50 \times -1\text{MW} = -$50</td>
</tr>
<tr>
<td>LOAD</td>
<td>$50 \times 101\text{MW} = $5,050</td>
</tr>
<tr>
<td>TOTAL</td>
<td>+$3,000</td>
</tr>
</tbody>
</table>

*All Prices = LMP*

**Congestion and Pricing (cont’d.)**

Who gets the $3,000?

- A. SPP
- B. Gen₁
- C. Gen₂
- D. TCR Holder

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Congestion and Pricing (cont’d.)

TCR Components:

| Holder: | MP_LOAD |
| Period: | JUNE |
| ToU: | ON |
| Quantity: | 100MW |
| Source SL: | GEN1 |
| Sink SL: | LOAD |

Congestion and Pricing (cont’d.)

Day-Ahead (DA) Settlement:

\[
LMP = \text{MEC} + \text{MCC} + \text{MLC}
\]

\[
(M_{\text{C}_{\text{sink}}} - M_{\text{C}_{\text{source}}}) \times \text{Quantity} = \text{TCR Payout}
\]

\[
($30 - $0) \times 100\text{MW} = $3,000
\]

This is same amount collected from DA Market. Had SPP sold more or less than 100MW of TCR, SPP would have under- or over-collected respectively. This is why it’s critical to have consistency between DA and TCR models.
Instruments in the Integrated Marketplace

- OASIS
- Allocation
- Auction
- Day-Ahead
- Real-Time

Gray Arrows demonstrate instrument flow.

Green Arrows demonstrate monetary flow for financial instruments (Settlements).

Dashed Arrow demonstrates that Transmission Service Request (TSR) is physical, not financial.

Acquiring TCRs

Buy Bid:
- MP pays cash in Auction.

Self-Convert Bid:
- MP is Price Taker in Auction.
- MP receives equal payment for settled Auction Revenue Right (ARR).
- MP keeps ARR (and gains TCR).

Secondary Market:
- Buyer pays seller directly.
- SPP tracks credit and settlement.
Acquiring TCRs (cont’d.)

- **Annual TCR Auction: May**
  - Multi-Period (Months/Seasons)
  - Multi-Class (On Peak/Off Peak)
  - Based on reduced system capability

- **Monthly TCR Auction**
  - Single Round (July, Aug, Sept) or Two Rounds (Oct-Apr)
  - Multi-Class (On Peak/Off Peak)
  - Based on residual capability

- **TCR Secondary Market**
  - Bilateral trading
  - Open 24/7

Key Points in this Section

**TCRs:**

- Are financial instruments.
- Settle against DA MCCs.
- Can contribute to large monetary impacts.
Section 3

MARKET CLEARING

TCR Market Clearing

Supply/Demand Assumptions:

• Indifferentiable Product
• Perfect Information

![Diagram showing equilibrium point (P*, Q*)](image)
TCR Market Clearing: Are All TCRs Equal?

Nome, AK

Miami Beach, FL

TCR Market Clearing: Perfecting Information

Marginal Bid @
100 $/MW
TCR Market Clearing: Perfecting Information (cont’d.)

- One Demand (MP’s Part)
- One Bid
  - C → D
  - 200$ @ 0MW
  - 0$ @ 200MW

TCR Market Clearing: Perfecting Information (cont’d.)

One Supply (SPP System Part)

- Limit: 75MW
- 25MW + 75MW = 100MW Awarded
TCR Market Clearing: Perfecting Information (cont’d.)

Supply/Demand Equilibrium:
- Boring Demand
- Interesting Supply
  - “Free” Supply
  - Infinite Cost
- Equilibrium
  - 100 $/MW, 100MW

Shift Factor (SF) Means:
- Observed flow (O)
- Injection/Withdrawl (IW)
- SF = O/IW * 100%

In this example:
- \( SF_{C\to D} = \frac{75}{100} \times 100\% = 75\% \)
- \( SF_{A\to B} = \frac{25}{100} \times 100\% = 25\% \)
- \( SF_{B\to D} = \frac{25}{100} \times 100\% = 25\% \)
- \( SF_{A\to C} = \frac{-25}{100} \times 100\% = -25\% \)
**TCR Market Clearing: Perfecting Information (cont’d.)**

**What is Shadow Price of Line C → D?**
- Marginal Bid = M
- $P_S = \frac{M}{SF_{C\rightarrow D}} = \frac{100}{75\%} = \$133$

**What is Price of each Path?**
- $P_{TCR} = SF \times P_S$
  - $C \rightarrow A$: $25\% \times \$133 = \$33$
  - $C \rightarrow B$: $50\% \times \$133 = \$67$
  - $C \rightarrow D$: $75\% \times \$133 = \$100$

Same price MP is paying for Marginal TCR

**Ref Bus = $0**
**Key Points in this Section**

- Path is important
  - Location, location, location
- MPs don’t see the whole story (inside the box)
- Supply/Demand
  - System Model = Supply
  - MP Bids = Demand
- Many prices / One bid
Section 4

RISK AND EXPOSURE

Exposure in Day-Ahead Market (TCR)

• DA prices can be volatile.
  – This creates high degree of uncertainty for Load Service Entities (LSEs).

• What if MP_LOAD did **not** have a TCR?

**Price with TCR:**
DA Qty + TCR Qty = Net DA Settlement
\[ 5,050 + (-3,000) = \$2,050 \]

**Price without TCR:**
DA Qty + TCR Qty = Net DA Settlement
\[ 5,050 + 0 = \$5,050 \]
Exposure in TCR Auction (ARR)

Self-Converts (Price Takers)
- Extremely unlikely to be negative
- Related ARR means MP pays itself

Non-Action ARRs (Price Takers)
- May be negative
- No hedge against DA

Self-Bids (Price Setters)
- “Reserve Price”
- Credit requirements

Self-Converts: Price Takers
- Co-optimized with other Bids
- Price modeled as “infinite”
  - Gives Self-Converts first priority
  - Must never be marginal
  - Causes odd behavior if infeasible
Non-Action ARRs: Price Takers

- Still settled at system capacity
  - 100% (June)
  - 90% (July, Aug, Sept)
  - 60% (Fall, Winter, Spring)
  - +50% / +100% (Monthly)

- NO Reserve Price
  - eBay metaphor

Non-Action ARRs: Price Takers (cont’d.)

Poll Question #1:
What is the TCR Reserve Price?

A. The Reserve Price is $1.
B. There is a Reserve Price, but it is dependent on factors.
C. There is no Reserve Price.

Write Notes Here:
_____________________
_____________________
_____________________
_____________________
Self-Bids: Price Setters

- Covers settled ARR percentage
  - 60% (Fall)
  - 30% Self-Convert (MP will get TCR*)
  - 30% Self-Bids (set Reserve Price)
- Credit implications
  - Cost to Acquire: Cost in TCR
  - Cost to Hold: Cost in DA

- 0 $/MW Bids

*Subject to pre-run and feasibility

Credit Implications: Credit for Self-Bid

Credit* for TCRs:

- Cost to Acquire
  - MAX(Bid$*BidMW)
- Cost to Hold
  - “Bad” case scenario in DA
- Self-Bid $0/MW
  - Cost to Acquire = $0
- Contrast: Self-Convert
  - Cost to Hold only after Auction

* Refer to Credit Requirements in Protocols
Key Points in this Section

• **Self-Convert:**
  – Modeled as infinite price
  – Most likely to get TCR

• **ARR Non-Action**
  – **NO** Reserve Price (not even $0)
  – Will never result in TCR

• **Self-Bid:**
  – Results in TCR if “Reserve” not met
  – Credit implications

Section 5

NEGATIVE IMPLICATIONS
### Negative Implications

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• ARR/TCR liability</td>
<td>• Negative Value Settlement Statement</td>
<td>• Better payoff in DA</td>
</tr>
<tr>
<td>• Over-hedge in DA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### One Protocol Correction

**Original Protocols** *(ARR for Example)*

\[
A = (-1) \cdot \left( \frac{ACP_{\text{Snk}} - ACP_{\text{Src}}}{D} \right) \cdot Q
\]

**Corrected Protocols** *(ARR for Example)*

\[
A = (-1) \cdot \left( \frac{ACP_{\text{Src}} - ACP_{\text{Snk}}}{D} \right) \cdot Q
\]
Important Formulas for Examples

ARR Settlement
• 100 days/period

\[ A = \left( -1 \right) \cdot \frac{\left( ACP_{Src} - ACP_{Snk} \right) \cdot Q}{D} \]

TCR Settlement
• 100 days/period

\[ A = \frac{\left( ACP_{Src} - ACP_{Snk} \right) \cdot Q}{D} \]

TCR Settlement in DA
• 1 day settled

\[ A = \sum_{\text{hours}} \left( MCC_{Src} - MCC_{Snk} \right) \cdot Q \]

DA Energy Cost
• 1 day settled

\[ A = \sum_{\text{hours}} \left( LMP_{Snk} \right) \cdot Q \]

Negative Implication #1: Self-Converting

Example 1:

<table>
<thead>
<tr>
<th>Arrangement</th>
<th>Formula/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARR Settlement (assume 100 days/period)</td>
<td>((-1) \cdot (ACP_{Src} - ACP_{Snk}) \cdot \text{Qty} / \text{Days}) = $200/day</td>
</tr>
<tr>
<td>TCR Settlement (assume 100 days/period)</td>
<td>((ACP_{Src} - ACP_{Snk}) \cdot \text{Qty} / \text{Days}) = -$200/day</td>
</tr>
<tr>
<td>TCR Settlement in DA (assume 1 day settled)</td>
<td>(\sum (MCC_{Src} - MCC_{Snk}) \cdot \text{Qty}) = $200/day</td>
</tr>
<tr>
<td>DA Energy Cost (assume 1 day settled)</td>
<td>(\sum (LMP_{Snk}) \cdot \text{Qty}) = $120/day</td>
</tr>
</tbody>
</table>

Why did MP get ARR in first place?
Pays $200 more in DA due to TCR liability
**Negative Implication #1: Self-Converting (cont’d.)**

**Example 2:**

<table>
<thead>
<tr>
<th>ARR Settlement (assume 100 days/period)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-1) * (ACP\textsubscript{Src} – ACP\textsubscript{Snk}) * Qty / Days</td>
</tr>
<tr>
<td>(-1) * (-$200 – -$400) * 100 / 100 = -$200/day</td>
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<tr>
<th>TCR Settlement in DA (assume 1 day settled)</th>
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<tbody>
<tr>
<td>(\sum (MCC\textsubscript{Src} – MCC\textsubscript{Snk}) * Qty)</td>
</tr>
<tr>
<td>(\sum ($4 – $2) * 100 = $200/day)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DA Energy Cost (assume 1 day settled)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\sum (LMP\textsubscript{Snk}) * Qty)</td>
</tr>
<tr>
<td>(\sum ($2) * 60 = $120/day)</td>
</tr>
</tbody>
</table>

**Poll Question #2:**

Using this example, what would happen if the TCR was 60MW?

A. MP still pays $200 more.
B. MP pays only $120 more.
C. MP gets $120 payment.

*Write Notes Here:_______________*
Negative Implication #2: ARR Non-Action

ARR Settlement (assume 100 days/period)
\[ (-1) \times (ACP_{Src} - ACP_{Snk}) \times \text{Qty} / \text{Days} \]
\[ (-1) \times (-\$400 - -\$200) \times 100 / 100 = \$200/day \]
- ARR is “negative” valued (Price Taker)
- Why did MP get ARR in first place?

TCR Settlement (assume 100 days/period)
\[ (ACP_{Src} - ACP_{Snk}) \times \text{Qty} / \text{Days} \]
\[ (-\$400 - -\$200) \times 0 / 100 = \$0/day \]
MP gets no TCR

TCR Settlement in DA (assume 1 day settled)
\[ \sum (MCC_{Src} - MCC_{Snk}) \times \text{Qty} \]
\[ \sum (\$2 - \$4) \times 0 = \$0/day \]
MP gets no TCR

DA Energy Cost (assume 1 day settled)
\[ \sum (LMP_{Snk}) \times \text{Qty} \]
\[ \sum (\$4) \times 60 = \$240/day \]
No hedge in DA

Negative Implication #3: Self-Bidding

ARR Settlement (assume 100 days/period)
\[ (-1) \times (ACP_{Src} - ACP_{Snk}) \times \text{Qty} / \text{Days} \]
\[ (-1) \times (-\$200 - -\$400) \times 100 / 100 = -\$200/day \]
ARR is “positive” valued (Price Taker)

TCR Settlement (assume 100 days/period)
\[ (ACP_{Src} - ACP_{Snk}) \times \text{Qty} / \text{Days} \]
\[ (-\$200 - -\$400) \times 0 / 100 = \$0/day \]
MP gets no TCR (does not pay)

TCR Settlement in DA (assume 1 day settled)
\[ \sum (MCC_{Src} - MCC_{Snk}) \times \text{Qty} \]
\[ \sum (\$2 - \$8) \times 0 = \$0/day \]
MP gets no TCR (does not pay)

DA Energy Cost (assume 1 day settled)
\[ \sum (LMP_{Snk}) \times \text{Qty} \]
\[ \sum (\$8) \times 60 = \$480/day \]
No hedge in DA (very high prices)
Key Points in this Section

• Self-Convert:
  – MP may receive over-priced TCRs

• ARR Non-Action:
  – May settle for (-) dollars
  – No hedge in DA

• Self-Bid:
  – May undervalue TCR
  – May not provide hedge in DA
### Positive Implications

1. **Self-Converting**
   - TCR “certainty”

2. **ARR Non-Action**
   - One perfect scenario

3. **Self-Bidding**
   - Negative priced TCR
   - Positive priced TCR

### Positive Implication #1: Self-Converting

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</tr>
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<td>(-1) * (-$200 – -$1000) * 100 / 100 = -$800/day</td>
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<th>DA Energy Cost (assume 1 day settled)</th>
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<tr>
<td>(\sum (LMP_{Snk}) \times Qty)</td>
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<td>(\sum ($4) \times 60 = $240/day)</td>
</tr>
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</table>
Positive Implication #2: ARR Non-Action

**ARR Settlement (assume 100 days/period)**
\[
(-1) \times (ACP_{src} - ACP_{snk}) \times \text{Qty} / \text{Days} \\
(-1) \times (-200 - (-1000)) \times 100 / 100 = \$800/\text{day}
\]

**High value in TCR Market**

**TCR Settlement (assume 100 days/period)**
\[
(ACP_{src} - ACP_{snk}) \times \text{Qty} / \text{Days} \\
(-200 - (-1000)) \times 0 / 100 = \$0/\text{day}
\]

**MP gets no TCR (does not pay)**

**TCR Settlement in DA (assume 1 day settled)**
\[
\sum (MCC_{src} - MCC_{snk}) \times \text{Qty} \\
\sum (2 - 4) \times 0 = \$0/\text{day}
\]

**Low value in DA**

**Only good scenario (would have same outcome with Self-Bid)**

**DA Energy Cost (assume 1 day settled)**
\[
\sum (LMP_{snk}) \times \text{Qty} \\
\sum (4) \times 60 = \$240/\text{day}
\]

**Low value in DA**

**Only good scenario (would have same outcome with Self-Bid)**

---

Positive Implication #3: Self-Bidding

**Example 1:**

**ARR Settlement (assume 100 days/period)**
\[
(-1) \times (ACP_{src} - ACP_{snk}) \times \text{Qty} / \text{Days} \\
(-1) \times (-400 - (-200)) \times 100 / 100 = \$200/\text{day}
\]

**ARR “negative” valued (Price Taker)**

**TCR Settlement (assume 100 days/period)**
\[
(ACP_{src} - ACP_{snk}) \times \text{Qty} / \text{Days} \\
(-400 - (-200)) \times 100 / 100 = \$200/\text{day}
\]

**MP gets TCR (pays for TCR)**

**TCR Settlement in DA (assume 1 day settled)**
\[
\sum (MCC_{src} - MCC_{snk}) \times \text{Qty} \\
\sum (2 - 4) \times 100 = \$200/\text{day}
\]

**MP gets TCR (pays for TCR)**

**DA Energy Cost (assume 1 day settled)**
\[
\sum (LMP_{snk}) \times \text{Qty} \\
\sum (4) \times 60 = \$240/\text{day}
\]

**Hedge in DA (normal prices)**
### Positive Implication #3: Self-Bidding (cont’d.)

**Example 2:**

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ARR “positive” valued (Price Taker)

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MP gets no TCR (does not pay)

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No hedge in DA (normal prices)

Similar to “negative” scenario

### Key Points in this Section

- **Self-Convert:**
  - MP always* receives TCR
- **ARR Non-Action:**
  - Perfect scenario only...
- **Self-Bid:**
  - Most robust option
  - Most control to MP

* Subject to pre-run and feasibility
Section 7

MP ACTIVITY: OBSERVATION VS. EXPECTATION

Participation in Phase 2 Annual Auction

Problem
Phase 2 Annual Auction showed unexpected results, including high revenue inadequacy

Solution

SPP Staff Solution: Found and solved Logic Error in pre-run

MP Solution: Must participate realistically to get realistic results
Participation in Phase 2 Annual Auction (cont’d.)

More Choices is Better

Volume (Q):
- Bids in Auction: 87
- Normal Load: 200,000
- Max Capacity: 280,000
- Less than: $\frac{1}{2}$ of $\frac{1}{10}$ of 1%
Participation in Phase 2 Annual Auction (cont’d.)

Price (P):

- Example bids:
  - 100,000MW @ 0.01 $/MW
  - 0.1MW @ 100,000 $/MW
- A few MPs did make sensible bids
- More volume would filter out bids that are not sensible

What SPP Staff did in Mock Auction

Researched historic Energy Imbalance Service (EIS) Location Imbalance Pricing (LIPs) + Created “Random” bids + Input 50M $/mo in simulated “speculative” bids

Question: What is a “speculative” bid?
What SPP Staff did in Mock Auction (cont’d.)

Answer

Buy bids designed to make money; not to hedge load

Buy bids during Mock Auction:

• 80%-100% EIS Value, “Positive” Value
  – Pay little, get lots
• 100%-120% EIS Value, “Negative” Value
  – Paid lots, owe little
• “Penny” Bids, Small MW, Large Variety

What SPP is Asking YOU to Do

✓ Participate like real-life
  • Volume (+/- 20%)
  • Price (+/- 20%)
✓ Simulate Financial-Only MP
  (“speculative” bids)
  • Look at EIS and Structured Market Trials (SMT)
  • Try something (throw more darts)
  • Use your credit limit
  • Use your 2000 bid limit
✓ Exercise yourself and your Market
When is SPP Asking You to Do This

Phase 2 Annual Auction Re-Run: **June 25-28**

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Bid Window

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When is SPP Asking You to Do This

- **Annual Re-Run Posting:** **July 3**
- **Phase 2 Monthly Processes**
  - **Nominations:** July 8, August 7, **and** September 9
  - **Bids/Offer:** July 15-16, August 12-13, **and** September 16-17
Key Points in this Section

• 25th-28th (THIS WEEK!!)

• Don’t forget the other dates!

• Participate
  – Real World (+/- 20%)
  – Extra! (Simulate “speculative”)

Section 8

ONE LAST POINT...
### Pre-Run Fix and MP Behavior

Sensitivities based on Phase 2 Annual, Winter Off-Peak

<table>
<thead>
<tr>
<th>MP</th>
<th>Original Pre-Run</th>
<th>Original with Self-Bids</th>
<th>Fixed Pre-Run</th>
<th>Fixed with Self-Bid</th>
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**Far from $0 Net**

**Near $0 Net**

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### Section 9

**WRAP UP**

**INTEGRATED MARKETPLACE**

6/24/2013
Concerns, Ideas, Questions

Jason Robison

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RMS: https://spprms.issuetrak.com/

SPP Customer Relations: CustomerRelations@spp.org

Questions