CALIFORNIA ISO

California Independent
System Operator

Meeting On
Congestion Revenue Rights Studies

Monday, October 20, 2004
California ISO

10:00 am to Noon and 1:00 to 3:00 pm

ISO Board Room

Call-In Number: 888-803-5681
Call I.D. Number: 3215309

Agenda

•	1	Introduction	(10:00 --10:15)
•	2	Modeling Overview	(10:15 --10:45)
•	3	Market Run Sequence	(10:45 --11:00)
•	4	CRR Study 1 – Q & A	(11:00 -- Noon)
•	5	Lunch Break (On your Own)	(Noon -- 1:00)
•	6	Proposed CRR Sensitivity Runs	(1:00 -- 1:15)
•	7	CRR Study 2	(1:15 -- 1:45)
•	8	CRR – Q & A Continued	(1:45 -- 2:45)
•	9	Future Steps	(2:45 – 3:00)

Modeling Overview

Study Period

- The year 2005
- Annual CRR term allocation
- 4 monthly CRR term allocation
  - 4 representative months out of the year were chosen to reduce data management and computational issues
- More in line with start of MD02 Phase III
  - New network upgrades
  - Termination of ETCs

Full Network Model

- Derived from a heavy summer 2002 case (~ 3,300 nodes and ~ 4,700 branches)
- Developed with the support of Operations Engineering
- It includes upgrades through Oct. 2002
- It is based on a passive DC model
  - No load
  - No generation
- It includes an external equivalent
- It contains 9 bulk transmission system upgrades

Enforced Constraints

- All normal thermal rating on facilities above 100 kV
- Current Inter-zonal Interfaces
- Other constraints
  - Humboldt
  - San Francisco
  - Greater Bay Area
  - San Diego
  - North Bay
  - Fresno

Point-to-Point CRRs

- Source to a Sink
- Typical Sources
  - Generators
  - Imports
  - Trading Hubs
- Typical Sinks
  - Load Points
  - Exports
  - Load Aggregations
- No functionality (yet) in the study software for Network Service CRRs

Optimization

- Security constrained optimization problem
- DC model => Linear Programming problem
- Objective function
  - Maximize the quote-based value of the awarded CRRs
  - In allocation, no bids, maximize awarded CRR MW
- Subject to constraints
  - Power balance constraints at each bus (like Power Flow)
  - Equality constraints for point-to-point CRRs
    - Like the market separation rule
    - Source MW = Sink MW
  - Flows within the enforced limits, i.e., Simultaneous Feasibility Test (SFT)

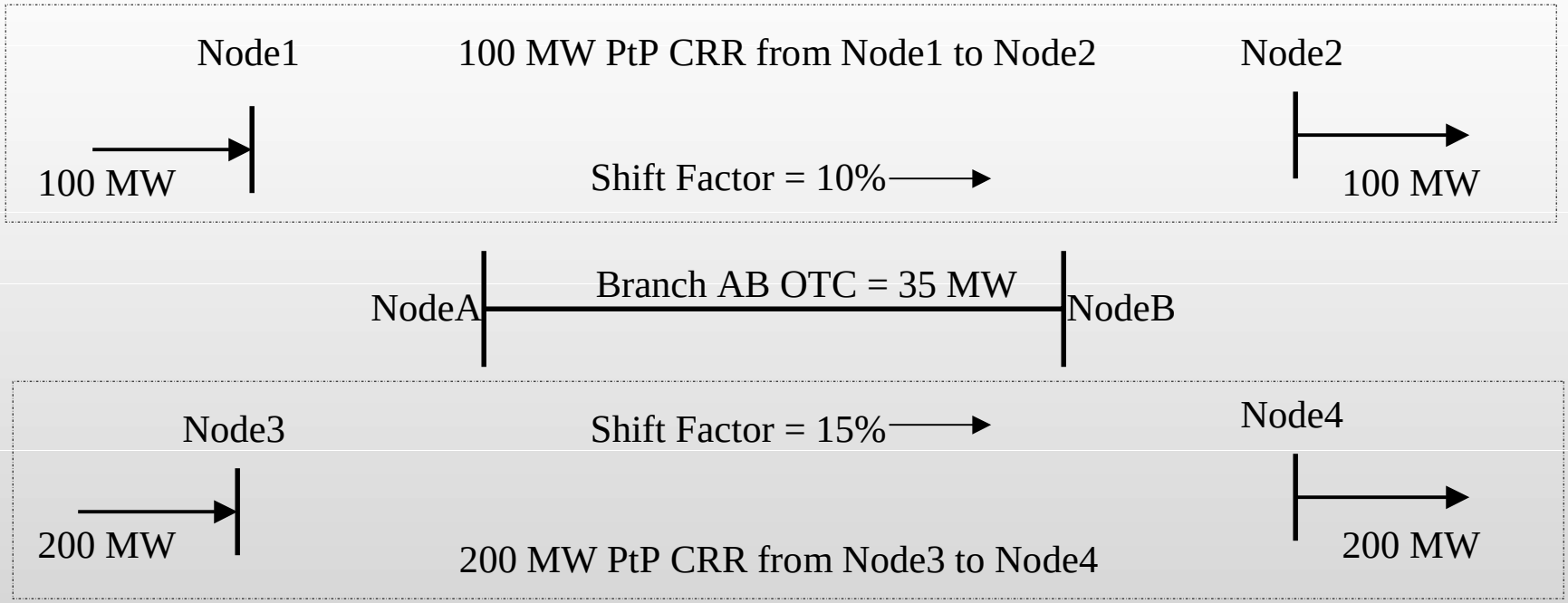
Allocation Procedures

- Start with the passive network model
  - No load and no generation
- Apply sources and sinks
  - Sources act as generation and import
  - Sinks act as load and exports
- Optimization will maximize CRRs awards subject to constraints

Simple Allocation Example to Show Use of Shift Factors

- Shift Factors or Power Transfer Distribution Factors (PTDF)
- Gives % of flow and direction on a transmission line due to a locational injection and a locational withdrawal

Simple Allocation Example to Show Use of Shift Factors



Simple Allocation Example to Show Use of Shift Factors

- Flow on Branch AB (from NodeA to NodeB)
- 100 MW PtP CRR from Node1 to Node2

  100 * 10% = 10 MW
- 200 MW PtP CRR from Node3 to Node4

  200 * 15% = 30 MW
- Total Flow

  10 MW + 30 MW = 40 MW > 35 MW OTC
- Need to curtail 5 MW to relieve overload

Simple Allocation Example to Show Use of Shift Factors

- What if 100 MW CRR is curtailed
- To get 5 MW off of Branch AB
- 5 divided by 10% = 50 MW
- Need to curtail 100 MW CRR by 50 MW
- Resultant flow on Branch AB
- (100 – 50) * 10% + 200 * 15% = 35 MW

Simple Allocation Example to Show Use of Shift Factors

- What if 200 MW CRR is curtailed
- To get 5 MW off of Branch AB
- 5 divided by 15% = 33.33 MW
- Need to curtail 200 MW CRR by 33.33 MW
- Resultant flow on Branch AB
- 100 * 10% + (200 – 33.33) * 15% = 35 MW

Simple Allocation Example to Show Use of Shift Factors

- Optimization
- Try to maximize CRRs awarded
- Try to minimize CRRs curtailed
  - 100 MW CRR curtailed by 50 MW
    or
    200 MW CRR curtailed by 33.33 MW
- Optimal to curtail the 200 MW CRR by 33.33 MW
- Any curtailment combination of the 100 MW and the 200 MW CRR will be greater than 33.33 MW

Simple Allocation Example to Show Use of Shift Factors

- With only 1 constraint binding (overloaded and needs curtailment)
- Rule
  - Curtail the CRR with the largest shift factor
  - If multiple CRRs with same shift factors
    - Pro rata based on CRR MW

Simple Allocation Example to Show Use of Shift Factors

- Assume a price is given for each CRR
  - 100 MW CRR at $100/MW
  - 200 MW CRR at $500/MW
  - Maximize the quote-based value of the awarded CRRs
- Concept of **Effective Price**
- Value of CRR divided by shift factor
  - 100 MW CRR: ($100/MW) / 10% = $1,000/MW
  - 200 MW CRR: ($500/MW) / 15% = $3,333/MW
  - These are the objective function cost reductions for 1 MW of reduction of overload
  - For example, to reduce 1 MW of overload on the branch by the 100 MW CRR requires 10 MW reduction of that CRR, 10 MW reduction is $1,000
  - ~~Maximize the quote-based value of the awarded CRRs implies to~~ minimize the cost of curtailment
  - Since $1,000/MW < $3,333/MW, the optimal curtailment would be on the 100 MW CRR

Simple Allocation to Show Use of Shift Factors

- With only 1 constraint binding (overloaded and needs curtailment)
  - Easy to use shift factors to understand curtailment
- With more than 1 constraint binding (overloaded and needs curtailment)
  - More difficult to use shift factors to understand curtailment
  - Linear Program does this

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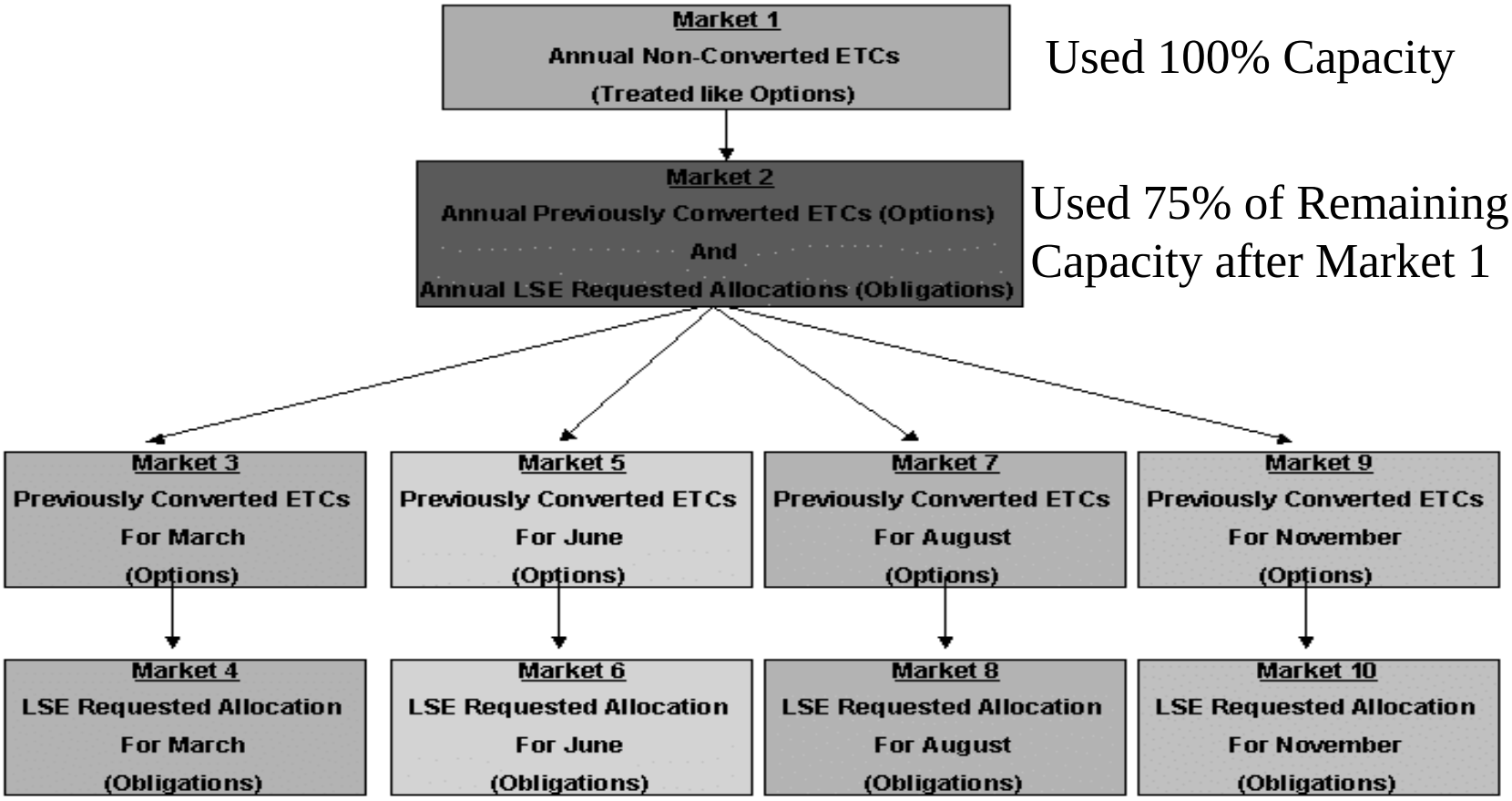
Market Run Sequence

Graphic Showing Sequence of Market Runs for CRR Study



Markets 3 through 10 -- Used 100% of Remaining Capacity
After Market 1 and Market 2

Question and Answer Period

Lunch
(Noon to 1:00 p.m.)

Proposed Sensitivity Runs

- Perform sensitivity runs by changing data that is easy to manage
- Limit the amount of work for the sensitivity run
- Wait until Study 2 to make major changes
- Run 1
  - Change all ETC Options to Obligations
    - Except for COTP
  - Remove the “load” to “gen” direction of the ETC
  - Re-run all Markets
- Run 2
  - Change all CRR nominations to Options
  - Re-run all Markets

CRR Study 2

Question and Answer Period

Future Steps