

CRR Overview

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CongestionRevenueRightsOverviewPresentation2014_03_25_CB

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1.1 Congestion Revenue Rights (CRR)



1.2 Introduction



1.3 Goal of this Training Course

Goal of this Training Course

Provide an overview of the various CRR processes that participants should understand in order to be able to participate in the CRR Allocation and/or CRR Auction.



1.4 Training Course Agenda

Training Course Agenda

In this presentation we will discuss the following topics related to Congestion Revenue Rights:

- Section 1 - General Overview of CRRs
- Section 2 – Simultaneous Feasibility Test
- Section 3 - CRR Allocation Overview
- Section 4 - CRR Auction Overview
- Section 5 - CRR Holding Requirements
- Section 6 - Secondary Registration
- Section 7 – CRR Related Grid Management Charges




1.5 Section 1 – General Overview of CRRs Topics

Section 1 – General Overview of CRRs Topics

General Overview of CRRs


- Registration
- CRR Types – Obligations and Options
- CRR Terms and TOU Definition
- CRRs are Financial Rights
- Non-Disclosure Agreement (NDA) Process for access to the CRR FNM
- Helpful Tools for CRR processes

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1.6 Registration Process

Registration Process

- Entities do not need to be a Scheduling Coordinator (SC) to hold CRRs
- The process is similar to the SC registration
- Process takes approximately 60 days to complete
- Send any registration correspondence to SCRequests@caiso.com

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1.7 Registration Process (cont.)

Registration Process (cont.)

- Establish ISO Minimum Participation Requirement: See Credit Management BPM
<https://bpm.caiso.com/bpm/bpm/list>
- Completed CRR Entity Agreement Information Request Sheet:
<http://www.caiso.com/rules/Pages/ContractsAgreements/Default.aspx>
- Execute a CRR Entity Agreement (Pro Forma):
<http://www.caiso.com/rules/Pages/ContractsAgreements/Default.aspx>
- Demonstrate ability to complete financial transactions:
<http://www.caiso.com/Documents/FedWireForm19-Jan-11.doc>



1.8 Registration Process (cont.)

Registration Process (cont.)

- Completed CRR Holder Affiliate form:
<http://www.caiso.com/Documents/ISOAffiliationResourceControlAgreementDisclosureForm.xls>
- Completed the CRR training courses (CRR Overview, SRS & Market User Interface (MUI) allocation or auction)
- Completed CRR FNM NDA (optional):
<http://www.caiso.com/market/Pages/ProductsServices/CongestionRevenueRights/Default.aspx>
- Establish Portal Access:
<http://www.caiso.com/participate/Pages/ApplicationAccess/Default.aspx>
 - Establish Point of Contact
 - User Application Access Request Form



1.9 CRR Types


CRR Types

CRR Obligation

- Entitles CRR Holder to a CRR Payment if Congestion is in the same direction of the CRR and requires a charge if Congestion is in the opposite direction of the CRR

CRR Option

- Entitles CRR Holder to a CRR Payment if Congestion is in the same direction as the CRR, but requires no payment if Congestion is in the opposite direction of the CRR
- Currently CRR Options are only available to Project Sponsors of a Merchant Transmission Facility that do not elect some form of regulatory cost recovery



1.10 CRR Terms


CRR Terms

Terms of CRRs

- Seasons are defined on a quarterly basis
 - Season 1 = Jan, Feb and Mar
 - Season 2 = Apr, May and June
 - Season 3 = Jul, Aug and Sep
 - Season 4 = Oct, Nov and Dec
- Long Term CRRs extend nine years after annual term for a total of ten years (Allocation only)
- Months are calendar months (e.g., January, February, ...)

Example

A PTP CRR for season 1, on-peak applies to all hours in season 1 that are defined as on-peak




1.11 CRR Time of Use

CRR Time of Use

CRR Time of Use Definition

- The time-of-use period definition is consistent with WECC and NERC
 - WECC = Western Electric Coordination Council
 - NERC = National Electric Reliability Council
- The on-peak period
 - Consists of the hours from 6 am (HE7) to 10 pm (HE22) for Monday, Tuesday, Wednesday, Thursday, Friday and Saturday, (assuming these days are non-holidays)


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1.12 CRR Time of Use

CRR Time of Use

CRR Time of Use Definition (cont.)

- The off-peak period
 - Consists of the hours from 10 pm (HE23) to 6 am (HE6) for Monday, Tuesday, Wednesday, Thursday, Friday and Saturday
 - All 24 hours for days that are Sunday and holidays
 - Holidays are New Year's day, Memorial Day, Independence day, Labor Day, Thanksgiving Day, Christmas Day
 - If the holiday falls on a Sunday, the first following Monday is treated as if it were a Sunday (i.e., all hours are off-peak)
- CRR TOU posted at <http://www.caiso.com/market/Pages/ProductsServices/CongestionRevenueRights/Default.aspx>, under Current Processes

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1.13 CRRs are Financial Rights

CRRs are Financial Rights

- A Market Participant does not need a CRR to Bid Energy into the Day-Ahead Market (DAM)
- If a Market Participant has a CRR and Bids in Energy, the Energy Bid does not need to be consistent with the CRR in terms of CRR Sink or CRR Source locations or MW quantities
- On the flip-side, a Market Participant does not need to Bid in Energy to hold a CRR
- The CRR only settles on the Marginal Cost of Congestion (MCC) of the Day-Ahead Locational Marginal Pricing (LMP) for each respective hour, adjusted for any shortfall between what is collected in the DAM and what is to be paid out to CRR holders, by constraint.



1.14 Non-Disclosure Agreement (NDA) Process for access to the CRR FNM

Non-Disclosure Agreement (NDA) Process for access to the CRR FNM

- Entities need to execute the CRR FNM NDA: <http://www.caiso.com/market/Pages/ProductsServices/CongestionRevenueRights/Default.aspx>
- Individuals need to execute Exhibit A.
- Consultants need to execute Exhibit C.
- Once the NDA is executed the POC needs to submit the User Access Application Request Form to request access to the CRR FNM SharePoint site on the Market Participant Portal (MPP).
- Data is released to NDA holders via the CRR FNM SharePoint site. <https://portal.caiso.com/crrfnm/default.aspx>
- An email is sent out to notify primary recipients that data is available for download
- Send questions regarding CRR FNM data to crrdata@caiso.com



1.15 Helpful Tools for CRR processes

Helpful Tools for CRR processes

- Websites
- CRR Market Participants distribution list
- Market Notice Subscription Form
- Weekly CRR Conference Call
- crrdata mailbox



1.16 Websites

Websites

- CRR Production Page:
<http://www.caiso.com/market/Pages/ProductsServices/CongestionRevenueRights/Default.aspx>
- CRR Initiative Page:
<http://www.caiso.com/informed/Pages/StakeholderProcesses/Default.aspx>
- The ISO Tariff:
<http://www.caiso.com/rules/Pages/Regulatory/Default.aspx>



1.17 Websites

Websites

- Business Practice Manual (BPM) Library:
<https://bpm.caiso.com/bpm/bpm/list>
 - BPM for Candidate CRR Holder Registration
 - BPM for Congestion Revenue Rights
 - BPM for Credit Management
- Market Report:
<http://www.caiso.com/market/Pages/ReportsBulletins/Default.aspx>
- OASIS (CRR Public Market Results & Clearing Prices):
<http://oasis.caiso.com/mrtu-oasis/>



1.18 CRR Market Participants distribution list

CRR Market Participants distribution list

- Upon completing the process for registering to become a Candidate CRR Holder, the primary contact is automatically added to this distribution list
- This distribution list is used to send out reminders and information notifications to CRR Market Participants (i.e. window reminders, posting of results, etc.)
- You are not required to be a registered Candidate CRR Holder to be a member of this list and can have as many members on this list as you desire
- If you wish to be added to this list, please send an email to crrdata@caiso.com and provide us with your name, company and email address



1.19 Market Notice Subscription Form

Market Notice Subscription Form

- Formal notification will be sent out as Market Notices (i.e. posting of schedule, stakeholder meetings, training)
- To receive these Market Notices, please complete the Market Notice Subscription Form located at <http://www.caiso.com/informed/Pages/Notifications/Default.aspx>.
- For the CRR process, please check the following notice categories:
 - Market Operations
 - Settlements and Market Clearing



1.20 Weekly CRR Conference Call

Bi-Weekly CRR Conference Call

The California ISO hosts a bi-weekly conference call on Wednesdays. This is an opportunity for Candidate CRR Holders to ask general questions regarding the CRR process. Please check the CAISO calendar on [caiso.com](http://www.caiso.com) for dates and call-in information.



1.21 crrdata mailbox

crrdata mailbox

- Please send technical and proprietary questions / issues related to the CRR process to crrdata@caiso.com
- This mailbox is monitored by the CRR Team



1.22 Section 1 - QUESTIONS ?

Section 1 - QUESTIONS ?

General Overview of CRRs

- Registration
- CRR Types – Obligations and Options
- CRR Terms and TOU Definition
- CRRs are Financial Rights
- Non-Disclosure Agreement (NDA) Process for access to the CRR FNM
- Helpful Tools for CRR processes




1.23 Section 2 – Simultaneous Feasibility Test

Section 2 – Simultaneous Feasibility Test

Simultaneous Feasibility Test

- Overview of SFT process
- Key Elements for SFT process
 - Full Network Model (FNM)
 - Operating Constraints and Contingencies
 - APNodes
 - Distribution/Allocation Factors
 - Outages (Monthly Process)
- Shift Factors
- Weighted Least Square
- Retirement Process




1.24 Simultaneous Feasibility Test

Simultaneous Feasibility Test

The idea behind the SFT is to take the CRR Source(s) location, the CRR Sink(s) location and MW quantity(s) of the CRR nomination or CRR bid and apply these to the FNM as if they were Generator(s) and Load(s)

- The FNM used here is similar to the FNM used in the DA IFM
 - Topology
 - Constraints Limits
- The CRR FNM is a DC model and as such does not have any resistance, thus there are no transmission losses and the total amount injected into the system is equal to the total amount withdrawn from the system
- When infeasibility does occur, a process is applied that reduces the CRR nomination or CRR bid MW quantities until feasibility is achieved



1.25 Simultaneous Feasibility Test

Simultaneous Feasibility Test

- This optimization formulation is used in both the CRR Allocation and CRR Auction process
 - The objective function is slightly different in each
 - The topology and constraints are the same
- The objective functions in the CRR Allocation and CRR Auction process
 - **CRR Allocation:** Starting from January 2011 monthly CRR process the objective function has been modified to utilize the weighted least squares (WLS)
 - **CRR Auction:** the objective function used in the CRR Auction process is to maximize the bid based value of the awarded CRRs



1.26 Simultaneous Feasibility Test - Allocation

Simultaneous Feasibility Test - Allocation

- For the monthly/annual allocation tiers, the objective function is to minimize the weighted least squares (WLS)
$$\min \left(\sum_{i=1}^N \alpha_i (\bar{X}_i - X_i)^2 \right)$$
- With WLS there is a sharing of the reduction as compared to the old methodology which was to maximize the CRR MW amount in which the most effective control variable is reduced/removed first.
- Since it is important to understand how shift factors work to understand the WLS optimization we will wait until after the discussion on shift factors to go through an example of how WLS is applied.



1.27 Simultaneous Feasibility Test - Auction

Simultaneous Feasibility Test - Auction

- For the monthly/annual auction process, the objective function is to maximize the bid value of the awarded CRRs
- With the allocation process, participants only request MW amounts for the CRR source/sink pairs being nominated while for the auction participants also provide a bid curve.
- A simple example of how the auction optimization works is provided after the example on WLS later in this presentation



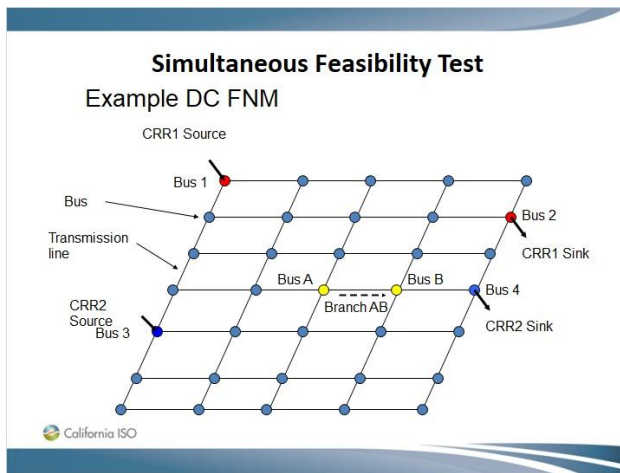
1.28 Simultaneous Feasibility Test

Simultaneous Feasibility Test

- The CRR Allocation and CRR Auction process will provide CRRs for terms of one season/TOU and one month/ TOU, so choosing the proper set of underlying data for the SFT can be difficult
- When setting up the process for the CRR Allocation or CRR Auction the following data must be used within the SFT process
 - FNM topology (from which the shift factors are derived)
 - APNodes and their allocation factors
 - Constraint limits
- Given a CRR Allocation or CRR Auction process that will create a bundle of CRRs for a particular term/TOU
 - Every CRR created will be tested by an SFT that has one FNM, one set of allocation factors for each APNode, and one set of Constraint Limits



1.29 Simultaneous Feasibility Test



1.30 Simultaneous Feasibility Test – Full Network Model

Simultaneous Feasibility Test – Full Network Model

For CRR purposes, certain simplifying assumptions are made about the FNM to make it a linear model

- All resistances are set to zero (no transmission losses)
- All voltage magnitudes are set to 1.0 per-unit
 - Reactive power is ignored
- The flow across a transmission branch is assumed to be a linear function of the bus angles, which are at either end of the line
 - This results in a linear model, i.e., the injection of power at a bus to the change in flow over a given branch is a linear relationship (i.e., the shift factor) and this relationship is only dependent upon the reactance of the transmission branches
- Only active power (MW) flowing over transmission branches can be calculated in the DC FNM

1.31 Simultaneous Feasibility Test – Full Network Model

Simultaneous Feasibility Test – Full Network Model

- The FNM for the Long Term process will include sixty (60) percent of the Seasonal Available CRR Capacity that is used in the annual process
- The FNM for the annual process will include seventy five (75) percent of the Seasonal Available CRR Capacity that is in service for the start of the annual CRR allocation and auction processes
- For the monthly processes, the FNM will include one hundred (100) percent of the Monthly Available CRR Capacity associated with transmission facilities that are in-service when the monthly allocation and auction process begins.
 - We will not model “expected” upgrades



1.32 Simultaneous Feasibility Test - Constraints

Simultaneous Feasibility Test - Constraints

Constraint limits used in the Day-Ahead operation of the power system include limits placed on observable (measurable) variables in the power system such as:

- Flows on individual or groups of branches
 - Also enforced under contingency analysis
- Generation levels in certain areas of the system
- Voltage levels
- Relationships between Generation levels, Load levels, voltage levels and branch (or branch group) flows



1.33 Simultaneous Feasibility Test - Constraints

Simultaneous Feasibility Test - Constraints

- Constraints enforced in the CRR process should be consistent with those used in Integrated Forward Market (IFM), as much as possible, but due to timing differences and the use of a DC model in the CRR process there are some inherent differences
 - Coordinate with IFM team on Interface, branch group and nomogram constraints, thermal constraints and contingency constraints recognizing timing and modeling differences
- Constraint limit values will be based on operating procedures utilized by the IFM
- **Adjustments will be made to constraint limits to take into consideration the absence of reactive power and losses**
 - Monitored facilities limits reduced to account for reactive power (3%) and losses (2%)
 - Interface limits reduced to account for losses (2%)



1.34 Simultaneous Feasibility Test - Constraints

Simultaneous Feasibility Test - Constraints

- Adjustments made to the constraint limits used in the monthly CRR processes.
 - Global De-rate Factor (GDF) – This adjustment is reflected through the monitored facilities to account for unplanned outages and the impact on internal transmission elements
 - Local De-Rate Factor (LDFR) – This adjustment is reflected through the interface limits file to account for unplanned outages and is adjusted on an interface-by-interface basis.
 - Outages are modeled in the monthly processes whereas with the annual process all lines are assumed to be in-service unless a long-term outage is known prior to the running of the annual process.



1.35 Simultaneous Feasibility Test - APNodes


Simultaneous Feasibility Test - APNodes

Aggregated Pricing Nodes (APNodes)

- Most sinks used in defining CRRs are APNodes
- APNodes are also used in the IFM for bidding purposes

Allowable Sources and Sinks (PNodes or APNodes)


- The list of allowable Sources (Injections) and Sinks (Withdrawals) will be made available on the ISO website and the CRR System prior to running any allocation or auction markets
<http://www.caiso.com/market/Pages/ProductsServices/CongestionRevenueRights/Default.aspx>

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1.36 Simultaneous Feasibility Test - APNodes

Simultaneous Feasibility Test - APNodes

- **Aggregated Pricing Nodes (APNode)**
 - A group of PNodes that may represent such items as a Load Aggregation Point or a Trading Hub
 - The term PNode is a location in the FNM, typically a bus
- **The main purpose of an APNode is that it represents physical scheduling resources in the IFM that connect to the FNM at more than one location**
 - Through the IFM an LMP is determined for each of the different APNodes that are Bid into the IFM

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1.37 Simultaneous Feasibility Test - APNodes

Simultaneous Feasibility Test - APNodes

- APNodes can also be defined for non-bidding purposes
 - A Trading Hub is not bid into the IFM, but an LMP is still calculated
- The CRR Sources and CRR Sinks are modeled as either PNodes or APNodes in the CRR SFT process



1.38 Simultaneous Feasibility Test - APNodes

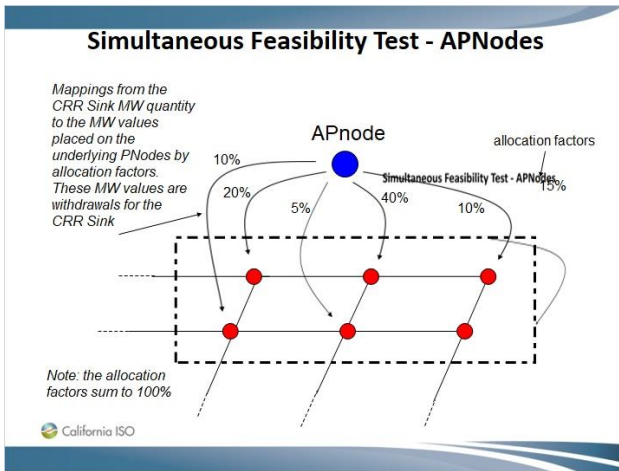
Simultaneous Feasibility Test - APNodes

Two Attributes of Aggregated Pricing Node

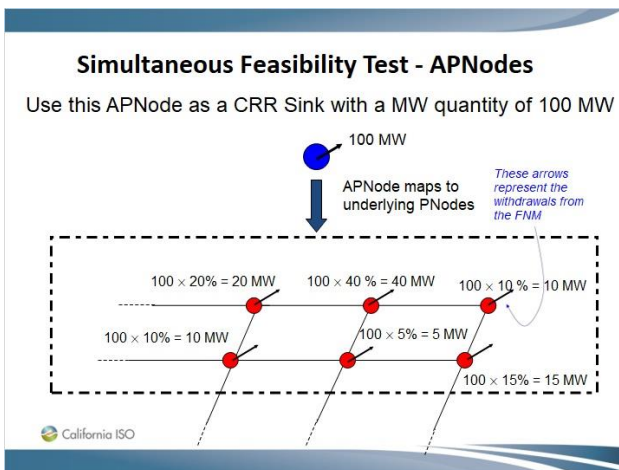
- A set of two or more PNodes
 - Each PNode provides a mapping back to the underlying FNM
 - An LMP is calculated by the IFM for each PNode in this set
- A set of allocation factors, one allocation factor for each PNode
 - These are also referred to as either Load or Generator Distribution Factors for Load or Generator Aggregation Points
 - For the CRR SFT, they are generally called allocation factors
 - The properties of the allocation factors are:
 - Each allocation factors is greater than or equal to 0.0
 - Each allocation factors is less than or equal to 1.0
 - The allocation factors for a particular APNode sum to 1.0



1.39 Simultaneous Feasibility Test - APNodes



1.40 Simultaneous Feasibility Test - APNodes




1.41 Simultaneous Feasibility Test

Simultaneous Feasibility Test
– Distribution Factors

Distribution Factors

- Distribution Factors for Load Aggregation Points will be based on historical load patterns as seen through the running of the DAM – applies to:
 - Default Load (DLAP) Aggregation Points
 - Sub Load (SLAP) Aggregation Points
 - Metered Subsystem Load (MLAP) Aggregation Points
 - Custom Load (CLAP) Aggregation Points
- Trading Hubs
 - Distribution factors are based on the weighted average generation output, for the prior full year of historical data, of all Generating Units within a Trading Hub


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1.42 Simultaneous Feasibility Test – Trading Hub

Simultaneous Feasibility Test – Trading Hub

Trading Hub

- For the CRR Allocation, CRR nominations with Trading Hubs as sources will be disaggregated into Point-to-Point CRRs each of whose CRR Source is a Generating Unit PNode that is an element of the Trading Hub
 - Each nomination will equal the MW quantity of the CRR nomination multiplied by the weighting factor of the corresponding Generating PNode
- The Trading Hub allocation factors will be updated once a year to coincide with the CRR annual processes
- Due to disaggregation of the Trading Hub and the .001 MW limit for CRRs, it is possible that the total disaggregated MW amount could be less than the nominated amount after the SFT is run
 - In addition, awards less than .001MW will be truncated to zero

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1.43 Simultaneous Feasibility Test – Trading Hub

Simultaneous Feasibility Test – Trading Hub

- Starting from January 2011 CRR monthly process for all allocation markets, trading hub CRRs are re-aggregated after the SFT process
- The re-aggregation is performed to reduce the number of awarded CRRs
- The process of re-aggregation is explained here with a simple example
- Consider a simple trading hub which consists of five PNodes A through E the disaggregation and re-aggregation of CRRs are shown in the following slide



1.44 Simultaneous Feasibility Test – Trading Hub

Simultaneous Feasibility Test – Trading Hub

Total CRR nominated at trading hub is 50 MW

				Max Percent	100%
Nodes	AF	Nominated	Allocated		Counter Flow
A	0.2	10	10	100%	0
B	0.2	10	10	100%	0
C	0.2	10	0	0%	10
D	0.2	10	10	100%	0
E	0.2	10	10	100%	0
			40		1
		Trading Hub MW		50	1
		CRR Count			2




1.45 Simultaneous Feasibility Test - Outages

Simultaneous Feasibility Test - Outages

Outages


- Scheduled outages may be considered in the annual process if the transmission facilities will be out-of-service for several weeks over a season, otherwise, all lines are considered in-service for annual process
- For the monthly process, the ISO will be applying selected 30 days' rule outages together with an appropriate global de-rating factor to the model to account for unplanned outages
- The detailed process is included in the CRR BPM

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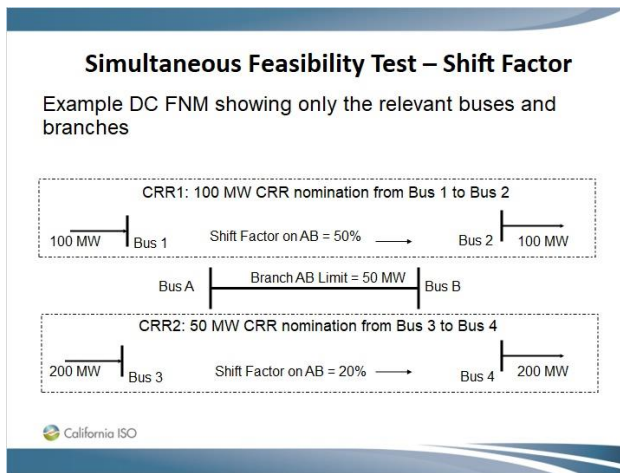
1.46 Simultaneous Feasibility Test – Shift Factors

Simultaneous Feasibility Test – Shift Factors

- Shift Factors are also known by other names
 - Power transfer distribution factors (PTDFs)
 - Power distribution coefficients (PDCs)
 - Effectiveness factors
 - Impedance factors
- This shift factor definition is:
 - **SF_{ji} = shift factor for bus i (with respect to the reference location) on constraint j**
 - i.e., the incremental amount of power flow on constraint j when an additional unit of power is injected at bus i and withdrawn from the reference location
 - Shift factors are dependent upon the network topology of the FNM from which they are derived

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1.47 Simultaneous Feasibility Test – Shift Factor



1.48 Simultaneous Feasibility Test –Shift Factor

Simultaneous Feasibility Test –Shift Factor

- CRR1: 100 MW PTP CRR nomination from Bus 1 to Bus 2
- CRR2: 200 MW PTP CRR nomination from Bus 3 to Bus 4
- Flow on Branch AB (from Bus A to Bus B)
 - MW quantity \times Shift factor
 - CRR1: $100 \times 50\% = 50$ MW
 - CRR2: $50 \times 20\% = 10$ MW
- Total flow on the Branch AB (from Bus A to Bus B)
 - 50 MW + 10 MW = 60 MW > 50 MW Limit
 - Feasibility is violated, the SFT fails
- Need to reduce the flow on the Constraint by 10 MW to relieve overload

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1.49 Simultaneous Feasibility Test –Shift Factor

Simultaneous Feasibility Test –Shift Factor

- Let's explore the different alternatives for relieving the overload and see the impact of each alternative on the objective function
- There are three alternatives
 - Use only CRR1 to relieve the Constraint overload
 - Use only CRR2 to relieve the Constraint overload
 - Use a combination of CRR1 and CRR2 to relieve the Constraint overload



1.50 Simultaneous Feasibility Test – Shift Factor

Simultaneous Feasibility Test – Shift Factor

What if the MW quantity from CRR1 is reduced

- The impact that CRR1 has (i.e., a change in the MW quantity of CRR1) on the flow on the Constraint
 - If the MW quantity from CRR1 is increased by 1 MW what is the increase to the flow on Branch AB
 - $1 \text{ MW} \times 50\% = 0.5 \text{ MW}$
 - If the MW quantity from CRR1 is decreased by 1 MW what is the decrease to the flow on Branch AB
 - $(-1 \text{ MW}) \times 50\% = -0.5 \text{ MW}$
- To get 10 MW off of Branch AB we will need to reduce the MW quantity from CRR1 by 20 MW
 - $10 \text{ divided by } 50\% = 20 \text{ MW}$
- Resultant flow on Branch AB
 - $(100 - 20) \times 50\% + 50 \times 20\% = 50 \text{ MW}$



1.51 Simultaneous Feasibility Test – Shift Factor

Simultaneous Feasibility Test – Shift Factor

What if the MW quantity from CRR2 is reduced

- Go through a similar process that was applied to CRR1
- To get 10 MW off of Branch AB the amount of the MW quantity from CRR2 needs to be reduced by
 $10 \text{ divided by } 20\% = 50 \text{ MW}$
- Resultant flow on Branch AB
 $100 \times 50\% + (50 - 50) \times 20\% = 50 \text{ MW}$
- In this case CRR2 is reduced to zero to relieve the constraint



1.52 Simultaneous Feasibility Test – Shift Factor

Simultaneous Feasibility Test – Shift Factor

The three alternatives

- Reduce the MW quantity from CRR1 by 20 MW
- Objective function = CRR1 MW quantity + CRR2 MW quantity = $(100 - 20) + 50 = 130 \text{ MW}$
or
- Reduce the MW quantity from CRR2 by 50 MW
- Objective function = CRR1 MW quantity + CRR2 MW quantity = $100 + (50 - 50) = 100 \text{ MW}$
or
- Reduce both nominations/bids and share the reduction



1.53 Simultaneous Feasibility Test – Shift Factor

Simultaneous Feasibility Test – Shift Factor

- How to determine which nomination or bid will get reduced depends on the optimization formula that is being used
- As discussed earlier in this presentation there are two basic objective functions used by the CRR System, one for the allocation and another for the auction;
 - CRR Allocation – Weighted Least Squares
 - CRR Auction – Maximize bid based value of the awarded CRRs



1.54 Simultaneous Feasibility Test – Weighed Least Square

Simultaneous Feasibility Test – Weighed Least Square

- The WLS formula for deriving the reduction of a nomination is noted below

\bar{X}_i denote nominated MW for CRR i

$SF_{i,k}$ be shift factor of CRR i wrt constraint k

$\Delta V_{k,i}$ Reduction in each nomination be

ΔV Total overload

$\Delta V_{k,i}$ reduction in flow because of CRR i

$\Delta V_{k,i} = R_{i,k} \cdot \Delta V$

$$R_{i,k} = \frac{\bar{X}_i \cdot SF_{i,k}^2}{\sum_{i=1}^N (\bar{X}_i \cdot SF_{i,k}^2)}, \text{ where } \sum_{i=1}^N R_{i,k} = 1$$



1.55 Simultaneous Feasibility Test – Weighed Least Square

Simultaneous Feasibility Test – Weighed Least Square

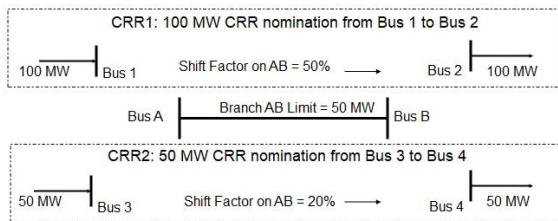
- Prior to WLS the objective function for the allocation was to maximize the number of awarded CRRs, which reduced nominations with the highest SF first.
- In the WLS formulation, the reduction on the flow on the constraint is pro-rated based on squares of the shift factors and the weight of the nomination amount
- WLS distributes the curtailment across all CRR nominations that are effective in relieving the congestion, and thus spreads the curtailment among multiple allocation participants
- The WLS was implemented as a more equitable formulation for the CRR allocation process; in that CRR nominations share the available capacity



1.56 Simultaneous Feasibility Test – WLS Example

Simultaneous Feasibility Test – WLS Example

Continuing with the prior example, assume two nominations and one enforced constraint with a limit of 50MW on the system



1.57 Simultaneous Feasibility Test - Allocation

Simultaneous Feasibility Test - Allocation

- Since CRR1 has a SF of 0.5 and CRR2 has a SF of 0.2 on the constraint, these combined nominations create an overload of 10MW ($(50 - (100*0.5) - (50*0.2))$).
- If the objective function were still based on maximizing awarded MWs then CRR1, since it is most effective in relieving the constraint, would be reduced by 20MW to achieve feasibility ($0.5*20 = 10$).
- With WLS the first step is to calculate the sharing of the 10MW overload between the two nominations by taking each of the nominated amounts times the square of the respective SF and divide by the sum of all nominations times the respective square of the SF
- For CRR1 the result is $100*0.5^2 / 100*0.5^2 + 50*0.2^2$, which equals $25/25+2 = 25/27 = .9259$

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1.58 Simultaneous Feasibility Test - Allocation

Simultaneous Feasibility Test - Allocation

- For CRR2 the result is $50*0.2^2 / 100*0.5^2 + 50*0.2^2$, which equals $2/25+2 = 2/27 = .0741$
- CRR1 share of reduction is $10*.9259 = 9.259\text{MW}$
- CRR2 share of reduction is $10*.0741 = 0.741\text{MW}$
- The above values are the amounts before taking into consideration the effectiveness (SF) of each nomination on the constraint, therefore the last step is to adjust the reduction for each nomination's SF. In other words, what do I need to adjust the nomination amount by in order to get the required reduction and relieve the constraint.

 California ISO

1.59 Simultaneous Feasibility Test - Allocation

Simultaneous Feasibility Test - Allocation

- CRR1 adjustment is $(1/0.5) * 9.259 = 18.518$
- CRR2 adjustment is $(1/0.2) * 0.741 = 3.705$
- CRR1 award is $100 - 18.518 = 81.482$
- CRR2 award is $50 - 3.705 = 46.295$
- Constraint limit of 50MW is now met, which is equal to the awarded amounts for the two new CRRs times the respective shift factor of each CRR.
- CRR1 flow contribution = $40.741 (81.482 * 0.5)$
- CRR2 flow contribution = $9.259 (46.295 * 0.2)$
- Total flow contribution = $40.741 + 9.259 = 50\text{MW}$



1.60 Simultaneous Feasibility Test - Allocation

Simultaneous Feasibility Test - Allocation

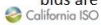
- Notice that the WLS objective function results in a sharing of the reduction, but consideration is given to the effectiveness (shift factor) of the nomination on relieving the constraint as well as the nomination amount.
- CRR1 with the higher shift factor took a larger share of the reduction, even though its nomination amount was twice that of CRR2. The reduction for CRR1 was 18.518% of the nomination while for CRR2 the reduction was 7.41% of the nomination amount.



1.61 Simultaneous Feasibility Test - Auction

Simultaneous Feasibility Test - Auction

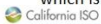
- To provide a simple example of how the auction optimization would work let's assume the same set up as described in the allocation example with the addition of the two bid curves shown below in the format (MW,\$):
 - CRR1 (0,40), (100,40)
 - CRR2 (0,50), (50,50)
- As noted in the previous allocation example there is only 50MW of capacity available (assuming no counter-flow positions) on the identified constraint.
- Also from the previous example we know that these two bids contribute to 60MW of flows across the constraint, based on the respective shift factors, so the CRR System needs to determine which bids are awarded and at what levels.



1.62 Simultaneous Feasibility Test - Auction

Simultaneous Feasibility Test - Auction


- Since the auction optimization formula wants to maximize the bid value of the awarded CRRs the software will start lowering the lowest valued bids until it no longer has a binding constraint. In this example there is only a single constraint and only two bids so it is fairly simple. In reality this is not the case and there are multiple constraints that need to be resolved with thousands of bids to consider.
- The software needs to reduce flows on the constraint by 10MW, so since the CRR1 bid is the lower valued bid and has a SF of 0.5 the software will reduce the CRR1 bid by 20MW ($20 * 0.5 = 10$) to eliminate the binding constraint.
- The results will be that CRR2 is awarded the full 50MW bid, with CRR1 being awarded 80MW. The clearing price would be the marginal bid which is \$40.



1.63 Retirement Process

Retirement Process


- Driven by IFM change
 - Generator Retirement
 - Model Change
- Impacts to CRR
 - Existing CRRs which have source/sink located at the retired PNodes/APNodes will be mapped to the closest electrically connected CRR biddable location
 - Retirement notices will be sent to CRR Market Participants
 - An updated list of CRR Source and Sink APNodes will be posted at <http://www.caiso.com/market/Pages/ProductsServices/CongestionRevenueRights/Default.aspx>
 - An updated CRR APNode Name Change Mapping file will be posted at <http://www.caiso.com/market/Pages/ProductsServices/CongestionRevenueRights/Default.aspx>



1.64 Retirement Process

Retirement Process

- Impacts to CRR
 - Should the retirement of a PNode/APNode be related to a change in system topology, i.e. the CRR source or sink is no longer within the ISO BAA then after the reconfiguration a SFT is performed to ensure feasibility of the reconfigured CRRs
 - If the reconfigured CRRs are not feasible then they will be reduced until feasibility is achieved




1.65 Section 2 – QUESTIONS ?

Section 2 – QUESTIONS ?

Simultaneous Feasibility Test

- Overview of SFT process
- Key Elements for SFT process
 - Full Network Model (FNM)
 - Operating Constraints and Contingencies
 - APNodes
 - Distribution/Allocation Factors
 - Outages (Monthly Process)
- Shift Factors
- Weighed Least Square
- Retirement Process


 California ISO

1.66 Section 3 – CRR Allocation Overview Topics

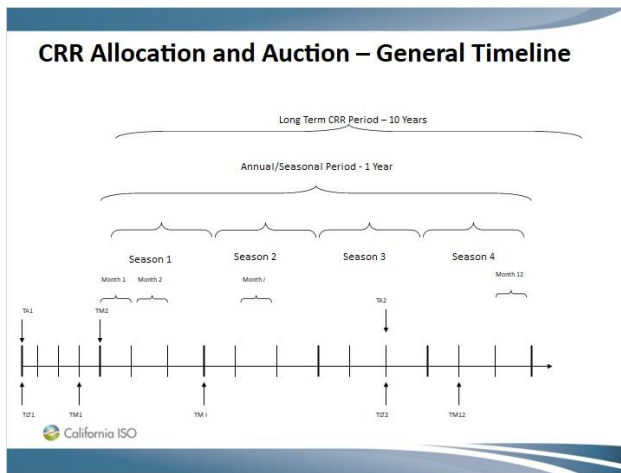
Section 3 – CRR Allocation Overview Topics

CRR Allocation Overview

- General timeline
- Eligibility to Participate
- Calculating Eligible Quantities
- CRR Allocation and Auction – Annual Processes
- CRR Allocation and Auction – Monthly Processes
- TOR and ETC Modeling
- Load Migration

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1.67 CRR Allocation and Auction – General Timeline



1.68 CRR Allocation and Auction – Annual Timeline

CRR Allocation and Auction – Annual Timeline

Annual Process timeline overview


- Only 65% of the FNM capacity will be made available
- T_{A1} & T_{LT1} : Approximately 4 months before the start of the CRR year, the annual allocation/auction process will begin, which will produce seasonal/TOU CRRs for Seasons 1, 2, 3 and 4. Tier LT of the annual allocation process will produce seasonal/TOU long term CRRs that will be allocated for the duration of 10 years (one year from the annual allocation and a nine-year extension through the long-term tier).

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1.69 CRR Allocation and Auction – Annual Timeline (cont.)

CRR Allocation and Auction – Annual Timeline (cont.)

- During the annual allocation/auction process:
 - Tier 1 for all four seasons and TOU will be processed simultaneously, then
 - Tier LT for all four seasons and TOU will be processed simultaneously, then
 - Tier 2 for all four seasons and TOU will be processed simultaneously, then
 - Tier 3 for all four seasons and TOU will be processed simultaneously, then
 - The auction for all four seasons and TOU will be processed simultaneously

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T_{A2} & T₁₇₂: Approximately 4 months before the start of the next year (year 2), the annual allocation/auction process will begin, which will

1.70 CRR Allocation and Auction – Annual Timeline (cont.)

CRR Allocation and Auction – Annual Timeline (cont.)

- “Process simultaneously” means when all four seasonal tier-one allocation markets are processed, all four are opened for nomination submission and all four are then closed for nomination submission at the same time
- The ISO will then run the SFT process for each seasonal tier-one (one SFT for the on-peak period and one SFT for the off-peak period, for each season)
- The ISO will post all of these market results at the same time

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1.71 Eligible Allocation Participants

Eligible Allocation Participants

Allocation

Must be classified as one of the following:

- Load Serving Entity (LSE), which includes:
 - Entities serving load within the ISO Control Area
 - Metered Subsystems – Gross and Net election
- Out of Balancing Authority Area Load Serving Entity (OBAALSE), which includes:
 - Load external to the ISO Balancing Authority Area being served with internally owned or contracted generation that is subject to Congestion on the ISO controlled grid
 - Subject to other conditions, such as prepayment of WAC




1.72 Eligible Allocation Participants (cont.)

Eligible Allocation Participants (cont.)

Merchant Transmission

- Will be eligible for MT CRRs only if such entity has turned over the qualifying facilities to the ISO and has elected not to recover costs of its investments through a regulated cost recovery mechanism
- May request up to five nominations for each TOU
- Three step process for releasing MT CRRs
 - Determine the capability of the existing Transmission System
 - Determine the mitigation of impacts on existing encumbrances
 - Determine the incremental Merchant Transmission CRRs
- Duration of MT CRRs will be 30yrs or pre-specified intended life of facility
- MT holders can elect to receive CRR Options or Obligations



1.73 Calculating Eligible Quantities

Calculating Eligible Quantities

Once a Candidate CRR Holder has registered and becomes eligible to participate in the CRR Allocation process the ISO will require the entity to submit either historical or forecast Load data

- Which is used to determine either the Seasonal CRR Eligible Quantity or Monthly CRR Eligible Quantity, respectively
- For entities with load that fluctuates based on hydrological conditions, monthly data can be forecast or historical.



1.74 Calculating Eligible Quantities (cont'd.)

Calculating Eligible Quantities (cont'd.)

Seasonal CRR Eligible Quantity

- Seasonal CRR Process
 - Start with historical load duration curves, to derive the 0.5% exceedance level for CRR Load Metric which is based on season, time of use and load area. OBAALSEs will submit similar data but associated with usage of export points and the level of load subject to ISO congestion
 - Subtract load served by TOR and ETC to determine the Adjusted Load Metric (ALM)
 - Multiply result by 75%
 - This value is the Seasonal CRR Eligible Quantity




1.75 Calculating Eligible Quantities (cont'd.)

Calculating Eligible Quantities (cont'd.)

Long Term Eligible Quantity

- Limited up to fifty (50) percent of the Adjusted Load Metric
- Nominations are validated against cleared CRRs from the Priority Nomination Tier of the annual process for the current CRR year

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1.76 Calculating Eligible Quantities (cont'd.)

Calculating Eligible Quantities (cont'd.)

Monthly Eligible Quantity

Monthly CRR Process

- Start with forecasted load duration curves to derive the 0.5% exceedence for the CRR Load Metric based on month, time of use and load area
- Subtract load served by TOR and ETC
- Subtract seasonal allocated CRRs from the annual and long term CRR processes that correspond to the month in which the allocation is to be run
- Validated against the CEC 60-day ahead forecast
- This value is the Monthly CRR Eligible Quantity


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1.77 Calculating Eligible Quantities – (cont'd.)

Calculating Eligible Quantities – (cont'd.)

Allocation to Metered Subsystems (MSS)

- Annually, must choose net or gross settlement treatment
- If gross is selected, process is the same as non-MSS LSEs
- If net is selected, MSS Operator submits hourly historical net Demand data (seasonal) and forecast net Demand data (monthly) from which the ISO constructs net Load duration curves to determine their Seasonal and Monthly CRR Eligible Quantities

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1.78 Calculating Eligible Quantities – (cont'd.)

Calculating Eligible Quantities – (cont'd.)

OBAALSE Process

Before calculating the eligible quantity for an OBAALSE, it must demonstrate eligibility to participate in the CRR Allocation by the following:

- Show legitimate need by demonstrating the entity holds an existing contract with or owns Generation external to the ISO Control Area
- Pre-pay the appropriate Wheeling Access Charge based on the amount of CRRs being nominated
- Confirm that the external load for which the CRRs are being nominated is not served under Transmission Ownership Rights (TORs) or Existing Transmission Contract (ETC) rights and is exposed to the ISO Congestion charges
- All CRR nominations in all CRR years must be source verified


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1.79 Calculating Eligible Quantities (cont'd.)

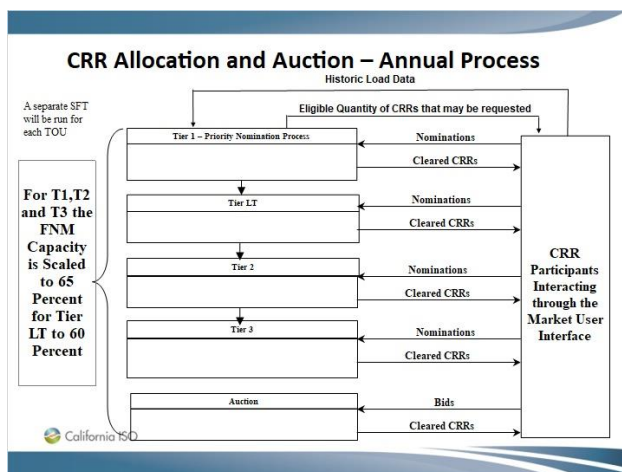
Calculating Eligible Quantities (cont'd.)

OBAALSE Process (cont'd.)

- The OBAALSE will submit two sets of hourly data from which the CRR system will construct load duration curves for determining the Seasonal and Monthly CRR Eligible Quantities. Their eligible quantity will be based on the lesser of the 0.5% exceedance point on the duration curves generated by the following data
 - Historical hourly exports at the Scheduling Point (s) for which the CRR request will be sunk at, summed for all Scheduling Points being requested, or
 - Hourly data that reflects the prior years hourly metered load associated with the load that was subject to the ISO Congestion Charges for use of the ISO Controlled Grid



1.80 CRR Allocation and Auction – Annual Process



1.81 CRR Allocation – Annual Tiered Process

CRR Allocation – Annual Tiered Process

- For the annual allocation process Tier 1 will be the Priority Nomination Process (PNP)
- Entities that did not participate or did not receive any CRRs through the annual allocation process, or load migration are not eligible to participate in the PNP



1.82 CRR Allocation – Annual Tiered Process (cont.)

CRR Allocation – Annual Tiered Process (cont.)

- In the PNP an LSE or OBAALSE may make nominations up to the lesser of:
 - two-thirds of its Seasonal CRR Eligible Quantity multiplied by two-thirds, minus the quantity of Long Term CRRs for each season, time of use period and CRR Sink for that year; and minus the net MW amount of load migration CRRs valid for each season, time of use period and CRR sink for that year or,
 - The total quantity of Seasonal CRRs allocated to that LSE in the previous annual CRR Allocation; plus the net quantity of load migration CRRs associated with the immediately preceding Seasonal CRR Allocations for the corresponding season, time of use, and CRR sink location; minus the quantity of Long Term CRRs allocated in the immediately preceding Seasonal CRR Allocation for each season, time of use period and CRR Sink; and minus the net MW amount of load migration CRRs valid for each season, time of use period and CRR sink for that year



1.83 CRR Allocation – Annual Tiered Process (cont.)

CRR Allocation – Annual Tiered Process (cont.)

- In the PNP, CRR nominations are all Signature validated
 - Meaning the CRR source-sink pairs have to have been allocated in the immediately previous annual CRR Allocation process and cannot exceed the MW amounts that were allocated
- In the PNP, CRR nominations with the Trading Hub as a source are allowed
- In the PNP, CRR nominations with the Sub-LAP as a sink are not allowed



1.84 CRR Allocation – Annual Tiered Process (cont.)

CRR Allocation – Annual Tiered Process (cont.)

- Tier LT is limited to a maximum of 50% of its Adjusted Load Metric (ALM), minus the quantity of previously allocated Long Term CRRs that are valid for that year.
- CRR nominations are all Signature validated
 - Meaning the CRR source-sink pairs have to have been allocated in the immediately PNP and cannot exceed the MW amounts allocated
- One year prior to the expiration of LT CRRs an election is required to either re-nominate in the next year's PNP or in the LT process.
 - For example, when running the 2020 annual process we also run the 2021-2029 LT process. If the LT CRRs expire in 2020 then the election is to re-nominate in the 2021 PNP next year or the 2021 LT in the current year



1.85 CRR Allocation – Annual Tiered Process (cont.)

CRR Allocation – Annual Tiered Process (cont.)


- Tier 2 is limited to two thirds of its Seasonal CRR Eligible Quantity for each season, time of use and CRR sink, minus the quantity of:
 - CRRs allocated to that LSE or OBAALSE in tier 1,
 - Long Term CRRs previously allocated that are valid for the CRR term currently being allocated,
 - the net MW amount of long-term Load Migrations CRRs assigned to the LSE that are valid for the term currently being allocated.
- CRR nominations with the Trading Hub as a source are allowed
- Sub-LAPs will be eligible CRR sinks provided that the Sub-LAP is within the nominating entities Default LAP

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1.86 CRR Allocation – Annual Tiered Process (cont.)

CRR Allocation – Annual Tiered Process (cont.)

- After Tier 2 of the annual allocation a process is performed to set-aside 50% of the residual import capacity on the interfaces, this is referred to as the set-aside process (pursuant to tariff section 36.8.4.2.2)
- The set-aside amounts are made public prior to the opening of tier 3 of the annual allocation
- For example, if an interface has an import limit of 100MW and 60MW is taken up by previously awarded CRRs then there would be a residual import amount of 40MW, of which 20MW would be the set-aside value. This 20MW would reduce the import limit going into tier 3, leaving a limit of 80MW. The auction limit would be increased back to the original 100MW.

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1.87 CRR Allocation – Annual Tiered Process (cont.)

CRR Allocation – Annual Tiered Process (cont.)

- An LSE in Tier 3 is limited to 100% of its Seasonal CRR Eligible Quantity for each season, time of use and CRR sink, minus quantity of:
 - Any Tier 1 and 2 allocated CRRs,
 - Long Term CRRs previously allocated that are valid for the CRR term currently being allocated,
 - the net MW amount of long-term Load Migration CRRs assigned to the LSE that are valid for the term currently being allocated.
- CRR nominations with the Trading Hub as a source are allowed
- Sub-LAPs will be eligible CRR sinks provided that the Sub-LAP is within the nominating entities Default LAP

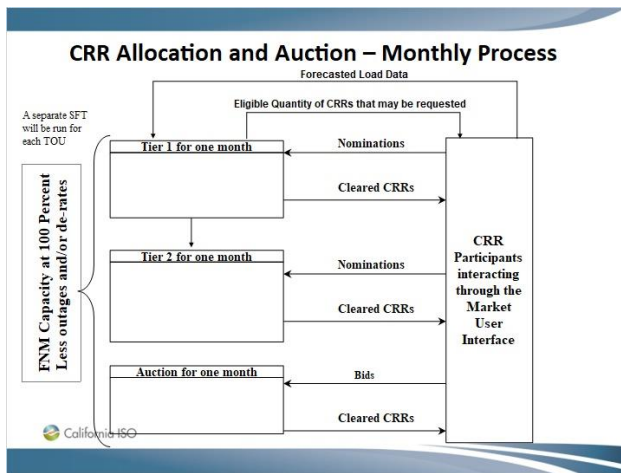
1.88 CRR Allocation and Auction – Monthly Timeline

CRR Allocation and Auction – Monthly Timeline

- 100% of the FNM capacity will be made available after accounting for any adjustments for outages or derates (global or due to outages)
- Approximately 6 weeks before the start of any month, the CRR monthly process begins, which produces monthly/TOU CRRs for the month
- For each monthly process there are typically four CRR FNM releases
 - Version 0 – Full data set without outages reflected
 - Version 1 – Initial list of outages for review
 - Version 2 – Updated files with outage data incorporated
 - Version 3 – This version includes the set-aside limit updates

The monthly process is illustrated in the monthly process figure

1.89 CRR Allocation and Auction – Monthly Process



1.90 CRR Allocation – Monthly Tiered Process

CRR Allocation – Monthly Tiered Process

- In the monthly allocation process there is not a PNP
- In Tier 1 of the monthly allocation LSEs and OBAALSEs can nominate up to 100% of the difference between its Monthly CRR Eligible Quantity and the total of any Seasonal CRRs allocated in the annual CRR Allocation and any holdings of Long Term CRRs that are valid for the month and time of use of the CRRs being nominated
- Trading Hubs are allowed as sources
- Sub-LAPs will be eligible CRR sinks provided that the Sub-LAP is within the nominating entities Default LAP

1.91 CRR Allocation – Monthly Tiered Process (cont.)

CRR Allocation – Monthly Tiered Process (cont.)

- In Tier 2 of the monthly allocation LSEs and OBAALSEs can nominate up to 100% of the difference between its Monthly CRR Eligible Quantity and the total of any Seasonal CRRs allocated in the annual CRR Allocation and any holdings of Long Term CRRs that are valid for the month and time of use of the CRRs being nominated minus the number on Monthly CRRs allocated in Tier 1
- Trading Hubs are allowed as sources
- Sub-LAPs will be eligible CRR Sinks provided the Sub-LAP is within the entities Default Lap



1.92 CRR Allocation – Monthly Tiered Process (cont.)

CRR Allocation – Monthly Tiered Process (cont.)

- After tier 1 of the monthly allocation a process is performed to set-aside 50% of the residual import capacity on the interfaces, this is referred to as the set-aside process (pursuant to tariff section 36.8.4.2.2)
- The set-aside amounts are made public prior to the opening of tier 2 of the monthly allocation
- For example, if an interface has an import limit of 100MW and 60MW is taken up by previously awarded CRRs then there would be a residual import amount of 40MW, of which 20MW would be the set-aside value. This 20MW would reduce the import limit going into tier 2, leaving a limit of 80MW. The auction limit would be increased back to the original 100MW.



1.93 TOR and ETC Modeling

TOR and ETC Modeling

- There are two basic types of transmission rights that the ISO models through the CRR process
 - Transmission Ownership Rights (TORs)
 - Existing Transmission Contracts (ETCs)
- These rights are defined through the Transmission Rights Transmission Curtailment (TRTC) procedures
- When the ISO models these rights the intent is to remove capacity, which has a “perfect hedge”, so that CRRs are not allocated or auctioned on this capacity
- The ISO holds these CRRs not the rights holder



1.94 TOR, ETC Modeling (cont'd.)

TOR, ETC Modeling (cont'd.)

Modeling of Transmission Rights

Transmission Ownership Rights (TORs) Modeling

- Exempt from all ISO congestion charges if schedules are within rights (“perfect hedge”)
- The ISO will remove capacity from the FNM by modeling TORs as Point-to-Point CRR Options (do not provide counter-flow)
 - levels based on contractual rights



1.95 TOR, ETC Modeling (cont.)

TOR, ETC Modeling (cont.)

Modeling of Transmission Rights (cont.)

Existing Transmission Contract (ETC) Rights

- Exempt from all ISO congestion charges if schedules are within rights (“perfect hedge”)
- The ISO will model CRRs to account for the congestion charge exemption of ETCs, so as to ensure CRR revenue adequacy
- ETCs are modeled as Point-to-Point CRR Obligations (provide counter-flow)
 - levels based on contractual rights and historical usage



1.96 Load Migration

Load Migration

- Introduction to the ISO Load Migration Process
- Tracking Load Migration
- Simple Load Migration Example
- Conclusion



1.97 Introduction to Load Migration

Introduction to Load Migration

What is Load Migration?

- Load Migration is the process of tracking the transfer of load between a pair of Load Serving Entities (LSEs).
- LSEs may have CRRs in different Utility Distribution Company (UDC) territories, but only those sinking at a UDC's location where the migrated load is placed will be considered in the corresponding transfer. In other words, an LSE losing load only in UDC1 would only lose CRRs sinking in UDC1.
- The calculation for the transfer of allocated CRRs held by the load-losing LSE is computed for each source to sink combination in the load-losing LSE's portfolio of allocated CRRs, by season and TOU. Only CRRs with the same path can be netted.



1.98 Introduction to Load Migration (cont'd.)

Introduction to Load Migration (cont'd.)

What is Load Migration? (cont'd.)

- Load Migration only tracks instances where a customer moves within a UDC service area, the closing or opening of an account are not tracked as load migration between LSEs.
- It is designed to transfer the appropriate quantity of CRRs between LSEs involved in load migration. In other words, when load moves from one LSE to another, allocated CRRs must be transferred to follow the load.
- Load migration only applies to LSEs, and only for annual allocated CRRs (not monthly allocated CRRs), i.e., seasonal and LT CRRs will be transferred.
- The ISO is using a one-to-one percentage relationship to determine the CRR transfers.



1.99 Tracking Load Migration

Tracking Load Migration

- The ISO will receive monthly records from each UDC reflecting transfer of customers between LSEs.
- UDCs are required to submit data in three different files, usually on the 20th of each month.
 - Direct Access Service Request (DASR) summary files containing the information about the net positive number of end-use customers per customer class transferring from one LSE to another LSE.
 - Number of customers (in each customer class) of each LSE doing business in their territories.
 - Average consumption rates for each customer class (once a year, each July).



1.100 Tracking Load Migration (cont'd.)

Tracking Load Migration (cont'd.)

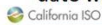
- Load Migration adjustment process is on a monthly basis
- The Load Migration Tool (LMT) calculations for CRR transfers usually take place on the 20th of each month for the transactions reported in the DASR summary records, which have the effective start date as of the first day of the next month.
- The DASR summary records should include the customers completing transfers within the month plus customers which completed transfers prior to the current month but have not been reported in previous DASR summary records.



1.101 Tracking Load Migration (cont'd.)

Tracking Load Migration (cont'd.)

- The effective start date is the effective start date for the CRR transfer, which is the first day of the next month.
- For example, for a file to be submitted on April 20th for May 2012 CRR monthly process, the number of customers will include the customers completing transfers between April 1st and April 20th, (some cut-off determined by the UDC to submit by April 20th) 2012 (inclusive), plus customers which completed transfers before April 1st, 2012 but were never reported in previous DASR summary records. The effective start date will be May 1st, 2012



1.102 Simple Load Migration Example

Simple Load Migration Example

1. Track load migration. After counting the number of customers per class and getting the net load in MW for each pair of LSEs and for each class at the same sink X, the following information is obtained:
 - a. LSE2 loses 20MW to LSE3 in the commercial class
 - b. LSE1 loses 10MW to LSE2 in the residential class
 - c. LSE2 loses 5MW to LSE3 in the industrial class
2. Compute the net Load Migration Quantity (LMQ) for each load-losing LSE. The net migration for each load-losing LSE is:
 - a. LSE1 loses 10 MW to LSE2
 - b. LSE2 loses 25 MW to LSE3



1.103 Simple Load Migration Example (cont'd.)

Simple Load Migration Example (cont'd.)

3. Compute the Current Eligible Quantity (CEQ) for the LSEs. With the current number of customers and the current MW/customer, the following CEQs are computed:

	CEQ	CRR holdings
LSE1	140	A-X=100
LSE2	200	B-X=150
LSE3	400	C-X=170

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1.104 Simple Load Migration Example (cont'd.)

Simple Load Migration Example (cont'd.)

4. Calculate percentage of load migration and CRR transfers

a. LSE1 loses 10 MW to LSE2

<ul style="list-style-type: none"> > LSE1 loses 10 MW a) CEQ=140 MW b) MW lost=10 MW c) Migration % = $10/140=7.142\%$ d) CRR owned A-X=100 MW e) New counter-flow CRR X-A = $100 \cdot 7.142\% = 7.142$ MW f) Net CRR holdings A-X = $100 - 7.142 = 92.858$ MW 	<ul style="list-style-type: none"> > LSE2 gains 10 MW a) CEQ=200 MW b) CRR owned B-X=150 MW c) New issued CRR A-X=7.142 MW d) Net CRR holdings B-X = 150 MW A-X = 7.142 MW
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1.105 Simple Load Migration Example (cont'd.)

Simple Load Migration Example (cont'd.)

5. Calculate percentage of load migration and CRR transfers

b. LSE2 loses 25 MW to LSE3

<ul style="list-style-type: none"> > LSE2 loses 25 MW a) CEQ=200 MW b) MW lost=25 MW c) Migration % =25/200=12.5% d) CRR owned B-X=150 MW e) New issued counter-flow CRR X-B =150*12.5% =18.75 MW f) Net base CRR holdings B-X=150-18.75 =131.25 MW 	<ul style="list-style-type: none"> > LSE3 gains 25 MW a) CEQ=400 MW b) CRR owned C-X=170 MW c) New issued CRR B-X=18.75 MW d) Net base CRR holdings C-X=170 MW B-X=18.75 MW
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1.106 Simple Load Migration Example (cont'd.)

Simple Load Migration Example (cont'd.)

6. After the computation of the CRR transfers, a load migration file is created for uploaded to the Nexant system. This file has the newly created CRR portfolios for LSEs involved in migration

LSE1	LSE2	LSE3	CRR type
A-X=100	B-X=150	C-X=170	Original owned
X-A=7.142	A-X=7.142		New issued, Transfer 1
	X-B=18.75	B-X=18.75	New issued, Transfer 2
A-X=100 X-A=7.142	B-X=150 X-B=18.75 A-X=7.142	C-X=170 B-X=18.75	Updated CRR portfolio for each LSE

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1.107 Load Migration - Conclusion

Load Migration - Conclusion

The primary purpose for implementing the Load Migration process is to ensure that each Market Participant's (MP) CRR portfolio would be accurate in the event of transfer of load between LSEs



1.108 Section 3 – QUESTIONS ?

Section 3 – QUESTIONS ?

CRR Allocation Overview

- General timeline
- Eligibility to Participate
- Calculating Eligible Quantities
- CRR Allocation and Auction – Annual Processes
- CRR Allocation and Auction – Monthly Processes
- TOR and ETC Modeling
- Load Migration



1.109 Section 4 – CRR Auction

Section 4 – CRR Auction

- Auction Eligibility
- Auction Overview
- Auction Clearing Prices
- Bid Structure
- Maximum Purchase Amount
- Pre-Auction Credit Requirement
- Credit Margin



1.110 CRR Auction: Auction Eligibility

CRR Auction: Auction Eligibility

All entities can participate in the auction that have:

- Registered as a Candidate CRR Holder with the ISO
 - Registration process is detailed in the BPM for Candidate CRR Holder Registration, which can be found at: <https://bpm.caiso.com/bpm/bpm/list>
- Post minimum required collateral for participation
 - Minimum collateral for annual auction - \$500,000
 - Minimum collateral for monthly auction - \$100,000



1.111 CRR Auction: Auction Overview

CRR Auction: Auction Overview


- Bid-based market that produces market clearing prices (MCP) for each CRR and every APNode
- Based on the MCP for each CRR awarded, the holder may
 - Incur a charge (positive MCP)
 - Incur no charge (the MCP is zero for the CRR)
 - Be paid by the ISO (negative MCP)
- Monthly Auction begins after the 2-tiered monthly Allocation process
 - CRRs are awarded in 1-month durations
- Annual Auction begins after the 4-tiered annual Allocation process
 - CRRs are awarded in four 3-month durations (to equal 12 months)
- Auction market open & close dates will be posted



1.112 CRR Auction: Auction Overview (cont'd.)

CRR Auction: Auction Overview (cont'd.)

- All bids submitted into the auction process are subject to:
 - Initial validations of maximum portfolio credit exposure against Aggregate Credit Limit
 - A Simultaneous Feasibility Test with all previously allocated CRRs for the same period and TOU modeled as fixed injections and withdrawals
- Bids may not be withdrawn after the submission window has closed



1.113 CRR Auction: Auction Overview (cont'd.)

CRR Auction: Auction Overview (cont'd.)
Allowable CRR Auction Sources & Sinks

		SINK LOCATIONS			
		LAP	GEN	TH	SP
SOURCE LOCATIONS	GEN	X		X	X
	TH	X			X
	SP	X		X	

LAP Includes DLAPs, Sub-LAPs, MSS LAPs, CLAPs
GEN Generator PNode and APNode locations
TH The three trading hub locations
SP Scheduling Points associated with interfaces/Ties

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1.114 CRR Auction: Auction Clearing Prices

CRR Auction: Buy and Sell Offers

- In the auction participants can submit buy offers, subject to the source-sink limitations in the previous slide
- In addition, auction participants can submit sell offers for any CRRs that they acquired in a prior allocation or auction market.
- For example if a CRR Holder acquired a season 2 CRR in the annual allocation or auction they can offer to sell this CRR in any of the monthly auctions held for April, May or June

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1.115 CRR Auction: Auction Clearing Prices

CRR Auction: Auction Clearing Prices

- All CRR APNode market clearing prices (MCPs) will be published after each market
- For a buy offer the following applies:
 - Source MCP minus Sink MCP = Positive = Charge
 - Source MCP minus Sink MCP = Negative = Payment
- For a sell offer the following applies:
 - Source MCP minus Sink MCP = Positive = Payment
 - Source MCP minus Sink MCP = Negative = Charge



1.116 CRR Auction: Bid Structure

CRR Auction: Bid Structure

- Bid must contain:
 - The associated season/month and time-of-use period
 - The associated CRR Source and CRR Sink
- All CRR bids are piecewise linear
- MW portion must be greater than or equal to zero and denominated in thousandths of MW
- CRR bid price input in \$/MW (per month or season)
 - Price may be negative
 - The first MW quantity used in the bid must be 0
 - The second MW quantity must be greater than 0



1.117 CRR Auction: Bid Structure (cont'd.)

CRR Auction: Bid Structure (cont'd.)

CRR buy bid

- Each CRR bid must contain at least two price point pair
- Bid must be monotonically decreasing
 - (MW increase, \$ decrease or stay the same-flat)
- Each price point (\$/MW) on the CRR bid curve represents the maximum price the bidder is willing to pay for the next increment of CRR MW quantity
- Positive bid price is what they are willing to pay to buy
- Negative bid price is what they are willing to be paid to buy


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1.118 CRR Auction: Bid Structure (cont'd.)

CRR Auction: Bid Structure (cont'd.)

CRR sell bid

- Each CRR bid must contain at least two price point pair
- Bid must be monotonically increasing
 - (MW increase, \$ increase or stay the same-flat)
- Each price point (\$/MW) on the CRR bid curve represents the minimum price the bidder is willing to be paid for the next increment of CRR MW quantity
- Positive bid price is what they want to be paid to sell
- Negative bid price is what they are will to pay to sell

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1.119 CRR Auction: Maximum Purchase Amount

CRR Auction: Maximum Purchase Amount

Maximum Purchase Amount – Buy bid

- Can be calculated before the CRR Auction is processed (before the actual MCPs are determined) since it is based off the bid curve submitted
- It is the maximum MW by price value across all bid segments of a bid.
- It is used as an upper bound for the actual purchase amount, which may not exceed the Aggregate Credit Limit.



1.120 CRR Auction: Maximum Purchase Amount

CRR Auction: Maximum Purchase Amount

The steps for calculating the maximum purchase amount – Buy bid:

- The price at each MW level indicates the maximum price the buyer is willing to pay for the next MW
- The MCP for clearing that MW level will not exceed the bid price at that MW level
- The MCP may be less than the bid price at that MW level
- Actual purchase price for a CRR will be equal to or less than the maximum purchase amount



1.121 CRR Auction: Maximum Purchase Amount



1.122 CRR Auction: Maximum Purchase Amount

CRR Auction: Collateral required for Sell Offers

- Sell offers at a positive price have no collateral requirement since the seller wants to be paid
- Sell offers at a negative price will require collateral up to the maximum amount the seller is willing to pay.
- The price at each MW level indicates the minimum price the seller is willing to be paid for the next MW
- The MCP for clearing that MW level will not be less than the bid price at that MW level
- The MCP may be more than the bid price at that MW level
- Actual sales price for a CRR will be equal to or less than the maximum purchase amount
- Credit margin is not considered for sell offers

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1.123 CRR Auction: Pre-Auction Credit Requirement

CRR Auction: Pre-Auction Credit Requirement

Pre-Auction Credit Requirement Overview

- Calculates the maximum possible credit exposure of each bid should the market participant win the bid made in the auction and includes the credit margin for buy offers
- For sell offers the credit exposure is only applicable if the bid is negative and does not include any adjustment for credit margin
- Evaluated against Available Secured Credit on a portfolio basis
 - A portfolio can contain multiple bids
 - Available Secured Credit = Aggregate Secured Credit Limit ("ASCL") – max(CRR Estimated Aggregate Liability ("EAL"),0)
- Minimum secured credit requirement for participating in an auction is:
 - Annual - \$500,000
 - Monthly - \$100,000
- Exceeding available secured credit results in the rejection of the entire portfolio


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1.124 CRR Auction: Pre-Auction Credit Requirement

CRR Auction: Pre-Auction Credit Requirement

Pre-Auction Credit Requirement Overview (cont'd.)

- Maximum credit exposure of a **positive buy bid** is the maximum value of the bid quantity (MW) multiplied by the sum of bid price corresponding to the bid quantity and the Credit Margin of the CRR
- Maximum credit exposure of a **negative buy bid** is the maximum submitted bid quantity (MW) multiplied by the Credit Margin. Since CRRs awarded with a negative clearing price have their proceeds passed directly to the bidder's collateral account the bid price is not considered.
- Aggregate Credit Limit must equal or exceed the greater of \$100K (monthly)/\$500K(annual) and the sum of the maximum credit exposures of all MP's bids submitted


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1.125 CRR Auction: Pre-Auction Credit Requirement

CRR Auction: Pre-Auction Credit Requirement

Pre-Auction Credit Requirement Overview (cont'd.)

- Maximum credit exposure of a **positive sell bid** is zero since the selling party wants to be paid to sell the CRR
- Maximum credit exposure of a **negative sell bid** is the maximum submitted bid quantity (MW) multiplied by the bid price (smallest negative value). For a negative sell offer this type of bid requires the seller to pay the cleared amount.

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1.126 CRR Auction: Pre-Auction Credit Requirement


CRR Auction: Pre-Auction Credit Requirement

Steps to Calculate Maximum Bid Exposure

- Calculate the maximum bid exposure for each bid segment
- The final pre-auction credit requirement of a CRR bid is the maximum value of the highest credit exposure of all bid segments

A Bid Segment between a Positive Bid Price and a Negative Bid Price

- A bid point with interpolated MW is introduced to perform the credit exposure calculation when two bid points cross the zero price axis
- Maximum credit exposure is calculated for two bid segments
- One segment is between the positive bid point and a bid point with interpolated MW and 0 price, the other segment is between a bid point with interpolated MW and 0 price and the negative bid points

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1.127 CRR Auction: Credit Margin

CRR Auction: Credit Margin

Credit Margin Calculation

- The difference between the expected value and the fifth percentile value of the congestion revenue generated by a one-MW ST-CRR

$$\text{Credit Margin} = \text{Expected CRR Cong. Reven.} - \text{5th Percentile CRR Cong. Reven.}$$

- The Expected and the 5th Percentile CRR Congestion Revenue are determined based on the probability distribution of the congestion revenue of a one-MW ST-CRR
- The probability distribution is derived based on the historical LMP data



1.128 CRR Auction: Credit Margin

CRR Auction: Credit Margin


- **Data Used in Credit Margin Calculation**
 - Most current 36 months of hourly LMP congestion prices
- **Calculation Frequency**
 - Credit margin is currently calculated annually
- **Calculation results will be posted no later than 30 days prior to the start of the annual allocation**



1.129 Section 4 – QUESTIONS ?

Section 4 – QUESTIONS ?

- Auction Eligibility
- Auction Overview
- Auction Clearing Prices
- Bid Structure
- Maximum Purchase Amount
- Pre-Auction Credit Requirement
- Credit Margin


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1.130 Section 5 – CRR Holding Requirements

Section 5 – CRR Holding Requirements

CRR Holding Requirements

- Overview
- Formula for Calculating CRR Holding Requirements
- Compliance Measures


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1.133 CRR Holding Requirements: Calculation - Groups

CRR Holding Requirements: Calculation - Groups

CRR Holding Requirements Groups:

- **Short Term Auction group** = CRRs obtained from annual and monthly Auctions, and SRS trades.
- **Short-term Allocation group** = (1) CRRs obtained from monthly/seasonal allocation process, (2) load migration CRRs for load transfers of CRRs from seasonal allocations (3) CRRs obtained from long-term allocations which have remaining effective periods less than a year.
- **Long-term Allocation group (LT1)** = (1) CRRs obtained from long-term allocations which have remaining effective periods longer than a year but less than nine years. (2) Load migration CRRs created for load transfer of CRRs originated from markets in the LT1 group.
- **Long-term Allocation group (LT2)** = (1) CRRs obtained from long-term allocations which their effective periods have not been started. (2) Load migration CRRs created for load transfer of CRRs originated from markets in the LT2 group
- **Long-term Allocation group (LT3)** = (1) CRRs obtained from long-term allocations which their effective periods have not been started and will be started a year later than long-term allocations in LT2. (2) Load migration CRRs created for load transfer of CRRs originated from markets in the LT3 group.
- **Financial group** tracks only the selling of annual allocated CRRs, including CRRs from load migration being traded.




1.134 CRR Holding Requirements: Calculation - Groups

CRR Holding Requirements: Calculation - EAL

Credit Holding Requirement(EAL) =
 $\max(0, LT1+LT2+LT3+STAllocation) + \max(0, STAuction) + \max(0, Financial)$

Example:

Participant Name	LT2	LT3	ST ALLOCATION	ST AUCTION	CreditHoldingReq(EAL)= $\max(0, LT2+LT3+ST alloc) + \max(0, ST auction)$
A			-500	400	\$400
B	-14,000	-16,000	-34,000	-600	\$0
C	130	200	-200	100	\$230
D	-39,000	-40,000	300	300	\$300
E			500	400	\$900
F	-1,000	1,000	1,000	-2,000	\$1000



1.135 CRR Holding Requirements: Compliance Measures

CRR Holding Requirements: Compliance Measures

Compliance Measures for Failure to Meet CRR Holding Requirements

- Terminate all CRR agreements with the defaulting CRR Holder
- Exclude the holder from CRR Allocation or CRR Auction until all defaults have been cured
- Require the CRR Holder to post additional Financial Security Amount for future participation



1.136 Section 5 – QUESTIONS ?

Section 5 – QUESTIONS ?

CRR Holding Requirements


- Overview
- Formula for Calculating CRR Holding Requirements
- Compliance Measures



1.137 Section 6 – Secondary Registration System

Section 6 – Secondary Registration System


- Overview
- Credit Check

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1.138 Secondary Registration System - Overview

Secondary Registration System - Overview

- The Secondary Registration System (SRS) is built into the CRR System to help facilitate the trading of CRRs through a bilateral mechanism
- Information about CRRs that an entity wants to buy and sell is made available on a “bulletin board” in SRS
- In order to have access to the SRS and to effect trades both entities must be fully registered
- The SRS does not settle transactions but merely facilitates the recording of the owner of record
- Financial settlement is done outside of the SRS

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1.139 Secondary Registration System – Credit Check

Secondary Registration System – Credit Check

- As part of the CRR Holding Requirements the CRR System will perform a credit check on both the trading (“selling) and receiving (“buying”) parties in a SRS trade.
- This credit check will ensure that the receiving party has sufficient collateral to add the SRS trade to their CRR portfolio
- This credit check will also ensure that the trading party, if the CRR is positively valued, has sufficient collateral to remove the SRS trade from their CRR portfolio



1.140 Section 6 – QUESTIONS ?

Section 6 – QUESTIONS ?


- Overview
- Credit Check



1.141 Section 7 – CRR Related Grid Management Charges

Section 7 – CRR Related Grid Management Charges


- Overview
- CRR Services Charge
- CRR Bid Transaction Fee

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1.142 CRR Related Grid Management Charges

CRR Related Grid Management Charges

- There are two types of CRR related GMC charges: CRR Services Charge and CRR Bid Transaction Fee.
- CRR Services Charge (Charge Code 4562)
 - It is designed to recover costs the ISO incurs for running the CRR markets.
 - It is applied to each CRR holder's net MW holdings of CRRs that are applicable to each hour.
 - The rate is calculated by dividing the annual GMC revenue requirement allocated to CRR service category by forecasted annual sum of awarded MW of CRRs per hour.

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1.143 CRR Related Grid Management Charges

CRR Related Grid Management Charges

- CRR Bid Transaction Fee (Charge Code 4516)
 - It is designed to recover CRR costs on a transactional basis.
 - It applies to both the CRR allocation process and the CRR auction process.
 - The rate is applied on a per nomination or per bid basis, without consideration of the number of segments.
 - GMC rates can be updated intra-year to reflect actual cost collection. The current rates can be found at: <http://www.caiso.com/market/Pages/Settlements/Default.aspx>, under Market and Administrative Charges / Grid Management Charge



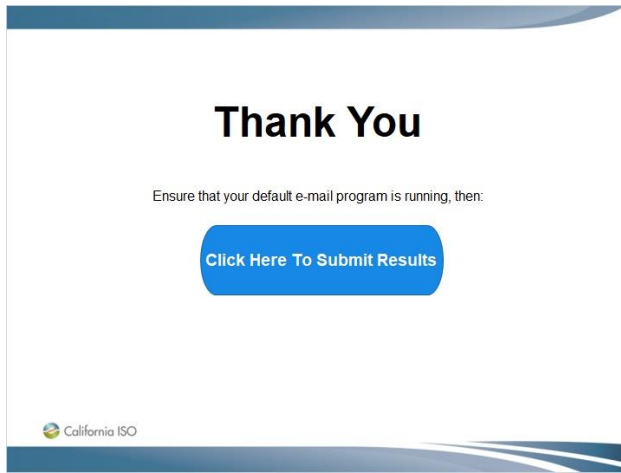
1.144 Section 7 – Questions

Section 7 – Questions

- Overview
- CRR Services Charge
- CRR Bid Transaction Fee
- End of CRR Overview Training




1.145 End - Thank You



Thank You

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