



Modeling Transmission Outages in the CRR Network Model

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Outline of Today's Discussion

- CRR Revenue Adequacy
- Timing of Scheduled Outage Information
 - Significant Facilities and Significant Outages
 - 30-Day Rule
- Modeling Scheduled Outages
 - Annual Allocation/Auction Process
 - Monthly Allocation/Auction Process
- Modeling Unscheduled Outages
- Possible Ideas for a CAISO Study
- Practices of Other ISOs



CRR Revenue Adequacy

- **Definition: Net congestion rents collected from the hourly IFM are sufficient to cover net payments to CRR holders.**
- **CAISO aims to balance competing objectives in CRR release:**
 - Release as many CRRs as possible to return congestion rents fully to market participants, but
 - Don't release too many CRRs and violate revenue adequacy.
- **If release of CRRs satisfies Simultaneous Feasibility Test (SFT) for assumed grid conditions, CRRs will be revenue adequate under the same grid conditions.**
- **But typically:**
 - Grid conditions vary hourly whereas SFT must use a single snapshot of grid conditions for the entire CRR term
 - Changes to grid topology and flow limits are not completely known at the time the CAISO releases CRRs.



Maintaining Revenue Adequacy

– Hourly Revenue Adequacy

- For each hour of the IFM, the net congestion rents equal or exceed net CRR payments
- Difficult to achieve and not an efficient objective – would require very conservative release of CRRs

– Monthly Revenue Adequacy

- CAISO will maintain a CRR Balancing Account to achieve revenue adequacy over each month, expecting that some hours will not be revenue adequate
- At the end of each month the final amount of funds in the CRR Balancing Account should be non-negative
 - Avoid charging a shortfall to Measured Demand
 - Avoid relying on CRR auction revenues.



Maintaining Revenue Adequacy

- **Hinges on making good assumptions about grid conditions for the SFT network model**
 - Topology of the network model
 - Transmission flow limit values
- **Annual CRR process is limited to 75% of transmission capacity**
 - CAISO assumes optimal grid conditions unless major outages are known well in advance.
- **Monthly CRR process models expected transmission outages and derates, then releases 100% of the capacity expected to be available.**
- **Important for CAISO to have good information on scheduled outages in time to adjust the monthly CRR network model to**
 - Remove lines expected to be out of service from the CRR network model and/or
 - Reduce transmission flow limits.



Reliable and Timely Information on Scheduled Outages

- **Enables CAISO to formulate the monthly FNM to best balance the competing objectives**
 - Release quantities of CRRs that leave the CRR Balancing Account with close to zero balance at the end of each month.

Two needs to address regarding scheduled outages:

- **Workable requirements for reporting planned outages to the CAISO**
 - Balance CAISO information needs with realistic PTO maintenance scheduling practices, to get accurate and timely information
- **Transparent procedures whereby the CAISO models reported outages in the network for CRRs**
 - Guidelines for removing facilities and reducing transmission flow limits
 - Flexibility for the CAISO to make engineering judgment decisions and learn from past CRR results
 - Ability to provide all eligible participants with the final SFT modeling information before the CRR allocation/auction process proceeds



Reporting of Scheduled Outages – Significant Facilities and 30-Day Rule

■ Significant Facilities

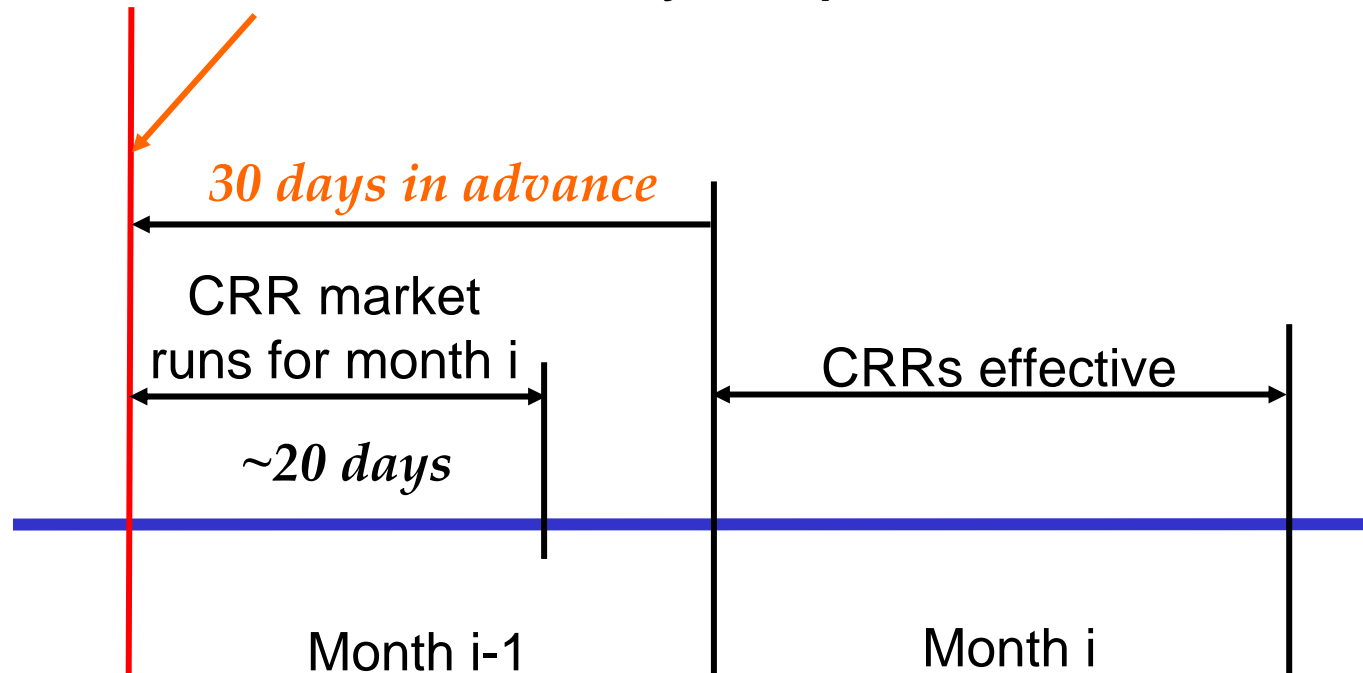
- Define a set of facilities that potentially have a significant impact on revenue adequacy if de-rated or outaged and not accounted for in the CRR FNM

■ “30 Day Rule” applies to Significant Facilities

- PTOs must report any scheduled outage associated with a significant facility at least 30 days prior to the start of the month in which the outage will occur
- Rule may include a duration threshold, e.g., outages that require 24 hours or more total duration in the month
- Rule does not preclude taking or rescheduling outages with 72 hours notice if necessary, subject to CAISO outage coordination approval.

30 Day Rule

Timeline for consideration of outages
in the monthly CRR process



Significant Facilities

- **Proposed definition of significant outages**
 - All facilities with one side at 200 kV or higher
 - All facilities that are part of a CAISO defined flow limit
 - Any transmission facility that was out of service in the last few years for which the CAISO determined a special temporary flow limit was needed for use in real-time operation
- **Note, this definition is not different for on/off peak, nor is there a time duration value involved**
- **However, the 30 day rule may include a minimum duration threshold that triggers 30-day reporting requirement.**

TMCC Proposed Criteria for 30-day Rule

Proposed scheduling of work time frames, to be used with proposed MRTU CCR's in place.

Work to be done during Peak (6am-10pm)

Short term work as listed in the BPM T-113 section 2.1 and 2.2 shall be scheduled with a 72 hour notice with approval to be made after CAISO Outage Coordination Office looks at the outage with consideration to reliability to the system. (This would be no different than scheduling an outage in today's atmosphere prior to MRTU)

On:

- Voltages above 200 Kv- any outage 24 hours or less
- Voltages below 200 Kv- any outage 72 hours or less

All outages that fall under E-509A shall be scheduled as they are prior to the MRTU.

All other outages would be considered long term and would be subject to the revised MRTU scheduling practices(30-60 day ahead of the outage)

Other work to be scheduled with 72 hour notice

Multiday during Non Peak

Any paths that do not have CCR's sold above the CCR's that have been released for the PTO's for the up coming scheduling period, the CAISO shall post to the PTO's which paths will be released from the 30-60 day outage scheduling requirement.

Outage Modeling in the Annual Process

- Annual process assumes all lines in-service unless a scheduled outage of a significant facility is known in time to reflect it in the FNM for the annual process
- FNM is a single grid snapshot per 3-month season
- CAISO will either
 - #1. Remove the facility from the FNM, or
 - #2. Reduce the associated flow limits by a factor of (total days out of service in the season)/(total days in the season)
- **Criteria for deciding between 1 and 2 is yet to be determined.**
 - For example, it may be best to have a rule that says “If the outage is for n days or more then do #1, otherwise do #2.”
 - For example, n may be 20 days

Outage Modeling in the Monthly Process

- **Monthly FNM accounts for**
 1. Outages of significant facilities scheduled under the 30 day rule
 2. Outages of significant facilities not scheduled under the 30 day rule
 3. Outages of other facilities that may have some impact on revenue adequacy and are not scheduled under the 30 day rule, including forced outages and derates.
- **Types 2-3 cannot be modeled explicitly, so CAISO needs another way to account for their impact in the CRR FNM**
- **Develop a reduction or derating factor or factors to apply to all grid facilities, to account statistically for the impact of unknown outages on revenue adequacy.**



Outage Modeling for February 2008

- **CRR Allocation/Auction process for February 2008 will begin in October 2007**
 - 30 day rule will not provide information in time
 - CAISO cannot model any specific transmission outages explicitly
 - Instead, apply a reduction or derate factor to all flow limits
 - Similar to the process applied to the months of April and August in the CRR Dry Run
 - Reduction factor to be determined via a study to be performed by CAISO (outline of study is presented later)

Monthly Outage Modeling Post Feb-08

- For scheduled outages on significant facilities that are scheduled under the 30 day rule
 - Either remove lines from service, or reduce flow limits depending on scheduled outage duration
- For outages not scheduled under the 30-day rule
 - Including both planned and unplanned outages and derates
 - Apply a system wide or area wide reduction factor that may be a function of kV level
 - Reduction factor(s) to be determined via CAISO studies.

Possible Study Ideas

■ Objectives

1. For non-30-day rule outages
 - Determine a reduction factor(s) that should be applied to the FNM to account for revenue adequacy impacts
2. For 30-day rule outages
 - Determine an outage duration threshold
 - For an outage whose duration is greater than this value, the facility will be removed from the FNM
 - Determine reduction factors
 - For an outage whose duration is less than this cut-off value, the facility or associated facilities will be de-rated by a factor that is dependent on the duration of the outage

Possible Study Ideas - 2

■ Potential Approaches

- Base the study on strict simultaneous feasibility standards
 - Similar to the quick study used to determine the reduction factors used for the months of April and August in the CRR dry run
 - May be too conservative
- Perform a study that compares CRR payments vs Congestion rent collection
 - Similar to CRR dry run

Possible Study Ideas - 3

Mid-level details

- Assume a full set of CRRs allocated/auctioned on a FNM with all branches in service
- For a specified set of hours run the LMP Study process with all lines in (used as a base line) and run with a specified (yet practical) set of outages applied to the network model
 - Practical in the sense that the CAISO Outage Coordination Department would allow these simultaneous outages
- Compare the CRR payments to the two sets of congestion rent
- If CRR payments are greater than congestion rent then determine scaling factor to apply to CRR available capacity and thus also to reduce the CRRs
- CAISO must determine another cut-off parameter, a reduction factor cut-off parameter for which we never want to go below for reducing down flow limits
- For example, the CAISO would certainly never want to reduce the system below 75% (already allocated 75% in the annual process)
- A value of 85% to 90% seems like a good cut-off limit
- If the ratio falls below this limit the line would need to be modeled out of service in the CRR process network model

Possible Study Ideas - 4

More granular details

- Do *not* simulate 8760 worth of LMP hours
- Select 4 to 5 representative periods over a year, the periods when most outages occur due to amenable weather and lower load levels
 - For example, late October, early March
- For each period pick a representative day or days
- For the CRR dry run results gather the CRRs for these days and scale up by $(4/3) = (100\%/75\%)$
 - This assumes a full extension of the seasonal CRRs to each month
- For each day process the LMPs using a network with all lines in service (set 1) and process the LMPs with the specified set of outages applied (set 2)

Possible Study Ideas - 5

Still more granular details

- Simply assume the following monthly Balancing account settlement assuming the lines are out for m days
- $BA = [(30 - m) \times (24 \text{ hour Congestion Rent Set 1 minus } 24 \text{ hour CRR payments})]$ PLUS $[(m) \times (24 \text{ hour Congestion Rent Set 2 minus } 24 \text{ hour CRR payments})]$
- The same set of LMPs are assumed to be equal for each day the lines are outaged (set 2) and the same apply for all days the lines are not outaged (set 1)
- For values of $m = 1, 2, \text{ to } 5$ say, determine BA
 - Outage Coordination and TMCC will help determine valid values of m
- If $BA < 0$ (revenue inadequate), then need to reduce the CRRs originally allocated/auctioned
- Determine α such that $[(30 - m) \times (24 \text{ hour Congestion Rent Set 1 minus } 24 \text{ hour CRR payments} \times \alpha)]$ PLUS $[(m) \times (24 \text{ hour Congestion Rent Set 2 minus } 24 \text{ hour CRR payments} \times \alpha)] = 0$
- If α is not smaller than say 96% or 97% then this value will help provide a foundation for applying a factor for non 30 day rule outages

Possible Study Ideas - 6

You say you want even more granular details?

- **The same process can be applied to determine the outage duration cut-off parameter(s)**
 - Outage Coordination and TMCC can provide a practical set(s) of significant outages along with typical outage durations
- **In this process, the reduction factors would never be allowed to go below say 90%**
- **Based on this value, the value of m can be determined at which the reduction factor is at a value of 90%**
- **For outages of days greater than m the outage will be modeled as out-of-service in the CRR process network model**
- **Need to make sure that possibly different bids patterns are selected for each representative period/day so that different congestion patterns arise**
 - No congestion then no CRR payments
- **If time permits, the CAISO may actually apply the outages to the CRR model and reprocess**

Other ISO Approaches

PJM	MISO	ISO New England	New York ISO
<p>For the annual auction, lines taken out of model if an outage of two or more months is expected. For monthly auction, take lines out if outage is equal or greater than five days, unless line is one critical to revenue adequacy. In which case, it is taken out of the model regardless of the duration of the outage.</p>	<p>For annual process, lines taken out of model for the full season if , in one or more months of the season, a line outage is expected to last seven or more days and one of the days includes the 15th of the month. For monthly process, lines taken out of model if outage is expected to last seven or more days and one of the days includes the 15th of the month.</p>	<p>For 345 kV lines, will take lines of importance out of FNM for outages equal or greater than three days. Will derate constraint limits for outages less than three days.</p>	<p>If a line is scheduled to be out for more than half the term of the upcoming TCC auction, it is a candidate to be removed from the full network model. The NYISO then asks the transmission owner whether it should be taken out or remain in the model.</p>