Proposed Network Service Right Definition for the CRR Allocation Process

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1 Introduction

This white paper presents the proposed definition of the Network Service Right[1] (NSR) in the context of the CRR Allocation. This paper provides the structure of the NSR, the manner in which the NSR is used to generate a revenue stream and some useful insights into how to construct a NSR.

2 NSR Definition

A Network Service Right (NSR) is similar to a Point-to-Point (PTP) CRR in that it is a financial instrument that entitles the holder to a stream of revenues or charges based on Locational Marginal Prices from the Day-ahead market. The NSR is different from the PTP CRR in that it contains one or more Source points and one or more Sink points. The total Source MW (summed over the Source points) equals the total Sink MW (summed over the Sink points). In this form, the NSR CRR is a generalization of a PTP CRR, which contains just one Source point, one Sink point, with the Source MW equal to the Sink MW. The NSR is a new CRR construct that could provide additional flexibility in hedging congestion costs to the Market Participants in California. Currently other ISOs, while they offer PTP CRRs, do not offer NSR CRRs.

The reason for offering NSRs along with PTP CRRs is to increase the MW amount of allocated CRRs relative to the MW amount of nominated CRRs. The following example demonstrates the concept of increased allocated CRRs due to the presence of a NSR CRR. Suppose a PTP CRR is requested (this is the nomination) from Source A to Sink B of x MW. Further, suppose that due to some enforced constraint this CRR violates the constraint and is reduced during the Simultaneous Feasibility Test (SFT). In this case the allocated (or cleared or final) CRR is from Source A to Sink B of y MW, ($y < x$). The CRR nomination of x MWs was reduced by ($x - y$) MW to ensure simultaneous feasibility, i.e., the requested injection of x MW at Source A was reduced to y MW of injection and the requested withdrawal of x MW at Sink B was reduced to y MW. The use of a NSR CRR however, instead of the PTP CRR, could result in the allocation of the total requested amount of x MW. The curtailed amount of ($x - y$) MW could have been served from another Source, say Source C, which is at another location.

To indicate which Sources should be used first in trying to serve the Sink(s), priorities are associated with each Source along with a maximum MW value. The priorities are ranked from highest to lowest. If all of the Sink(s) MW cannot be served by the highest priority Source(s) (due to either a network constraint or the fact the maximum MW specified in the highest Source(s) priority may be less than the total Sink MW), the next highest priority Source(s) will be used to serve that amount of MW that cannot be serve by the higher priority Source(s) and so on. Only if the total Sink MW cannot be served feasibly by the Source(s) and their associated MW, the Sink MW will be reduced so that feasibility is enforced. A market participant eligible

[1] The name "Network Service Right' may be misleading. It is not to be confused with related terms that are used in the context of procuring transmission service with a transmission provider.

for the CRR Allocation may submit multiple NSRs and/or multiple Point-to-Point CRRs in the CRR Allocation process.

3 Cleared or Final NSR

Upon completion of the CRR Allocation process, a cleared (or final) NSR CRR has the following attributes:

- One or more Source points;
- One or more Sink points;
- The total Source MW (summed over the Source points) equals to the total Sink MW (summed over the Sink points); and
- The Source Points and the Sink Points and the MW cleared at each point do not change for the term of the CRR, i.e., they are **fixed**.

4 NSR Revenue Settlement

The payment or charge to a CRR Holder that has a NSR CRR is calculated by subtracting the sum of the congestion component of the Source LMPs times their associated CRR MW quantities from the sum of the congestion component of the Sink LMPs times their associated CRR MW quantities. Note that the LMPs used in the settlements of the CRRs do not include the marginal loss component of the LMPs; they only include the energy and congestion components of the LMPs. The NSR revenue equation is given below in equation 1.

$$\text{NSR Revenue} = \sum_{i \in Sinks} \left(LMP_{Sink\_i} \cdot SinkMW_i \right) - \sum_{j \in Sources} \left(LMP_{Source\_j} \cdot SourceMW_j \right) \qquad \text{(Eq1)}$$

5 Nominating NSR Data

As noted, the NSR CRR allocation is based on priorities that are associated with the Source(s). These priorities indicate the preference with which Source(s) should be used to serve the Sink(s) and thus balance out the NSR CRR in terms of the MW amount. The NSR CRR nomination data used to describe the Sources, Sinks, MWs and priorities are given below.

The format for providing NSR Source data for a NSR CRR nomination is described in Table 1. The market participant will provide a list of one or more Source names. Market participants will also provide for each Source name the associated maximum MW amount[2] and its priority that will be used in the allocation process. The priority for the Source can be 1, 2, 3 or 4 with 1 being the highest priority and 4 the lowest priority (the higher the priority, the higher the preference of the Source to serve the Sink(s)).

[2] The maximum MW allowable for each Source may be limited by a combination of historical usage data, physical supply capacity, and demonstration of delivery requirements of actual or imminent forward contracts.

Table 1. Format for the Source data for CRR NSR nomination

Source Name	Nominated MW	Priority
…	…	…

The format for proving NSR Sink data for a NSR CRR nomination is described in Table 2. The market participant will provide a list of one or more Sink names. Market participants will also provide for each Sink name the associated MW amount[3]. The priority is implicitly set for each Sink to be equal to the first priority of the Source (i.e., Source priority 1).

Table 2. Format for the Sink data for CRR NSR nomination

Sink Name	Priority 1 Nominated MW
…	…

5.1 Example

The following is an example of the data submitted by a market participant for a NSR CRR nomination for a particular CRR term and a particular time-of-use period (on-peak or off-peak). There are two Sink points and five Source points. Note that the total amount of Sink MW requested is 300 MW, (100 + 200). The market participant prefers to serve the 300 MW Sink by a 300 MW combination of the two Sources, Pnode3 and Pnode4 since these are both priority 1 sources, with Pnode3 providing no more than 100 MW and Pnode4 providing no more than 250 MW. These two priority-1 Sources cannot serve the total Sink MW individually. Thus, if (due to simultaneous feasibility requirement) the combination of both of these two Sources cannot serve the Sink, the next priority should be used and so on.

Note that the nomination of the CRR Sources does not require a lower or upper MW limit on the amount of MWs a Source for a particular priority can provide relative to the Sink MW. For example, there is no constraint that states that a given priority-1 Source should provide a certain amount of MWs that must be equal to or greater than the Sink MW. These constraints should not be confused with the maximum MW allowable constraints mentioned above in the footnotes for individual Sources and Sinks. Suppose an eligible market participant has a certain Source and the CAISO has determined that the maximum MW allowance for this Source to participate in the CRR Allocation is 100 MW. Suppose that this market participant submits a NSR CRR nomination with a Sink of 500 MW and includes this Source with a MW value of 100 MW and a priority 1. This is allowable since the participant is allowed 100 MW from this Source and it is allowable to use this in this NSR nomination although the Sink is 500 MW. However, this

[3] The maximum MW allowable for each Sink may be limited by a combination of historical demand data, and demonstration of delivery requirements of actual or imminent forward contracts.

participant may not use this Source in any other CRR nomination since it is only allowed 100 MW and has decided to use all of the 100 MW in the NSR CRR nomination. Note, that the total amount of 100 MWs may not be used to serve the 500 MW of Sink since the Source may need to be reduced in the case of infeasibility).

If there were not enough Source MW in priority-1 then the next priority would be used. If there is not enough MW in total over all of the Sources to match the total MW of the Sinks, then the Sink(s) and the Source (s) will be reduced in an optimal manner to enforce feasibility given the priorities provided by the Market participants.

Table 3. Example: Source nomination data for a NSR

Source Name	Nominated MW	Priority
Pnode3	100	1
Pnode4	250	1
Pnode5	50	2
Pnode6	50	3
Pnode7	50	4

Table 4. Example: Sink nomination data for a NSR

Sink Name	Priority 1 Nominated MW
APnode1	100
APnode2	200

Assume that after the completion of the Allocation Optimization and the SFT, the final cleared NSR Sources and Sinks are as shown in Table 5. Note that in this example, Sources Pnode6 and Pnode7 were not used to serve the Sink.

Table 5. Example: cleared NSR Source data

Source Name	Cleared MW	Priority
Pnode3	50	1
Pnode4	200	1
Pnode5	50	2
Pnode6	0	3
Pnode7	0	4

Table 6. Example: cleared NSR CRR Sink data

Sink Name	Priority 1 MW (cleared)
APnode1	100
APnode2	200

5.2 NSR Revenue Settlements Example

Assume for a given hour, the Day-ahead LMPs (excluding the marginal loss component) for each of the Source and Sink points are calculated. The NSR revenue for this hour is given in Table 7. Note that the Sources for Pnode6 and Pnode7 are no longer listed; the reason is that the cleared MW for these two Sources were zero in the CRR Allocation.

Table 7. Example: NSR revenue for a given hour

Source/Sink Name	Cleared MW	LMP ($/MWh) (Excluding the marginal loss component)	Revenue: Cleared MW * LMP ($/h)
Pnode3	50	10	500
Pnode4	200	15	3,000
Pnode5	50	20	1,000
Source Totals	300		**4,500**
APnode1	100	35	3,500
APnode2	200	30	6,000
Sink Totals	300		**9,500**

The payment for this hour to the CRR holder for this specific NSR would be $9,500 – $4,500 = $5,000.

Assume for another given hour, the Day-ahead LMPs (excluding the marginal loss component) for each of the Source and Sink points are calculated. The NSR revenue for this hour is given in Table 8. Note that the MW amounts for each Source and Sink within a NSR CRR are fixed for the term of this NSR CRR. Thus, the Source and Sink MW are equivalent to those in Table 7 and the change is in the LMPs.

Table 8. Example: NSR revenue for a different given hour

Source/Sink Name	Cleared MW	LMP ($/MWh) (Excluding the marginal loss component)	Revenue Cleared MW * LMP ($/h)

Pnode3	50	40	2,000
Pnode4	200	20	4,000
Pnode5	50	30	1,500
Source Totals	300		**7,500**
APnode1	100	40	4,000
APnode2	200	30	6,000
Sink Totals	300		**10,000**

The payment for this hour to the CRR holder for this specific NSR would be \$10,000 – \$7,500 = \$2,500.

6 NSR Priorities and NSR Revenue Stream

In choosing the priorities to set for each Source in the NSR CRR nomination, the market participant should take into consideration how various priority schemes affect the CRR revenue stream in the final combined portfolio of NSRs and CRRs. If the market participant decides to set each Source in the NSR as a priority one, then the market participant must value all of these Sources equally in terms of a CRR revenue stream from the final allocated NSR CRR. On the other hand, if the market participant were to prefer some Sources to others in term of their revenue stream, then these Sources should be given a higher preference in the NSR CRR allocation process.

6.1 Example

The following example provides some insights in selecting Source priorities in a NSR nomination. Suppose a market participant owns two generators (Source1 and Source2) and schedules load (Sink1) (the load is scheduled at a Standard Load Aggregation Point). Furthermore, assume that the Market Participant plans to use one of the generators (Source1) most of the time to serve its load.

Suppose the market participant has an upper bound for the CRR Allocation of 100 MW and intents to request a NSR with the load as the Sink and the two generators as the two Sources. The following are two potential nominations along with the cleared NSR and a potential revenue stream for each of the cleared NSRs.

NSR Nomination 1: Assume that the market participant provides a priority 1 for each Source. Tables 9 and 10 provide the nomination data, but also include a column for an assumed MW clearing from the CRR Allocation for the Sources and Sink in the NSR.

Table 9. Example: final (or cleared) Source data for a NSR

Source Name	Nominated MW	Priority	Cleared MW
Source1	100	1	55
Source2	50	1	45

Table 10. Example: final (or cleared) Sink data for a NSR

Sink Name	Priority 1 Nominated MW	Cleared MW
Sink1	100	100

NSR Nomination 2: Assume that the market participant provides a priority 1 for Source1 and a priority 2 for Source2. Tables 11 and 12 provide the nomination data, but also include a column for an assumed MW clearing from the CRR Allocation for the Sources and Sink in the NSR.

Table 11. Example: final (or cleared) Source data for the NSR

Source Name	Nominated MW	Priority	Cleared MW
Source1	100	1	90
Source2	50	2	10

Table 12. Example: final (or cleared) Sink data for the NSR

Sink Name	Priority 1 Nominated MW	Cleared MW
Sink1	100	100

In NSR Nomination 1, the cleared MW for Source1 and Source2 were 55 MW and 45 MW, respectively. This allocation did not include any preference of one Source over another and the final cleared MW were basically a function of the effectiveness of each of the Sources in alleviating transmission constraint violations and tie-breaking schemes[4]. In NSR Nomination 2, the cleared MW for Source1 and Source2 were 90 MW and 10 MW, respectively. This allocation included a preference of Source1 over Source 2 and this was taken into account by clearing more MWs for Source1 compared to the NSR CRR nomination 1 (55 MW).

As noted, Source1 is scheduled most often in the Day-ahead market to serve the load. The following table provides the NSR MWs (not the Day-ahead market scheduled MWs) along with assumed Day-ahead LMPs and the NSR revenue components.

Table 13 Example: NSR Revenue for the two different NSR Nominations

[4] If two CRRs have the same effectiveness in alleviating a transmission constraint violation, and these CRRs are reduced to alleviate the constraint violation, they will be reduced pro-rata.

		NSR Nomination 1		NSR Nomination 2	
A	**B**	**C**	**D**	**E**	**F**
NSR Resource	**LMP ($/MWh)**	**NSR Cleared MW**	**NSR Revenue ($/h) B * (-C)**	**NSR Cleared MW**	**NSR Revenue ($/h) B * (-E)**
Source1	20	55	-1,100	90	-1,800
Source2	35	45	-1,575	10	-350
Sink1	40	100	+4,000	100	+4,000
		Net Revenue	+1,325	Net Revenue	+1,850
The NSR Revenue is LMP * NSR Resource MW. For Sources this is a negative value and for Sinks this is a positive value (See Eq1).					

The key point in this example is that the Day-ahead market LMP for Source2 is assumed to be $35/MWh while the Day-ahead market LMP for Source1 is assumed to be $20/MWh. This is a valid assumption if Source2 is not often used.

In NSR Nomination 1, the market participant receives $1,325 in CRR revenue for this hour, but in NSR Nomination 2, the market participant receives $1,850 in CRR revenue for this hour, an amount of $525 over the revenue from NSR Nomination 1. Thus, in this example, the market participant would extract a higher value in its revenue stream from NSR CRR Nomination 2 than the NSR CRR Nomination 1.The reason that NSR Nomination 2 generates more revenue is the following:

The formula for the calculation of the NSR revenue is given again in Equation 2 (same as Eq1).

$$\text{NSR Revenue} = \sum_{i \in Sinks} \left(LMP_{Sink\_i} \cdot SinkMW_i \right) - \sum_{j \in Sources} \left(LMP_{Source\_j} \cdot SourceMW_j \right) \qquad \text{(Eq2)}$$

Comparing the sample nomination, the revenue associated with the Sink is the same, i.e., in both cases it is (100 MW) * ($40/MWh) = $4,000/h. However, the revenue associated with the Sources is different. This revenue component is subtracted from the Sink revenue component of the revenue equation. The two prices to be applied are $20/MWh for Souce1 and $35/MWh for Source2 and the total MW of Source1 plus Source2 is 100 MW. Since this source revenue component is subtracted in the NSR revenue equation, the higher the MW that is multiplied with the $20/MWh (applied to Source1) the smaller the quantity that will be associated with the Source component of the NSR revenue equation. In turn, the smaller the Source component of the revenue equation the larger the entire NSR revenue. Thus in this case, since Nomination2 has 90 MW associated with Source1, it will produce more NSR revenue than Nomination1.

Hence, the market participant will put more value or preference in Source1 when requesting the NSR (by putting a higher priority for Source1 than for Source2). Source1 will have a smaller LMP resulting in higher NSR revenue.

The previous example attempts to provide the market participants with some insight into the importance of selecting priorities on the Sources submitted in the NSR nomination. Care must be taken when selecting the priorities so that the revenue stream from the NSR hedges the Day-ahead market congestion costs over a period of time (e.g., over the term of the NSR). Effective priority selection requires a basic understanding of the LMP volatility and patterns of movement under various market and system conditions of the California transmission grid.