ECC Task Force

WHITE PAPER

ECC Future State

Approved by ECCWG: April 30, 2024

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Problem Statement

The Western Interconnection lacks a uniform congestion management process that each RC, BA, and TOP follow in coordination together to support reliability and equity in application for all systems and customers.[1] A lack of uniform coordination creates inconsistency in how transmission congestion is resolved across the West, resulting in BAs and TOP largely resolving issues on their own. The inconsistency in application creates uncertainty and limits transparency for customers on curtailment processes for transactions moving across the West, including how impacts of loop flows are managed. As a result, some customers in one region may experience curtailments for reasons that are different than a similarly situated customers in another area of the West region because differences in methodologies applied by individual BAs and TOPs, and because of the limitations of the WIUMFP.[2]

As the Western Interconnection transitions to services requiring broader coordination with neighbors to facilitate organized markets and evolving generating fleets, establishing a standardized and efficient framework for addressing congestion management interconnection wide will be essential for reliability, equitability, and transparency. After a detailed review of the webECC, the ECCETF proposes the Western Interconnection adopt the existing webECC tool to facilitate the systematic allocation of relief amongst impacting parties based on pre-determined criteria. Unlike existing practices in place in the West, the webECC includes the capability to identify a comprehensive list of congestion impacts across the interconnection and can be leveraged to form the basis of a uniform congestion management approach.

[1] The Western Interconnection manages congestion pursuant to the Western Interconnection Unscheduled Flow Mitigation Plan ("WIUFMP") and individual BA/TOP business practices. The WIUFMP currently manages four paths and all other congestion management in the West (that represent the vast majority of potential coordinating issues) is addressed within the individual BA/TOPs tariffs and business practices. The eastern interconnection adopted uniform congestion management procedures in 1999.

[2] The WIUFMP is limited to only four paths, is outdated (created in 1996), and insufficient to address current congestion along BA seams, and is unprepared to address developing markets.

Purpose

The purpose of this report is to provide a comprehensive overview of the activities of the Enhanced Curtailment Calculator Expansion Task Force ("ECCETF") and outcomes of the group's evaluation of the existing capabilities and current uses of the Enhanced Curtailment Calculator ("ECC") tool "webECC" provided by Open Access Technology International, Inc ("OATI"). This report outlines the key objectives, findings, and proposed implementation approach resulting from the ECCETF's evaluation.

Background and Key Objectives of ECCETF

ECCWG is a technical advisory group established as a means to ensure the western Reliability Coordinators have input and oversight with respect to tools used to perform Reliability Coordination functions within the WECC footprint. The ECCWG established the ECCETF to evaluate and advise the working group regarding all aspects of the webECC.

The ECCETF assessed the webECC's potential to accurately capture MW impacts by Balancing Authority ("(BA"), Transmission Operator ("TOP"), Transmission Service Provider ("TSP"), or market operator dispatch, as well as impacts of tagged transactions on transmission constraints.

1. The ECCETF determined the technical feasibility of expanding curtailment capability procedures capabilities from the Qualified Paths to include System Operating Limits ("SOLs") and Interconnection Reliability Operating Limits ("IROLs") constraints.[3] Western Interconnection
2. A comprehensive curtailment approach was drafted by the ECCETF for both tagged and non-tagged transaction MWs, using a prioritization approach consistent with existing NAESB standards.

[3] The SOLs and IROLs would be defined by each TOP and Reliability Coordinator ("RC") in the Western Interconnection.

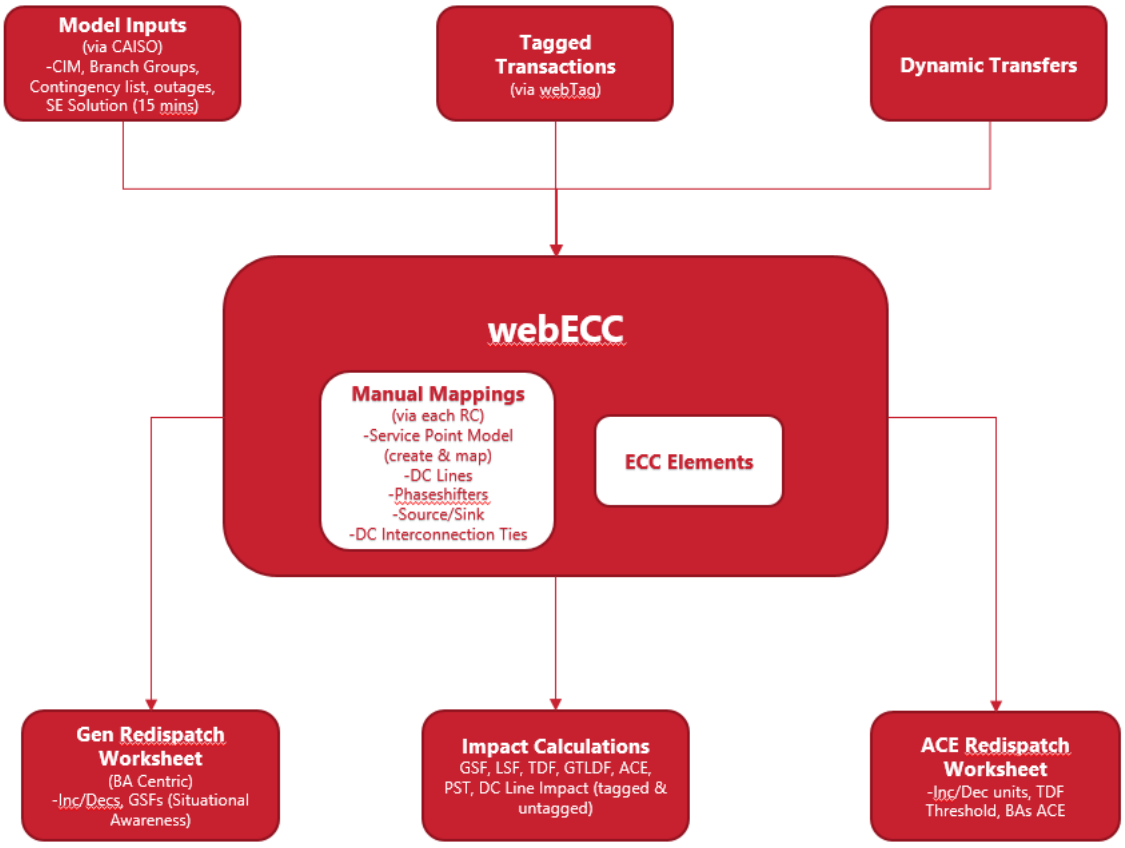
3. The ECCETF evaluated the compatibility and coordination between Western Interconnection Unscheduled Flow Mitigation Plan ("WIUFMP") on Qualified Paths ("QP" s) and other ECC curtailment events in the Western Interconnection, including phase shifter coordination.
4. New required standards from NERC, NAESB, and/or WECC were deemed necessary in order to implement an expanded curtailment approach beyond QPs.
5. The ECCETF documented software requirements, possible tariff impacts, and business practice changes needed to implement an expanded Western Interconnection congestion management approach.
6. The ECCETF proposed an implementation approach of these changes taking into account the technical considerations, compliance implications, and operational transparency.

webECC Current Functionality and Capability

The ECCETF assessed the webECC's capability to capture MW impacts by BA or market footprint(s) and transaction on transmission constraints.

OATI provided the task force with numerous education sessions to describe current tool functionality, as depicted in Image 1.

Image 1



The webECC power flow calculation is based on the California ISO model of the Western Interconnection, provided on a 4–6 week cycle. The base model includes system topology, unique identifiers for equipment, line and transformer impedance, generation capabilities, and transformer and phase shifter tap ranges. The modeling data is provided every 15 minutes and includes the circuit breaker and switch actual status, generation and pump output, individual load, PST tap position and status, LTC tap, DC line flows, transmission line and transformer high and low limits, and branch group high and low limits. Web ECC performs a DC power flow solution utilizing the combination of all the modeling data.

Shift factor calculations represent the impact of defined webECC elements. Calculations results include Generation Shift Factors ("GSF"), Load Shift Factors ("LSF"), Transfer Distribution Factors ("TDF"), and Generation-to-Load Distribution Factors ("GLDF").

Generation Shift Factors represent the change in flow on an element due to an incremental injection at a generator bus and a corresponding withdrawal at a swing bus defined within webECC. The principles of superposition will apply when calculating GSFs (the GSF difference between two generators is the difference between the computed GSFs for each generator to the swing bus). GSFs are used in TDF and GLDF calculations.

Transmission Distribution Factor ("TDF") represents the impact of an interchange transaction on a given element and determines those eligible for curtailment in webECC. For example, an e-Tag with a calculated TDF of 8.3% on an element indicates 8.3% of the MW amount on that e-Tag will flow on element X. The webECC calculation uses a mapping to determine what level of granularity to use for the determination of TDFs; the granularity order of use is Source/Sink, then POR/POD, and ultimately a BA level factor if no granularity is defined. webECC integrates with OATI webRegistry and obtains the most current POR/POD/Source/Sink information for TDF calculations in combination with mapping this data in webECC. webECC calculates the real time TDFs on monitored elements based upon the model incorporated into the tool and the points mapped to the model. webECC uses RT system topology and data, including actual generation and outages, when calculating TDFs and mitigation responsibilities.

Load Shift Factors are used to calculate GLDFs, which are used to determine GTL obligations (i.e., the LSF is a component of the GLDF). Similar to TDFs, LSFs are calculated as the weighted sum of individual loads distribution factor, for all loads belonging to a BA or zone. webECC has the ability to model LSFs at the BA level or more granularly.

Generation-to-Load Distribution Factor is the difference between a GSF and an LSF and determines the total impact of a generator serving its native BA load on an identified transmission facility or monitored element. GLDFs will be used to determine the GTL of BAs where generators in the BA serve the native and network integration load of the BA. webECC serves native load with e-Tags entered for load and then properly decrements the generation to serve remaining load represented as untagged NL/NI load. The GTL calculation can form the basis for determining a BA redispatch relief obligation when curtailment is needed.

webECC requires the definition of elements in order to determine impact calculations. webECC supports two types of element definitions:

- webECC Elements
    - Power Transfer Distribution Factor ("PTDF") elements are elements that do not consider contingencies during curtailment evaluation. With PTDF elements, the monitored branches alone are considered during curtailment evaluation. Elements default to PTDF unless contingent equipment is specified.
    - Outage Transfer Distribution Factor ("OTDF") elements are elements that take into account a predefined or manually defined contingency during curtailment evaluation. With OTDF elements, the monitored branches are considered with a specific facility removed from service during curtailment evaluation.

webECC uses the calculation of factor data at a BA level as the default. webECC can support defining service points for specific generation and load aggregations to provide more specificity in the impact calculations.

A service point is a generation and/or load aggregation that is mapped and used when a given source/sink or POR/POD that is used on an e-Tag. Once a service point is mapped to a field on an e-Tag then the shift factor calculations create a TDF with the specific aggregated generation/load in place of a broader BA level TDF. Reliability Coordinators are responsible for the creation of service points and working with BA and TSP entities to create and modify the mappings.

webECC impact calculations determine the amount of impact a transaction between two points on the transmission system has. The impact calculations may represent an interchange between two BAs (inter-BA transaction) or generation serving load within a BA area (intra-BA). Transactions may or may not be scheduled, and many times scheduled transactions represent generation from a source point comprised of multiple generators supplying the load.

- Tagged (e-Tag) transactions – e-Tags are visualized as an impact to webECC elements.
    - Grouped e-Tag data will be shown by transmission priority. The e-Tags are also grouped into On-Path and Off-Path impacts for those webECC elements that are qualified into the Western Interconnection Unscheduled Flow Mitigation Plan.

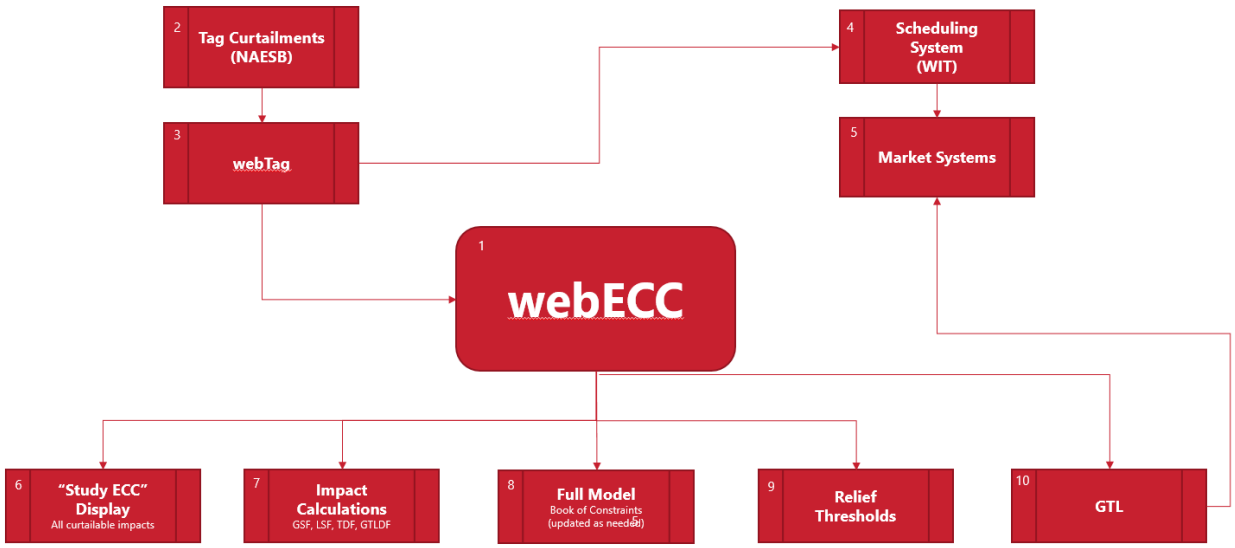
    - Dynamic Transfers – Dynamic transfer information is visualized on webECC elements. Dynamic schedules are populated based on e-Tag information, whereas Pseudo-ties require real time dynamic transfer telemetry to be provided to webECC.
- ACE – ACE information is visualized on the webECC elements.
    - This information requires real-time ACE information to be provided to webECC.
- NL/NI Load Serving (GTL) – NL/NI Load served within a BA is visualized within webECC through the use of other inputs to webECC.
    - This impact calculation is based on deduction from other webECC inputs such as the tagged flows, actual load, and actual generation. This value is not explicitly provided to webECC from an external source.
- Control Devices – in addition to the e-Tag, GTL, ACE, and dynamic transfer impact calculations, webECC computes and displays impact on elements of control devices at their set points (subtracted by the e-Tags scheduled through the control devices).
- Unaccounted element flow – this layer accounts for any flows that are not assigned to the other defined portions.
    - Examples of power that may fall into this category include transmission losses and minor discrepancies arising from modeling or calculation issues. The unaccounted flow value can be calculated by comparing the webECC calculated post-contingent flow to the sum of the individual calculated components.

Technical Feasibility in Expanding Curtailments

The ECC Task Force has determined the technical feasibility in expanding curtailments on SOLs and IROL constraints as determined and defined by each TOP and RC in the Western Interconnection.

After review of the current state of ECC, several areas of potential change were identified. In general, a proposal for Reliability Coordinators to lead congestion management is needed. This change will allow a consistent interconnection-wide approach that will address equity and reliability. Additional areas are listed below (not in order of importance) as shown in Image 2 (ECC Future State):

Image 2 (ECC Future State)



1. There is a need for increased transparency and access to a shared interconnection wide model. The RCs have committed to work on modeling accuracies and best practices to allow for better visibility into the models and data feeding webECC.

Inputs to webECC

2. e-Tag Curtailment rules will feed into webTag, as a result of anticipated NAESB standards.
3. e-Tags will feed into webECC and WIT from webTag as they do today.
4. WIT will send schedule and NSI information to each Market System.
5. Market systems will send data to webECC.

Outputs of webECC

6. A new display in webECC is needed to present all curtailable impacts on constraints in one view. This display is similar to the Study TLR screen in the Eastern Interconnection's IDC. For the process proposed in this whitepaper ACE impacts would not be included. If ECC allocated relief based on e-Tags, dynamic schedules, and GTL (calculated with real time outputs) all contributing entities will be allocated their equitable share of the required relief. GTL

calculations using real time topology and generation outputs are more accurate than an entity approximated impact from a high or low ACE. [4]

7. Impact calculations are currently set at 10% and should be updated to 5%. It is not uncommon in the Western Interconnection to see congestion with all impact layers having less than a 10% impact. Some common congestions issues are heavily impacted by relatively isolated load or generation pockets. Changing this threshold to 5% will help control those difficult congestion issues while being consistent with other industry practices in other interconnects.
8. Full model details give the ability for users to download the full western network model being utilized by webECC. Additionally, a full list of defined constraints should be available to all users. Benefits include increased transparency, ability to compare models for troubleshooting, and individual responsibility for each RC's own footprint.
9. Relief threshold details are included in the next section.
   GTL details are included in the next section.

Curtailment/Relief Obligation Approach

The ECC Task Force has drafted a curtailment approach of tagged and non-tagged transactions/MWs by priority under existing NAESB standards.

The ECC expansion proposal is to issue relief obligations on a pro rata basis while respecting transaction priorities. The relief obligation should be based upon constraints defined in ECC to resolve or prevent SOL exceedances. The first step in this relief obligation assignment process is to determine if BAs and have a material contribution to the SOL exceedance. For the ECC Expansion, an entity has a material impact when an individual Impact Layer component (e-Tag, Dynamic Transfer, and Generation to Load

[4] Excluding ACE in the GTL calculation will not change current Reliability Coordinators' existing congestion management methodologies. The ability to work with BAs within each RC footprint and coordinate with neighboring RCs and BAs will persist.

GTL) is greater than or equal to a 5% Impact Threshold. If the ECC identifies no Impact Layer components above the Impact Threshold, then that ECC Element would remain a local issue that the BA, TOP and RC would resolve with existing methods. Calculations should respect any existing seams agreements and be able to accommodate future seams agreements.

Once the Impact Layer components above the Impact Threshold are identified, the ECC relief obligation allocation will be calculated for each BA having impacts above the threshold in any layer.

e-Tag and Dynamic Transfers

The e-Tag and Dynamic Transfer Impact Layer components will perform calculations based on the real-time value from the e-Tag or from available telemetry. When e-Tags or Dynamic Transfers are used to assign relief obligations, ECC will respect transmission priorities so that non-firm curtailments are requested prior to firm curtailments using a bucket approach. e-Tags or Dynamic Transfers included in the relief obligations will be subject to systematic curtailment. BAs will have the authority to reject the curtailments of specific e-Tags if the curtailment of those e-Tags would create emergency conditions for the BA.

Generation to Load

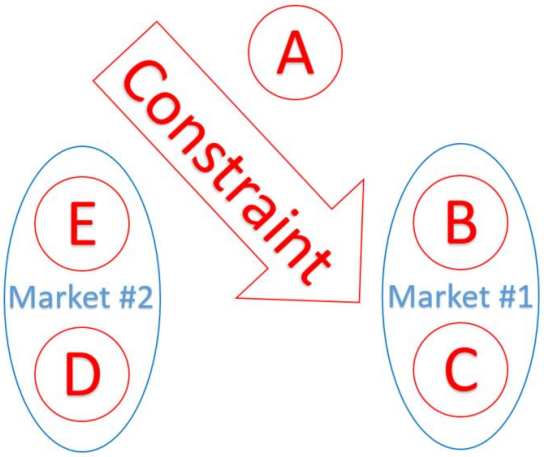
The Generation to Load ("GTL") Impact Layer component will account for the impact of a BA or market area serving load within that area. BAs participating in an organized market will be aggregated and their net GTL relief obligation will be issued for the entire market area. The GTL calculation will be done by ECC using real time telemetry and unit outputs. This will ensure that the methodology used to calculate GTL impacts is uniform and applied consistently across the interconnection. GTL components above the Impact Threshold will default to the highest transmission priority so that they are aligned with the firm e-Tags when determining relief obligation. If specific generators serving load within a BA do not have firm transmission service, the TSP will need to provide this information so that non-firm GTL relief obligations are issued with the appropriate e-Tag curtailments.

Relief obligations will be effective immediately upon issuance from the ECC and terminate at the end of the clock hour. e-Tag and Dynamic Schedule curtailments will happen systematically through ECC and WIT. BAs or market areas issued GTL relief obligations will need to redispatch their systems to achieve the relief obligation. A re-evaluation and recalculation of the ECC relief obligation, that includes all

transactions approved to begin at the top of the hour, will be performed at 45 minutes after the hour. Relief obligation assignments for the next hour will be calculated using ECCs future time points.

The ECC will continue to support the business requirements of the WIUFMP and issuance of events for Elements configured as Qualified Paths. The business rules presented within this White Paper will apply directly to SOLs defined as constraints in ECC.

Example



In this example there are 5 Balancing Authorities, A-E. Balancing Authorities B and C are participating in market 1 while Balancing Authorities E and D are participating in market 2 and Balancing Authority A is not participating in a market. The constraint represents an SOL on the BES with a limit of 500 MW and the post contingent flow is currently 600 MW. So, for this example 100 MW of relief is needed to return flows to the SOL.

Below are charts showing all impactful e-Tags, GTL impacts.

e-Tag ID	Priority	Schedule MW	TDF %	Relief Available MW
1	2	150	3.0	N/A Does not meet 5% threshold
2	2	100	10.0	10

3	3	200	7.5	15
4	7	400	17.5	70
5	7	250	12.0	30
6	7	250	20.0	50

	GTL
BA A	12
Market 1	36
Market 2	27

Since e-Tag 1 is below the 5% impact threshold it would not be eligible for curtailment and would not go into any of the relief calculations. Also, in the GTL table you see that BA A has a GTL while BAs B/C and E/D have been aggregated into their market areas. All GTL values would be calculated by ECC. For the purpose of this example all GTL impacts are considered firm, however ECC will need to assign priorities to non-firm GTL so that it is curtailed appropriately.

Since this approach respects transmission rights, the curtailments would start with the lowest priority e-Tags. Since e-Tags 2 and 3 are both non-firm in this example they would be curtailed to 0 providing 25 MW of relief on the constraint. Since a total of 100 MW of relief is needed, firm curtailments would need to take place. This would happen on a pro rata basis. By summing the total impact of firm e-Tags 4, 5 and 6 we see that they have 150MW of impact. We can also sum the total impact from GTL for a combined impact of 75 MW. As a result, the 75 MW of remaining relief would be achieved by 50 MW of firm e-Tag curtailments and 25 MW of relief obligations assigned to BAs or market areas. The firm e-Tag curtailments would be done on a pro rata basis calculated by the impact each e-Tag has on the constraint. BA and market areas would be expected to achieve their relief obligation by redispatching their respective areas.

Curtailments and relief obligations are seen in the charts below.

e-Tag ID	Priority	Schedule MW	TDF %	Relief Available MW	e-Tag Curtailed to MW	Relief provided
1	2	150	3.0	N/A Does not meet 5% threshold	None	0
2	2	100	10.0	10	0	10.0
3	3	200	7.5	15	0	15
4	7	400	17.5	70	266	24
5	7	250	12.0	30	166	10
6	7	250	20.0	50	165	17

**figures rounded to whole numbers

	GTL	Relief Obligation
BA A	12	4
Market 1	36	12
Market 2	27	9

Coordination with UFMP

The ECC Task Force has evaluated and determined the co-existence, coordination of UFMP on Qualified Paths, and other ECC curtailment events in the WI, including establishing Phase Shifter coordination.

Expansion to Generation to Load ("GTL"), intra-BA schedules, impact of MW curtailments, and congestion management across SOLs will live in coordination with WIUFMP. There is no proposal to change current WIUFMP practices. This will continue to be a congestion management tool that can be utilized in the Western Interconnection, in addition to the expansion contemplated in this whitepaper.

Regulatory Requirements

The ECC Task Force has assessed NERC, NAESB, and WECC standards needed to implement an expanded curtailment approach on non-Qualified Paths.

The task force recommends that a NAESB standard request is submitted after working group review, endorsed by this task force, the ECCWG, and the RC Executive Committee, as well as any other industry participants that have expressed interest in ECC expansion. The NAESB process can detail the specific requirements and notify the industry of opportunities for participation, comments, and voting.

Potential changes to NERC standards may also be necessary, to address any new NAESB standards that effectually get approved. Coordination with WECC will be necessary as the NAESB process gets underway. Regulatory requirements that may be impacted must be considered as the industry works toward agreement on the use of the ECC to provide an assigned relief obligation on element exceedances. The current NERC standard that governs all Interconnection-wide transmission loading relief processes is IRO-006-5, "Reliability Coordination — Transmission Loading Relief ("TLR")" and more specifically IRO-006-WECC-3, "Qualified Transfer Path Unscheduled Flow (USF) Relief" for the Western Interconnection, also known as the WIUFMP. The IRO-006 variance for the Western region requires that entities must respond to the assistance requested under the WIUFMP, however, the scope of equipment under the WIUFMP rules is limited to only the Qualified Paths. A standard modification for IRO-006-5 may also be necessary in the future.

The task force has also identified Tariff implications that may be impacted with an expanded curtailment approach. Jurisdictional entities under FERC are mandated to follow NAESB standards and should update their tariffs to follow them. Additional tariff changes may be necessary for individual entities to align current curtailment practices with any approved NAESB curtailment practices.

Next Steps and Recommendations

The ECC Task Force has documented required software changes, possible tariff impacts, and business practice changes needed to implement an expanded Western Interconnection congestion management approach.

The first step to expanded congestion management is to request a NAESB standard that covers: general requirements for Interconnection wide congestion management procedures, interchange and intra-BA transaction priorities for interconnection wide congestion management procedures, and procedures for physical curtailment of interchange transactions, intro-BA transactions and assignment of GTL relief obligations. The details adopted at this level will then drive any necessary webECC software changes during implementation. At this time, there is no proposal to require changes until a NAESB standard is approved.

Implementation Approach

The ECC Task Force recommends the following implementation approach:

1. Present this whitepaper to the ECCWG.
2. Present this whitepaper to the Western Interconnection Reliability Coordinator Executive Committee ("WIRCEC").
3. Present this whitepaper to the WECC RRC.
4. Submit a standard request at NAESB after working group review.
    a. Industry to draft required standards for curtailments.
        i. NAESB outcome will drive ECC Tool enhancements necessary to achieve standards drafted.
        ii. NAESB outcome will drive necessary Tariff changes required to follow the new standard.

5. Discuss with WECC any necessary changes to current standards.

In parallel with the above steps:

1. SPP and CAISO to work on a calculation assessment of webECC by:
    a. Identifying constraints on the seam,
    b. Benchmarking flow calculations
    c. Discuss and enhance modeling transparency,
    d. Update Service Point Model mapping.

Appendix

ECCWG Charter - https://spp.org/documents/61819/ecc%20charter_final.pdf
ECCETF Charter - https://spp.org/documents/67699/ecc%20expansion%20task%20force%20charter.pdf