2024 ISO LCR Study Criteria, Methodology, and Assumptions

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Stakeholder Web Conference

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Agenda

- Introductions
- General Resource Adequacy (RA) concepts
- General interpretation of existing standards
- Applicable ratings
- Deliverability of generation and imports
- Definition of load pockets
- Transparency of operating solutions
- Contingencies
- Load forecast
- Summary of all LCR assumptions
- Next Steps
- Improvement to the process, other stakeholder input
- Action Items

General LCR Transparency

- Base Case Disclosure
  - –ISO will publish the base cases on the ISO protected web site (https://mpp.caiso.com/tp/Pages/default.aspx)
  - –Remember to execute WECC/ISO non-disclosure agreements (http://www.caiso.com/planning/Pages/TransmissionPlanning/Default.aspx)
- Publication of Study Manual (Plan)
  - Provides clarity and allows for study verification
- Description of Proposed Operating Solutions
  - Subject to established ISO Confidentiality Rules
  - Will not indicate specific operational impact on particular generating facilities during identified contingencies
- ISO to respond in writing to questions raised (also in writing) during stakeholder process

GENERAL RA CONCEPTS AND INTERPRETATION OF APPLICABLE STANDARDS

General Resource Adequacy Concepts

- Resource Adequacy (RA)
  - Ensure that capacity exists and is under contract in order for all load to be served by responsible Load Serving Entities (LSEs)
  - Generally, LSEs will demonstrate that they have secured adequate qualified capacity to serve their peak load including planning reserve (every month in the month ahead timeframe).
  - Generally, LSEs will demonstrate, in the year ahead timeframe that they have secured minimum 90% of the next summer's peak load needs including planning reserve.
  - All resources participating in the ISO markets under an RA contract will have an RA must-offer-obligation to the ISO.

General Resource Adequacy Concepts

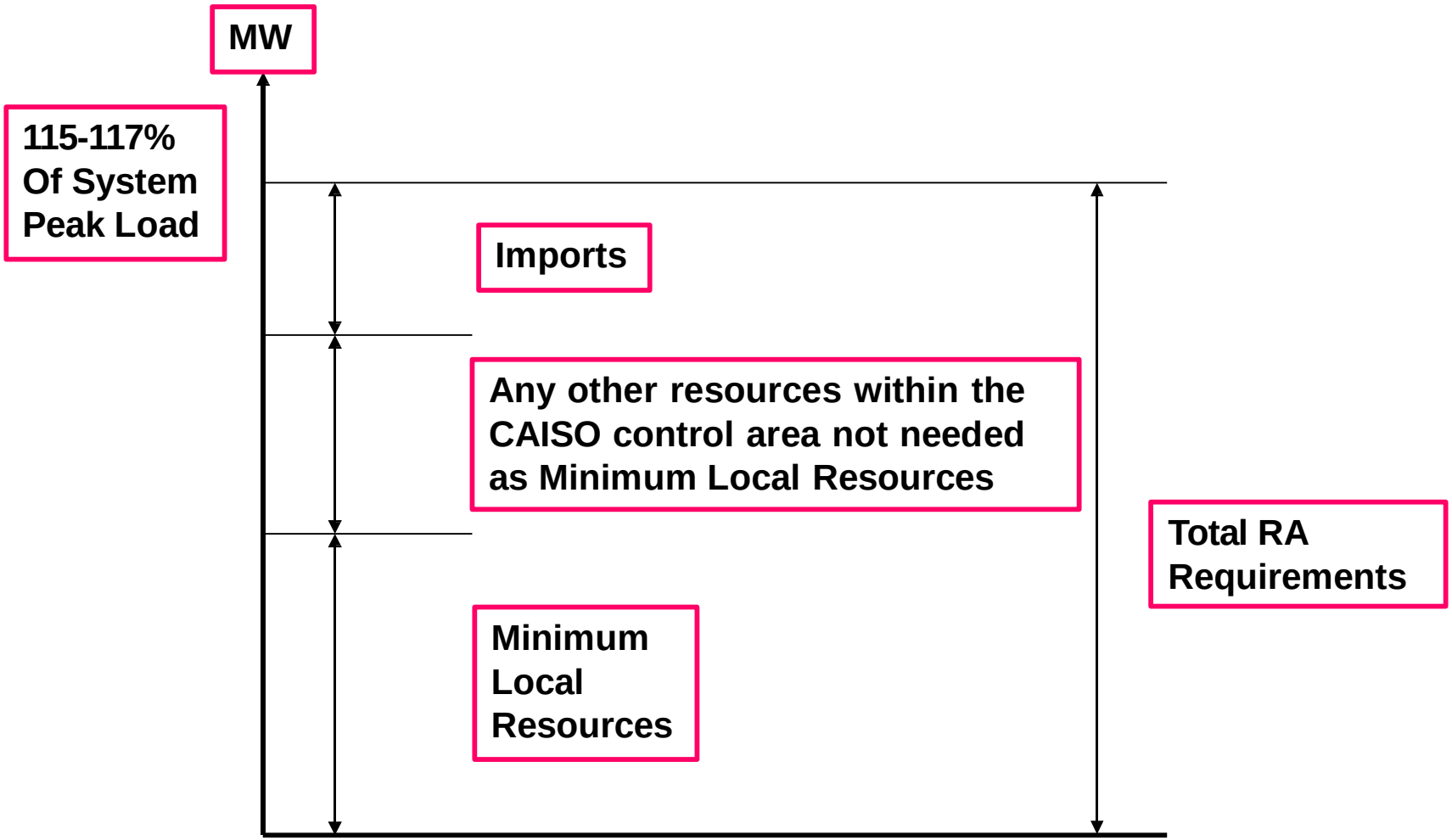
- ISO Tariff
  - ISO can determine minimum local resource requirements on LSEs in order to maintain reliability standards
  - If LSE procurement falls short of ISO's identified needs then ISO may engage in backstop procurement role to assure reliability standards are met in local areas

- Minimize ISO Backstop Procurement
  - General agreement exists that ISO reliability back-stop procurement role should be minimized
  - The ISO methodology meets reliability requirements and minimizes its backstop procurement
  - LCR methodology is based on the existing applicable reliability standards used by the ISO to measure its own compliance

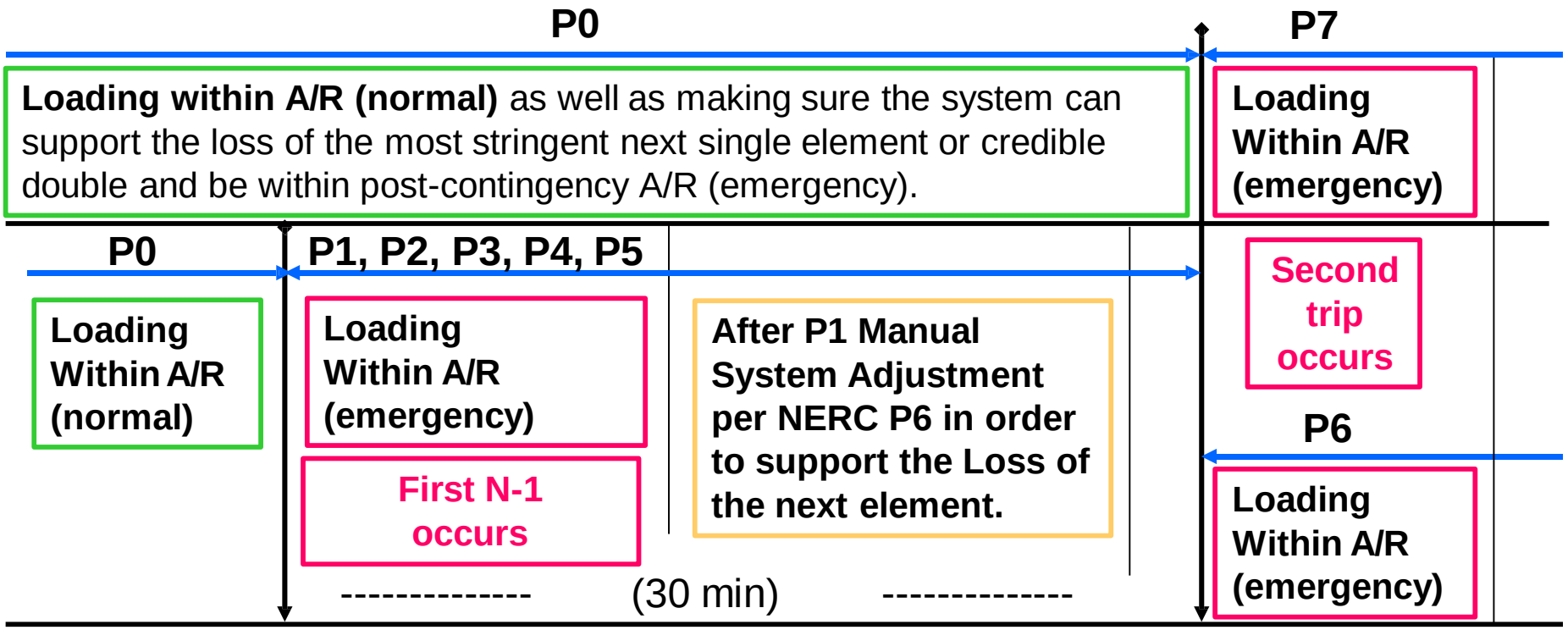
General Resource Adequacy Concepts

- Year ahead Resource Adequacy & Reliability Planning
  - If a resource is not under an RA type contract or otherwise retained by the ISO for reliability services, it will be considered off-line and will not be available to meet reliability needs of the ISO because:
    - These resources will have no must-offer-obligation to the ISO; therefore, they are not obligated to have bids in the ISO markets. ISO could be forced to go out-of-market and these resources may be unavailable or unwilling to respond to the ISO reliability calls.
  - As a result, all units under RA contract + those retained by the ISO for reliability reasons can be used to meet applicable reliability standards.

Total Resource Adequacy Procurement



Minimum Local Capacity Requirements



Load Shedding Not Allowed After:

P0, P1, P2.1, P2.2EHV, P2.3EHV, P3, P4.1-5EHV, P5.1-5EHV, P6(High Density), P7(High Density)

Planned and Controlled Load Shedding Allowed After:

P2.2HV, P2.3HV, P2.4, P4.1-5HV, P4.6, P5.1-5HV, P6(Non-High Density), P7(Non-High Density)

Terms

- P0 (N-0) normal system conditions; use normal ratings
- P1, P2 (N-1) single contingency conditions: use emergency ratings
- P3 (G-1)(N-1) conditions; use emergency ratings
- P4, P5 (N-1)(breaker or relay failure) conditions: use emergency ratings
- P6 (N-1-1) conditions; non-generator P1 manual readjustment and then another non-generator P1; use emergency ratings
- P7 (N-2) common mode (same structure); use emergency ratings
- EHV BES Voltage level > 300 kV
- HV BES Voltage level <= 300 kV
- A/R Applicable Rating
- Manual Adjustment – any adjustment done by operators (other than load drop) in order to assure that the system is in a safe operating zone and can support the loss of the next most stringent single contingency
- Planned load drop means that the most limiting equipment has a higher short-term emergency rating (i.e., 30 min) AND the operators have a operating procedure that clearly describes the actions needed to be taken in order to shed load
- Controlled load drop means the use of a Special Protection Scheme

WHAT IS AN APPLICABLE RATING?

LCR Criteria

- The LCR study is a planning function that currently forecasts local operational needs one year in advance
- The LCR study relies on:
  - ISO/NERC/WECC Planning Standards
  - WECC OC – Path Rating
  - System Operating Limits (SOL)
- Applicable Ratings Incorporate:
  - ISO/NERC/WECC Planning Standards – Thermal Rating
  - WECC OC – Path Rating
  - System Operating Limits (SOL)

Summary

- LCR Criteria includes ISO/NERC/WECC Planning Standards, WECC OC Path Rating and RC System Operating Limits (SOL)

- ISO and PTO transmission expansion plans will need to recognize WECC OC Path Rating and RC System Operating Limits (SOL) in order to propose transmission projects which would reduce LCR

ENFORCING DELIVERABILITY

Deliverability Recap

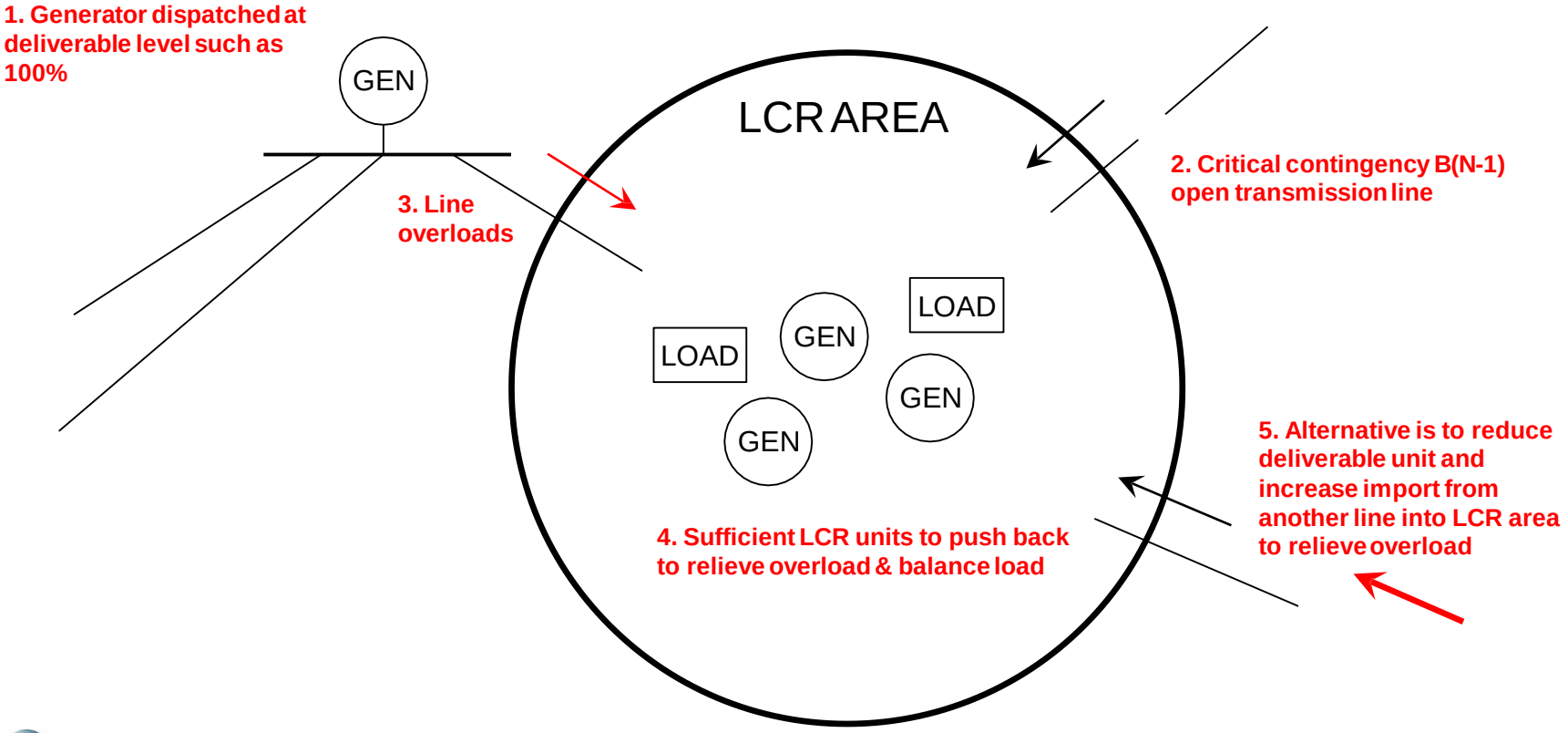
- **Basics**
  - A resource must be deemed “deliverable” under on-peak load conditions (FCDS, PCDS, or IDS) to count for RA
  - Being deemed “deliverable” conveys no priority rights when a resource utilizes the ISO controlled grid
- **Study Methodology**
  - Peak load condition
  - “Generation Pocket” concept - generation in an area may exceed the transmission capacity available to deliver resource outside the area
- **Resources**
  - Imports (into the control area) – deliverable amount determined based on average of highest historical usage during summer peak conditions
  - Generation – deliverable amount determined based on studies with deliverable imports enforced

LCR Recap

- **Basics**
  - It is a subset of the System RA requirements and represents the capacity that needs to be procured in specific local areas
  - Represents the minimum resource capacity needed and available in a local area to safely operate the grid
- **Study Methodology**
  - Peak load condition
  - “Load Pocket” concept - load within a local area may exceed the maximum transmission capacity available to deliver resources into that area
- **Resources**
  - Any resources that are considered deliverable within the defined local area

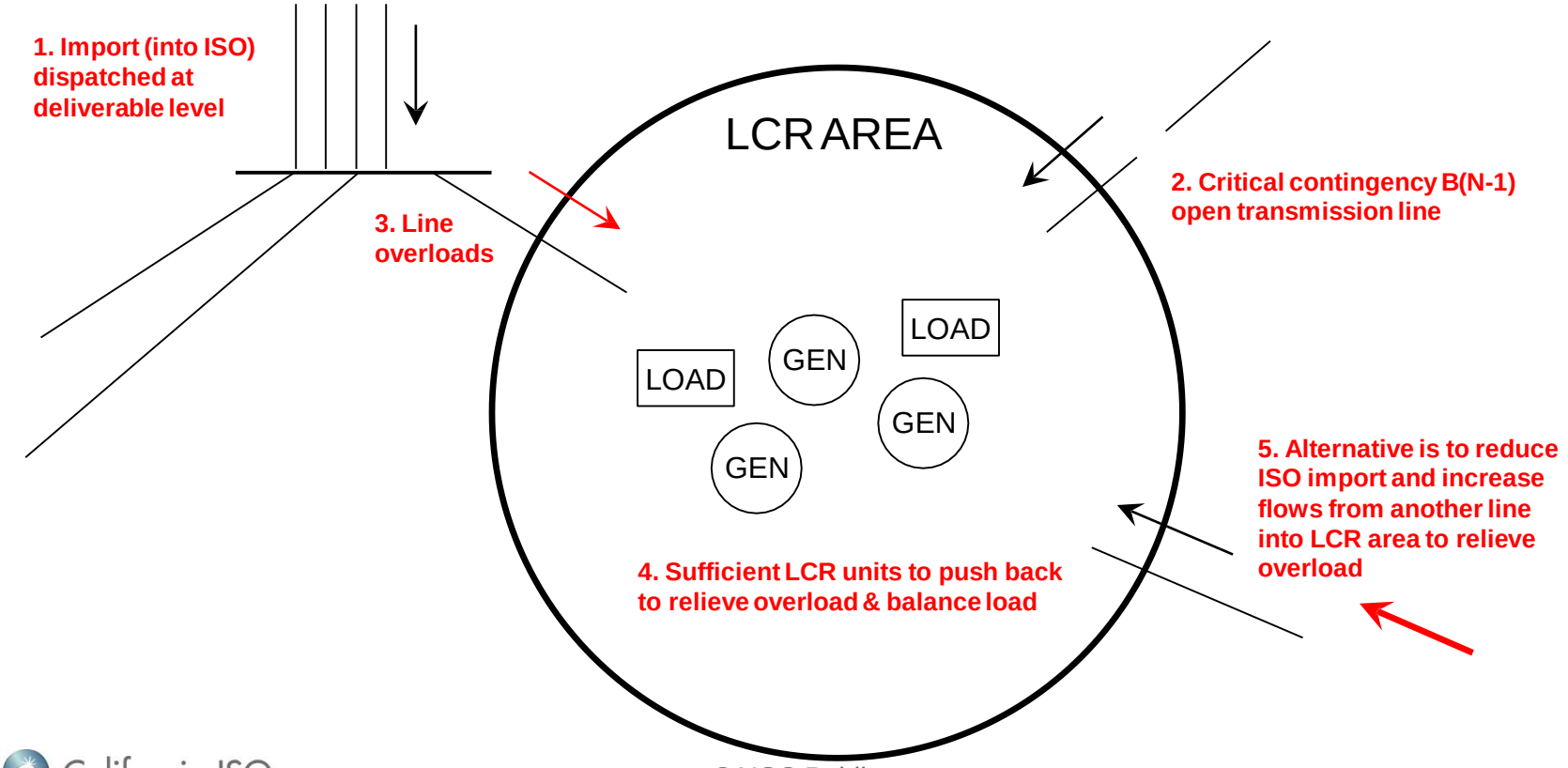
Deliverable Generation Enforced

Deliverability of generator outside the LCR area is enforced under normal P0 (N-0), single P1 (N-1), and common mode P7 (N-2) contingencies. For P3 & P6 (N-1-1), immediately after the first contingency any unit (subject to maximum MW number) can be decremented as part of the manual adjustment.



Deliverable Import (into the control area) Enforced

Deliverability of generator outside the LCR area is enforced under normal P0 (N-0), single P1 (N-1), and common mode P7 (N-2) contingencies. For P3 & P6 (N-1-1), immediately after the first contingency any import (subject to maximum MW number) can be decremented as part of the manual adjustment per existing operating procedure agreed upon by both neighboring control areas.



If Deliverability is not enforced in the LCR Analysis

- Minimum LCR requirements will be reduced or remain the same
- Potentially there will be an insufficient amount of LCR to ensure deliverability of import and/or internal generation
- Could result in less procurement if the “deliverable resources” (imports/generation) are not procured for RA or otherwise extensively used in real-time
- ISO would NEED to rely on other tools like:
  - Using it’s year ahead back stop procurement authority for requirements beyond those published in the LCR requirements
  - Day ahead and real time use market units without an RA contract with potential of engaging the backstop procurement authority
  - Load shedding if local area uncontracted units retire and are needed

Actual Examples . . .

- Local areas most impacted are Sierra and Fresno
- For Sierra, the impact is driven by COI imports as well as PG&E-owned Northern Hydro River System and the State Water Projects
- For the most part, there will be rather large decreases in import allocations and generation deliverability for rather small decreases in local area LCR requirements
- Showings will likely rely on the above mentioned resources. As such, the ISO would need to account for their full RA capacity

- In Summary:
- Deliverability of allocated RA Imports and existing generation should be maintained under normal P0 (N-0), single contingency P1 (N-1), and common mode P7 (N-2) contingency conditions

Major path flows that influence LCR

- **General rule**
  - If a major path (that does not flow directly into a local area) influences the LCR evaluation then, it should be chosen such that the resulting local generation can support the maximum path flow we have seen in the last 3 years for the hour of study
  - This will assure that the local area problem will not exacerbate into a zonal or system problem because of insufficient local generation

- **Path 15**
  - Path 15 flow will be set at 2500 MW South to North flow when studying Fresno LCR

DEFINITION OF LOAD POCKETS

Technical versus Commercial Issues

- Technical definition of load pocket:
  - Based on a transmission constraint(s), which will change as the system changes => different physical needs and different boundaries
  - Results in more frequent changes in LCR requirements and resources needed to mitigate them
  - Hard to achieve in local areas where more then one contingency drives the total requirement

- Commercial definition of load pocket:
  - Based on a fixed transmission boundary
  - Desire to enter into LT contracts where resources and load responsible for meeting LCR requirements are more stable and will continue to count towards local RA obligation for the term of the contract (even though physical needs may not be met)

Transmission Reinforcements

- Changes in the transmission network will change:
  - The boundary of Load Pockets
  - The effectiveness of generators and/or loads to relieve the potential transmission constraint(s)
- Relief of existing transmission constraint may shift the transmission constraint outside the Load Pocket
  - Thus enlarging the Load Pocket resulting in larger number of generators to meet LCR (more generators may increase competition leading to lower prices)
- Leads to lower number of generators required for LCR

If Load Pocket Boundaries are NOT Fixed

- In general, the probability of long term Local RA contracts becoming a "stranded cost" is greater
- Hard to implement in local areas where more then one contingency drives the total LCR requirement
- When the transmission system changes, so would the transmission constraint(s) and local area resources available for LCR procurement

If Load Pocket Boundaries are Fixed

- Resources outside the old pocket boundary that may effectively relieve the new constraint(s) would not be counted towards the local requirement
- Generation that LSEs do procure in an old pocket boundary may no longer meet the local area need
- Long-term, misalignment could increase the chance of ISO back-stop procurement potentially resulting in increased cost

TRANSPARENCY IN OPERATIONAL SOLUTIONS

Consensus:

- Any new “manual” operational adjustments used by ISO in its studies should be fully transparent such that stakeholders can perform studies of the limiting contingency.

- Any operational solution must be validated and implemented in real time by ISO.

- Manual operational solutions should be implemented by market engineering group as best as possible in order to assure that the solution could be run by SCOPF (Security Constrained Optimal Power Flow).

CONTINGENCIES

Contingencies to be used

- Any contingency can determine the minimum LCR requirement
- Limiting equipment determine if a condition should be catalogued as local, zonal or system
  - Example: An outage of SWPL will have a local effect if the overload is on the South of Songs 230 kV path; a zonal effect for a SCIT violation or overload on path 26; and a system effect if reserves dip below minimum allowed, or if COI is overloaded
- Limiting the number of contingencies (e.g., boundary elements) would contradict with real time operations where the ISO needs to maintain system reliability for all possible contingencies

LOAD FORECAST, OTHER CONSIDERATIONS AND SUMMARY OF LCR ASSUMPTIONS

Load Forecast to be used

- Use the latest available CEC load forecast
- CEC to provide the ISO and PTO the starting data before December 1, 2022 for initial base case development (else the California Energy Demand Forecast 2021-2035 Baseline - Mid Demand with low AAEE and high AAFS case will be used)
- 2022 IEPR Update adopted forecast will be used for the LCR study (January 15, 2023)
- LCR study is fully integrated into the annual transmission planning process. As such it uses the 1-in-10 year summer peak forecast for local areas.
  - See CAISO Planning Standards at: http://www.caiso.com/Documents/ISOPlanningStandards-September62018.pdf

Other Considerations

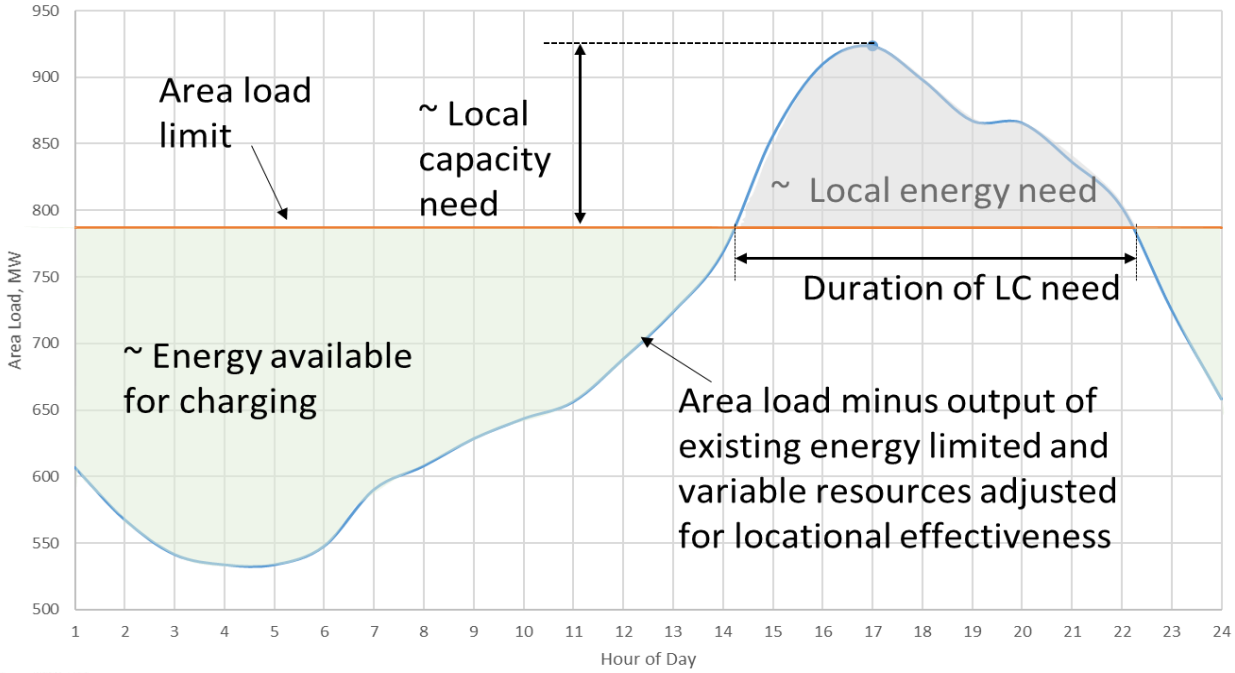
- Peak shift (moving of actual peak hour later in the day mostly due to distributed PV installations)
  - CEC managed peak demand will be used
  - For areas where CEC does not provide direct forecasting the PTO/ISO will provide the managed peak demand
- Effective resources shall be dispatch up to the latest available NQC and, where applicable, not to exceed historical (projected for new resources) output values at the time of the managed peak load in the local area
  - CEC provided solar output shapes for managed peak hour (ISO to provide solar output shape if not available from CEC)
  - Consistent with TPP assumptions for other resources (Wind, QF)

Charging for Storage used as local RA resources

- Local storage resources must be able to charge from the grid during all extended outage conditions (except extreme events) by using
  - Remaining transmission capacity into the constrained area
  - Other contracted for resources inside the constrained area

Methodology for assessing local energy need and charging feasibility

- Due to the energy limitation and need for charging, the following the methodology has been developed for assessing energy requirement and charging feasibility.
- The methodology is based on comparing the forecast hourly area effective net load for peak day against the area load carrying capability limit (area load limit).



Energy Storage Assessment Approach – Load vs load serving capability

- The assessment includes an hour-by-hour comparison of the net load versus the total (transmission + generation) load serving capability.
- Peak day 24-hour load profile is used, either directly from the CEC hourly load forecast or future year load profile developed by escalating from the historical load profile for the study area.
- Total local load serving capability includes the transmission load serving capability and local generation load serving capability.
  - The transmission load serving capability is calculated under the worst contingency condition without any local generation.
  - The local generation load serving capability is calculated under the worst contingency condition with the amount of generation needed according to the local capacity requirement considering effectiveness of the aggregate of local generation to the worst constraint.

Key assumptions used in energy storage assessment

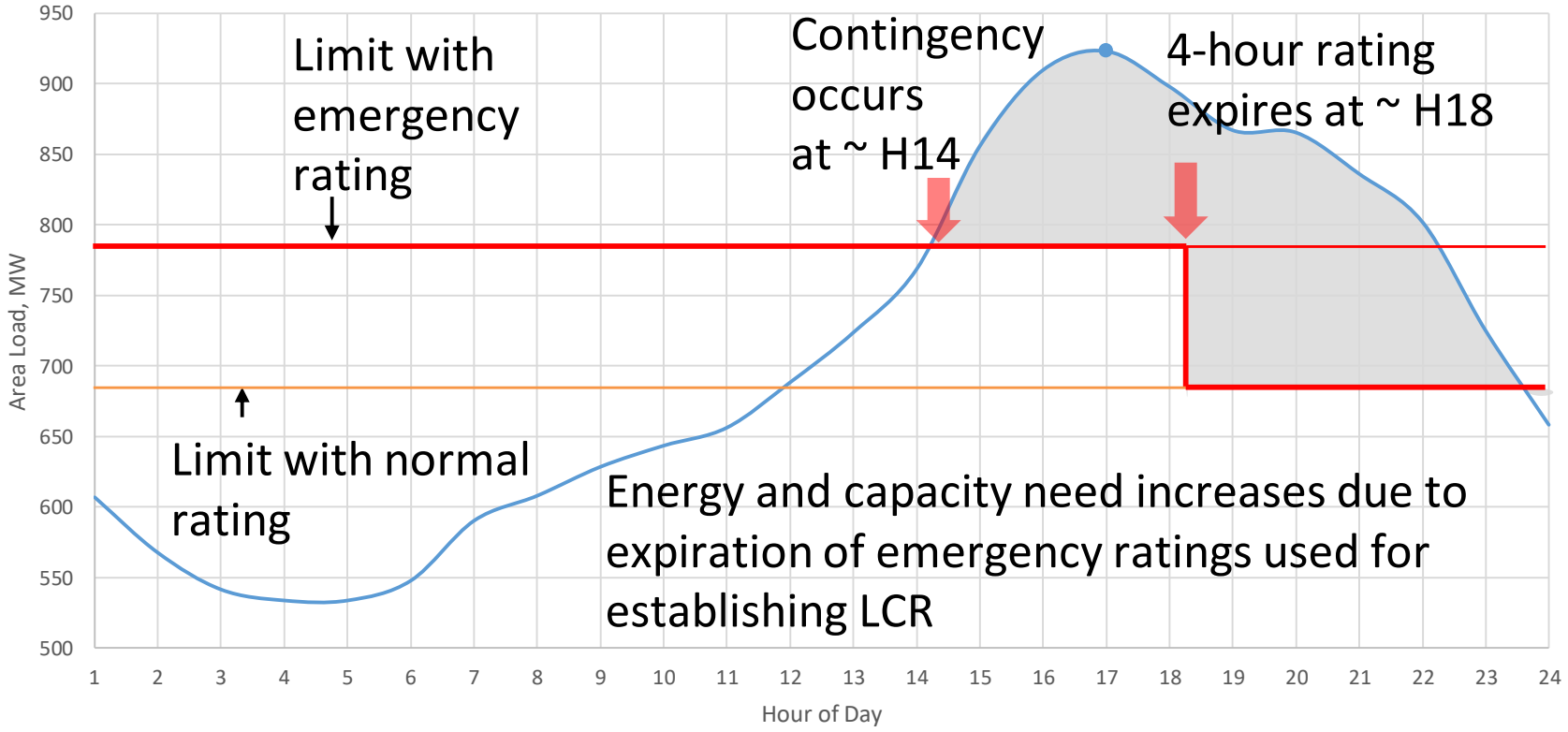
Assumption	Rationale
Storage added displaces existing generation (all types) MW for MW in aggregation.	To maintain local RA capacity. Any incremental storage is assumed to be a local RA resource.
Maximum storage addition cannot exceed LCR amount.	To maintain local RA capacity. Any incremental storage is assumed to be a local RA resource.
Includes storage charging/discharging efficiency of 85%.	Based on general battery efficiency.
Storage is charged in all hours where the storage is not discharged. Maximum charging is capped at the amount of storage size (Pmin).	Under worst contingency condition, for battery to have sufficient discharge energy, it is assumed that battery is charged in all hours it is not discharged.
An hourly energy margin of 5% or 10 MW, the larger of the two, is applied to both charging and discharging need.	To add margin when battery is discharging so it does not have to follow load curve exactly. For charging same margin is added to discount available system capability each hour.

Additional consideration in presenting storage capability as part of Local Capacity Requirement (LCR) study

- Majority of LSEs are procuring 4 hour batteries (due to current CPUC rules for system RA counting)
- The CAISO has introduced “Maximum MW quantity of 4-hour battery as 1 for 1 replacement” of resources needed in that local area or sub-area
  - Beyond this limit batteries may not reduce the need for other local resource on a 1 for 1 bases.

Effect of difference between normal and emergency ratings

Relevant for thermal rating limited areas



Summary of LCR Assumptions

- Transmission and generation modeled if on-line before June 1, 2024
- Maximize import capability into local areas
- Maintain established path flow limits
- Units under long-term contract turned on first
- Maintain deliverability of generation and imports
- Fixed load pocket boundary
- Maintain the system into a safe operating range
- Performance criteria includes normal, single as well as double contingency conditions in order to establish the LCR requirements in a local area
- Any relevant contingency can be used if it results in a local constraint
- System adjustment applied (up to a specified limit) between two single contingencies
- Use the latest CEC 1-in-10 peak load in defined load pockets
- Use of managed peak demand and effective resource output at the time of managed peak (not to exceed NQC)

NEXT STEPS

Current Calendar

Methodology, criteria, and assumptions for 2024 LCR study finalized by early-December

- CPUC and the ISO have determined overall timeline
- Submit comments by November 14, 2022
- Posting of comments with ISO response by the November 28, 2022
- Base case development will start in November-December 2022
- Receive base cases from PTOs January 3, 2023
- Publish base cases January 16, 2023 – comments by the 30th
- Draft study completed by February 24, 2023
- ISO Stakeholder meeting March 9, 2023 – comments by the 23rd
- ISO receives new operating procedures March 23, 2023
- Validate op. proc. – publish draft final report April 3, 2023
- ISO Stakeholder call April 12, 2023 – comments by the 19th
- Final report April 28, 2023

OPEN DISCUSSION REGARDING IMPROVEMENTS TO THE PROCESS, OTHER STAKEHOLDER INPUT

Action Items

Thank you for your participation.