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# DR ELCC Guide: Using LIP-Informed Profiles to Calculate DR ELCC in SERVVM

Developed for CAISO

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## Acronyms and Descriptions

Acronym	Name	Description
API	Agricultural and Pumping Interruptible	DR program to suspend agricultural pumping
BIP	Base Interruptible Program	Participants are offered capacity credits for reducing their demand up to a pre-determined level in response to an event call
CBP	Capacity Bidding Program	DR program where aggregators work on behalf of utilities to enroll customers, arrange for load reduction, receive and transfer notices and payments
DR	Demand Response	Reductions in customer load that serve to reduce the need for traditional supply-side resources
ELCC	Effective Load Carrying Capability	Equivalent perfect capacity measurement of an intermittent or energy-limited resource, such as DR
LCA	Local Capacity Area	Transmission constrained load pocket for which minimum capacity needs are identified for reliability
LIP	Load Impact Protocol	Protocols prescribed by the CPUC for accurate and consistent measuring (and forecasting) of DR program performance
LOLP	Loss of Load Probability	Probability of a load shedding event due to insufficient generation to meet load + reserve requirements
NQC	Net Qualifying Capacity	A resource's contribution toward meeting RA after testing, verification, and accounting for performance and deliverability restrictions
PDR	Proxy Demand Response	Resources that can be bid into the CAISO market as both economic day-ahead and real-time markets providing energy, spin, non-spin, and residual unit commitment services
PRM	Planning Reserve Margin	Capacity in excess of median peak load forecast needed for reliability
RA	Resource Adequacy	Resource capacity needed for reliability
RDRR	Reliability Demand Response Resource	Resources that can be bid into CAISO market as supply in both economic day-ahead and real-time markets dispatched for reliability services

SAC	Smart AC Cycling	Direct air conditioner load control program offered by PG&E
SDP	Summer Discount Plan	Direct air conditioner load control program offered by SCE
SEP	Smart Energy Program	SCE program wherein a smart thermostat provider adjusts A/C usage in response to an event
LCR	Local Capacity Requirement	Resources procured by SCE (incl. DR) for local capacity needs in the LA Basin
SubLAP	Sub-Load Aggregation Point	Defined by CAISO as relatively continuous geographical areas that do not include significant transmission constraints within the area

# The ELCC Guide

## 1 Introduction

This guide defines a clear process for calculating ELCCs for individual event-based DR programs administered by the IOUs that would form the basis for QC accreditation used by the CPUC in the RA proceeding. These programs are listed in Table 1. Sub-divisions of these programs will be uniquely modeled. This will help account for different characteristics of residential and commercial participants and to account for different notification periods – day-ahead (DA) v/s day-of (DO), for example.

**Table 1: Preliminary List of IOU Demand Response Programs to be Covered**

Utility	DR Programs
<b>PG&amp;E</b>	BIP, CBP (DA Res, DA Non-Res), SAC
<b>SCE</b>	API, BIP (15-min, 30-min), CBP (DO, DA), SDP (Res, Com), LCR
<b>SDG&amp;E</b>	AC Saver (DO Res, DO Com, DA Res, DA Com), CBP (DO, DA), BIP

Calculating ELCCs involves several key steps including developing a model and model inputs, clearly defining the characteristics and limitations of DR programs, including both hourly availability and use limitations, and ensuring that interactions between DR programs and other resources are properly accounted for. This guide seeks to clearly define each step and outline the process that should be followed for calculating DR ELCCs.

This guide has been developed under the assumption that ELCCs would be calculated by the CPUC in the SERVVM model, which is already used to calculate ELCCs for wind and solar in the RA proceeding. Utilizing this model will both leverage model development that has already been undertaken and ensure consistency across the accreditation of all resources in the RA proceeding.

The guide is structured as follows:

- + **Section 2: Inputs and Assumptions**
- + **Section 3: Running SERVVM**
- + **Section 4: Outputs and Allocating Interactive Effects**

## 2 Inputs and Assumptions

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### 2.1.1 Set Up SERVVM Model

Calculating ELCCs for any resource requires a model with a representation of *all* loads and resources. These inputs include hourly load, capacities and generating characteristics of all resources such as natural gas, nuclear, hydro, solar, wind, and energy-limited resources like pumped and battery storage. The existing SERVVM model run by the CPUC already contains these inputs and can be leveraged to calculate DR ELCCs.

### 2.1.2 Develop DR Hourly Availability

The ELCC of DR is highly dependent on the hourly availability profile of each program and the extent to which the DR resource is available during the hours in which the system needs it most for reliability. Hourly variability of DR programs can vary based on month, hour of day, day-type (weekday/weekend), weather, etc. There are two options to characterize the hourly availability of DR resources- 1) develop DR availability profiles (like wind or solar) over a large period of historical weather conditions or 2) develop DR availability profiles for a set of representative days that can be used to estimate DR availability over a longer weather record. Each option is described more fully below.

- 1. Develop DR availability profiles over larger period of historical weather conditions**
  - a. CPUC would provide IOUs with weather data for the time-horizon modeled in SERVVM
  - b. IOUs would feed this weather data into the regression model trained for the LIP process and produce DR availability outputs for weather modeled in SERVVM
- 2. Develop DR availability profiles for a set of representative days**
  - a. CPUC would provide IOUs with weather data for a set of representative days. The set of representative days should cover the full expected range of DR availability across different months, day-types (e.g. weekday/weekend), and temperature conditions
  - b. IOUs would provide expected hourly DR availability for each program on each representative day
  - c. CPUC would then take the DR for each representative day and map to the historical weather record, creating a full DR availability profile

The hourly availability profiles would be developed without regard for call constraints. This would enable use of this hourly profile as an hourly nameplate- equivalent for DR programs, and call constraints can be enforced during dispatch in SERVVM.

### 2.1.3 Develop DR Call Limitations

DR programs are often subject to call limitations that define the maximum number of times an IOU can call on customers to reduce load per month/season/year as well as how long customers will respond when called. For each modeled DR program, the IOUs should provide the CPUC with a set of call constraints that

can be implemented in SERVVM. In addition, any constraints associated with the notification period may also be provided.

Sometimes different participants in a program can be subject to different call constraints – for example, CBP. A weighted average (weights informed by number of customers and size of load subject to each of the call-constraint combinations) or the single call constraint combination that is applicable to most customers can be used in SERVVM.

#### **2.1.4 Aggregate DR programs (Optional)**

The most accurate method to calculate DR ELCCs would uniquely define and model each DR program in Table 1. DR programs may be aggregated in a way that is deemed reasonable by stakeholders to reduce the complexity of the entire process. The CPUC could also aggregate each DR program by location – for example, one aggregate DR profile for PG&E SAC in the Bay Area or one aggregate DR profile for all PG&E’s SAC participants.

#### **2.1.5 Factors Not Considered in the Interim**

To streamline the analysis and keep it manageable, the following factors are **not** proposed to be included in modeling DR ELCC:

1. No modeling of “snap-backs”. For example, no increase in load in hours pre or post a DR event.
2. No modeling of “fatigue”. For example, no change in the hourly availability in the 3<sup>rd</sup> week of July after SERVVM calls on the DR resource in the 2<sup>nd</sup> week of July.

## **3 Running SERVVM**

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Once all necessary SERVVM model inputs and assumptions have been gathered, the CPUC will run the model to produce a set of values that can then be used to credit an ELCC value to each individual DR program. It is important to note that there is no single calculation that can be run for each DR program that can accurately reflect its ELCC contribution to system reliability in conjunction with its interactions with all other resources. For this reason, a set of calculations must be performed as described below.

#### **3.1.1 Calculate Portfolio ELCC of All Resources**

- Calculate aggregate portfolio ELCC of all resources in SERVVM. The “portfolio” should include all resources with limitations including wind, solar, storage, and DR. The portfolio can be expanded to include other resources such as hydro, imports, or natural gas as appropriate.
- Number of model runs = 1

### **3.1.2 Calculate First-In ELCC for each resource class**

- “First-in” ELCC is calculated for each resource class (wind, solar, storage, DR) as the marginal ELCC for a small increment of that class on a system with only perfect resources. In other words, a system with no solar, wind, hydro, storage, or DR.
- Number of model runs = Number of resource classes (likely 4)

### **3.1.3 Calculate Last-In ELCC for each resource class**

- “Last-in” ELCC is calculated for each resource class (wind, solar, storage, DR) as the marginal ELCC for a small increment of that class on a system with all resources expected to be online in that year. In other words, a system with solar, wind, hydro, storage, and DR.
- Number of model runs = Number of resource classes (likely 4)

### **3.1.4 Calculate First-In ELCC for each DR program**

- “First-in” ELCC is calculated for each DR program (defined in Table 1) as the marginal ELCC for a small increment of that DR program on a system with only perfect resources. In other words, a system with no solar, wind, hydro, storage, or DR.
- Number of model runs = Number of DR programs (for example, 12)

### **3.1.5 Calculate Last-In ELCC for each DR program**

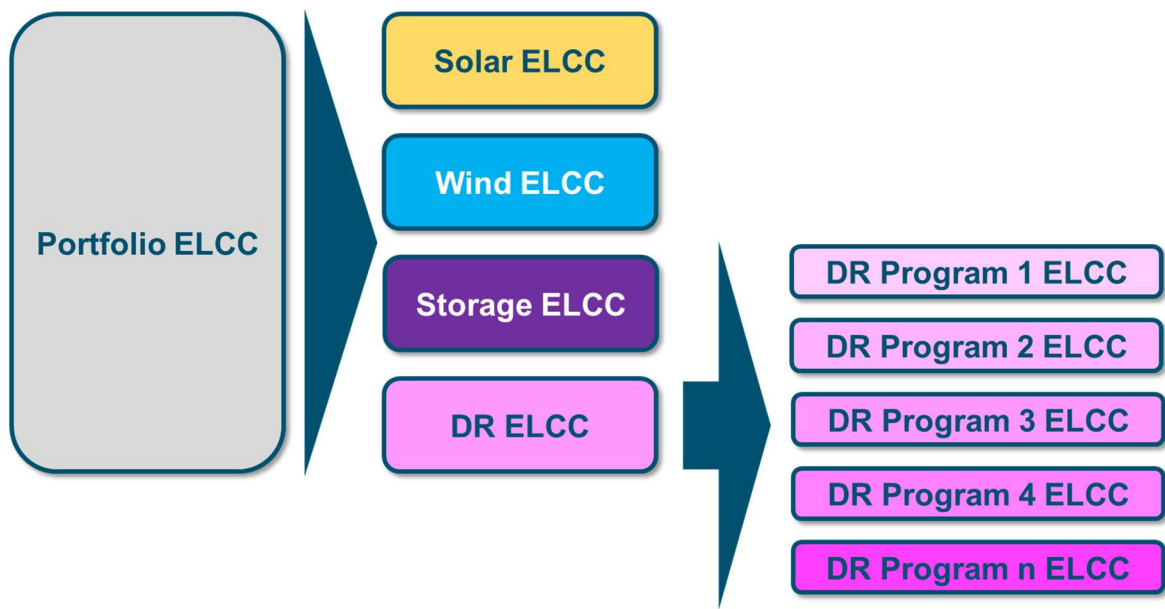
- “Last-in” ELCC is calculated for each DR program (defined in Table 1) as the marginal ELCC for a small increment of that DR program on a system with all resources expected to be online in that year. In other words, a system with solar, wind, hydro, storage, and DR.
- Number of model runs = Number of DR programs (for example, 12)

## **4 Outputs and Allocating Interactive Effects**

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Using the values calculated by the SERVM model in Section 3, the CPUC would calculate a final accredited ELCC value for each DR program to be used as its QC value in the RA program. This process will properly and fully account for synergistic and antagonistic interactive effects between resources, including for example the antagonistic interaction between storage and DR. This process will ensure that the sum total of all resources correctly sums to the Portfolio ELCC as calculated in Section 3. Broadly, the calculation process will involve allocating the Portfolio ELCC among each resource class and then allocating the DR class ELCC to each individual DR program as illustrated below.





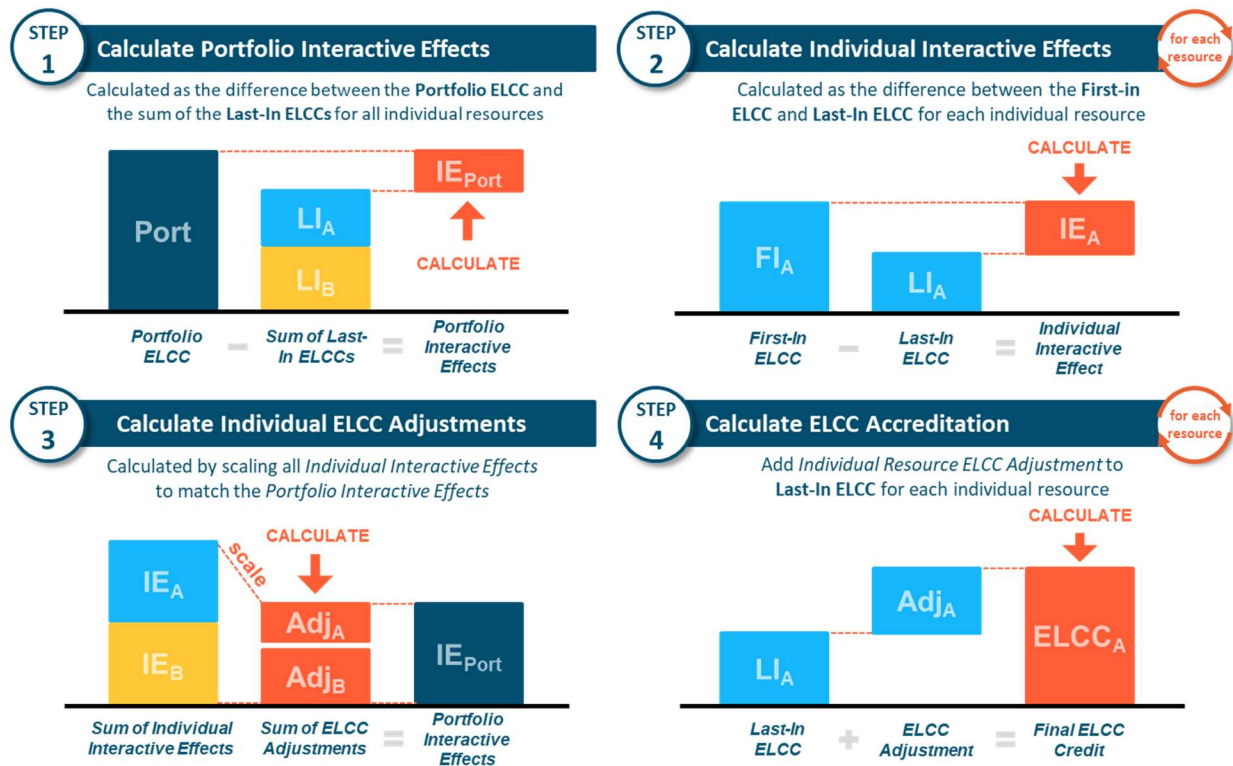
#### ***4.1.1 Allocation of Portfolio ELCC to Resource Classes***

The allocation of the Portfolio ELCC to each resource class will be conducted using the “delta” method. An overview of the delta method is provided below, with more details on the mathematical formulas available here.<sup>1</sup>

In the first step, the Portfolio ELCC and individual resource class ELCCs would be utilized.

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<sup>1</sup> <https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf>



#### 4.1.2 Allocation of DR Class ELCC to Individual DR Programs

The allocation of the DR class ELCC to each DR program will be conducted using the “delta” method. An overview of the delta method is provided in the section above. The DR class ELCC is an output of the first step that allocates the portfolio ELCC to each resource class. Treating the DR class ELCC as the “portfolio”, that is then further allocated to each individual DR program using the delta method.

#### 4.1.3 Additional outputs for stakeholder engagement

If time permits and functionality in SERVIM already exists, following outputs could be generated to aid understanding of the process and the results-

1. Month-hour heat maps highlighting critical periods
  - a. Separately for weekends and weekdays
2. Statistics highlighting number and duration of DR events called
  - a. For example, if only 5 events are called and no event lasts more than 4 hours, the reason why a 6-hr/event, 30 events/year DR program may get less than 100% ELCC could be attributed to its hourly variability