Western Resource Adequacy Program 2026 Summer and 2026-2027 Winter Advance Assessment Scope of Work

SPP Resource Adequacy

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION	COMMENTS
7/8/2024	SPP Staff	Initial	Draft to WPP
8/11/2024	SPP Staff	Updated	n/a

Contents

1. Introduction

For the 2026 Summer and 2026-2027 Winter Season of the Western Power Pool (WPP) Western Resource Adequacy Program (WRAP), Loss of Load Expectation (LOLE) and Effective Load Carrying Capability (ELCC) studies will be performed for the determination of Planning Reserve Margin (PRM) and Qualifying Capacity Contribution (QCC) for wind, solar, energy storage, and thermal resources. The Program Operator is Southwest Power Pool (SPP) in this scope of work.

2. Time Frames and Deliverable Timelines

2.1. LOLE Timeframes and Deliverable Timelines

The 2026 Summer and 2026-2027 Winter Season LOLE study will be performed for the following seasons and timeframes

Season/Scenario ID	Season	Season Dates
1	Summer 2026	June 1, 2026 – September 15, 2026
2	Summer 2029	June 1, 2029 – September 15, 2029
3	Winter 2026-2027	November 1, 2026 – March 15, 2027
4	Winter 2029-2030	November 1, 2029 – March 15, 2030

The following deliverables are required for the LOLE Study.

- Summer 2026 and Summer 2029 Seasons

Task	Date	Responsible Party
Model development and LOLE simulations	April-October 2024	Program Operator
Draft Results	September 15, 2024	Program Operator
Final Results	October 31, 2024	Program Operator
Final LOLE report	December 31, 2024	Program Operator

- Winter 2026-2027 and Winter 2029-2030 Seasons

Task	Date	Responsible Party
Model development and LOLE simulations	October 2024 -March 2025	Program Operator
Draft Results	February 15, 2025	Program Operator
Final Results	March 31, 2025	Program Operator
Final LOLE report	May 31, 2025	Program Operator

2.2. ELCC Timeline and Deliverable Timeframes

The ELCC study will be performed for the following seasons and timeframes

Season/Scenario ID	Season	Season Dates
1	Summer 2026	June 1, 2026 – September 15, 2026
2	Winter 2026-2027	November 1, 2026 – March 15, 2027

The following deliverables are required for the wind, solar, and energy storage ELCC studies.

- Summer 2026

Task	Date	Responsible Party
ELCC Simulations	April-October 2024	Program Operator
Draft Results	September 15, 2024	Program Operator
Final Results and QCC provided to participants	October 31, 2024	Program Operator
Final ELCC report	December 31, 2024	Program Operator

- Winter 2026-2027

Task	Date	Responsible Party
ELCC Simulations	October 2024 – March 2025	Program Operator
Draft Results	February 15, 2025	Program Operator
Final Resultsand QCC provided to Participants	March 31, 2025	Program Operator
Final ELCC Report	May 31, 2025	Program Operator

3. Software Used

The SERVM software will be used to model and simulate ELCC and LOLE studies as described in this scope of work.

4. LOLE Study

4.1. LOLE Introduction

The LOLE will be studied such that the LOLE (while maintaining Contingency Reserves) for the applicable planning year does not exceed one event-day in 10 years for the Summer season and one event-day in 10 years for the Winter season.

4.2. Area Modeling

For the LOLE study, the WRAP footprint will be modeled as nine (9) Load Resource Zones (LRZs) to consider weather variability across the fooprint. The load and resources of an individual LRZ will be modeled as a "bubble" representing each zone. For the LOLE simulations, import and export capabilities ("pipe sizes") between LRZs will not be constrained when determining the WRAP footprint PRM value. After the WRAP footprint PRM value has been found, the nine (9) LRZs will be aggregated into two (2) WRAP Subregions (Subregions), a NorthWestern Subregion (MIDC) and Southwest and and Eastern Subregion (SWEDE) and an analysis of each Subregion will be performed.

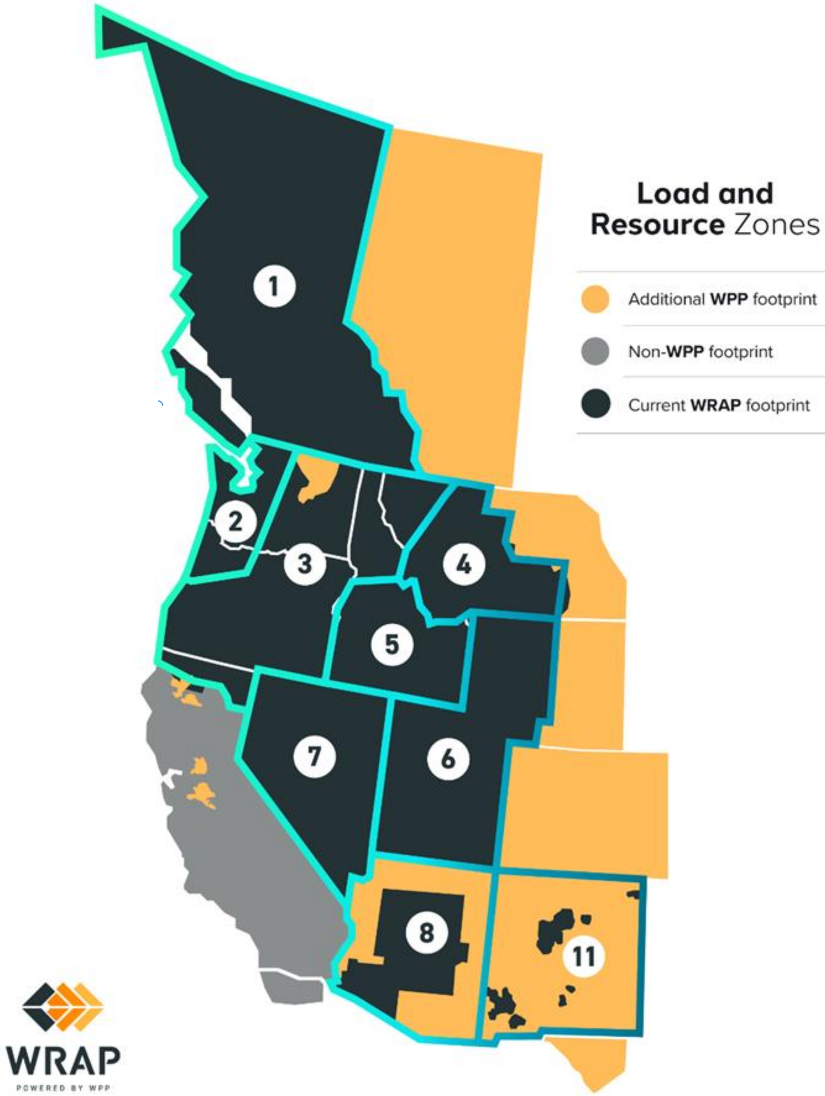

Figure 1. WRAP Load and Resource Zones

4.3. Load Modeling

A minimum of forty-four (44) weather years of data through 2023 will be used for the load modeling in the study. For years 1980-2018, historical load shapes provided by Participants for years 2019-2023, have been combined with historical temperature data to synthesize the historical weather years for each LRZ using "neural network" type analysis. The median peak year load peak will be set to the projected peak demand of each zone for the applicable season while keeping the correlation to all other weather years.

4.4. Generation Modeling

4.4.1. Thermal Generators

Thermal generators will be modeled as units at their installed tested maximum capacity with forced outages applied as necessary in accordance with their forced outage rate (EFORd). Updates to thermal resource data will be provided by the Participants and will include the following parameters that may be necessary for dispatching units on a 'commit-all' basis.

Thermal Generator Parameters
Capmax (summer)
Capmax (winter)
Fuel Type and Technology Type
In Service Date
Retirement Date
Load Resource Zone

Forced outage modeling for thermal resources will consist of using the EFORd values (EFORd equation as defined by NERC GADS), forced outage durations and outage events sourced from NERC GADS (or equivalent) data provided by the Participants. For thermal resources where such data is not provided, an average forced outage rate will be calculated and applied based on size, fuel type, and technology type of the resource using the provided NERC GADS data. If there is no available information based on size, fuel type, and technology type, then NERC published values can be used in their place at the discretion of the Program Operator and shall be noted. No planned or maintenance outages will be modeled. A "commit all" approach will be used for the analysis, meaning all resources will be treated as available and dispatched every hour that the resource is not on outage.

4.4.2. Storage Hydro

The WRAP Storage Hydro QCC Methodology will establish QCC values for all storage hydro plants on a monthly basis. For the LOLE and ELCC studies, storage hydro plants will be modeled at their QCC values for each month. The methodology utilized to assess QCC values for hydro facilities accounts for the availability of storage such that in the LOLE modeling, it is appropriate to assume the facility has enough stored energy to output the monthly QCC value for each hour in the simulation.

4.4.3. Wind, Solar, Energy Storage, and Run of River Resources

Actual or synthesized hourly data for wind, solar, and run of river resources for the years under study will be used.

4.4.3.1. Wind Resources

New wind resources provided by Participants will be included and modeled as one value per wind VER zone. Operational and synthesized wind data will be utilized for the analysis, which was dervied from taking historical profiles from 2014-2023 for wind resources and matching with daily profiles from 1980-2014 that best aligned with peak load profile +/- 25 days of the source day that was available for the 10-year period.

4.4.3.2. Solar Resources

New solar resources and any resources that have little or no operational data will use operational and synthesized irradiance data for resources in close proximity that have been synthesized previously. Solar profiles for resources will be developed using irradiance and weather data that was obtained for each site for the years 1998-2022 from the National Renewable Energy Laboratory's (NREL) National Solar Radiation Database (NSRDB) Data Viewer. Profiles were otained at the sites found on the map below. This data was entered into the NREL System Advisor Model (SAM) for each year and site to generate 8,760 hourly profiles. Profiles from 1980-1998 were selected by using the daily profiles from the day that best matched the peak load out of all the day +/- 3 days of the source day of the 10 year period from 2014-2023.

Figure 2. Solar Profile Locations

4.4.3.3. Energy Storage Resources

Energy Storage Resources (ESRs) will be modeled as energy limited devices that will charge and discharge in accordance with their equipment specifications. ESRs will be modeled to charge and discharge in a 'preserve reliability' mode, which means they will only be discharged as a consequence when there is a lack of any other resources available to serve load. ESRs will be discharged prior to Demand Response Programs.

4.4.3.4. Run of River Resources

New run of river resources provided by Participants will be included and modeled as one value per LRZ. Operational and synthesized run of river data will be utilized for the analysis, which was dervied from taking historical profiles from 2014-2023 for run of river resources and matching with daily profiles from 1980-2014 that best aligned with peak load profile +/-25 days of the source day that was available for the10 year period.

4.4.4. Demand Response Programs

The model will include properties and values of Demand Response (DR) Programs provided by Participants. Programs will be modeled as equivalent thermal resources to be added to the model with high fuel costs, such that these representative "thermal" resources would be dispatched last by the model to reflect DR operating scenarios. Forced outage rates will not be assigned to the DR Programs.

4.4.5. External Capacity Modeling

Firm external imports and exports will be modeled based on external transactions submitted by the Participants. A synthesized non-firm interchange schedule between the WRAP and external areas is no longer modeled in the Advance Assessment.

4.5. Treatment of Contingency (Operating) Reserves (CR)

In accordance with standard NERC reliability standard BAL-002-WECC-3, Balancing Authority Areas' total Contingency Reserve (CR) needs are based on the requirement to carry reserves on three percent (3%) of hourly integrated load and three percent (3%) of hourly integrated generation. The LOLE study will assure that during events tallied as loss of load that all contingency reserves are maintained. To ensure this, the LOLE study will assume an average six percent (6%) CR requirement when determining the capacity requirements to maintain the 1 day in 10 year LOLE requirement.

4.6. Determination of 1 Day in 10-year threshold

For the LOLE study, loss of load events will be tabulated during the hours of the binding season for determination of the one day in ten year LOLE metric. Loss of load events that occur during hours outside of the binding season will not go into the calculation of LOLE. All hours of the month within each applicable binding season will be eligible for being tabulated for an occurring loss of load event.

Pure negative (or pure positive if the system is generation deficient) capacity with no outage rate will be added in all hours of the applicable binding season until the WRAP footprint or subregion reaches the 0.1 day per year reliability threshold. The pure negative (or positive) capacity assigned will be the same amount for all hours in the season of interest.

Monthly Implications - In accordance the WRAP tariff and business practices, the positive or negative capacity will be adjusted to ensure that all months of the applicable binding season have at least 0.01 day per year LOLE in that given month, while at the same time ensuring the the LOLE for the entire binding season does not exceed 0.1 day per year per season LOLE. Only the winter season PRM for each month will be determined in this scope of work separately maintaining a 0.1 day per year per season threshold.

4.7. PRM Calculation

The Program PRM will be determined on an Unforced Capacity (UCAP) basis. To calculate the PRM on a UCAP basis, the capacity value must be converted to a UCAP value.

Table 1. Resource capacity used for the UCAP PRM calculation.

Resource type	UCAP values used in PRM calculation
Thermal Generation	QCC values calculated by the Program Operator using the thermal QCC methodology
Wind and Solar	Values for wind, solar, and ESR resources will be determined by calculating the contribution of the aggregate value of all three resource types (wind, solar, ESR) by performing an ELCC analysis without the resources in the model (to the 0.1 day per year per season metric) and calculating the difference in capacity needed from the model with the resources in service. The capacity values attributed to wind, solar, and ESR resources will need to be consistent with the QCC values assigned to such resources in the QCC analysis.
Storage Hydro	QCC values submitted by the Participants
Run-of-River hydro	QCC values calculated by the Program Operator using the run of river QCC methodology
Demand Response	Modeled maximum capacity of all programs submitted by the Participants
Pure Capacity adjustment to meet 1 day in 10-year LOLE	Value added to each month to achieve the desired metric

The UCAP PRM is calculated using the equation below.

$$PRM\ (UCAP)\ (\%) = \frac{Capacity\ (@1 - in - 10) - Demand}{Demand} * 100$$

4.8. Simulation Process

The probabilistic LOLE study will model random forced outages for resources in the footprint during each hour of the study. Each simulation accounts for a different variation of forced outages, Variable Energy Resource (VER) output, and weather year for all hours of the year. The stop criterion for the modeling simulation is when the LOLE convergence factor is greater than or equal to 95% for consideration of probabilistic indices.

5. ELCC Analysis

5.1. ELCC Introduction

The determination of the Qualified Capacity Contribution (QCC) for specified VERs or limited duration resources will accomplished through the completion of an Effective Load Carrying Capability (ELCC) study, which will analyze the ability of the VER or limited duration resources to reliably serve the footprint's demand. For this study, the resource types that will be analyzed are wind, solar, and ESRs in the WRAP footprint. The ELCC will be determined by running analysis with and without the resource being analyzed to determine its capacity value.

5.2. Area Modeling

For the ELCC study, the footprint will be divided into VER zones for wind and solar resources and by Subregion for ESRs. The VER zones for wind and solar will be totally contained within each Subregion. There will be a total of six (6) wind zones, three (3) solar zones, and two (2) sub-regions for ESRs.

The intent of the ELCC study is to determine the QCC (ELCC) for each VER zone or Subregion singularly as well as determine the ELCC for the entire resource portfolio of all three resource types.

No transmission constraints between the VER zones will be modeled in the ELCC study.

5.3. Load Modeling

The same hourly shapes and peak loads used in the LOLE Study will be used for the ELCC Study

5.4. Generation Modeling (except wind, solar, and ESR resources)

Thermal generators, storage hydro resources, run of river hydro resources, and external capacity modeling will be modeled the same fashion as in the LOLE study.

5.5. Wind, Solar, and Energy Storage Resources

For the evaluation of either wind, solar, or ESRs, the base study model will include all resources of the resource type that is not being analyzed (e.g. for the wind evaluation, solar and ESRs will be included in the base case). For resources currently installed or proposed to be in-service prior to the study year, hourly generation profiles will be assigned to each resource. Hourly generation is based upon historical profiles correlated with the yearly load shapes as utilized in the LOLE Study.

5.6. ELCC Study Process

5.6.1. Weather Years Application

The ELCC Study will utilize the weather years from the LOLE Study and analyze all weather years together.

5.6.2. Seasonal Considerations

The Summer season will be analyzed and is defined as June 1, to September 15.
The Winter season will be analyzed and is defined as November 1 to March 15. LOLE events for winter ELCC analysis will be November 1 to March 30.

5.6.3. Determination of ELCC

To determine total ELCC, an LOLE value for the benchmark system will be calculated. The benchmark system is defined as load supplied by all conventional (coal, gas, etc.) and storage hydro generation in the footprint. The VER or ESR of interest will be excluded from the benchmark system. All other VER and ESR types will be included. For example, if the wind resource type is being analyzed, only wind will be excluded from the benchmark system.

If the resulting LOLE is greater than the 0.1 day per year per season threshold, "pure capacity" will be added until the 0.1 threshold is achieved. *("pure capacity" refers to adding same amount of capacity for every hour of the year or season without an assigned forced outage rate.)*

If LOLE is less than the 0.1 day per year per season threshold, "pure negative capacity" will be added until the 0.1 threshold is achieved.

The capacity calculated is designated in Figure 3-9 as "Pure Capacity 1."

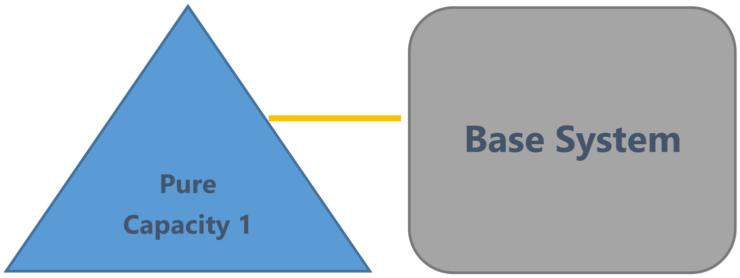

Figure 3-9. Diagram of system without renewable resources.

The pure capacity value calculated after adding back in the resource type being analyzed is designated in Figure 3-10 as "Pure Capacity 2."

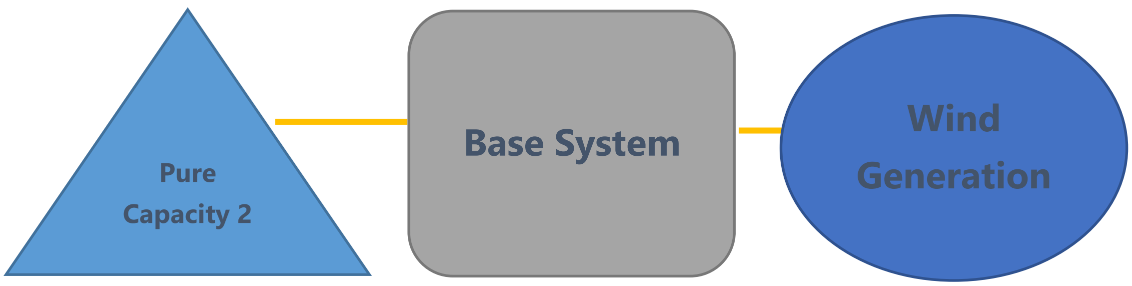

Figure 3-10. Diagram of system with wind resources.

The difference between the results of these two scenarios is considered the ELCC accredited value of the resources being studied.

$$\boldsymbol{ELCC\ of\ VER\ or\ ESR\ (under\ study) = Pure\ capacity\ 1 - Pure\ capacity\ 2}$$

5.7. Wind and Solar Zones

The ELCC study will determine the amount of capacity provided by all VERs (of the specified type, e.g., wind) analyzed in the footprint.

ELCC studies will be performed for each VER zone (and VER type), calculating a total capacity value of the resource of interest in that zone. The capacity calculated for each zone will be allocated to VERs of that type in that zone on a pro-rata basis.

The proposed VER zones are shown in the figures below.

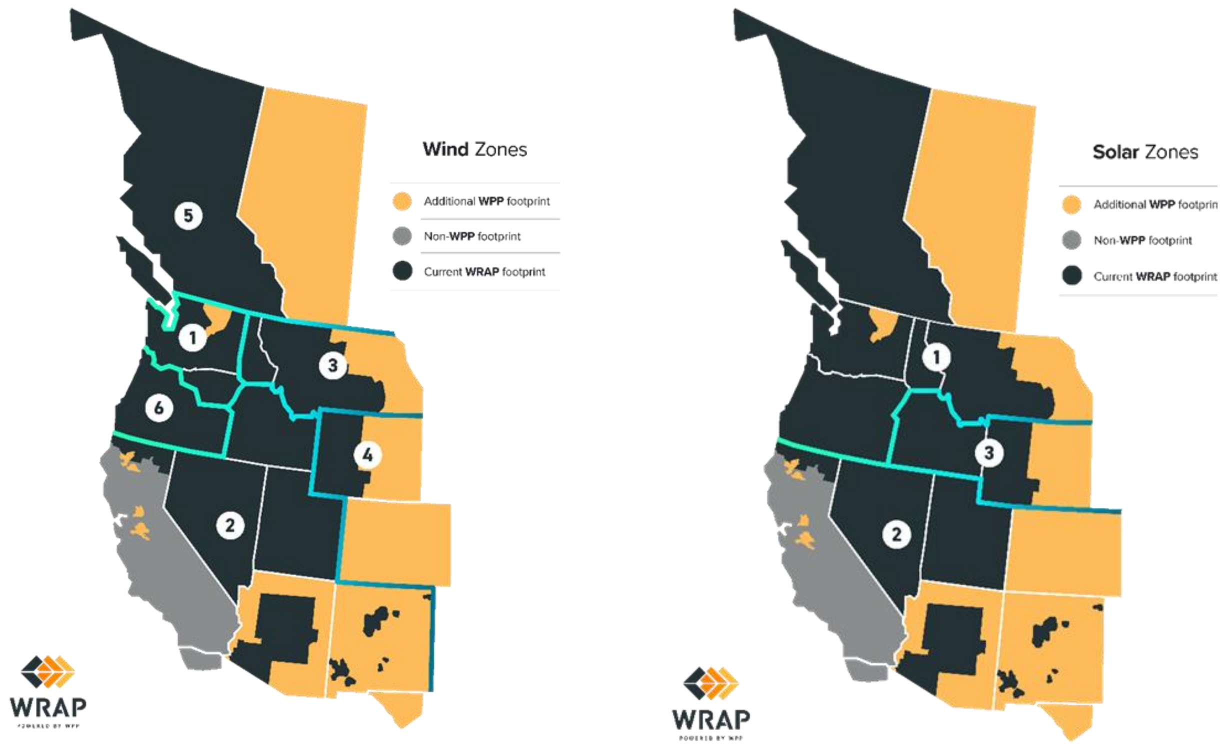

Figure 3. Wind and Solar Zone

To ensure correlation between the PRM and that over-accreditation of VERs does not occur, an ELCC study of all resource types will be performed and a total capacity value for all VERs (of each type) will be calculated. After all VER zone capacity totals (for each VER type) have been determined, the sum of the VER zone totals will be compared to the regional total. If the sum of the zones is greater than the regional total, all VER zone totals will be scaled down until the totals match the regional total. **Error! Reference source not found.** provides an example of the calculations to determine total VER (in this case: wind) capacity.

Table 2. ELCC Study of RA Program footprint to calculate total wind capacity.

A study of four wind zones reveals the following capacity values for wind in each zone:				
Zone 1	Zone 2	Zone 3	Zone 4	**Total**
1,000 MW	800 MW	700 MW	1,000 MW	**3,500 MW**
A study of the region reveals the following capacity value for the region's wind:				
Regional wind = 3,200 MW				
The zones will be recalculated as follows:				
Zone 1	Zone 2	Zone 3	Zone 4	**Total**

1,000 * (3,200/3,500)	800 * (3,200/3,500)	700 * (3,200/3,500)	1,000 * (3,200/3,500)	
914 MW	732 MW	640 MW	914 MW	**3,200 MW**

5.8. Seasonal and Monthly Impacts

Final QCC values for individual resources will be determined on a monthly basis for wind and solar resources and on a seasonal basis for ESR resources. In accordance with Business Practice Manual 105 (BPM105), the monthly QCC value of wind and solar resources will be calculated by a proration of the seasonal ELCC values in accordance with each individual resource's performance during capacity critical hours (CCHs). The conversion from a zonal seasonal ELCC value to a resource specific monthly QCC value will be accomplished as follows. Monthly ELCC values for each zone will be calculated by shaping the seasonal ELCC value in accordance with aggregate performance of all resources in the zone during the CCH. Months that have higher resource performance during the CCH will be allocated a higher portion of the average ELCC across the season. After the total monthly ELCC is calculated for each zone, the allocation to each resource will be calculated based on the individual resource's performance during the CCH.

5.9. Simulation Process

The probabilistic ELCC study will model random forced outages for resources in footprint during each hour of the study. Each simulation accounts for a different variation of forced outages, and VER output for all hours of the season. The stop criterion for the modeling simulation is when the LOLE convergence factor is greater than or equal to 95% for consideration of probabilistic indices.

5.10. Determination of ELCC for future VER Resources

For each VER zone, after the QCC of all existing and near-term planned VERs have been calculated and allocated, ELCC studies will be performed to account for future VERs (of each type) in each zone. It is proposed to study incremental additions of wind, solar in each subregion (Southwest and Northwest) of 3,000 MW, 6,000 MW and 9,000 MW. These additional wind and solar resource amounts will be created by scaling up the number of wind turbines (nameplate capacity) or solar photovoltaic in each zone. The Program Operator will provide an ELCC curve that can be used to determine future capacity values for new resources dependent upon the penetration of resources in that zone. ESRs will continue to be modeled by subregion to account for the significant difference in installed capacity between subregions.

5.11. Treatment of other ELCC resource classes in each ELCC study

For consistency, the ELCC Studies will include all VERs not being analyzed in the base case when studying the resources of interest. In other words, the wind ELCC study will include all solar and energy storage resources in both situations with and without the wind resources; the solar ELCC study will include all wind and energy storage resources in both situations with and without the solar resources; and the ESR study will include all wind and solar resources in both situations with and without the energy storage resources. This methodology may need to be further evaluated in the study as the effects of ESRs and Demand Response are further reviewed.

5.12. ELCC Study Scenarios

Scenario	Season	Fuel Type	Zone	Nameplate
1	Summer	Wind	1	2026 planned
2	Summer	Wind	2	2026 planned
3	Summer	Wind	3	2026 planned
4	Summer	Wind	4	2026 planned
5	Summer	Wind	5	2026 planned
6	Summer	Wind	6	2026 planned
7	Summer	Wind	MID-C	2026 planned + 3,000MW (in the ratio for each zone of 2026 planned resources)
8	Summer	Wind	MID-C	2026 planned + 6,000MW (in the ratio for each zone of 2026 planned resources)
9	Summer	Wind	MID-C	2026 planned + 9,000MW (in the ratio for each zone of 2026 planned resources)
10	Summer	Wind	SWEDE	2026 planned + 3,000MW (in the ratio for each zone of 2026 planned resources)
11	Summer	Wind	SWEDE	2026 planned + 6,000MW (in the ratio for each zone of 2026 planned resources)
12	Summer	Wind	SWEDE	2026 planned + 9,000MW (in the ratio for each zone of 2026 planned resources)

13	Summer	Solar	MID-C	2026 planned
14	Summer	Solar	MID-C	2026 planned + 3,000MW (in the ratio for each zone of 2026 planned resources)
15	Summer	Solar	MID-C	2026 planned + 6,000MW (in the ratio for each zone of 2026 planned resources)
16	Summer	Solar	MID-C	2026 planned + 9,000MW (in the ratio for each zone of 2026 planned resources)
17	Summer	Solar	SWEDE	2026 planned + 3,000MW (in the ratio for each zone of 2026 planned resources)
18	Summer	Solar	SWEDE	2026 planned + 6,000MW (in the ratio for each zone of 2026 planned resources)
19	Summer	Solar	SWEDE	2026 planned + 9,000MW (in the ratio for each zone of 2026 planned resources)
20	Summer	ESR	MID-C	2026 planned
21	Summer	ESR	SWEDE	2026 planned
22	Summer	ESR	MID-C	2026 planned +3000MW
23	Summer	ESR	SWEDE	2026 planned + 3000MW
24	Summer	ESR	MID-C	2026 planned + 6000MW
25	Summer	ESR	SWEDE	2026 planned + 6000MW
26	Summer	ESR	MID-C	2026 planned + 9000MW
27	Summer	ESR	SWEDE	2026 planned + 9000MW
28	Winter	Wind	1	2026 planned
29	Winter	Wind	2	2026 planned
30	Winter	Wind	3	2026 planned
31	Winter	Wind	4	2026 planned
32	Winter	Wind	5	2026 planned
33	Winter	Wind	6	2026 planned
34	Winter	Wind	MID-C	2026 planned + 3,000MW (in the ratio for each zone of 2026 planned resources)
35	Winter	Wind	MID-C	2026 planned + 6,000MW (in the ratio for each zone of 2026 planned resources)

36	Winter	Wind	MID-C	2026 planned + 9,000MW (in the ratio for each zone of 2026 planned resources)
37	Winter	Wind	SWEDE	2026 planned + 3,000MW (in the ratio for each zone of 2026 planned resources)
38	Winter	Wind	SWEDE	2026 planned + 6,000MW (in the ratio for each zone of 2026 planned resources)
39	Winter	Wind	SWEDE	2026 planned + 9,000MW (in the ratio for each zone of 2026 planned resources)
40	Winter	Solar	MID-C	2026 planned + 3,000MW (in the ratio for each zone of 2026 planned resources)
41	Winter	Solar	MID-C	2026 planned + 6,000MW (in the ratio for each zone of 2026 planned resources)
42	Winter	Solar	MID-C	2026 planned + 9,000MW (in the ratio for each zone of 2026 planned resources)
43	Winter	Solar	SWEDE	2026 planned + 3,000MW (in the ratio for each zone of 2026 planned resources)
44	Winter	Solar	SWEDE	2026 planned + 6,000MW (in the ratio for each zone of 2026 planned resources)
45	Winter	Solar	SWEDE	2026 planned + 9,000MW (in the ratio for each zone of 2026 planned resources)
46	Winter	ESR	MID-C	2026 planned
47	Winter	ESR	SWEDE	2026 planned
48	Winter	ESR	MID-C	2026 planned +3000MW
49	Winter	ESR	SWEDE	2026 planned + 3000MW
50	Winter	ESR	MID-C	2026 planned + 6000MW
51	Winter	ESR	SWEDE	2026 planned + 6000MW
52	Winter	ESR	MID-C	2026 planned + 9000MW
53	Winter	ESR	SWEDE	2026 planned + 9000MW

6. General Deliverables

- Program Operator will develop and provide reports of its analyses and results.
- Program Operator will present results to appropriate working groups and committees. Program Operator will provide appropriate QCC values of all resources to Participants.