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BEFORE THE PUBLIC UTILITIES COMMISSION OF NEVADA

Joint Application of Nevada Power Company d/b/a)	
NV Energy and Sierra Pacific Power Company d/b/a)	
NV Energy for approval of their joint 2025-2044)	Docket No. 24-05041
integrated resource plan, for the three year Action Plan)	
period 2025-2027, and the Energy Supply Plan period)	
of 2025-2027.)	

BEFORE THE PUBLIC UTILITIES COMMISSION OF NEVADA

Nevada Power Company d/b/a NV Energy and
Sierra Pacific Power Company d/b/a NV Energy

Docket No. 24-05041

Prepared Direct Testimony of

Maria Roumpani, PhD

on behalf of

Advanced Energy United

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Attachment MR-1: CV of Maria Roumpani

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Attachment MR-3: Selected Data Request Responses

1 **I. INTRODUCTION AND SUMMARY OF RECOMMENDATIONS**

2 **Q. PLEASE STATE YOUR NAME, OCCUPATION, BUSINESS ADDRESS, AND**
3 **THE PARTY FOR WHOM YOU ARE FILING TESTIMONY.**

4 A. My name is Maria Roumpani. I am a Founding Partner of Current Energy Group LLC.
5 My business address is 528 North Treat Avenue, Tucson, Arizona 85716. I am filing testimony
6 on behalf of Advanced Energy United (“United”).

7 **Q. PLEASE DESCRIBE ADVANCED ENERGY UNITED.**

8 A. United, formerly Advanced Energy Economy, is a national association of businesses
9 involved in the advanced energy industry sector. Its membership represents a broad coalition of
10 large and small companies working across the energy technology spectrum, including energy
11 efficiency, demand response, solar photovoltaics, wind, storage, electric vehicle manufacturer
12 and charging infrastructure providers, advanced metering infrastructure, transmission and
13 distribution developers, enabling software, and more. It also includes large energy customers
14 looking to meet sustainability goals with access to advanced energy resources.

15 United maintains in-house expertise in resource and transmission planning and
16 procurement, utility regulation, and energy markets. United also draws on the expertise and input
17 of its membership.

18 **Q. PLEASE DESCRIBE ADVANCED ENERGY UNITED’S MEMBERS AND**
19 **INTERESTS IN NEVADA’S RESOURCE PLANNING.**

20 A. The member companies of United span a wide range of economic interests in NV
21 Energy’s (“NVE” or “the Companies”) Integrated Resource Plan (“IRP”) and associated

1 transmission planning and resource procurement. United's members work with NVE in a wide
2 variety of ways, as large customers and vendors, as development partners and competitors, and
3 as providers of direct-to-consumer technologies with large impacts and dependencies on NVE's
4 systems and rates. Each of these relationships may affect, and is affected by, NVE's IRP
5 planning and related transmission and procurement decisions discussed in this Application.

6 As United members' businesses are significantly impacted by NVE's decision-making,
7 United members benefit from transparency into the needs and plans of NVE as well as
8 confidence in the thoroughness of NVE's decision-making process and the prudence of its
9 decisions. In particular, United's developer members have specific interests and expertise in the
10 resource planning and procurement process for NVE.

11 **Q. PLEASE DESCRIBE YOUR PROFESSIONAL BACKGROUND AND**
12 **EXPERIENCE.**

13 A. I specialize in the economic and technical analysis of grid planning and operations issues.
14 I have conducted analysis and submitted expert testimony or comments on integrated resource
15 planning, plant economics, unit commitment practices, and power cost issues before state utility
16 regulators in Arizona, Colorado, Kentucky, Michigan, Minnesota, North Carolina, Oregon,
17 South Carolina, and Virginia.

18 Prior to co-founding Current Energy Group in 2024, I was the Technical Director at
19 Strategen. While at Strategen, I led economic and technical grid modeling engagements,
20 including capacity expansion, production cost, and energy storage dispatch modeling. My clients
21 included government entities and state bodies, including the Oregon Public Utility Commission,

1 the Kentucky Public Service Commission, the Maryland Office of People’s Counsel, the South
2 Carolina Office of Regulatory Staff, non-governmental organizations, and trade associations, as
3 well as large energy buyers.

4 Before joining Strategen in 2018, I contributed to the development of analytical tools
5 used in energy impact assessment studies. I have a Ph.D. from the Management Science and
6 Engineering Department at Stanford University and a Master of Science in Electrical and
7 Computer Engineering from the National Technical University of Athens, Greece. My full
8 resume is attached to this testimony as **Attachment MR-1**.

9 **Q. HAVE YOU PREVIOUSLY TESTIFIED BEFORE THE PUBLIC UTILITIES**
10 **COMMISSION OF NEVADA (“COMMISSION”)?**

11 A. No.

12 **Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?**

13 A. I provide a review and critique of NVE’s supply-side resource planning efforts in the
14 Companies’ 2025-2044 IRP. I explain how NVE’s selection of the Balanced Plan (which
15 includes the proposed Valmy combustion turbine (“CT”) additions) does not minimize cost or
16 risk as much as other potential portfolio options. I discuss how a modified version of the
17 Renewable Plan would be a superior option. I also explain how NVE’s IRP process is not well
18 suited for identifying future portfolio needs or creating a robust and competitive procurement
19 process. Finally, I discuss the role of flexible load resources and “next generation” transmission
20 solutions in the IRP context. My testimony includes a few references to information NVE has
21 designated as confidential; as such, all text referencing such confidential information has been

redacted in this public version of my testimony, and all corresponding, unredacted information is being submitted separately pursuant to NAC 703.5274(1)(a).

Q. WHAT ARE UNITED’S SPECIFIC RECOMMENDATIONS IN PHASE III OF THIS PROCEEDING?

A. I recommend the following:

1. The Commission should reject the Balanced Plan as the Preferred Plan.
2. The Commission should order NVE to adopt the Renewable Plan as the Preferred Plan, with the following modifications:
 - Consistent with the Renewable Plan, NVE should procure approximately 500 megawatts (“MW”) of standalone battery energy storage system (“BESS”) resources in lieu of the Companies’ proposed CT additions at Valmy.
 - NVE should accelerate the procurement of these BESS resources from 2030 to 2028 to better address NVE’s open position in 2028 and 2029.
 - As part of this BESS procurement, NVE should consider targeting the Valmy location as a means of partially or wholly reducing the must-run constraint.
3. The Commission should order NVE to issue an all-source Request for Proposals (“RFP”) as soon as possible to procure additional resources consistent with the needs identified in the Renewable Plan and this testimony. These specific needs should include:
 - Capacity resources that would reduce the Companies’ open position in the 2028 timeline (for example, accelerating the BESS resources included in the Renewable Plan);

- 1 • Local capacity at the Valmy location. The RFP should specify the resource capabilities
2 needed to partially or wholly alleviate the must-run constraint by 2031 when the
3 Companies' modeling shows that removing the constraint would result in reduced
4 operations of the Valmy steam units;
- 5 • Flexible load resources by 2027, as described in Section VI; and
- 6 • Incremental renewable resources as soon as practicable (the Companies' analysis
7 shows that renewable resources, including 952 MW of Idaho wind added in 2029,
8 would be part of an optimal portfolio).

9 After the Companies receive the bids, a new capacity expansion modeling run should be
10 conducted in PLEXOS LT and presented to the Commission. This capacity expansion
11 modeling run should allow the model to select from all qualified resource bids *in parallel*
12 while reflecting their actual cost and performance characteristics. The portfolio results should
13 be presented to the Commission within six months of receipt of the RFP bids through an IRP
14 amendment. This amendment should also include a procurement plan for contracting with or
15 acquiring the selected resources.

- 16 4. The Commission should order NVE to defer the 2028 Valmy CT additions and instead
17 pursue the incremental near-term BESS additions contemplated in the Renewable Plan.
- 18 5. The Commission should direct NVE to evaluate alternative solutions to alleviating the
19 Valmy must-run constraint at a future date, including through transmission upgrades,
20 long-duration storage resource additions, interruptible load demand response, and
21 contractual arrangements with other local generators.

- 1 6. The Commission should order the following changes to NVE's future IRP and resource
2 procurement processes:
- 3 • The Commission should require NVE to revise its IRP and resource procurement
4 processes to more closely reflect the two-step process implemented in Colorado.
 - 5 • The Commission should require NVE to better identify system needs in the near-
6 and medium-term based on more robust capacity expansion modeling in step one
7 of future processes.
 - 8 • The Commission should require NVE to more clearly link its future RFPs to the
9 needs identified in step one of future processes.
 - 10 • Following the RFP results, in step two of future processes the Commission should
11 require NVE to conduct additional capacity expansion modeling that
12 simultaneously selects from the full range of project bids.
 - 13 • For long-term resource needs, the Commission should require NVE to evaluate a
14 more complete range of dispatchable options, including long-duration energy
15 storage, advanced geothermal systems, and flexible loads.
- 16 7. The Commission should adopt all of United's recommendations set forth in its Phase II
17 testimony regarding the near-term deployment of flexible load resources.
- 18 8. The Commission should order NVE to modify its PLEXOS modeling going forward to
19 include higher amounts of flexible load resources.
- 20 9. The Commission should set a longer-term demand reduction target (*e.g.*, for 2030 and/or
21 2040) that is greater than 680 MW in 2030 and greater than 1657 MW in 2040.

1 10. The Commission should require NVE to conduct a study (to be completed within six
2 months) of the benefits of “next generation” transmission solutions, including Grid
3 Enhancing Technologies (“GETs”). At a minimum, the study should include the
4 following parameters consistent with my testimony in Section VII:

- 5 • A clearly stated objective that includes 1) identifying where solutions can minimize
6 operating costs, and 2) identifying where solutions can defer or avoid future
7 transmission upgrades.
- 8 • A sufficient time horizon in the evaluation (*i.e.*, 5, 10, and 20 years into the future).
- 9 • A specified geographic focus (*i.e.*, the entirety of NVE’s transmission system).
- 10 • A minimum list of benefits to be evaluated, as enumerated in my testimony.
- 11 • A near-term action plan for implementing solutions that are found to be beneficial.
- 12 • A Technical Advisory Group to help guide the study process that would include
13 members from the Bureau of Consumer Protection (“BCP”), the Commission Staff,
14 the advanced transmission solution industry, and other stakeholders.

15 **II. BACKGROUND: NVE’S DEVELOPMENT OF PORTFOLIO OPTIONS.**

16 **Q. HOW DOES NVE PRESENT ITS PREFERRED RESOURCE PORTFOLIO FOR**
17 **THE COMMISSION’S CONSIDERATION?**

18 A. NVE presents its selection of a preferred resource portfolio as essentially a choice
19 between four alternative plan options: 1) Balanced Plan, 2) Renewable Plan, 3) Low Carbon

Plan, and 4) No Open Position Plan.¹ Within these, the Companies further seem to suggest that there are really two primary choices: the Balanced Plan (NVE’s “preferred” option) and the Renewable Plan (NVE’s “alternate” option).²

Q. ARE THERE OTHER REASONABLE OPTIONS OR VARIATIONS OF RESOURCE PORTFOLIOS BEYOND THE FOUR PORTFOLIOS NVE PRESENTS?

A. Yes. There are many feasible portfolio options that were not explored by NVE’s analysis or presented in its findings. Some of these unexplored options are likely to be superior to NVE’s preferred plan across multiple dimensions.

Q. SETTING ASIDE WHETHER THERE ARE ANY ALTERNATIVE PORTFOLIOS SUPERIOR TO THOSE NVE CHOSE TO PRESENT, CAN YOU DESCRIBE SOME OF THE KEY FEATURES OF AND KEY DIFFERENCES BETWEEN NVE’S BALANCED PLAN AND ITS RENEWABLE PLAN?

A. Yes. Both plans are relatively similar since they were derived from the same initial Base Case portfolio developed in PLEXOS.³ However, there are some key differences. The most notable difference is that the Balanced Plan includes a 411 MW gas CT addition in 2028, while the Renewable Plan does not include this addition at all and instead includes 502 MW of incremental BESS additions in 2030, as well as other incremental BESS additions in subsequent years. Despite its name, the Renewable Plan does not contain more renewable energy resources

¹ Supply Plan (Volume 8), Pages 6-7 of 393.

² Supply Plan (Volume 8), Page 7 of 393.

³ Supply Plan (Volume 8), Page 240 of 393.

than NVE’s preferred plan. In fact, the Renewable Plan contains 1,000 MW *less* solar by year 2050 than the Balanced Plan. In the medium-term the higher levels of BESS additions in the Renewable Plan are relatively modest (*i.e.*, 502 MW by 2030), but this differential increases significantly by year 2050, with BESS additions that are 6,169 MW greater than the corresponding level in the Balanced Plan.

*Table 1: Difference in Resources Between the Renewable and Balanced Plans (MW)*⁴

	Difference between the Renewable Plan and the Balanced Plan (MW)				
	2025	2028	2030	2040	2050
Coal	0	0	0	0	0
Gas	0	-411	-411	-411	-411
Firm	0	0	0	0	0
Other	0	0	0	0	0
Hydro	0	0	0	0	0
Geo	0	0	0	0	0
Wind	0	0	0	-1	-1
Solar	0	0	0	0	-1000
PSH	0	0	0	0	0
BESS	0	0	502	1460	6169

Q. HAVE YOU REVIEWED THE ANALYTICAL PROCESS THROUGH WHICH NVE CONSTRUCTED THESE PORTFOLIOS?

A. Yes, I have conducted a detailed review of NVE’s analysis and approach to constructing the portfolios. The sequence steps for constructing the portfolios can be summarized as follows:

1. **Base Case developed:** This step constitutes the only true economic optimization of the resource portfolio by modeling generic resource additions in the PLEXOS LT capacity expansion model. Adjustments to the Base Case are then made in Steps 2, 3, and 4 below.

⁴ Table created based on information in Workpaper “2024 IRP Economic Analysis Narrative Figures” Tab “EA-7,30,33,36,39 Installed Cap.”

1 **2. Screening Evaluation performed:** This step adds potential projects⁵ to the Base Case
2 and adjusts placeholder resources to assess how the potential projects compare against
3 each other. In NVE’s analysis, several CTs and three paired photovoltaic (“PV”)/BESS
4 resources passed the screening and advanced to the next step.

5 **3. Combination Cases developed:** This step develops alternative portfolios through
6 different combinations of the potential projects that advanced from Step 2.

7 **4. Alternative Plans developed:** This step identifies the four portfolios to be considered
8 for final evaluation.

9 **5. Preferred Plan selected**

10 I discuss each of these steps further in Section V below.

11 **Q. DO YOU THINK NVE’S APPROACH TO CONSTRUCTING THESE**
12 **PORTFOLIOS REFLECTS INDUSTRY BEST PRACTICES?**

13 A. No, I do not believe NVE followed industry best practices. I have many critiques of
14 NVE’s methodology, which I will describe in greater detail below.

⁵ NVE compiled a set of “potential projects” that could fill a portion of the Companies’ near-term need for additional capacity and renewable credits. These resource options were developed from a combination of self-development efforts, request for proposal bid responses, and bilateral negotiations. They include: CTs at Valmy, CTs at Ft. Churchill, CTs at Harry Allen, CTs at Higgins, Dry Lake East PV/BESS, Boulder Solar III PV/BESS, Libra PV/BESS, Geo-1, Solar-1, Battery-1, Solar-2, Wind-1. Supply Plan (Volume 8), Pages 229-231 of 393.

1 **III. NVE’S BALANCED PLAN RESULTS IN HIGHER COSTS, EMISSIONS, AND**
2 **RISKS IN THE NEAR TERM THAN ITS RENEWABLE PLAN.**

3 A. NVE’S EVALUATION OF THE RENEWABLE PLAN VERSUS THE BALANCED
4 PLAN FAILS TO ACCURATELY ASSESS THE COSTS ASSOCIATED WITH
5 THESE PLANS.

6 **Q. CAN YOU SUMMARIZE HOW THE BALANCED PLAN AND RENEWABLE**
7 **PLAN WERE DEVELOPED BY NVE?**

8 A. The Balanced Plan and the Renewable Plan both reflect updated Combination Cases
9 developed by NVE as described above. The Companies note that most of the future resource
10 additions, which are identified as “named placeholders,”⁶ are identical in both plans.⁷
11 Meanwhile, the Renewable Plan was presented as “an option that adds no near-term thermal
12 projects.”⁸ In other words, it appears that the purpose of developing the Renewable Plan was to
13 evaluate an option that was nearly identical to NVE’s preferred plan, but did not include the
14 proposed new gas CTs at Valmy.

15 **Q. OTHER THAN REMOVING THE VALMY CTS, DID NVE MAKE OTHER**
16 **CHANGES WHEN DEVELOPING THE RENEWABLE PLAN?**

17 A. Yes. NVE made other changes beyond removing the 411 MW Valmy CT additions. As
18 mentioned above, NVE added significant amounts of battery storage to the Renewable Plan,
19 particularly in the later years. For instance, 3,400 MW of BESS was added between 2044-2050.

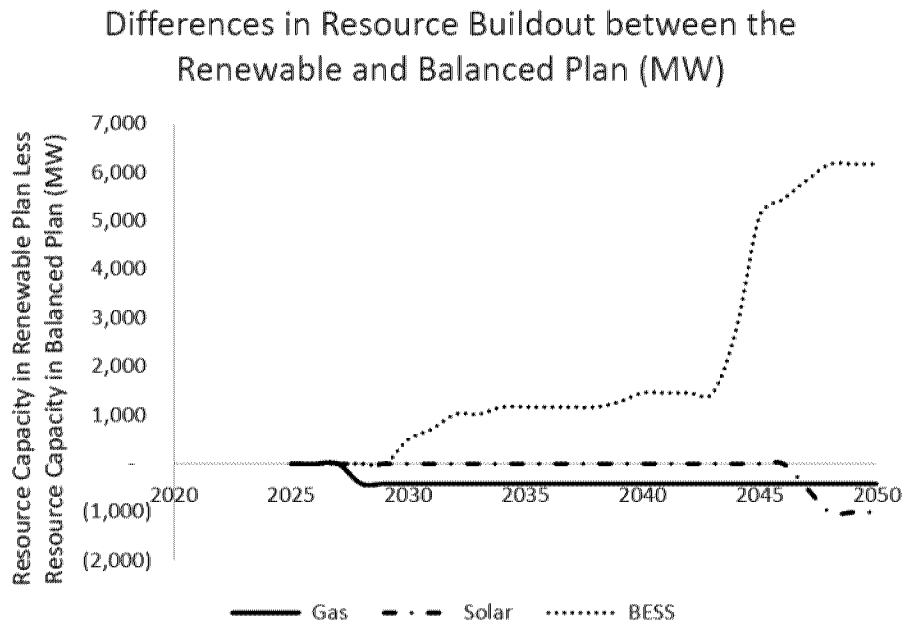
⁶ According to NVE, “Named placeholders are provided to represent reasonably known projects in progress or requested and to reflect anticipated Company-owned projects.” Volume 8, Narrative - Supply Plan, page 240 of 393.

⁷ Volume 8, Narrative - Supply Plan, page 241 of 393.

⁸ Volume 8, Narrative - Supply Plan, page 241 of 393.

The chart below shows the steep ramp up in BESS for the Renewable Plan after 2040, which is absent from the Balanced Plan.

*Figure 1: Differences in Resource Buildout between the Renewable and Balanced Plans (MW)*⁹



Q. WHAT DID NVE’S ANALYSIS FIND WHEN COMPARING THE COST OF THE TWO PORTFOLIOS?

A. NVE’s analysis found that the Renewable Plan has a 20-year Present Worth of Revenue Requirement (“PWRR”) that is \$321 million higher than the Balanced Plan (a 1.0% increase), and a 26-year PWRR that is \$1,047 million higher than the Balanced Plan (a 2.5% increase).¹⁰

⁹ Figure created based on information in Workpaper “2024 IRP Economic Analysis Narrative Figures” Tab “EA-7,30,33,36,39 Installed Cap.”

¹⁰ Volume 8, Narrative – Supply Plan, pages 271-272 of 393.

1 **Q. HOW DO YOU INTERPRET THIS COST DIFFERENCE?**

2 A. Without further consideration, one might interpret these findings to suggest that
3 excluding the proposed Valmy CTs results in a slightly more expensive portfolio. However, the
4 PWRR cost differential is primarily driven by other factors. In particular, the 4,700 MW of
5 BESS additions that NVE chose to add during the 2044-2050 timeframe play a significant role in
6 driving up the PWRR of the Renewable Portfolio relative to the Balanced Portfolio. Based on
7 NVE's assumptions, I estimate these late-term BESS additions to add over [REDACTED] billion in capital
8 costs.¹¹ Moreover, there is not a clear justification for such substantial additions of short-duration
9 BESS resources in these later years since 1) the Renewable Plan does not contain any additional
10 renewable resources that might require battery storage for integration, 2) the implied Effective
11 Load Carrying Capability ("ELCC") value of incremental BESS resources in these later years is
12 very low and does not provide significant capacity value relative to other possible resource
13 options, and 3) these BESS additions were included through hand-picked adjustments made by
14 NVE and were not part of any economic optimization (*e.g.*, via PLEXOS LT).

15 Regarding the ELCC value, it is worth noting that the initial 502 MW of incremental
16 BESS by 2030 included in the Renewable Plan results in 418 MW of incremental firm capacity
17 (or approximately 83%).¹² However, adding another 5,658 MW of incremental BESS to the
18 Renewable Plan by 2050 (6,160 MW total increase between the Renewable and Balanced Plan)

¹¹ Based on NVE's assumption of \$ [REDACTED]/kW for Battery-Standalone resources in 2040 as shown in
ECON-10, (*i.e.*, 4,700 MW x \$ [REDACTED]/kW = [REDACTED] billion).

¹² Comparing the firm capacity of "PPA.Placeholders.Storage.BESS-4" in 2030 between the VBDL1
and BDL2 tables in ECON-5, pages 2 and 5 of 88.

1 results only in incremental firm capacity of 338 MW (or approximately 5%).¹³ Given the very
2 low value of this firm capacity contribution, the Companies’ decision to keep adding short-
3 duration BESS does not appear logical. Instead, a more logical approach would have been to add
4 other types of “clean firm” resources in these later years that provide higher capacity value (*e.g.*,
5 Long Duration Energy Storage (“LDES”), Advanced Geothermal, hydrogen capable CTs, etc.).
6 Furthermore, although it is reasonable to assume that the ELCC of energy storage declines due to
7 saturation, the Companies’ assumptions, approximated in Table 2 below, are quite puzzling, with
8 5.5 gigawatts (“GW”) of incremental energy storage in the Renewable Plan *reducing* the total
9 BESS firm capacity by 10 MW, *i.e.*, reducing the total BESS firm capacity from 348 MW in
10 2030 to 338 MW in 2050.¹⁴

¹³ Calculation based on Workpaper “2024 IRP Economic Analysis Narrative Figures” Tab “EA-31,34,37,40 2050 Firm Cap.”

¹⁴ Based on information from the L&R tables (ECON-5) and Workpaper “2024 IRP Economic Analysis Narrative Figures” Tab “EA-31,34,37,40 2050 Firm Cap.”

1 *Table 2: Nameplate and Firm Capacity of BESS additions in the Balanced and Renewable Plans¹⁵*

	Nameplate Capacity (MW)			Firm Capacity (MW)		
	Balanced Plan	Renewable Plan	Difference	Balanced Plan	Renewable Plan	Difference
2025	946	946	-	946	946	-
2026	1,343	1,343	-	1,185	1,185	-
2027	1,746	1,746	-	1,502	1,502	-
2028	2,515	2,515	-	2,148	2,148	-
2029	2,573	2,573	-	2,195	2,195	-
2030	2,733	3,235	502	2,368	2,716	348
2031	3,198	3,908	710	2,721	3,050	329
2032	3,739	4,759	1,020	2,989	3,309	320
2033	3,995	5,015	1,020	3,116	3,435	319
2034	4,479	5,647	1,168	3,320	3,621	301
2035	4,509	5,677	1,168	3,340	3,639	299
2036	4,539	5,707	1,168	3,358	3,661	303
2037	4,569	5,737	1,168	3,371	3,672	301
2038	4,517	5,685	1,168	3,355	3,656	301
2039	4,844	6,120	1,276	3,455	3,774	319
2040	6,127	7,587	1,460	3,791	4,111	320
2041	6,908	8,368	1,460	3,985	4,309	324
2042	8,366	9,826	1,460	4,322	4,657	335
2043	9,390	10,850	1,460	4,563	4,896	333
2044	10,522	13,300	2,778	4,830	5,162	332
2045	11,407	16,517	5,110	5,069	5,374	305
2046	12,167	17,611	5,444	5,158	5,472	314
2047	13,439	19,277	5,838	5,265	5,595	330
2048	13,627	19,796	6,169	5,303	5,639	336
2049	14,070	20,239	6,169	5,318	5,654	336
2050	15,413	21,582	6,169	5,425	5,763	338
2030-2050	12,840	19,009	6,169	3,230	3,568	338
2045-2050	4,891	8,282	3,391	595	601	6
2031-2050	12,680	18,347	5,667	3,057	3,047	-10

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¹⁵ Attachment MR-2 (Public) (Table2_AEUWorkpaper).

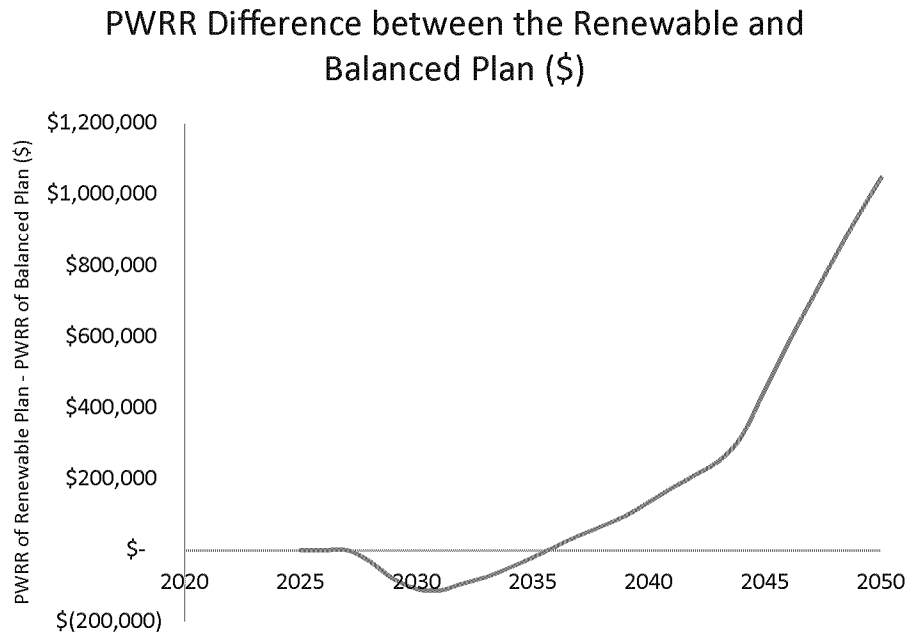
Q. BASED ON THIS ANALYSIS, WHAT IS YOUR OVERALL ASSESSMENT OF NVE'S APPROACH?

A. Overall, I'm concerned that NVE's hand-selected portfolio adjustments inappropriately inflated the cost of the Renewable Plan by including these very late-term BESS resources that have little portfolio value and are very uncertain relative to any near-term actions. This gives the false impression that near-term CT additions are more economic than they truly are, and that near-term BESS resource additions are less valuable than they truly are. The economics of the portfolio are largely driven by the ELCC assumptions, which raise several questions.

Q. HOW DO THE ECONOMICS OF THE TWO PORTFOLIOS COMPARE IN THE NEAR-TERM AND MEDIUM-TERM?

A. The following graph shows the difference in the cumulative PWRR between the two plans. As shown, the PWRR of the Renewable Plan is lower in cost than the Balanced Plan at least through 2035, and only becomes higher in cost than the Balanced Plan *after* the Companies begin to include significant amounts of BESS towards the 2040 timeframe. These late-term additions are not linked to the absence of the CTs (which have already been cost-effectively replaced by BESS in earlier years) and should not dictate the Companies' overall portfolio selection.

Figure 2: Differences in PWRR between the Renewable and Balanced Plans (\$) ¹⁶



**Q. BASED ON THIS ANALYSIS DO YOU AGREE WITH NVE THAT THE
BALANCED PLAN IS THE LEAST COST PORTFOLIO?**

A. No. As I demonstrated above, based on NVE's own analysis, the Renewable Plan is the least cost portfolio at least through 2035. After 2035, the Renewable Plan may become more costly, but that is only true if one accepts NVE's questionable and unsupported assumptions about the need for significant BESS resource additions in the 2035-2050 timeframe, and the absence of more economic alternatives in that timeline. Thus, NVE's conclusion that the Balanced Plan is least cost depends heavily upon extending the timeframe of the IRP analysis to

¹⁶ Figure created based on information in ECON-7.

20 years or longer, rather than focusing on a shorter period. Furthermore, NVE's conclusion depends heavily on NVE's cost assumptions and on NVE's assumptions that those hand-selected BESS additions are economically optimal even though the Companies have not re-optimized the portfolio in PLEXOS LT to confirm this.

Q. COULD A DIFFERENT SET OF LATE-TERM RESOURCE ADDITIONS (I.E., 2045-2050) COULD BE MORE COST-EFFECTIVE THAN THE 3,400 MW OF BESS NVE CHOSE?

A. Yes. Reviewing the nameplate and firm capacity provided by BESS in the two plans, the Renewable Plan adds 3.4 GW of nameplate capacity from 4-hour BESS more than the Balanced Plan in years 2045-2050. This leads to more than \$600 million of incremental PWRR.¹⁷ However, these additions result in firm capacity from BESS of 6 MW and are thus simply not necessary (no significant capacity difference exists between the Renewable and Balanced Plan during any year for this period). If all of the incremental BESS additions beyond the 502 MW of BESS additions in 2030 were removed from the Renewable Plan, then the Plan's PWRR would be reduced by more than \$1.2 billion, and would be approximately \$200 million lower than the Balanced Plan's PWRR.¹⁸ It is worth repeating that the incremental BESS additions in the Renewable Plan after the first 502 MW lead to a reduction in the overall firm capacity based on the Companies' assumptions, and thus the resulting PWRR should not be relied upon to inform the selection of the Preferred Portfolio. Given that the Companies did not re-optimize the Plan

¹⁷ See Attachment MR-2 (Confidential) (CONFIDENTIAL BESSCost AEUWorkpaper).

¹⁸ See Attachment MR-2 (Confidential) (CONFIDENTIAL BESSCost AEUWorkpaper).

1 after including the 2030 BESS (instead of the CTs), there could be a plan in which optimized
2 capacity additions would result in a Plan with lower PWRR over the entire planning period.
3 Those could include longer duration energy storage options, as well as flexible load resources,
4 which I further discuss in Section VI, or even firm capacity based on other emerging
5 technologies.

6 *B. THE INITIAL MODEL RUN UNDERPINNING THE BALANCED PLAN'S*
7 *ADDITION OF NEW GAS CT GENERATION BY 2028 (I.E., THE PLEXOS LT*
8 *BASE CASE) WAS BASED ON ERRONEOUS COST ASSUMPTIONS.*

9 **Q. CAN YOU EXPLAIN HOW NVE JUSTIFIED THE INCLUSION OF 411 MW OF**
10 **NEW GAS GENERATION BY 2028 IN ITS PREFERRED PORTFOLIO?**

11 A. The inclusion of 411 MW of new gas generation stems initially from NVE's PLEXOS
12 LT model run that was performed to develop the Base Case, which was ultimately used to
13 develop the Balanced Plan (*i.e.*, the Preferred Portfolio) after some adjustments. PLEXOS LT is
14 a capacity expansion model that uses mathematical optimization to identify the least cost
15 portfolio of resources based on a set of input assumptions. Based on the modeling assumptions
16 NVE chose, the PLEXOS LT model economically selected to add a 420 MW gas CT resource by
17 2027 in the Base Case. Notably, this result persists in subsequent steps of NVE's analysis. These
18 subsequent steps include manual adjustments to add or subtract resources, but none of them "re-
19 optimize" the plan to determine if the gas addition is still part of a least cost portfolio. Thus, the
20 CT addition is "baked in" from the initial Base Case model run.

Q. WHAT ARE SOME OF THE KEY MODELING ASSUMPTIONS PLEXOS USED TO DETERMINE RESOURCE ADDITIONS IN THE BASE CASE?

A. Some of the most important modeling assumptions include the timing of resource needs (*e.g.*, MW by year) and the cost of candidate resources that can meet those needs (*e.g.*, \$/kW capital costs). Since NVE has a significant open position, its capacity resource needs are essentially immediate. As such, capacity cost (\$/kW) and year of availability are undoubtedly the driving factors determining model-selected resource additions in the Base Case.

Q. DO YOU THINK THE CAPACITY COST ASSUMPTIONS NVE USED IN ITS PLEXOS LT MODELING WERE CORRECT?

A. No. NVE's cost assumptions for the Base Case were inconsistent with both reputable public data sources and NVE's own estimates of capital costs.

Q. CAN YOU EXPLAIN FURTHER WHY THE COMPANIES' CANDIDATE RESOURCE COSTS WERE ERRONEOUS?

A. Yes. Technical Appendix ECON-10 includes information regarding candidate resources considered in the Companies' PLEXOS modeling. Those inputs informed the development of the Base Case, which resulted in the selection of 420 MW of new CT capacity. According to the Appendix, the capital cost NVE assumed for new CT capacity was [REDACTED]/kW (in 2024 dollars).¹⁹ This is significantly lower than the actual Valmy CT costs, which the Companies reported as

¹⁹ ECON-10 – Candidate Resources.

1 being \$1,433/kW.²⁰ Additionally, the 2024 Advanced Technology Baseline (“ATB”)²¹—a
2 publicly available database of technology costs developed by the National Renewable Energy
3 Laboratory that the Companies relied upon for many of their cost assumptions²²— projects the
4 capital cost for a CT resource in 2027 to be \$1,462/kW.²³ In other words, the Companies’ cost
5 assumptions for new CT units that led to the selection of new CTs in the Base Case were [REDACTED] %
6 too low.

7 Meanwhile, the Companies’ cost assumptions for potential alternatives the model could
8 select instead of the CTs were too high. For example, for a paired resource of BESS and PV, the
9 Companies assume capital expenses of \$ [REDACTED] /kW (in 2024 dollars) for the solar asset in 2030,
10 and \$ [REDACTED] /kW (in 2024 dollars) for the battery asset in 2030,²⁴ thus leading to a combined
11 capital cost of \$3,564/kW.²⁵ This estimate does not adequately reflect the synergistic effects of a
12 paired resource that reduce its capital costs, and it also assumes high costs for solar. In contrast,
13 the ATB projects a combined capital cost for a paired BESS and PV resource with similar

²⁰ Volume 8, Narrative - Supply Plan, Page 19 of 393.

²¹ Electricity Annual Technology Baseline, *available at*
<https://data.openei.org/files/6006/2024%20v2%20Annual%20Technology%20Baseline%20Workbook%20Errata%207-19-2024.xlsx>.

²² *See, e.g.*, Volume 8, Narrative - Supply Plan, page 90 of 393 (the Companies’ cost assumptions for renewable energy and energy storage resources were based on the ATB).

²³ ATB projects a cost of \$1,300/kW in 2022\$. This was converted to 2024\$ using inflation of 8% in 2022 and 4.1% in 2023. *See* <https://www.usinflationcalculator.com/inflation/annual-averages-for-rate-of-inflation/>.

²⁴ ECON-10 – Candidate Resources.

²⁵ Calculated based on a PV:BESS ratio of [REDACTED] which NVE assumes prior to 2028 (see ECON-10 – Candidate Resources). Starting in 2028 NVE assumes a [REDACTED] ratio which I calculated to equal to a combined capital cost of [REDACTED] /kW.

configuration to be \$2,645/kW in 2030.²⁶ This suggests that the Companies modeled paired BESS and PV resources using a cost that was █% higher than what the ATB estimates.

Q. ARE THERE OTHER POTENTIAL FACTORS THAT MAY HAVE LED NVE TO OVER-ESTIMATE THE COST OF ALTERNATIVES TO NEW CTS?

A. Yes, my review suggests there may be additional factors. First, although, I have not performed an in-depth review of the Companies' ELCC study, its results are quite puzzling as shown in Table 2, and should not be relied upon to inform the selection of the preferred portfolio. The ELCC is a critical input in the capacity expansion model, which based on these assumptions perceives the alternative to CTs to be an unreasonably high amount of BESS.

Furthermore, based on my review of ECON-10 and the Companies' Supply Plan Narrative, I was unable to find any indication that the Companies' cost assumptions for BESS resources properly reflected the recently enacted Inflation Reduction Act tax credits in the capacity expansion modeling (although they are reflected in the screening analysis). These credits would significantly reduce the cost of renewable resources and energy storage – potentially lowering capital expenses for standalone storage by 30 percent or more – and should have been included as part of the initial resource selection step. Meanwhile, these credits would have no impact on the capital cost of fossil fuel additions, including the proposed CTs. An additional critical factor that leads to an overestimation of the cost of alternatives to new CTs is the assumed firm capacity of the different resource types, as discussed in Section III(a).

²⁶ Based on a PV:BESS ratio of █. Applying a PV:BESS ratio of █ under the ATB assumptions leads to a combined capital cost of \$1,947/kW (adjusted for inflation to reflect 2024 dollars).

1 **Q. WHAT ARE THE IMPLICATIONS OF THESE ERRONEOUS COST**
2 **ASSUMPTIONS FOR THE BASE CASE MODEL RESULTS FROM WHICH NVE**
3 **DERIVED ITS RESOURCE PORTFOLIO?**

4 A. Taken together, these erroneous assumptions have the effect of biasing the model towards
5 selecting new CTs and away from selecting other options such as BESS or BESS paired with
6 PV. Although the costs of specific projects might differ from either the ATB or placeholder
7 costs, these erroneous assumptions are informing the Base Case, resulting in a suboptimal initial
8 portfolio and impacting all subsequent steps and results.

9 *C. THE RENEWABLE PLAN PERFORMS BETTER THAN THE BALANCED PLAN*
10 *IN TERMS OF EMISSIONS.*

11 **Q. DOES THE RENEWABLE PLAN RESULT IN LOWER EMISSIONS THAN THE**
12 **BALANCED PLAN?**

13 A. Yes. According to NVE's analysis, the Renewable Plan yields a reduction in societal
14 costs (relative to the Balanced Plan) of approximately \$3 million from conventional and toxic air
15 emissions and \$64 million from CO2 emissions.²⁷

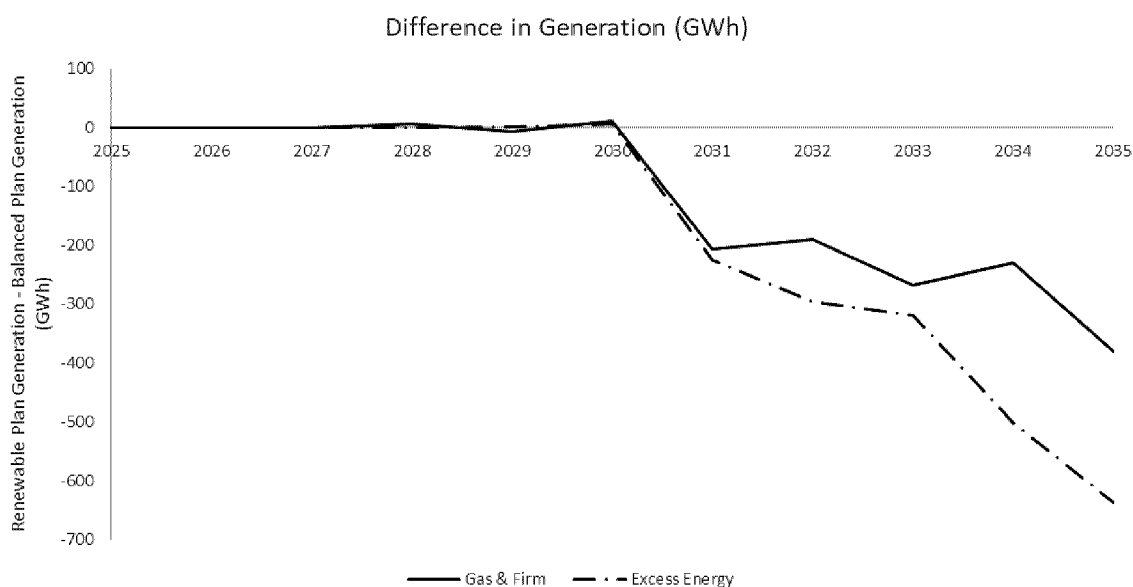
16 **Q. HOW DOES THE RENEWABLE PLAN ACHIEVE THESE REDUCTIONS?**

17 A. The Renewable Plan, despite its name, does not include higher levels of renewable
18 resources (as shown in Table 1). To the contrary, it includes *less* solar than the Balanced Plan:
19 500 MW less of solar in 2047 and 1 GW less in 2048 and beyond. Still, the Renewable Plan

²⁷ Volume 8, Supply Plan, pages 276 and 280 of 393.

results in lower emissions than the Balanced Plan. The reduced emissions can largely be explained by the reduction in gas generation, as illustrated in the figure below.

Figure 3: Difference in Gas Generation and Excess Energy between the Renewable and Balanced Plans (GWh)²⁸



The energy used to displace gas is not provided by increased renewable resources, as there are no incremental renewable resources in the Renewable Plan; rather, it seems to be associated with lower levels of “excess energy” in the system. This is likely due to the incremental BESS additions included in the Renewable Plan starting in 2030, which can absorb “excess” renewable energy that would otherwise be curtailed and dispatch that energy when it is needed. The BESS

²⁸ Figure created based on information in Workpaper “2024 IRP Economic Analysis Narrative Figures” Tab “EA-29,32,35,38 Energy Alt Plan.” (Excess Energy is reported as a negative value in the Companies’ workpapers as it is unneeded - Volume 8- Supply Plan, Page 254 of 393. In this graph, the reduction of excess energy corresponds to a reduction of excess/unneeded energy in the Renewable Plan.)

additions also add flexibility to the system, which can reduce costs and inefficiencies associated with ramping up or down thermal generation that would otherwise have to respond to the changing grid needs.

D. THE SELECTION OF THE BALANCED PLAN DOES NOT ACCOUNT FOR ALL THE RISKS ASSOCIATED WITH NEW GAS RESOURCE ADDITIONS.

Q. DO YOU BELIEVE THE ANALYSIS PRESENTED BY NVE OF THE BALANCED PLAN FULLY ACCOUNTS FOR THE RISKS ASSOCIATED WITH INVESTING IN NEW GAS CAPACITY?

A. No.

Q. WHAT ARE SOME OF THE RISKS ASSOCIATED WITH INVESTING IN NEW GAS CAPACITY THAT HAVE NOT BEEN PROPERLY ASSESSED OR PRESENTED?

A. There are three risk factors of particular concern to me that I did not find to be adequately represented in the analysis NVE provided. They are as follows:

1. *H2 feasibility and cost risk*: The Companies refer to the proposed CTs as hydrogen-capable but have presented no plan or analysis that can support the units' operation on hydrogen. Without a plan to operate on hydrogen, the proposed CTs introduce some risk as to the Companies' ability to achieve a net zero future by 2050.
2. *Stranded cost risk*: Investing in new fossil fuel resources carries the risk that, if additional regulations on carbon emissions are implemented in the future, these resources could become stranded assets.
3. *Opportunity cost risk*: The proposed CT units represent a substantial capital investment of \$573 million that will put significant upward pressure on customer rates in exchange for a

1 system benefit that has not been properly quantified (*i.e.*, relieving the Valmy must-run
2 constraint). For the same investment dollars, NVE customers might be able to capture
3 greater benefits through alternative investment options.

4 **Q. REGARDING THE FIRST OF THESE RISKS (H2 FEASIBILITY AND COST),**
5 **HAVE THE COMPANIES PRESENTED ANY ANALYSIS OR DATA ABOUT THEIR**
6 **PLANS TO OPERATE THE NEW CT UNITS BURNING HYDROGEN?**

7 A. No. While the Companies mention that the new units would be “hydrogen-capable”, they
8 have presented no evidence or analysis around the technical feasibility, the cost implications, and
9 the availability of fuel if the units were to operate on hydrogen. Specifically, in their response to
10 WRA 6-02, the Companies state that:

- 11 • “NV Energy does not currently have a plan to source and blend hydrogen at the Valmy
12 Generating Station.”
- 13 • “Since hydrogen manufacturing and supply is not available in Nevada at the scale
14 necessary for the operation of these units at this time, NV Energy cannot make plans or
15 develop costs and benefits for a hydrogen fuel supply at this time.”²⁹

16 **Q. WHAT IS THE COMPANIES’ RATIONALE FOR NOT INCLUDING H2-**
17 **RELATED COSTS IN THEIR ANALYSIS?**

18 A. The Companies imply that the conversion costs do not need to be included since “[t]he
19 economic analysis for the Valmy Simple Cycle Units is based on natural gas operation. The

²⁹ See **Attachment MR-3** (Companies Response to WRA 6-02).

1 ability of the units to operate on hydrogen is a secondary benefit, not included in the economic
2 analysis.”³⁰ However, this is contradictory to Nevada’s state goal of meeting its electricity
3 demand with 100% zero carbon resources by 2050. Thus, the units could become a stranded cost
4 well before their projected end of life (assumed to be 30 years) due to policy restrictions, or
5 result in significant additional costs if the Companies convert them to hydrogen. These risks are
6 present not only for the proposed near-term CT additions, but also for the future Combined Cycle
7 units the Companies’ preferred plan includes in the 2045 timeframe.

8 **Q. HAVE THE COMPANIES EVALUATED OTHER AVAILABLE OR EMERGING**
9 **TECHNOLOGIES THAT CAN PROVIDE FIRM DISPATCHABLE CAPACITY IN LIEU**
10 **OF THE PROPOSED NEAR-TERM CT ADDITIONS OR THE FUTURE COMBINED**
11 **CYCLE UNITS?**

12 A. No. The Companies’ portfolio analysis includes new CT and Combined Cycle (“CC”)
13 units with the notion that they could at some point burn hydrogen. However, the Companies’
14 analysis fails to consider other options that could provide firm dispatchable capacity. Thus, I am
15 concerned that a rush to install the Valmy CTs now presents an opportunity cost risk since these
16 installations would crowd out other viable technology options that could provide similar or
17 greater benefits without carrying the same risks discussed above. For example, while candidate
18 resources in the Companies’ modeling include battery storage of four-hour duration, no batteries
19 or energy storage assets of longer duration (*i.e.*, long-duration energy storage, or “LDES”) were

³⁰ See **Attachment MR-3** (Companies Response to United 3-02).

1 considered. Similarly, there was insufficient consideration of advanced geothermal resources,
2 particularly in light of Nevada’s significant geothermal potential. I discuss this in further detail in
3 Section V herein.

4 *E. THE BENEFITS OF ALLEVIATING THE MUST-RUN CONSTRAINT AT VALMY*
5 *VIA NEW CT INVESTMENTS ARE SMALL COMPARED TO THE SYSTEM-WIDE*
6 *BENEFITS OF AN ALTERNATIVE INVESTMENT IN NEW BESS RESOURCES.*

7 **Q. DOES THE EXISTENCE OF THE MUST-RUN REQUIREMENT AT VALMY**
8 **HAVE A NEGATIVE EFFECT ON NVE’S OPERATING COSTS AND EMISSIONS?**

9 A. All else being equal, the existence of a must-run requirement like the one at Valmy is
10 likely to exacerbate both costs and emissions to some degree due to the fact that it forces an
11 older, less-efficient gas-fired steam generator to operate more frequently than it otherwise would
12 without the must-run constraint. Thus, any steps that could eliminate this must-run constraint,
13 such as NVE’s proposal to install new CTs at Valmy under its preferred portfolio, might have a
14 positive effect on overall costs and emissions. However, such positive benefits should not be
15 considered in isolation. Rather, these benefits must be compared to the benefits that could be
16 produced by alternative investment choices.

17 **Q. HOW DO THE POTENTIAL BENEFITS OF ELIMINATING THE VALMY**
18 **MUST-RUN REQUIREMENT VIA NEW CT INVESTMENTS COMPARE TO THE**
19 **BENEFITS THAT COULD BE GENERATED FROM AN ALTERNATIVE**
20 **INVESTMENT, SUCH AS ADDITIONAL BESS?**

21 A. Such a comparison can be readily accomplished by evaluating NVE’s Balanced Plan
22 (which includes the Valmy CTs) versus NVE’s Renewable Plan, which essentially substitutes the

Valmy CTs for a 502 MW BESS addition in 2030. As demonstrated above in Sections III.a and III.c herein, the Renewable Plan likely outperforms the Balanced Plan in terms of both cost and emissions.

Thus, the positive effect from alleviating the must-run constraint via the Valmy CTs does not appear to be significant enough to outweigh the positive effects of the near-term BESS additions. In other words, there is an opportunity cost to investing in the Valmy CTs in the near-term, when a similarly sized BESS investment can produce a greater number of system benefits. Below is a qualitative comparison of the benefits that could be provided by each alternative:

System Benefits Provided	411 MW Valmy CT	502 MW BESS
Capacity (Resource Adequacy)	Yes	Yes
10-min Operating Reserves	Yes	Yes
Alleviates Valmy Must-Run Constraint	Yes	Not Fully Evaluated
Reduced Curtailment (system-wide)	No	Yes
Reduced Gas Generation (system-wide)	No	Yes

Q. ARE THERE OTHER INVESTMENTS, BESIDES CTS, THAT COULD ALLEVIATE THE VALMY MUST-RUN CONSTRAINT AT A LATER DATE BEYOND 2028?

A. Yes. This might include additional transmission upgrades, long-duration storage, interruptible load demand response, or contractual arrangements with other local generation facilities. To my knowledge, NVE has not evaluated these as potential alternatives to the Valmy

1 CTs.³¹ Furthermore, NVE did not consider a resource combination or alternative resource plan
2 that included only one of the two Valmy CTs plus a solar/storage resource.³²

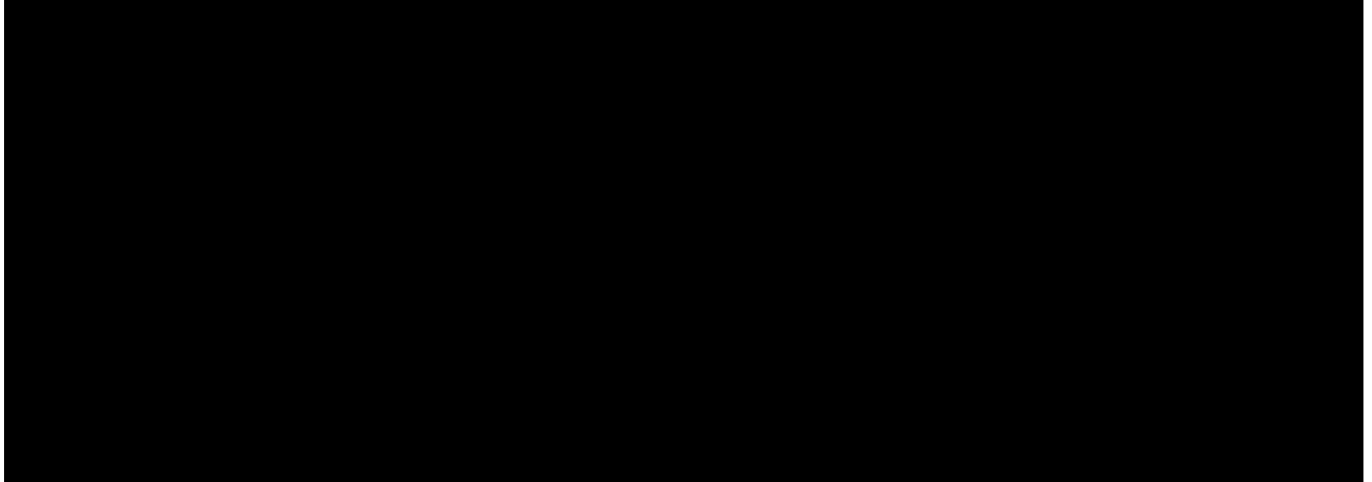
3 **Q. IS THERE ANY URGENCY OR INCREASED BENEFIT FROM REMOVING**
4 **THE MUST-RUN CONSTRAINT BY 2028 THAT WOULD JUSTIFY INSTALLING THE**
5 **VALMY CT INVESTMENTS BY THAT DATE?**

6 A. No. In fact, when comparing NVE's own analysis of the Balanced Plan (which installs
7 the Valmy CTs by 2028) to the Renewable Plan (which does not include the Valmy CTs), I
8 found that there is no meaningful reduction in the amount of gas-fired generation (*i.e.*, MWh)
9 produced at Valmy until 2031. In other words, there appears to be little downside from a cost or
10 emissions perspective to deferring the proposed CT investments for at least three years, which
11 would allow for other solutions to be properly evaluated.

³¹ See **Attachment MR-3** (Companies Response to United 3-06).

³² See **Attachment MR-3** (Companies Response to IEA 002).

1 *Table 3: Projected Gas Generation and Fuel Offtake at Valmy Station in Balanced and*
2 *Renewable Plans*³³



3
4
5 *F. RECOMMENDATIONS*

6 **Q. WHAT ARE YOUR RECOMMENDATIONS WITH RESPECT TO THE**
7 **COMPANIES' PREFERRED PORTFOLIO AND THE VALMY CTS?**

8 A. My recommendations are:

- 9 1. The Commission should reject the Balanced Plan as the Preferred Plan.
- 10 2. The Commission should order NVE to defer the 2028 Valmy CT additions and instead
- 11 pursue the incremental near-term BESS additions contemplated in the Renewable Plan.

³³ Tables created based on information in workpapers “2024IRP - BDL2 Alternative-Plan_PLEXOUT14194” and “2024IRP - VBDL1 Alternative-Plan_PLEXOUT14167.” United’s analysis is included in **Attachment MR-2** (Confidential) (CONFIDENTIAL_ValmyGeneration_AEUWorkpaper).

1 3. The Commission should direct NVE to evaluate alternative solutions to alleviating the
2 Valmy must-run constraint at a future date, including through transmission upgrades,
3 long-duration storage resource additions, interruptible load demand response, and
4 contractual arrangements with other local generators.

5 **IV. THE RENEWABLE PLAN SHOULD BE ADOPTED AS THE PREFERRED**
6 **PLAN AND MODIFIED TO ACCELERATE BESS RESOURCE ADDITIONS**
7 **FROM 2030 TO 2028.**

8 **Q. YOU EXPLAINED HOW THE NEAR-TERM ACTIONS OF THE RENEWABLE**
9 **PLAN OUTPERFORM THOSE OF THE BALANCED PLAN (I.E., NVE’S PREFERRED**
10 **PLAN) IN TERMS OF EMISSIONS, COST, AND VARIOUS RISK FACTORS. ARE**
11 **THERE ANY ASPECTS OF THE RENEWABLE PLAN THAT ARE LESS FAVORABLE?**

12 A. The Balanced Plan, as NVE has conceived of it, has modestly reduced reliability risk
13 during years 2028 and 2029 due to a smaller open position. However, I believe this result arises
14 primarily due to arbitrary limits in NVE’s modeling assumptions rather than any insurmountable
15 practical limits.

16 **Q. CAN YOU EXPLAIN HOW THE RELIABILITY RISK DIFFERS BETWEEN THE**
17 **PORTFOLIOS IN 2028 AND 2029?**

18 A. Yes. As NVE explains, “placeholder resources in the combination cases are adjusted to
19 ensure similar open positions are present in each case to the extent possible. This adjustment
20 ensures that the cases are similarly reliable.”³⁴ In other words, during the Combination Case step,

³⁴ Volume 8, Supply Plan, page 238 of 393.

NVE made adjustments to all candidate portfolios to ensure they had similar open positions in most years. However, as shown in the table below, the Companies did not do so for years 2028 and 2029.³⁵

Table 4: Open Position of Balanced and Renewable Plans (MW)³⁶

	Open Position (MW)							
	2025	2026	2027	2028	2029	2030	2040	2050
Balanced Plan	1396	1226	1024	265	254	615	635	716
Renewable Plan	1396	1226	1024	644	633	614	631	739

As a result, the Renewable Plan that NVE constructed does have a larger open position in years 2028 and 2029. This is due to the fact that NVE allows the 411 MW Valmy CTs to come online by 2028 in the Balanced Plan, but does not allow the 502 MW of additional BESS resources in the Renewable Plan to come online until 2030. If NVE’s methodology had allowed these incremental BESS resources to come online by 2028, the discrepancy in open position between the two plans would be eliminated.

Q. DID NVE’S MODELING METHODOLOGY ALLOW FOR INCREMENTAL BESS RESOURCES TO BE ADDED PRIOR TO 2030?

A. NVE’s initial PLEXOS modeling assumptions included limits on storage additions of 139 MW in 2026 and 117 MW in 2027. These limits are described as being based on “potential projects.”³⁷ However, these specific MW values do not appear to be linked to a list of potential

³⁵ Workpaper “2024 IRP Economic Analysis Narrative Figures” tab “EA-23 Open Position Alt Plan.”

³⁶ Table created based on information in Workpaper “2024 IRP Economic Analysis Narrative Figures” Tab “EA-23 Open Position Alt Plan.”

³⁷ Volume 8, Supply Plan, page 224 of 393.

1 projects³⁸ or named placeholders³⁹ that NVE identified elsewhere in its plan. Additionally, in the
2 Combination Case stage of its modeling, NVE arbitrarily decided to eliminate incremental new
3 resources additions (*i.e.*, “placeholder resources”) in 2028.⁴⁰ This arbitrary limit precludes most
4 new resource additions (including BESS and BESS paired with PV) from being considered until
5 at least 2029. Importantly, however, NVE did not apply this limitation to new gas CTs by 2028.

6 Thus, NVE applied unequal treatment to potential new resource additions in the 2028
7 timeframe. In addition, 2028 is the year that NVE applied a more restrictive limit (*i.e.*, 750 MW)
8 to its open position, driving additional resource need in that year.⁴¹ Taken together, these near-
9 term limits in NVE’s modeling assumptions – many of which are arbitrary – seem geared
10 towards driving a singular possible outcome: the addition of 420 MW of new CTs in 2028.

11 **Q. CONTRARY TO THESE ASSUMPTIONS, COULD THE COMPANIES**
12 **REALISTICALLY PURSUE A NEW BESS PROJECT PRIOR TO 2028?**

13 A. Yes. The U.S. Energy Information Administration (“EIA”) estimates the lead time
14 needed for battery storage systems to be one year.⁴² Furthermore, several recent IRPs include
15 battery storage as an option selectable in 2028. Specifically:

³⁸ Volume 8, Supply Plan, pages 229-231 of 393.

³⁹ Volume 8, Supply Plan, page 241 of 393.

⁴⁰ Volume 8, Supply Plan, page 236 of 393.

⁴¹ In the Companies’ Response to Staff 99, the Companies recognize the use of a higher open position in previous IRPs, and that determining an open position is not an exact science. *See Attachment MR-3* (Companies Response to Staff 99).

⁴² US EIA, Cost and Performance Characteristics of New Generating Technologies, Annual Energy Outlook 2023, Table 1, https://www.eia.gov/outlooks/aeo/assumptions/pdf/elec_cost_perf.pdf.

- 1 - PacifiCorp estimates the construction period for a BESS to be 12 months and indicates that
2 in their upcoming 2025 IRP they will assume the soonest commercial operation date
3 possible for BESS to be 2028.⁴³ It is also worth noting that PacifiCorp has shared its
4 intention to include longer duration options, including gravity batteries, Compressed Air
5 Energy Systems, and Iron air 100-hour batteries with the soonest operation dates possible
6 being 2028, 2030, and 2032.⁴⁴
- 7 • Duke Energy Progress and Duke Energy Carolinas, in their 2023 Resource Plan
8 allowed the capacity expansion model to select standalone storage in 2027.⁴⁵ This
9 includes 4-hour, but also 6- and 8-hour options.
 - 10 • In the draft and upcoming 2025 IRP, the Tennessee Valley Authority (“TVA”) will
11 assume lithium-ion batteries to be available beginning 2029.⁴⁶ TVA assumes that
12 advanced chemistry batteries (10-hour) will also be available beginning 2029.

⁴³ 2025 PacifiCorp Integrated Resource Plan Public Input Meeting July 17-18, 2024, https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2025-irp/PacifiCorp_2025_IRP_PIM_July_17-18_2024.pdf.

⁴⁴ 2025 PacifiCorp Integrated Resource Plan Public Input Meeting August 14-15, 2024, https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2025-irp/PacifiCorp_2025_IRP_PIM_August_14-15_2024.pdf.

⁴⁵ Duke Carolinas Resource Plan, Appendix C (Quantitative Analysis), Table C-24, <https://www.duke-energy.com/-/media/pdfs/our-company/carolinas-resource-plan/appendix-c-quantitative-analysis.pdf?rev=635a32c849544b98a9653fdf972967b7>.

⁴⁶ 2025 Draft IRP, at 3-17, https://tva-azr-eastus-cdn-ep-tvawcm-prd.azureedge.net/cdn-tvawcma/docs/default-source/environment/environmental-stewardship/integrated-resource-plan/2025/draft-2025-irp-volume-1-092324.pdf?sfvrsn=26f01b64_1.

- In the 2023 Clean Energy and Integrated Resource Plan, Portland General Electric included storage with a commercial operation date of 2026.⁴⁷ The Plan includes options of 2-, 4-, 6-, 8-, 16-, and 24-hour durations.

Q. IF THE COMMISSION REQUIRES NVE TO ACCELERATE THE NEAR-TERM BESS PROCUREMENT AS YOU HAVE RECOMMENDED, ARE THERE ADDITIONAL ASPECTS OF THIS PROCUREMENT THAT SHOULD BE CONSIDERED?

A. Yes. NVE should be required to evaluate the potential for BESS targeted at the Valmy site to alleviate the must-run constraints there. This evaluation should consider whether these constraints could be alleviated either partially or fully if short-duration (*i.e.*, <4hrs) storage is used. If short-duration storage is insufficient, the evaluation should consider whether other technology options would be sufficient (*e.g.*, long-duration storage).

Q. ASIDE FROM ACCELERATING THE NEAR-TERM BESS PROCUREMENT, ARE THERE OTHER WAYS THAT THE RENEWABLE PLAN COULD BE IMPROVED?

A. Yes. There should be more consideration of resource adjustments to the Renewable Plan in the longer-term (*i.e.*, 2035 and beyond), beyond the short-duration BESS additions used to minimize NVE's open position. At a minimum, this should include long-duration battery storage,

⁴⁷ Portland General Electric Clean Energy Plan and Integrated Resource Plan 2023, Chapter 8, Table 33, https://downloads.ctfassets.net/416ywc1laqmd/6B6HLox3jBzYLBgskor5/63f5c6a615c6f2bc9e5df78ca27472bd/PGE_2023_CEP-IRP_REVISED_2023-06-30.pdf.

advanced geothermal, and flexible load resources. It could also include hydrogen capable CTs or CCs, since there would be ample time to evaluate the risk factors described above.

Q. WHAT ARE YOUR SPECIFIC RECOMMENDATIONS REGARDING HOW THE RENEWABLE PLAN SHOULD BE IMPROVED?

A. I recommend that the Commission order NVE to adopt the Renewable Plan as the Preferred Plan, with the following modifications:

1. Consistent with the Renewable Plan, NVE should procure approximately 500 MW of standalone BESS resources in lieu of the Companies' proposed CT additions at Valmy.
2. NVE should accelerate the procurement of these BESS resources from 2030 to 2028 to better address NVE's open position in 2028 and 2029.
3. As part of this BESS procurement, NVE should consider targeting the Valmy location as a means of partially or wholly reducing the must-run constraint.

1 **V. NVE’S IRP PROCESS IS NOT DESIGNED TO IDENTIFY FUTURE**
2 **PORTFOLIO NEEDS AND ALLOW THOSE NEEDS TO DRIVE A ROBUST**
3 **PROCUREMENT PROCESS.**

4 A. NVE’S 2023 SOLICITATION PROCESS HAD SIGNIFICANT SHORTCOMINGS
5 THAT LIKELY LED TO A SUBOPTIMAL 2024 RESOURCE PORTFOLIO.

6 **Q. CAN YOU DESCRIBE NVE’S RECENT SOLICITATION PROCESS AND HOW**
7 **IT RELATES TO THE RESOURCES ULTIMATELY INCLUDED IN THE COMPANIES’**
8 **PREFERRED PLAN?**

9 A. In 2023, NVE conducted a solicitation for new resources called the Open Resource RFP.

10 This RFP resulted in a number of project proposals. However, many were eliminated based on
11 due diligence evaluations. As NVE stated:

12 For example, of the 84 project proposals that the Companies evaluated in the RFP, over a
13 third were identified to have critical flaws due to transmission constraints that delayed
14 proposed in-service dates beyond the interconnection date. Additionally, most new
15 generation projects require significant transmission network upgrades that are long
16 duration and costly to implement.⁴⁸

17
18 According to the Supply Plan Narrative, this due diligence evaluation was concurrent with the
19 Screening Analysis step of NVE’s IRP evaluation, and ultimately, it led to many potential
20 projects being removed from portfolio consideration, including Battery-1, Solar-1, Solar-2,
21 Wind-1, and Geo-1. This left the Companies with a very small set of potential projects to meet
22 the Companies’ growing load. In total, out of the 84 bids received via the 2023 RFP, 28 made the

⁴⁸ Volume 8, Supply Plan, Page 47 of 393.

RFP shortlist, and only three were further analyzed for potential inclusion in the Preferred Portfolio.⁴⁹

Q. WHAT IS YOUR IMPRESSION OF THE FACT THAT ONLY THREE PROJECTS FROM THE 2023 RFP WERE INCLUDED IN THE IRP ANALYSIS?

A. Only a very limited number of projects advanced from NVE’s due diligence evaluations and thus could be considered for further analysis in this IRP. Unfortunately, this deprives the Companies and their ratepayers of opportunities to further reduce costs, emissions, and exposure to the market. By contrast, Xcel Colorado’s 2022 RFP yielded over 1,000 bids with over 380 advancing to further modeling phases. Moreover, in Xcel’s case, “Bids that raised due diligence concerns were further evaluated and provided the opportunity to clarify and/or cure deficiencies, and ultimately, relatively few bids were discarded.”⁵⁰

Q. WAS THE 2023 RFP CONDUCTED IN RESPONSE TO ANY ANALYSIS NVE PERFORMED IN THE CURRENT IRP CYCLE TO IDENTIFY OPTIMAL PORTFOLIO NEEDS?

A. No. If anything, the 2023 RFP would have been responsive to resource needs identified in the previous IRP cycle, though it’s not clear to me that the RFP appropriately targeted those needs. Moreover, the IRP portfolio was not reoptimized based on bids received. Thus, there is a significant mismatch between the analysis NVE conducted in PLEXOS LT in the current IRP

⁴⁹ See **Attachment MR-3** (Companies Response to IEA 007).

⁵⁰ See https://www.xcelenergy.com/staticfiles/xcelresponsive/Company/Rates%20&%20Regulations/PUBLIC%202021%20ERP%20&%20CEP_120-Day%20Report_FINAL.pdf.

cycle to identify a least cost portfolio and the resources that it sought or the bids it received through its 2023 RFP.

Q. WERE THERE OTHER PROBLEMS WITH THE 2023 RFP PROCESS THAT COULD HAVE LED TO A SUBOPTIMAL 2024 PORTFOLIO?

A. Even for the resource types for which NVE did receive qualified bids, the RFP led to suboptimal results. For example, NVE's analysis shows that the Battery-1 screening analysis performed better than the Base Case and could have been used to further strengthen the Companies' portfolio.⁵¹ Unfortunately, however, this project was removed after the due diligence evaluation.

Overall, the high number of projects rejected through the due diligence process raises questions as to whether a better designed RFP process could have resulted in more robust bids that would have proactively addressed transmission or other issues that emerged during the due diligence phase. Any RFP process that does not clearly specify system needs, identify potential barriers (*e.g.*, transmission limits), or provide opportunities to cure due diligence concerns is less likely to yield a robust pool of competitive bids and more likely to yield a suboptimal portfolio. Moreover, a poorly structured RFP process can create a vicious cycle: developers can become hesitant to dedicate time and resources to develop bids towards an NVE RFP given these bids might be rejected based on information that was not proactively described in the RFP.

⁵¹ Supply Plan, Figure EA-10.

Moreover, the nature of the screening analysis, which evaluates projects one by one in a piecemeal fashion, meant that there was no opportunity to identify a complete portfolio based on simultaneously optimization of multiple project bid costs. This may have revealed multiple projects in combination yielding an overall lower cost portfolio, even if a single project did not perform well during the screening analysis.

B. NVE'S SELECTIVE USE OF INFORMATION FROM PROJECT BIDS IN ITS PORTFOLIO OPTIMIZATION MODELING YIELDS BIASED RESULTS.

Q. IS NVE'S INITIAL PORTFOLIO OPTIMIZATION MODELING (I.E., THE PLEXOS LT BASE CASE) INFORMED BY ACTUAL PROJECT BID INFORMATION?

A. Not in any logical or consistent manner. As explained in Section II, the Companies perform a capacity expansion model run in PLEXOS LT that results in the Base Case. The Base Case then serves as the starting point for all portfolio development. Through a series of subsequent individual project screening cases and combination screening cases, NVE claims to evaluate the potential projects against each other to develop the alternative plans. However, the initial PLEXOS modeling uses assumptions that selectively reflect or deviate from identified projects attributes, thus creating the potential for bias towards specific resources.

For example, as explained above, NVE included annual build limits on future BESS projects that the Companies claim were based on potential projects identified to date.⁵² Furthermore, the modeled cost of future BESS resources (as well as other resources) is “based

⁵² “The buildout for the first few years is based on potential projects, with a build limit in 2026 and 2027 of 139 MW and 117 MW, respectively.” Supply Plan, page 224 of 393.

1 upon NREL data and is adjusted based upon results of recent RFPs.”⁵³ On the contrary, the cost
2 of CTs significantly deviates from the Companies’ own estimate for the identified Valmy CT
3 projects.⁵⁴ Thus, it appears that the Base Case reflects real-world project limitations and costs for
4 all resource types *except* for the CTs, which are represented by an artificially low cost estimate
5 that is untethered from reality.

6 **Q. ARE THERE VALID REASONS TO CONSIDER MODELING GENERIC**
7 **RESOURCES IN THE NEAR TERM, RATHER THAN JUST SPECIFICALLY**
8 **IDENTIFIED PROJECTS?**

9 A. Yes. In most cases, modeling generic resources is more appropriate for identifying
10 medium or long-term portfolio needs. However, including generic resources (*i.e.*,
11 “placeholders”) could allow the model to identify near-term resources that would be optimal to
12 add – beyond just the specific potential projects already known to the Companies. This would be
13 a reasonable approach, especially if the Companies were open to pursuing near-term solicitations
14 (*e.g.*, by 2028) for new resources that could improve portfolio performance. However, this does
15 not seem to be the intention in NVE’s case. As described above, with the exception of the CTs,
16 the portfolios NVE designed did not allow for new placeholder resources from 2025 through
17 2028.⁵⁵ Thus, the sole purpose of modeling generic placeholder resources in the years 2025

⁵³ Supply Plan, page 225 of 393.

⁵⁴ See discussion above in Section III.b.

⁵⁵ Supply Plan, page 236 of 393.

through 2028 appears to be to allow the inclusion of new CTs in the resource portfolio (albeit at an artificially lowered cost).

Q. DO YOU HAVE ADDITIONAL CONCERNS WITH HOW THE COMPANIES EVALUATED THE POTENTIAL PROJECTS?

A. Yes. In addition to the Base Case development being informed by erroneous assumptions, the Companies further screen potential resources using screening cases that include manual adjustments of resources. These adjustments are not limited to one-for-one swaps of generic resources with specific projects of the same type but can instead include a series of adjustments for any screening case. The Companies' Supply Plan states that screening cases "were developed by adding these projects individually to the Base Case, then adjusting placeholder resources to achieve similar open positions and similar amounts of renewable energy in each screening case."⁵⁶ These adjustments are not the result of re-optimizing the portfolio while including the specific project, but rather of NVE-imposed changes that might be suboptimal. Thus, any difference in the PWRR of the screening cases cannot be confidently attributed to the specific project being screened. This approach results in PWRR tables in the Supply Plan Narrative that are of low informational value and undermines confidence in the screening case results and the ranking of the alternative portfolios.

⁵⁶ Volume 8, Narrative - Supply Plan, Page 229 of 393.

1 **Q. WHAT WOULD BE A MORE REASONABLE MODELING APPROACH?**

2 A. In most IRP analyses, utilities model generic resources to be selected in the capacity
3 expansion step (*e.g.*, PLEXOS LT). These generic resources are meant to be representative of the
4 available technology options and can be used to identify system needs to be targeted in
5 subsequent RFPs. However, in this case NVE already conducted its RFP prior to modeling its
6 system needs. While this sequence is not ideal, the fact is that the Companies now have
7 information on a set of near-term projects that can be used as inputs for portfolio optimization.
8 There is no need for the additional abstraction NVE has included in its initial Base Case
9 modeling.

10 Moreover, a better overall process would start with the identification of capacity and
11 other system needs, as well as relevant transmission constraints and local issues that need to be
12 addressed, *before* the RFP is issued. After the RFP, a second phase of modeling can be
13 conducted reflecting attributes of the actual bids. During this second phase of modeling, generic
14 placeholder resources can still be included after the Action Plan period.

15 C. OTHER JURISDICTIONS HAVE MORE ROBUST PROCUREMENT
16 PROCESSES THAT ARE MORE CLEARLY LINKED TO THE RELEVANT
17 RESOURCE PLANNING ANALYSES.

18 **Q. DO YOU KNOW OF OTHER UTILITIES CONDUCTING RESOURCE**
19 **MODELING USING ACTUAL BIDS?**

20 A. Yes. Public Service Company of Colorado (“Xcel Colorado”) conducts portfolio
21 modeling in two phases. In Phase II of its Energy Resource Plan process, Xcel Colorado
22 conducts modeling to evaluate projects bids received through a previously issued RFP. The two-

1 phased approach in Colorado’s energy planning serves as an example of how resource
2 procurement can be more effectively linked to resource planning and can more effectively
3 engage the market, resulting in a robust set of projects to be evaluated.

4 In Phase I, the Colorado Commission reviews and decides on:⁵⁷

5
6 [T]he utility's assessment of need for additional resources in the resource acquisition
7 period; the utility's plans for acquiring additional resources through an all-source
8 competitive acquisition process or through an alternative acquisition process; components
9 of the utility's proposed RFP, such as the model contracts and the proposed evaluation
10 criteria; and, the alternate scenarios for assessing the costs and benefits from the potential
11 acquisition of increasing amounts of renewable energy resources, demand-side resources,
12 energy storage systems, or Section 123 resources.⁵⁸

13
14 Phase I is a litigated proceeding in which intervenors submit testimony before the
15 Commission on issues that could potentially improve the final resource selection. Once the RFP
16 is issued, and bids are received, the utility reviews whether each potential resource meets the
17 requirements specified in the resource solicitation and performs an initial assessment of the bids.
18 The utility may also participate in the competitive resource acquisition process by proposing the
19 development of a new utility resource that the utility will own as a rate base investment. The
20 utility also shares the information with an independent evaluator who can verify the findings or
21 further investigate certain issues.

22 In Phase II of the Resource Plan proceeding, the utility conducts modeling to identify the
23 cost-effective plans that conform to the range of scenarios, assessing the costs and benefits from

⁵⁷ 4 CCR § 723-3, 3617(c).

⁵⁸ “Section 123 resources” means new energy technology or demonstration projects, including new clean energy or energy-efficient technologies.

1 the potential acquisition of increasing amounts of renewable energy resources, demand-side
2 resources, energy storage systems, or Section 123 resources. Within 120 days, the utility files a
3 report with the Commission describing its findings.

4 It is worth noting that all bids that are advanced to Phase II modeling are modeled
5 simultaneously as candidate resources under the assumptions approved in Phase I, allowing the
6 model to select the least cost combination of resources. This process stands in stark contrast with
7 NVE's approach, which selectively evaluates projects one-by-one in a step-wise procedure, not
8 allowing various resource complementarities to emerge as options for consideration. For
9 example, in the individual project screening step, NVE screens capacity resources, which are
10 defined as either CTs or standalone batteries. Battery-1 is the only battery evaluated in this step,
11 and although its screening results are favorable, it is rejected based on the Companies' due
12 diligence evaluation. Other resources such as paired solar and storage could also provide the
13 same capacity (while also providing energy), but these resources are not considered during this
14 step.

15 Finally, it is important to highlight that modeling of specific bids can result in very
16 different outcomes as compared to the modeling of generic resources.⁵⁹ This is because actual
17 bids can be very different (*e.g.*, lower or higher in cost) than the generic candidate resources.

⁵⁹ J.D. Wilson, M. O'Boyle, R. Lehr, and M. Detsky, Making the most of the power plant market: Best Practices for All-Source Electric Generation Procurement, <https://energyinnovation.org/wp-content/uploads/2020/04/All-Source-Utility-Electricity-Generation-Procurement-Best-Practices.pdf>.

1 This was indeed the case for the CT capacity in NVE's analysis. Thus, it is important to conduct
2 the second phase of modeling with the actual project bids. The table below provides a high-level
3 comparison of the contrasting processes.

NVE's Process	Xcel Colorado's Process
<ul style="list-style-type: none"> • RFP conducted • Capacity Expansion modeling identifies generic resource additions • RFP results screened, and many rejected • Screened RFP projects substituted for generic resources additions from modeling • Manual selections made to determine final portfolio 	<ul style="list-style-type: none"> • Phase 1 modeling: Capacity Expansion model identifies needs using generic resource assumptions • RFP conducted based on Phase 1 needs with opportunities to cure deficiencies • Phase 2 modeling: Capacity Expansion model using RFP results • Final modeled portfolio determined project short list

4 *D. NVE'S CANDIDATE RESOURCES FOR MEDIUM- AND LONG-TERM NEEDS*
5 *DO NOT CAPTURE RECENT ADVANCEMENTS FOR LONG-DURATION*
6 *ENERGY STORAGE OR ADVANCED GEOTHERMAL.*

7 **Q. YOU ALSO EXPRESSED CONCERNS ABOUT THE CANDIDATE RESOURCES**
8 **IN THE LONG TERM. PLEASE ELABORATE.**

9 A. As I mentioned in Section III(d), the Companies' candidate resources do not include
10 LDES and the economic analysis does not properly evaluate advanced geothermal options.

11 **Q. DO YOU AGREE WITH THE COMPANIES' EXCLUSION OF LDES**
12 **TECHNOLOGIES FROM THEIR CANDIDATE RESOURCES?**

13 A. No. The Companies' exclusion of additional storage alternatives, particularly LDES, for
14 the totality of the period studied is inconsistent with the pace at which LDES technologies are
15 becoming commercially available and economically viable, the Companies' need for additional

1 capacity alternatives, and the policy and reliability risks of thermal assets. Beyond lithium-ion
2 assets, a suite of LDES technologies, like iron-air storage systems, are commercially ready for
3 the planning period and have been procured or are in planning stages. For example, Georgia
4 Power has announced a 15 MW / 1.5 GWh iron-air battery;⁶⁰ Xcel in Minnesota has received
5 approval for a 10 MW / 1 GWh battery;⁶¹ Dominion Energy is piloting two storage technologies
6 with 12 and 100 hours of duration;⁶² and Puget Sound Energy is exploring a 10 MW /1 GWh
7 battery.⁶³

8 In this context, it is unreasonable for the Companies to exclude said storage alternatives
9 with durations beyond four hours for the totality of the period studied. In fact, the longer duration
10 of these battery resources suggests that they may even be good candidates for alleviating the
11 must-run constraints at the Valmy location (discussed further in Section III.e).

⁶⁰ Michael Schoeck, Form Energy to deploy 100-hour iron-air battery system in Georgia, PV-Magazine (June 12, 2023), <https://pv-magazine-usa.com/2023/06/12/form-energy-to-deploy-100-hour-iron-air-battery-system-in-georgia/>.

⁶¹ Ethan Howland, Minnesota PUC Approves Xcel's Plan to Install a 10-MW/1,000-MWh Form Energy Battery System, Utility Dive (Jul. 7, 2023), <https://www.utilitydive.com/news/minnesota-puc-xcel-form-energy-battery-sherco-solar/685460/>.

⁶² Andy Colthorpe, Dominion Energy in 'innovative and timely' pilot of long-duration energy storage technologies, Energy Storage News, (Sept. 20, 2023), <https://www.energy-storage.news/dominion-energy-in-innovative-and-timely-pilot-of-long-duration-energy-storage-technologies/>.

⁶³ Kavya Balaraman, Puget Sound Energy, Form Energy explore 10-MW, 100-hour iron-air battery pilot, Utility Dive, (Jan. 9, 2024), <https://www.utilitydive.com/news/puget-sound-energy-form-energy-long-duration-iron-battery/704026/>.

1 **Q. WHAT DO YOU RECOMMEND WITH RESPECT TO LDES TECHNOLOGIES?**

2 A. I recommend that the Companies' analysis be revised to include LDES technologies in
3 the near- to medium-term (*e.g.*, 2030), as the availability of these resources in a few years could
4 have an impact on the selection of resources during the 2025-2027 action plan.

5 **Q. DO YOU AGREE WITH THE COMPANIES' EXCLUSION OF ADVANCED**
6 **GEOTHERMAL TECHNOLOGIES FROM THEIR CANDIDATE RESOURCES?**

7 A. No. While NVE does include geothermal as a candidate resource in its PLEXOS
8 modeling, the assumptions used to represent future geothermal additions do not appear
9 representative of recent advancements in Advanced Geothermal System technologies that could
10 improve performance and cost relative to traditional geothermal resources. As NVE confirmed,
11 the performance profiles were based on historical performance, and no modifications were made
12 to represent improvements for future resources.⁶⁴ Based on the data NVE provided, the
13 Companies appear to assume future geothermal resources will have a capacity factor of
14 approximately 58%⁶⁵ and an ELCC value of 41-42%.⁶⁶ This contrasts with recent data from EIA
15 showing that capacity factors for geothermal power plants in the U.S. are approximately 76% on
16 average.⁶⁷

⁶⁴ See **Attachment MR-3** (Response to WRA 6-05).

⁶⁵ See **Attachment MR-3** (Attachment to WRA 6-05).

⁶⁶ Calculation based on Workpaper "2024 IRP Economic Analysis Narrative Figures" Tab "EA-31,34,37,40 2050 Firm Cap."

⁶⁷ See <https://www.eia.gov/todayinenergy/detail.php?id=42036>.

1 Developments in advanced geothermal technology may also further improve performance
2 and/or reduce costs for future geothermal resource additions in Nevada. For example, the 115
3 MW Corsac Enhanced Geothermal System (“EGS”) project currently under development
4 through a partnership between NVE, Google, and Fervo is expected to operate “anywhere from
5 70-97% of nameplate.”⁶⁸ As part of this particular project, NVE also contemplates a novel Clean
6 Transition Tariff (“CTT”) that would “allow large energy users to pay a premium for 24/7 clean
7 energy from new resources.”⁶⁹ If this CTT construct is approved by the Commission, any
8 premium paid by large users to develop EGS systems could be considered a reduction in the
9 overall cost of EGS resources from NVE ratepayers’ perspective. Such a reduction in resource
10 costs should be reflected in NVE’s future IRP modeling assumptions.

11 *E. RECOMMENDATIONS*

12 **Q. BASED ON YOUR ASSESSMENT, CAN YOU SUMMARIZE YOUR CONCERNS**
13 **WITH NVE’S ANALYTICAL PROCESS IN THIS IRP?**

14 A. Yes, I am concerned that NVE’s IRP analysis is not designed for identifying future
15 system needs and using that analysis to develop a robust and competitive resource procurement
16 process. Instead, it appears that NVE has conducted a poorly designed RFP; identified some of
17 the resources resulting from that RFP that it would like to procure; and then wrapped its IRP

⁶⁸ *See* <https://ecms.nv.gov/puc/api/Document/AdYRPeH9myaCJOFDy2hEmAkfb8RRrD9FRQNaYwUIJO4EzfeB1APBk%C3%81P9iLTqb1YFxAgo0YRdlb56cU6baMGzAWY=?OverlayMode=View>.
⁶⁹ *See* <https://www.utilitydive.com/news/google-fervo-nv-energy-nevada-puc-clean-energy-tariff/719472/>.

analysis around those predetermined results. Unsurprisingly, this deeply flawed process has resulted in a suboptimal portfolio.

Q. IS NVE PLANNING TO ISSUE ANOTHER OPEN RESOURCE RFP?

A. According to the Companies' response to Staff 63, issued on July 8, 2024, NVE was planning to issue an all source (formerly open resource) RFP in August 2024. To my knowledge this has not yet been issued.

Q. DO YOU HAVE A RECOMMENDATION WITH RESPECT TO THE COMPANIES' NEXT RFP?

A. Yes. As detailed above, this IRP started with a limited pool of near-term projects that NVE identified. NVE then followed a process that included erroneous assumptions and methodological choices to develop a portfolio around those identified projects. Meanwhile, in the near-term the Renewable Plan outperforms the Balanced Plan in terms of emissions, costs, and risk mitigation. Accelerating the procurement of energy storage to 2028 or earlier would further strengthen the portfolio and reduce the Companies' open capacity position. Thus, while this adjusted Renewable Plan may not be the optimal portfolio out of all possible futures NVE could have pursued, it is currently the best available portfolio, derived from a model, that has identified general system needs. The Renewable Plan could be considered somewhat analogous to the first step of the model results used in Colorado.

To further strengthen the Renewable Plan, I recommend that the Companies issue an all-source RFP as soon as possible to procure additional resources consistent with the specific needs identified in the adjusted Renewable Plan. These specific needs should include:

- 1 • Capacity resources that would reduce the Companies' open position in the 2028
2 timeline (for example, accelerating the BESS resources included in the Renewable
3 Plan);
- 4 • Local capacity at the Valmy location. The RFP should specify the resource capabilities
5 needed to alleviate the must-run constraint by 2031 when the Companies' modeling
6 shows that removing the constraint would result in reduced operations of the Valmy
7 steam units;
- 8 • Flexible load resources by 2027, as described in Section VI; and
- 9 • Incremental renewable resources as soon as practicable (for example, the Companies'
10 analysis shows that renewable resources, including 952 MW of Idaho wind added in
11 2029 would be part of an optimal portfolio).

12 After the Companies receive the bids, a new capacity expansion modeling run should be
13 conducted in PLEXOS LT and presented to the Commission. This capacity expansion
14 modeling run should allow the model to select from all qualified resource bids *in parallel*
15 while reflecting their actual cost and performance characteristics. The portfolio results should
16 be presented to the Commission within six months of receiving the RFP bids through an IRP
17 amendment. This amendment should also include a procurement plan for contracting with or
18 acquiring the selected resources.

Q. WHAT DO YOU RECOMMEND WITH RESPECT TO NVE’S FUTURE IRP AND RESOURCE PROCUREMENT PROCESSES BEYOND THE NEAR-TERM RFP?

A. I recommend the Commission order the following changes to NVE’s future IRP and resource procurement processes:

- The Commission should require NVE to revise its IRP and resource procurement processes to more closely reflect the two-phase process implemented in Colorado.
- The Commission should require NVE to better identify system needs in the near-and medium-term based on more robust capacity expansion modeling in the first step of future processes.
- The Commission should require NVE to more clearly link its future RFPs to the needs identified in the first step of future processes.
- Following the RFP results, in the second step of future processes the Commission should require NVE to conduct additional capacity expansion modeling that simultaneously selects from the full range of project bids.
- For long-term resource needs, the Commission should require NVE to evaluate a more complete range of dispatchable options, including long-duration energy storage, enhanced geothermal systems, and flexible loads.

1 **VI. NVE’S SUPPLY PLAN FAILS TO SUFFICIENTLY CONSIDER FLEXIBLE**
2 **LOAD RESOURCES THAT COULD ADDRESS NEAR-TERM CAPACITY**
3 **NEEDS, RESULT IN ADDITIONAL BENEFITS, AND MITIGATE RISK**
4 **EXPOSURE.**

5 **Q. DID NVE’S IRP MODELING IN PLEXOS INCLUDE FLEXIBLE LOAD**
6 **RESOURCES?**

7 A. Yes, but there were significant limitations to what was included. United addressed this
8 issue more extensively in its testimony in Phase II of this proceeding.⁷⁰ To reiterate, NVE
9 witness Steele explained that “the Companies introduced flexible load technologies and
10 distributed resources as supply resources, rather than load modifiers” when modeling their
11 system in PLEXOS.⁷¹ However, this did not lead to any meaningful difference in the near-term
12 level of flexible load resources selected in the candidate portfolios. In effect, the amount of
13 flexible load resources appears to have been “baked in” prior to 2030. Thus, only a single level
14 of demand-side resources was meaningfully considered in the near-term. In fact, NVE confirmed
15 that these flexible load resources were “not ‘economically optimized’” and were “not modeled as
16 a candidate resource to be selected in the resource expansion analysis using PLEXOS LT.”⁷²

17 **Q. HOW DOES NVE REPRESENT FLEXIBLE LOAD RESOURCES IN ITS**
18 **SUPPLY-SIDE MODELING IN PLEXOS?**

19 A. Although it does not allow PLEXOS to adjust or optimize flexible load resources, NVE
20 does include two flexible load resource types in its model runs: AC Load Management

⁷⁰ Burgess Direct, pages 34-37.

⁷¹ Steele Direct, page 6.

⁷² See **Attachment MR-3** (Companies Response to United DR 1-09).

1 (“ACLM”) and Behind the Meter (“BTM”) Storage. My understanding is that ACLM is
2 primarily intended to reflect NVE’s demand response programs targeting smart thermostats (or
3 other controllable devices), whereas BTM Storage is intended to reflect batteries paired with
4 rooftop solar PV as well as EV managed charging.

5 **Q. IN ITS IRP MODELING, WHAT LEVEL OF FLEXIBLE LOAD RESOURCES**
6 **DOES NVE ASSUME IS ON ITS SYSTEM NOW, AND WHAT ADDITIONAL AMOUNTS**
7 **DOES IT ASSUME WOULD BE DEPLOYED OVER THE NEXT 5 YEARS AND NEXT**
8 **15 YEARS?**

9 A. Under its preferred portfolio, NVE assumed that approximately 219 MW of ACLM
10 resources would be on its system in 2025.⁷³ This is roughly consistent with the Companies’
11 targets as presented in their Demand Side Plan, and their recent achievement of over 150 MW of
12 controllable demand response resources in 2023.⁷⁴ Going forward, NVE’s preferred portfolio
13 assumes 561 MW of flexible load resources will be deployed by 2030, and 743 MW will be
14 deployed by 2040, representing an increase of about 342 MW over the next 5 years and an
15 increase of 524 MW over the next 15 years.

⁷³ See Load and Resource tables presented in ECON-5.
⁷⁴ Demand Side Plan (Volume 9).

Table 4. Flexible Load Resources (MW) Selected in NVE’s Supply-Side Plan Modeling Versus NVE-identified Economic Potential.⁷⁵

	2025	2026	2027	2030	2040
Balanced Portfolio (“VBDL1”)					
AC Load Management (“DR/DSM.ACLM”)	219	234	249	283	342
BTM Storage (“DR/DSM.BESS”)	0	52	117	278	401
Total	219	286	366	561	743
NVE-identified Economic Potential (incl. EV-MC)	307	380	446	680	1657
Difference (MW)	88	94	80	119	914
Difference (%)	40%	33%	22%	21%	123%

Q. HOW DOES THIS COMPARE TO THE POTENTIAL FOR FLEXIBLE LOAD RESOURCES THAT NVE IDENTIFIED IN NVE’S MARKET POTENTIAL STUDY?

A. It is significantly lower. For example, by 2030 NVE identified 680 MW of potential from cost-effective flexible load resources plus EV managed charging (which is also cost effective).⁷⁶ This represents a difference (*i.e.*, an underestimate) of approximately 120 MW, or about 21%. The magnitude of this underestimate becomes 914 MW by 2040, or about 123%.

Q. DO YOU THINK THAT NVE’S MARKET POTENTIAL STUDY CORRECTLY IDENTIFIED THE AMOUNT OF COST-EFFECTIVE FLEXIBLE LOAD RESOURCES THAT NVE CAN AND SHOULD ACHIEVE OVER THE NEXT 5 YEARS OR 15 YEARS?

A. No. United discusses the MPS limitations extensively in its Phase II testimony in this proceeding. Based on that analysis, I believe that NVE significantly underestimated the amount

⁷⁵ See Attachment MR-2 (Public) (Flexible Load MW Tables).

⁷⁶ See Attachment MR-2 (Public) (Flexible Load MW Tables).

1 of cost-effective flexible load resources that it could achieve in the future. Thus, the estimates for
2 economic flexible load resources potential included in the MPS likely represent a lower bound
3 for what NVE should include in its IRP modeling. However, as I mentioned above, NVE's IRP
4 modeling assumed an *even lower* amount of flexible load resources than its own MPS suggests is
5 economic.

6 **Q. BASED ON THESE OBSERVATIONS AND CONCLUSTIONS, WHAT DO YOU**
7 **RECOMMEND THE COMMISSION DO?**

8 A. 1. First and foremost, the Commission should adopt all of United's recommendations set
9 forth in its Phase II testimony. Bolstering near-term deployment of flexible load resources, as
10 United recommended in Phase II, should minimize NVE's open position and provide greater
11 assurance that NVE's reliability needs can be met. These greater levels of flexible load resources
12 can be pursued in conjunction with the near-term procurement of incremental BESS resources, as
13 recommended above. Pursuing both these strategies in parallel should afford greater assurance
14 that NVE's reliability needs will be met, even while the Companies defer their proposed
15 investments in Valmy CTs.

16 2. The Commission should order NVE to modify its PLEXOS modeling going forward to
17 include higher amounts of flexible load resources, as this would be more consistent with the
18 long-term economic potential values of these resources.

19 3. The Commission should set a longer-term demand reduction target (*e.g.*, for 2030
20 and/or 2040) that is greater than 680 MW in 2030 and greater than 1657 MW in 2040.

1 **VII. ADDITIONAL TRANSMISSION OPTIONS COULD UNLOCK**
2 **RELIABILITY, COST, AND CLEAN ENERGY BENEFITS FOR NVE.**

3 **Q. PLEASE PROVIDE A BRIEF SUMMARY OF THE COMPANIES'**
4 **TRANSMISSION PLAN.**

5 A. The Companies are continuing to develop the Greenlink Nevada Transmission project,
6 which consists of both Greenlink West and Greenlink North. Although the Greenlink
7 transmission project has experienced significant cost escalation, the Companies maintain that it
8 remains the best option to provide optimal resource options to its retail, interconnection, and
9 network customers. Therefore, the Companies request approval to construct Greenlink.

10 **Q. DO YOU AGREE THAT THE GREENLINK PROJECT WILL UNLOCK**
11 **SIGNIFICANT BENEFITS FOR THE COMPANIES AND THEIR RATEPAYERS?**

12 A. Yes. According to the Companies, the Greenlink projects “facilitate a reduced overall
13 PRM [“Planning Reserve Margin”] requirement for NV Energy, systemwide access to the
14 diverse renewable resources abundant in Nevada, and systemwide access to the benefits of
15 WRAP [“Western Resource Adequacy Program”] and a future market or RTO [“Regional
16 Transmission Organization”].”⁷⁷ In general, I agree that transmission can unlock significant
17 benefits, including increased reliability, reduced capacity needs, access to additional renewable
18 resources, and increased operational efficiency. Consequently, I support the Companies’ request
19 for approval of the Greenlink project.

⁷⁷ Supply Plan, page 295 of 393.

1 **Q. ARE THERE OTHER STRATEGIES THAT NVE COULD EMPLOY TO**
2 **ENHANCE THE TRANSMISSION CAPABILITY OF ITS SYSTEM, AND IN TURN**
3 **ENHANCE ACCESS TO NEW GENERATING RESOURCES?**

4 A. Yes. I think the Companies’ analysis could be further improved through a more thorough
5 assessment of various transmission-related strategies that could assist with either accommodating
6 new resources, minimizing costs, or both. A recent 20-year transmission planning study by
7 Energy Strategies, Connected West, focused on identifying “next generation” transmission
8 investments, targeting the identification of portfolios of new transmission expansion projects that
9 represent investment above and beyond upgrades that have been previously proposed by Western
10 utilities and developers.⁷⁸ Connected West found that to support an electrified and deeply
11 decarbonized Western grid in 2045, significant transmission expansion is required, although
12 “results indicate that a significant portion of new transmission capacity across the West can be
13 met with a blend of reconductoring existing lines, co-locating upgrades, and selective use of
14 advanced conductors, HVDC solutions, advanced transmission technologies, along with
15 continued use of traditional transmission expansion approaches.”⁷⁹

16 One set of advanced transmission technologies that should be considered along these
17 lines is frequently referred to as GETs. Some of these solutions may be able to help alleviate
18 some of the issues facing project proposals NVE received in response to its 2023 RFP that were

⁷⁸ Energy Strategies, The Connected West Study (2024), *available at* www.energystrat.com.

⁷⁹ *Id.*

transmission related. Considering these kinds of technologies in addition to other more traditional solutions would lead to a more robust and competitive resource procurement process.

Q. WHAT ARE GETS?

A. GETs include several technologies that can enhance transmission planning and operations by improving the real-time capacity of existing transmission infrastructure, helping to maximize cost-efficiency for these assets. GETs can also be deployed more rapidly relative to transmission expansion projects (*i.e.*, in a matter of months), lowering time costs associated with upgrades and providing additional near-term transmission capacity to complement long-term transmission infrastructure buildout. Some examples of GETs include:

- Advanced Power Flow Control: Technologies that push or pull power away from overloaded lines and onto underutilized corridors within the existing transmission network. This is achieved by injecting voltage in series with a facility to increase or decrease effective reactance, thereby pushing power off overloaded facilities or pulling power on to underutilized facilities.
- Dynamic Line Ratings: Adjusts thermal ratings based on actual weather conditions, including ambient temperature and wind, in conjunction with real-time monitoring of resulting line behavior.
- Topology Optimization: Automatically finds reconfiguration to re-route flow around congested or overloaded facilities while meeting reliability criteria.

By unlocking normally unused transmission capacity, these technologies can reduce production and congestion costs, as well as defer capital costs for transmission system upgrades to drive

1 significant short-term savings. Thus, utilization of GETs can potentially reduce operating costs
2 through lower production costs, as well as capital costs through deferred transmission upgrades.
3 Additionally, GETs may be able to facilitate integration of new resources. For example, a 2021
4 study by Brattle focused on the Southwest Power Pool found that, by implementing the three
5 aforementioned GETs, Kansas and Oklahoma will be able to integrate an additional 2,670 MW /
6 8,776 GWh of renewables—more than twice the amount of renewables to be integrated under a
7 scenario without GETs—while yielding \$175 million in annual production cost savings.³⁹

8 **Q. WHAT WERE THE ESTIMATED COSTS OF INSTALLING THESE GETS**
9 **MEASURES?**

10 A. Brattle estimated the costs to be \$90 million, with annual operations and maintenance
11 costs of approximately \$10 million.⁸⁰ Thus, based on operating cost savings alone, GETs
12 installed in SPP would have a very short simple payback period of approximately six months and
13 would yield continued net benefits to customers thereafter.

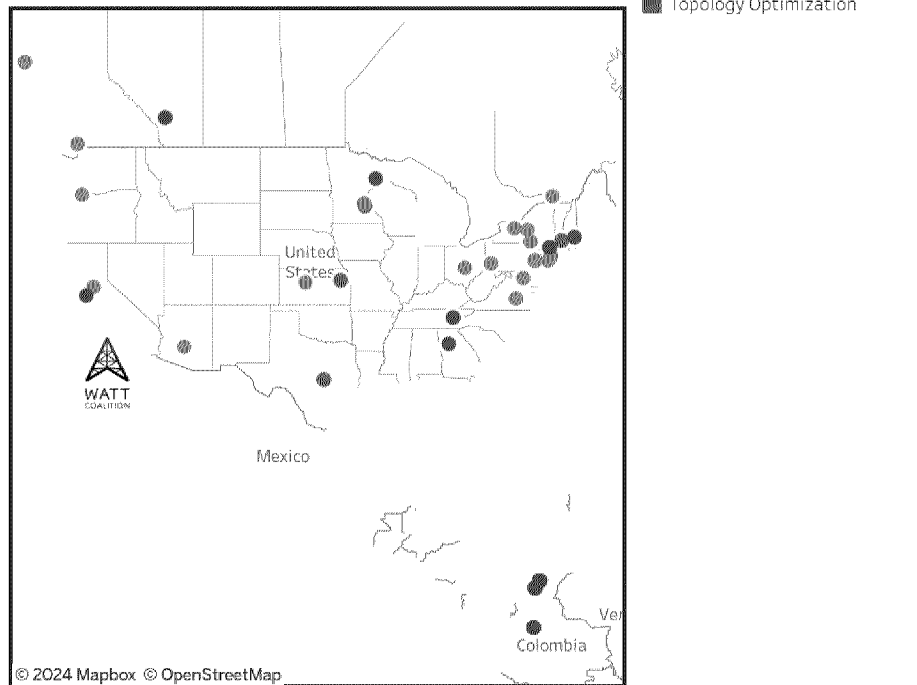
14 **Q. HAVE OTHER UTILITIES IN THE U.S. DEPLOYED GETS?**

15 A. Yes. The map below, created by the Watt Coalition, shows a high-level summary of
16 utilities that have deployed GETs in the U.S.⁸¹

⁸⁰ See https://watt-transmission.org/wp-content/uploads/2021/02/Brattle_Unlocking-the-Queue-with-Grid-Enhancing-Technologies_Final-Report_Public-Version.pdf⁹⁰.pdf.

⁸¹ WATT Coalition Global Deployments of Grid-Enhancing Technologies, *available at* <https://public.tableau.com/app/profile/abby.sherman/viz/WATTCoalitionGlobalDeploymentsofGrid-EnhancingTechnologies/Dashboard1>.

Global Deployments of Grid-Enhancing Technologies



Q. WHAT SHOULD NVE DO TO TAKE ADVANTAGE OF “NEXT GENERATION” TRANSMISSION SOLUTIONS, INCLUDING GETS, GOING FORWARD?

A. NVE should accelerate deployment solutions that maximize net benefits to its customers while helping to achieve its long-term clean energy targets. At a minimum, the Companies should conduct a robust evaluation of these solutions in a timely manner (*e.g.*, 6 months).

Q. ARE THERE ANY SPECIFIC PARAMETERS THAT SHOULD GUIDE THIS STUDY OR EVALUATION?

A. Yes. In particular, I recommend that the study should have a clearly stated objective, a sufficient time horizon in the evaluation, a specified geographic focus, and a minimum list of benefits to be evaluated. It should also include a near-term action plan for implementing solutions that are found to be beneficial. In addition to NVE, it may be prudent to identify a

1 Technical Advisory Group to help guide the study process; this group could include members
2 from the BCP, the Commission Staff, the advanced transmission solution industry, and other
3 stakeholders.

4 **Q. WHAT DO YOU RECOMMEND FOR THE STUDY'S OBJECTIVE?**

5 A. The objective should be two-fold: one objective should be to identify where on NVE's
6 transmission system deployment of GETs or other advanced transmission solutions would be
7 most effective at minimizing operating costs. The second objective should be to identify where
8 deploying these solutions would be most effective at maximizing the capacity of the existing
9 transmission system.

10 **Q. WHAT DO YOU RECOMMEND FOR THE STUDY'S TIME HORIZON AND**
11 **GEOGRAPHIC FOCUS?**

12 A. I recommend that the study look 5, 10, and 20 years out. I also recommend that the study
13 evaluate the entirety of NVE's transmission system.

14 **Q. WHAT BENEFITS DO YOU RECOMMEND THE STUDY INCLUDE IN ITS**
15 **EVALUATION?**

16 A. I recommend that the study include the following, at a minimum:

- 17 • Estimated increases in line ratings for NVE's existing transmission system.
- 18 • Estimated increases in line ratings of proposed new transmission projects.
- 19 • Estimated increases in incremental renewable resources that could be integrated, based
20 on the capacity gains realized through increased line ratings.
- 21 • Estimated reduction in operating expenses through production cost savings.

- Estimated reduction in capital costs through deferred or avoided cost of new deferred transmission upgrades.
- Reliability benefits.

VIII. CONCLUSION

Q. PLEASE SUMMARIZE YOUR RECOMMENDATIONS TO THE COMMISSION REGARDING PHASE III OF THIS PROCEEDING.

A. I recommend the following:

1. The Commission should reject the Balanced Plan as the Preferred Plan.
2. The Commission should order NVE to adopt the Renewable Plan as the Preferred Plan, with the following modifications:
 - Consistent with the Renewable Plan, NVE should procure approximately 500 MW of standalone BESS resources in lieu of the Companies' proposed CT additions at Valmy.
 - NVE should accelerate the procurement of these BESS resources from 2030 to 2028 to better address NVE's open position in 2028 and 2029.
 - As part of this BESS procurement, NVE should consider targeting the Valmy location as a means of partially or wholly reducing the must-run constraint.
3. The Commission should order NVE to issue an all-source RFP as soon as possible to procure additional resources consistent with the needs identified in the Renewable Plan and this testimony. These specific needs should include:

- Capacity resources that would reduce the Companies' open position in the 2028 timeline (for example, accelerating the BESS resources included in the Renewable Plan);
- Local capacity at the Valmy location. The RFP should specify the resource capabilities needed to partially or wholly alleviate the must-run constraint by 2031 when the Companies' modeling shows that removing the constraint would result in reduced operations of the Valmy steam units;
- Flexible load resources by 2027, as described in Section VI; and
- Incremental renewable resources as soon as practicable (the Companies' analysis shows that renewable resources, including 952 MW of Idaho wind added in 2029, would be part of an optimal portfolio).

After the Companies receive the bids, a new capacity expansion modeling run should be conducted in PLEXOS LT and presented to the Commission. This capacity expansion modeling run should allow the model to select from all qualified resource bids *in parallel* while reflecting their actual cost and performance characteristics. The portfolio results should be presented to the Commission within six months of receipt of the RFP bids through an IRP amendment. This amendment should also include a procurement plan for contracting with or acquiring the selected resources.

4. The Commission should order NVE to defer the 2028 Valmy CT additions and instead pursue the incremental near-term BESS additions contemplated in the Renewable Plan.

1 5. The Commission should direct NVE to evaluate alternative solutions to alleviating the
2 Valmy must-run constraint at a future date, including through transmission upgrades,
3 long-duration storage resource additions, interruptible load demand response, and
4 contractual arrangements with other local generators.

5 6. The Commission should order the following changes to NVE's future IRP and resource
6 procurement processes:

- 7 • The Commission should require NVE to revise its IRP and resource procurement
8 processes to more closely reflect the two-step process implemented in Colorado.
- 9 • The Commission should require NVE to better identify system needs in the near-
10 and medium-term based on more robust capacity expansion modeling in step one
11 of future processes.
- 12 • The Commission should require NVE to more clearly link its future RFPs to the
13 needs identified in step one of future processes.
- 14 • Following the RFP results, in step two of future processes the Commission should
15 require NVE to conduct additional capacity expansion modeling that
16 simultaneously selects from the full range of project bids.
- 17 • For long-term resource needs, the Commission should require NVE to evaluate a
18 more complete range of dispatchable options, including long-duration energy
19 storage, advanced geothermal systems, and flexible loads.

20 7. The Commission should adopt all of United's recommendations set forth in its Phase II
21 testimony regarding the near-term deployment of flexible load resources.

- 1 8. The Commission should order NVE to modify its PLEXOS modeling going forward to
2 include higher amounts of flexible load resources.
- 3 9. The Commission should set a longer-term demand reduction target (*e.g.*, for 2030 and/or
4 2040) that is greater than 680 MW in 2030 and greater than 1657 MW in 2040.
- 5 10. The Commission should require NVE to conduct a study (to be completed within six
6 months) of the benefits of “next generation” transmission solutions, including GETs. At a
7 minimum, the study should include the following parameters consistent with my
8 testimony in Section VII:
- 9 • A clearly stated objective that includes 1) identifying where solutions can minimize
10 operating costs, and 2) identifying where solutions can defer or avoid future
11 transmission upgrades.
 - 12 • A sufficient time horizon in the evaluation (*i.e.*, 5, 10, and 20 years into the future).
 - 13 • A specified geographic focus (*i.e.*, the entirety of NVE’s transmission system).
 - 14 • A minimum list of benefits to be evaluated, as enumerated in my testimony.
 - 15 • A near-term action plan for implementing solutions that are found to be beneficial.
 - 16 • A Technical Advisory Group to help guide the study process that would include
17 members from the BCP, the Commission Staff, the advanced transmission solution
18 industry, and other stakeholders.

19 **Q. DOES THIS CONCLUDE YOUR PREPARED DIRECT TESTIMONY?**

20 **A. Yes.**



Maria Roumpani

Partner

mroumpani@currentenergy.group

Professional Summary

Maria is an expert in energy system planning and an energy modeler. She focuses on the economic and technical analysis of grid planning and operations issues and has experience in capacity expansion optimization, production cost simulations, and energy storage dispatch modeling. Maria has submitted expert testimony and comments on integrated resource planning, plant economics, unit commitment practices, and power cost issues and her clients include consumer advocates, public interest organizations, energy project developers, government agencies, and large energy buyers.

Education

PhD, Management Science & Engineering

Stanford University, 2018

MSc, Electrical and Computer Engineering

National Technical University of Athens, 2009

Work Experience

Founding Partner, Current Energy Group, (May 2024 – Present)

- Founding partner specializing in the economic and technical analysis of grid planning and operations issues, including capacity expansion, production cost, and energy storage dispatch modeling.

Founder, ELO Engineering Consulting (March 2024 – May 2024)

- Works on energy planning and regulatory issues.

Technical Director | Strategen Consulting (2018 – March 2024)

- Led firmwide technical and economic modeling and analysis to support consulting engagements. Specialized in the use of modeling tools to inform grid planning and decarbonization issues.

Research Assistant | Precourt Institute for Energy, Stanford University (2011 – 2017)

- Conducted research in a wide range of topics, from game theoretical approaches in electricity markets to behavioral economics.

Researcher | Energy, Economics, & Environment Modeling laboratory, National Technical University of Athens, (2009-2010, 2015)

- Contributed to the development of mathematical models:
 - Capacity expansion of electricity supply
 - Wholesale electricity market competition model

Expert Testimony

- Duke Energy Carolinas and Duke Energy Progress 2023 Integrated Resource Plans, on behalf of Sierra Club, South Carolina Coastal Conservation League, Southern Alliance for Clean Energy, Upstate Forever, and Vote Solar
Public Service Commission of South Carolina,
Docket No. 2023-8-E & No. 2023-10-E, [Testimony](#)
- Biennial Consolidated Carbon Plan and Integrated Resource Plans of Duke Energy Carolinas, and Duke Energy Progress, on behalf of the Southern Alliance for Clean Energy, Sierra Club, Natural Resources Defense Council, and North Carolina Sustainable Energy Association
North Carolina Utilities Commission, Docket E-100, Sub 190, [Testimony](#)
- Biennial Consolidated Carbon Plan and Integrated Resource Plans of Duke Energy Carolinas, LLC, and Duke Energy Progress, LLC, on behalf of Southern Alliance For Clean Energy, Sierra Club, Natural Resources Defense Council, And North Carolina Sustainable Energy Association,
North Carolina Utilities Commission, Docket No. E-100, SUB 190, [Testimony](#)
- Annual Review of Base Rates for Fuel Costs of Dominion Energy South Carolina, Inc. on behalf of the South Carolina Office of Regulatory Staff,
Public Service Commission of South Carolina, Docket No 2023-2-E, [Testimony](#)
- Annual Review of Base Rates for Fuel Costs of Duke Energy Progress, LLC, on behalf of the South Carolina Office of Regulatory Staff,
Public Service Commission of South Carolina, Docket No 2023-1-E, [Testimony](#)
- Virginia Electric and Power Company 2023 IRP, on behalf of Advanced Energy United Virginia State Corporation Commission, Case No. PUR-2023-00066, [Testimony](#)
- PacifiCorp's Transition Adjustment Mechanism,
Oregon Public Utilities Commission, Docket No. UE 420, [Testimony](#)
- DTE 2022 IRP, on behalf of the Michigan Energy Innovation Business Council
Michigan Public Service Commission, Case U-21193, [Testimony](#)
- Duke Energy Carolinas and Duke Energy Progress 2022 Carbon Plan, on behalf of the Tech Customers

North Carolina Utilities Commission, Docket E-100, Sub 179, Testimony

- Public Service Company of Colorado, on behalf of Sierra Club
Colorado Public Utilities Commission, Proceeding No. 21A-0141E, Testimony

Selection of other Relevant Experience

- Assessment of Clean Energy Alternatives to New Natural Gas Resources: Duke Energy Indiana Combined Cycle Project (2023)
- Assessment of Clean Energy Alternatives to New Natural Gas Resources: Part 2 (2023)
- Alternative Resource Plan for Salt River Project's Integrated System Plan (2022)
- Analysis of Arizona Public Service's Integrated Resource Plan (2021)
- Alternative Resource Plan Analysis for Tucson Electric Power (2020)
- Long Duration Energy Storage for California's Clean Reliable Grid (2020)
- Energy Storage Alternatives for a Proposed Peaking Power Plant, Report (2021) | Additional Analysis (2022)

Testimony Table

	Nameplate Capacity (MW)			Firm Capacity (MW)		
	Balanced Plan	Renewable Plan	Difference	Balanced Plan	Renewable Plan	Difference
2025	946	946	-	946	946	-
2026	1,343	1,343	-	1,185	1,185	-
2027	1,746	1,746	-	1,502	1,502	-
2028	2,515	2,515	-	2,148	2,148	-
2029	2,573	2,573	-	2,195	2,195	-
2030	2,733	3,235	502	2,368	2,716	348
2031	3,198	3,908	710	2,721	3,050	329
2032	3,739	4,759	1,020	2,989	3,309	320
2033	3,995	5,015	1,020	3,116	3,435	319
2034	4,479	5,647	1,168	3,320	3,621	301
2035	4,509	5,677	1,168	3,340	3,639	299
2036	4,539	5,707	1,168	3,358	3,661	303
2037	4,569	5,737	1,168	3,371	3,672	301
2038	4,517	5,685	1,168	3,355	3,656	301
2039	4,844	6,120	1,276	3,455	3,774	319
2040	6,127	7,587	1,460	3,791	4,111	320
2041	6,908	8,368	1,460	3,985	4,309	324
2042	8,366	9,826	1,460	4,322	4,657	335
2043	9,390	10,850	1,460	4,563	4,896	333
2044	10,522	13,300	2,778	4,830	5,162	332
2045	11,407	16,517	5,110	5,069	5,374	305
2046	12,167	17,611	5,444	5,158	5,472	314
2047	13,439	19,277	5,838	5,265	5,595	330
2048	13,627	19,796	6,169	5,303	5,639	336
2049	14,070	20,239	6,169	5,318	5,654	336
2050	15,413	21,582	6,169	5,425	5,763	338
2030-2050	12,840	19,009	6,169	3,230	3,568	338
2045-2050	4,891	8,282	3,391	595	601	6
2031-2050	12,680	18,347	5,667	3,057	3,047	-10

Row Labels	Sum of Technical - 2025	Sum of Economic - 2025	Sum of Technical - 2026	Sum of Economic - 2026	Sum of Technical - 2027	Sum of Economic - 2027	Sum of Technical - 2030	Sum of Economic - 2030	Sum of Technical - 2040	Sum of Economic - 2040
Batteries	6,253	5,548	12,336	11,728	18,780	18,136	44,054	42,816	220,799	214,271
EVs	14,038	0	28,719	0	38,106	0	73,892	0	239,696	0
Other	30,342	0	30,645	0	31,261	0	32,856	0	38,144	25,959
Pool Pumps	7,299	7,299	14,596	14,596	21,905	21,905	29,558	29,558	37,945	37,945
Thermostats	283,785	279,595	328,843	324,617	371,998	367,736	534,131	529,759	1,132,007	1,127,249
Water Heaters	3,915	0	7,830	0	11,528	0	22,928	3,964	62,086	12,015
Grand Total	345,633	292,543	422,969	358,941	493,639	487,837	737,419	686,907	1,738,678	1,417,440
Econ DR • EVs		305,581		379,560		445,944		579,969		1,657,136

Values are in millions of dollars unless otherwise noted. All values are in thousands of dollars unless otherwise noted.

Line	Category	Description	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647
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Flex Load MW Table

	2025	2026	2027	2030	2040
Balanced Portfolio ("VBDL1")					
AC Load Management ("DR/DSM.ACLM")	219	234	249	283	342
BTM Storage ("DR/DSM.BESS")	0	52	117	278	401
Total	219	286	366	561	743
NVE-identified Economic Potential (incl. E	307	380	446	680	1657
Difference (MW)	88	94	80	119	914
Difference (%)	40%	33%	22%	21%	123%

Values copied from NVE Workpaper: "2024 IRP Economic Analysis Narrative Figures.xlsx"

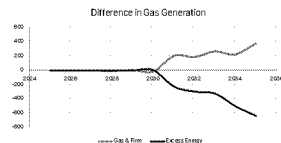
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Figure 3

Case	ChartType	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	0
Renewable Plan	Cost	446.8248	446.8248	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Renewable Plan	Gas & Firm	22591.72	22591.72	22767.67	22625.53	22068.54	19571.32	17493.22	17079.44	16860.15	16557.607	15407.606	15415.61	14200.96	12483.476	12483.079	12284.815	11415.484	10612.48	10406.96
Renewable Plan	Other	79.77501	79.77501	79.77501	79.77501	114.463	112.1157	112.1157	112.1157	112.43369	18.78007	28.78007	28.78007	28.78007	28.78007	28.78007	28.78007	28.78007	28.78007	28.78007
Renewable Plan	Gas	1990.206	1990.206	2239.522	2263.272	2574.251	2540.816	2140.805	2130.72	2074.7843	1201.6761	1200.7914	1209.7096	1202.8227	1207.5271	1215.6845	1214.5798	1217.4501	1212.41	1211.328
Renewable Plan	Hydro	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797
Renewable Plan	Wind	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154
Renewable Plan	Solar	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674	9108.674
Renewable Plan	Battery Discharge	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884	119.6884
Renewable Plan	Market Energy	130.9688	130.9688	115.7405	151.9072	523.2553	2959.614	2344.516	3712.468	4132.9714	3814.1854	3614.5255	2685.0947	4238.2752	3863.4275	3545.1021	3063.9219	4510.8968	4279.438	4050.499
Renewable Plan	Emergency Energy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Renewable Plan	Battery Charging	-125.824	-125.824	-154.79	-172.452	-189.545	-171.4	-668.827	-1901.15	-2772.263	-3263.406	-3728.707	-5484.433	-6306.827	-6128.903	-6378.18	-7286.486	-6962.481	-6214.9	-11489
Renewable Plan	Excess Energy	-28.2177	-28.2177	-15.2532	-25.5512	-41.7042	-12.4935	-174.524	-318.8	-174.3590	-471.7623	-620.2609	-363.6347	-723.3353	-698.3969	-558.1679	-1132.312	-671.7931	-2282.71	-2105.74

Case	ChartType	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	0
Renewable Plan	Cost	445.9913	445.9913	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Renewable Plan	Gas & Firm	22592.18	22592.18	22767.44	22619.9	22075.93	19559.9	17492.44	17099.16	16860.17	16557.603	14200.963	14200.963	12483.476	12483.079	12284.815	11415.484	10612.48	10406.96	
Renewable Plan	Other	79.77501	79.77501	79.77501	79.77501	114.463	112.1157	112.1157	112.1157	112.43369	18.78007	28.78007	28.78007	28.78007	28.78007	28.78007	28.78007	28.78007	28.78007	28.78007
Renewable Plan	Gas	1990.206	1990.206	2239.522	2263.272	2574.251	2540.816	2140.805	2130.72	2074.7843	1201.6761	1200.7914	1209.7096	1202.8227	1207.5271	1215.6845	1214.5798	1217.4501	1212.41	1211.328
Renewable Plan	Hydro	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797	280.7797
Renewable Plan	Wind	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154	315.3154
Renewable Plan	Solar	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684	9108.684
Renewable Plan	Battery Discharge	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879	119.6879
Renewable Plan	Market Energy	121.769	121.769	115.9711	157.961	520.4306	2963.843	2350.958	3632.058	3963.1887	3649.4155	3484.2666	2641.052	4241.8916	3817.5318	3500.8542	2815.5326	4267.8357	4706.946	4457.578
Renewable Plan	Emergency Energy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Renewable Plan	Battery Charging	-125.888	-125.888	-154.993	-172.25	-189.943	-170.279	-199.855	-553.484	-1268.474	-1483.238	-1905.388	-4153.999	-5053.411	-4974.005	-4995.71	-5684.858	-6754.996	-6122.38	-11392.2
Renewable Plan	Excess Energy	-28.2177	-28.2177	-15.2532	-25.5512	-41.7042	-12.4935	-174.524	-318.8	-174.3590	-471.7623	-620.2609	-363.6347	-723.3353	-698.3969	-558.1679	-1132.312	-671.7931	-2282.71	-2105.74

Difference	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Cost	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas & Firm	0	0	0	-6	7	-11	207	190	266	231	263	60	152	143	43	-121
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solar	0	0	0	-6	0	0	4	-10	-6	-1	-23	-42	-66	-76	-68	-29
Battery Discharge	0	0	0	0	0	4	-652	-665	-1278	-1343	-1158	-1129	-1161	-1102	-1168	-1380
Market Energy	1	1	0	0	-3	4	-64	-80	-170	35	-60	-44	13	-79	42	212
Emergency Energy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Battery Charging	0	0	0	0	0	-5	769	1138	1500	1583	1833	1310	1336	1185	1375	1602
Excess Energy	0	0	0	2	7	-225	-296	-319	-501	-638	-604	-419	-158	-294	-401	-500



Source 2024 IEP Economic Analysis Narrative Figures

Case	Chart Type	2023	2029	2033	2040	2043	2049
B&E	Coal	2051	-	-	-	-	-
B&E	Gas	0,315	0,000	0,000	0,007	0,004	0,004
B&E	Flm	-	-	-	-	0,000	0,000
B&E	Other	236	315	319	347	309	307
B&E	Hydro	145	130	130	130	135	135
B&E	Geo	422	415	204	232	232	1,235
B&E	Wind	152	1,104	2,372	4,953	4,953	4,953
B&E	Solar	3,440	5,873	9,719	10,324	15,943	16,970
B&E	PSR	-	-	1,000	1,000	1,000	1,000
B&E	BES	946	2,735	4,932	6,130	11,430	15,923
Renewable Plan	Coal	2051	-	-	-	-	-
Renewable Plan	Gas	0,315	0,000	0,000	0,007	0,004	0,004
Renewable Plan	Flm	-	-	-	-	0,000	0,000
Renewable Plan	Other	236	315	319	347	309	307
Renewable Plan	Hydro	145	130	130	130	135	135
Renewable Plan	Geo	422	415	204	232	232	1,235
Renewable Plan	Wind	152	1,104	2,372	4,953	4,953	4,953
Renewable Plan	Solar	3,440	5,872	9,719	10,324	15,943	16,970
Renewable Plan	PSR	-	-	1,000	1,000	1,000	1,000
Renewable Plan	BES	946	2,735	4,932	6,127	11,427	15,443
Low-Carbon Plan	Coal	2051	-	-	-	-	-
Low-Carbon Plan	Gas	0,315	0,079	0,079	0,237	0,434	444
Low-Carbon Plan	Flm	-	-	-	-	0,000	0,000
Low-Carbon Plan	Other	236	315	319	347	309	307
Low-Carbon Plan	Hydro	145	130	130	130	135	135
Low-Carbon Plan	Geo	422	415	204	232	232	1,235
Low-Carbon Plan	Wind	152	1,104	2,372	4,953	4,953	4,953
Low-Carbon Plan	Solar	3,440	5,872	9,719	10,324	15,943	16,970
Low-Carbon Plan	PSR	-	-	1,000	1,000	1,000	1,000
Low-Carbon Plan	BES	946	2,735	5,877	7,887	10,517	15,922
No Open Reaction	Coal	2051	-	-	-	-	-
No Open Reaction	Gas	0,315	7,435	7,435	7,083	0,230	1,200
No Open Reaction	Flm	-	-	-	-	0,000	0,000
No Open Reaction	Other	236	315	319	347	309	307
No Open Reaction	Hydro	145	130	130	130	135	135
No Open Reaction	Geo	422	415	204	232	232	1,235
No Open Reaction	Wind	152	1,104	1,374	4,953	4,953	4,953
No Open Reaction	Solar	3,440	5,872	9,719	10,324	15,943	16,970
No Open Reaction	PSR	-	-	1,000	1,000	1,000	1,000
No Open Reaction	BES	946	2,969	6,590	8,486	10,553	14,829

From L&E
RESOURCES

From L&E
RESOURCES

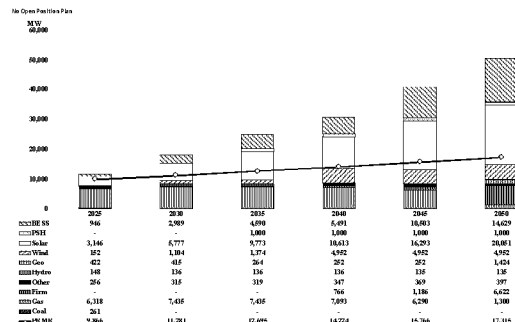
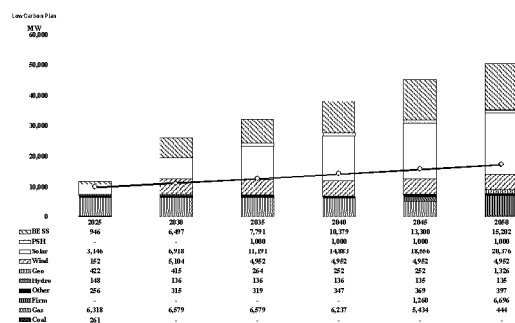
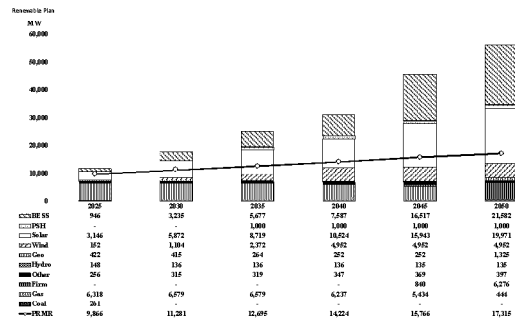
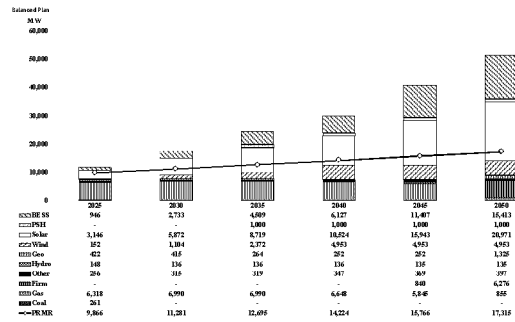
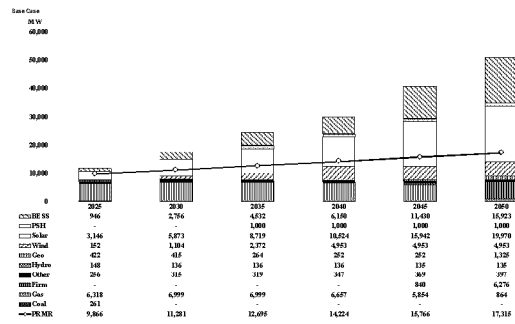
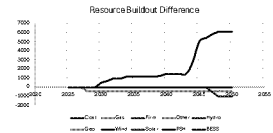


Table 1

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NV Energy

RESPONSE TO INFORMATION REQUEST

DOCKET NO:	24-05041	REQUEST DATE:	08-06-2024
REQUEST NO:	IEA 002	KEYWORD:	vol 4 p96-97 williams direct; resource combination alternative valmy CT
REQUESTER:	Harris	RESPONDER:	DeMaggio, Jonai (NV Energy)

REQUEST:

According to Kimberly Williams' testimony, NV Energy evaluated several alternative resource plans, including those with solar/storage resources (Volume 4, pages 96 and 97–100).

- a. Did NV Energy consider a resource combination or alternative resource plan that included one of the two Valmy CTs plus a solar/storage resource?
- b. Did NV Energy consider a resource combination or alternative resource plan that included only one CT at any candidate location?
- c. If the answer to subpart (a) or (b) is yes, please provide the details of this consideration, including the criteria and outcomes of such an analysis.

RESPONSE CONFIDENTIAL (yes or no): No

TOTAL NUMBER OF ATTACHMENTS: None

RESPONSE:

- a. No, NV Energy did not consider a resource combination or alternative resource plan that included only one of the two Valmy CTs plus a solar/storage resource.
- b. Assuming the question refers to proposed projects as opposed to placeholder resources, no, NV Energy did not consider a resource combination or alternative resource plan that included only one CT at any candidate location.
- c. N/A

NV Energy

RESPONSE TO INFORMATION REQUEST

DOCKET NO:	24-05041	REQUEST DATE:	08-06-2024
REQUEST NO:	IEA 007	KEYWORD:	2023 open resource RFP bids projects shortlist contract types
REQUESTER:	Harris	RESPONDER:	Spitzer, Sean (NV Energy)

REQUEST:

The summary of the IRP describes the number of bids and selected projects.

- a. How many bids were received via the 2023 Open Resource RFP?
- b. Of those, how many projects made the RFP shortlist?
- c. How many were chosen from the shortlist?
- d. List the generation technology types and MW amounts in aggregate for bids at each stage.
- e. Enumerate the number of differing contract types (BTA, PPA, Company-build) evaluated by the Company for each stage.

RESPONSE CONFIDENTIAL (yes or no): No

ATTACHMENT CONFIDENTIAL (yes or no): No

TOTAL NUMBER OF ATTACHMENTS: One (Zipped)

RESPONSE:

- a) 84 bids
- b) 28 bids
- c) 3 bids
- d) Please see the attached "24-05041 - IEA 007-Attach 01.xlsx".
- e) Please refer to the attached "24-05041 - IEA 007-Attach 01.xlsx" provided in d.

NV Energy

RESPONSE TO INFORMATION REQUEST

DOCKET NO:	24-05041	REQUEST DATE:	06-21-2024
REQUEST NO:	Staff 63	KEYWORD:	issue next open resource RP; current bilateral negotiations renewables
REQUESTER:	Olesky	RESPONDER:	Spitzer, Sean (NV Energy)

REQUEST:

Reference: RFP

Question: Please state when NV Energy plans to issue its next open resource RFP. Please state if NV Energy is currently involved in any bilateral negotiations with renewable project developers.

RESPONSE CONFIDENTIAL (yes or no): No

ATTACHMENT CONFIDENTIAL (yes or no): No

TOTAL NUMBER OF ATTACHMENTS: None

RESPONSE:

NV Energy is currently planning to issue an all source (formerly open resource) RFP in August 2024. NV Energy is not currently involved in bilateral negotiations with any renewable project developers.

NV Energy

RESPONSE TO INFORMATION REQUEST

DOCKET NO:	24-05041	REQUEST DATE:	07-01-2024
REQUEST NO:	Staff 99	KEYWORD:	open capacity position target vol 8 p217; 750MW guideline
REQUESTER:	Venkat	RESPONDER:	Runyan, Joe (NV Energy)

REQUEST:

Reference: Open Capacity Position Target

Question: Volume 8, Page 217 of 393 states that the Companies set an open capacity position target of no more than 750 MW in 2028 and every year thereafter. Please answer the following questions:

A. Please explain why the Company chose a guideline of 750 MW.

B. Did the Company consider any different guidelines for an open position? If so, what other guidelines were considered and why was 750 MW chosen?

C. In Docket No. 21-06001, the Companies chose a guideline of 2,000 MW for the open position. Please explain in detail the reason for the change from 2,000 MW in the last IRP to 750 MW in the instant filing.

RESPONSE CONFIDENTIAL (yes or no): No

ATTACHMENT CONFIDENTIAL (yes or no): No

TOTAL NUMBER OF ATTACHMENTS: None

RESPONSE:

A. The Companies chose to set an open position capacity target of no more than 750 MW starting in 2028 as stated in the narrative on page 217 of 393 and elsewhere in Volume 8 due to

Attachment MR-3: Selected Data Request Responses

ongoing concern about the uncertain availability and deliverability of market capacity and energy as well as the requirement to be resource sufficient in WRAP with the initial binding season in winter 2027-2028, which is also an expected requirement of a future regional market or RTO.

Western Markets are in considerable flux since the last IRP which has led to more uncertainty in market availability and deliverability. The testimony of Ryan Atkins, in his Q&A 11 in this filing, discusses the risk of having a large open position and points to the testimony of Nicolai Schlag. In testimony in the Fifth Amendment to the 2021 IRP (Docket No. 23-08015), Mr. Schlag discussed risks associated with maintaining a large open position as well as evidence to support the notion that the supply of capacity in western wholesale markets is growing increasingly constrained. He also discussed the extent to which other utilities in the west count on short-term market purchases to meet their needs in their resource plans and signaled intent by utilities that currently hold large open positions to reduce those positions over time. In his Q&A 17-19 in the instant docket, Mr. Schlag explains the evidence that led to his conclusion that the Companies' plans to reduce the open position were reasonable in the Fifth Amendment and states additional evidence to support this position as well as support of the Companies continued efforts to reduce its open position in this filing.

While in the 2021 IRP, a larger open position of 2,000 MW was deemed reasonable, the current market landscape and experience in recent years suggest that availability and deliverability of external market capacity and energy will be more limited and uncertain. The open positions in alternative plans in the Companies' more recent filings have been lower than the 2,000 MW target in the 2021 IRP. Open positions of the alternative plans in the Fourth and Fifth Amendments to the 2021 IRP were reduced to near or below 600 MW in the first 20 years of the plans. The open position target in this filing is consistent with recent filings.

In addition to concerns about uncertain market availability and deliverability, there is risk in relying on market purchases to meet resource sufficiency requirements in WRAP as stated on page 351 of 393 in the narrative:

"Any participant that fails the forward showing will be subject to penalties that utilize a cost of new entry charge, which is equal to the amount that it would cost to build new generation. It is important to note that market purchases may apply towards the forward showing, however, any contracts will need to satisfy strict requirements and limited market supply is available that meets the guidelines. Contracts must be in place ahead of the seven-month deadline to submit the forward showing for the binding season in order to count towards qualifying capacity for the forward showing. The contract must also include an identified source committed to the supply, provide assurance the capacity is not used for another entity's resource adequacy requirements, provide assurance the seller will not fail to deliver, and also commit that the energy will be delivered on firm transmission. Therefore, it may not always be possible for an entity to close forward showing shortfalls with contractual supply."

The Companies sent out a Request for Information ("RFI") in mid-November 2023 seeking to purchase source specific energy, consistent with WRAP requirements for qualifying capacity, for June-September 2026-2028. Response was received from three counterparties as shown below.

- Counterparty A – 85 MW firm and source specific, was ready to be executed but not cost

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competitive compared to forward pricing we were seeing

- Counterparty B – No firm price or quantity given, additional negotiation needed, indicated an openness to begin negotiations for up to 300 MW
- Counterparty C – No actual energy offered, more of a 'conversation starter' with no price or quantity given, just stating they would be interested if they could find source specific energy to sell to us

Informed by the concerns and evidence presented as well as the results of the RFI, the Companies chose to set an open position capacity target of no more than 750 MW starting in 2028.

B. Determining an open position target is not an exact science. For that reason, the Companies worked to determine a balanced approach that reduced the risk of relying too heavily on market purchases while not being overly conservative. The topic was discussed with subject matter experts within the Companies and the 750 MW target was agreed upon.

C. See response to item A.

NV Energy

RESPONSE TO INFORMATION REQUEST

DOCKET NO:	24-05041	REQUEST DATE:	09-11-2024
REQUEST NO:	United 1-09	KEYWORD:	Steele direct p6; varying levels flexible load technologies distributed resource
REQUESTER:	Kantor	RESPONDER:	Steele, Marie

REQUEST:

Reference: Steele – Direct, page 6

Question: Referring to Steele – Direct, page 6, which states: “the Companies introduced flexible load technologies and distributed resources as supply resources, rather than as load modifiers ... These resources are modeled the same in all cases and plans”:

(a) Please explain whether varying levels of “flexible load technologies and distributed resources” could be selected by PLEXOS as part of the economic optimization. If not, please explain how the level of these resources (in MW) was determined for each portfolio modeled in PLEXOS.

(b) If these resources were economically selectable in PLEXOS, please explain why the amount of DSM-ACLM resource was identical in both the VBDL1 and BDL2 scenarios.

(c) If these resources were economically selectable in PLEXOS, please explain why the amount of DSM-BESS resource was identical in both the VBDL1 and BDL2 scenarios through 2029.

RESPONSE CONFIDENTIAL (yes or no): No

TOTAL NUMBER OF ATTACHMENTS: None

RESPONSE:

- a. No, the resources were not "economically optimized." Flexible load technologies and distributed resources were not modeled as a candidate resource to be selected in the resource expansion analysis using PLEXOS LT. They were, however, modeled in all production cost analyses using PLEXOS ST for the alternative plans and at levels determined by the Integrated Energy Services group that is described in Question 11 of the direct testimony of Marie Steele.
- b. The resources were not economically selectable.
- c. The resources were not economically selectable

NV Energy

RESPONSE TO INFORMATION REQUEST

DOCKET NO:	24-05041	REQUEST DATE:	09-24-2024
REQUEST NO:	United 3-02	KEYWORD:	supply plan p17 OEM 15 percent hydrogen mixture CT capability, pinyon lateral
REQUESTER:	Kantor	RESPONDER:	Lescenski, John

REQUEST:

Reference: Supply Plan, page 17

Question: Referring to the Supply Plan, page 17, which states: "Information from the Original Equipment Manufacturer ('OEM') for this unit states that the unit is capable of operating on a 15 percent hydrogen mixture, with the OEM planning a path towards allowing the unit to operate on 100 percent hydrogen":

(a) Please explain whether the 15 percent hydrogen mixture is by volume or energy content.

(b) Please explain whether the Company has included in its analysis a cost estimate for the conversion of the unit from 15% to 100% hydrogen capable.

i. If yes, please provide the estimate and explain whether it is included in the \$573 million estimate.

ii. If not, please explain why not.

(c) Please provide the timeline during which the Company expects to convert the units to burn 100 hydrogen.

(d) Please explain whether the Pinyon natural gas lateral will be capable of delivering hydrogen and the costs associated with any necessary upgrades for it to deliver volumes for the 15% hydrogen CT capability, the 100% capability, and any other percentage mixtures the Company has evaluated.

(e) Please explain whether the Company's analysis has evaluated how the hydrogen will be produced. If the hydrogen is assumed to be green hydrogen, please explain whether the availability and cost of the necessary renewable resources has been incorporated in the Company's analysis.

RESPONSE CONFIDENTIAL (yes or no): No

TOTAL NUMBER OF ATTACHMENTS: None

RESPONSE:

(a) The 15 percent is by volume (See the manufacturers website for more information - <https://www.gevernova.com/gas-power/future-of-energy/hydrogen-fueled-gas-turbines>)

(b) The Company did not include the cost to upgrade to 100 percent in its cost estimate. The conversion could be completed through normal parts replacement (i.e., burners) in a future outage when a hydrogen fuel source is available.

(c) The Company does not have a timeline for conversion to hydrogen. The Company is not developing a hydrogen fuel source.

(d) The Pinon natural gas lateral is currently designed to deliver natural gas to the site. The Company is not involved in the design and is not aware of design considerations to deliver a hydrogen mixture, or associated costs

(e) The Company's analysis did not evaluate how the future hydrogen would be produced. The economic analysis for the Valmy Simple Cycle Units is based on natural gas operation. The ability of the units to operate on hydrogen is a secondary benefit, not included in the economic analysis. The Company continues to monitor developments in hydrogen as a fuel source and could further investigate hydrogen fueling of its generating units as the market develops.

NV Energy

RESPONSE TO INFORMATION REQUEST

DOCKET NO:	24-05041	REQUEST DATE:	09-24-2024
REQUEST NO:	United 3-06	KEYWORD:	evaluate other resource type than CTs eliminate must-run requirement, cost emiss
REQUESTER:	Kantor	RESPONDER:	Williams, Kimberly

REQUEST:

Reference: Supply Plan, page 235

Question: Referring to the Supply Plan, page 235, which states: "Of all the siting options studied for the addition of two CTs, only the Valmy location has the benefit of eliminating the existing Valmy steamer must-run requirement as described in the Transmission Section of the narrative":

(a) Please explain whether the Company evaluated any other resource types (other than CTs) for the elimination of the must-run requirement. If not, why not?

(b) Please explain why and how the construction of the CTs will eliminate the must-run requirement.

(c) Please explain whether the Company has estimated the costs and emission savings from eliminating the must-run requirement. If so, please provide these estimates and all supporting analyses/workpapers. If not, why not?

RESPONSE CONFIDENTIAL (yes or no): No

TOTAL NUMBER OF ATTACHMENTS: None

RESPONSE:

a) No other resource types were evaluated for the elimination of the Valmy must-run requirement. See the description of the Valmy must-run requirement on page 177 of 393 in Volume 8 and response to data request AEU 1-08. Only the presence of resources near the Carlin Trend load pocket that are able to rapidly ramp up generation to reduce system imports

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following certain contingencies, as described in response to AEU 1-08, will allow the termination of the Valmy must-run requirement as it is currently known. Clearly, these resources must be able to respond to these contingencies whenever they may occur and therefore variable resources and/or storage are not considered to be viable options to allow the Valmy must-run requirement to be removed.

b) See response to item a above and data request United 1-08.

c) See response to data request United 1-08 item b.

NV Energy

RESPONSE TO INFORMATION REQUEST

DOCKET NO:	24-05041	REQUEST DATE:	08-19-2024
REQUEST NO:	WRA 6-02	KEYWORD:	Hydrogen blending proposed facility, potential costs benefits risks
REQUESTER:	Holman	RESPONDER:	Lescenski, John

REQUEST:

Reference: Hydrogen Blending

Question: Please answer the following questions:

1. What is NV Energy's plan, if any, to source and blend hydrogen for the proposed facility?
2. What are the potential costs, benefits, and risks associated with potential hydrogen blending at the proposed facility?

RESPONSE CONFIDENTIAL (yes or no): No

TOTAL NUMBER OF ATTACHMENTS: None

RESPONSE:

1. NV Energy does not currently have a plan to source and blend hydrogen at the Valmy Generating Station.
2. Since hydrogen manufacturing and supply is not available in Nevada at the scale necessary for the operation of these units at this time, NV Energy cannot make plans or develop costs and benefits for a hydrogen fuel supply at this time. NV Energy continues to follow developments in the hydrogen fuel industry and will develop and plan in the future when it is prudent to pursue hydrogen supply at the Valmy Generating Station.

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NV Energy noted in the Supply Side Narrative of this filing that the Valmy Simple Cycle Units proposed for the project would be capable of operation on a 15 percent blend of hydrogen and that the equipment manufacturer is pursuing a path to the units being capable of operation on 100 percent hydrogen when that option is available.

NV Energy

RESPONSE TO INFORMATION REQUEST

DOCKET NO:	24-05041	REQUEST DATE:	08-19-2024
REQUEST NO:	WRA 6-05	KEYWORD:	PLEXOS LT ST firm capacity geothermal operational profiles ELCC values
REQUESTER:	Holman	RESPONDER:	Wasiuta, Matthew (NV Energy)

REQUEST:

Reference: Firm Capacity of Geothermal

Question: Please provide and answer the following:

1. The operational profiles for geothermal used for the development of ELCC values and used for candidate resource assessment in PLEXOS LT and PLEXOS ST.
2. Are all values used intended to reflect historical performance of the existing geothermal fleet? Are modifications made to represent performance of future resources?

RESPONSE CONFIDENTIAL (yes or no): No

ATTACHMENT CONFIDENTIAL (yes or no): No

TOTAL NUMBER OF ATTACHMENTS: One (Zipped)

RESPONSE:

1. Please see the attached Excel file "24-05041 WRA 6-05 – Attach 01".
2. Yes. No modifications were made to represent performance of future resources.

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Month	Day	Period	Value	Units are in %
1	1	1	68.289	
1	1	2	68.408	
1	1	3	68.534	
1	1	4	68.583	
1	1	5	68.612	
1	1	6	68.664	
1	1	7	68.648	
1	1	8	68.792	
1	1	9	67.993	
1	1	10	66.971	
1	1	11	66.376	
1	1	12	65.411	
1	1	13	64.857	
1	1	14	64.449	
1	1	15	63.94	
1	1	16	63.786	
1	1	17	64.325	
1	1	18	64.979	
1	1	19	65.755	
1	1	20	66.615	
1	1	21	67.354	
1	1	22	67.535	
1	1	23	67.784	
1	1	24	67.989	
1	2	1	68.289	
1	2	2	68.408	
1	2	3	68.534	
1	2	4	68.583	
1	2	5	68.612	
1	2	6	68.664	
1	2	7	68.648	
1	2	8	68.792	
1	2	9	67.993	
1	2	10	66.971	
1	2	11	66.376	
1	2	12	65.411	
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1	2	17	64.325	
1	2	18	64.979	
1	2	19	65.755	
1	2	20	66.615	
1	2	21	67.354	
1	2	22	67.535	
1	2	23	67.784	
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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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2	1	7	67.183
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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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2	13	3	67.45
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2	13	5	67.358
2	13	6	67.354
2	13	7	67.183
2	13	8	66.361
2	13	9	65.676
2	13	10	65.032
2	13	11	64.449
2	13	12	64.064
2	13	13	63.562
2	13	14	63.204
2	13	15	62.876
2	13	16	63.935
2	13	17	64.586
2	13	18	65.59
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2	13	21	66.919
2	13	22	67.011
2	13	23	67.35

Attachment MR-3: Selected Data Request Responses

2	13	24	67.306
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2	14	3	67.45
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2	14	5	67.358
2	14	6	67.354
2	14	7	67.183
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2	14	14	63.204
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2	15	23	67.35
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2	16	7	67.183
2	16	8	66.361
2	16	9	65.676
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2	17	9	65.676
2	17	10	65.032
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2	17	13	63.562
2	17	14	63.204
2	17	15	62.876

Attachment MR-3: Selected Data Request Responses

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2	17	18	65.59
2	17	19	66.197
2	17	20	66.619
2	17	21	66.919
2	17	22	67.011
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2	18	7	67.183
2	18	8	66.361
2	18	9	65.676
2	18	10	65.032
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2	21	1	67.189
2	21	2	67.223
2	21	3	67.45
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2	21	5	67.358
2	21	6	67.354
2	21	7	67.183

Attachment MR-3: Selected Data Request Responses

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2	21	10	65.032
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2	21	13	63.562
2	21	14	63.204
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2	22	7	67.183
2	22	8	66.361
2	22	9	65.676
2	22	10	65.032
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2	22	12	64.064
2	22	13	63.562
2	22	14	63.204
2	22	15	62.876
2	22	16	63.935
2	22	17	64.586
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2	23	7	67.183
2	23	8	66.361
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2	23	10	65.032
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2	23	14	63.204
2	23	15	62.876
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2	24	4	67.487
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2	24	15	62.876
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2	24	18	65.59
2	24	19	66.197
2	24	20	66.619
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2	24	22	67.011
2	24	23	67.35

Attachment MR-3: Selected Data Request Responses

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2	25	2	67.223
2	25	3	67.45
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2	25	5	67.358
2	25	6	67.354
2	25	7	67.183
2	25	8	66.361
2	25	9	65.676
2	25	10	65.032
2	25	11	64.449
2	25	12	64.064
2	25	13	63.562
2	25	14	63.204
2	25	15	62.876
2	25	16	63.935
2	25	17	64.586
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2	25	19	66.197
2	25	20	66.619
2	25	21	66.919
2	25	22	67.011
2	25	23	67.35
2	25	24	67.306
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2	26	7	67.183
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2	26	9	65.676
2	26	10	65.032
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2	26	14	63.204
2	26	15	62.876
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2	26	21	66.919
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2	26	23	67.35
2	26	24	67.306
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2	27	7	67.183
2	27	8	66.361
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2	27	10	65.032
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2	28	9	65.676
2	28	10	65.032
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2	28	13	63.562
2	28	14	63.204
2	28	15	62.876

Attachment MR-3: Selected Data Request Responses

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2	28	18	65.59
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2	28	20	66.619
2	28	21	66.919
2	28	22	67.011
2	28	23	67.35
2	28	24	67.306
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3	1	2	66.901
3	1	3	64.942
3	1	4	66.886
3	1	5	67.283
3	1	6	67.489
3	1	7	67.706
3	1	8	67.768
3	1	9	67.13
3	1	10	66.067
3	1	11	64.793
3	1	12	63.849
3	1	13	62.933
3	1	14	62.206
3	1	15	61.704
3	1	16	61.442
3	1	17	61.634
3	1	18	62.2
3	1	19	62.678
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3	1	21	64.371
3	1	22	64.939
3	1	23	65.572
3	1	24	66.124
3	2	1	66.687
3	2	2	66.901
3	2	3	64.942
3	2	4	66.886
3	2	5	67.283
3	2	6	67.489
3	2	7	67.706
3	2	8	67.768
3	2	9	67.13
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3	2	11	64.793
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3	2	14	62.206
3	2	15	61.704
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3	2	21	64.371
3	2	22	64.939
3	2	23	65.572
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3	3	1	66.687
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3	3	6	67.489
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3	3	15	61.704
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3	4	1	66.687
3	4	2	66.901
3	4	3	64.942
3	4	4	66.886
3	4	5	67.283
3	4	6	67.489
3	4	7	67.706

Attachment MR-3: Selected Data Request Responses

3	4	8	67.768
3	4	9	67.13
3	4	10	66.067
3	4	11	64.793
3	4	12	63.849
3	4	13	62.933
3	4	14	62.206
3	4	15	61.704
3	4	16	61.442
3	4	17	61.634
3	4	18	62.2
3	4	19	62.678
3	4	20	63.651
3	4	21	64.371
3	4	22	64.939
3	4	23	65.572
3	4	24	66.124
3	5	1	66.687
3	5	2	66.901
3	5	3	64.942
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3	5	6	67.489
3	5	7	67.706
3	5	8	67.768
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3	5	11	64.793
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3	5	14	62.206
3	5	15	61.704
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3	5	21	64.371
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3	6	1	66.687
3	6	2	66.901
3	6	3	64.942
3	6	4	66.886
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3	6	6	67.489
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3	6	8	67.768
3	6	9	67.13
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3	6	13	62.933
3	6	14	62.206
3	6	15	61.704
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3	7	17	61.634
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3	7	23	65.572

Attachment MR-3: Selected Data Request Responses

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3	8	2	66.901
3	8	3	64.942
3	8	4	66.886
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Attachment MR-3: Selected Data Request Responses

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3	15	6	67.489
3	15	7	67.706

Attachment MR-3: Selected Data Request Responses

3	15	8	67.768
3	15	9	67.13
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3	15	11	64.793
3	15	12	63.849
3	15	13	62.933
3	15	14	62.206
3	15	15	61.704
3	15	16	61.442
3	15	17	61.634
3	15	18	62.2
3	15	19	62.678
3	15	20	63.651
3	15	21	64.371
3	15	22	64.939
3	15	23	65.572
3	15	24	66.124
3	16	1	66.687
3	16	2	66.901
3	16	3	64.942
3	16	4	66.886
3	16	5	67.283
3	16	6	67.489
3	16	7	67.706
3	16	8	67.768
3	16	9	67.13
3	16	10	66.067
3	16	11	64.793
3	16	12	63.849
3	16	13	62.933
3	16	14	62.206
3	16	15	61.704
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3	16	18	62.2
3	16	19	62.678
3	16	20	63.651
3	16	21	64.371
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3	17	13	62.933
3	17	14	62.206
3	17	15	61.704
3	17	16	61.442
3	17	17	61.634
3	17	18	62.2
3	17	19	62.678
3	17	20	63.651
3	17	21	64.371
3	17	22	64.939
3	17	23	65.572
3	17	24	66.124
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3	18	3	64.942
3	18	4	66.886
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3	18	6	67.489
3	18	7	67.706
3	18	8	67.768
3	18	9	67.13
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3	18	13	62.933
3	18	14	62.206
3	18	15	61.704
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3	18	17	61.634
3	18	18	62.2
3	18	19	62.678
3	18	20	63.651
3	18	21	64.371
3	18	22	64.939
3	18	23	65.572

Attachment MR-3: Selected Data Request Responses

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3	19	2	66.901
3	19	3	64.942
3	19	4	66.886
3	19	5	67.283
3	19	6	67.489
3	19	7	67.706
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3	19	21	64.371
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3	20	21	64.371
3	20	22	64.939
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3	21	3	64.942
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3	21	6	67.489
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3	21	24	66.124
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3	22	4	66.886
3	22	5	67.283
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3	22	9	67.13
3	22	10	66.067
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3	22	12	63.849
3	22	13	62.933
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3	22	15	61.704

Attachment MR-3: Selected Data Request Responses

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3	22	19	62.678
3	22	20	63.651
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3	22	22	64.939
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3	22	24	66.124
3	23	1	66.687
3	23	2	66.901
3	23	3	64.942
3	23	4	66.886
3	23	5	67.283
3	23	6	67.489
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3	23	8	67.768
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3	23	14	62.206
3	23	15	61.704
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3	24	21	64.371
3	24	22	64.939
3	24	23	65.572
3	24	24	66.124
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Attachment MR-3: Selected Data Request Responses

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3	26	14	62.206
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3	26	21	64.371
3	26	22	64.939
3	26	23	65.572
3	26	24	66.124
3	27	1	66.687
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3	27	3	64.942
3	27	4	66.886
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3	27	6	67.489
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3	27	15	61.704
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3	27	21	64.371
3	27	22	64.939
3	27	23	65.572
3	27	24	66.124
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3	28	2	66.901
3	28	3	64.942
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3	29	14	62.206
3	29	15	61.704
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3	29	17	61.634
3	29	18	62.2
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3	29	20	63.651
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3	29	22	64.939
3	29	23	65.572

Attachment MR-3: Selected Data Request Responses

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3	30	3	64.942
3	30	4	66.886
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3	30	7	67.706
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3	30	9	67.13
3	30	10	66.067
3	30	11	64.793
3	30	12	63.849
3	30	13	62.933
3	30	14	62.206
3	30	15	61.704
3	30	16	61.442
3	30	17	61.634
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3	30	21	64.371
3	30	22	64.939
3	30	23	65.572
3	30	24	66.124
3	31	1	66.687
3	31	2	66.901
3	31	3	64.942
3	31	4	66.886
3	31	5	67.283
3	31	6	67.489
3	31	7	67.706
3	31	8	67.768
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3	31	11	64.793
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3	31	17	61.634
3	31	18	62.2
3	31	19	62.678
3	31	20	63.651
3	31	21	64.371
3	31	22	64.939
3	31	23	65.572
3	31	24	66.124
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4	1	4	62.582
4	1	5	62.92
4	1	6	62.915
4	1	7	61.833
4	1	8	60.068
4	1	9	58.559
4	1	10	57.195
4	1	11	55.942
4	1	12	54.894
4	1	13	54.161
4	1	14	53.521
4	1	15	53.116
4	1	16	53.32
4	1	17	53.62
4	1	18	54.403
4	1	19	55.728
4	1	20	57.189
4	1	21	58.403
4	1	22	59.179
4	1	23	60.155
4	1	24	60.792
4	2	1	61.262
4	2	2	61.736
4	2	3	62.096
4	2	4	62.582
4	2	5	62.92
4	2	6	62.915
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4	2	8	60.068
4	2	9	58.559
4	2	10	57.195
4	2	11	55.942
4	2	12	54.894
4	2	13	54.161
4	2	14	53.521
4	2	15	53.116

Attachment MR-3: Selected Data Request Responses

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4	2	18	54.403
4	2	19	55.728
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4	2	21	58.403
4	2	22	59.179
4	2	23	60.155
4	2	24	60.792
4	3	1	61.262
4	3	2	61.736
4	3	3	62.096
4	3	4	62.582
4	3	5	62.92
4	3	6	62.915
4	3	7	61.833
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4	3	10	57.195
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4	3	12	54.894
4	3	13	54.161
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4	3	17	53.62
4	3	18	54.403
4	3	19	55.728
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4	3	21	58.403
4	3	22	59.179
4	3	23	60.155
4	3	24	60.792
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4	4	5	62.92
4	4	6	62.915
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4	4	10	57.195
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4	4	13	54.161
4	4	14	53.521
4	4	15	53.116
4	4	16	53.32
4	4	17	53.62
4	4	18	54.403
4	4	19	55.728
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4	4	21	58.403
4	4	22	59.179
4	4	23	60.155
4	4	24	60.792
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4	5	10	57.195
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4	5	12	54.894
4	5	13	54.161
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4	5	15	53.116
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4	5	18	54.403
4	5	19	55.728
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4	5	21	58.403
4	5	22	59.179
4	5	23	60.155
4	5	24	60.792
4	6	1	61.262
4	6	2	61.736
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4	6	5	62.92
4	6	6	62.915
4	6	7	61.833

Attachment MR-3: Selected Data Request Responses

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4	6	10	57.195
4	6	11	55.942
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4	6	13	54.161
4	6	14	53.521
4	6	15	53.116
4	6	16	53.32
4	6	17	53.62
4	6	18	54.403
4	6	19	55.728
4	6	20	57.189
4	6	21	58.403
4	6	22	59.179
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4	7	5	62.92
4	7	6	62.915
4	7	7	61.833
4	7	8	60.068
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4	7	13	54.161
4	7	14	53.521
4	7	15	53.116
4	7	16	53.32
4	7	17	53.62
4	7	18	54.403
4	7	19	55.728
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4	7	21	58.403
4	7	22	59.179
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4	7	24	60.792
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4	8	5	62.92
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4	8	16	53.32
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4	8	18	54.403
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4	9	14	53.521
4	9	15	53.116
4	9	16	53.32
4	9	17	53.62
4	9	18	54.403
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4	9	22	59.179
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Attachment MR-3: Selected Data Request Responses

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4	10	3	62.096
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4	10	6	62.915
4	10	7	61.833
4	10	8	60.068
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4	10	24	60.792
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4	13	15	53.116

Attachment MR-3: Selected Data Request Responses

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4	13	18	54.403
4	13	19	55.728
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4	13	22	59.179
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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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7	14	16	39.815
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7	14	18	39.912
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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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8	1	9	47.305
8	1	10	45.256
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8	1	12	42.271
8	1	13	41.118
8	1	14	40.441
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Attachment MR-3: Selected Data Request Responses

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8	1	22	46.585
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8	2	3	52.265
8	2	4	53.053
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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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11	1	13	58.221
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11	1	16	57.708
11	1	17	58.745
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11	1	22	63.271
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11	1	24	63.926
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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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11	12	10	61.816
11	12	11	60.406
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11	12	13	58.221
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Attachment MR-3: Selected Data Request Responses

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11	19	10	61.816
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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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11	24	8	64.887
11	24	9	63.467
11	24	10	61.816
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Attachment MR-3: Selected Data Request Responses

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11	27	24	63.926
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11	28	2	64.492
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11	28	5	64.753
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11	28	8	64.887
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11	28	10	61.816
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11	29	21	62.762
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11	30	10	61.816
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Attachment MR-3: Selected Data Request Responses

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11	30	20	61.99
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11	30	24	63.926
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12	1	3	65.469
12	1	4	65.597
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12	1	6	65.664
12	1	7	65.593
12	1	8	65.578
12	1	9	65.171
12	1	10	64.533
12	1	11	64.1
12	1	12	63.392
12	1	13	62.92
12	1	14	62.618
12	1	15	62.541
12	1	16	62.801
12	1	17	63.257
12	1	18	63.744
12	1	19	64.248
12	1	20	64.705
12	1	21	64.768
12	1	22	64.862
12	1	23	65.068
12	1	24	65.145
12	2	1	65.422
12	2	2	65.599
12	2	3	65.469
12	2	4	65.597
12	2	5	65.708
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12	2	9	65.171
12	2	10	64.533
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12	2	14	62.618
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12	2	16	62.801
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12	2	20	64.705
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12	2	23	65.068
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12	3	9	65.171
12	3	10	64.533
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12	3	13	62.92
12	3	14	62.618
12	3	15	62.541
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12	4	2	65.599
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12	4	5	65.708
12	4	6	65.664
12	4	7	65.593

Attachment MR-3: Selected Data Request Responses

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12	4	11	64.1
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12	4	13	62.92
12	4	14	62.618
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12	4	23	65.068
12	4	24	65.145
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12	5	7	65.593
12	5	8	65.578
12	5	9	65.171
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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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Attachment MR-3: Selected Data Request Responses

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12	31	20	64.705
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AFFIRMATION

Pursuant to the requirements of NRS 53.045 and NAC 703.710, I, Maria Roumpani, hereby affirm that I am the person identified in the foregoing prepared testimony and/or exhibits; that such testimony and/or exhibits were prepared by me or under my direction; that the answers and/or information appearing therein are true to the best of my knowledge and belief; and that if asked the questions appearing therein, my answers thereto would, under oath, be the same.

I declare under penalty of perjury under the law of the State of Nevada that the foregoing is true and correct.

Date: October 18, 2024

/s/ Maria Roumpani
Maria Roumpani

CERTIFICATE OF SERVICE

I hereby certify that on the 18th day of October 2024, I caused the foregoing Prepared Direct Testimony of Maria Roumpani, PhD on behalf of Advanced Energy United to be sent via e-mail to the following:

NV Energy

aaron.schaar@nvenergy.com
jfedinec@nvenergy.com
Sandra.blain@nvenergy.com
Timothy.clausen@nvenergy.com
roman.borisov@nvenergy.com
regulatory@nvenergy.com

Staff Counsel Division
Public Utilities Commission of Nevada

pucn.sc@puc.nv.gov
dlomoljo@puc.nv.gov

Attorney General's Office
Bureau of Consumer Protection

bcpserve@ag.nv.gov
ajwalsh@ag.nv.gov
msaunders@ag.nv.gov
mbadorine@ag.nv.gov

Advanced Energy United

bturner@advancedenergyunited.org
sdunbar@keyesfox.com
jkantor@keyesfox.com
shallstrom@advancedenergyunited.org

Google LLC

ezuckerman@google.com
jcaviglia@parsonsbehle.com
rshaffer@parsonsbehle.com
Carolyn.berry@bateswhite.com

Nevada Workers

nathan@rrvlawyers.com
hls5@ibew1245.com
nring@stranchlaw.com

Sierra Club

Maddie.lipscomb@sierraclub.org
Nihal.shrinath@sierraclub.org
Patrick.woolsey@sierraclub.org
Joe.halso@sierraclub.org

Western Resources Advocates

Emily.walsh@westernresources.org
George.cavros@westernresources.org
Hunter.holman@westernresources.org
rnichols@westernresources.org

Vote Solar	claudine@votesolar.org dbender@earthjustice.org rick@votesolar.org
Western Power Association	dlc@dvclaw.com maw@dvclaw.com rds@dvclaw.com
Caesars Enterprise Services LLC	jruskowitz@caesars.com lkgranier@hollandhart.com
Clark County	Catherine.jorgenson@clarkcountyda.com mhenson@clarkcountynv.gov
Interstate Renewable Energy Council	mari@irecusa.org kmilks@kcnvlaw.com sgoldman@smwlaw.com yzakai@smwlaw.com
Interwest Energy Alliance	dah@dvclaw.com rikki@interwest.org sam@interwest.org
Las Vegas Convention and Visitors	cdavis@mcdonaldcarano.com lfoletta@mcdonaldcarano.com
MGM Resorts International	hshields@mgmresorts.com lkgranier@hollandhart.com
Microsoft Corporation	hsaltman@microsoft.com jeffriles@microsoft.com jordanw@microsoft.com kpeterston@allisonmackenzie.com kloehr@perkinscoie.com waldok@microsoft.com
Mt. Wheeler Power, Inc.	katie@kmlawnv.com kevinr@mwpower.org info@kmlawnv.com
Nevada Resort Association	lkgranier@hollandhart.com valentine@nevadaresorts.org
Nevada Rural Electric Association	apongracz@sklar-law.com cmturner@nrea.coop

	<u>mfox@sklar-law.com</u>
Smart Energy Alliance	<u>crl@dvclaw.com</u>
Tract Management Company	<u>Dennis.bartlett@tract.com</u> <u>legal@tract.com</u> <u>rds@dvclaw.com</u>
Amanda Sanchez	<u>alsanchez@hollandhart.com</u>
Carolyn Tanner	<u>lina@tannerlnv.com</u>
Collin Thomas	<u>collin@tripleoakpower.com</u>
Joanne Bradley	<u>jbradley@lspower.com</u>
Southwestern Energy Efficiency Project	<u>jbrant@swenergy.org</u> <u>cgatchalian@swenergy.org</u> <u>c.mixson@kempjones.com</u> <u>ralatorre@swenergy.org</u> <u>tmadsen@swenergy.org</u> <u>vmandell@comcast.net</u>
Lisa Hickey	<u>lisa@interwest.org</u>
Robbin Palmer	<u>rpalmer@nnps.reno.nv.us</u>
Wil Gehl	<u>wgehl@seia.org</u>
Andrea Black	<u>ablack@ormat.com</u>
Elizabeth Helms	<u>ehelms@ormat.com</u>
Micki Arguello	<u>marguello@ormat.com</u> <u>ljacobsen@ormat.com</u>
Christopher Cox	<u>Christopher.cox@telos.energy.com</u>
Derek Stenclik	<u>Derek.stenclik@telos.energy.com</u>
Elysia Vannoy	<u>Elysia.vannoy@renewhome.com</u>

/s/ Blake Elder
 Blake Elder
 Keyes & Fox LLP
belder@keyesfox.com