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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	
	)	
CALVERT CLIFFS 3 NUCLEAR PROJECT, LLC AND UNISTAR NUCLEAR OPERATING SERVICES, LLC	)	Docket No. 52-016-COL
	)	
(Calvert Cliffs Nuclear Power Plant, Unit 3)	)	

REBUTTAL TESTIMONY OF UNISTAR WITNESSES DIMITRI LUTCHENKOV, STEFANO RATTI, AND SEPTIMUS VAN DER LINDEN

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I. INTRODUCTION

Q1. Please state your full name.

A1. My name is Dimitri Lutchenkov ("DL").

My name is Stefano Ratti ("SR").

My name is Septimus van der Linden ("SVDL")

Q2. Have you previously presented testimony in this proceeding?

A2. (DL, SR, SVDL) Yes. We provided testimony to support UniStar's position on October 21, 2011. Specifically, we sponsored those statements that were marked with our initials. In addition, our professional qualifications were included in that filing.

Q3. Have you reviewed the Intervenors' testimony and NRC Staff's statement of position and testimony?

A3. (DL, SR, SVDL) Yes, we have reviewed the Intervenors' testimony and exhibits that were filed on October 28th as well as the NRC Staff's testimony and exhibits that were filed on October 21st.

Q4. Please describe the purpose of your Rebuttal Testimony.

A4. (DL, SR, SVDL) The purpose of our Rebuttal Testimony is to respond to statements made in Exh. JNT000001, entitled "Testimony of Scott Sklar, President of the Stella Group, Ltd., on Contention 10," dated October 28, 2011, the "NRC Staff's Initial Statement of Position," dated October 21, 2011 ("NRC Staff Position Statement"), and "Prefiled Direct Testimony of Andrew J. Kugler and Katherine A. Cort Concerning Environmental Contention 10C," dated October 21, 2011 (Exh. NRC000004) ("NRC Staff Testimony").

II. OVERVIEW

Q5. Please summarize the conclusions in your initial testimony regarding Contention 10C.

A5. (SR) In my initial testimony, I concluded that, on balance, assuming that the addition of a storage technology was technically and economically feasible, it is plausible, but unlikely, that 100 MW(e) of "baseload" wind energy could be available in Maryland in the next 10 years. I therefore concluded that the use of 100 MW(e) of wind energy in the FEIS is reasonable.

In addition, I concluded that installation of the equivalent of 75 MW(e) "baseload" solar (assuming that energy storage is technically and economically feasible) is plausible and therefore reasonable. I therefore concluded that the use of 75 MW(e) of solar energy in the FEIS is reasonable.

(SVDL) In my initial testimony, I concluded that, assuming that sufficient wind energy over and above 100 MW can be delivered on a continuous basis such that another 100 MW could be stored for use in a CAES plant, it is technologically plausible to create 100 MW of "baseload" wind power. Similarly, I concluded that, assuming that enough solar energy can be delivered on a continuous basis such that sufficient energy can be stored, it is technologically plausible to create 75 MW of "baseload" solar power. However, I also concluded that, given the current state of CAES development and the lack of any known storage resources in Maryland, such volumes of storage are not reasonably foreseeable. Thus, I concluded that the FEIS combination of energy alternatives is speculative, at least to the extent that it relies on the availability of CAES.

(DL) In my initial testimony, I agreed with the NRC Staff's conclusions in the FEIS. I concluded that the combination of energy alternatives considered in the FEIS is reasonable based on evaluations of technologically and economically achievable generation technologies in the region of interest. Based on the assessment of the environmental impacts of a range of reasonable energy alternatives, I concluded that combinations involving wind and solar power with storage, supplemented with natural gas, are not environmentally preferable to Calvert Cliffs 3 — even considering the potential for significant increases in the contributions of wind and solar. Finally, I explained that any dispute over the specific mix of wind or solar used in the combination of alternatives is not one that would affect the outcome of the NEPA analysis.

Q6. Have you reviewed the NRC Staff Testimony and the exhibits cited in that testimony?

A6. (DL, SR, SVDL) Yes, we have reviewed the NRC Staff testimony and the exhibits.

Q7. What is your general reaction to the NRC Staff Testimony?

A7. (DL, SR, SVDL) Overall, we agree with the testimony of Mr. Kugler and Ms. Cort. The methodologies, assumptions, and results in the NRC Staff testimony are generally in agreement with those in the UniStar testimony. The NRC Staff used a slightly different approach to estimating the relative contribution of renewable energy sources (mostly DOE/EIA projections, adjusted for Maryland), but reached the same result as the methodology employed in the UniStar testimony. These independent lines of analysis demonstrate the robustness of the FEIS conclusions.

Q8. Have you reviewed the Intervenors' testimony and the exhibits cited in that testimony?

A8. (DL, SR, SVDL) Yes, we have reviewed the Intervenors' testimony and the exhibits.

Q9. What is your general reaction to the Intervenors' Testimony?

A9. (DL, SR, SVDL) The Intervenors' testimony does not appear to take into account the purpose of the FEIS discussion at issue. The FEIS aims to provide a range of energy alternatives, including a combination of energy alternatives, that reflects what is reasonably foreseeable. The FEIS analysis does <u>not</u> aim to chronicle the theoretical maximum contribution of wind, solar, and other renewable sources to the energy supply. Much of the Intervenors' testimony is therefore immaterial. In addition, the Intervenors' testimony does not take into account the project purpose and need, which is to generate 1600 MW(e) of baseload power in Maryland. Instead, the testimony of Mr. Sklar questions the need for baseload generation. In short, the Intervenors' testimony does not provide any information that calls into question the conclusions in the FEIS, the NRC Staff's testimony, or our testimony.

III. DISCUSSION

A. Need for Baseload Power

Q10. In Mr. Sklar's testimony (at ¶9, page 15), he asserts that the best value that solar can achieve is to reduce the midday energy loads, which are the highest cost power. Can you comment on whether this is relevant to the FEIS analysis.

A10. (DL) This is not relevant to the FEIS analysis. As noted in my initial testimony at ¶18, the purpose and need for the proposed NRC action (issuance of a combined license for Calvert Cliffs 3) is to provide for additional large baseload electrical generating capacity within the State of Maryland. Calvert Cliffs 3 will provide approximately 1600 MW(e) of baseload power in the region of interest. Reducing midday loads does not satisfy the project purpose or meet the need for power described in the FEIS. Baseload power is necessary to meet the anticipated overall load, whether those loads are reduced by solar or not.

Q11. To the best of your knowledge, is the need for Calvert Cliffs 3 within the scope of Contention 10C?

A11. (DL) As I understand it, the scope of Contention 10C does not include a challenge to the purpose and need for the project. In fact, the Licensing Board specifically rejected the Intervenors' challenge to the purpose and need for the project.

Q12. In Mr. Sklar's testimony (at ¶10, page 17), he argues that it is "disingenuous" to rely on Calvert Cliffs 3 as a baseload plant since it is a merchant plant. Can you comment on this?

A12. (DL) The manner in which the power from Calvert Cliffs is sold does not change the nature of the energy source. Nuclear power plants can run continuously for hundreds of days in a row. The mere fact that the plant must periodically shut down for refueling and maintenance does not make it something other than baseload power.

Overall baseload capacity must account for periodic maintenance or refueling of baseload generation plants regardless of fuel type. Mr. Sklar's testimony also ignores the conclusions of the MPSC that the proposed new unit at Calvert Cliffs will promote stability and reliability of the grid. By increasing the stability and reliability of the grid, Calvert Cliffs 3 could actually facilitate increased contributions from renewable energy sources.

B. Energy Alternatives

Q13. In ¶5 of his testimony, Mr. Sklar states that the "Applicants and NRC staff have consistently understated the potential contributions of solar and wind power to Maryland." Do you agree with this statement?

A13. (SR) No. First, Mr. Sklar is ignoring the fact that these potential contributions are not baseload. But, even more significantly, Mr. Sklar is confusing the notion of what is "theoretically possible" with what is "reasonably foreseeable."

In his testimony, Mr. Sklar correctly points out that the absolute potential for wind and solar energy in Maryland is relatively high, referring to some of the same sources I referred to in my October 21 filing. For example, Mr. Sklar states (at ¶7) that "using existing, proven technology in shallow waters (0-35 m), there is potential to install 14,625 MW of capacity, generating 4,982 MW on average" and that "[t]his is far greater than the potential contribution for wind power provided in the FEIS." Mr. Sklar also claims (at ¶9) that "over 450 million square feet of roof space would be suitable for solar panels in the State of Maryland [and] would add over 5,000 megawatts of capacity to the State." However, such "potential" merely indicates what is "theoretically possible." This is not a very useful metric, and gives no indication of what is "reasonably foreseeable." Availability of resources does not translate into technology deployment, if the economics or state of technology do not justify or allow it.

Mr. Sklar's testimony does not provide any discussion of the economics of solar and wind energy in Maryland at the current or projected state of the technological development, which ultimately determines what is "reasonably foreseeable." At bottom, Mr. Sklar's testimony, which focuses on the "theoretically possible," does not call into question the NRC Staff analysis of what is reasonably foreseeable.

Q14. Mr. Sklar states (at ¶5, page 5) that "all the renewable energy resources should be considered in an EIS profile of options, including baseload renewables, sustainable biomass electric power and marine power (freeflow hydropower, wave, tidal, and ocean currents)." Do you agree?

A14. (SR) I concur with Mr. Sklar's statement that a variety of renewable energy resources should be considered. Indeed, the FEIS already accounts for other forms of renewable energy, such as biomass and hydropower.[1] Other renewable energy technologies, such as marine power, are more expensive to deploy than the renewable energy technologies selected in the FEIS, and therefore would not be deployed at all unless costs of those technologies can be reduced to levels competitive with the other, more mature, renewable energy technologies. Any such developments are speculative at present.

Regardless, the cumulative deployment of all renewable energy sources, which are all more costly to harness than conventional natural gas generation, will be driven by the

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[1] The FEIS calls for a cumulative deployment of 300 MW(e) of average renewable energy capacity: 75 MW(e) solar, 25 MW(e) hydropower, 100 MW(e) biomass, and 100 MW(e) wind.

Renewable Portfolio Standard ("RPS") requirement. In other words, even in the highly unlikely case that marine power technologies became cheaper than wind technologies, the former would be deployed instead of, and not in addition to, the latter.

The RPS standard, as outlined in the Maryland LTER, is likely to drive approximately 2,800 GWh of renewable energy in Maryland.[2] This is approximately 320 MW(e) of average capacity. Importantly, this estimate includes some renewable resources that have already been developed — that is, additional new renewable capacity is projected by the LTER to be less than 320 MW(e). As noted above, the FEIS calls for a cumulative deployment of 300 MW(e) average renewable capacity. The FEIS also calls for a 100 MW(e) additional demand-side reduction, which, for a 20% RPS, results in a 20 MW(e) reduction in the renewable energy requirements. Thus, the RPS-based projection in the LTER further supports my conclusion that the contribution from renewables in the FEIS combination of energy alternatives is reasonable (and, if anything, optimistic with respect to the total contribution of renewables).

Therefore, while it is possible that the mix of renewable resources deployed in Maryland in the upcoming years could deviate from the FEIS scenario, it is unlikely that the cumulative amount of renewable energy deployed will be materially different from that considered in the FEIS. The total contribution from all renewable energy

[2] A large portion of the Maryland RPS is expected to be met with out-of-state renewable energy.

resources is still effectively defined by the RPS, given the anticipated economics of those energy sources.

Q15. Mr. Sklar asserts that "the costs for solar photovoltaics are now competitive, and in many cases already cheaper than other forms of electricity generation" and states that this should lead to more solar PV. Do you agree with his conclusions? Is this applicable to wind power as well?

A15. (SR) While solar photovoltaics ("PV") may be "cheaper than other forms of electricity generation," it not necessarily the cheapest alternative. Solar cannot be expected to displace other, cheaper generation sources unless it is mandated or incentivized. For reference, EIA's Annual Energy Outlook of 2011 (Exh. NRC000021) reports the following levelized costs:

- Advanced natural gas combined cycle: $63.1 per MWh
- Onshore wind: $97.0 per MWh
- Offshore wind: $243.2 per MWh
- Solar PV: $210.7 per MWh

Clearly, natural gas is significantly cheaper than solar PV and offshore wind, and cheaper than onshore wind, especially considering that these estimates for solar PV and onshore wind are based on national averages and are likely to be optimistic for Maryland's relatively mediocre solar and wind resources. Additionally, these estimates do not include the energy storage costs that would be needed for these intermittent sources to make a true "baseload-to-baseload" cost comparison.

Wind and solar energy still are deployed because wind and solar developers can monetize Renewable Energy Credits ("RECs") or Solar Renewable Energy Credits ("SRECs") and use federal and state incentives, such as Investment or Production Tax

Credits, to lower their effective prices. For example, Maryland SRECs trade at $200 per MWh today and therefore are crucial for the economics of solar power.

However, even assuming that federal and state incentives remain in place indefinitely — an optimistic assumption — RECs and SRECs are only available up to the point in which the RPS requirements are fulfilled. Therefore, the contribution of onshore wind and solar energy is effectively capped at the RPS percentage, unless a completely new RPS is put in place, which is speculative at best.

Significantly, offshore wind is not competitive even with RECs and federal incentives. Offshore wind is even more expensive than solar, but does not benefit from a special carve-out (*e.g.*, the 2% of the RPS allocated to solar), and therefore does not have access to a high-price REC market that can close the economic gap. Deployment of offshore wind will occur only if a new legislative framework is passed, which is, again, speculative.

C. Wind Power

Q16. Mr. Sklar states (at ¶7, page 8-9) that Google and GoodEnergies have established a consortium in a $5 billion transmission backbone to bring offshore wind in the region to shore. He also states that such large investments are not made to transmit small amounts of electricity. Does this consortium have any relevance to the FEIS analysis?

A16. (SR) No. There has been no significant investment in transmission for offshore wind power yet. While the formation of the Atlantic Wind Consortium is an interesting development regarding offshore wind energy in the Mid-Atlantic, no "large investments" have been made to date. The $5 billion sum is simply the total estimated price tag for all five phases of the project. The announcement of such a project does not indicate that offshore wind deployment is likely to occur anytime soon. Any significant investment will be made only if there is a clear indication that offshore wind farms will actually be deployed.

Q17. Mr. Sklar states (at ¶7, page 8) that that there is well-documented, substantial real interest in developing Maryland's offshore wind potential. Mr. Sklar cites NRG Bluewater Wind's proposal for a 600 MW wind farm off the coast of Maryland and asserts that the project would itself provide four times the amount of wind power initially examined in the FEIS. Mr. Sklar also states that Bluewater Wind has received approval to build a 450 MW wind farm off the coast of Delaware. Can you comment on these statements?

A17. (SR) The interest in building offshore wind farms in Maryland is actually quite limited. NRG Bluewater Wind has taken virtually no steps towards developing an offshore wind farm off the coast of Maryland, other than expressing publicly an interest in building one. Also, Mr. Sklar refers to an October 2010 source (Exh. JNT000005), at which time the Maryland Offshore Wind Energy Act was about to be introduced to the Maryland legislature. That bill was subsequently defeated.

Additionally, Bluewater Wind has not received final approval to build a wind farm off the Delaware coast. As mentioned in the October 21 submittal, the only offshore wind project in the U.S. that has received permits to build is the Cape Wind project. And, even those permits are uncertain because on October 21st the United States Court of Appeals for the District of Columbia Circuit vacated and remanded the Federal Aviation Administration's ("FAA") "No Hazard" determinations for the Cape Wind project.[3] This is another setback for the project. While not necessarily

[3] *Cape Wind v. FAA*, __ F.3d __ (D.C. Cir.) (slip op. October 28, 2011) (Exh. APL000059).

applicable to the offshore wind in the Mid-Atlantic region, this does highlight the challenges associated with permitting offshore wind projects.

Finally, 600 MW of offshore wind would only equate to a maximum of 240 MW(e) of average capacity, which is only 2.4 times the amount of wind power considered in the FEIS (not the "four times" asserted by Mr. Sklar).

D. Solar Power

Q18. Do you agree with Mr. Sklar's conclusion (at ¶8) that the FEIS assumption of 75 MW ignores Maryland law and that the minimum amount is "likely to be greatly exceeded"?

A18. (SR) No. Mr. Sklar states that "Maryland state law … mandates that a minimum of 2% of the state's generating capacity be provided from solar power by 2022" and notes that "approximately 250 MW" (presumably indicating 250 MW of average generation)[4] must be generated from solar power. I concur that the 2% requirement should be taken into consideration. And, my assessment is that a portion of this requirement will be fulfilled through new solar power installations, whether they are rooftops or utility-scale projects. However, it is unlikely that the entire 2% requirement will be fulfilled through new solar power installations, and extremely unlikely that there will be any solar energy deployed beyond the 2% requirement.

[4] As explained in the UniStar testimony, the "MW(e)" values presented for wind and solar power are average values based on capacity factors. A reference to "MW" without any modifier indicates installed capacity — that is, the maximum power than a plant can provide on an instantaneous basis. The use of MW(e) indicates average equivalent capacity — that is, the average power provided by a power plant over a sufficiently long period of time (typically one year). This allows for comparison of energy sources by taking account of different capacity factors for each energy sources. While we use MW(e) in the testimony, the latter may also be described as "MWa" (average megawatt).

My conclusions are based on an assessment of the market for renewable energy in Maryland. Today's SREC prices (November 2011) are at $200 per MWh. The Solar Alternative Compliance Payment ("SACP") is at $400 per MWh, so Load Serving Entities ("LSEs") are currently choosing to purchase SRECs to fill their solar RPS quota.[5] The structure of the Maryland solar RPS is such that the ACP decreases, but stays above $200 per MWh until 2018. As a result, the solar RPS is likely to continue to be fulfilled up until 2018, when the requirement is 0.9% (approximately 75 MW(e)) of Maryland electricity sales. This is predicated upon the continued availability of federal and state incentives, such as the Investment Tax Credit ("ITC"), which pays for 30% of the installed cost of a solar plant, and the Maryland Clean Energy Grant Program, which provides a $500 per KW rebate. Should such incentives disappear, solar energy developers would have to make up the difference by obtaining higher REC prices, which is not likely given the SACP reduction schedule, or by lowering their production costs very significantly.

After 2018, the SACP goes below $150 per MWh. At this level, LSEs would elect to make the compliance payment rather than invest in more solar development — that is, because the cost of developing solar exceeds the SACP, the economics are unlikely to support further solar development, even considering continuous availability of the ITC and other incentives, unless there are very significant cost reductions. Mr.

[5] The SACP is the amount that LSEs must pay per MWh of solar electricity that they are unable to generate themselves or buy rights to through SREC purchases in order to meet the Maryland RPS solar requirement. Making an alternative compliance payment is an alternate method for complying with the Maryland RPS.

Sklar's statement that the minimum (2%) contribution is "likely to be greatly exceeded" is not substantiated, and is speculative at best.[6]

In summary, compliance up to 2018 levels of the solar RPS (0.9%) is likely, compliance up to the full 2% amount is possible, but unlikely, and compliance beyond the 2% amount is extremely unlikely.

Q19. Do you have any comment on Mr. Sklar's statement that the 2% solar contribution amounts to 250 MW, which exceeds the 75 MW used in the FEIS?

A19. (SR) Based on Maryland Long-term Electricity Report ("LTER") and an average capacity factor of 15%, the 2% contribution is equal to roughly 160 MW of average generation capacity, not 250 MW (presumably also average generation capacity), as stated by Mr. Sklar. The discrepancy may be due to different capacity factors (Mr. Sklar does not specify the capacity factor he uses) or to overestimating the base on which the 2% is calculated, which is Maryland electricity sales and not generating capacity. Regardless, as I explained above, installed capacity up to the full 2% amount is unlikely. Instead, I conclude that the 2018 level of the solar RPS (0.9%) is likely, which is 75 MW(e).

6 In the Intervenors' testimony that was subsequently withdrawn, Mr. Mariotte mentioned deployment of solar power in New Jersey and Germany. These examples highlight the reliance of solar power on incentives. For example, New Jersey has a solar carve-out in its RPS that is approximately double the size of Maryland's 2022 target (and more than ten times Maryland's 2011 target). But, most importantly, the New Jersey solar RPS has a SACP of $675 per MWh and SRECs in New Jersey traded just below the SACP in November 2011, at $670 per MWh. *See* "SREC Trade – Results of November 2011 Auction" (Exh. APL000060). Germany has a system of so-called "feed-in-tariffs" ("FIT"), which provide "off-the-shelf" long-term contracts to renewable energy developers at a pre-determined price. In Germany, solar FITs are currently in the $300-$400 per MWh range, depending on the size of the installation and the exchange rate, and a few years ago were in the $700-$750 per MWh range.

Q20. Does Mr. Sklar provide any information that undermines your prior testimony on solar power.

A20. (SR) No. Solar power deployment in Maryland is tracking the solar RPS, as expected. Mr. Sklar notes (at ¶8, page 14) that "[SunEdison and Standard Solar recently completed] 16.4 MW [of solar power installations] in Maryland. This indicates that a potential solar photovoltaic contribution of well above 75 MW is well within reach."[7] However, 16.4 MW of installed solar capacity is only equivalent to 2.5 MW(e) of average capacity. That is about 3.3% of 75 MW(e) — hardly a clear indication that a "contribution of well above 75 MW is "well within reach." According to SRECtrade,[8] the total supply of SRECs in Maryland was 30.8 MW, as of November 2011, which is in line with demand (driven by the solar RPS). This represents approximately 4.6 MW(e) of average capacity, or about 6.2% of 75 MW(e).

Q21. Mr. Sklar argues (at ¶8, page 15) that the FEIS undervalues solar PV because it does not take into account the effects of line losses. Can you comment on this statement?

A21. (SR) I concur with Mr. Sklar that rooftop installations will contribute to the overall solar mix in Maryland. I also concur with Mr. Sklar that transmission and distribution losses have not been discussed in previous documents. However, as

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7 As an aside, Mr. Sklar refers to SunEdison as a regional company (at ¶8, page 14). SunEdison moved its headquarters from Maryland to California in October 2011, and will transfer 100 employees to the new location in Belmont, CA. SunEdison decided to move away from Maryland to be closer to its customers and to the California renewable energy market.

8 *See* "SREC Trade – Results of November 2011 Auction" (Exh. APL000060).

explained in my October 21 filing,[9] solar rooftops are even more expensive than utility-scale plants — approximately $6,000 per KW for solar residential rooftops versus $3,500 per KW for utility-scale plant. That is a significant differential in installed cost between the two options, which can only be partially off-set by the transmission and distribution advantage of solar rooftops. These cost differences are a critical impediment to development of rooftop solar PV, even taking into account line losses.

Q22. Mr. Sklar argues (at ¶10, page 19) that solar thermal plants, which use hot heat-transfer oil or molten salt as heat storage, can operate into the night, thereby contributing to "baseload" (or near-baseload) power. Can you comment on this?

A22. (SR) Solar thermal plants are not a viable option in the Mid-Atlantic, because they cannot operate in diffuse light conditions, which are typical of the region. Therefore, a discussion of these types of storage options is not relevant to meeting the need for baseload power in Maryland.

E. <u>Energy Storage</u>

Q23. Can you please provide your views on Mr. Sklar's assessment of the energy storage?

A23. (SVDL) There should be no misconception about "baseload" operation — it is the ability to be online 24/7 and provide capacity to the grid demand cycle, with the inevitable load changes experienced throughout the day. This is consistent with the definition of baseload used by the NRC Staff and UniStar.[10] Solar PV and wind

9 UniStar Testimony at ¶42.

10 NRC Staff Testimony at ¶10.

simply cannot provide that service in the absence of an energy storage system with suitable capacity. Energy storage systems range from capacitors to batteries to large storage technologies that can facilitate the integration of the renewable resources mentioned. However, no storage device or system can provide baseload power delivery. At best, the use of wind or solar, in conjunction with an energy storage system, can provide energy that approximates baseload.

Q24. Can you provide some examples to illustrate this point?

A24. (SVDL) Yes. Two examples are given below to illustrate this point. First, the 98 MW Laurel Mountain wind facility in West Virginia is the largest project to couple wind with batteries.[11] The shipping container size batteries allow AES to gradually adjust power to the grid up and down rather than have a sudden drop off in power due to a change in wind. From a commercial point of view, the purpose of the battery is to sell frequency regulation services to the local grid operator, PJM. The batteries supply 32 megawatts of power in quick bursts to maintain an even balance between power supply and demand on the grid, displacing a job which had been done by a natural gas power plant. Significantly, the quick bursts of 32 MW from batteries cannot be sustained for longer than a few hours before the batteries need recharging — if wind is not available the energy must be drawn from the grid. This example demonstrates that energy storage may have limited benefits for specialized services, but not enough to turn variable wind into baseload power.

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[11] The 98 MW wind farm has 32 MW battery system this reflects the 30% capacity factor for wind.

Mr. Sklar also references thermal storage. However, this is not a low cost option and, in any event, cannot deliver baseload power. The reality is, that to provide 100 MW(e) for 4 hours, two salt storage tanks are required measuring 30 ft high x 80 ft diameter. These formulated nitrate salts are expensive, corrosive, and require special material for pumps, valves, and piping. Furthermore the "cold" salt at (290 degrees C) cannot be allowed to go to lower temperatures as the salt will solidify. The back up heat source must be electrical power or fired natural gas heaters. In addition, the power recovery uses a Rankine steam cycle, which entails the associated issues of a conventional steam cycle, water management, and cooling needs.

Q25. Does the Mr. Sklar's testimony change your conclusion regarding energy storage in the combination of alternatives?

A25. (SVDL). No. Mr. Sklar's testimony does not in any way grapple with the challenges associated with generating baseload-equivalent power from intermittent renewable resources. As I concluded previously, given the current state of CAES development and the lack of any known storage resources in Maryland, volumes of storage such as those included in the FEIS are not reasonably foreseeable.

F. Assessment of Environmental Impacts of Reasonable Energy Alternatives

Q26. Does the Intervenors' testimony call into question the NRC Staff's analysis of the impacts of the combination of energy alternatives?

A26. (DL) No. Mr. Sklar's testimony is limited to discussing the relative contribution of wind and solar to the combination of alternatives. He does not testify that the impacts associated with wind or solar power production are any different from those discussed in the FEIS. Mr. Sklar has not provided any information that calls into question the NRC Staff's "sensitivity analysis" regarding environmental impacts (quadrupled wind power assumption in combination of alternatives). As that sensitivity analysis indicates, even a much larger contribution from wind power (assuming availability of sufficient energy storage) would not change the conclusions in the FEIS regarding environmental impacts.

IV. CONCLUSIONS

Q27. What are your conclusions regarding the NRC Staff testimony?

A27. (DL, SR, SVDL) We agree with the methodologies, statements, and conclusions in the NRC Staff testimony. To the extent that we utilized a different approach, we reached similar conclusions. This demonstrates the robustness of the FEIS analysis.

Q28. What are your conclusions regarding the Intervenors' testimony?

A28. (DL, SR, SVDL) We conclude that the statements and information presented in the Intervenors' testimony are mostly irrelevant to the FEIS analysis because they fail to account for the project purpose and need (1600 MW(e) of baseload power in Maryland) and because they do not focus on reasonably foreseeable contributions from wind or solar power. The FEIS is not (and should not be) based on the theoretical potential of wind and solar power.

Q29. What are your overall conclusions regarding the reasonableness of the NRC Staff's assumption of 100 MW(e) of wind power, in conjunction with energy storage, as baseload power in the FEIS combination of alternatives?

A29. (SR) On balance, assuming that the addition of a storage technology was technically and economically feasible, it is plausible, but unlikely, that 100 MW(e) of "baseload" wind energy could be available in Maryland in the next 10 years. The use of 100 MW(e) of wind energy in the FEIS is therefore reasonable.

(SVDL) Assuming that sufficient wind energy over and above the 100 MW can be delivered on a continuous basis such that another 100 MW could be stored for use in a CAES plant, it is technologically plausible to create 100 MW of "baseload" wind power. However, given the current state of CAES development and the lack of any known storage resources in Maryland, this is not reasonably foreseeable. Thus, the FEIS combination of energy alternatives is speculative, at least to the extent that it relies on the availability of CAES.

Q30. What are your overall conclusions regarding the reasonableness of the NRC Staff's assumption of 75 MW(e) of solar power, in conjunction with energy storage, as baseload power in the FEIS combination of alternatives?

A30. (SR) As I noted previously, increases in installed solar capacities are likely to be driven by Maryland's RPS. In my professional opinion, installation of the equivalent of 75 MW(e) "baseload" solar (assuming that energy storage is technically and economically feasible) is plausible and therefore reasonable. The use of 75 MW(e) of solar energy in the FEIS is therefore reasonable. However, generation of greater amounts of "baseload" solar is unlikely to occur in the next 10-15 years.

(SVDL) Assuming that enough solar energy can be delivered on a continuous basis such that sufficient energy can be stored, it is technologically plausible to create 75 MW(e) of "baseload" solar power. However, given the current state of CAES development and the lack of any known storage resources in Maryland, the current state of thermal solar storage development generally (and particularly in Maryland), and the technological and economic limitations associated with batteries, it is not reasonably foreseeable that energy storage technologies could support the use of solar power as "baseload" generation. Thus, the solar contribution to the FEIS combination of energy alternatives is speculative, at least to the extent that it relies on the availability of energy storage.

Q31. What are your overall conclusions regarding the assessment of energy alternatives in the FEIS?

A31. (DL) I continue to agree with the NRC Staff's conclusions. The combination of energy alternatives considered in the FEIS is reasonable based on evaluations of technologically and economically achievable generation technologies in the region of interest. Based on the assessment of the environmental impacts of a range of reasonable energy alternatives, combinations involving wind and solar power with storage, supplemented with natural gas, are not environmentally preferable to Calvert Cliffs 3 — even considering the potential for significant increases in the contributions of wind and solar. Any dispute over the specific mix of wind or solar used in the combination of alternatives is not one that would affect the outcome of the NEPA analysis.