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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	)	Docket No. 52-016
	)	
(Calvert Cliffs 3 Nuclear Project, LLC)	)	
	)	

PREFILED DIRECT TESTIMONY OF ANDREW J. KUGLER AND KATHERINE A. CORT CONCERNING ENVIRONMENTAL CONTENTION 10C

Q1. State your names, occupations, and by whom are you employed.

A1a. [AJK][1] My name is Andrew J. Kugler. I am employed as a Senior Project Manager by the U.S. Nuclear Regulatory Commission's ("NRC") Office of New Reactors, Division of Site and Environmental Review, Environmental Projects Branch 2.[2] I have been employed at the NRC for more than 21 years as a safety project manager (1990 to 2000) and environmental project manager (2000 to present). A statement of my professional qualifications is attached hereto as Exhibit NRC000005.

A1b. [KAC] My name is Katherine A. Cort. I am employed as a Staff Scientist and Economist at Pacific Northwest National Laboratory (PNNL), operated for the U.S. Department of Energy (DOE) by Battelle Memorial Institute. I have been employed at PNNL for 13 years. A statement of my professional qualifications is attached hereto as Exhibit NRC000006.

Q2. Describe your job duties and responsibilities.

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[1] In this testimony, the identity of the witness who supports each numbered paragraph is indicated by the notation of his/her initials in parentheses.

[2] Effective December 1, 2011, Andrew Kugler will be employed in the Office of New Reactors, Division of Site Safety and Environmental Analysis, Environmental Technical Support Branch.

A2a. [AJK] I am a senior project manager in Environmental Projects Branch 2, Division of Site and Environmental Reviews, Office of New Reactors. In that role I am responsible for leading environmental review teams. I also provide technical support to other review teams as a technical reviewer. One area in which I have focused over the last few years has been alternatives analyses under NEPA. For the Calvert Cliffs Unit 3 combined license (COL) application environmental review in particular, I am the lead technical reviewer for energy alternatives and alternative sites. In this role I provided technical oversight to the NRC Staff and PNNL reviewers, and provided technical input to the evaluation of energy alternatives. My assessment of energy alternatives is contained in Section 9.2 of NUREG-1936, "Environmental Impact Statement for the Combined License (COL) for the Calvert Cliffs Nuclear Power Plant, Unit 3, Final Report," May 2011 ("FEIS") (Ex. NRC000003A, NRC000003B).

A2b. [KAC] My current responsibilities at PNNL include (1) assisting the NRC Staff with environmental reviews for new nuclear power plant licensing and operating plant license renewals in the areas of socioeconomics, land use, environmental justice, alternative sites, energy alternatives, and benefit-cost analysis including need for power; (2) providing economic, building energy, and environmental analytical support for the DOE's Office of Energy and Renewable Energy (EERE); (3) developing and maintaining models for, and assessment of, the energy impacts of EERE energy efficiency and renewable energy programs; and (4) developing National benefit estimates for EERE's buildings portfolio including metrics for building energy codes, commercial, and residential buildings integration programs.

Q3. Describe your professional qualifications including education, training, work experience, and publications.

A3a. [AJK] I earned a B.S. in Mechanical Engineering from Cooper Union and an M.S. in Technical Management from Johns Hopkins University. I have been employed by NRC from 1990 to the present, working in both the safety (1990 to 2000) and environmental

(2000 to present) arenas. Prior to joining the NRC, I was an engineering group supervisor and an NRC licensed senior reactor operator at River Bend Nuclear Station in Louisiana. Before that I served in the U.S. Navy as an officer in the engineering department of a nuclear submarine.

Addressing my qualifications specific to energy alternatives, I have led or supported teams developing environmental impact statements (EISs) for nuclear power plant license renewal applications (10 projects, of which I was lead for 3), 2 early site permits (ESP; of which I was lead for 1), and COL applications (7 projects, of which I was lead for 1). For all of the new reactor reviews and many of the license renewal reviews, I was directly involved in the preparation of the sections on alternatives, including energy alternatives. I've also completed 7 courses related to National Environmental Policy Act (NEPA) reviews, including Environmental Regulation, and Current and Emerging Issues in Environmental Policy. I attended the Energy and the Environment 2010 Conference, and made presentations regarding environmental reviews and alternatives to national and international audiences. Finally, I authored the 2007 revisions to the Environmental Standard Review Plan (ESRP, NUREG-1555) Introduction, which addresses guidance common to all sections, and the sections for the review of alternatives, including those sections specific to energy alternatives.

A3b. [KAC] I received a B.S. in Economics from Southern Methodist University and a M.A. in Economics from the University of Washington. I have been employed at PNNL from 1998 to the present. I am a scientist on the technical staff of the Energy and Efficiency Division. Prior to my employment with PNNL, I was an economic analyst for the State of Washington conducting economic analyses of legislative and rule changes. Prior to that, I was an economic analyst for the City of Seattle Public Utilities in the water conservation office. I spent one year in San Jose, Costa Rica (1994-1995) as part of a research fellowship examining economic incentives for sustainable land use and watershed

management of the Arenal Watershed, working in conjunction with the Tropical Science Center, a non-profit, non-governmental scientific and environmental organization. I have been conducting economic impact studies for more than 15 years, and I have been involved in assessing energy alternatives related to nuclear power plants over the previous 12 years. I have prepared EIS sections on socioeconomics, benefits and costs, need for power, environmental justice, alternatives, and land use for 3 nuclear power plant license renewal and 5 ESP and COL applications.

Q4. Describe your involvement and responsibilities regarding the NRC Staff's preparation of the EIS for the COL for Calvert Cliffs Unit 3.

A4a. [AJK] I became involved in the Calvert Cliffs Unit 3 alternatives review in mid-2008, initially assisting in the review of the site selection process. At the beginning of 2009, I took over as the lead reviewer for alternatives for the environmental review. In this role I provided oversight to our contractor, PNNL, and provided input for the energy alternatives and alternative sites portions of the draft and final EIS.

A4b. [KAC] Prior to my participation in this hearing process, my involvement in the Calvert Cliffs Unit 3 environmental review has been to peer review EIS sections prior to formal publication by the NRC. I have worked closely with the recently retired PNNL staff member previously assigned to the energy alternatives portion of the EIS and have participated in an orderly transition of responsibility for the technical aspects of the review.

Q5. What is the purpose of your testimony?

A5. [AJK, KAC] The purpose of this testimony is to present the NRC Staff's position with regard to Contention 10C. Specifically, we will discuss the process used to develop and evaluate the combination of energy alternatives, present the results of the evaluation of that alternative, and demonstrate its compliance with the requirements of NEPA.

Q6. Are you familiar with Contention 10C?

A6. [AJK, KAC] Yes, we are familiar with Contention 10C. Contention 10C,

submitted in this proceeding by intervenors Nuclear Information and Resource Service, Beyond Nuclear, Public Citizen and Southern Maryland Citizens' Alliance for Renewable Energy Solutions (collectively, "Joint Intervenors"), as restated by the Atomic Safety and Licensing Board in its December 28, 2010 Order, alleges that:

> The DEIS [draft environmental impact statement] discussion of a combination of alternatives is inadequate and faulty. By selecting a single alternative that under-represents potential contributions of wind and solar power, the combination alternative depends excessively on the natural gas supplement, thus unnecessarily burdening this alternative with excessive environmental impacts.

Calvert Cliffs 3 Nuclear Project, LLC, and Unistar Nuclear Operating Services, LLC (Combined License Application for Calvert Cliffs Unit 3), LBP-10-24, 72 NRC __, __ (Dec. 28, 2010) (slip op. at 10) (2010 Order). We are also familiar with the Joint Intervenors' related filings, including the Submission of Contention 10 by Joint Intervenors (June 25, 2010); the Submission of Amended Contention 10C by Joint Intervenors (June 20, 2011); and the Atomic Safety and Licensing Board's Memorandum and Order (Denying Summary Judgment of Contention 10C, Denying Amended Contention 10C, and Referring Ruling on Contention 1 (Aug. 26, 2011) (unpublished).

Q7. Did the FEIS's combination of energy alternatives analysis under-represent the contribution of wind and solar power to the combination of energy alternatives and depend excessively on the natural gas component, unnecessarily burdening the alternative with excessive environmental impacts?

A7. [AJK, KAC] No. The approach used to develop a combination of energy alternatives included the maximum contribution from renewable sources that could be reasonably expected within the region of interest and within the timeframe of the proposed project. In doing so, the size of the contribution from natural gas generation was minimized. The approach was based on data from authoritative sources and is consistent with the ESRP.

In the following testimony, we will describe the approach and the regulatory guidance that was employed to determine and evaluate the combination of energy alternatives in the

FEIS. We will provide the sources of information on which the analysis is based and describe how this information was used to develop and evaluate the combination of energy alternatives. We will explain the assumptions used to develop the combination of energy alternatives and specifically describe how the level of contribution from wind power, solar power, and fossil-fired power generation was determined.

Q8. Did you review or rely on any specific documents to prepare your testimony?

A8. [AJK, KAC] Yes. The assessment of energy alternatives, including the combination of energy alternatives, is presented in the FEIS in Section 9.2 (Ex. NRC000003A). In preparing this testimony we have also considered and referenced the following specific documents (with NRC Exhibit numbers as noted) in the responses for which we are individually responsible, as indicated by our initials:

<u>Exhibits</u>

- [AJK] Notice of Availability of Memorandum of Understanding Between U.S. Army Corps of Engineers and U.S. Nuclear Regulatory Commission on Environmental Reviews Related to the Issuance of Authorization to Construct and Operate Nuclear Power Plants, 73 Fed. Reg. 55,546 (Sept. 25, 2008) (Ex. NRC000007).

- [AJK, KAC] Tim Wheeler, *MD's largest solar project under construction*, B'more Green Blog (Sept. 29, 2011), *available at* http://weblogs.baltimoresun.com/features/green/2011/09/mds_largest_solar_project_unde.html (B'moreGreen 2011) (Ex. NRC000039).

- [AJK, KAC] Alison M. Conner & James E. Francfort, Idaho National Engineering and Environmental Laboratory, U.S. Hydropower Resource Assessment for Maryland DOE/ID-10430(MD) (1997) (Conner and Francfort 1997) (Ex. NRC000042).

- [AJK, KAC] *Power Generation: Generation Facilities*, Constellation Energy, http://www.constellation.com/portal/site/constellation/menuitem.24df26f4581930908d84ff10025166a0 (last visited Jan. 7, 2011) (Constellation 2011) (Ex. NRC000026).

- [AJK, KAC] *Roth Rock*, Gestamp Wind, http://www.gestampwind.com/en/business/innovating-projects/roth-rock (last visited Oct. 18, 2011) (Gestamp 2011) (Ex. NRC000025).

- [AJK, KAC] *ConocoPhillips Joins $54.5M Series B for General Compression*, Houston citybizlist (June 7, 2011), http://Houston.citybizlist.com/17/2011/6/7/ConocoPhillips-Joins-54.5B-Series-B-for-General-Compression.aspx (Houstoncitybizlist 2011) (Ex. NRC000041).

- [AJK, KAC] John Hynes, *How to Compare Power Generation Choices*, Renewable Energy World.com (Oct. 29, 2009), http://www.renewableenergyworld.com/rea/news/article/2009/10/how-to-compare-power-generation-choices (Hynes 2009) (Ex. NRC000013).

- [AJK, KAC] Maryland Public Service Commission, Electric Supply Adequacy Report of 2007 (2007), *available at* http://webapp.psc.state.md.us/Intranet/Reports/2007SupplyAdequacyReport_01172007.pdf (MPSC 2007) (Ex. NRC000017).

- [AJK, KAC] Maryland Public Service Commission, Final Report Under Senate Bill 400: Options for Re-Regulation and New Generation (Dec. 16, 2008), *available at* http://webapp.psc.state.md.us/Intranet/sitesearch/MD%20PSC%20Slide%20Presentation_12.16.08_Re%20SB%20400%20Final%20Report.pdf (MPSC 2008b) (Ex. NRC000023).

- [AJK, KAC] Maryland Public Service Commission, In the Matter of the Application of UniStar Nuclear Energy, LLC and UniStar Nuclear Operating Services, LLC for a Certificate of Public Convenience and Necessity to Construct a Nuclear Power Plant at Calvert Cliffs in Calvert County, Maryland, Case Number 9127, Order Number 82741 (June 26, 2009) (MPSC 2009a) (Ex. NRC000014).

- [AJK, KAC] Maryland Public Service Commission, Ten-Year Plan (2008-2017) of Electric Companies in Maryland (2009), *available at* http://webapp.psc.state.md.us/Intranet/psc/Reports_new.cfm (MPSC 2009b) (Ex. NRC000016).

- [AJK, KAC] Maryland Public Service Commission, In the Matter of the Application of UniStar Nuclear Energy, LLC and UniStar Nuclear Operating Services, LLC for a Certificate of Public Convenience and Necessity to Construct a Nuclear Power Plant at Calvert Cliffs in Calvert County, Maryland, Case Number 9127, Proposed Order of Hearing Examiner (Apr. 28, 2009) (MPSC 2009c) (Ex. NRC000015).

- [AJK, KAC] Maryland Public Service Commission, Ten-Year Plan (2009 – 2018) of Electric Companies in Maryland (2010), *available at* http://webapp.psc.state.md.us/Intranet/psc/Reports_new.cfm (MPSC 2010) (Ex. NRC000018).

- [AJK, KAC] Maryland Public Service Commission, Ten-Year Plan (2010 – 2019) of Electric Companies in Maryland (2011), *available at* http://webapp.psc.state.md.us/Intranet/psc/Reports_new.cfm (MPSC 2011) (Ex. NRC000028).

- [AJK, KAC] Walter Musial & Bonnie Ram, National Renewable Energy Laboratory, Large-Scale Offshore Wind Power in the United States; Assessment of Opportunities and Barriers, NREL/TP-500-40745 (2010) (NREL 2010) (Ex. NRC000024).

- [AJK, KAC] ReliabilityFirst Corporation, Long Term Resource Assessment 2009-2018 (2009) (ML100481002) (RFC 2009) (Ex. NRC000019).

- [AJK, KAC] *ReliabilityFirst – About Us*, ReliabilityFirst Corporation, https://rfirst.org/Pages/AboutUs.aspx (last visited Oct. 17, 2011) (RFC 2011) (Ex. NRC000020).

- [AJK, KAC] *Solar Installation at Perdue to be One of East Coast's Largest*, Renewable Energy World.com (Jan. 18, 2011), http://www.renewableenergyworld.com/rea/partner/standard-solar-inc/news/article/2011/01/solarinstallation-at-perdue-to-be-one-of-east-coasts-largest/. (RenewableEnergyWorld.com 2011) (Ex. NRC000037).

- [AJK, KAC] Southern Co. and Georgia Institute of Technology, Southern Winds: Summary Project Report 2007: A Study of Wind Power Generation Potential off the Georgia Coast (2007), *available at* http://www.energy.gatech.edu/research/Summary-Southern-Winds.pdf (Southern and GIT 2007) (Ex. NRC000034).

- [AJK, KAC] Samir Succar & Robert H. Williams, Princeton University: Energy Systems Analysis Group, Compressed Air Energy Storage: Theory, Resources, and Applications for Wind Power (2008), *available at* http://www.princeton.edu/~ssuccar/caesReport.html (Succar and Williams 2008) (Ex. NRC000040).

- [AJK, KAC] Tina Casey, *Baltimore GM Factory Grows with Solar Power*, TriplePundit (May 23, 2011), http://www.triplepundit.com/2011/05/baltimore-gm-solar-power/ (TriplePundit 2011) (Ex. NRC000038).

- [AJK, KAC] UniStar Nuclear Energy, Calvert Cliffs Nuclear Power Plant Unit 3 Combined License Application, Part 1: General Information, Revision 7, Section 1.1.3 (Dec. 20, 2010) (ML103620352) (UniStar 2010) (Ex. NRC000011).

- [AJK] U.S. Department of Energy, Energy Information Administration, An Updated Annual Energy Outlook 2009 Reference Case Reflecting Provisions of the American Recovery and Reinvestment Act and Recent Changes in the Economic Outlook, SR/OIAF/2009-03 (2009), *available at* http://www.eia.doe.gov/oiaf/servicerpt/stimulus/index.html (ML100490743) (DOE/EIA 2009) (Ex. NRC000033).

- [AJK, KAC] U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook 2010, DOE/EIA-0383, Tables A9 and 90 (2010), *available at* http://www.eia.doe.gov/oiaf/archive/aeo10/index.html (ML111170385) (DOE/EIA 2010a) (Ex. NRC000035).

- [AJK, KAC] U.S. Department of Energy, Energy Information Administration, Levelized Cost of New Generation Resources in the Annual Energy Outlook 2011 (2010), *available at* http://205.254.135.24/oiaf/aeo/electricity_generation.html (DOE/EIA 2010b) (Ex. NRC000021).

- [AJK, KAC] *Electricity Terms and Definitions*, U.S. Department of Energy, Energy Information Administration, http://www.eia.gov/cneaf/electricity/page/glossary.html (last visited on Sept. 19, 2011) (DOE/EIA 2011a) (Ex. NRC000012).

- [AJK, KAC] U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook 2011, DOE/EIA-0383, Table 58.9 (2011), available at http://www.eia.gov/oiaf/aeo/tablebrowser/#release=AEO2011&subject=0-AEO2011&table=67-AEO2011&region=3-9&cases=ref2011-d020911a (DOE/EIA 2011b) (Ex. NRC000022).

- [AJK, KAC] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, 2008 Solar Technologies Market Report (2010), *available at* http://www1.eere.energy.gov/library/asset_handler.aspx?src=http://www1.eere.energy.gov/solar/pdfs/46025.pdf&id=4129 (DOE/EERE 2010) (Ex. NRC000036).

- [AJK, KAC] U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, 2010 Wind Technologies Market Report (2011), *available at* http://www1.eere.energy.gov/windandhydro/pdfs/51783.pdf (DOE/EERE 2011) (Ex. NRC000029).

- [AJK, KAC] U.S. Department of Interior, Interior Initiates Process for First "Smart for the Start" Lease for Commercial Wind Power Offshore Delaware: Determines No Competitive Interest for Area Proposed by NRG Bluewater Wind Delaware, LLC (2011), *available at* http://www.doi.gov/news/pressreleases/Interior-Initiates-Process-for-First-Smart-from-the-Start-Lease-for-Commercial-Wind-Power-Offshore-Delaware.cfm (ML110950238) (DOI 2011) (Ex. NRC000027).

- [AJK] U.S. Department of the Interior, Minerals Management Service, Cape Wind Energy Project, Final Environmental Impact Statement (2009), *available at* http://www.boemre.gov/offshore/RenewableEnergy/CapeWindFEIS.htm (MMS 2009) (Ex. NRC000032).

- [AJK] U.S. Nuclear Regulatory Commission, NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Volume 1, Section 8.3.1 & Table 8.1 (1996), *available at* http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437/ (NRC 1996) (Ex. NRC000031).

- [AJK, KAC] U.S. Nuclear Regulatory Commission, NUREG-1555, *Environmental Standard Review Plan -- Standard Review Plans for Environmental Reviews for Nuclear Power Plants*, Rev. 1, Sections 8.4, 9.2.1, 9.2.2, 9.2.3 (2007) (ML071810034, ML071830296, ML071830302, ML071830304) (NRC 2007) (Ex. NRC000008).

- [AJK] U.S. Nuclear Regulatory Commission, Staff Memorandum from Andrew Kugler, Senior Project Manager, to Brent Clayton, RENV Branch Chief, *Supplemental Staff Guidance to NUREG 1555, "Environmental Standard Review Plan," (ESRP) for Alternatives Reviews* (Apr. 26, 2010) (ML100840031) (NRC 2010a) (Ex. NRC000009).

- [AJK, KAC] U.S. Nuclear Regulatory Commission, Staff Memorandum from Jack Cushing, Senior Project Manager, to Brent Clayton, RENV Branch Chief, *Supplemental Staff Guidance for Cumulative Effects Analysis* (Apr. 8, 2010) (ML100990271) (NRC 2010b) (Ex. NRC000010).

- [AJK, KAC] U.S. Nuclear Regulatory Commission, NUREG-1936, *Final Environmental Impact Statement for Combined Licenses (COLs) for Calvert Cliffs Nuclear Power Plant, Unit 3: Final Report*, Volumes 1 and 2 (May 2011) (ML11129A167, ML11129A179) (Ex. NRC000003A, NRC000003B).

- [AJK, KAC] *Cape Wind Energy Project Permit Application Cape Wind Associates, LLC*, U.S. Army Corps of Engineers, http://www.nae.usace.army.mil/projects/ma/capeWind.htm (last visited Oct. 19, 2011) (USACE 2011) (Ex. NRC000030).

Q9. What is the Review Team as referred to in the FEIS?

A9. [AJK] The Review Team is composed of NRC Staff, NRC contractors, and staff from the U.S. Army Corps of Engineers (Corps). FEIS at 4-2 (Ex. NRC000003A). The NRC is the lead agency and the Corps is a cooperating agency on the preparation of the Calvert Cliffs Unit 3 EIS, in accordance with the updated Memorandum of Understanding between the Corps and the NRC. *See* 73 Fed. Reg. 55,546 (Sept. 25, 2008) (Ex. NRC000007). The NRC and the Corps established this cooperative agreement because both agencies have concluded it is the most effective and efficient use of Federal resources in the environmental review of a proposed new nuclear power plant. The goal of this cooperative agreement is the development of EISs for new reactor applications that provide all the environmental information and analyses needed by the NRC to make a license/permit decision and all the information needed by the Corps to make a permit decision. The Corps did not participate in the preparation of this testimony.

OVERVIEW OF THE REVIEW TEAM'S ENERGY ALTERNATIVE ANALYSIS IN THE FEIS

Q10. What is the NRC guidance regarding the review of energy alternatives?

A10. [AJK] The guidance published in the Environmental Standard Review Plan (ESRP) (NUREG-1555), Chapter 9, Sections 9.2.1 through 9.2.3, as modified by a

memorandum dated April 26, 2010, provides the basis for the NRC Staff's review of the combination of energy alternatives in an EIS. NRC 2007, 2010a (Ex. NRC000008, NRC000009). As part of this review, the Review Team assesses the environmental impacts of technically feasible and commercially viable energy alternatives available in the region of interest that would be able to meet the purpose and need of the project (NRC 2007) (Ex. NRC000008), and supply the projected demand for electrical energy identified in the need for power analysis in Chapter 8 of the FEIS. (Ex. NRC000003A). The feasibility of offsetting energy supply needs through conservation and other demand-side management measures is also considered as part of the energy alternatives analysis, as are power purchases from other utilities outside the applicant's power system and reactivation or extended plant life within the power system.

Regarding the combination of energy alternatives in particular, ESRP 9.2.2, page 9.2.2-3, states, "[t]he reviewer should review the alternative energy sources and combinations of sources available to the applicant, and categorize them as either competitive or noncompetitive with the proposed project. A competitive alternative is one that is feasible and compares favorably with the proposed project in terms of environmental and health impacts. If the proposed project is intended to supply baseload power, a competitive alternative would also need to be capable of supplying baseload power. A competitive alternative could be composed of combinations of individual alternatives." NRC 2007 (Ex. NRC000008). It also states that, for electrical power generation, "[t]he energy conversion technology should be developed, proven, and available in the relevant region." *Id*. And "[t]he alternative energy source should provide generating capacity substantially equivalent to the capacity need established by the reviewer of ESRP 8.4." *Id*. In addition, ESRP 9.2.2 states that the scope of the review should be directed by regional energy plans from State or regional authorities and by the extent to which the energy sources may be considered as commercially exploitable. *Id*.

Q11. How does the Review Team go about determining which alternative sources of

energy could reasonably be expected to meet the demand for additional generating capacity of a proposed project?

A11. [AJK] This analysis is essentially forward looking. The Review Team must consider not only what alternative sources of energy are currently viable and at what levels, but what technologies and capacities will be viable within the timeframe of the proposed action. The NRC Staff used a methodology very similar to that which is used for cumulative impacts analysis to identify those alternative energy projects that are reasonably expected (in the language of ESRP 9.2.2), or reasonably foreseeable (in the language of cumulative impacts analysis). When considering future actions, NRC guidance (adapted from NRC 2010b) (Ex. NRC000010) indicates that the following may fall under the definition of reasonably foreseeable: (1) actions which have been approved by the proper authorities, have submitted license/permit applications, or which may not require approval of a regulating agency, but for which procurement contracts have been signed; (2) actions conditioned upon approval of the project under review. Actions that are not reasonably foreseeable are those that are based on mere speculation or conjecture, or those that have only been discussed on a conceptual basis. Future actions that do not fall under the definition of reasonably foreseeable, but could potentially take place as indicated by trending in the vicinity or less formal communications, may be addressed in a general manner.

While the guidance in NRC 2010b was specifically developed for cumulative impacts analysis, the Staff used this same approach to identify those energy sources that would be included in the evaluation of energy alternatives, consistent with ESRP 9.2.2.

Q12. What was the approach the Review Team used to develop the combination of energy alternatives?

A12. [AJK, KAC] The combination of energy alternatives was developed such that, collectively, the combination of generation and demand-side management strategies could

reasonably replace the proposed generation from a 1600 megawatt-electric (MW(e)) baseload plant supplying power to the State of Maryland. There are many possible combinations of alternatives. The Review Team followed the methodology and guidance set out in the ESRP to determine a combination of energy alternatives for baseload power that was technically feasible and commercially viable in the region of interest (Maryland) in the timeframe of the proposed project. NRC 2007 (Ex. NRC000008). The Review Team minimized the environmental impacts of the combination of energy alternatives by including renewable energy sources in amounts that were determined to be achievable within the timeframe of the proposed project. The estimated commercial operations date for Calvert Cliffs Unit 3 used in the FEIS was December 2015.[3] FEIS at 8-1 (Ex. NRC000003A).

Q13. What is a baseload power generation plant?

A13. [AJK, KAC] A "Baseload Plant" as defined by the DOE's Energy Information Administration (DOE/EIA) is one that houses high-efficiency steam-electric units, which are normally operated to take all or part of the minimum load of a system, and which consequently produce electricity at an essentially constant rate and run continuously. These units are operated to maximize system mechanical and thermal efficiency and minimize system operating costs. DOE/EIA 2011a (Ex. NRC000012). Also, "Base load power plants typically have annual load capacity factors that exceed 75%, but usually are more like 90% to 98%. Power plants that fall into this category can be large (400 megawatts (MW) and larger) fossil fueled plants (coal, natural gas or–less often–fuel oil) as well as nuclear plants." Hynes 2009 (Ex. NRC000013).

Q14. What is the capacity factor of a power plant?

A14. [AJK, KAC] The capacity factor is the ratio of the actual energy produced in a given period to the maximum rated output (i.e. running full time). For example, the following

[3] The Staff notes in the "General Information" section of the *Calvert Cliffs Nuclear Power Plant Unit 3 Combined License Application* Revision 7 (UniStar 2010) (Ex. NRC0000011), the applicant states the current projected date for the completion of construction of Unit 3 is December 31, 2017. This 2-year change does not impact the analysis of energy alternatives in the FEIS.

equation would represent the capacity factor for a power plant with a rated capacity of 1,000 MW that produces 648,000 megawatt-hours (MWh) in a 30-day month:

$$\frac{648{,}000\ \mathrm{MW*hours}}{(30\ \mathrm{days})*\frac{24\mathrm{hours}}{\mathrm{day}}*1000\mathrm{MW}} = 0.90 \text{ (or 90\%)}$$

Q15. How did the Review Team define the purpose and need of the proposed project?

A15. [AJK, KAC] In the case of the Calvert Cliffs Unit 3 application, the purpose and need defined by the Review Team is to provide baseload power generation for the State of Maryland. FEIS at 1-9 (Ex. NRC000003A). The Review Team developed this purpose and need based upon the application and the need for baseload power within the State of Maryland (FEIS at 8-6 to 8-7) (Ex. NRC000003A), as stated by the Maryland Public Service Commission (MPSC) in the Certificate of Public Convenience and Necessity (CPCN) it issued to the applicant on June 26, 2009 (MPSC 2009a) (Ex. NRC000014) affirming the Proposed Order of Hearing Examiner (MPSC 2009c at 52 to 53) (Ex. NRC000015). The Review Team recognizes the MPSC as the expert on the subject of the need for power in Maryland. In the FEIS, the Review Team concluded that the process used by the MPSC in granting the CPCN was systematic, comprehensive, subject to confirmation, and responsive to forecast uncertainty; thus, the process was consistent with the ESRP, and therefore the Review Team gave great weight to the MPSC's conclusions. ESRP 8.4 at 8.4-7 (Ex. NRC000008); FEIS at 8-8 to 8-9 (Ex. NRC000003A).

Q16. Why does the Review Team focus its analysis in the FEIS on energy alternatives on baseload power generation?

A16. [AJK, KAC] As discussed above, for the Calvert Cliffs Unit 3 combined license application, the purpose and need defined by the Review Team is to provide baseload power generation for the State of Maryland. FEIS at 1-9 (Ex. NRC000003A). As stated in ESRP 9.2.2, if the proposed project is intended to supply baseload power, a competitive alternative would

also need to be capable of supplying baseload power. NRC 2007 ESRP 9.2.2 at 3 (Ex. NRC000008). As part of this review, the Review Team assessed the environmental impacts of technically feasible and commercially viable energy alternatives that would be available in Maryland, able to meet the purpose and need of the project in the timeframe of the proposed project, and supply part of the projected demand for electrical energy identified in Chapter 8 of the FEIS (Ex. NRC000003A).

Q17. How did the Review Team determine which energy sources would contribute to combination of energy alternatives?

A17. [AJK, KAC] In Section 9.2.3 of the FEIS, the Review Team evaluated alternative energy sources, including oil, wind, solar, hyrdropower, geothermal, wood waste, municipal solid waste, other biomass, and fuel cells. For the combination of energy alternatives, the Review Team considered which of these sources to include and what amount they could contribute. While any number of options and variations is theoretically possible, the Review Team selected those alternative energy sources that are available in Maryland, and at levels of contribution that the Review Team reasonably expects can be achieved to meet the purpose and need of the project within the timeframe of the proposed project. In keeping with NEPA principles, the Review Team established a reasonable combination of energy alternatives to meet the purpose and need for the proposed project that is not inconsistent with energy plans and planning documents for Maryland. See MPSC *Ten-Year Plan (2008-2017) of Electric Companies in Maryland*. MPSC 2009b (Ex. NRC000016) and MPSC *Electric Supply Adequacy Report of 2007*. MPSC 2007 (Ex. NRC000017).

The Review Team concluded that coal and natural gas power plants were feasible alternatives to the proposed project. FEIS Section 9.2.2 (Ex. NRC000003A). In Section 9.2.3 of the FEIS the Review Team evaluated a number of other individual alternatives to the operation of an additional nuclear unit at the proposed site, each of which was insufficient on its own to generate the equivalent of Calvert Cliff Unit 3's proposed 1600 MW(e) because of the small size

of the resource or lack of cost-effective opportunities in Maryland. The value of 1600 MW(e) was used by the Review Team based on the application and the demonstrated need for power in the region of interest (i.e., Maryland) as discussed in Chapter 8 of the FEIS. FEIS at 8-9 to 8-10 (Ex. NRC000003A). The Review Team determined that it was conceivable that a combination of alternatives might be feasible and cost-effective. FEIS at 9-27 (Ex. NRC000003A). Because the only alternatives that were sufficient to individually generate baseload power equivalent to the proposed Calvert Cliffs Unit 3 were fossil-fired generation (i.e., coal-fired and natural gas-fired), which also produce emissions of air pollutants associated with global climate change (e.g., carbon dioxide), the Review Team integrated renewable resources and demand-side management into the combination of energy alternatives, as discussed below.

Q18. How did the Review Team apportion the energy sources within the combination of alternatives?

A18. [AJK, KAC] The apportionment of energy sources within the combination of alternatives is based on data from authoritative sources using an approach that is consistent with the ESRP. The Review Team did not speculate concerning the achievement of theoretical maximums (i.e., converting “potential” into reality) for individual energy technologies. Rather, the Review Team struck a balance between the limited implementation successes for energy technologies such as wind and solar, and the potential of those resources in Maryland. The Review Team relied upon the insights of the DOE, as the agency responsible for energy planning in the U.S., as a reliable source for future predictions and market analyses. To the degree that information unique to the State of Maryland was available, the Review Team adjusted the DOE predictions for renewable energy production upward when it determined that it was appropriate to do so. The resulting combination represents what the Review Team concludes could be reasonably achieved within the region of interest and the timeframe of the proposed project. More detailed discussions of the Review Team’s evaluations for wind and solar power are provided below. While it is possible to speculate on different contributions to

the combination of alternatives, as discussed below, any combination will include a significant fossil-fuel component with its commensurate environmental impacts. FEIS at 9-28 (NRC000003A).

Q19. Does the Review Team consider "reasonably foreseeable" or "theoretically possible" energy alternatives in its analyses?

A19. [AJK, KAC] The energy alternatives that the Review Team considered are "reasonably foreseeable" as opposed to theoretically possible or maximally possible. The Review Team used the definition of "reasonably foreseeable" that is provided in NRC Staff guidance. NRC 2010b (Ex. NRC000010). The discussion of this methodology as applied to the wind and solar contributions to the combination of energy alternatives is provided in separate subsections below.

Q20. How did the consideration of "reasonably foreseeable" energy alternatives affect the Review Team's selection of the combination of energy alternatives?

A20. [AJK, KAC] In considering what is likely or reasonable versus what might be theoretically possible, the Review Team recognized that there are a number of energy projects that are conceived or proposed that never come to fruition. Considering, for example, wind power projects in Maryland, the MPSC's "Ten-Year Plan (2009 – 2018) of Electric Companies in Maryland" (MPSC 2010 (Ex. NRC000018)), updated June 29, 2010, Table III.C.1 illustrates that the MPSC received and approved applications for CPCNs for four onshore wind projects in Maryland. Of these four, two (totaling 120 MW capacity) have been built and are operating. The other two (totaling about 110 MW capacity) have been suspended. In the report, MPSC stated that it does not have any other requests for CPCNs for wind power. This report illustrates two points. First, only half of the wind projects that received CPCNs were built. Second, there is little or no current activity in terms of requests for future wind facilities in Maryland. Similarly,

in its *Long Term Resource Assessment 2009 – 2018*, the ReliabilityFirst Corporation (RFC)[4] assigns the Bluewater Wind project in Maryland a "confidence factor" of 21.6% (RFC 2009, page 31, Queue ID T122) (Ex. NRC000019). The confidence factor is used by RFC to estimate the portion of conceptual capacity to include in its planning. The relatively low percentage is an indicator that a high percentage of proposed projects are never completed.

In its June 25, 2010 submission of Contention 10, the Joint Intervenors point to the potential for offshore wind, and to offshore wind projects that have been "proposed and approved that will feed directly into Maryland and the PJM service area." Submission of Contention 10 by Joint Intervenors at 7-8 (June 25, 2010). The Joint Intervenors also specifically refer to the 600 MW(e) Bluewater Wind project that has been proposed off the coast of Maryland.

Based on the NRC Staff guidance, the Review Team did not equate the "potential" of wind energy off the coast of Maryland with a technically feasible and commercially exploitable electric generation resource in the region of interest. "Potential" projects do not provide any power to the grid unless and until they are completed projects. In addition, as will be discussed further below, the Bluewater Wind project off the coast of Maryland has been announced, but has not progressed to the point at which the Review Team considers it to be reasonably foreseeable.

In summary, for the combination of energy alternatives, the Review Team did not use a value for wind energy, or any other energy source in the combination of energy alternatives, based on what was theoretically possible. Rather, the Review Team used a value based on what it determined was reasonably foreseeable in the region of interest and in the timeframe of the proposed project.

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[4] ReliabilityFirst Corporation is one of eight regional electric reliability councils that sets and enforces electric reliability standards. Maryland is in the ReliabilityFirst Corporation territory. RFC 2011 (Ex. NRC000020).

Q21. What was the combination of energy alternatives that was selected and evaluated by the Review Team in the FEIS?

A21. [AJK, KAC] The Review Team developed the following as its combination of energy alternatives for detailed evaluation: 1200 MW(e) of natural gas combined-cycle generating units at the Calvert Cliffs site; 25 MW(e) from hydropower; 75 MW(e) from solar power; 100 MW(e) from biomass sources, including municipal solid waste; 100 MW(e) from conservation and demand-side management programs (beyond what is currently planned); and 100 MW(e) from wind power.

Q22. What were the key assumptions made by the Review Team in selecting and evaluating the combination of energy alternatives in the FEIS?

A22. [AJK, KAC] The combination of energy alternatives was developed based on the following considerations. The wind and solar power contributions would need to be coupled with a storage mechanism such as compressed air energy storage (CAES) to provide baseload power. For wind power, 100 MW(e) equates to at least 250 to 300 MW(e) of installed capacity[5] coupled with a 100 MW(e) CAES plant. The contribution from solar power was determined to be smaller because of the marginal solar power potential for large-scale projects in the Maryland region. FEIS at 9-28 (Ex. NRC000003A). The Review Team developed this combination after researching information from reliable sources such as the DOE/EIA (which is tasked with estimating the future contributions to electrical generation of various sources), DOE/EERE, the National Energy Technology Laboratory (NETL), the National Renewable Energy Laboratory (NREL), and the MPSC. The bases behind key assumptions related to the contributions of wind, solar and natural gas are described in more detail below.

[5] Note that this amount of capacity is based simply on the capacity factor of wind. It ignores the fact that there will be extended periods of low wind that will exhaust the stored energy capacity of the CAES facility, requiring some other source of electrical power to back up the wind/CAES combination.

Q23. Did the Review Team consider the possible ranges of contributions of renewable energy resources to the combination of energy alternatives?

A23. [AJK, KAC] Yes. The Review Team did not begin its review with any preconceived ideas about how much energy each resource could provide to a combination of alternatives. Rather, starting from the information developed for each resource in Section 9.2.3 of the FEIS (Ex. NRC000003A), the Review Team derived contributions of renewable resources to the combination of energy alternatives that it concluded were realistic within the region of interest (Maryland) and within the timeframe of the proposed project. In taking this approach, the Review Team realizes that the actual contributions from renewable sources that develop over the next several years could be higher or lower than those used by the Review Team. But, as discussed above, the Review Team approach used reasonable contributions to the combination of energy alternatives, as NEPA requires.

After developing the contributions of renewable energy resources, the Review Team found that the total of the contributions was significantly less than the 1600 MW(e) baseload generation target. Therefore, the Review Team included a non-renewable source to bring the capacity of the combination of energy alternatives to 1600 MW(e).

Q24. Why does the Review Team's combination of energy alternatives in the FEIS include fossil-fired generation?

A24. [AJK, KAC] Given that the purpose and need as defined by the Review Team is for new baseload generation capacity (FEIS at 1-9) (Ex. NRC000003A), the combination of energy alternatives must be capable of providing baseload generating capacity "substantially equivalent to the capacity need established by the reviewer of ESRP 8.4." NRC 2007 ESRP 9.2.2 at 3 (Ex. NRC000008). A viable alternative to the proposed project must be developed, proven, and available to be placed in service within the timeframe of the proposed project. NRC 2007 ESRP 9.2.2 at 3 to 4 (NRC000008).

In Sections 9.2.2 and 9.2.3 of the FEIS, the Review Team concluded that, besides coal and natural gas-fired generation, the other potential generating sources were not feasible individually as alternatives to the proposed nuclear plant because they could not reasonably be expected to generate baseload power in Maryland in quantities substantially equivalent to, and in the timeframe of, the proposed project. FEIS at 9-20 to 9-27 (Ex. NRC000003A). As discussed above, the total contribution from renewable energy sources in concert with conservation and demand-side management was much less than the 1600 MW(e) baseload target. Therefore, the Review Team concluded that a fossil energy source, most likely coal or natural gas, would need to be a significant contributor to any technically feasible and commercially exploitable combination of energy alternatives to ensure a dispatchable source of baseload generation in the timeframe of the proposed project. The need for a significant contribution to the combination of energy alternatives by a fossil-fueled energy source is supported by the Review Team's evaluation of non-fossil-fueled energy sources (i.e., those other than coal and natural gas) in Section 9.2.3 of the FEIS (Ex. NRC000003A).

Q25. How did the Review Team determine what portion of the energy alternatives combination should be fossil-fired generation?

A25. [AJK, KAC] To determine the magnitude of the fossil-fired contribution to the combination, the Review Team first developed what it determined to be reasonably foreseeable contributions from wind and solar power. The Review Team then did the same to develop contributions from other sources that it determined to be probable contributors: hydropower, biomass (including municipal solid waste), and conservation and demand-side management programs. These added up to a baseload equivalent of 400 MW(e). Having determined the total contribution to the baseload need from renewable sources and conservation/demand-side management, the Review Team allocated the remaining 1200 MW(e) of baseload need to a non-renewable source. Of the two options for this component of the combination of alternatives, coal and natural gas, natural gas would involve less environmental impacts. *See* FEIS Table 9-

4; FEIS at 9-30 (Ex. NRC000003A). Based on this, the Review Team selected a 1200 MW(e) natural gas plant to complete the combination of energy alternatives. This approach yields a combination of energy alternatives with the least environmental impacts overall.

Q26. Does the combination of energy alternatives selected and evaluated by the Review Team depend excessively on natural gas, as alleged by the Intervenors?

A26. [AJK] No. Contention 10C alleges that the combination of alternatives developed by the Review Team "depends excessively on the natural gas supplement, thus unnecessarily burdening this alternative with excessive environmental impacts." 2010 Order at 46. As discussed above, the approach used by the Review Team developed an alternative that included the maximum contribution from renewable sources that would be reasonably foreseeable within the region of interest and within the timeframe of the proposed project. In doing so, the Review Team minimized the size of the contribution from natural gas.

In addition, in the FEIS the Review Team illustrated that another scenario, with the contribution from wind power quadrupled, would not have led to a significant difference in the environmental impacts of the combination of energy alternatives. FEIS at 9-28, 9-30 (Ex. NRC000003A). This scenario, with an installed wind capacity of 1000 to 1200 MW(e), would involve an addition of wind power considerably larger than the proposed Bluewater Wind project off the coast of Maryland. But as previously discussed, the Review Team does not consider the Bluewater Wind project off the coast of Maryland to be reasonably foreseeable at this time.

Q27. What is a merchant plant and does Calvert Cliffs Unit 3's status as a proposed merchant plant impact the evaluation of combination of alternatives?

A27. [AJK, KAC] A merchant plant is an electric generator not owned and operated by an electric utility. It sells its output to wholesale and/or retail customers. Merchant plants may also be called nonutility generators or independent power producers.

Calvert Cliffs Unit 3's status as a proposed merchant plant did not impact the evaluation of the combination of alternatives. The Review Team still focused its review on developing and

evaluating a combination of energy alternatives to a 1600 MW(e) baseload electric generating plant that are technically feasible, commercially viable, and available in the region of interest in the timeframe of the proposed project. The Joint Intervenors expressed a concern that, as a merchant plant, there "is no assurance that any electricity from Calvert Cliffs-3, as a merchant power plant, will be sold or used in Maryland." Submission of Contention 10 by Joint Intervenors at 5 (June 25, 2010). However, as stated in the FEIS, Maryland currently imports a significant percentage of its electric power, approximately 30% of its electric power in 2006. FEIS at 8-5 (Ex. NRC000003A). In 2007, the MPSC issued its *Electric Supply Adequacy Report of 2007*. MPSC 2007 (Ex. NRC000017). Among its findings were (1) Maryland cannot meet its own electricity needs from internal resources and has not done so for more than 15 years, and (2) if new generating capacity is not built and/or upgrades to the transmission system are not made, the likelihood of a reliability crisis in Maryland, and eastern PJM Interconnection, LLC, generally, will increase and may become unavoidable. *Id.*; FEIS at 8-6 to 8-7 (Ex. NRC000003A).

Aware that the proposed Calvert Cliffs Unit 3 would be a merchant plant, the MPSC issued its CPCN. Among its conclusions, the MPSC found that (1) Unit 3 would constitute a new large source of power that would be of benefit to the citizens and the State of Maryland, (2) Unit 3 would be a welcome source of baseload power designed to run continuously, which would help peak period congestion on transmission lines within Maryland to the benefit of the public, and (3) Unit 3 would have a positive effect on the reliability and stability of the electric system and would be a beneficial power source for Maryland and the electric grid in general. MPSC 2009a at 2-3 (Ex. NRC000014), affirming the Proposed Order of Hearing Examiner (MPSC 2009c at 52 to 53) (Ex. NRC000015). The Review Team relied upon these findings by the State of Maryland to support the Review Team's use of Maryland as the region of interest for the evaluation of energy alternatives.

EVALUATION OF WIND AND SOLAR POWER

Q28. Are wind and solar generation resources considered baseload resources?

A28. [AJK, KAC] No, they are intermittent resources because the energy available from wind and the sun naturally varies over a wide range at a given location. Thus, wind and solar power plants often produce substantially less than their design output or "capacity," to as little as zero output, for example, when the wind is not blowing for wind power or at night for solar power. The intermittent nature of these renewable resources is the primary reason that they have substantially lower capacity factors than fossil and nuclear baseload generation. In addition, these intermittent resources are not "dispatchable" – that is, you cannot necessarily start them up when you most need them.

Q29. Can an intermittent resource provide baseload generation?

A29. [AJK, KAC] As previously mentioned, baseload power generators are designed to produce electricity at an essentially constant rate and run continuously. An intermittent power source, by itself, would not be able to supply baseload power.

Q30. How did the Review Team address the power generation capacity factors related to large-scale wind and solar powered facilities versus coal or natural gas powered facilities?

A30. [AJK, KAC] In the case of the Calvert Cliffs Unit 3 application, the purpose and need, as defined by the Review Team, is to provide baseload power generation for the State of Maryland. FEIS at 1-9 (Ex. NRC000003A). Baseload power plants typically have annual capacity factors around 80 to 90%, where the capacity factor is the ratio of actual power output over some given period of time and its potential output if it operates at full capacity. Coal-fired generation facilities typically operate with an average annual capacity factor around 85%. DOE/EIA 2010b (Ex. NRC000021). This means that a coal-fired unit rated (i.e., nameplate) at 100 MW capacity would generate approximately 100 MW x 0.85 x 365 days/year x 24 hours/day = 744,600 MWh per year. Wind generation has a lower capacity factor than fossil-based generation, such as coal or natural gas. DOE/EIA reports that newer installations of wind

turbines have capacity factors around 34%. DOE/EIA 2010b (Ex. NRC000021). Thus, a wind farm with a generation capacity of 100 MW would generate approximately 100 MW x 0.34 x 365 days/year x 24 hours/day = 297,840 MWh per year. Additionally, as previously mentioned, the megawatt-hour generation from the wind facility is not dispatchable power, as it would not necessarily be available at any given time.

DOE/EIA reports an average capacity factors for solar generation around 18 to 25%. DOE/EIA 2010b (Ex. NRC000021). A 100 MW(e) solar generation facility would generate approximately 100 MW x 0.25 x 365 days/year x 24 hours/day = 219,000 MWh per year, using the 25% capacity factor. As with wind, this power is not dispatchable power. The Review Team considered these corresponding capacity factors when developing the combination of alternatives for baseload generation and in comparing the feasibility of one form of generation to another.

WIND CONTRIBUTION

Q31. What information did the Review Team consider in determining the contribution of wind power generation to the combination of energy alternatives in the FEIS?

A31. [AJK, KAC] Because the Review Team was developing and evaluating a combination energy alternative that would need to be operational by approximately 2015, the Review Team relied on shorter-term projections from reliable sources to inform its evaluation. In its Annual Energy Outlook 2011 (DOE/EIA 2011b; NRC000022), DOE/EIA provides an estimate of the growth in onshore and offshore wind capacity in the ReliabilityFirst Corporation/East region (which includes New Jersey, Delaware, and most of Maryland and Pennsylvania). In addition, the Review Team relied on information from the MPSC (MPSC 2008b, 2009b (Ex. NRC000023, NRC000016)) as well the NREL report (Ex. NRC000024), which considers the offshore wind energy potential throughout the United States, as well as proposed U.S. offshore wind projects and capacities.

Q32. How did the Review Team consider Maryland's wind development potential in the FEIS?

A32. [AJK, KAC] ESRP 9.2.2 states that the scope of the review should be directed by regional energy plans from State or regional authorities and by the extent to which the energy sources may be considered as commercially exploitable. Ex. NRC000008. As previously indicated, the Review Team relied on reliable sources of information to inform its review. In addition to Federal sources (such as the DOE and its National Laboratories), the Review Team also considered information unique to the State of Maryland. The MPSC considered the potential for wind power in Maryland in a 2008 report (MPSC 2008b (Ex. NRC000023)) and concluded the economic benefits from renewables remain uncertain and challenging. Onshore wind yields net economic benefits, albeit on a small scale. Offshore wind, as modeled in the report, does not yield economic benefits. FEIS at 9-20 (Ex. NRC000003A).

There is utility-scale wind energy in Maryland; but there are only two moderate-sized projects (50 and 70 MW), and they are both onshore projects. Gestamp 2011 (Ex. NRC000025); Constellation 2010 (Ex. NRC000026). No Maryland wind projects are approved for offshore locations. The first of the two operating wind projects in Maryland, the 70 MW Criterion onshore wind project, went online in December 2010. Constellation 2010 (Ex. NRC000026). The other, the 50 MW onshore Roth Rock project, went online in July 2011. Gestamp 2011 (Ex. NRC000025). The NRG Bluewater Wind project off the nearby Delaware coast in Federal waters is currently planned to have a capacity of 450 MW(e), of which 293 MW(e) has been allocated to power purchase agreements. DOI [U.S. Department of Interior] 2011 (Ex. NRC000027). The project would be located approximately 11 miles east of Dewey Beach, Delaware. *Id*. NREL did not identify any other wind energy projects off the coast of Maryland or adjoining States (Delaware and Virginia) in either State or Federal waters that it considered sufficiently advanced to include in its report. *See* FEIS at 9-23 (Ex. NRC000003A).

According to the MPSC "Ten-Year Plan (2009 – 2018) of Electric Companies in Maryland" (MPSC 2010 (Ex. NRC000010)), there are no other active wind projects in Maryland of which MPSC is aware.[6] Based on this information, the Review Team concluded that significant development of wind generation in Maryland is not likely in the timeframe of the proposed project.

Q33. In addition to its review of Maryland's overall potential for wind development, did the Review Team consider Maryland's offshore wind potential in particular?

A33. [AJK, KAC] Yes. The Review Team primarily relied on NREL's 2010 report (Ex. NRC000024) related to large-scale offshore wind in the United States to assess the offshore wind potential in Maryland. The Mid-Atlantic Region (New Jersey to North Carolina) has up to 570 GW of potential offshore wind capacity (page 59, Table 4-2). About 54 GW (less than 10%) is attributable to Maryland, 15 GW (about 3%) to Delaware, and 94 GW (about 16%) to Virginia (pages 60 – 63, Table 4-3). However, the NREL report (Ex. NRC000024) lists only one offshore wind project, NRG Bluewater Wind, Delaware, in the Delaware/Maryland/Virginia area. The report states (pages 30 – 31, Table 3-3), "[a]lthough many more proposals have been made, the projects listed in the table are more advanced, meeting one or more of the following criteria: they have been approved by their state, received an interim lease from BOEM [Bureau of Ocean Energy Management] (2010), or granted a BOEM lease." Another DOE report, DOE/EERE 2011 (Ex. NRC000029), contains similar information, with minor adjustments that do not affect the key information or conclusions drawn from the report.

The Joint Intervenors expressed a concern that the Review Team had not included the Bluewater Wind project off the coast of Maryland in the FEIS. Submission of Amended Contention 10C by Joint Intervenors at 4 (June 20, 2011). The Bluewater Wind project off the

[6] MPSC has updated its ten-year plan. The MPSC "Ten-Year Plan (2010 – 2019) of Electric Companies in Maryland" is consistent with the Review Team's conclusions. MPSC 2011 (Ex. NRC000028).

coast of Maryland is a different project from the NRG Bluewater Wind project off the coast of Delaware listed in the NREL report. The NREL report does not include the Bluewater Wind project in Maryland in the list of projects that have sufficiently advanced because that project has not made any significant progress in the leasing/permitting process. The Review Team did not include this project in the FEIS because, based on the project's status, it is not reasonably foreseeable. As a point of reference, the Cape Wind Project off the coast of Cape Cod, Massachusetts, has been engaged in the leasing/permitting process for over a decade, and has yet to be constructed. Corps 2011 (Ex. NRC000030). Therefore, it is unlikely that a project such as the Bluewater Wind project in Maryland, which has not made any significant progress in the leasing/permitting process, could be operational within the timeframe of the proposed project.

The Review Team reviewed the Wind Technologies Market Report (DOE/EERE 2011 (Ex. NRC000029)), which found, consistent with the 2010 NREL report, that:

> To date, no offshore projects have been installed in the United States, and the emergence of a U.S. offshore wind power market still faces many challenges. Perhaps most importantly, the projected near-term costs of offshore wind energy remain high. Additionally, though political support exists for offshore wind energy in some quarters, planning, siting, and permitting can be challenging, as demonstrated in the long history of the Cape Wind project. Competing uses of offshore waters and public concerns can complicate the process and, despite recent progress in clarifying the permitting procedures in federal waters, uncertainties in federal and state permitting processes remain.

Id. at 10. The MPSC considered the potential for wind power in Maryland in a 2008 report. MPSC 2008b (Ex. NRC000023). Offshore wind, as modeled in the report, does not yield economic benefits. Because of this, development of wind power off the coast of Maryland is unlikely without subsidies or other incentives. Based on this information, the Review Team concluded that offshore wind would not significantly contribute to the combination of energy alternatives in the timeframe of the proposed project.

Q34. How did the Review Team derive the 100 MW(e) wind power contribution to the combination of energy alternatives.?

A34. [AJK, KAC]: As previously mentioned, the Review Team primarily relied on U.S. DOE's Annual Energy Outlook (DOE/EIA 2011b (NRC000022), NREL's 2010 report (Ex. NRC000024) related to large-scale offshore wind in the United States, and MPSC's Ten-Year Plan (MPSC 2009b) (Ex. NRC000016) to determine the likely contribution of wind power to the combination energy alternative. For the RFC/East region, DOE/EIA projects a growth of 420 MW of onshore wind capacity and 200 MW of offshore wind capacity between 2010 and 2035. DOE/EIA 2011b (Ex. NRC000022). If Maryland is conservatively assumed to account for a third of this growth, that would equate to about 210 MW(e). Using 34% for the capacity factor of wind, the 210 MW of capacity equates to about 71 MW of baseload capacity. The Review Team value of 100 MW in the combination of energy alternatives is reasonable in comparison to the DOE/EIA projection. While the data from DOE/EIA are projections, based on the limited wind development in Maryland, the Review Team concluded it would be unreasonable to expect large-scale development of this resource within the timeframe of the proposed project.

Therefore, considering all of this information, the Review Team determined that significant growth in wind energy in Maryland is unlikely within the timeframe of the proposed project. In the combination of energy alternatives, the Review Team assumed the addition of wind generation equivalent to 100 MW(e) of baseload power. For wind power, 100 MW(e) equates to at least 250 to 300 MW(e) of installed capacity coupled with a 100 MW(e) CAES plant. FEIS at 9-28 (Ex. NRC000003A). The Review Team recognizes that the actual growth in wind energy in Maryland could be greater than, or less than, this value. But the Review Team concluded that the selected value represents an optimistic, but achievable, level of wind generation capacity in the region of interest within the timeframe of the proposed project. As such, this is an appropriate value for this NEPA evaluation.

Q35. How does the Review Team respond to the Joint Intervenors' assertion that the FEIS underestimates the wind contribution as part of the combination energy alternatives?

A35. [AJK] The Joint Intervenors have stated that the contribution of wind energy to

the combination of energy alternatives "is grossly underestimated in the DEIS' arbitrary formulation." Submission of Contention 10 by Joint Intervenors at 9 (June 25, 2010). However, the Joint Intervenors appear to have focused on the potential for wind as opposed to reasonably foreseeable development. Such a focus is not in accordance with NEPA or NRC Staff guidance, both of which focus on what is reasonable. In addition, as previously discussed, the formulation of the combination of energy alternatives was not arbitrary, but based on projections from reputable sources and the Review Team's technical judgment of reasonable energy development in the area of interest within the timeframe of the proposed project.

The Review Team considered the Joint Intervenors' comments on the DEIS, which stated that the Review Team had underestimated the contribution of wind energy to the combination of alternatives, and determined that these comments warranted additional discussion of the wind contribution in the combination of energy alternatives in the FEIS. FEIS at 9-28, 9-30, Appendix E at E-82 to E-83. (Ex. NRC000003A and NRC000003B). The Review Team also included in the FEIS a scenario in which it quadrupled the amount of wind power generation coupled with storage. In this scenario, the wind power contribution to the combination of alternatives would be 400 MW(e) of baseload power, equivalent to an installed capacity of at least 1000 (offshore) to 1200 (onshore) MW(e) with a 400 MW(e) CAES plant. This scenario would still require 900 MW(e) from natural gas. A 900 MW(e) natural gas-fired plant would still contribute significant emissions (i.e., 3.2 million tons/yr CO_2, 208 tons/yr NO_X, and 63 tons/yr SO_X, scaled from FEIS Section 9.2.4 (Ex. NRC000003A)) to this scenario, enough that the Review Team would still conclude that the impacts to air quality would be SMALL to MODERATE.

If an onshore wind farm is used with 2.5 MW turbines, roughly 480 wind turbines would be required covering a land area of approximately 60,000 acres to generate 400 MW(e) baseload equivalent. NRC 1996 (Ex. NRC000031). If an offshore wind farm is used with 5 MW turbines, roughly 200 turbines would be required. The 454 MW Cape Wind Project covers

approximately 25 square miles (MMS [U.S. Department of Interior, Minerals Management Service (now the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement] 2009) (Ex. NRC000032). Therefore, a 1000 MW offshore wind project would cover approximately 55 square miles. The CAES plant in this scenario would be larger than any such facility worldwide and offshore wind capacity of this magnitude exceeds by a factor of five or more the amount of offshore wind projected by DOE/EIA for the entire United States by the year 2030. DOE/EIA 2009[7] (Ex. NRC000033). Under this scenario, the impact category levels presented in Table 9-3 of the FEIS (FEIS at 9-29) (Ex. NRC000003A) would not change, except that if the project was onshore, the impacts to land use and terrestrial ecology might become LARGE because of the significant land area that would be used for the wind turbines. If the project was offshore, then increased impacts to aquatic ecology, aesthetics and recreation (as a minimum) would occur from the building and operation of the turbines. Based on the lack of mature proposals for onshore or offshore wind in Maryland (as discussed in other responses above), this scenario could not be implemented in the timeframe for the proposed project, and it is therefore not a reasonable alternative to the proposed action. As described above, the environmental impacts of this scenario would also be greater than the impacts of the proposed action, so this scenario would not be environmentally preferable. FEIS at 9-28, 30 (Ex. NRC000003A). The impacts would also be greater than those of the Review Team's combination of energy alternatives.

Q36. Why did the Review Team not quantify the environmental impacts of the scenario in which the contribution of wind to the combination of energy alternatives was quadrupled?

A36. [AJK] The discussion in the FEIS regarding this scenario was included to frame the range of the Review Team's consideration and to provide the decision makers with additional insights. As such, the Review Team did not quantify the impacts of this scenario

[7] The Review Team found that the DOE/EIA projection for offshore wind power has not changed in the Annual Energy Outlook 2011. DOE/EIA 2011b (Ex. NRC000022).

because it is not part of the combination of energy alternatives that is considered technically feasible and commercially viable in the region of interest within the timeframe of the proposed project, consistent with ESRP 9.2.2. In addition, the Review Team concluded in the FEIS that such a scenario would not be environmentally preferable to the proposed action. FEIS at 9-30 (Ex. NRC000003A).

Q37. Did the Review Team use the Southern Company/Georgia Institute of Technology report to estimate the wind energy potential for Maryland, as alleged by the Joint Intervenors?

A37. [AJK, KAC] No, the Review Team did not use the subject report (Southern and GIT 2007) (Ex. NRC000034) to estimate the wind energy potential for Maryland.

As stated in the FEIS, the Review Team used the report for information related to project costs, the ability of wind turbines to withstand hurricanes, and the Federal regulatory authority related to offshore wind farms. The Review Team maintains that its position as stated in the FEIS, that the conclusions in the subject report related to these issues "would generally apply to a wind farm located offshore of Maryland based on the similarities in the physical and regulatory environments," is correct. This statement in the FEIS has apparently been misunderstood by the Joint Intervenors to mean that the Review Team considers the wind resource and utility regulatory environments in Maryland and Georgia to be similar. This is incorrect. The Review Team drew no such conclusion, and believes that the FEIS clearly articulates that this is not the case. The Joint Intervenors state that the offshore wind potential in Maryland is roughly seven times that of Georgia. The Review Team did not evaluate the offshore wind potential in Georgia, nor compare it to Maryland. Such a comparison is not relevant to the team's analysis because the Review Team's analysis specifically addressed wind resources in Maryland. The Review Team used regionally appropriate data for Maryland from NREL 2010 to estimate Maryland's wind potential. *See* NREL 2010 (Ex. NRC000024).

SOLAR CONTRIBUTION

Q38. What information did the Review Team consider in determining the contribution of solar power to the combination of energy alternatives in the FEIS?

A38. [AJK, KAC] Because the Review Team was developing and evaluating a combination energy alternative that would need to be operational by approximately 2015, the Review Team relied on shorter-term projections from reliable sources to inform the evaluation. The Review Team primarily relied on DOE's Annual Energy Outlook (DOE/EIA 2011b (NRC000022)) and MPSC's Ten-Year Plan (MPSC 2009b (Ex. NRC000016)) to determine the likely contribution of solar power to the combination energy alternative.

Q39. How did the Review Team address Maryland's solar power development potential in the FEIS?

A39. [AJK, KAC] ESRP 9.2.2 states that the scope of the review should be directed by regional energy plans from State or regional authorities and by the extent to which the energy sources may be considered as commercially exploitable. As previously indicated, the Review Team relied on reliable sources of information to inform its review. In addition to Federal sources (such as the DOE and its National laboratories), the Review Team also considered information unique to the State of Maryland. The MPSC considered the potential for solar power in Maryland in a 2008 report (MPSC 2008b (Ex. NRC000023)) and concluded the economic benefits from renewable sources remain uncertain and challenging. For solar energy, the MPSC concluded that the overall economics of solar remain negative, but could improve if technology progresses much faster than contemplated in the report and various financial incentives continue over the long term.

In addition, DOE/EIA does not project the addition of any utility-scale solar thermal or solar photovoltaic power, and limited additions of end-use (i.e., onsite distributed) solar photovoltaic power in the Mid-Atlantic Area Council (now RFC/East, which includes Maryland)

through the year 2035. DOE/EIA 2010a, Table 90 (Ex. NRC000035); FEIS at 9-24 (NRC000003A).

Q40. Did the Review Team consider the potential of end-use (i.e., onsite) distributed solar photovoltaic (or PV) power in its combination of energy alternatives?

A40. [AJK, KAC] Yes. Energy from solar power is available in every part of the country. When the Review Team considered how much solar energy was appropriate to be included in the combination of energy alternatives, it had to consider the likelihood that there would be additions of solar photovoltaic generating capacity in Maryland not only at the utility-scale, but also at the end-use level. Both DOE/EIA (DOE/EIA 2010a, Table 90 (Ex. NRC000035)) and MPSC (MPSC 2008b (Ex. NRC000023)) indicate that any significant development of utility-scale solar power is unlikely in the region of interest; however, DOE/EIA does show some growth in end-use generation. MPSC tempers its conclusion by indicating that if technological advances occur faster than contemplated, the economics of solar power could improve to the point that it would be more cost-effective.

Q41. Why is the solar contribution in the combination of energy alternatives not larger if DOE identifies its potential as "Good"?

A41. [AJK, KAC] The solar potential used in the FEIS was based on regional characteristics and the projections of DOE/EIA and MPSC's ten-year plan. DOE/EIA 2010a, Table 90 (Ex. NRC000035)); MPSC 2009b (Ex. NRC000016). The DOE/EERE 2008 Solar Technologies Market Report, Figure 5.5, page 111, indicates that Maryland has a "Good" solar resource potential on a scale that categorizes solar potential as "Moderate," "Good," "Very Good," or "Excellent." DOE/EERE 2010 (Ex. NRC000036). Placing this into context, the Review Team notes that only Alaska and the northwest corner of Washington State are rated less favorably ("Moderate") than Maryland; and well over half the area of the contiguous United States is rated "Very Good" or "Excellent." *Id*. The rating of "Good" for Maryland does not indicate that solar power will be a significant contributor to generating capacity in the State. As

discussed below, the Review Team determined that the use of DOE/EIA projections was an appropriate source to establish the contribution of solar energy to the combination of energy alternatives.

Q42. How did the Review Team derive the 75 MW solar power contribution to the combination of energy alternatives in the FEIS?

A42. [AJK, KAC] Although DOE and regional sources suggest the solar potential in Maryland is relatively low, because generation from solar is possible and currently available in Maryland, the Review Team integrated a solar power contribution into the combination of energy alternatives to help offset the impacts of the fossil-fueled portion of the alternative. The 75 MW(e) level of contribution was based on DOE/EIA's overall prediction of growth in solar as an end-use generation source and the Review Team's technical judgment of this prediction as authoritative and reasonable. The Review Team assumed that this solar capacity would be coupled with a 75 MW(e) CAES plant. FEIS at 9-28 (Ex. NRC000003A).

DOE/EIA predicts 0 MW for utility solar capacity between 2010 and 2035 in the RFC/East region, and the addition of 810 MW of end-use solar capacity (all photo-voltaic, or PV) in that region over the same period. DOE/EIA 2011b (Ex. NRC000022). End-use facilities are typically of small size because they are only designed to meet a specific local need.

Assuming that Maryland accounts for roughly a third of the RFC/East region, additions of end-use solar capacity in Maryland by 2035 would be about 270 MW. According to DOE/EIA, an average PV capacity factor ranges from 18 to 25% in the U.S. DOE/EIA 2010b (Ex. NRC000021). Using 25% for simplicity, the 270 MW of capacity equates to about 68 MW of baseload capacity. Typical solar-to-electric power plants require 5 to 10 acres for every MW of generating capacity. FEIS at 9-23 (Ex. NRC000003A). Using this number, the 270 MW (75 MW(e) baseload equivalent) solar contribution would impact 1350 to 2700 acres of land and associated terrestrial resources. A larger solar contribution would impact a correspondingly larger land area.

The Review Team concluded that a value of 75 MW in the combination of energy alternatives is reasonable in comparison to the DOE/EIA projection and the MPSC ten-year plan.

Q43. Do the announced solar projects in Maryland, or any that were identified by the Joint Intervenors, conflict with the Review Team's combination of energy alternatives?

A43. [AJK, KAC] No. The Joint Intervenors identified two solar projects that have recently been announced in Maryland: a 3.7 MW solar facility to power two Perdue Farms facilities and a 1.2 MW project to power a new plant making batteries in Baltimore for the Chevrolet Volt automobile. Submission of Amended Contention 10C by Joint Intervenors at 10 (June 20, 2011); RenewableEnergyWorld.com 2011 (Ex. NRC000037); TriplePundit 2011 (Ex. NRC000038). The Perdue Farms solar project is, in fact, two projects, with more than half of the capacity installed at a Perdue facility in Delaware, and the rest at the Perdue Farms headquarters in Maryland. In addition, the output of the facilities is expected to average 3700 MWh per year. Using a 25% capacity factor, this would yield a total capacity for the two projects of 1.7 MW, not 3.7. RenewableEnergyWorld.com 2011 (Ex. NRC000037). The Review Team notes that these two projects have a combined (and intermittent) output of less than 3 MW. Other larger solar power projects (16.1 MW(e) and 20 MW(e), respectively) have been announced in Maryland recently. B'moreGreen 2011 (Ex. NRC000039). These announcements are not inconsistent with the Review Team's analysis and findings which assume the addition of 270 MW of end-user solar power capacity. Most of that growth was expected to occur in the near-term according to DOE/EIA. DOE/EIA 2011b (Ex. NRC000022). Using the same assumption that Maryland accounts for roughly one third of the growth in the RFC/East region, DOE/EIA expected the addition of roughly 60 MW(e) of solar PV generation capacity in 2011 and 2012. These additions of roughly 40 MW(e) of capacity are consistent with that prediction.

ENERGY STORAGE

Q44. What is energy storage and how is it used with electric power generation?

A44. [AJK, KAC] Energy storage is accomplished by devices or physical media that store some form of energy to perform some useful operation, such as electricity generation, at a later time. Energy storage, such as battery storage, CAES, or a pumped storage facility can be coupled with intermittent power sources to simulate a power generation profile comparable to baseload generation.

Q45. What is a CAES facility?

A45. [AJK, KAC] A CAES facility can take power provided by a generation source, such as a wind turbine, and provide the power to compress the air into a storage volume, such as an underground salt cavern or aquifer. In the two existing commercial CAES systems (globally), the compressed air is discharged from the storage volume into a set of gas turbines that are fired with natural gas. The efficiency of the turbines is improved because compression of the inlet air is provided by the CAES facility instead of by the turbine itself. The only operating CAES system in the United States is at the McIntosh Power Plant in Alabama. The CAES system has a capacity of 110 MW(e). Succar and Williams 2008 (Ex. NRC000040). The Review Team is aware of a conceptual design for a CAES system that does not use combustion turbines. However, this design has not been built, tested, or proven. A pilot project for the design is being built in Texas. Houstoncitybizlist 2011 (Ex. NRC000041).

Q46. How did the Review Team consider energy storage for wind and solar in the combination of alternatives in the FEIS?

A46. [AJK, KAC] As discussed in Sections 9.2.3.2, Wind Power, and 9.2.3.3, Solar Power, in the FEIS (Ex. NRC000003A), wind or solar power "in conjunction with energy storage mechanisms such as pumped hydroelectric or CAES, or another readily dispatchable power source, such as hydropower, might serve as a means of providing baseload power." As stated in Section 9.2.3.2 of the FEIS, a pumped storage or other hydroelectric facility is highly unlikely based on the DOE/EIA projection (DOE/EIA 2010a, Table A9 (Ex. NRC000035)) for pumped

storage and the low potential for new hydroelectric development in Maryland. Conner and Francfort 1997 (Ex. NRC000047). For the combination of energy alternatives, the Review Team assumed that the wind and solar contributions would need to be coupled with a storage mechanism such as CAES to provide baseload power. FEIS at 9-28 (Ex. NRC000003A).

Regarding CAES, as discussed in Section 9.2.3.2 of the FEIS (Ex. NRC000003A), to date one facility was built in 1978 (290 MW, in Germany) and another in 1991 (110 MW, in Alabama). There is a current proposal for a 268 MW CAES plant coupled to a wind farm in Iowa, and some other proposals in various stages of development in the U.S. None of the proposals is for a facility in Maryland, and it is unclear that such a facility could be sited in the State of Maryland (i.e., that appropriate geological formations exist in the State). The Joint Intervenors point to companies that are working to develop new CAES technologies. These systems are neither developed nor proven. The Joint Intervenors state that these demonstrations "can be increased [in size] quickly before Calvert Cliffs Unit 3 becomes operational." But this statement is speculative, and the Joint Intervenors do not provide any relevant support for this conclusion. In addition, the Review Team found no evidence that any company has made any proposal for a CAES facility in Maryland. ESRP 9.2.2 (NRC 2007) (Ex. NRC000008) states that the "energy conversion technology should be developed, proven, and available in the relevant region." The demonstration systems referred to by the Joint Intervenors meet none of these criteria.

Although there are no plans for CAES facilities in Maryland, the Review Team included some CAES in the combination of energy alternatives in order to include the contributions of wind and solar power in an alternative to the proposed baseload project. However, the Review Team concluded that including a CAES facility in Maryland that is sufficiently large that it would significantly reduce the air emissions impacts of the combination of energy alternatives is speculative, and not within the reasonable range of alternatives based on the history, current

state, and projected future potential of CAES development. FEIS at 9-21 (Ex. NRC000003A). Therefore, such a facility was not included in the Review Team's NEPA analysis.

CONCLUSION

Q47. Did the Review Team identify any energy alternatives or combination of energy alternatives that would be environmentally preferable to the proposed action?

A47. [AJK, KAC] No. None of the alternatives capable of meeting the purpose and need of the project in the region of interest and in the timeframe of the proposed project were environmentally preferable to the proposed project. FEIS at 9-31 (Ex. NRC000003A).

Q48. Is the combination of energy alternatives presented in the FEIS unnecessarily burdened with excessive environmental impacts due to an under-representation of wind and solar power and excessive reliance on natural gas, as alleged by the Joint Intervenors?

A48. [AJK] No. As discussed above, the approach used by the Review Team developed an alternative that included the maximum contribution from renewable sources that would be reasonably foreseeable within the region of interest and within the timeframe of the proposed project. In doing so, the Review Team minimized the size of the contribution from natural gas generation. As mentioned above, in the discussion of wind potential, based on the limited wind development in Maryland, the Review Team concluded that it would be unreasonable to expect large-scale development of this resource in the timeframe of the proposed project. In the combination of energy alternatives, the Review Team assumed the addition of wind generation equivalent to 100 MW(e) of baseload power. For wind power, 100 MW(e) equates to at least 250 to 300 MW(e) of installed capacity coupled with a 100 MW(e) CAES plant. FEIS at 9-28 (Ex. NRC000003A). The selection of 100 MW(e) of wind capacity for the alternative energy combination reflects the Review Team's discussion in Section 9.2.3.2 of the FEIS. Sections 9.2.3.2 and 9.2.4 of the FEIS are the basis for the NRC Staff's testimony that 100 MW(e) of wind power is reasonable and a representative value for the wind power

contribution to the combination of energy alternatives considering the development of wind generation in the region to date and the potential development of this resource in the region in the timeframe of the proposed project.

The Review Team also considered a scenario in which the wind contribution was quadrupled to 400 MW(e) of baseload power, equivalent to an installed capacity of at least 1000 to 1200 MW(e) with a 400 MW(e) CAES plant. Under this scenario, the combination of energy alternatives would still require 900 MW(e) from a natural gas-fired plant in order to meet the target generation capacity of 1600 MW(e), as discussed above. The CAES plant in this scenario would be larger than any such facility worldwide and offshore wind capacity of this magnitude exceeds by a factor of five or more the amount of offshore wind capacity projected by DOE/EIA for the entire United States by the year 2030 (DOE/EIA 2009 (Ex. NRC000033)). Under this scenario, the impact categorizations in Table 9-3 in the FEIS (Ex. NRC000003A) would not change, except that impacts to land use and terrestrial ecology might become LARGE if onshore wind energy is used. If offshore wind is the energy source, then increased impacts to aquatic ecology, aesthetics and recreation (as a minimum) would occur from the building and operation of the turbines. Based on the limited proposals for onshore and offshore wind in Maryland, this scenario could not be implemented in the timeframe for the proposed project. As described above, the environmental impacts of this scenario would still be greater than the impacts of the proposed action, so this scenario would not be environmentally preferable.

When the Review Team considered the contribution of solar power included in the combination of energy alternatives, it had to consider the likelihood that there would be additions of solar generating capacity in Maryland. Both DOE/EIA 2010a, Table 90 (Ex. NRC000021) and MPSC 2008b (Ex. NRC000023) indicate that any significant development is unlikely. Nevertheless, because generation from solar is possible in Maryland, because DOE/EIA is predicting growth in solar as an end-use generation source, and to offset some of the impacts of the fossil-fueled portion of the combination of energy alternatives, the Review

Team concluded that a contribution of 75 MW(e) of solar generation in the combination of energy alternatives was reasonable. Sections 9.2.3.3 and 9.2.4 of the FEIS (Ex. NRC000003A) provide the basis for the NRC Staff's testimony for the selection of 75 MW(e) of solar power as a reasonable contribution to the combination of energy alternatives, based on the projections by DOE/EIA and MPSC.

Q49. Is the FEIS comparison of energy alternatives accurate and complete?

A49. [AJK, KAC] Yes. The Review Team formulated a set of energy alternatives, including one that consisted of a combination of energy alternatives. It followed the guidance in the ESRP, including ESRP 9.2.2 (NRC 2007 (Ex. NRC000008)), which states, "The energy conversion technology should be developed, proven, and available in the relevant region." The Review Team considered a range of values for certain contributors to the combination to illustrate the robustness of its assessment. The bases in selecting the value for each contribution to the combination of energy alternatives were described accurately and completely.

The Review Team recognizes that there are numerous other combinations that might be considered realistic as well. NEPA does not call for certainty, but it expects a hard look using a reasoned methodology and reasonable range of alternatives. Based on present technology and future projections, any reasonable energy alternative to the proposal (either individually or in combination with other energy technologies) to provide baseload capacity must involve a significant fossil-fueled component.

Therefore, as discussed above, the Review Team chose the reasonable contributions to the combination of energy alternatives identified in the FEIS. FEIS at 9-27 to 9-30 (Ex. NRC000003A).

Q50. Does this conclude your testimony?

A50. [AJK, KAC] Yes.

October 21, 2011

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
	)	
(Combined License Application for Calvert Cliffs	)	
Unit 3)	)	

AFFIDAVIT OF ANDREW J. KUGLER CONCERNING PREFILED
TESTIMONY ON CONTENTION 10C

I, Andrew J. Kugler, do declare under penalty of perjury that my statements in the "Prefiled Direct Testimony of Andrew J. Kugler and Katherine A. Cort Concerning Environmental Contention 10C" and my statement of professional qualifications (Exhibit NRC000005) are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)
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Executed at Rockville, MD
this 21st day of October 2011

October 21, 2011

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
	)	
(Combined License Application for Calvert Cliffs	)	
Unit 3)	)	

AFFIDAVIT OF KATHERINE A. CORT CONCERNING PREFILED
TESTIMONY ON CONTENTION 10C

I, Katherine A. Cort, do declare under penalty of perjury that my statements in the "Prefiled Direct Testimony of Andrew J. Kugler and Katherine A. Cort Concerning Environmental Contention 10C" and my statement of professional qualifications (Exhibit NRC000006) are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 CFR § 2.304(d)

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Executed at Rockville, MD
this 21th day of October 2011