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Energy Resources

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In the Matter of: Application for Certification for the PUENTE POWER PROJECT	Docket No. 15-AFC-01 EXPERT DECLARATION OF PHILLIP MINEART IN RESPONSE TO SUPPLEMENTAL TESTIMONY OF DR. REVELL

I, Phillip Mineart, declare as follows:

1. I am employed by AECOM, which has been retained by the Applicant in these proceedings to conduct certain analyses associated with the proposed Puente Power Project (Project) and am duly authorized to make this declaration.

2. I earned a Bachelor of Science degree in Environmental Engineering from Humboldt State University in 1979 and a Master of Science degree in Civil Engineering from Cornell University in 1983. I have over 30 years of experience in the fields of hydrologic, hydraulic and hydrodynamic analysis, coastal engineering, erosion and sediment transport modeling, environmental restoration, risk assessments, climate change and sea level rise. A copy of my current curriculum vitae was previously submitted in these proceedings (TN #215582). Based on my education, training and experience, I am qualified to provide expert testimony as to the matters addressed herein.

3. Except where stated on information and belief, the facts set forth herein are true of my own personal knowledge, and the opinions set forth herein are true and correct

articulations of my opinions. If called as a witness, I could and would testify competently to the facts and opinions set forth herein and in the attachments hereto.

4. I have reviewed and am knowledgeable of the contents of the following documents:

- Committee Orders for Additional Evidence and Briefing Following Evidentiary Hearings, March 10, 2017 (TN #216505);
- Applicant's March 28, 2017 CEC Workshop Presentation, April 3, 2017 (TN #216784);
- Presentation City of Oxnard Past Efforts to Communicate Model Complexities, April 4, 2017 (TN #216792);
- Presentation - Committee Orders for Additional Evidence, Staff's Slides at March 28, 2017 Staff Workshop, April 4, 2017 (TN #217281);
- Presentation - Coastal Vulnerability in Ventura County using CoSMoS USGS Presentation at March 28, 2017 Staff Workshop, April 24, 2017 (TN #217282);
- Staff's Supplemental Testimony Filed In Response To The Committee's March 10, 2017 Order For The Puente Power Project, June 13, 2017 (TN #218274);
- Supplemental Testimony of Dr. Revell, June 15, 2017 (TN #218873-1); and
- Supplemental Testimony of Dr. Revell Exhibit Final Draft Guidelines for Coastal Flood Hazard Analysis and Mapping, June 15, 2017 (TN #218882).

5. On March 10, 2017, the Committee ordered submission of additional evidence on a limited number of specific issues identified in the "Committee Orders for Additional Evidence and Briefing Following Evidentiary Hearings" (TN #216505) (the "March 10 Orders").

6. The March 10 Orders direct the California Energy Commission (CEC) staff and Applicant, and invite the other parties, to prepare and submit specific additional evidence pertaining to four topic areas, including "Soil and Water Resources." With respect to the topic of Soil and Water Resources, the March 10 Orders request the following:

- Develop and provide specified information pertaining to the CoSMoS 3.0 model utilized by CEC staff to analyze potential coastal hazards affecting the Puente Power Project.

- Conduct a noticed workshop to discuss and identify the best approach or approaches to supplement the assessment of coastal flooding risk for the Puente Power Project through 2050.
- Identify the best approach or approaches for assessing coastal flooding risk, and conduct an analysis using that approach or approaches, taking into consideration the effects of potential dune erosion, beach erosion, and change in beach angle.

7. I participated in the workshop to discuss and identify the best approach or approaches to supplement the assessment of coastal flooding risk for the Project, which was held on March 28, 2017.

8. In response to the March 10 Orders, I prepared and filed additional testimony identified as Expert Declaration of Phillip Mineart in Response to March 10, 2017 Committee Orders, June 15, 2017 (TN #218900).

9. In response to the March 10 Orders, Intervener City of Oxnard filed additional testimony identified as Supplemental Testimony of Dr. Revell, June 15, 2017 (TN #218873-1) and Supplemental Testimony of Dr. Revell Exhibit Final Draft Guidelines for Coastal Flood Hazard Analysis and Mapping, June 15, 2017 (TN #218882) (collectively, the "Supplemental Revell Testimony").

10. As permitted by the March 10 Orders, I hereby submit this further additional testimony in response to the Supplemental Revell Testimony.

11. In the Supplemental Revell Testimony, Dr. Revell identifies several issues pertaining to the modeling analysis completed by the CEC Staff and the United States Geologic Service (USGS) using the CoSMoS 3.0 model, and his preference for using the Coastal Resilience Ventura model developed for The Nature Conservancy (the "TNC Model"). Most of these issues have been raised previously by Dr. Revell and have been addressed by the CEC Staff and the Applicant in written and verbal testimony, and by the USGS at the March 28, 2017 Workshop. This declaration summarizes the responses to the issues identified in the Supplemental Revell Testimony.

Revell: CoSMoS 3.0 was not intended for site specific analysis.

12. This assertion is not entirely correct. CoSMoS is not a single model, but a collection of models. The individual models that comprise CoSMoS are models that can and normally would be used for a site specific analysis; thus, if the appropriate input data are available and used, CoSMoS is appropriate for use in a site specific analysis – and that is precisely what the CEC Staff and USGS have done in this case.

13. In contrast, site-specific data were not used in the TNC Model runs that have been submitted for this proceeding by Dr. Revell. A site specific comparison of the TNC Model results to what actually occurred at MGS during the storm of record show the TNC Model grossly overestimated the flooding that occurred. (See Expert Declaration of Phillip Mineart in Response to March 10, 2017 Committee Orders (TN #218900)).

14. Furthermore, the TNC Model uses less refined algorithms and is not as advanced as CoSMoS. For example, the dune erosion algorithm in the TNC Model uses a "maximum storm wave of unlimited duration" to model dune erosion – a completely unrealistic assumption. In contrast to the limited utility and less refined algorithms contained in the TNC Model, and as presented in Staff's Supplemental Testimony on Soil and Water Resources:

- *"All model components of CoSMoS 3.0 Phase 2 have been extensively tested, calibrated, and validated with local, historic data on waves, water levels, and coastal change. Storm events were tested with extensive historical data, including large storms of November/December 1982, December 2005, and January 2010."* (TN #218274, p. 2)
- *"Long-term shoreline change was tested by analyzing the CoSMoS-COAST model performance from 2005-2015, where semi-annual topographic-data were collected along the study site."* (TN #218274, p. 2)
- *"Further, the primary components of CoSMoS utilize the Delft3D suite of models (e.g., SWAN, FLOW and XBeach), which have been extensively developed, tested, and validated globally for decades, with over 5,000 publications."* (TN #218274, p. 3)

15. The CoSMoS model is the most advanced coastal hazard model available and was used with appropriate local conditions by the CEC Staff and USGS. The TNC Model was not used with appropriate local conditions in the runs presented by Dr. Revell. Therefore, I believe that the results presented by CEC Staff and USGS based on the CoSMoS model are the most accurate predictions of potential future coastal hazards in the record.

Revell: CoSMoS 3.0 is based on 2009 topographic data that does not reflect over 200 feet of historic beach variability fronting the Puente project site.

16. The variability of the beach fronting the Project site has been taken into consideration in the analysis conducted by CEC Staff and USGS, and there is no evidence in the record to indicate that 2009 topographic data are not representative of the beach as it is today.

17. All beaches are subject to seasonal and long-term changes. The Applicant collected 20 historical aerial photographs from 1947 to 2014. The photographs provide an indication of the trend in beach width over time since the photos did not include any topographic data with them. The beach has progressively grown <u>wider</u> over time. The trend in the photos is consistent with the available topographic data, which also show an historical growth in beach width. Additional information on historical beach accretion can be found in: Expert Declaration of Phillip Mineart in Response to March 10, 2017 Committee Orders (TN #218900); Application for Certification [AFC] Appendix N-2 (TN #204220-14; Exhibit No. 1042); Applicant's Responses to Oxnard Data Requests Set 2, Response to Data Request 64 (TN #206310; Exhibit No. 1059); and Comments on California Coastal Commission Report to California Energy Commission on AFC 15-AFC-01 – NRG Puente Power Project (TN #213625; Exhibit No. 1087).

18. The USGS predicted long-term shoreline changes using the CoSMoS-COAST model. The CoSMoS-COAST model is calibrated based on historic measured shoreline locations, including measured shorelines near Mandalay Beach, and therefore, the CoSMoS model does incorporate the variability in beach width over the long term. (See Staff's Supplemental Testimony on Soil and Water Resources, June 13, 2017 (TN #2182734); USGS Presentation at March 28, 2017 Staff Workshop (TN #217282)).

19. I do not believe that the use of 2009 topographic data within the CoSMoS 3.0 model diminishes the validity of the conclusions reached by the Applicant, CEC Staff, or USGS.

Revell: CoSMoS 3.0 relies on dynamic water level, which is not typically used as the basis for engineering hazard identification.

20. There are three different water levels with different time scales that can be used to represent different levels of inundation or hazard: still water level, wave runup, and dynamic water level. These water levels are defined as follows:

- Still water level (SWL) is the tidal elevation plus storm surge. Water levels can be at or near this value for several hours. This would be the lowest water level of the three types.
- Dynamic water level is the increase in water level on the beach due to wave breaking. Water can be at this level for several minutes.
- Wave runup is the maximum vertical extent of wave uprush on the beach. Water is at this level for seconds.

Inundation maps are generally based on the SWL because this represents a sustained water level that has sufficient duration and volume to cause extensive flooding. The 100-year SWL at Mandalay Beach is approximately 8 feet, which is well below the toe of the dunes.

21. Man-made structures exposed to waves (e.g., levees, dams, seawalls) are generally made high enough to prevent overtopping by wave runup. Wave overtopping does not generally have the duration or volume of water to cause extensive flooding so it is <u>not</u> typically used for inundation mapping; rather, this level is used when the water can damage a structure that was not built to withstand wave erosion. Generally the front (water-facing) side of a structure (such as a levee) is built to withstand erosion, but the backside is generally not; consequently, such a structure could be damaged by waves that overtop the structure. For natural structures such as dunes, overtopping of the dune is unlikely to cause any extensive flooding because of the short duration and small volume associated with wave runup. In addition, it is unlikely that a dune such as that found at Mandalay Beach would be overtopped by waves because of the dune width (30-40 foot top width, > 100 foot bottom width). Any erosion

that could occur would be on the front face of the dune. On FEMA maps, the areas that are subject to wave action and/or high-velocity water are represented as VE zones. At Mandalay Beach, the VE zone is at 20 feet, which is below the top of the dunes.

22. Dynamic water level is an intermediate water level between the SWL and wave runup. Though not traditionally used for inundation mapping, it is sometimes used as it provides a more conservative estimate than SWL. For the CoSMoS model, a two-minute sustained duration was used for the dynamic water level. Since dynamic water level is the increase in water level due to waves breaking, it only applies to the water level on the beach where waves are breaking. In areas where waves are not breaking (for example behind a dune), the SWL is more appropriate.

23. These three different metrics – SWL with storm surge, dynamic water level, and maximum wave runup - are used to answer different questions with respect to water hazards. Both the SWL and dynamic water level are based on a sustained elevated water level, while the maximum wave runup is an <u>instantaneous</u> value. Typically, an analysis of potential flooding hazard would be based on a sustained water level, which can result in persistent elevated water levels for a period of time ranging from many minutes to hours. The CoSMoS 3.0 model uses a more conservative two-minute sustained water level to calculate maximum <u>flood</u> extent. This is more conservative than the more typically used SWL. I believe using this value is more appropriate than using wave runup, since flooding – in this case, flooding of the plant site sufficient to cause the plant trip off line – requires more than just a splash from a wave that lasts a matter of seconds. Furthermore, it should be noted that even the wave runup water level is below the top of the dunes.

24. I do not believe that the use of dynamic water level within the CoSMoS 3.0 model diminishes the validity of the conclusions reached by the Applicant, CEC Staff, or USGS. If anything, I believe this provides a more conservative analysis than the more typical use of SWL.

Revell: CoSMoS 3.0 relies on Mean High Water (MHW) levels to assess future shoreline changes and does not explicitly show the long-term changes to the upper profile of the beach.

25. To assess future shoreline changes, a common point of reference must be selected that can be compared across different historic and/or future conditions. MHW is a reasonable reference point for comparison. It is the average elevation of the all the high tides and provides a measure of whether a beach is growing or shrinking and at what rate. Another reference point could be selected such as Mean Higher High Water (MHHW, the average of the highest tide each day) but the result would be the same. I do not believe that the use of MHW within the CoSMoS 3.0 model diminishes the validity of the conclusions reached by the Applicant, CEC Staff, or USGS.

Revell: Even setting aside limitations in the FEMA analysis that likely underpredict the 1% storm responses, FEMA maps for existing conditions, with the addition of 2 feet of sea level rise (SLR) based on the state technical method, show coastal flooding at the Mandalay site.

26. The "irregularities" cited by Dr. Revell are not, in fact, irregularities but show a misunderstanding by Dr. Revell of what the Total Water Level (TWL) represents and how it is calculated. The first "irregularity" Dr. Revell claims is that the base flood elevation at FEMA transect 47 (the transect closest to the Project site) is 0.3 feet lower than the TWL Dr. Revell calculated for the January 18, 1988 storm of record. The base flood elevation shown on the FEMA map is the TWL that has a 1% chance of being exceeded in any given year. It is not the TWL associated with the 1% wave or storm event or any other event (see discussion below for more explanation of the difference between 1% TWL and 1% storm event). There is no reason that the TWL for the storm of record should be equal to the 1% TWL.

27. The second "irregularity" that Dr. Revell asserts is the difference between the wave period used to calculate TWL at transect 47, which was 14 seconds, and the wave period in an adjacent transect, which was 17 seconds. He then states that if FEMA had used a 17 second wave period instead of a 14 second wave period, the TWL would have been higher (22.1 feet).

Therefore, he concludes that FEMA underestimated the 1% TWL. Again, this assertion is due to a misunderstanding of what the 1% TWL represents and how it was calculated. The 1% total water level is the water level that has a 1% chance of being exceeded in any given year. There are multiple combinations of wave height and wave period that could cause the water level to be higher than the 1% TWL, but there is only a 1% chance that one of those combinations will occur in a given year. Also, one cannot take the wave height from one transect (e.g., transect 47) and combine it with a wave period from another transect (adjacent transect), as Dr. Revell suggests above, to calculate wave runup. The wave height and period have to be from the same wave for the calculation of runup to be valid. It is worth noting the maximum calculated TWL at both FEMA transects near Mandalay round to 20 feet, so the two transects are consistent with each other.

28. A description of what the TWL represents and how it is calculated will help clarify some of the misunderstandings in Dr. Revell's testimony. The TWL is the combined water level from tides, storm surge, wave setup and wave runup. Tides are the variations in water level that are experienced on a daily basis and can be predicted years in advance fairly accurately. Storm surge is the increase in water level due to a storm generated by low atmospheric pressure and winds. On the Pacific coast, storm surge is relatively small. The sum of tides and storm surge is known as the Still Water Level (SWL); this is what is measured by a tide gage. Wave setup is the increase in water level on the beach due to wave breaking. Wave runup is the maximum vertical extent of wave uprush above the SWL. Typically, the sum of wave setup and wave runup are calculated together and referred to as wave runup since it is hard to separate them in measured data. TWL is the sum of SWL, wave setup and wave runup.

29. FEMA used what is known as the Stockdon equation to calculate wave runup and wave setup on Mandalay Beach. The inputs to the Stockdon equation include wave height, wave period, and foreshore slope. FEMA assumed a conservative value of 10% for the slope; the slopes on Mandalay Beach are generally less than 10%. FEMA did not "assume" a specific wave period or height to calculate the 1% TWL or any other return period TWL. The TWL was calculated by transforming the deepwater waves modeled far offshore to the nearshore for each

hour for a 50-year period. The resulting wave periods and wave heights and assumed 10% slope were then used to calculate wave runup for each hour. This was added to the SWL obtained from nearby tide gages for the same times. The 50 years of TWL data were then statistically analyzed to estimate the TWL that had a 1% chance of being exceeded at each transect. The 1% TWL was not associated with any particular wave height, period, or storm event; as I indicate above, there could be multiple combinations of wave height and period that could exceed the 1% value. In terms of the calculation of TWL there is no such thing as a 1% storm; there are 1% wave heights and 1% wave periods, but they do not necessarily, and are unlikely to, occur together (such an occurrence would represent a storm event with a much lower likelihood).

30. There were many instances in the FEMA study up and down the coast where the peak historical TWL (from 1988, or 1983, or whenever the storm of record was for that particular location) exceeded the FEMA estimate of the 1% annual chance TWL. Similarly, there were also many instances where the 1% annual chance TWL exceeded the peak historical TWL at a given transect. In general though, they are quite close (usually within 1 foot).

31. The calculation of the expansion of the VE zone provided in the Supplemental Revell Testimony contains serious flaws. In Table 3 of the January 18, 2017 Testimony of Dr. Revell (TN # 215427) (reproduced below), which is referred to in the Supplemental Revell Testimony, the profile transgression shown in the 3rd column ignores the historic accretion of Mandalay Beach. The values in the 3rd column are calculated as the sea level rise (SLR) values times the shoreface slope of 1:75. For example, with 1 foot of SLR the profile transgression is 75 feet, with 2 feet of SLR it is 150 feet (see column 3 in table below). Since the construction of the Mandalay Generating Station (MGS) in 1959, there has been about 3 inches of SLR (0.25 feet). According to the calculations in Table 3 below there should have been 19 feet of profile transgression (slope of 1:75 x 0.25 of SLR) over time (i.e., the beach should have decreased in width). However, the beach has actually <u>grown</u> by about 200 to 300 feet. The difference is that the method used to calculate profile transgression in Table 3 assumes that the beach is in equilibrium and there is no net transport of sediment onto or off the beach. The method used by Dr. Revell in Table 3 will <u>always</u> show that the VE zone is moving inland regardless of what is

actually occurring. Mandalay Beach has been an accreting beach (i.e., the beach is growing seaward), so the assumption that the beach is moving landward is not valid. In fact, the VE zone should be moving seaward based on actual observations. As stated in Staff's Supplemental Testimony on Soil and Water Resources (page 9): "…staff does not agree with the Intervenor's conclusion that the VE-Zone would be expected to move landward by 195 to 354 ft with two feet of SLR".

Table 3. Results of the sea level rise adjustment to the FEMA VE zone (Feet, Elevation NAVD)

Year	Sea Level Rise	Profile Transgression*	Flood Elevation	2016 Elevation at transgressed profile	Depth of flooding (negative freeboard)	Extension of Vzone from depth of flooding (Composite slope)	Extension of Vzone from depth of flooding (Cox and Machemehl)	Inland shift in Vzone (Composite)	Inland shift in Vzone (Cox and Machemehl)
2016	0	0	20	19.8	0.2	45.0	10.0	45.0	10.0
2050	1	75	21	20.3	0.7	84.2	18.7	159.2	93.7
2050	2	150	22	17.9	4.1	203.7	45.3	353.7	195.3
2100	4.5	337.5	24.5	12.7	11.8	345.7	76.8	683.2	414.3
2100	9.5	712.5	29.5	8.2	21.3	464.4	103.2	1176.9	815.7

* Based on measured shoreface slope of 1:75 using a 40' closure depth

Revell: The Coastal Resilience Ventura [TNC] model represents the only mapping and modeling that follows federal coastal hazard guidelines to incorporate beach profile changes with coastal erosion and storm hazards and includes the influence of sea level rise.

32. Dr. Revell's assertion is incorrect. The TNC Model was initially developed in 2013 and has not been updated since. In contrast, the CoSMoS model is built upon models that have been developed over the past several decades and has been updated just within the past few months. The CoSMoS model uses state-of-the-science algorithms that incorporate beach profile changes with coastal erosion and storm hazards and includes the influence of sea level rise.

33. The USGS, the developer of CoSMoS 3.0, states the following with respect to the model:

- Predicts coastal hazards for the full range of sea level rise (0-2, 5 m) and storm possibilities (up to 100-year storm) using sophisticated global climate and ocean modeling tools.
- Explicit, high-resolution, dynamic modeling of waves, currents, storm surge, flooding, and beach change.

- Considers the future evolution of storm patterns based on the latest Global Climate Models (See Presentation – Coastal Vulnerability in Ventura County using CoSMoS (TN #217282), pages 2 and 3).

34. CEC Staff reviewed the TNC Model in detail in the FSA and its Supplemental Testimony on Soil and Water Resources, and concluded that that "*. . . the best approach to supplement the assessment of coastal flooding risk is utilizing CoSMoS 3.0 Phase 2, which is consistent with the state guidance for sea-level rise (using the most recent and best available science, considering timeframe and risk tolerance, considering storms and other extreme events, and changing shorelines).*" (TN #218274, Soil and Water Resources, p. 1).

35. The mapping in the TNC Model is unrealistic at the Mandalay Generating Station (MGS) property in that it shows flooding in cases with no flooding source. This is the case in all scenarios in which the dunes are not completely eroded. For example, the MGS property is shown as flooded from wave runup at Oxnard Shores. Though there is a direct connection from the MGS property to Oxnard Shores through the SCE McGrath Peaker property and the County Park, it is not possible to flood MGS from Oxnard Shores without sustained flooding (such as due to SWL) at Oxnard Shores beyond what could be provided by wave runup. Any water that might overtop the dunes would be of short duration and limited volume and would not result in extensive inundation of the site.

Revell: The majority of the public agencies in Ventura and Santa Barbara Counties who are engaged in resiliency planning rely on the Coastal Resilience models.

36. Dr. Revell is incorrect. At the time that the TNC Model was developed in 2013, this statement may have been true; however, the CoSMoS model is now the state-of-the art model.

37. According to the USGS, numerous local, state and federal agencies use CoSMoS (see Presentation - Coastal Vulnerability in Ventura County using CoSMoS (TN #217282), pp. 7-8). This includes jurisdictions such as Santa Barbara County, Los Angeles County, City of Santa Barbara and City of Los Angeles. Key state and federal agencies, including the California Coastal Commission, Ocean Protection Council, California Coastal Conservancy, and NOAA for

Coastal Management. CoSMoS is also used for regional analysis by the Regional Water Quality Control Board for Los Angeles and Ventura Counties; the Coastal Ecosystem Vulnerability Assessment, Santa Barbara; AdaptLA, Coastal Impacts Planning for the Los Angeles Region; and others.

Revell: Methods applied to the proposed project site under Coastal Resilience Ventura follow approved regulatory approach for coastal flood mapping.

38. The CoSMoS model is the most advanced coastal hazard model available. Regulatory guidelines generally do not prohibit or discourage the use of more sophisticated or state-of-the-science models. The CoSMoS model is a state of the art coastal flooding and erosion model that is accepted and used by numerous agencies.

39. I believe that the analyses presented by the CEC Staff, USGS and Applicant represent the most accurate and reliable forecast of the potential for inundation hazards in the record, based on the use of state-of-the-science models and assumptions appropriate for the Project site and type of analysis performed.

40. I hereby sponsor this declaration into evidence in these proceedings.

Executed on July 14, 2017, at San Francisco, California.

I declare under penalty of perjury of the laws of the State of California that the foregoing is true and correct.

Phillip Mineart