Docket: **R.10-05-006**

ExhibitNo.: ____________

Commissioner: **MichaelR.Peevey**

ALJ: **PeterV.Allen**

BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans.	Rulemaking 10-05-006

TRACKIPREPAREDTESTIMONYOFHALAN.BALLOUZ ONBEHALFOFAESSOUTHLAND

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TRACKIPREPAREDTESTIMONYOFHALAN.BALLOUZ ONBEHALFOFAESSOUTHLAND

Q. Pleasestateyournameandcurrentemployment.

A. MynameisHalaN.Ballouz. Iamthe PresidentofElectricPowerEngineers,Inc.(EPE).

Q. Whatisyourprofessionalandeducationalbackground?

A. MyprofessionalandeducationalbackgroundissetoutinExhibitA.

Q. Whatisthepurposeofyourtestimony?

A. InmytestimonyIwillshowthatdetermininglocalcapacityrequirements(LCR)basedon awidearea definitionsuchastheLosAngelesBasin(LABasin)isnotsufficientto effectivelyaddresslocalsystemneedsandconstraintsandthatmoregranularitywithinthe LABasinareaisrequired--specificallyinthewesternportionofthisarea(WesternLA Basinsub-area). Iwillalsoverifythe importanceofconsideringresourcelocationwhen makingprocurementdecisionswithintheWesternLABasinsub-area.Mytestimonyis basedonanalysisperformedtostudytheeffectofthepossible retirementofthe generating unitsatHuntingtonBeach,AlamitosandRedondoBeachasaresultofOnce-Through-Cooling(OTC)compliancerequirementsandthe deficiencyofthesystemundersuch

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conditions. Throughoutthistestimony,Iwillshowthesignificance ofthe transmission locationsofHuntingtonBeach,AlamitosandRedondoBeachgenerationstationsthatare ownedbyAESSouthland(AES)andwhyredevelopmentatthese locationsisessentialfor effectivereliefofotherwisemajortransmissionconstraintswithintheWesternLABasin area.

I. <u>TESTIMONY OF SCE ON TRACK I ISSUES AND CAISO STUDIES</u>

Q. Have you reviewed the Testimony of Southern California Edison (SCE) on Track I Issues, as such testimony addresses LCR needs in the LA Basin Local Capacity Area (LCA)?

A. Yes, I have.

Q. SCE generally describes the LA Basin LCA in their Track I Testimony. Can you provide a further description of the LA Basin LCA by also discussing the sub-areas within the broader LA Basin LCA?

A. The LA Basin LCA is a large area of the electric grid that is very densely populated and includes several load concentrations around which transmission and generation have been developed over the years. This results in bottlenecks in power delivery within the LA Basin area, which in turn results in the creation of several sub-area LCAs with their own LCR needs. The SCE Testimony on page 8, footnote 11 states, "*SCE is aware that the CAISO is considering narrowing the LA Basin LCA designation to include only loads and resources in the western portion of this geographic area, and calling the new area the Western LA Basin LCA. However, the Load & Resources (L&R) tool as currently configured does not allow the implications of this change to be assessed.*" According to the CAISO's 2012 Local Capacity Technical Analysis dated April 29, 2011, the LA Basin LCA also includes three sub-areas – the Western sub-area, the Ellis sub-area and the El Nido sub-area. The CAISO estimates the 2012 LCR need in the LA Basin LCA is

10,865 MW. The CAISO also estimates the Western, Ellis and El Nido sub-area LCR needs at 5,785 MW, 474 MW and 362 MW, respectively. Therefore, not only does the CAISO conclude that the LA Basin LCA needs to have at least 10,865 MW of net qualifying capacity installed to meet the estimated 2012 LCR, CAISO also concludes that the sub-area LCR requirements inside the LA Basin LCA must also be satisfied in order to meet grid planning requirements.

Q. Will the local reliability needs of the LA Basin LCA necessarily be satisfied if the sub-area requirements within the LA Basin are not also satisfied?

A. No, they will not. Under certain critical contingency situations, if the sub-area LCR needs are not satisfied, even if the broader LA Basin LCA needs are satisfied, there will be a risk of overloading the system that serves the sub-areas, and load shedding or other measures may be needed to address the resulting system deficiencies.

Our study demonstrates that the locations of AES projects are strategic in serving local loads and their absence will force the import of power into the Western LA Basin area creating major transmission congestion that will jeopardize local system reliability without further transmission system upgrades. This is regardless of whether the LCR of the wider LA Basin area is met or not.

Q. The studies conducted by the CAISO and E3 indicate that the system is expected to have reserve margins between 46% and 51% (page 45 of CAISO's testimony) depending on which of the four scoping memo scenarios are analyzed. If the range of assumptions used in the scenarios is correct, does this mean that no new resources need to be constructed?

A. Not necessarily. Even though the system as a whole may have adequate reserve margins and sufficient flexibility, if the requirements for local capacity are not also satisfied, the electric grid will not be able to operate reliably, particularly under peak-load and contingency situations. Evaluation of reserve margin is not the only measure necessary to determine incremental resource needs; location of the newly installed resources must also be considered. Hence the CAISO is currently assessing the local area needs for generation resources in order to reach a reliable system configuration.

Q. Do you agree with SCE's conclusion that there will be at least a 2,000 MW deficiency in the LA Basin LCA when the OTC resources are retired?

A. I agree there will be a deficiency in the LA Basin LCA when the OTC resources are retired, and it is likely greater than 2,000 MW. EPE's analysis calculates the need for more than 2,000 MW in the LA Basin area, by identifying that approximately 2,300 MW will be required at the AES project locations to reliably serve the loads in the Western LA Basin sub-area (and significantly more generation may be needed if the required new resources are installed at locations other than the AES locations).

Further, in SCE's analysis, the 750 MW Sentinel facility was classified to be inside the LA Basin LCA. According to the CAISO, the entity performing the LCR studies, Sentinel is not considered to be in the LA Basin LCA; therefore the deficiency SCE calculated in its testimony should increase to 2,750 MW. In addition, the SCE analysis considers the LA Basin LCA as a whole, without recognition of certain local Western LA Basin transmission constraints (since the L&R tool used does not have an LCA modeled for the Western LA Basin area). If location within the LA Basin LCA is not considered and enough resources are not correctly identified and re-developed/constructed in the Western sub-area, then an even greater amount of new generation will be necessary above the 2,750 MW because the sub-area LCR needs may not be satisfied.

Q. Have you reviewed studies other than those described in the SCE testimony and is there any specific additional study that you would like to address?

A. Yes. I reviewed the CAISO 2010-2011 Transmission Plan, dated May 18, 2011 and approved by the ISO Board of Governors. That study noted that although major transmission upgrades were necessary for reliable operation in 2020, it correctly concluded that the planning and construction of major new transmission can be achieved "after the OTC repower implementation plans become available." I concur with this conclusion. Based on EPE's findings, the redevelopment of the generating units at Huntington Beach, Alamitos, and Redondo Beach will effectively mitigate at least seven major grid constraints that otherwise would require transmission system upgrades.

Q. Have you also conducted your own analysis of the local need for the capacity at the Huntington Beach, Alamitos and Redondo Beach locations owned by AES?

A. Yes, as I will further describe in this testimony.

II. REASONS THE HUNTINGTON BEACH, ALAMITOS AND REDONDO BEACH LOCATIONS ARE CRUCIAL TO THE WESTERN LA BASIN LCA

Q. Why are the Huntington Beach, Alamitos and Redondo Beach locations significant to the Western LA Basin transmission grid?

A. SCE's urban generation stations and transmission system are built to work together. The construction of the major Western LA Basin generation stations avoided the need for substantial amounts of transmission required to meet the Western LA Basin loads from generation located otherwise outside the Western LA Basin sub-area. The concurrent planning of generation stations and transmission lines to minimize urban transmission requirements has created a high

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level of local dependence on the 4,140[1] MW of local capacity that exists at the Huntington Beach, Alamitos and Redondo Beach generation station locations. Exhibit C illustrates the location of the sites and identifies more than 4,000 MW of local load that this generation serves. If this local generation were entirely removed, existing transmission would not be adequate to bring in replacement power from other generation locations, and major new transmission construction would be needed in these highly urban areas in order to maintain the electrical grid reliability in the Western LA Basin sub-area.

III. THE NATURE OF THE EPE STUDY AND MAJOR INPUT ASSUMPTIONS

Q. Please describe the nature of your study.

A. EPE's analysisstudiestheeffectivenessofthetransmissionlocationofHuntington Beach,AlamitosandRedondoBeachanddemonstrateshowtheredevelopmentof facilitiesatthesesitesisessentialforeffectivereliefofotherwisemajor transmissionconstraintswithintheWesternLABasin.

For the purpose of this analysis, EPE used the CAISO 2020 Portfolio 4 On Peak[2] assumptions to create its Base Case. Extensive single and critical multiple alternating current (AC) contingency events were modeled to determine major

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[1] The current combined installed capacity of Huntington Beach, Alamitos and Redondo Beach is 4,140 MWs. However the MWs available to AES for its redevelopment is 3,690 MWs as a result of the sale of Huntington Beach Units 3 and 4 to Edison Mission Energy.

[2] The California ISO provides 33% Renewables Portfolio Standards base cases for stakeholder reference. These base cases reflect study assumptions presented during the October 26-27, 2010 stakeholder meeting and are being used in the 2010-2011 ISO Transmission Plan. They are available on the Market Participant Portal under the Transmission Planning section at https://portal.caiso.com/tp/Pages/default.aspx.

transmission system constraints. Load-flow calculations were performed for several scenarios, and mitigation of the major system transmission constraints was used as criteria to determine the effectiveness of AES project locations, in comparison to other generation in the Western LA Basin.

Q. Please describe the Base Case that was used for your analysis.

A. The Base Case is the CAISO 2020 Portfolio 4 case with 2 modifications: 1) AES generation was removed entirely and 2) 447 MW of additional West LA Basin generation were added. The CAISO 2020 Portfolio 4 case is a hybrid renewable portfolio scenario that forecasts a mix of in-state, out-of-state and distributed generation resources for the RPS compliance year 2020 (33%). Portfolio 4 is the most likely RPS scenario, per the CAISO presentation "Overview & Portfolio Development" in the 2010/2011 ISO Transmission Planning Process Stakeholder Meeting on December 2, 2010. Portfolio 4 has the ISO transmission upgrades modeled (new lines, re-conductoring, and voltage conversion).

Load-flow calculations under contingency conditions were performed on the Portfolio 4 case as provided by CAISO, and several critical thermal overloads were identified. In discussions with CAISO, CAISO engineers suggested increasing the generation in the Western LA Basin area in order to reduce or mitigate the identified overloads. Please refer to the generation dispatch table of Exhibit B for a list of the resources that were included in the analysis done by EPE. Column 4 specifically identifies the 447 MW of Western LA Basin generation projects that were added to the Portfolio 4 case. The 447 MW are in addition to the 4,000 MW already in the Portfolio 4 case. The addition of the 447

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MW of Western LA Basin projects reduces the overloads on the critical Western LA Basin constraints, and therefore creates a Base Case that requires less AES or other Western LA Basin generation to resolve the critical constraints.

Q. What contingencies did you run on the Base Case?

A. AC contingency analyses were run under extensive single and critical multiple contingency events, listed as follows:

- Single contingency (N-1): single-line contingencies were run for every transmission element in the LA Basin and nearby areas: SCE, San Diego and LADWP
- Selected double contingencies (N-2) directly connected to AES project substations were considered throughout this study
- Loss of LA Basin generation projects as well as connected generators in SCE's service territory, one at a time
- Critical LA Basin multiple contingencies identified in the CAISO 2012 Local Capacity Technical Analysis study:
  - The loss of one unit at San Onofre followed by the PaloVerde-Devers 500 kV line
  - The loss of Serrano-Villa Park #1 or #2 230 kV line followed by the loss of the Serrano-Lewis 230 kV line or vice versa
  - The loss of the La Fresa-Redondo #1 and #2 230 kV lines
  - The loss of the La Fresa-Hinson 230 kV line followed by the loss of the La Fresa-Redondo #1 and #2 230 kV lines

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- The loss of the Barre to Ellis 230 kV line followed by the loss of the Santiago to San Onofre #1 and #2 230 kV lines

Q. Does your analysis constitute a complete reliability study of the type that CAISO or SCE may need to perform with respect to the Western LA Basin LCA?

A. No. Our study was instead an analysis of the effectiveness of generation at various sites under numerous contingencies. A complete reliability study will be able to fill in many additional details. However, a more complete reliability study will not change our study's conclusions, which identify the transmission system need for generation at the Huntington Beach, Alamitos and Redondo Beach locations.

IV. STUDY FINDINGS

Q. Please describe the resulting transmission line loadings if Huntington Beach, Alamitos and Redondo Beach are retired at the end of 2020, without redeveloping generation at these locations.

A. As I previously indicated, the removal of generation from the AES locations, which serve clusters of loads in the Western LA Basin area, will require importing power from outside this area. These needed imports cannot be supplied without causing transmission constraints and therefore violating system reliability. Complete retirement of the AES generation projects will result in the significant overload of eight Western LA Basin transmission lines as shown in Table 1 below and highlighted in the transmission map of Exhibit C.

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Table 1 - Loading of Base Case Critical Thermal Overloads

(Base Case = CAISO Portfolio 4 less AES generation plus 447 MW of Western LA Basin Generation)

Critical Thermal Constraints	***Base Case***
230 kV Center S to Delamo line, 988 MVA	*154%*
230 kV Delamo to Ellis line, 988 MVA	*196%*
230 kV Lewis to Barre line, 1494 MVA	*134%*
230 kV Miralome to Olinda line, 988 MVA	*109%*
230 kV Villa Park to Barre line, 1494 MVA	*120%*
230 kV Villa Park to Serrano line, Ckt 1, 1518 MVA	*131%*
230 kV Villa Park to Serrano line, Ckt 2, 1613 MVA	*123%*
500/230 kV Serrano transformer, 1344 MVA	*106%*

Q. Please describe the impact of the AES project locations on the loading of these eight thermal overloads.

A. Load-flow calculations demonstrated that the generation at the AES project locations will significantly reduce the loading of the major overloaded transmission lines under study. Injecting 1,800 MW of AES generation in the the Base Case, which is referred to as Combination 1, will significantly reduce the loading of the major constrained transmission lines and completely mitigate four of these thermal overloads. Combination 2, with 2,310 MW of AES generation added to the Base Case, mitigates all of the eight transmission constraints with the exception of the 230 kV Center S to Delamo line. Although this overload is not completely mitigated, it is significantly reduced. This is demonstrated in Table 2 below.

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Table 2 - Effectiveness of AES Generation

Critical Thermal Constraints	*Base Case*	Combination 1 AES 1,800 HB 450 AL 900 RB 450	Combination 2 AES 2,310 HB 960 AL 900 RB 450
230 kV Center S to Delamo line, 988 MVA	*154%*	133%	108%
230 kV Delamo to Ellis line, 988 MVA	*196%*	151%	Mitigated (<100%)
230 kV Lewis to Barre line, 1494 MVA	*134%*	Mitigated (<100%)	Mitigated (<100%)
230 kV Miralome to Olinda line, 988 MVA	*109%*	Mitigated (<100%)	Mitigated (<100%)
230 kV Villa Park to Barre line, 1494 MVA	*120%*	Mitigated (<100%)	Mitigated (<100%)
230 kV Villa Park to Serrano line, Ckt 1, 1518 MVA	*131%*	107%	Mitigated (<100%)
230 kV Villa Park to Serrano line, Ckt 2, 1613 MVA	*123%*	101%	Mitigated (<100%)
500/230 kV Serrano transformer, 1344 MVA	*106%*	Mitigated (<100%)	Mitigated (<100%)

Q. Can these eight critical base case thermal overloads be cost-effectively resolved by transmission upgrades in lieu of retaining generation at the Huntington Beach, Alamitos, and Redondo Beach locations?

A. Beyond identifying the critical overloaded elements in this study, EPE did not attempt to draw an alternate plan of transmission upgrades. However, from understanding the transmission grid in the area, complete retirement of generation at the AES locations is most likely going to result in transmission upgrades that will be very expensive and difficult to build (if not impossible) in this densely populated urban area. Additionally, complete retirement at the AES locations will likely result in less effective use of major 230 kV Western LA Basin transmission lines that have been built to enable generation at the AES locations to effectively serve the Western LA Basin's dense loads.

CAISO's 2010-2011 Transmission Plan also addresses this question. The thermal overloads identified in the CAISO's 2010-2011 Transmission Plan study parallel the overloads identified in EPE's effectiveness analysis. The CAISO Transmission Plan indicated that the increase of Western LA Basin generation projects will mitigate these thermal overloads. Additionally, the CAISO Transmission Plan provided a transmission mitigation alternative to the increase of generation in Western LA Basin. This alternative requires, among other upgrades, the construction of a new Mira Loma-Lighthipe 500 kV line. The CAISO Transmission Plan study indicated that maintaining adequate generation capacity in Western LA Basin is a less expensive solution than the alternative of constructing a new 500 kV line. The CAISO study notes also that the construction of this new 500 kV line should be further evaluated after the OTC repower implementation plans become available. The construction of such a line will also be very difficult, considering the densely populated area that this line may need to cross or avoid (if possible). Refer to the map of Exhibit C which shows the Mira-Loma and Lighthipe substations which are the terminating points of the above referenced 500 kV line.

Q. Can these eight critical Base Case thermal overloads be resolved by installation of comparable generation capacity in geographic locations of existing or planned generators other than the Huntington Beach, Alamitos, and Redondo Beach locations?

A. No, not from the available list of Western LA Basin generators or other planned projects known to EPE in the Western LA Basin Area. As I earlier noted, the urban transmission into and within the Western LA Basin sub-area was configured to rely on the significant generation capacity at the AES locations.

Our study findings also identified that significantly more generating capacity will be required from non-AES Western LA Basin locations, compared to the AES sites, in order to have an impact, and an inferior one for that matter, on reducing the loading on the major transmission constraints under study.

Table 3 - Effectiveness of non-AES Western LA Basin Projects (Added Equally)

Critical Thermal Constraints	***Base Case***	**AES at 1,800 MW (Combination 1)**	**AES at 2,300 MW (Combination 2)**	**AES at 0 MW +1,800 MW at West LaBasin Projects**	**AES at 0 MW +3,600 MW at West LaBasin Projects**
230 kV Center S to Delamo line, 988 MVA	*154%*	133%	108%	149%	143%
230 kV Delamo to Ellis line, 988 MVA	*196%*	151%	Mitigated (<100%)	197%	198%
230 kV Lewis to Barre line, 1494 MVA	*134%*	Mitigated (<100%)	Mitigated (<100%)	118%	103%
230 kV Miralome to Olinda line, 988 MVA	*109%*	Mitigated (<100%)	Mitigated (<100%)	Mitigated (<100%)	Mitigated (<100%)
230 kV Villa Park to Barre line, 1494 MVA	*120%*	Mitigated (<100%)	Mitigated (<100%)	106%	Mitigated (<100%)
230 kV Villa Park to Serrano line, Ckt 1, 1518 MVA	*131%*	107%	Mitigated (<100%)	120%	111%
230 kV Villa Park to Serrano line, Ckt 2, 1613 MVA	*123%*	101%	Mitigated (<100%)	113%	105%
500/230 kV Serrano transformer, 1344 MVA	*106%*	Mitigated (<100%)	Mitigated (<100%)	Mitigated (<100%)	Mitigated (<100%)

Table 3 demonstrates that adding 3,600 MW of Western LA Basin capacity (other than at the AES locations) to the Base Case is significantly less effective than the addition of 1,800 MW at the AES locations. The additional 1,800 and 3,600 MW of the non-AES West LA Basin generation was accomplished by adding an equal number of MW at each of the Western LA Basin units that are actively connected to the grid in the Base Case. The 3,600 MW of non-AES generation could only mitigate three of the eight constraints under study, whereas the AES generation would fully mitigate seven of the eight constraints at only 2,310 MW.

Q. Did you analyze multiple combinations of non-AES projects to test their efficacy in resolving the eight critical constraints under study?

A. Yes. Other combinations, with more emphasis on other project sites within the Western LA Basin, were studied. These additional studies identified that the AES generation locations remain significantly more effective in resolving the constraints under study than the other Western LA Basin project location combinations. Information on these other Western LA Basin combination studies can be provided upon request.

Q. What are the potential consequences if generator location is not considered when making procurement decisions?

A. If additional resources are not procured and constructed in the Western LA sub-area prior to the shutdown and retirement of the gas-fired resources that are subject to the OTC Policy, then this will result in an unreliable electric delivery system that is not able to meet its load resource requirements due to major transmission constraints under contingency conditions. Moreover, as EPE's analysis indicates, even if other local resources could be sited, if generator location is not considered when making procurement decisions, then more generation resources and transmission upgrades will likely be constructed than are necessary. This will result in stranded assets and higher overall costs to consumers.

Q. In your opinion, should the redevelopment of generation at the AES locations be an integral part of transmission planning?

A. Yes. Due to the demonstrated effectiveness of the AES locations to relieve critical Western LA Basin sub-area overloads, I believe that it is necessary to integrate the redevelopment plans of the AES generator locations into the transmission planning process. Plans for transmission grid re-enforcement cannot be undertaken and completed in a timely and effective manner without consideration and clear understanding of the commitment and transmission grid support provided by redevelopment at the AES locations.

Q. Does this conclude your testimony?

A. Yes.

EXHIBIT A

Exhibit A
Statement of Qualifications

Hala N. Ballouz, P.E.
B.S. & M.Sc. EE, Texas A&M University

President, Electric Power Engineers, Inc.
Partner and shareholder, International I.G.M. s.a.r.l.
Vice President of the Texas Renewable Energy Association.
Board Member Texas Renewable Energy Association

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Hala Ballouz, the President and Owner of Electric Power Engineers, with multiple offices in the U.S. and internationally, is a lead consultant in the Electric Power Industry since 1991, specifically for renewable energy development. She has over 15 years of experience in transmission system analysis, substation and distribution system design, resource and grid feasibility studies, renewable energy development, distribution System planning and operations, and Design/Engineering/Procurement for wind and solar generation projects. She has extensive experience in renewable energy integration and design of wind, solar, biomass, as well as energy storage, with numerous significant publications in the power industry. An accomplished and published industry writer and presenter, Mrs. Ballouz backs her work with certifications in substation engineering and design as well as wind energy and wind turbines. She is a registered Professional Engineer in three States and is also registered with the Board of Engineers in Lebanon.

Education:

M.Sc. in Electrical Engineering (Power), Aug. 1991, Texas A&M University, College Station, Texas.
B.Sc. in Electrical Engineering, Dec. 1989, Texas A & M University, College Station, Texas.
National Dean's List

Experience:

Over 19 years of power generation, transmission, and distribution experience
Transmission System Analysis using state-of the-art analysis software, Renewable Energy Development from site assessment to shovel ready.
Feasibility Studies and Evaluation of Renewable Generation Projects.
Distribution System Planning and Operations.
Design/Engineering/Procurement for wind and solar generation projects. See Key Qualifications.

Jan 06-Present **International Consultant**
Specialized in Power and Renewable Energy Transmission Integration and Design

- Soma 90 MW wind farm feasibility study, Turkey
- Ras El Khaimah long range plan for transmission grid expansion and supply/demand planning, UAE
- Ras El Khaimah wind integration, UAE
- Morocco Solar and Wind (Renewable Energy) Definitional Mission (USTDA)
- Kenya, Lamu and Lambwe renewable energy integration, Cordisons International.

Jul 91-Present	**Electric Power Engineers, Inc., Waco, TX.** President and Owner (Nov 07 – Present) Vice President & Shareholder (Dec 04- Oct 07) Senior Electrical Engineer & Shareholder (Jan 99- Nov 04) Vice President (Dec 92- Dec 98) Graduate Engineer (Jul 91-Dec 92)
Feb 06-Jun 06	**American University of Science and Technology:** Teaching CCE 444 "Power Transmission and Distribution". Also assemble the Syllabus and material for this new course.
Jun 92	**New York State Institute on Superconductivity- Buffalo, NY.** SMES Utility Interest Group- Specialty Conference, 2nd Session "Impact of SMES on Unit Availability and System Reliability", in collaboration with Dr. A.D. Patton / Texas A&M University.
Jan 90-Aug 91	**Texas A&M University, Electric Power Department, College Station, TX** Research Assistant, on the large-scale applications of superconductors in power systems, with Dr. A.D. Patton.
Nov 89	**Texas A&M University – Electronics Material Laboratory, C.S., TX.** Design and Construction of a High Temperature Superconductor Current Limiter.
Jul 88-Dec 88	**Bechtel Inc., Houston, TX.** Assistant Engineer - internship. Experience included control engineering as well as plant power and electric design aspects (cable sizing, lighting, motor start etc.).

Professional Memberships and Registrations:

Professional Engineer, State of Texas (License #80999)
Professional Engineer State of Idaho (License *#12315*)
Professional Engineer State of Rhode Island (License *#8696*)
Texas Society of Professional Engineers
National Society of Professional Engineers.
Board of Engineers, Lebanon

The Wind Coalition , ***member and representative in SPP***
Texas Renewable Energy Association (TREIA) ***Board Member***
American Wind Energy Association (AWEA)
Institute of Electrical and Electronics Engineers (IEEE).
Power Society of IEEE

Certifications:

Certificate for "Wind Energy and Wind Turbines" WTOnline course, with Dr. Vaughn Nelson, West Texas A&M University online, Fall 2003.
Certificate for "Substation Engineering and Design" Siemens Power Transmission & Distribution, Inc. Power Technologies International, Schenectady NY, December 2005.

Papers and Presentations:

- Nasr (Ballouz), Hala, and Patton, A.D., 1991. "**Impact of Energy Storage on Generating Unit Availability and System Reliability**", Paper and presentation, Conference *Proceedings of the Symposium on the Reliability of Electric Power Systems.*
- Ballouz, Hala, and Cousineau, Kevin, 2003. "**Evaluation of Power Factor Correction in Wind Parks and the Savings from Reduction in Power Loss**", Paper, *American Wind Energy Association Conference, Austin, Texas.*
- Ballouz, Hala, 2004. "**The cost benefits applied to a Wind/Storage System from the Impact of Energy Storage on Generator Availability and System Reliability**", Paper and presentation, *Global WINDPOWER 2004 Conference, Chicago, Illinois.*
- Ballouz, Hala, 2005, **"The Effect of Dynamic Rating of Transmission Lines on the Export Capacity Available to Wind Farms that are Applying for Interconnection.",** poster presentation,

WINDPOWER 2005 Conference, Denver, Colorado.

- Ballouz, Hala, 2006, **"Wind Farm Grid Interconnection Milestones—Do(s) and Don't(s)",** poster presentation, *WINDPOWER 2006 Conference, Pittsburgh, Pennsylvania*
- Ballouz, Hala, 2007, **"Introduction to Engineering and Regulatory Requirements Including Interconnection, Transmission, and Access Issues",** presentation, *Texas Renewables '07, Texas Renewable Energy Association, Abilene, Texas*
- Ballouz, Hala, Carlos Matar, and Michael Edds, 2009, **"Distributed Wind Interconnection Challenges for Utility-Scale Wind Turbines",** *WindPower 2009. American Wind Energy Association conferenc, Chicago, Illinois.*
- Ballouz, Hala, 2009, ***"Transmission Deliverability for Wind Developers",*** *Transmission Summit 2009, Sweetwater Texas.*
- Ballouz, Hala, 2009, ***"Distributed Wind Interconnection Challenges for Utility- Sxale Wind Turbines",*** *Wind Power 2009 Conference & Exhibition, Chicago Illiniois.*
- Ballouz, Hala, 2010, ***"Wind and Solar Projects Interconnection Issues",****Transmission Summit 2010, Sweetwater Texas.*

Key Qualifications:

Vast Experience in Transmission System Analysis**, owner's engineer** in development/ design/ engineering/ procurement of Renewable Projects, Distribution System Planning and Operations, as well as high end power system simulation software operation and programming.

Key player in the renewable energy industry serving as Board member and Vice President of the Texas Renewable Energy Association (TREIA), and representative of The Wind Coalition in the Southwest Power Pool (SPP).

International consultancy on Transmission Planning and Renewable Energy development, with recent project in Turkey, the United Arab Emirates, Morocco, Kenya, Jordan and Lebanon.

Transmission System Analysis:

Transmission System Planning Studies – Significant experience (since 1994) in analyzing the feasibility of generation interconnection to the transmission grid, including power flow calculations, transmission and wheeling pricing and operational issues. Conducted all the calculations for analyzing the capacity and limitations of the electric transmission grid to distribute electric power generated by renewable resources within the state of Texas (for the Sustainable Energy Development Council of the State of Texas). Several years experience using the widely known power system analysis software **PSS/E of PTI, as well as PowerWorld**.

Design/Engineering/Procurement

Substation and transmission interconnection one-line diagrams. Design of wind and solar generation plants medium and high voltage collection system. Protective relaying. Hold a certificate in substation design from Power Technologies, International.

Generation Interconnection

Processing interconnection of generators with the transmission grid from the initial filing of the application process all the way through the negotiations for the interconnection agreement and negotiations with the transmission providers.

Renewable Energy Development:

Assisting developers of renewable generation, in particular wind, in the evaluation and development of generation resources since 1994. Vast expertise in evaluating projects and development efforts from site assessment to shovel ready. Completed *load flow modeling, grid interconnection, and/or design of wind generation projects* for over 50 clients, including leading companies like GE, Airtricity (, AES, BP, Gamesa, Pattern Energy (Babcock and Brown), etc. The following highlights some of the expertise in renewable energy development.

- All phases and milestones of renewable energy development, from site assessment to shovel ready.
- Several years experience in *load flow* calculations and modeling of the electric transmission grid using the transmission program PSS/E of PTI/Siemens, as well as PowerWorld.
- Experience in evaluating *feasibility and system impact studies* that analyze the prospect of interconnecting wind to a transmission grid.
- Continuous research (since 1994) in the transmission industry operational standards and tariffs.
- Open Access Transmission Tariffs and Locational Marginal Pricing issues within several transmission grids.
- *Interface discussions* with transmission service providers as well the Electric Council of Texas (ERCOT) Independent System Operator (ISO) for the interconnection of renewable projects.
- *Responses to requests for proposals* for the purchase of renewable generation.
- *Evaluation transmission system construction upgrades and the associated costs* necessary to incorporate renewable generation projects into the transmission grid.
- Analysis expertise in the *evaluation of wheeling charges as well as losses* within a transmission grid or in export of power across one or more transmission grids.
- Proposing and utilizing *Special Protection Schemes* in order to accommodate or expand the scope of renewable generation projects under certain limiting grid conditions.
- *Mapping* of potential wind generation sites with the transmission grid.
- ***Design-engineering-procurement*** coordination for renewable generation projects, in particular wind and solar.

Distribution System Planning:

Involvement in all aspects of the operations & planning of electric utilities distribution system since 1991, largely in the State of Texas. Experience covers the daily operations and maintenance aspects, as well as short and long term planning analysis. Routinely produced many studies and reports on Distribution System Long Range and Short Range Work Plans, Sectionalizing Work Plans, Motor Start Analyses, and System Operations Summary Reports such as power factor & losses tune up as well as Voltage Regulation and others. Conducted power requirement studies which included Load forecasting.

Skilled in performing distribution system analysis using Electric Power Engineers' Engineering/Mapping software, which distinguishes itself in its advanced GIS-Mapping/Engineering features.

Distribution Power System Planning- Rural Electrification Administration work plans, system protection plans, rate studies, power requirement studies and load planning, as well as substation feasibility studies.

Power System Operation – System mapping, system operations summary, voltage regulator settings, power factor correction (capacitor placement and sizing), motor starting, and system maintenance.

Design – Distribution lines, protective relaying and basic Substation specification recommendations.

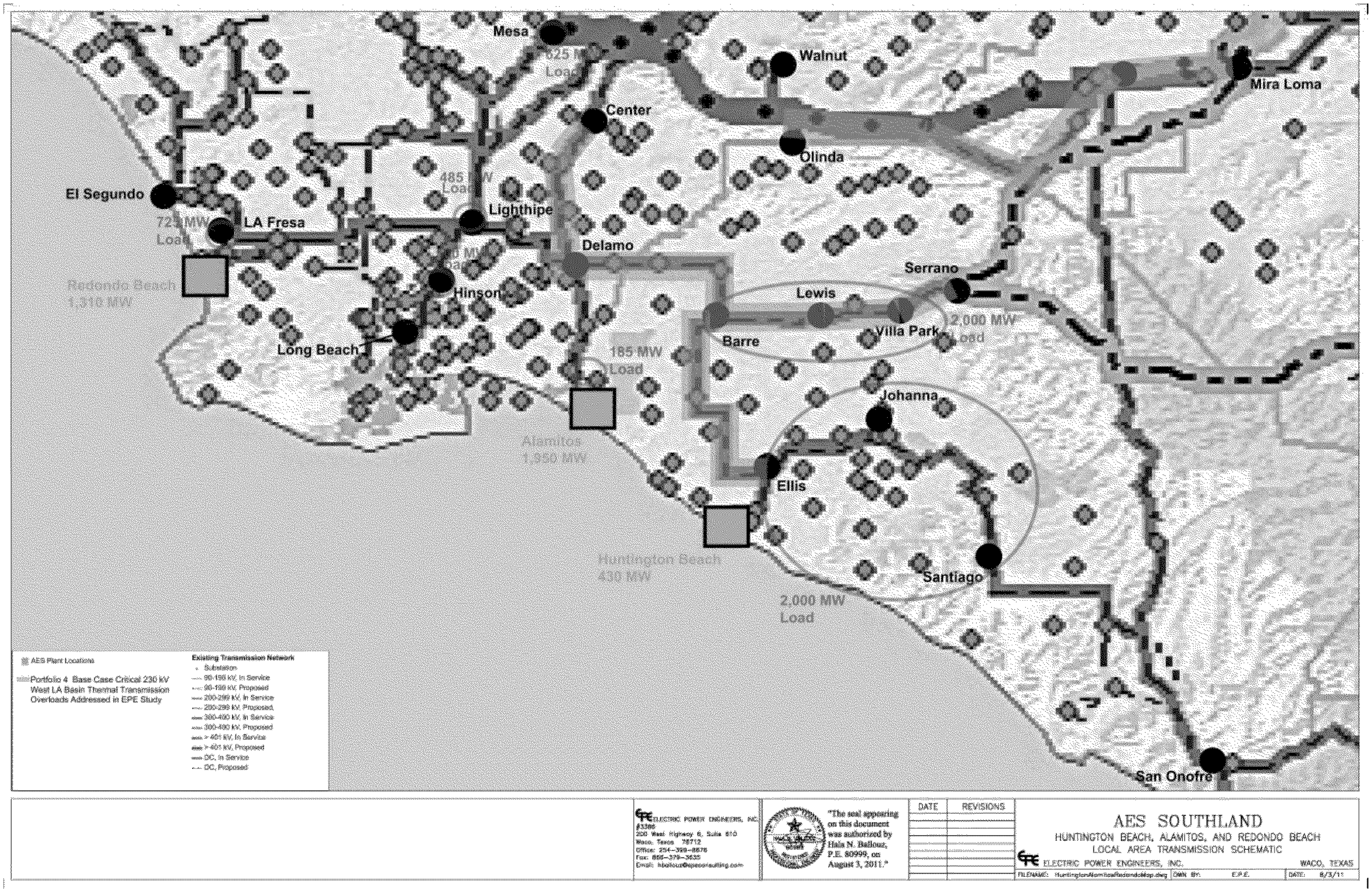
EXHIBIT B

Exhibit B
Western LA Basin Generation Dispatch

PTI Gen Name	*Pgen as in the CAISO 2020 Portfolio4 case (MW)*	*Pmax as in the CAISO 2020 Portfolio4 case (MW)*	*Additional 447 MW Western LA Basin (Base Case)*	Other non-AES Projects added up to 1,800 MW (Equally)	Other non-AES Projects added up to 3,600 MW (Equally)	Other non-AES Projects added up to 1,800 MW (Emphasis on El SEG & LB)	Other non-AES Projects added up to 3,600 MW (Emphasis on El SEG & LB)
ARCO 1G	*80*	*80*	*80*	110.45	143.32	91.39	118.65
ARCO 2G	*80*	*80*	*80*	110.45	143.32	91.39	118.65
ARCO 3G	*80*	*80*	*80*	110.45	143.32	91.39	118.65
ARCO 4G	*80*	*80*	*80*	110.45	143.32	91.39	118.65
BRIGEN	*0*	*35*	*0*	48.32	62.70	40.55	52.47
CARBGEN1	*15*	*17*	*15*	20.71	26.87	20.21	26
CHEVGEN1	*38*	*38*	*38*	52.46	68.08	43.94	56.89
CHEVGEN2	*38*	*38*	*38*	52.46	68.08	43.94	56.89
ELSEG3 G	*0*	*335*	*0*	0.00	0.00	0	0
ELSEG4 G	*0*	*335*	*0*	0.00	0.00	379.51	493.68
HARBOR G	*0*	*14*	*0*	19.33	25.08	16.82	21.59
HARBOR G	*90*	*90*	*90*	124.25	161.24	102.69	133.36
HILLGEN	*51.6*	*51.6*	*51.6*	71.24	92.44	59.3	76.89
HINSON	*0*	*47*	*0*	64.89	84.20	54.1	70.12
ICEGEN	*40*	*50.4*	*40*	55.22	71.66	57.95	75.12
MOBGEN1	*20*	*21.6*	*20*	27.61	35.83	25.41	32.77
S.ONOFR2	*1070*	*1070*	*1070*	1,477.21	1,916.92	1209.98	1574.62
S.ONOFR3	*1080*	*1080*	*1080*	1,491.02	1,934.83	1221.28	1589.33
SANTIAGO	*0*	*17*	*0*	23.47	30.46	20.21	26
SERRFGEN	*20.2*	*33*	*20.2*	27.89	36.19	38.29	49.53
ARCO 5G	*40*	*40*	*40*	55.22	71.66	46.2	59.83
ARCO 6G	*40*	*40*	*40*	55.22	71.66	46.2	59.83
LBEACH12	*0*	*56.3*	*0*	0.00	0.00	80.09	103.95
LBEACH12	*0*	*56.5*	*0*	0.00	0.00	80.09	103.95
LBEACH34	*0*	*56.5*	*0*	0.00	0.00	80.09	103.95
LBEACH34	*0*	*56.5*	*0*	0.00	0.00	80.09	103.95
OLINDA	*0*	*6*	*0*	8.28	10.75	7.78	9.82
MALBRG1G	*43*	*43*	*43*	59.36	77.03	49.59	64.24
MALBRG2G	*43*	*43*	*43*	59.36	77.03	49.59	64.24
MALBRG3G	*50*	*50*	*50*	69.03	89.58	57.49	74.53
ORCOGEN	*0*	*12*	*11*	14.91	19.35	14.56	18.65
THUMSGEN	*0*	*49.9*	*40*	55.22	71.66	57.38	74.39
CARBGEN2	*15*	*17*	*15*	20.71	26.87	20.21	26
MOBGEN2	*20*	*21.6*	*20*	27.61	35.83	25.41	32.77
OUTFALL1	*0*	*17*	*15*	20.71	26.87	20.21	26
OUTFALL2	*0*	*17*	*15*	20.71	26.87	20.21	26
PALOGEN	*3.6*	*13*	*3.6*	4.97	6.45	15.69	20.12
VENICE	*9*	*10.1*	*9*	12.43	16.12	12.41	15.85
COYGEN	*10*	*20*	*10*	13.81	17.80	23.6	30.41
FEDGEN	*0*	*24.7*	*22*	30.37	39.41	28.91	37.33
ANAHEIMG	*0*	*200*	*200*	200.00	200.00	226.98	226.98
HARBORG4	*0*	*14*	*0*	19.33	25.08	16.82	21.59
PASADNA1	*0*	*25*	*25*	34.51	44.79	29.25	37.77
PASADNA2	*0*	*25*	*25*	34.51	44.79	29.25	37.77
BRODWYSC	*60*	*65.3*	*60*	82.83	107.49	74.58	97.04
TOT135G1	*100*	*102.5*	*100*	138.06	179.15	116.71	151.64
TOT135G2	*100*	*102.5*	*100*	138.06	179.15	116.71	151.64
TOT135G3	*100*	*102.5*	*100*	138.06	179.15	116.71	151.64
TOT135G4	*100*	*102.5*	*100*	138.06	179.15	116.71	151.64
TOT135G5	*100*	*102.5*	*100*	138.06	179.15	116.71	151.64
CTRPKGEN	*0*	*49.9*	*47*	65.07	84.43	57.38	74.3
BARPKGEN	*0*	*47.2*	*47*	65.00	84.56	54.33	70.32
TOT041G5	*100*	*175*	*100*	138.06	179.15	175	227.48
TOT041S7	*150*	*280*	*150*	207.10	268.73	261.13	340.2
TOT041G6	*100*	*175*	*100*	138.06	179.15	175	227.48
REFUSE	*9.8*	*12*	*9.8*	13.53	17.56	14.52	18.65
SIGGEN	*23.9*	*29*	*23.9*	33.00	42.82	33.77	43.65
Totals	*4,000.10*	*5852.6*	***4447.1***	**6,247.10**	**8,047.10**	**6,247.10**	**8,047.10**
MW Added to Portfolio4			*447.00*	*2,247.00*	*4,047.00*	*2,247.00*	*4,047.00*
MW Added to +447 MW				**1,800.00**	**3,600.00**	**1,800.00**	**3,600.00**

EXHIBIT C

Exhibit C
Transmission Map Sketch



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