DOCKETED

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Alamitos Energy Center

(13-AFC-01)

Data Responses, Set 8

(Response to Data Request 170-175)

Submitted to

California Energy Commission

Prepared by

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With Assistance from

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March 17, 2016

Contents

Introduction

Attached are AES Southland Development, LLC's (AES or the Applicant) responses to the California Energy Commission (CEC) Staff Data Request, Set 8 (number 170-175) regarding the Alamitos Energy Center (AEC) (13-AFC-01) Supplemental Application for Certification (SAFC).

Transmission System Engineering (170-175)

BACKGROUND

Staff has had discussions with Mr. Robert Sims, an engineering consultant for AES, about draft responses to Transmission System Engineering data requests (Data Requests 160-166 from Energy Commission Staff's Data Request Set #6, filed November 30, 2015). The discussions were primarily focused on the completeness of the draft data responses; however, staff did have some concerns about specific equipment proposed by the applicant that will be documented both through this data request and a separate report of conversation. AES docketed its revised responses to staff's Data Requests 160, 161 and 163 on February 8, 2016. The discussion below is in response to this February 8, 2016 filing. There is still some missing data in the response and staff is concerned that some of the specific equipment is not appropriately sized for the generators. Data Request 166 (the California ISO exemption letter) has not been provided and is still outstanding.

The proposed switchyard equipment is designed for a generator operating between 0.90 lag to 0.95 lead but the generator itself can operate to 0.85 lag. CAISO Tariff 8.2.3.3 indicates the minimum requirement of the Power Factor (PF) of a generator in the ISO system is 0.90 lag to 0.95 lead, but the tariff also states that the CAISO could set a different requirement of the PF during operation which could go from 0.85 lag to 0.95 lead, as stated in the Huntington Beach Energy Project LGIA. The proposed design would meet the minimum requirements, but the proposed generators are rated for 0.85 PF (associated with operation at 0.85 lag). It would be appropriate, and consistent with standard safe practices, to design the switchyard equipment on the basis of 0.85 PF, which would increase the current in the switchyard circuits and the generation tie (gen-tie) lines, requiring higher rated equipment.

Staff is concerned about the proposed conductor in Figure 3.1-R for the gen-tie lines. The proposed aluminum conductor, steel supported (ACSS) conductor is not used very often and then for short reconductoring projects. The ratings for the ACSS conductor are based on 200 degrees Celsius where most of the equipment and other conductors have ratings based on 75 degrees Celsius. This means the proposed conductors would be operating at higher temperature than other equipment in order to accommodate the output of the proposed generator which could affect the reliability of the other equipment. Aluminum Conductor Steel Reinforced (ACSR) is the standard conductor used for transmission and gen-tie lines; ACSR is rated based on 75 degree Celsius operation.

DATA REQUEST

170. Please provide current ratings of the Disconnect Switches in the Switching bays of the SCE 230 kV Alamitos Switching Station.

Response: The disconnect switches and switching bays of the Southern California Edison Company (SCE) 230 kV Alamitos Switching Station are owned and operated by SCE. The Applicant does not have access to this equipment and does not know the disconnect switch ratings for these utility facilities. It should be noted that the existing equipment in the SCE Switching Station is 30 to 40 years old and will likely be replaced by SCE when each AEC generating unit is connected. This detailed design engineering will be performed by SCE under the Large Generator Interconnection Agreement (LGIA) in the usual course, post-Certification. SCE has the responsibility to properly size and install this SCE equipment to facilitate AEC's interconnection.

171. In Power Block 1, please provide:

    a. The high side bus size, type and Ampere ratings,

    b. The length, size and type of the short overhead conductor between the high side of the generator step-up (GSU) transformer and the 230 kV switchyard bus.

Response: These switchyards have not yet been designed and this level of specificity will not be available until detailed design is completed post-Certification, as it is with all Commission-approved projects. These electrical facilities will be designed and constructed, with conductors selected in conformance with the then-applicable standards and codes including the National Electrical Code, National Electrical Safety code, American National

Standards Institute, IEEE, and others to assure that they are properly sized for the application. The bus and cables in question under Data Request 171 are relatively short connections (in the range of 25 to 50 feet) within the AEC 230-kV switchyards. Furthermore, the Applicant expects the Energy Commission to include a standard Condition of Certification requiring a Chief Building Official to verify that the engineering design and construction comply with then-applicable laws, ordinances, regulations, and standards.

172. In Power Blocks 2a and 2b, please provide:

a. The high side bus size and type, Ampere ratings,

b. The length, size and type of the short overhead conductor between the high side of the GSU transformer and the 230 kV switchyard bus.

Response: These switchyards have not yet been designed and this level of specificity will not be available until detailed design is completed post-Certification, as it is with all Commission-approved projects. These electrical facilities will be designed and constructed in conformance with the then-applicable standards and codes including the National Electrical Code, National Electrical Safety code, American National Standards Institute, IEEE, and others to assure that they are properly sized for the application. The bus and cables in question under Data Request 172 are relatively short connections (in the range of 25 to 50 feet) within the project's 230-kV switchyards. Furthermore, the Applicant expects the Energy Commission to include a standard Condition of Certification requiring a Chief Building Official to verify that the engineering design and construction comply with then-applicable laws, ordinances, regulations, and standards.

173. Figure 3.1-1R and Figure DR161-1R are not consistent. Figure 3.1-1R shows four power blocks, 2a, 2b, 2c and 2d, connecting separately to the bus. Figure DR161-1R shows blocks 2a and 2b connecting as a pair to the bus and 2c and 2d connecting as a pair to the bus. Please provide consistent drawings.

Response: Figure DR173-1R presents a revised electrical system one-line drawing that is consistent with Figure DR161-1R. Figure 2.1-2R presents the revised general arrangement.

174. Given the discussion above and the high operating temperature ACSS conductor proposed in Figure 3.1-1R, please explain the choice of the ACSS conductor for the gen-tie line and why a more standard ACSR conductor was not chosen.

Response: The ACSS conductor was selected because it has superior mechanical properties and corrosion resistance. The electrical properties and ratings of ACSR and ACSS bare transmission conductors for any given size are nearly identical. Both types of conductors have the same area of aluminum conductor, the same alternating current (AC) resistance, and will operate at the same conductor temperature for any given conductor size and load. The ACSS type conductor is superior due to the higher quality steel support core and compressed trapezoid aluminum conductor. This allows the conductor to operate at temperatures up to 200 degrees Celsius; however, the application for the AEC will limit the maximum cable temperature to below 75 degrees Celsius. The ACSS conductor was selected because of its higher strength, lower susceptibility to sag, and more importantly it is corrosion resistant in a saline coastal environment. Given that the electrical properties and operating temperatures of ACSR and ACSS conductor are the same, the premium ACSS conductor with its superior mechanical properties and corrosion resistance are proposed for AEC.

175. Many of the circuit breakers and all of the Step-up transformers are not rated highly enough to allow the generators to operate at their rated 0.85 power factor.

Based on the equipment ratings provided in Figure 3.1-1R:

a. Please explain the choice of underrated equipment or redesign the switchyard and gen-tie lines with equipment that would allow the generators to operate at their rated 0.85 power factor (0.85 lag). If the switchyard is redesigned, resubmit all of the diagrams with the new equipment and the associated equipment ratings.

Response: The equipment is not underrated as demonstrated by the following calculations. It appears that the CEC staff has used the nameplate rating of the combustion turbine and steam turbine generators in the calculation of the maximum electrical loads. The AEC generator loadings for the combustion turbine generators and steam turbine generator will be limited by the available shaft horsepower from the combustion turbines and steam turbine. The electrical generators are oversized and will not operate at their nameplate ratings. As noted in the SAFC Figure 2.1-4a, the maximum output of the combustion turbines in combined cycle power block is limited to 226.639 gross megawatts (MW) under cool weather conditions, and the steam turbine generator is limited 228.709 MW due to the available steam. If these generation ratings are used to calculate the maximum transformer and equipment loads for all equipment, they will be found to be sufficiently sized for operation at a 0.85 power factor should it ever be required. Please note that the current power factor requirement for generators operating in the California Independent System Operator (CAISO) has been unchanged at 0.90 lagging to 0.95 leading since the creation of the CAISO. Under the current CAISO Tariff requirement, the power factor for the Alamitos Energy Center electrical equipment has a comfortable rating margin.

b. The 9,000 Amp, 18 kV Circuit Breaker 1 (CB1) in the Power Block No. 1 switchyard would not allow the STG to operate at its rated 0.85 PF.

Response: The breaker is properly rated as demonstrated by the following calculations. The maximum steam turbine generator output is 228.709 MW per SAFC Figure 2.1-4a. At a power factor of 0.85 this equals 269.069 MVA resulting in a maximum loading of 8,630 ampere at 18 kV. This is within the rating of the 9,000 ampere circuit breaker. As noted in the response to Data Request #173, the engineering design is ongoing and this breaker will be provided with a 10,000 ampere rating for consistency with the 2 – 10,000 ampere breakers on the 2 combusting turbine generators in the power block.

c. In Power Block 1, the Generator Step-up (GSU) transformers for the CTG 1 and CTG 2 generators are rated at 270 MVA. The CTGs are rated 234.5 MW, 0.85 PF. In order to accommodate the generators the GSU transformers should be rated at least 276MVA.

Response: The GSUs are properly rated as demonstrated by the following calculations. The maximum combined cycle combustion turbine generator output is 226.639 MW (gross) under cool weather conditions per SAFC Figure 2.1-4a. At a power factor of 0.85 this equals 266.634 MVA and is within the ratings of the transformer.

d. In the Power Blocks 2a and 2b, the highest rating of each transformer is 120 MVA while the generators would require a transformer with at least a 122 MVA rating in order to operate at a 0.85 power factor.

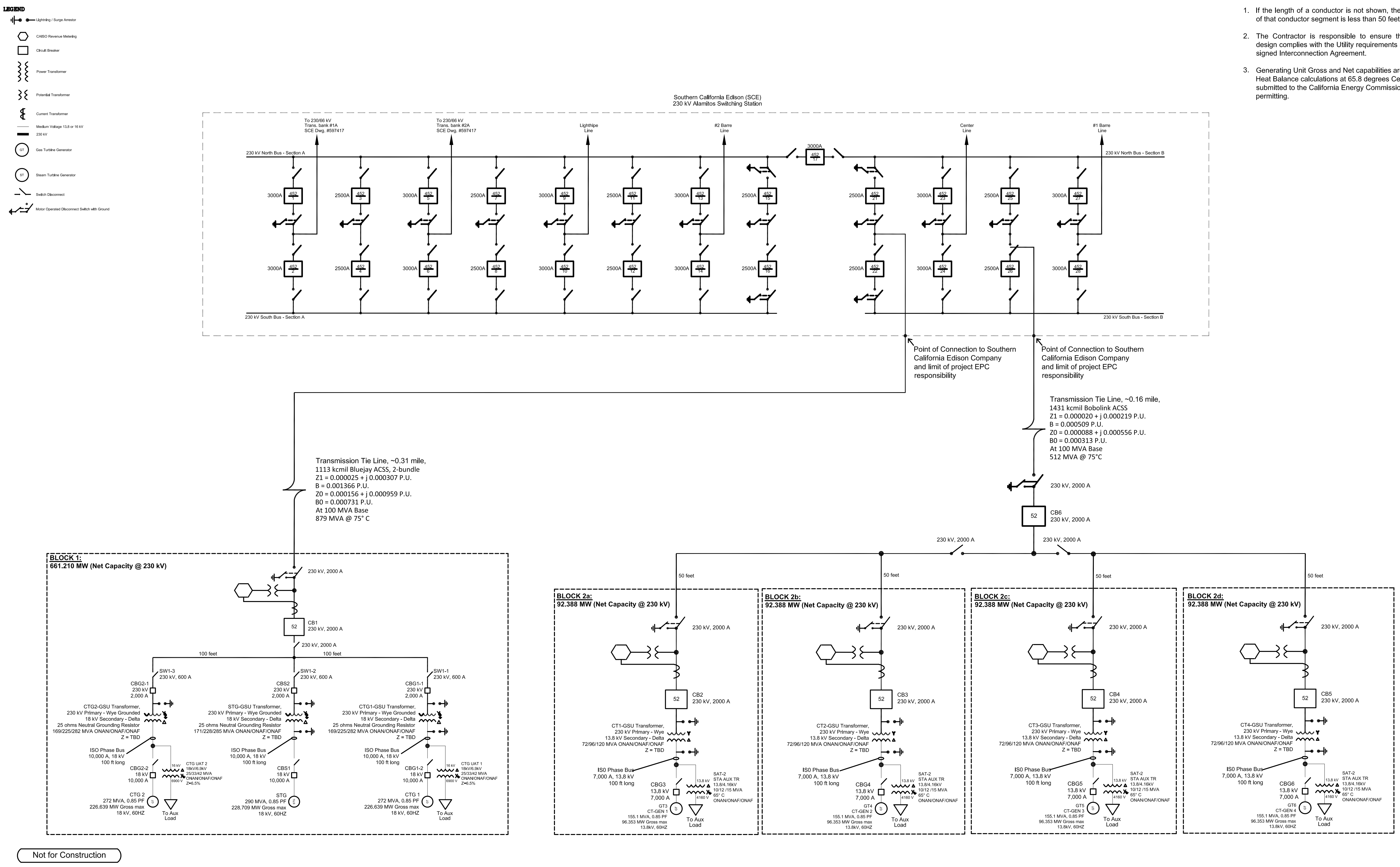
Response: The transformers are properly rated as demonstrated by the following calculations. The maximum simple cycle combusting turbine generator output is 96.353 MW (net) under cool weather conditions per SAFC Figure 2.1-4b. At a power factor of 0.85 this equals 113.36 MVA and is within the ratings of the transformer.

e. In Power Block 1, the 230 kV breaker, CB1 and associated disconnect switch are rated at 2,000 Amperes. In order to accommodate generators at 0.85 PF, the ratings of the 230 kV breaker and the disconnect switch should be at least 2, 100 ampere.

Response: The disconnect switch is properly rated as demonstrated by the following calculations. The maximum combined cycle power block 1 output is 661.210 MW (net) under cool weather conditions per SAFC Figure 2.1-4a. At a power factor of 0.85 this equals 1,660 ampere and is within the ratings of the 2,000 ampere circuit breaker and 2000 ampere disconnect switch.

Notes:

1. If the length of a conductor is not shown, then the length of that conductor segment is less than 50 feet.
2. The Contractor is responsible to ensure that the final design complies with the Utility requirements as set in the signed Interconnection Agreement.
3. Generating Unit Gross and Net capabilities are based on Heat Balance calculations at 65.8 degrees Celsius as submitted to the California Energy Commission for facility permitting.



Not for Construction

REV.:	DATE:	DESCRIPTION:	DRAWN BY:	CHECKED BY:	APPROVED BY:
0	12/11/15	Update CC & LMS Block Ratings	TI	CFM	HEM
1	03/11/16	Misc Updates	JR	CFM	HEM
2	03/15/16	Update Tie Line Specs and NGRs size	CFM	CFM	HEM

DWG FILE: Alamitos Project_One Line Diagram–2016 CEC Application_03–15–2016.dwg PLOTTED: Mar 15, 2016

This document is released for the purpose of preliminary design for CEC submittal under the authority of Hugo E. Mena, P.E. 20368 on 03/11/16. It is not to be used for construction purposes.

"The seal appearing on this document was authorized by Hugo E. Mena, P.E. 20368, on March 11, 2016."

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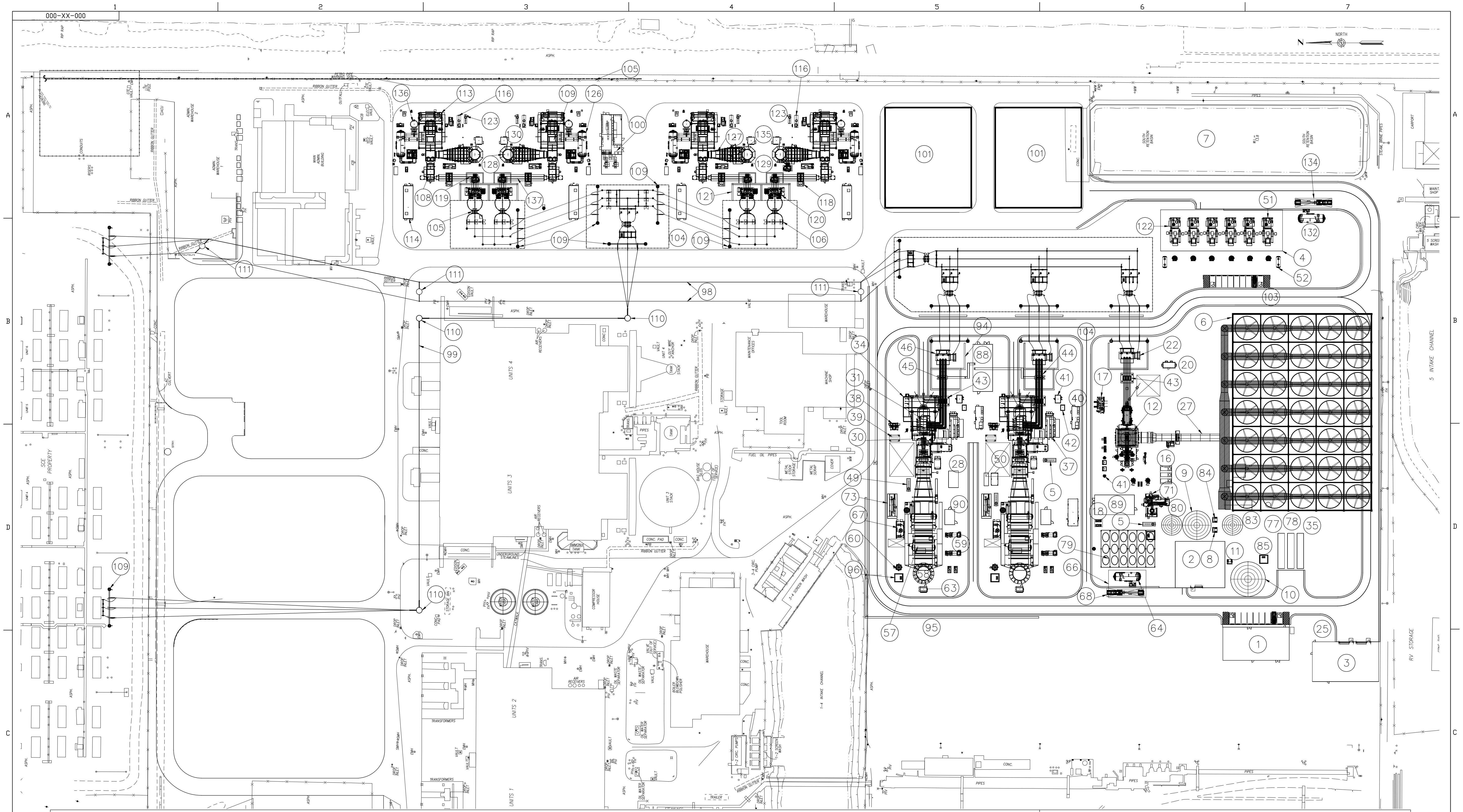
FIGURE DR173-1R
Electrical System One-Line Diagram
Alamitos Energy Center
Long Beach, California
March 2016

PLOT SCALE: ARCH 0 1 2 ENGRG 0 1 2
PROJ. NO.: —
SCALE: NA
DWG. NO.: —
SHEET: 2/2
REV.: 1



2X1 7FA LEGEND

NO.	DESCRIPTION	13		26		39	FUEL GAS STARTUP HEATER	52	FUEL GAS COMPRESSOR DRAINS TANK	65		78	NITROGEN STORAGE	91	
1	ADMINISTRATION BUILDING	14		27	ACC STEAM DUCT	40	UNIT EXCITATION/LCI EQUIPMENT	53		66	AMMONIA CONTAINMENT AREA	79	AIR COOLED HEAT EXCHANGER	92	
2	WATER TREATMENT BUILDING	15		28	CHEMICAL FEED CANOPY	41	ISOLATION TRANSFORMER	54		67	AMMONIA INJECTION SKID	80	WASTE WATER TANK	93	
3	WAREHOUSE BUILDING	16	CONDENSATE PUMPS	29		42	EXCITATION TRANSFORMER	55		68	AMMONIA UNLOADING CONTAINMENT AREA	81		94	TRANSFORMER WALL
4	GAS COMPRESSOR BUILDING	17	STG LUBE OIL MODULE	30	COMBUSTION TURBINE	43	GENERATOR BREAKER	56		69		82		95	ACOUSTICAL BARRIER
5	OIL/WATER SEPERATOR	18	CLOSED COOLING WATER PUMPS	31	COMBUSTION TURBINE GENERATOR	44	ISO PHASE BUS DUCT	57	HRSG	70		83	CONDENSATE TANK	96	CEMS CABINET
6	AIR COOLED CONDENSER	19		32		45	AUXILIARY TRANSFORMER	58	STACK	71	AUXILIARY BOILER AND ASSOCIATED EQUIPMENT	84	CONDENSATE TRANSFER PUMPS	97	
7	RETENTION BASIN	20	STG EXCITATION UNIT EQUIPMENT (GEC)	33		46	CTG STEP-UP TRANSFORMER	59	BOILER FEEDWATER PUMPS	72		85	RECYCLE SYSTEM SUMP	98	NEW 230KV TRANSMISSION LINE
8	DEMIN WATER PUMPS	21		34	AIR INLET FILTER	47		60	BLOWDOWN TANK	73	IP WATER FUEL GAS HEATER	86			
9	DEMIN WATER STORAGE TANK	22	STG STEP-UP TRANSFORMER	35	HYDROGEN STORAGE	48		61		74		87			
10	SERVICE WATER STORAGE TANK	23		36		49	WATER WASH DRAINS TANK	62		75		88	MEDIUM VOLTAGE ELECTRICAL ENCLOSURE		
11	SERVICE WATER PUMPS	24		37	PEECC	50	WATER WASH SKID	63	CEMS	76		89	STG ELECTRICAL ENCLOSURE		
12	STEAM TURBINE AND GENERATOR	25	PARKING AREA	38	FUEL GAS FILTER/SEPERATOR	51	FUEL GAS COMPRESSORS	64	AMMONIA STORAGE TANK	77	C02 STORAGE TANK	90	HRSG ELECTRICAL ENCLOSURE		

LMS 100 LEGEND

99	NEW 230KV TRANSMISSION LINE	112		125	
100	MEDIUM VOLTAGE ELECTRICAL ENCLOSURE	113	AIR INLET FILTER	126	INTERCOOLER SKID
101	FIN FAN COOLER	114	PACKAGED ELECTRICAL ELECTRONIC CONTROL CENTER (PEECC)	127	CTG EXHAUST DUCT
102	PARKING AREA	115		128	STACK
103	ROADWAY	116	FUEL GAS HEATER	129	SCR
104	SWITCHYARD FENCE	117		130	CONTINUOUS EMISSIONS MONITORING SYS. EQUIP.
105	SWITCHYARD BREAKER	118	GENERATOR BREAKER	131	
106	SWITCHYARD DISCONNECT	119	AUXILIARY TRANSFORMER	132	AMMONIA STORAGE TANK
107	COMBUSTION TURBINE	120	CTG STEP-UP TRANSFORMER	133	AMMONIA INJECTION SKID
108	COMBUSTION TURBINE GENERATOR	121	TRANSFORMER WALL	134	AMMONIA UNLOADING CONTAINMENT AREA
109	STRUCTURE TYPE A	122	FUEL GAS COMPR. BUILDING	135	CO CATALYST (BY OWNER)
110	STRUCTURE TYPE B	123	FUEL GAS REGULATOR	136	COMBUSTION TURBINE VBV SILENCER STACK
111	STRUCTURE TYPE G	124		137	ISO-PHASE BUS DUCT

REV	DATE	DESCRIPTION	DWN	DGN	CHK	APP
0	03-11-16	UPDATE FOR AFC	MLC	SRS	SRS	BJE

SCALE:
NONE
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

PEC

E SIZE 42"x30"

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Figure 2.1-2R
General Arrangement
Alamitos Energy Center
Long Beach, California
March 2016