INTERCONNECTION REQUEST

Provide **three copies** of this completed form pursuant to Section 7 of this GIP Appendix 1 below.

1.   The undersigned Interconnection Customer submits this request to interconnect its Generating Facility with the CAISO Controlled Grid pursuant to the CAISO Tariff (check one):
        ☐ Fast Track Process.
        ☐ Independent Study Process.
        ☒ Queue Cluster Process.
        ☐ One-Time Deliverability Assessment pursuant to GIP Section 8.1.
        ☐ Annual Deliverability Assessment pursuant to GIP Section 8.

2.   This Interconnection Request is for (check one):
        ☐ A proposed new Generating Facility.
        ☒ An increase in the generating capacity or a Material Modification to an existing Generating Facility.

3.   Requested Deliverability Status is for (check one):
        ☒ Full Capacity (For Independent Study Process and Queue Cluster Process only)
                (Note – Deliverability analysis for Independent Study Process is conducted with the next annual Cluster Study – See GIP Section 4.6)
        ☐ Energy Only

4.   The Interconnection Customer provides the following information:

        a.   Address or location, including the county, of the proposed new Generating Facility site or, in the case of an existing Generating Facility, the name and specific location, including the county, of the existing Generating Facility;

                Project Name: **Redondo Beach Energy Project**

                Project Location:
                        Street Address: **1100 North Harbor Dr**

                        City, State: **Redondo Beach, California**

                        County: **Los Angeles**

                        Zip Code: **90277**

                        GPS Coordinates (decimal format):

                                Latitude: **33.85130556**   Longitude: **-118.3933583**

        b.   Maximum net megawatt electrical output (as defined by section 2.c of Attachment A to this appendix) of the proposed new Generating Facility or the amount of net megawatt increase in the generating capacity of an existing Generating Facility;

                Maximum net megawatt electrical output (MW): **475.717 MW at 85 °F   OR**
                Net Megawatt increase (MW):

c. Type of project (i.e., gas turbine, hydro, wind, etc.) and general description of the equipment configuration (if more than one type is chosen include net MW for each);

- ☐ Cogeneration   (MW)
- ☐ Reciprocating Engine   (MW)
- ☐ Biomass   (MW)
- ☐ Steam Turbine   (MW)
- ☐ Gas Turbine   (MW)
- ☐ Wind   (MW)
- ☐ Hydro   (MW)
- ☐ Photovoltaic   (MW)
- ☒ Combined Cycle   **475.717** (MW)

- ☐ Other (please describe):   (MW)

General description of the equipment configuration (e.g. number, size, type, etc):
The project is comprised of one CCGT block (Block 1) having a maximun net output of 475.717 MW. The block is comprised of 3 gas turbines rated at 115.962 MW, 122.065 MVA each and 1 steam turbine rated at 145.568 MW, 153.229 MVA.

d. Proposed In-Service Date (first date transmission is needed to the facility), Trial Operation date and Commercial Operation Date by day, month, and year and term of service (**dates must be sequential**):

Proposed In-Service Date:	**07/01/2017**
Proposed Trial Operation Date:	**08/01/2018**
Proposed Commercial Operation Date:	**12/31/2018**
Proposed Term of Service (years):	**30 years**

e. Name, address, telephone number, and e-mail address of the Interconnection Customer's contact person (primary person who will be contacted);

Name:	**John Kistle**
Title:	**Project Development Team**
Company Name:	**AES Southland**
Street Address:	**690 N. Studebaker Road**
City, State:	**Long Beach, California**
Zip Code:	**90803**
Phone Number:	**(562) 493-7894**
Fax Number:	**(562) 493-7320**
Email Address:	**John.Kistle@AES.com**
DUNS Number:	

f. Approximate location of the proposed Point of Interconnection (i.e., specify transmission facility interconnection point name, voltage level, and the location of interconnection);

230 kV Redondo Beach Switching Station as shown in attached Site Drawing.

g. Interconnection Customer data (set forth in Attachment A)

The Interconnection Customer shall provide to the CAISO the technical data called for in GIP Appendix 1, Attachment A. Three (3) copies are required.

5.   Applicable deposit amount as specified in the GIP made payable to California ISO. Send check to CAISO (see section 7 for details) along with the:
    a.   Appendix 1 to GIP (Interconnection Request) for processing.
    b.   Attachment A to Appendix 1 (Interconnection Request Generating Facility Data).

6.   Evidence of Site Exclusivity as specified in the GIP and name(s), address(es) and contact information of site owner(s) (check one):
    Current Title Report is available upon request.

    Site is an existing generating facility, wholly owned by AES.
    Plant Manager: Tony Chavez
                            1100 N. Harbor Drive,
                            Redondo Beach, CA 90277
                            310-318-7240.

    ☐ Is attached to this Interconnection Request
    ☐ Deposit in lieu of Site Exclusivity attached, Site Exclusivity will be provided at a later date in accordance with this GIP

7.   This Interconnection Request shall be submitted to the CAISO representative indicated below:

            New Resource Interconnection
            California ISO
            P.O. Box 639014
            Folsom, CA 95763-9014

            Overnight address: California ISO, Attn: Grid Assets, 250 Outcropping Way, Folsom, CA 95630

8.   Representative of the Interconnection Customer to contact:

            [To be completed by the Interconnection Customer]
            Name: **Hala Ballouz, PE**
            Title: **President**
            Company Name: **Electric Power Engineers, Inc. (EPE)**
            Street Address: **9433 Bee Caves Road, Building 3, Suite 210**
            City, State: **Austin, Texas**
            Zip Code: **78733**
            Phone Number: **(512) 382-6700**
            Fax Number: **(866) 379-3635**
            Email Address: **hballouz@epeconsulting.com**

9.   This Interconnection Request is submitted by:

    Legal name of the Interconnection Customer: **AES North America Development, LLC**

    By (signature):   _____

    Name (type or print):   **John Kistle**

    Title: Vice President

    Date: **March 29, 2012**

Attachment A Generating Facility Data
To GIP Appendix 1
Interconnection Request

GENERATING FACILITY DATA

Provide three copies of this completed form pursuant to Section 7 of GIP Appendix 1.

1. **Provide two original prints and one reproducible copy (no larger than 36" x 24") of the following:**

    A. Site drawing to scale, showing generator location and Point of Interconnection with the CAISO Controlled Grid.
    B. Single-line diagram showing applicable equipment such as generating units, step-up transformers, auxiliary transformers, switches/disconnects of the proposed interconnection, including the required protection devices and circuit breakers. For wind and photovoltaic generator plants, the one line diagram should include the distribution lines connecting the various groups of generating units, the generator capacitor banks, the step up transformers, the distribution lines, and the substation transformers and capacitor banks at the Point of Interconnection with the CAISO Controlled Grid.

2. **Generating Facility Information**
    A. Total Generating Facility rated output (MW): **Gross: 493.454 MW at 85 °F and 95% PF**
    B. Generating Facility auxiliary Load (MW): **17.737 MW at 85 °F**
    C. Project net capacity (A-B)(MW): **475.717 MW at 85 °F and 95% PF**
    D. Standby Load when Generating Facility is off-line (MW): **0.8**
    E. Number of Generating Units: **1 block composed of 3 gas turbines and 1 steam turbine**
        (Please repeat the following items for each generator)
    F. Individual generator rated output (MW for each unit):
        Gas: 115.962 MW at 38.8°C rated coolant inlet temperature.
        Steam: 145.568 MW at 38.8°C rated coolant inlet temperature.
    G. Manufacturer: **BRUSH (for all generators)**
    H. Year Manufactured: _____
    I. Nominal Terminal Voltage (kV): **13.8 (for all generators)**
    J. Rated Power Factor (%):**0.95 (for all generators)**
    K. Type (Induction, Synchronous, D.C. with Inverter): **Synchronous (for all generators)**
    L. Phase (three phase or single phase): **Three Phase (for all generators)**
    M. Connection (Delta, Grounded WYE, Ungrounded WYE, impedance grounded):
        Impedance grounded
    N. Generator Voltage Regulation Range (+/- %):
        Gas: +/- 10%,
        Steam: Selectable from +/- 10% to +/- 25%.
    O. Generator Power Factor Regulation Range:
        Please refer to the attached generators PQ curves.
    P. For combined cycle plants, specify the plant net output capacity (MW) for an outage of the steam turbine or an outage of a single combustion turbine
        Net plant output of 359.755 MW at 85° F and 95% PF for an outage of a single combustion turbine.

3. **Synchronous Generator – General Information:**
    (Please repeat the following for each generator model)

    A. Rated Generator speed (rpm): **3600 (for all generators)**
    B. Rated MVA:

Gas: 122.065 MVA each,
Steam: 153.229 MVA

C.   Rated Generator Power Factor: **0.95 (for all generators)**
D.   Generator Efficiency at Rated Load (%):
Gas: 98.62% each
Steam: 98.67%
E.   Moment of Inertia (including prime mover):
42,707 kgm2 for each Gas Turbine + Generator.
6102 kgm2 for the Steam Turbine + Generator.
F.   Inertia Time Constant (on machine base) H:
1.26 kW sec/kVA for each gas turbine generator,
1.09 kW sec/kVA for the steam turbine generator sec or MJ/MVA
G.   SCR (Short-Circuit Ratio - the ratio of the field current required for rated open-circuit voltage to the field current required for rated short-circuit current):
Gas: 0.52 each
Steam: 0.49
H.   Please attach generator reactive capability curves.
I.   Rated Hydrogen Cooling Pressure in psig (Steam Units only): **N/A**
J.   Please attach a plot of generator terminal voltage versus field current that shows the air gap line, the open-circuit saturation curve, and the saturation curve at full load and rated power factor.

4.   **Excitation System Information**
 (Please repeat the following for each generator model)

A.   Indicate the Manufacturer **Gas: ABB inc., Steam: Brush** and Type **Gas: UNITROL 6000, Steam: Brushless** of excitation system used for the generator. For exciter type, please choose from 1 to 9 below or describe the specific excitation system.
     ☐ (1) Rotating DC commutator exciter with continuously acting regulator. The regulator power source is independent of the generator terminal voltage and current.
     ☐ (2) Rotating DC commentator exciter with continuously acting regulator. The regulator power source is bus fed from the generator terminal voltage.
     ☐ (3) Rotating DC commutator exciter with non-continuously acting regulator (i.e., regulator adjustments are made in discrete increments).
     ☐ (4) Rotating AC Alternator Exciter with non-controlled (diode) rectifiers. The regulator power source is independent of the generator terminal voltage and current (not bus-fed).
     ☐ (5) Rotating AC Alternator Exciter with controlled (thyristor) rectifiers. The regulator power source is fed from the exciter output voltage.
     ☐ (6) Rotating AC Alternator Exciter with controlled (thyristor) rectifiers.
     ☐ (7) Static Exciter with controlled (thyristor) rectifiers. The regulator power source is bus-fed from the generator terminal voltage.
     ☐ (8) Static Exciter with controlled (thyristor) rectifiers. The regulator power source is bus-fed from a combination of generator terminal voltage and current (compound-source controlled rectifiers system.
     ☒ (9) Other (specify):
         Steam: as in #1 above.
         Gas: Static Exciter with controlled (thyristors) rectifiers. The main power source for the Exciter is fed from an AC auxilliary source through a step down transformer
B.   Attach a copy of the block diagram of the excitation system from its instruction manual. The diagram should show the input, output, and all feedback loops of the excitation system.
C.   Excitation system response ratio (ASA):
Gas: 180% Ceiling Voltage; Steam: 2.4

D. Full load rated exciter output voltage: **Gas: 145 VDC (Based on Generator Field Data provided); Steam: 174 VDC**

E. Maximum exciter output voltage (ceiling voltage): **Gas: 263 VDC (Based on 180% Ceiling voltage requirement); Steam: 365 VDC**

F. Other comments regarding the excitation system?

    ———

5. Power System Stabilizer Information
(Please repeat the following for each generator model. All new generators are required to install PSS unless an exemption has been obtained from WECC. Such an exemption can be obtained for units that do not have suitable excitation systems.)

A. Manufacturer: **Gas: ABB; Steam: Brush**

B. Is the PSS digital or analog? **Gas: Digital; Steam: Digital**

C. Note the input signal source for the PSS:
☐ Bus frequency ☐ Shaft speed ☐ Bus Voltage
☒ Other (specify source):
Gas: Three phase generator CT's (Current Measurement);
Steam: Active Electrical Power Frequency & Generator Internal Voltage. Both inputs derived from sensing transformer signals.

D. Please attach a copy of a block diagram of the PSS from the PSS Instruction Manual and the correspondence between dial settings and the time constants or PSS gain.

E: Other comments regarding the PSS?

    ———

6. Turbine-Governor Information
(Please repeat the following for each generator model)

Please complete Part A for steam, gas or combined-cycle turbines, Part B for hydro turbines, and Part C for both.

A. Steam, gas or combined-cycle turbines:

    (1) List type of unit (Steam, Gas, or Combined-cycle): **Combined-cycle block (3 x Gas and 1 x Steam per block)**

    (2) If steam or combined-cycle, does the turbine system have a reheat process (i.e., both high and low pressure turbines)?   **Non- Reheat**

    (3) If steam with reheat process, or if combined-cycle, indicate in the space provided, the percent of full load power produced by each turbine:
        Low pressure turbine or gas turbine: _____%
        High pressure turbine or steam turbine: _____%

B. Hydro turbines:

    (1) Turbine efficiency at rated load: _____%

    (2) Length of penstock: _____ft

    (3) Average cross-sectional area of the penstock: _____ft2

    (4) Typical maximum head (vertical distance from the bottom of the penstock, at the gate, to the water level): _____ft

    (5) Is the water supply run-of-the-river or reservoir: _____

    (6) Water flow rate at the typical maximum head: _____ft3/sec

    (7) Average energy rate: _____kW-hrs/acre-ft

    (8) Estimated yearly energy production: _____kW-hrs

C. Complete this section for each machine, independent of the turbine type.

	(1)	Turbine manufacturer: **MHI for both Gas and Steam**
	(2)	Maximum turbine power output: _____ MW
	(3)	Minimum turbine power output (while on line): _____ MW
	(4)	Governor information:

        (a) Droop setting (speed regulation): **Gas: 4%, Steam: >4%**

        (b) Is the governor mechanical-hydraulic or electro-hydraulic (Electro-hydraulic governors have an electronic speed sensor and transducer.)? **Electro-Hydraulic for both Gas and Steam**

        (c) Other comments regarding the turbine governor system?

           _____

7. Induction Generator Data:

A. Rated Generator Power Factor at rated load: _____

B. Moment of Inertia (including prime mover): _____

C. Do you wish reclose blocking? ☐Yes ☐No

Note: Sufficient capacitance may be on the line now, or in the future, and the generator may self-excite unexpectedly.

8. Generator Short Circuit Data

For each generator model, provide the following reactances expressed in p.u. on the generator base:

- $X"1$ – positive sequence subtransient reactance: **Gas: 0.123, Steam: 0.14** p.u**
- $X2$ – negative sequence reactance: **Gas: 0.153, Steam: 0.183** p.u**
- $X0$ – zero sequence reactance: **Gas: 0.084, Steam: 0.091** p.u**

Generator Grounding (select 1 for each model):

A. ☐ Solidly grounded

B. ☒ Grounded through an impedance
(Impedance value in p.u on generator base

R: **614.66 on 100 MVA base (for all generators)** p.u.

X: **249.95 on 100 MVA base (for all generators)** p.u.)

C. ☐ Ungrounded

9. Step-Up Transformer Data

For each step-up transformer, fill out the data form provided in Table 1.

10. Interconnection Facilities Line Data

There is no need to provide data for new lines that are to be planned by the Participating TO. However, for transmission lines that are to be planned by the generation developer, please provide the following information:

Nominal Voltage: **230**kV

Line Length: **Two 3-phase lines, Circuit 1: 424 feet and Circuit 2: 580 feet.**

Line termination Points: _____

Conductor Type: **ACSR**   Size: **1033.5 kcmil**

If bundled. Number per phase: _____, Bundle spacing: _____in.

Phase Configuration. Vertical: **X**, Horizontal: _____

Phase Spacing: A-B: **15**ft.,   B-C: **15**ft.,   C-A: **30**ft.

Distance of lowest conductor to Ground at full load and 40ºC: **44.8** ft
Ground Wire Type: **AW** Size: **313.7**   Distance to Ground: **49** ft
Attach Tower Configuration Diagram
Summer line ratings in amperes (normal and emergency) **Normal: 1001.5 Amps (x 2; two 3-phase lines); Emergency: 1057.5 Amps (x 2; two 3-phase lines)**
Positive Sequence Resistance (R):   **Circuit 1: 0.000014; Circuit 2: 0.000019** p.u.** (for entire line length)
Positive Sequence Reactance: (X):   **Circuit 1: 0.000113; Circuit 2: 0.000154** p.u** (for entire line length)
Zero Sequence Resistance (R0):   **Circuit 1: 0.000057; Circuit 2: 0.000078** p.u.** (for entire line length)
Zero Sequence Reactance: (X0):   **Circuit 1: 0.000388; Circuit 2: 0.000531** p.u** (for entire line length)
Line Charging (B/2): **Circuit 1: 0.00012148; Circuit 2: 0.00016617** p.u**
** On 100-MVA and nominal line voltage (kV) Base

10a.   **For Wind/photovoltaic plants, provide collector System Equivalence Impedance Data Provide values for each equivalence collector circuit at all voltage levels.**

Nominal Voltage: _____
Summer line ratings in amperes (normal and emergency) _____
Positive Sequence Resistance (R1): _____ p.u. ** (for entire line length of each collector circuit)
Positive Sequence Reactance: (X1): _____ p.u** (for entire line length of each collector circuit)
Zero Sequence Resistance (R0): _____ p.u. ** (for entire line length of each collector circuit)
Zero Sequence Reactance: (X0): _____ p.u** (for entire line length of each collector circuit)
Line Charging (B/2):   _____ p.u** (for entire line length of each collector circuit)
** On 100-MVA and nominal line voltage (kV) Base

11.   **Wind Generators**

Number of generators to be interconnected pursuant to this Interconnection Request: _____

Average Site Elevation: _____   ☐Single Phase   ☐Three Phase

Inverter manufacturer, model name, number, and version:
_____

List of adjustable set points for the protective equipment or software:
_____
Field Volts: _____
Field Amperes: _____
Motoring Power (MW): _____
Neutral Grounding Resistor (If Applicable): _____
I22t or K (Heating Time Constant): _____
Rotor Resistance: _____
Stator Resistance: _____
Stator Reactance: _____
Rotor Reactance: _____
Magnetizing Reactance: _____
Short Circuit Reactance: _____
Exciting Current: _____
Temperature Rise: _____
Frame Size: _____
Design Letter: _____
Reactive Power Required In Vars (No Load): _____

Reactive Power Required In Vars (Full Load): _____
Total Rotating Inertia, H: _____ Per Unit on 100 MVA Base

Note: A completed General Electric Company Power Systems Load Flow (PSLF) data sheet must be supplied with the Interconnection Request. If other data sheets are more appropriate to the proposed device then they shall be provided and discussed at Scoping Meeting.

12.   **Load Flow and Dynamic Models:**

        Provide load flow model for the generating plant and its interconnection facilities in GE PSLF *.epc format, including new buses, generators, transformers, interconnection facilities. An equivalent model is required for the plant with generation collector systems. This data should reflect the technical data provided in this Attachment A.

For each generator, governor, exciter and power system stabilizer, select the appropriate dynamic model from the General Electric PSLF Program Manual and provide the required input data. The manual is available on the GE website at www.gepower.com. Select the following links within the website: 1) Our Businesses, 2) GE Power Systems, 3) Energy Consulting, 4) GE PSLF Software, 5) GE PSLF User's Manual. **Include any user written *.p EPCL files to simulate inverter based plants' dynamic responses (typically needed for inverter based PV/wind plants). Provide a completed *.dyd file that contains the information specified in this section.**

There are links within the GE PSLF User's Manual to detailed descriptions of specific models, a definition of each parameter, a list of the output channels, explanatory notes, and a control system block diagram. The block diagrams are also available on the CAISO Website.

If you require assistance in developing the models, we suggest you contact General Electric. Accurate models are important to obtain accurate study results. Costs associated with any changes in facility requirements that are due to differences between model data provided by the generation developer and the actual generator test data, may be the responsibility of the generation developer.

TABLE 1

TRANSFORMER DATA
(Provide for each level of transformation)

UNIT **Gas Generators (3 Identical Generators, 3 per Block)**

NUMBER OF TRANSFORMERS **1 per Gas Generator**   PHASE **Three**

RATING	H Winding	X Winding	Y Winding
Rated MVA	**75/99/123**	**75/99/123**	_____
Connection (Delta, Wye, Gnd.)	**Wye Grounded**	**Delta**	_____
Cooling Type (OA,OA/FA, etc) :	**ONAN/ONAF/ONAF**	**ONAN/ONAF/ONAF**	_____
Temperature Rise Rating	**65 °C**	**65 °C**	_____
Rated Voltage	**230**	**13.8**	_____
BIL	**900**	**95**	_____
Available Taps (% of rating)	**+/- 10%**	**N/A**	_____
Load Tap Changer? (Y or N)	**Y**	**N**	_____
Tap Settings		**N/A**	_____
IMPEDANCE	H-X	H-Y	X-Y
Percent	**10%**	_____	_____
MVA Base	**75**	_____	_____
Tested Taps	_____	_____	_____
WINDING RESISTANCE	H	X	Y
Ohms	_____	_____	_____

CURRENT TRANSFORMER RATIOS

H_____   X_____   Y_____   N_____

Percent exciting current at 100% Voltage _____ 110% Voltage _____

Supply copy of nameplate and manufacture's test report when available

TABLE 1

TRANSFORMER DATA
(Provide for each level of transformation)

UNIT **Steam Generator**

NUMBER OF TRANSFORMERS **1 per Steam Generator**   PHASE **Three**

RATING	H Winding	X Winding	Y Winding
Rated MVA	**94/124/154**	**94/124/154**	____
Connection (Delta, Wye, Gnd.)	**Wye Grounded**	**Delta**	____
Cooling Type (OA,OA/FA, etc) :	**ONAN/ONAF/ONAF**	**ONAN/ONAF/ONAF**	____
Temperature Rise Rating	**65 °C**	**65 °C**	____
Rated Voltage	**230**	**13.8**	____
BIL	**900**	**95**	____
Available Taps (% of rating)	**+/- 10%**	**N/A**	____
Load Tap Changer? (Y or N)	**Y**	**N**	____
Tap Settings		**N/A**	____
IMPEDANCE	H-X	H-Y	X-Y
Percent	**10%**	____	____
MVA Base	**94**	____	____
Tested Taps	____	____	____
WINDING RESISTANCE	H	X	Y
Ohms	____	____	____

CURRENT TRANSFORMER RATIOS

H____   X____   Y____   N____

Percent exciting current at 100% Voltage ____ 110% Voltage ____

Supply copy of nameplate and manufacture's test report when available

REDONDO BEACH POWER PLANT

CAISO APPLICATION
Supplemental Information:

Appendix 1:

6. AES Legal Structure

Attachment A:

1.A. Project Site Drawing

1.B. Project single line diagram

10. Transmission Tower Configuration Diagram
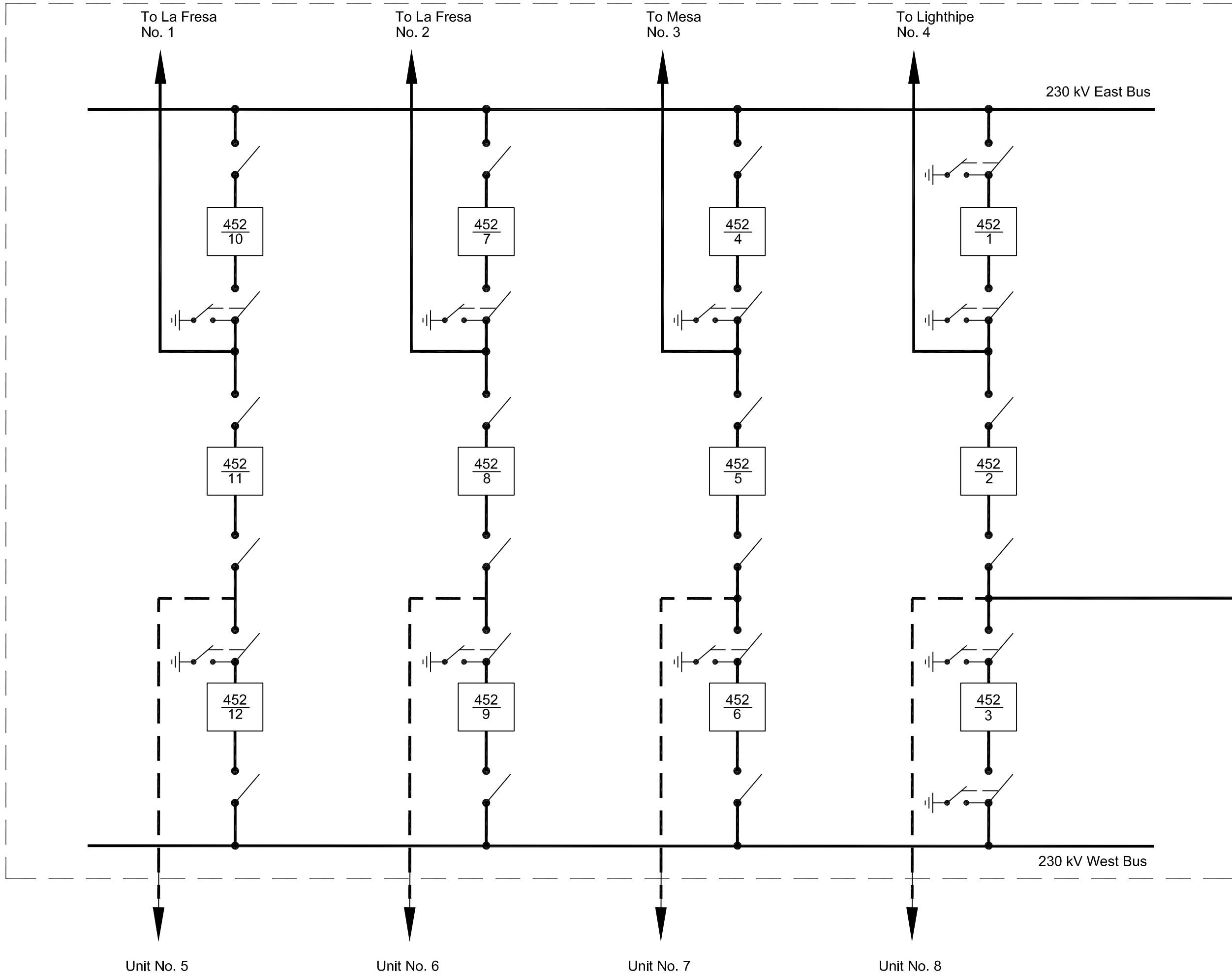
AES Legal Structure

March 9, 2012
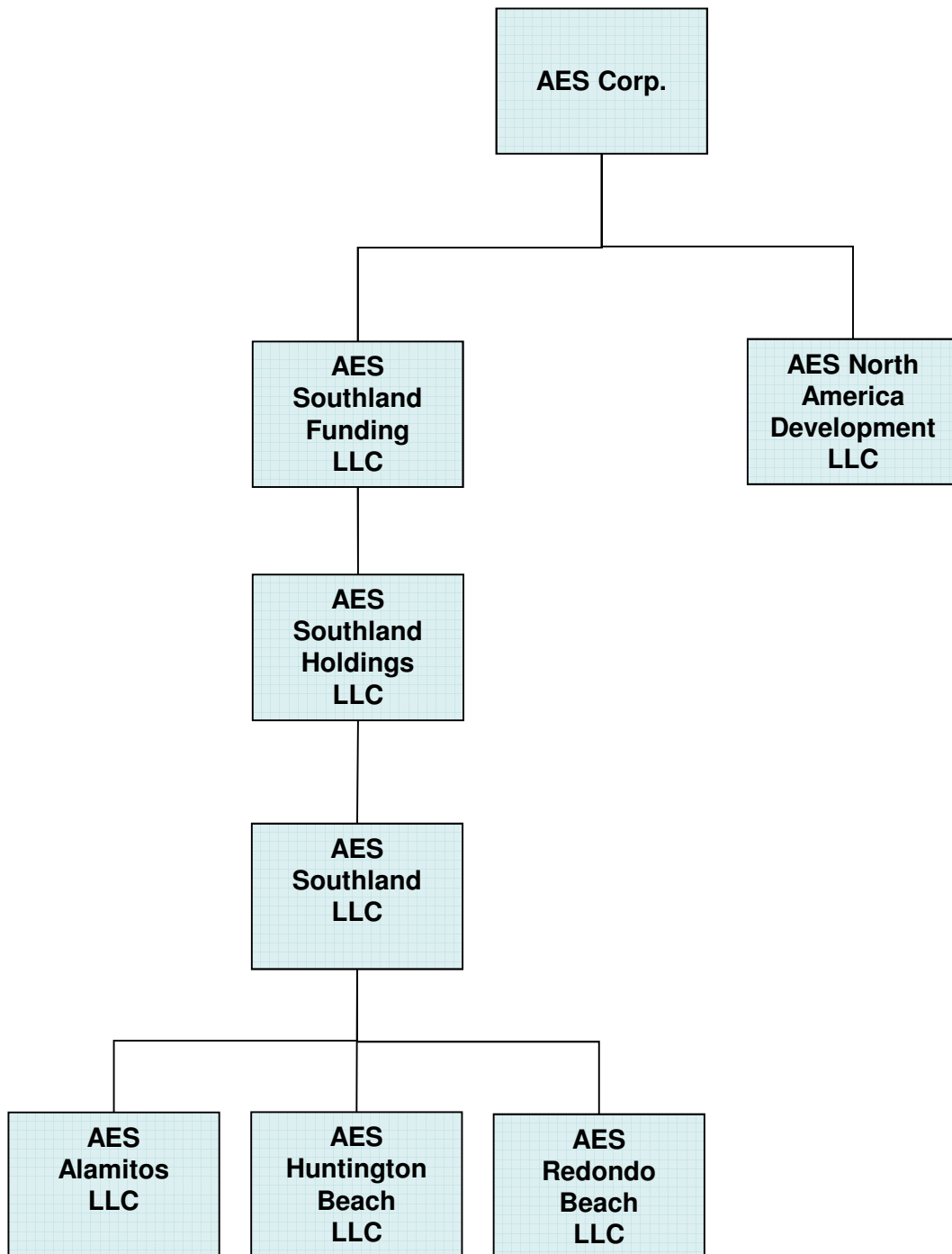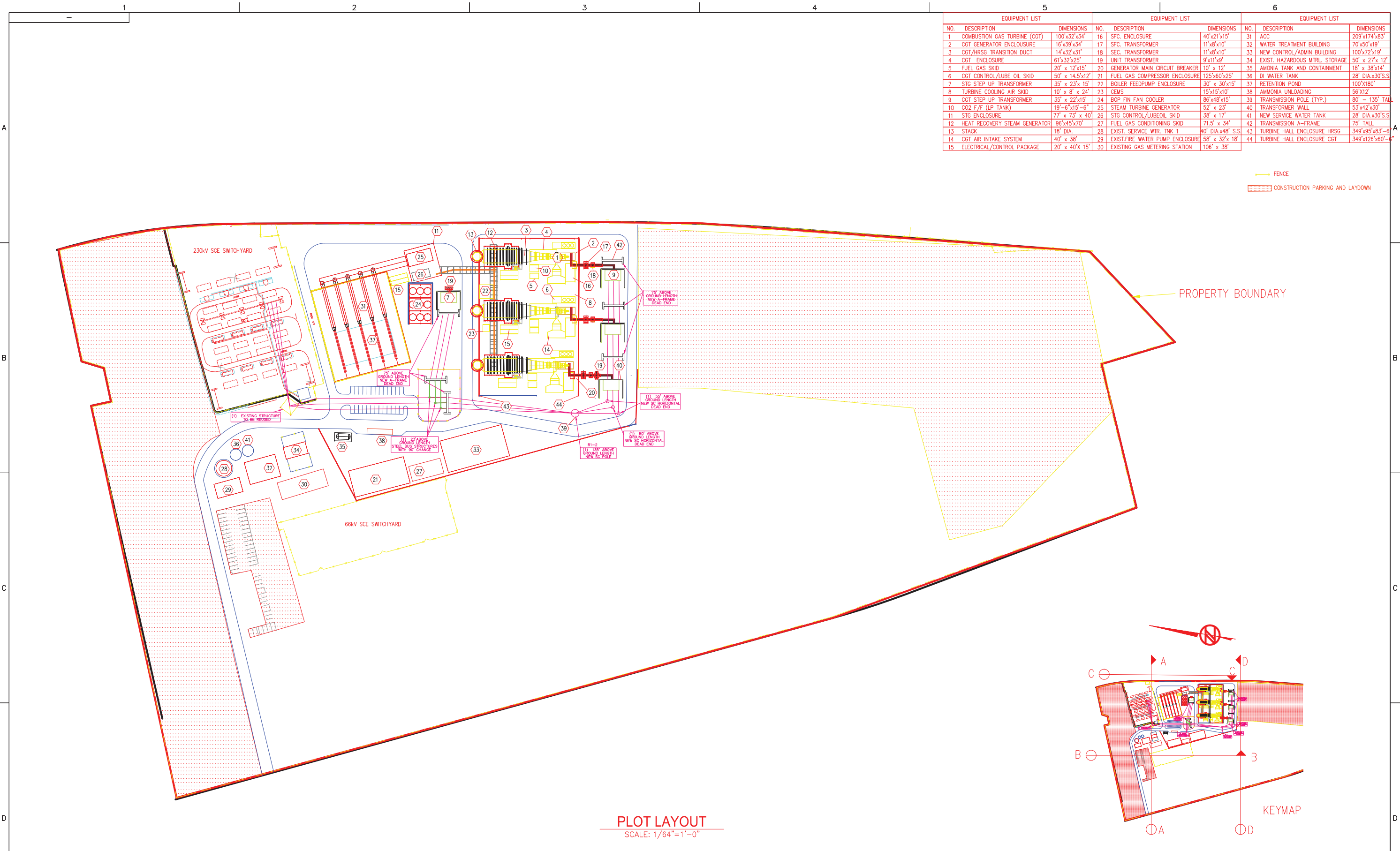
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                        ┌──────────────┐
                        │  AES Corp.   │
                        └──────┬───────┘
              ┌────────────────┴────────────────┐
     ┌────────────────┐                 ┌──────────────────┐
     │      AES       │                 │   AES North      │
     │   Southland    │                 │    America       │
     │    Funding     │                 │  Development     │
     │      LLC       │                 │      LLC         │
     └───────┬────────┘                 └──────────────────┘
     ┌────────────────┐
     │      AES       │
     │   Southland    │
     │    Holdings    │
     │      LLC       │
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     │      AES       │
     │   Southland    │
     │      LLC       │
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     ┌───────┼───────────────┬───────────────┐
┌──────────┐      ┌──────────────┐   ┌──────────────┐
│   AES    │      │     AES      │   │     AES      │
│ Alamitos │      │  Huntington  │   │   Redondo    │
│   LLC    │      │    Beach     │   │    Beach     │
│          │      │     LLC      │   │     LLC      │
└──────────┘      └──────────────┘   └──────────────┘
```

NO.	EQUIPMENT LIST DESCRIPTION	DIMENSIONS	NO.	EQUIPMENT LIST DESCRIPTION	DIMENSIONS	NO.	EQUIPMENT LIST DESCRIPTION	DIMENSIONS
1	COMBUSTION GAS TURBINE (CGT)	100'x32'x34'	16	SFC. ENCLOSURE	40'x21'x15'	31	ACC	209'x174'x83'
2	CGT GENERATOR ENCLOUSURE	16'x39'x34'	17	SFC. TRANSFORMER	11'x8'x10'	32	WATER TREATMENT BUILDING	70'x50'x19'
3	CGT/HRSG TRANSITION DUCT	14'x32'x31'	18	SEC. TRANSFORMER	11'x8'x10'	33	NEW CONTROL/ADMIN BUILDING	100'x72'x19'
4	CGT ENCLOSURE	61'x32'x25'	19	UNIT TRANSFORMER	9'x11'x9'	34	EXIST. HAZARDOUS MTRL. STORAGE	50' x 27'x 12'
5	FUEL GAS SKID	20' x 12'x15'	20	GENERATOR MAIN CIRCUIT BREAKER	10' x 12'	35	AMONIA TANK AND CONTAINMENT	18' x 38'x14'
6	CGT CONTROL/LUBE OIL SKID	50' x 14.5'x12'	21	FUEL GAS COMPRESSOR ENCLOSURE	125'x60'x25'	36	DI WATER TANK	28' DIA.x30'S.S
7	STG STEP UP TRANSFORMER	35' x 23'x 15'	22	BOILER FEEDPUMP ENCLOSURE	30' x 30'x15'	37	RETENTION POND	100'X180'
8	TURBINE COOLING AIR SKID	10' x 8' x 24'	23	CEMS	15'x15'x10'	38	AMMONIA UNLOADING	56'X12'
9	CGT STEP UP TRANSFORMER	35' x 22'x15'	24	BOP FIN FAN COOLER	86'x48'x15'	39	TRANSMISSION POLE (TYP.)	80' – 135' TALL
10	CO2 F/F (LP TANK)	19'–6"x15'–6"	25	STEAM TURBINE GENERATOR	52' x 23'	40	TRANSFORMER WALL	53'x42'x30'
11	STG ENCLOSURE	77' x 73' x 40'	26	STG CONTROL/LUBEOIL SKID	38' x 17'	41	NEW SERVICE WATER TANK	28' DIA.x30'S.S
12	HEAT RECOVERY STEAM GENERATOR	96'x45'x70'	27	FUEL GAS CONDITIONING SKID	71.5' x 34'	42	TRANSMISSION A–FRAME	75' TALL
13	STACK	18' DIA.	28	EXIST. SERVICE WTR. TNK 1	40' DIA.x48' S.S	43	TURBINE HALL ENCLOSURE HRSG	349'x95'x83'–6"
14	CGT AIR INTAKE SYSTEM	40' x 38'	29	EXIST.FIRE WATER PUMP ENCLOSURE	58' x 32'x 18'	44	TURBINE HALL ENCLOSURE CGT	349'x126'x60'–-"
15	ELECTRICAL/CONTROL PACKAGE	20' x 40'X 15'	30	EXISTING GAS METERING STATION	106' x 38'			

FENCE

CONSTRUCTION PARKING AND LAYDOWN

230kV SCE SWITCHYARD

66kV SCE SWITCHYARD

PROPERTY BOUNDARY

75' ABOVE GROUND LENGTH NEW A–FRAME DEAD END

75' ABOVE GROUND LENGTH NEW A–FRAME DEAD END

55' ABOVE GROUND LENGTH NEW SC HORIZONTAL DEAD END

(1) EXISTING STRUCTURE TO BE REVISED

(1) 80' ABOVE GROUND LENGTH NEW SC HORIZONTAL DEAD END

(1) 23' ABOVE GROUND LENGTH STEEL BUS STRUCTURES WITH 90' CHANGE

R1–2

(1) 135' ABOVE GROUND LENGTH NEW SC POLE

PLOT LAYOUT
SCALE: 1/64"=1'–0"

KEYMAP

REV	DATE	DESCRIPTION	DWN	DGN	CHK	APP
B	11–05–12	Update transmission tie line	TLI	TLI	HEM	HEM
–	10–31–12		TCH	TCH	HL	HL

SCALE: AS NOTED

WARNING:
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

D SIZE   36"x24"

Power Engineers Collaborative, L.L.C.
600 W. Jackson Blvd.   150 North Sunny Slope Road
Suite 600   Suite 110
Chicago, Illinois 60661   Brookfield, Wisconsin 53005
WWW.PECLLC.COM

REDONDO BEACH ENERGY PROJECT
REDONDO BEACH, CA.

REDONDO BEACH ENERGY PROJECT
GENERAL ELECTRICAL ARRANGEMENT

DWG#

Figure 3.1-3

REV.

LEGEND

- ⊣⊢●──● Lightning / Surge Arrestor
- ⬡ Revenue Metering
- ▢ Circuit Breaker
- Power Transformer
- Potential Transformer
- Current Transformer
- ── 13.8 kV
- ▬▬ 230 kV
- (GT) 115.962 MW, 122.065 MVA (Nameplate Capacity) Gas Turbine Generator
- (ST) Mitsubishi 145.568 MW, 153.229 MVA (Nameplate Capacity) Steam Turbine Generator
- Switch Disconnect
- Motor Operated Disconnect Switch

Southern California Edison (SCE)
230 kV Redondo Beach Switching Station

To La Fresa No. 1
To La Fresa No. 2
To Mesa No. 3
To Lighthipe No. 4

230 kV East Bus

452/10 452/7 452/4 452/1

452/11 452/8 452/5 452/2

452/12 452/9 452/6 452/3

230 kV West Bus

Unit No. 5 Unit No. 6 Unit No. 7 Unit No. 8

Transmission Tie Line 424 feet,
1033.5 ACSS
Z1 = 0.000014 + j 0.000112 P.U.
Zo = 0.000075 + j 0.000308 P.U.
At 100 MVA base

BLOCK 1:
475.717 MW (Net Capacity)

SW5
230 kV, 2000 A

CB1
52 230 kV, 2000 A

SW4 230 kV, 600 A
SW3 230 kV, 600 A
SW2 230 kV, 600 A
SW1 230 kV, 600 A

230 kV
75/99/123 MVA
10% Z, 34.1 X/R
13.8 kV

230 kV
75/99/123 MVA
10% Z, 34.1 X/R
13.8 kV

230 kV
75/99/123 MVA
10% Z, 34.1 X/R
13.8 kV

230 kV
94/124/154 MVA
10% Z, 34.1 X/R
13.8 kV

CBG1
13.8 kV
10,000 A

CBG2
13.8 kV
10,000 A
13.8 kV 7.5/9.375 MVA 4160 V To Aux Load

CBG3
13.8 kV
10,000 A

CBS1
13.8 kV
10,000 A
13.8 kV 7.5/9.375 MVA 4160 V To Aux Load

GT-1 GT-2 GT-3 ST-1

Notes:

1. All circuit breaks are Westinghouse SF-6, 2,000 Amp, 20,000 MVA per SCE drawing 597474, Sh.3.

2. Ground is optional.

3. Total project size is 475.717 MW @ 95% PF (Net Capacity)

4. Existing units 6 & 8 will be retired on June 1, 2018. Existing units 5 & 7 will be retired on October 2, 2018.

DATE	REVISIONS

REDONDO BEACH PROJECT
SIMPLIFIED ONE-LINE DIAGRAM
AES Southland

ELECTRIC POWER ENGINEERS, INC.
AUSTIN, TEXAS

FILENAME: Redondo Beach_One Line Diagram_2012-05-29.dwg | DWN BY: E.P.E. | DATE: 05/29/2012 | SCALE: NONE

NOT TO SCALE
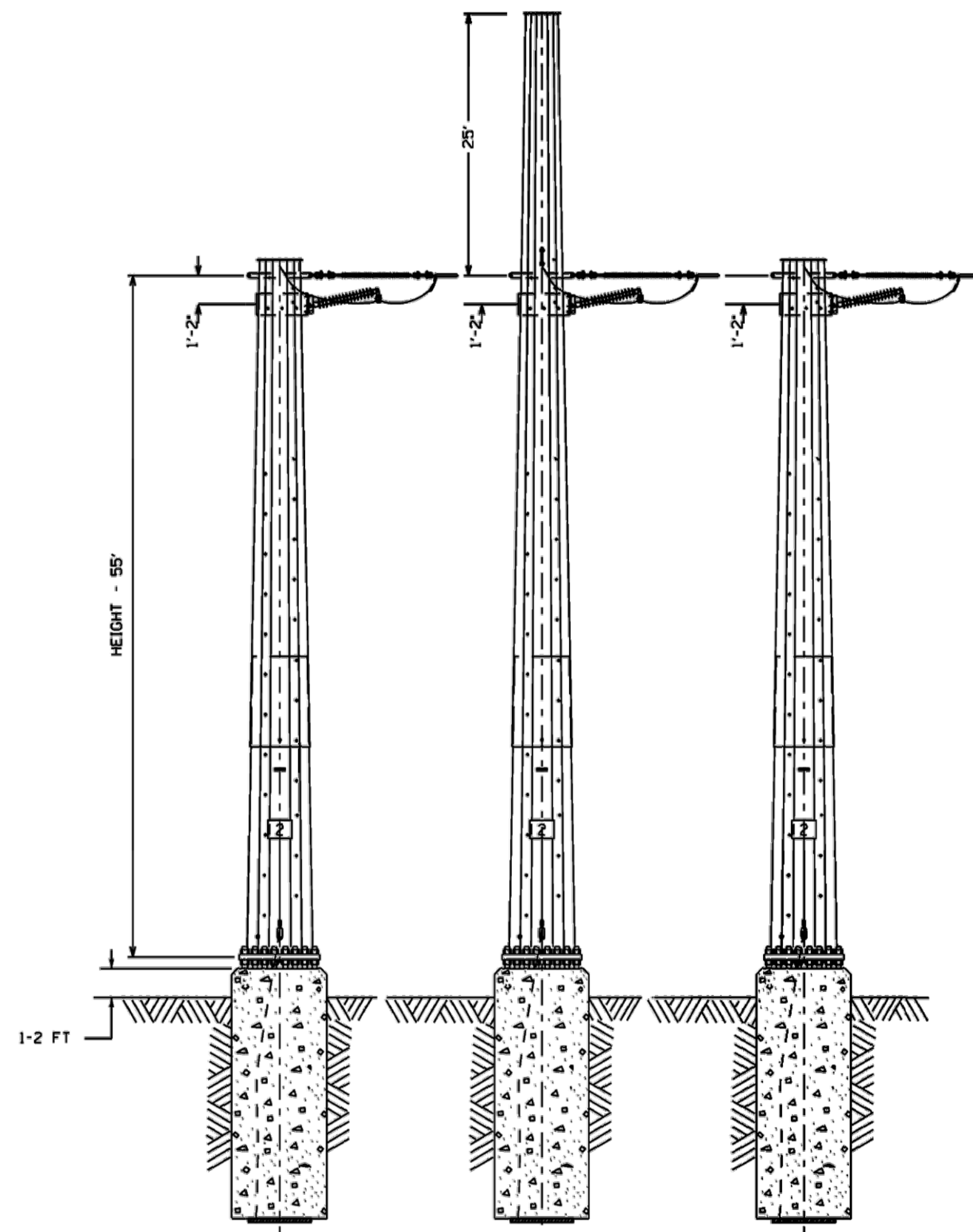
Single Circuit Horizontal Dead End
Structures: R1-1 & R2-1
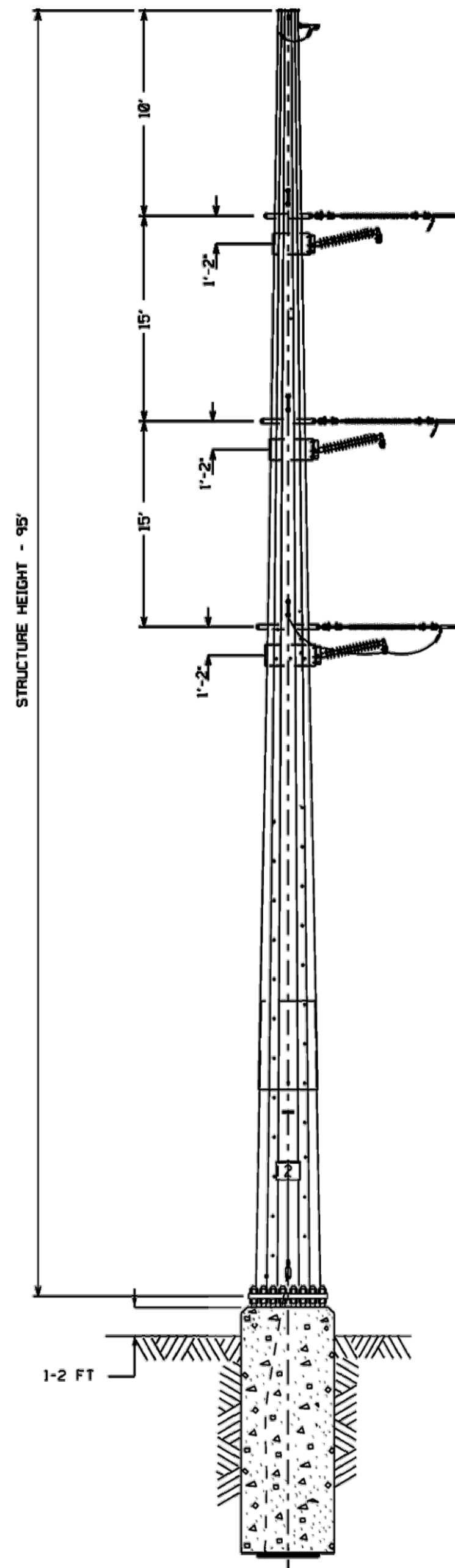
Single Circuit Dead End
Structures: R2-2

TOP OF POLE
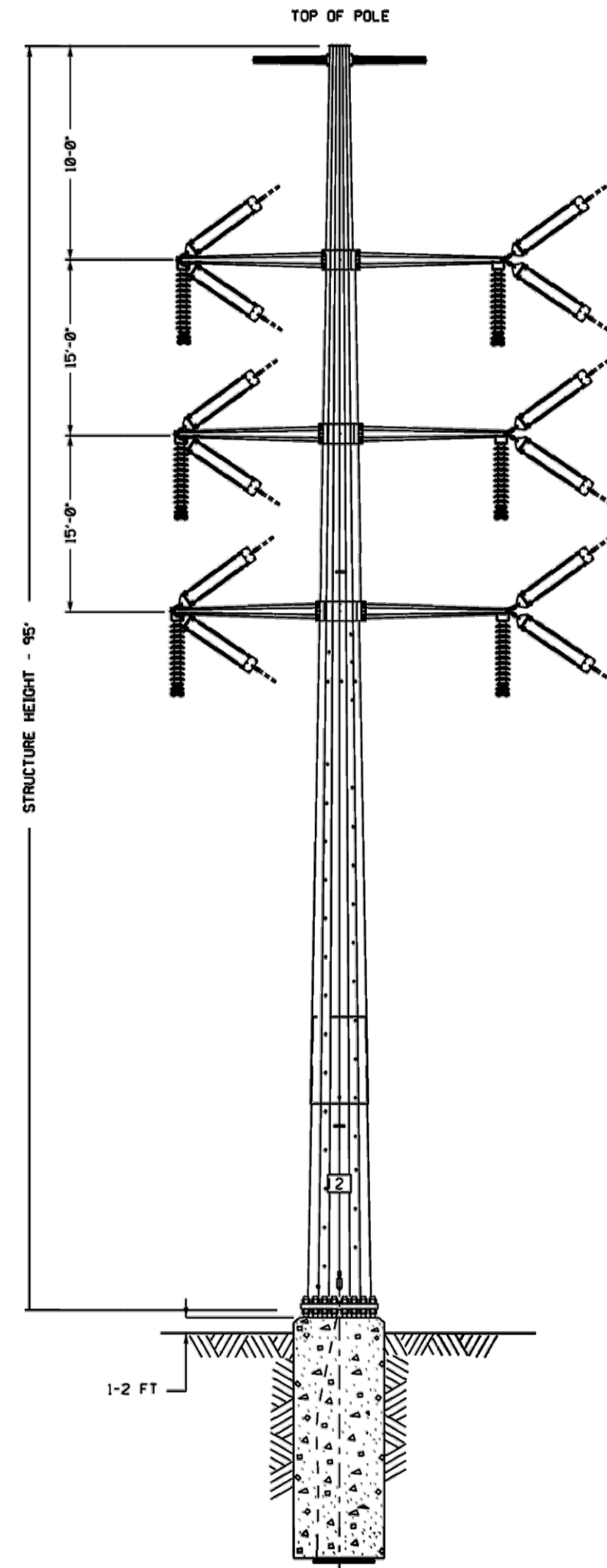
Double Circuit Dead End
Structures: R-DC

	DATE	REVISIONS

REDONDO BEACH 230 kV
CONCEPTUAL STRUCTURE CONFIGURATION
AES Southland

EPE ELECTRIC POWER ENGINEERS, INC.   AUSTIN, TEXAS

FILENAME: Redondo Beach Structure Configuration.dwg | DWN BY: M&S Engineering | DATE: 03/28/2012 | SCALE: NONE

REDONDO BEACH POWER PLANT

CAISO APPLICATION
Gas Generator:

3.H. Reactive Capability Curves

3.J. Generator Terminal Voltage curves

4.B. Excitation System block diagram

5.D. PSS Block Diagram

VARIATION OF GENERATOR OUTPUT WITH COOLANT TEMP

Y-axis: OUTPUT AT STATED POWER FACTOR : MW (100 to 160)

X-axis: GENERATOR COOLANT INLET TEMPERATURE : DEG C (10 to 40)

Curves labelled:
- 0.95   PF
- 0.9   PF
- 0.85   PF
- 0.8   PF

YDAX 8-400ERH   IN ACCORDANCE WITH
13. 80KV,   3 Ph, 60Hz.   IEEE C50. 13
                                 Class B temperatures.
Up to 1000   meters ASL   Total temperatures Stator 123 Deg C
                                                    Rotor   125 Deg C

Coolant: Fresh Water

Issue No. 1 : 05-Mar-2012
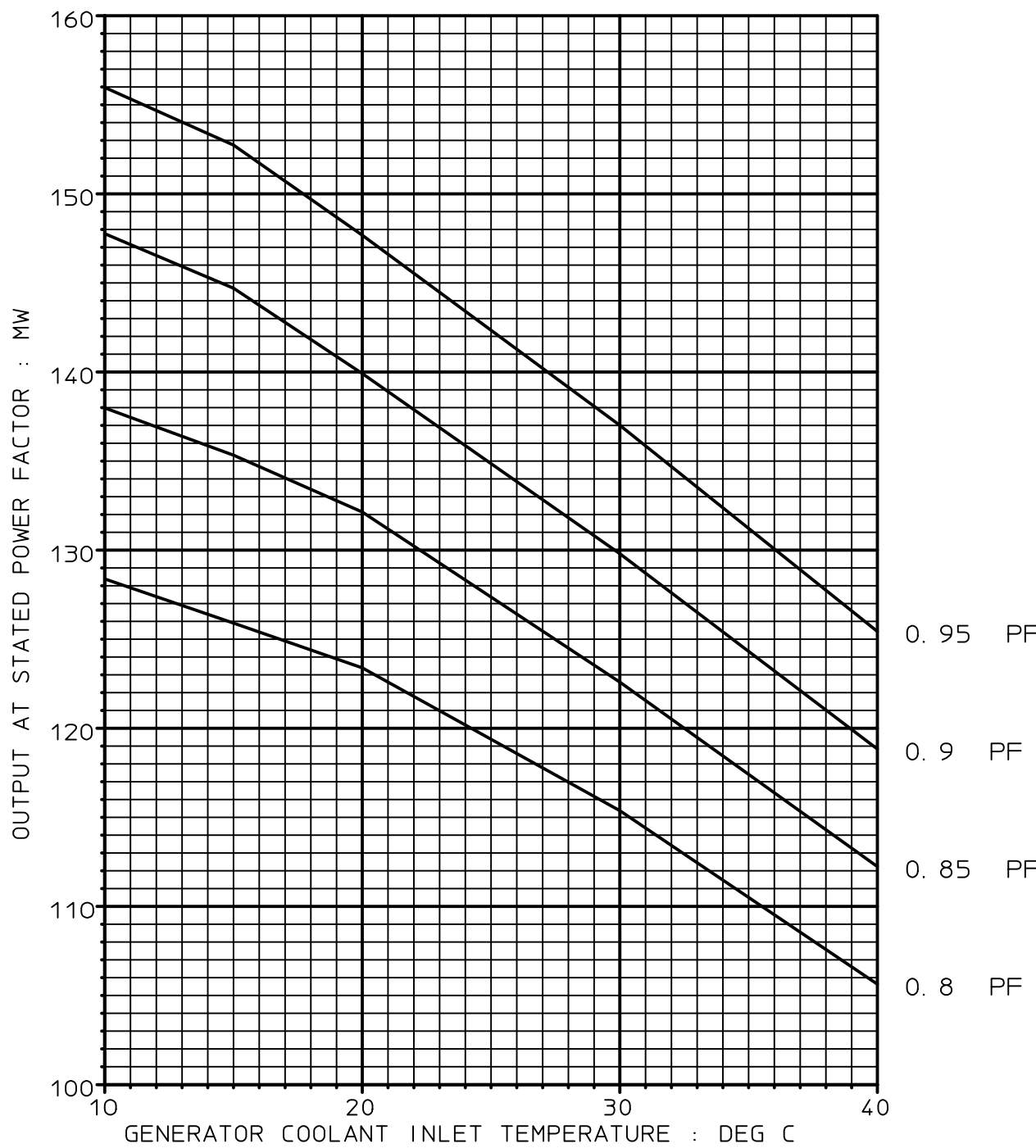
GENERATOR CAPABILITY DIAGRAM

YDAX 8-400ERH   IN ACCORDANCE WITH
13. 80KV,   3 Ph, 60Hz.   IEEE C50. 13
                               Class B temperatures.
Up to 1000 meters ASL   Total temperatures Stator 123 Deg C
                                                   Rotor   125 Deg C

Coolant: Fresh Water

VARIATION OF GENERATOR EFFICIENCY WITH LOAD

U. P. F
0. 95 P. F
0. 9 P. F
0. 85 P. F
0. 8 P. F

GENERATOR EFFICIENCY : %

GENERATOR LOAD : MW
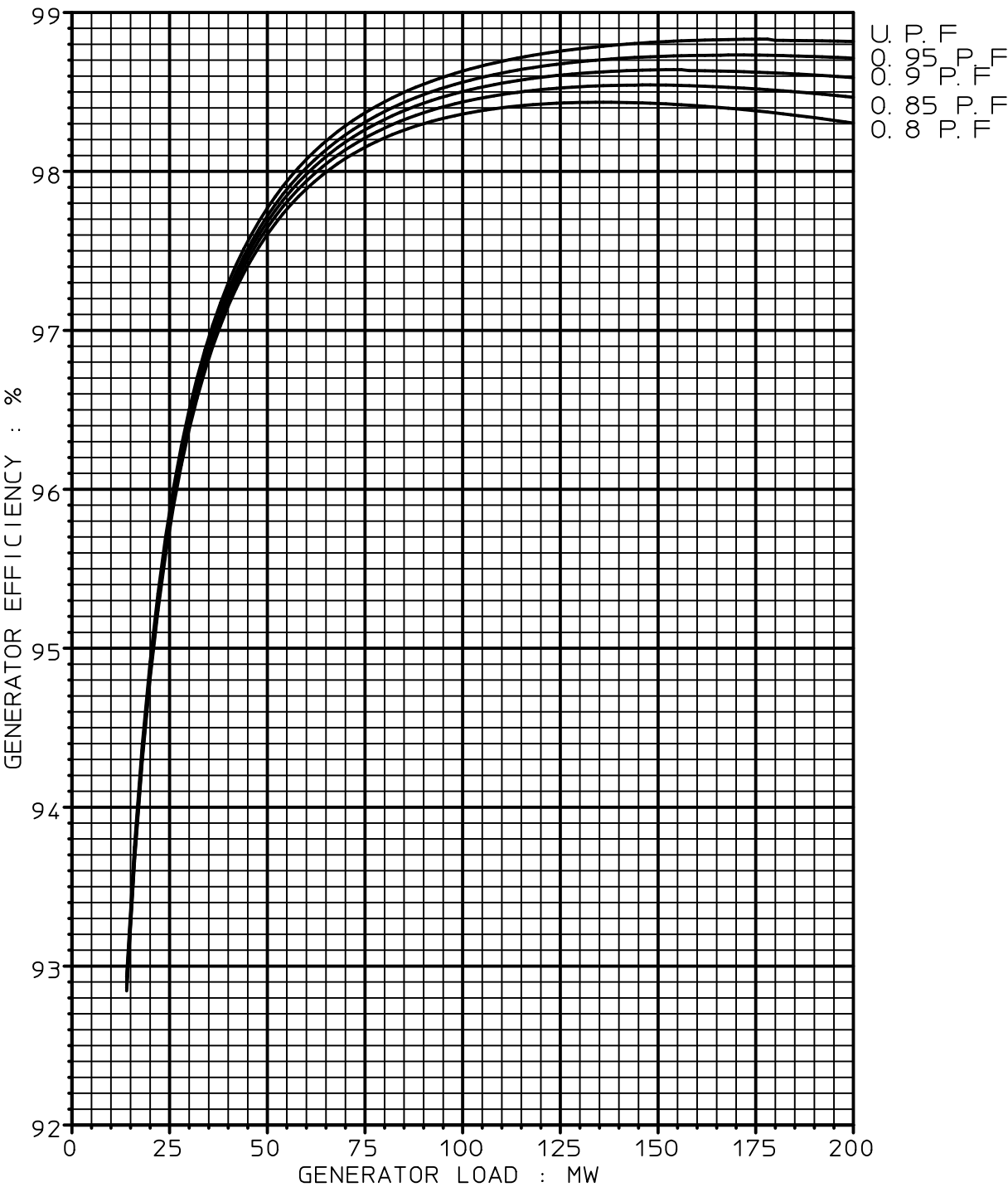
YDAX 8-400ERH
13. 8 KV,   3 Ph,   60 Hz.

Efficiencies shown are guaranteed
subject to the tolerance
specified in IEC 60034-1.

Issue No. 1:05-Mar-2012

OPEN CIRCUIT AND SHORT CIRCUIT CHARACTERISTIC
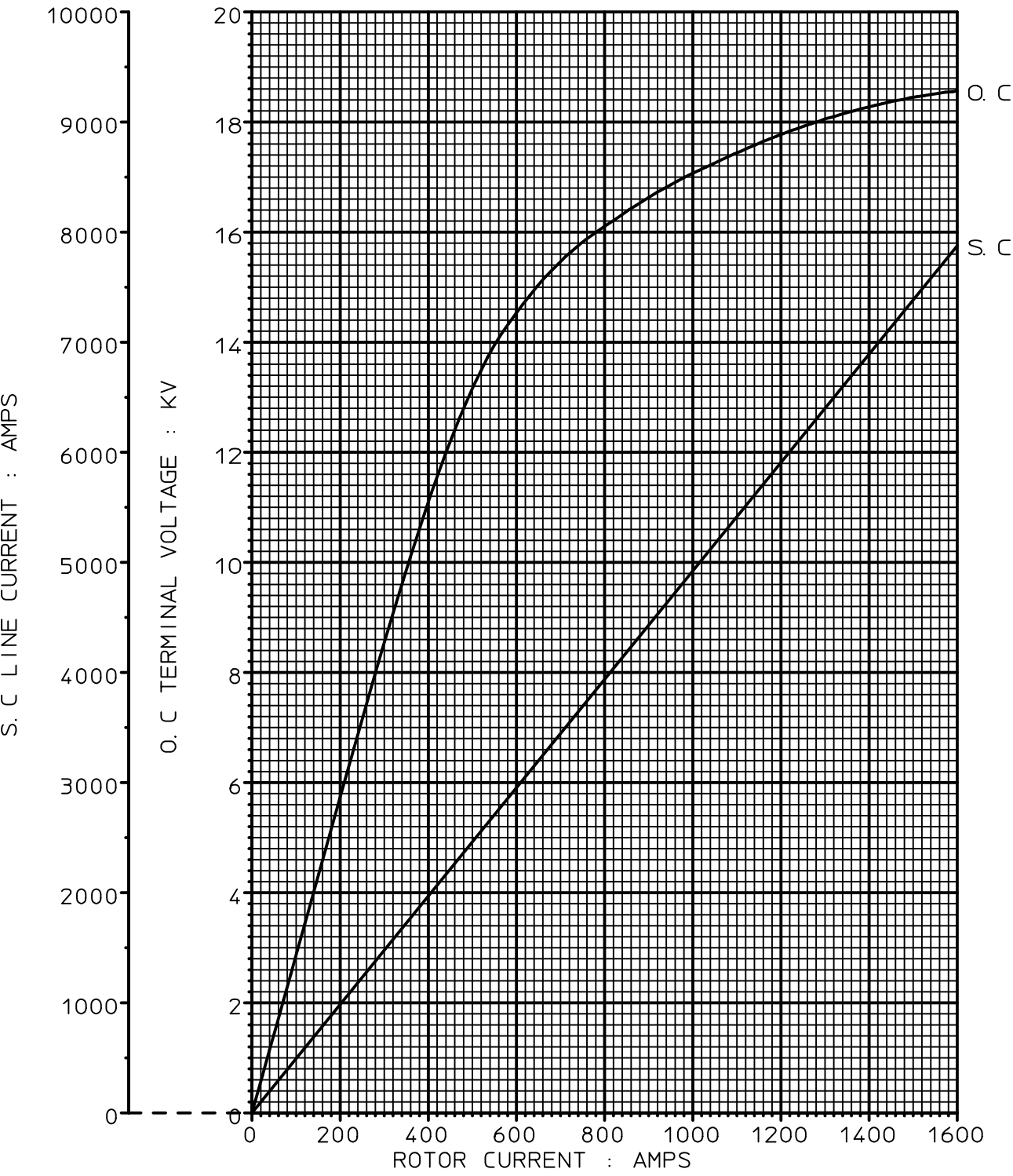
YDAX 8-400ER
3Ph, 60Hz,   3600 RPM.

PERMISSIBLE DURATION OF NEGATIVE SEQUENCE CURRENT

$$I_2^2 t = 30$$

TIME IN SECONDS

NEGATIVE SEQUENCE CURRENT I2 - AS A % OF RATED LINE CURRENT
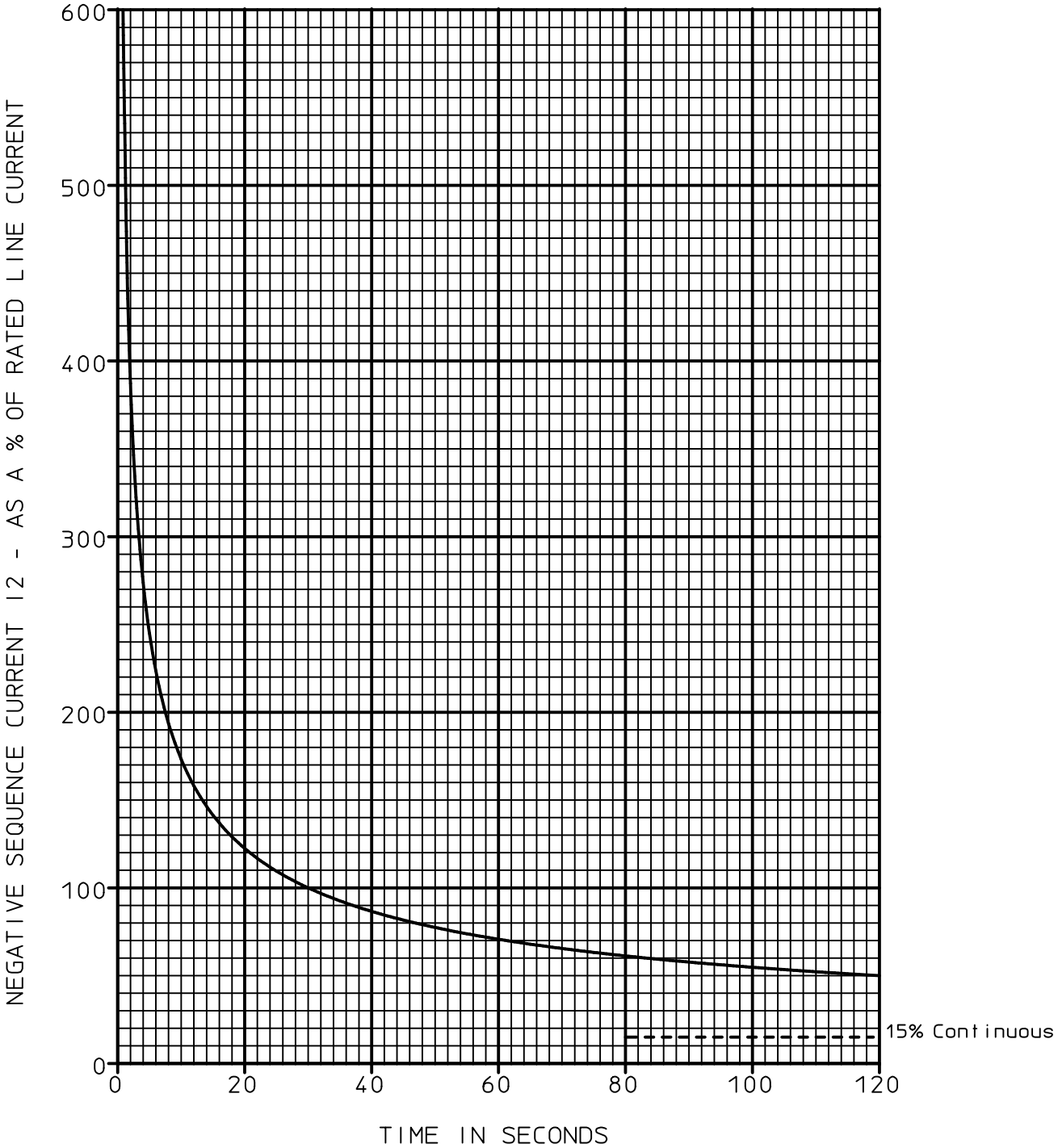
15% Continuous

NOTE: For continuous operation
rated current must not be
exceeded in any one phase.

Unitrol$^®$ 6000
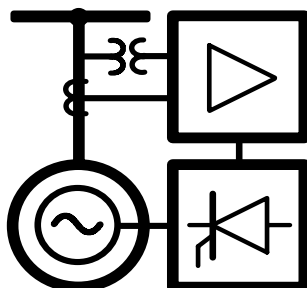
Static Excitation System
Model Conversion to IEEE Type ST1A

Type des.	Unitrol 6000		Part no.				
Prep.	A.Tristan	2010-11-15	Doc.kind	Technical description			No. of p.
Appr.	P.Smulders	2010-11-22	Title	Static Excitation System Model Conversion to IEEE Type ST1A			4
Resp.dept.	DMPE						
ABB	**ABB Inc.**		Doc. no. -		Lang. en	Rev. ind. -	Page 1

1. UNITROL 6000 AVR PARAMETERS AND IEEE MODEL

The Unitrol 6000 Model for Static Excitation Systems is directly represented by the ST5B model as defined in IEEE Standard 421.5-2005. The introduction of this model into the IEEE standard is relatively recent and as a consequence, power system simulator software for modeling and analisys of excitation systems performace may not have the ST5B model included. Since the ST5B is a variation of the ST1A model (figure 1) the later can be used as an alternate model to represent the Unitrol 6000 static excitation system.
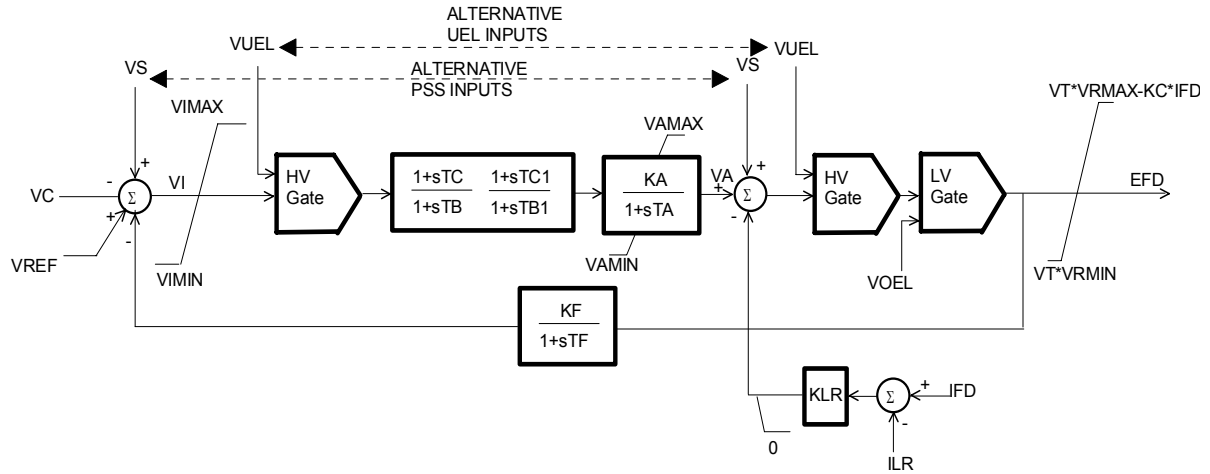
Figure 1 IEEE Model Type ST1A for Static Excitation

The following illustrates the conversion from Unitrol 6000 parameters to ST1A format

V_{RMax} = V_{Amax} = Upper Ceiling Factor Limit = $1.35 * U_{ac} * \cos(\alpha_{min})/(I_{fAGL} * U_{fn}/I_{fn})$ [pu]

V_{RMin} = V_{Amin} = Lower Ceiling Factor Limit = $1.35 * U_{ac} * \cos(\alpha_{max})/(I_{fAGL} * U_{fn}/I_{fn})$ [pu]

V_{IMax} $\cong V_{RMax} / V_p$ [pu]

V_{IMin} $\cong V_{RMin} / V_p$ [pu]

T_C = T_a [s]

T_B = $T_a(V_o/V_p)$ [s]

T_{B1} = $T_b(V_p/V_\infty)$ [s]

T_{C1} = T_b [s]

K_A = V_o [pu]

T_A = T_s = 0.003s

K_F = 0.0 (not applicable to Unitrol)

T_F = 0.001 (not applicable to Unitrol, but some programs do not accept 0.0)

I_{LR} = $1.6 * (I_{fn}/I_{fAGL})$ [pu]

KLR $\cong V_p$ (oel) [pu] (proportional gain of the Over-Excitation Limiter)

K_C can be set to 0 since the excitation transformer calculation already considers the voltage drop caused by commutation overlap

V_T variable representing the generator terminal voltage (excitation is fed from generator terminals).

	Doc. no.		Lang.	Rev. ind.	Page
ABB **ABB Inc.**	-		en	-	2

Abbreviations:

α_{min} : Minimum thyristor firing angle (typically 10deg)

α_{max} : Maximum thyristor firing angle (typically 150deg)

I_{fAGL} : Field current on air gap line to give rated terminal voltage (@ no-load)

I_{fn} : Nominal (rated) excitation current

U_{ac} : Excitation transformer rated secondary voltage

U_{fn} : Nominal (rated) excitation voltage

V_o : PID AVR low frequency gain

V_p : PID AVR proportional gain

V_∞ : PID AVR high frequency gain

T_a : PID AVR time constant

T_b : PID AVR time constant

$V_{p\,(oel)}$: PID Maximum Field Current Limiter proportional gain

T_s : Converter time delay (power stage)
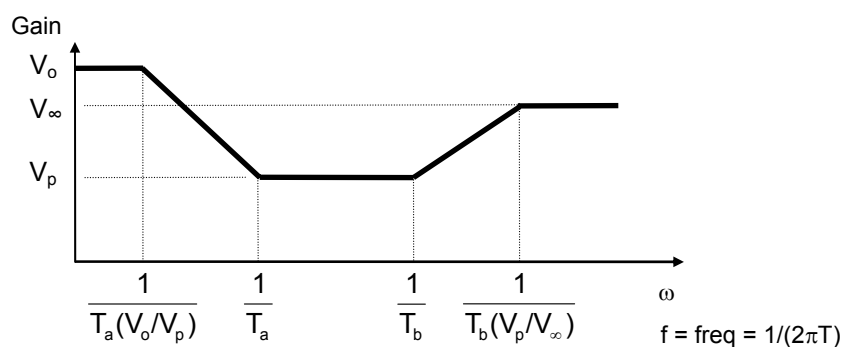
Figure 2 Unitrol 6000 PID-Filter characteristic

Unitrol 6000 parameter ranges		
Name	Description	Value range
UpperCeilingFactorLimit	Calculated automatically by software	-100..100
LowerCeilingFactorLimit	Calculated automatically by software	-100..100
vo	PID AVR low frequency gain	0.01..10000
vp	PID AVR proportional gain	0.01..10000
voo	PID AVR high frequency gain	0.01..10000
ta	PID AVR time constant	0..100 s
tb	PID AVR time constant	0..10 s
vp (oel)	PID Maximum Field Current Limiter proportional gain	0.01..10000

REVISION

Rev. ind.	Page (P) Chapt. (C)	Description	Date Dept./Init.

ABB

9

3 Power system stabilizer

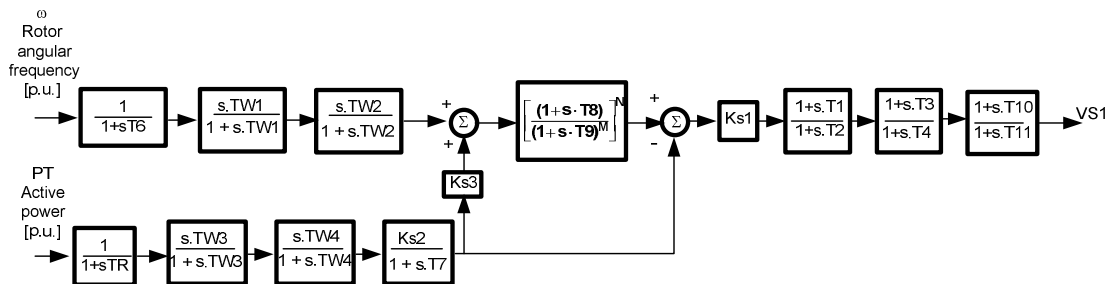## 3.1 Computer representation of IEEE PSS 2B

Figure 3-1: Computer representation of PSS2B according to IEEE 421.5 2005

Short model description of PSS2B (ref. to Figure 3-1)

The model consists of the following sub models:

• Calculation of driving power

• Filtering of torsional oscillations and noise components

• Calculation of acceleration power

• Phase and gain conditioning for stabilizing signal

The required signals for the generations of stabilizing signals are the active power PT and the rotor angular frequency deviation.
Both signals are submitted to two wash-out stages which are provided for the elimination of steady state signal component.
An approach for the integral of electric power is obtained by applying the output of the second washout filter of power channel to a first order transfer function. The value T7 shall correspond washout time constants TW1, TW2, TW3 that are selected to allow the operation of the PSS in the frequency range of interest (e.g. >0.1 Hz). The constant Ks2 shall be equal to T7/(2H) in order to obtain a proper signal relationship for the calculation of the acceleration power.
Ks3 is provided for the fine scaling between signals coming from power and frequency channels. Normally Ks3 is equal to 1.
The integral of driving power is obtained from the summation of conditioned frequency signal and the calculated integral of electric power variation.
A selective low pass filter so called "ramp tracking filter" is provided for the suppression of high frequency components (e.g. shaft torsional oscillations).
The integral of acceleration power is calculated from the difference between integral of driving power and integral of electric power.
The conditioning network consisting of the gain Ks1 and three lead-lag stages are provided in order to achieve the required phase and gain compensation for the stabilizing signal. Finally the maximum and minimum amplitudes of stabilizing signal can be limited as well by individual and adjustable maximum and minimum adjustable limitation parameters (ref. PSS control logic).

ABB

10

3.2 Parameter list of PSS2B

Parameter	Description	Unit	Standard settings	Proposed setting
TW1,TW2	Wash out time constants	s	2.0	
TW3,TW4	Wash out time constants	s	2.0	
Ks1	PSS gain factor	p.u.	5.0	
Ks2	Compensation factor for calculation of integral of electric power	p.u.	0.2	
Ks3	Signal matching factor	p.u.	1.0	
T1,T3,T10	Lead time constants of conditioning network	s	0.20 0.36 0.01	
T2,T4,T11	Lag time constants of conditioning network	s	0.04 0.12 0.01	
TR	Active power transducer time constant	s	0.02	0.02
T6	Rotor angular frequency deviation transducer time constant	s	0.02	0.02
T7	Time constant for integral of electric power calculation	s	2.0	
T8	Ramp tracking filter time constant	s	0.0	
T9	Ramp tracking filter time constant	s	1.0	
M	Ramp tracking filter degree	-	5	
N	Ramp tracking filter degree	-	1	

3.3 Correspondence between model parameters and equipmet settings

Parameter	Equipment settings correspondece for PSS2B
TR and T6	No correspondence, constant values
TW1	Reg_PSS_IEEE_2B.TW1
TW2	Reg_PSS_IEEE_2B.TW2
TW3	Reg_PSS_IEEE_2B.TW3
TW4	Reg_PSS_IEEE_2B.TW4
Ks1	Reg_PSS_IEEE_2B.Ks1
Ks2	Reg_PSS_IEEE_2B.Ks2
Ks3	Reg_PSS_IEEE_2B.Ks3
T1	Reg_PSS_IEEE_2B.T1
T2	Reg_PSS_IEEE_2B.T2
T3	Reg_PSS_IEEE_2B.T3
T4	Reg_PSS_IEEE_2B.T4
T7	Reg_PSS_IEEE_2B.T7
T8	Reg_PSS_IEEE_2B.T8
T9	Reg_PSS_IEEE_2B.T9
T10	Reg_PSS_IEEE_2B.T10
T11	Reg_PSS_IEEE_2B.T11
M	Reg_PSS_IEEE_2B.m
N	Reg_PSS_IEEE_2B.n

Gas Turbine Governor Model

1. Speed　Droop .... R=　　0.04
2. Controller　Lag　Time　Constant .... T1=　　0.1　second
3. Turbine　Power　Time　Constant .... T2=　　1.0　second
4. Turbine Exhaust Temperature Time Constant .... T3=　　5.0　second
5. Temperature Limitter Gain .... Kt=　　3 (1 + 1/24s)
6. Maximum Valve Position .... Vgmax=　1.0
7. Minimum Valve Position .... Vgmin=　0.05
8. Turbine Damping Coefficient .... Dturb=　0.10

Block　Diagram
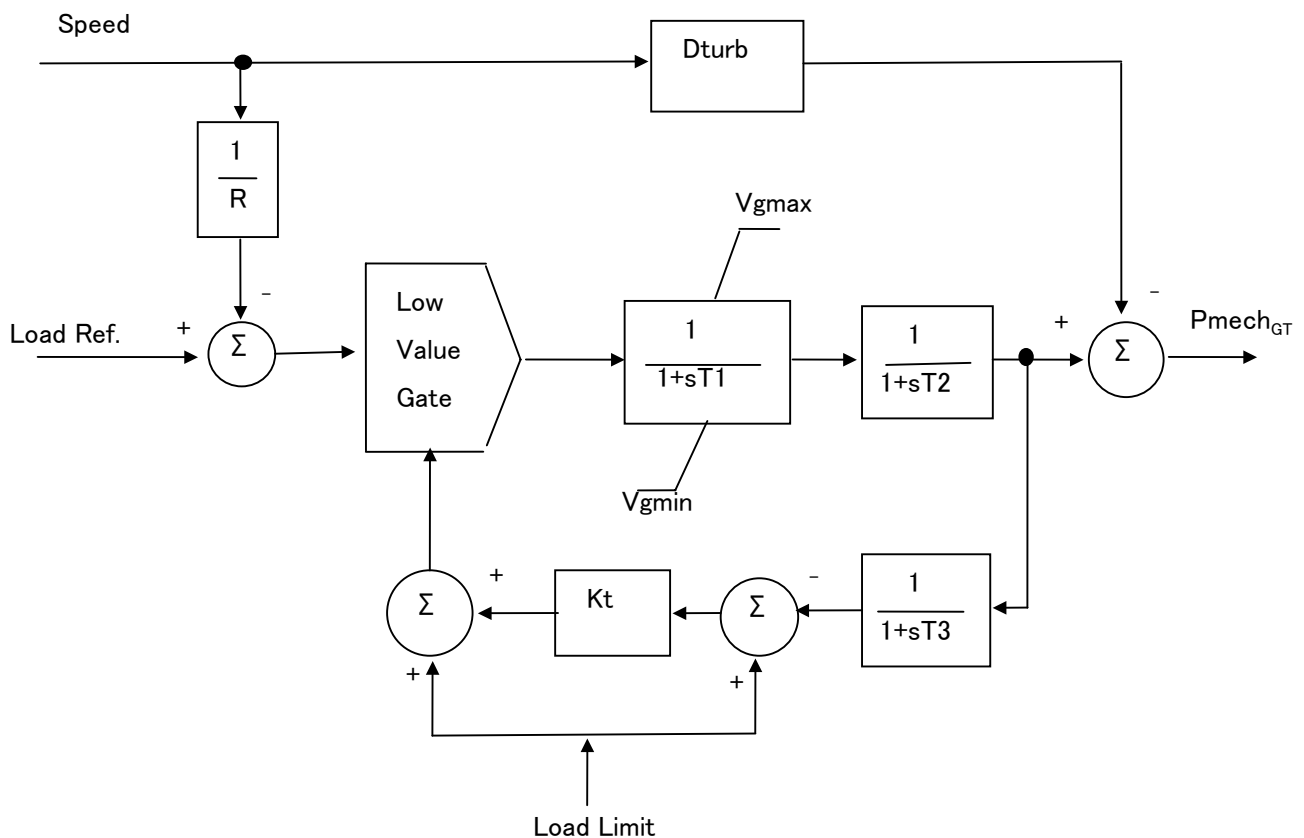
(based on GAST)

REDONDO BEACH POWER PLANT

CAISO APPLICATION
Steam Generator:

3.H. Reactive Capability Curves

3.J. Generator Terminal Voltage curves

4.B. Excitation System block diagram

5.D. PSS Block Diagram

VARIATION OF GENERATOR OUTPUT WITH COOLANT TEMP

Y-axis: OUTPUT AT STATED POWER FACTOR : MW (110 to 200)

X-axis: GENERATOR COOLANT INLET TEMPERATURE : DEG C (10 to 40)

Curve labels (right side, top to bottom): 0.95 PF, 0.9 PF, 0.85 PF, 0.8 PF
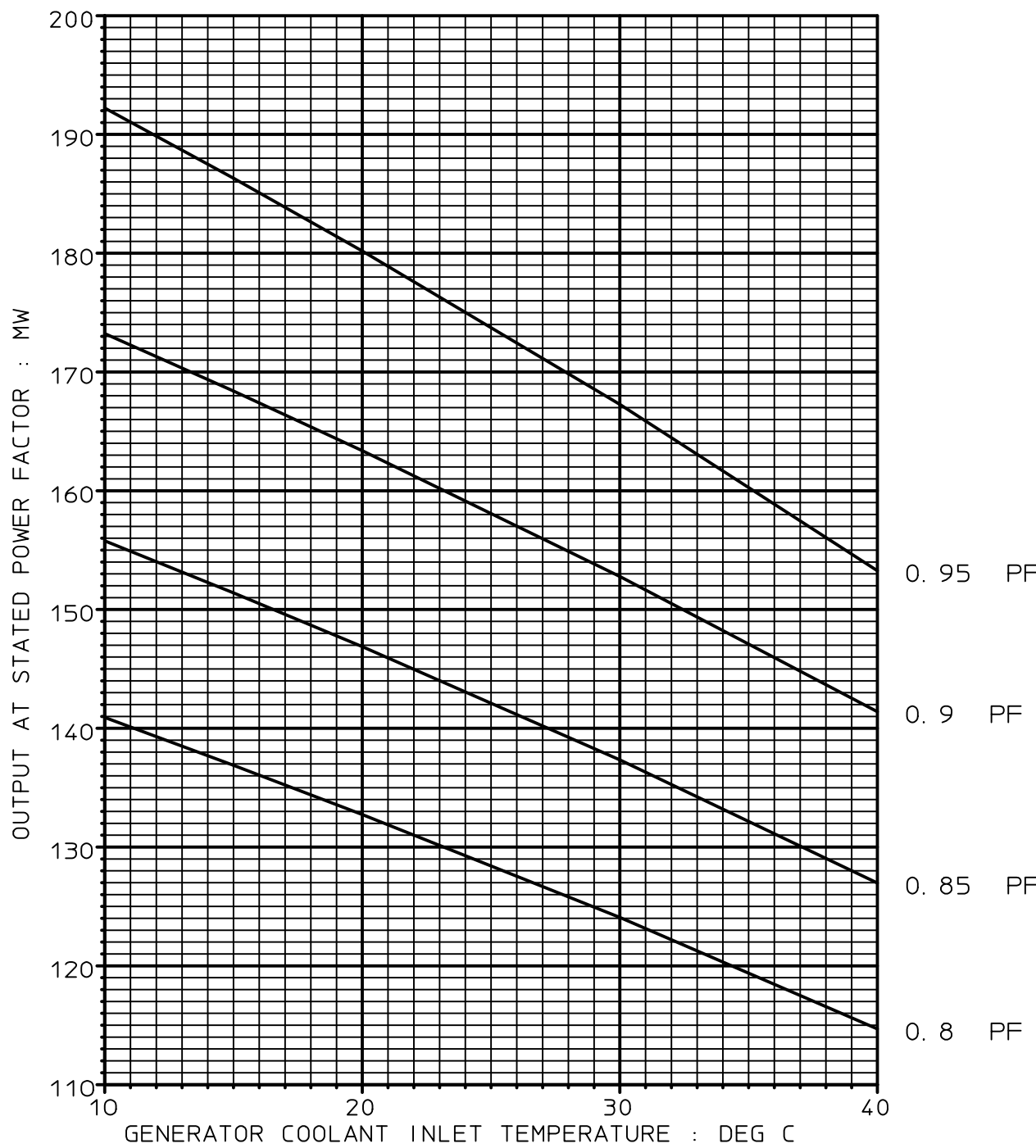
BDAX 82-445ERH   IN ACCORDANCE WITH
13.80KV,   3 Ph, 60Hz.   IEEE C50.13
                                 Class B temperatures.
Up to 1000   meters ASL   Total temperatures Stator 123 Deg C
                                                    Rotor   125 Deg C
Coolant: Fresh Water

GENERATOR CAPABILITY DIAGRAM
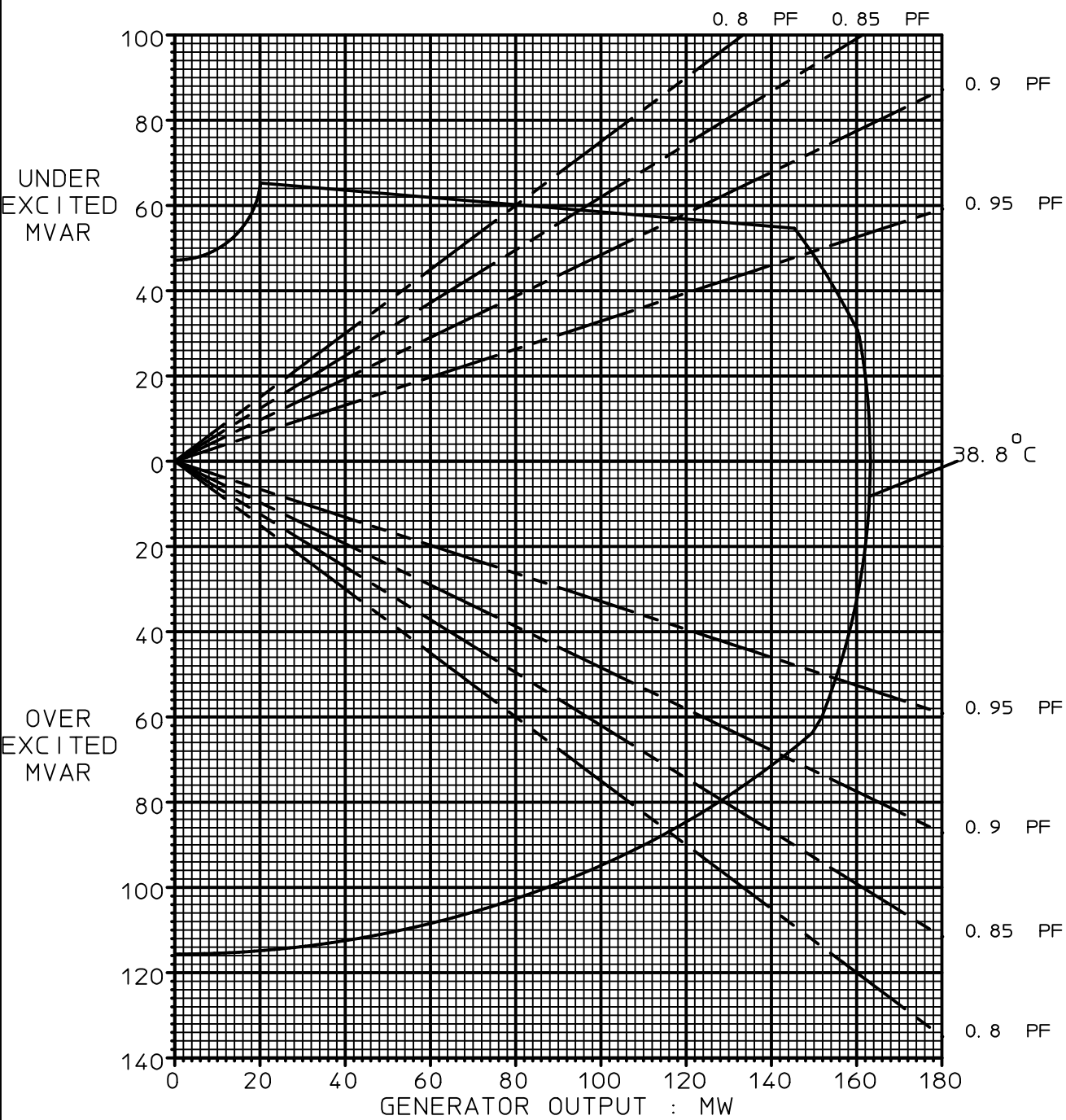
0.8 PF   0.85 PF

0.9 PF

UNDER
EXCITED
MVAR

0.95 PF

38.8°C

OVER
EXCITED
MVAR

0.95 PF

0.9 PF

0.85 PF

0.8 PF

100

80

60

40

20

0

20

40

60

80

100

120

140

0   20   40   60   80   100   120   140   160   180

GENERATOR OUTPUT : MW

BDAX 82-445ERH   IN ACCORDANCE WITH
13. 80KV,   3 Ph, 60Hz.   IEEE C50. 13
                           Class B temperatures.
Up to   1000   meters ASL Total temperatures Stator 123 Deg C
                                               Rotor   125 Deg C
Coolant: Fresh Water

Issue No. 1 : 16-Nov-2011

VARIATION OF GENERATOR EFFICIENCY WITH LOAD

U. P. F
0. 9 P. F
0. 85 P. F
0. 8 P. F

GENERATOR EFFICIENCY : %

GENERATOR LOAD : MW
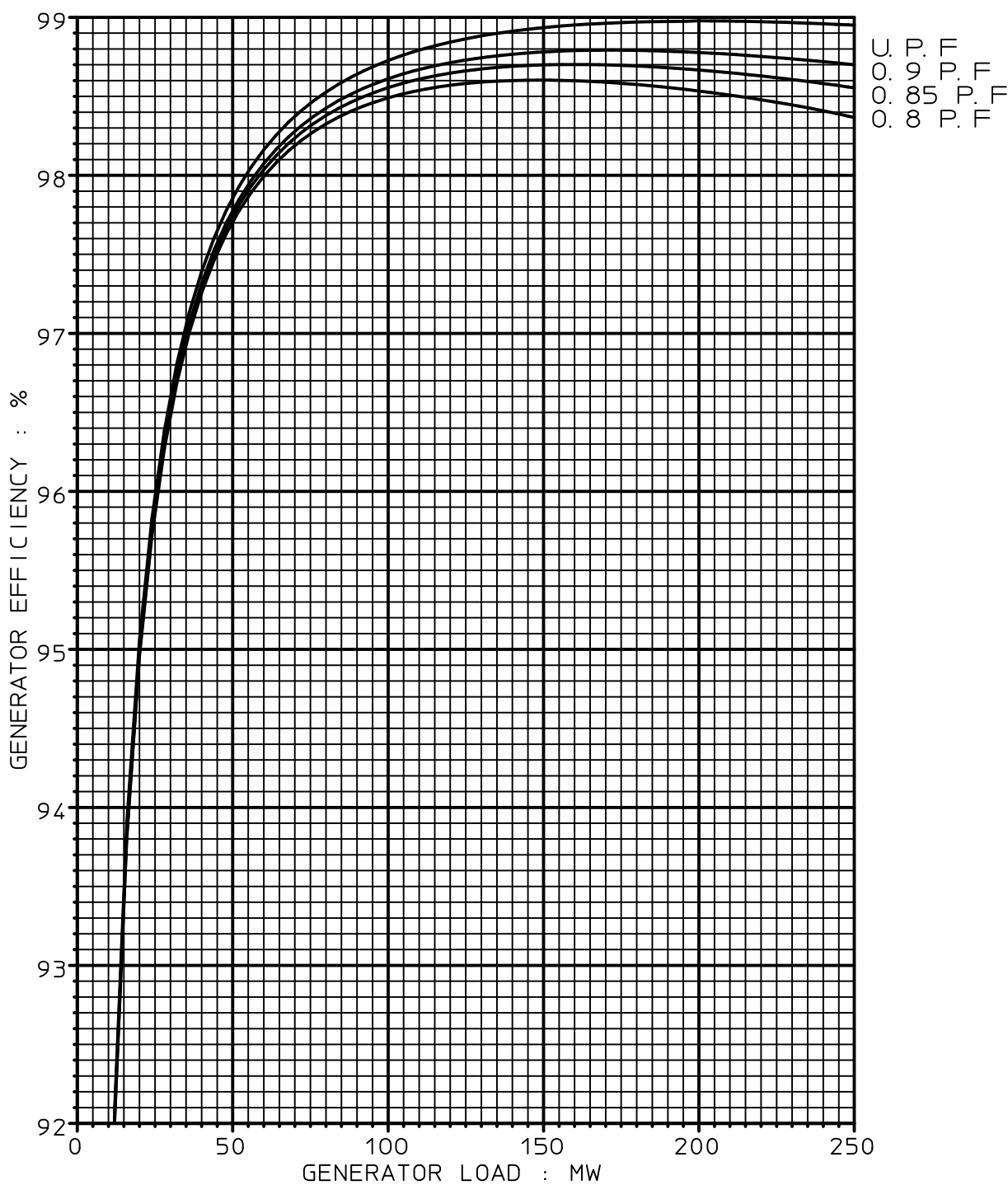
BDAX 82-445ERH
13. 8 KV,   3 Ph,   60 Hz.

Efficiencies shown are guaranteed
subject to the tolerance
specified in IEC 60034-1.

OPEN CIRCUIT AND SHORT CIRCUIT CHARACTERISTIC

S. C
O. C

Y-axis (left): S.C LINE CURRENT : AMPS — 0, 1000, 2000, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 10000

Y-axis (inner): O.C TERMINAL VOLTAGE : KV — 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

X-axis: ROTOR CURRENT : AMPS — 0, 250, 500, 750, 1000, 1250, 1500, 1750
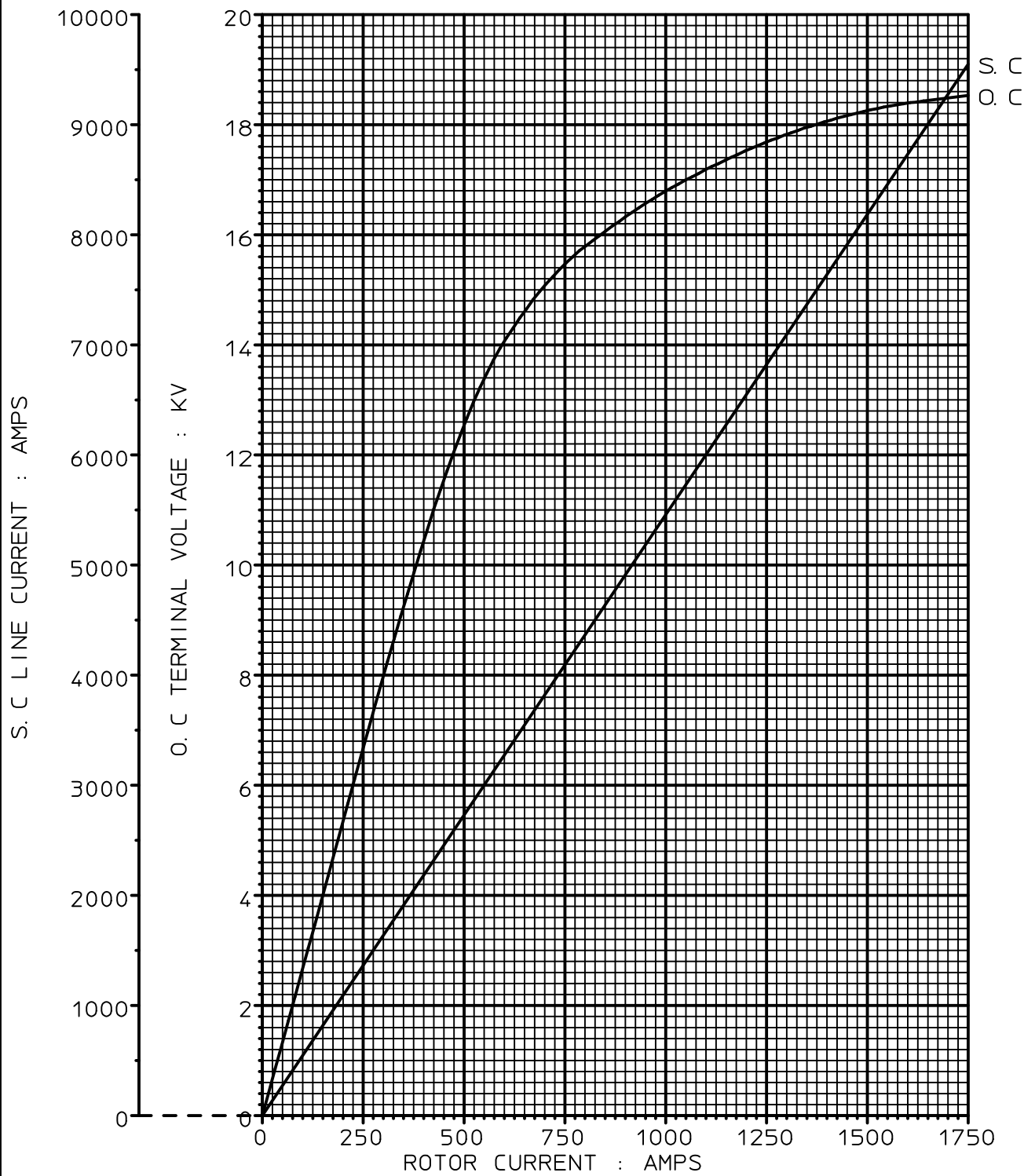
BDAX 82-445ERH
3Ph, 60Hz, 3600 RPM.

PERMISSIBLE DURATION OF NEGATIVE SEQUENCE CURRENT
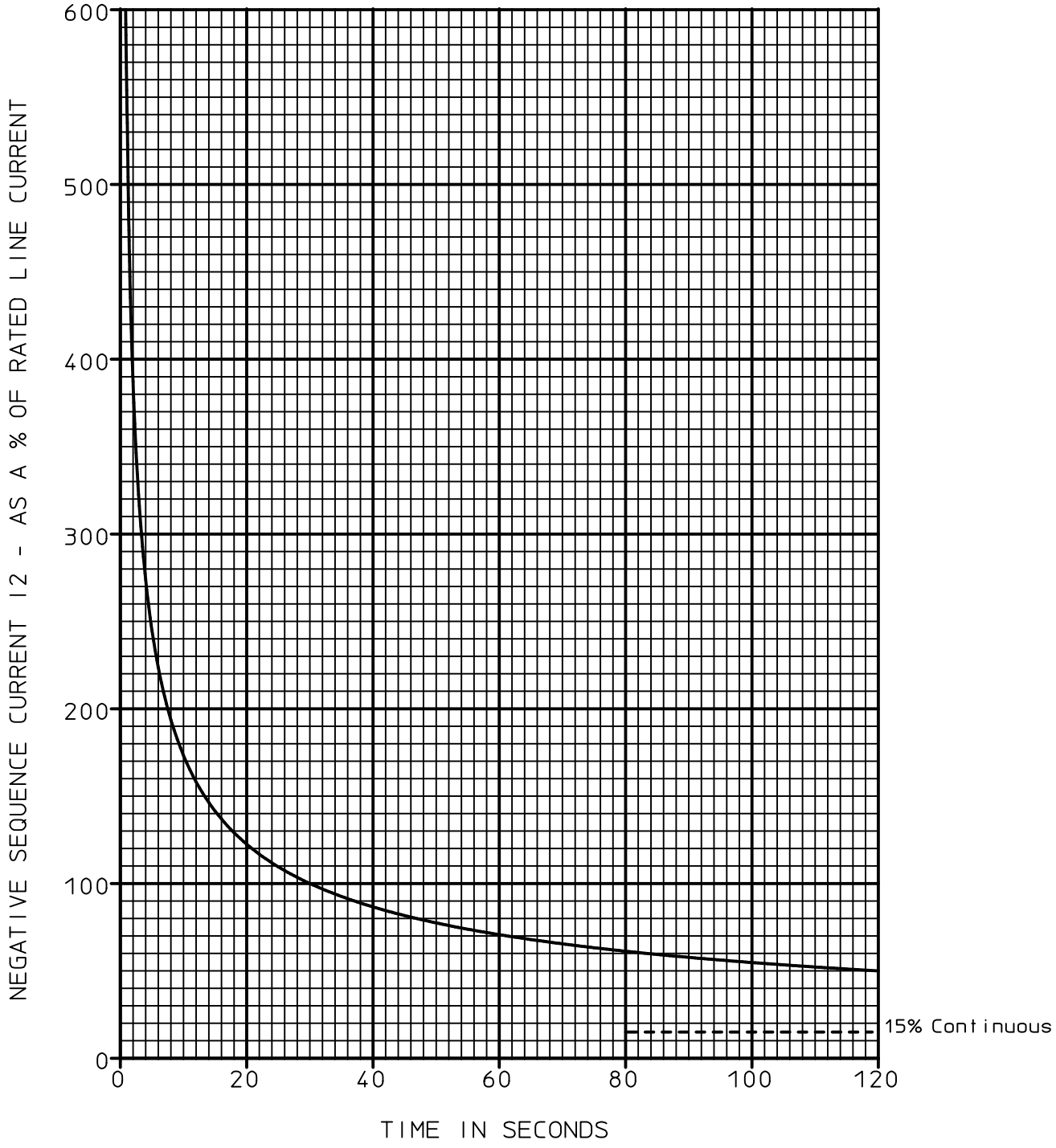
$$I_2^2 t = 30$$

TIME IN SECONDS

NEGATIVE SEQUENCE CURRENT I 2 – AS A % OF RATED LINE CURRENT

15% Continuous

NOTE: For continuous operation
rated current must not be
exceeded in any one phase.

EXCITATION SYSTEM MODEL

BRUSH

Reference no   OPP01562G1   Rating   128.35 MW, 0.85 pf   Supply   13.8 kV, 60 Hz
Frame sizes   Generator   BDAX 82-445ERH   Exciter   BXF 20.18-2S   Pilot Exciter   MX 51.08-A2

Transfer function diagram for excitation systems based on IEEE Std 421.5-2005 AC7B model.
Brush AVR Type : A12

Transfer Function Diagram

Generator / Exciter Parameters at 100°C
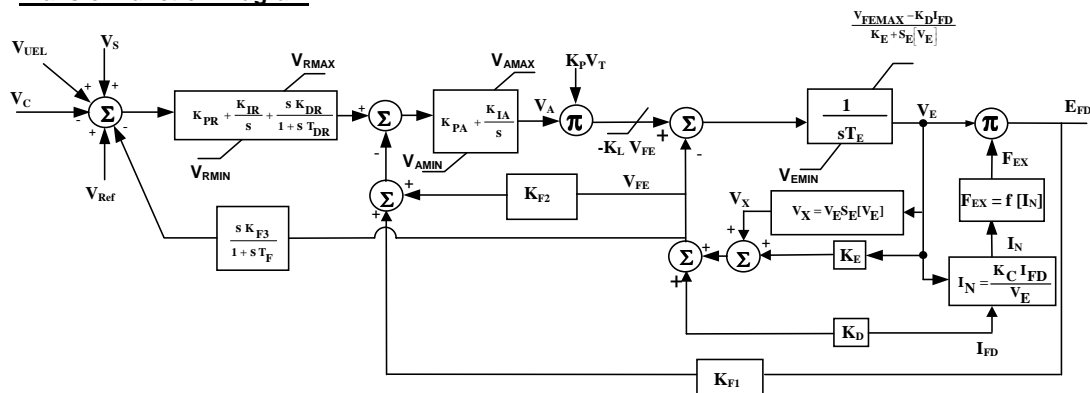
V_R	1 per unit exciter field voltage on air gap line (hot)	7.7	volts
R_F	Exciter field resistance (hot)	7.8	ohms
V_{PMG}	AVR input voltage	310	volts
E_{FD}	1 p.u. Exciter output voltage	52.1	Volts
T_E	Exciter field time constant	1.4	sec
K_E	Exciter constant	1.0	
$S_{E(E1)}$	Exciter saturation function at 75% ceiling voltage	0.15	
E1	75% ceiling voltage	6.9	p.u.
$S_{E(E2)}$	Exciter saturation function at 100% ceiling voltage	2.07	
E2	100% ceiling voltage	9.2	p.u.
K_D	Demagnetising factor (function of exciter reactance)	0.92	
K_C	Rectifier loading factor	0.47	
V_{FEMAX}	Maximum exciter field voltage	13.9	p.u.
V_{EMIN}	Minimum exciter output	0	p.u.

Automatic Voltage Regulator Parameters

K_{PR}	Voltage regulator proportional gain (adjustable in the range 1 to 80)	15	*
K_{IR}	Voltage regulator integral gain	1.88	*
K_{DR}	Voltage regulator derivative gain	0	*
T_{DR}	lag time constant	0.005	sec *
K_{PA}	I_{FE} Regulator proportional gain	48.38	*
K_{IA}	I_{FE} Regulator integral gain	0	
K_{F1}	Excitation control stabilizer gain	0	
K_{F2}	Excitation control stabilizer gain	0.15	
K_{F3}	Field current stabilising feedback gain	0.02	*
V_{Rmax}	Maximum regulator output voltage	3.2	p.u.
V_{Rmin}	Minimum regulator output voltage	-3.2	p.u.
V_{Amax}	Maximum Regulator output V	28.14	p.u.
V_{Amin}	Minimum Regulator output V	-23.32	p.u.
T_F	Field current stabilising feedback time constant	1.5	sec *
K_L		10000	
$K_P V_T$		1	

POWER SYSTEM STABILISER MODEL

BRUSH

Reference no   OPP01562G1   Rating   128.35 MW, 0.85 pf   Supply   13.8 kV, 60 Hz

Frame sizes   Generator   BDAX 82-445ERH   Exciter   BXF 20.18-2S   Pilot Exciter   MX 51.08-A2

Transfer function diagram for excitation systems based on IEEE Std 421.5-2005 PSS2B model.
Brush PSS Type : A12
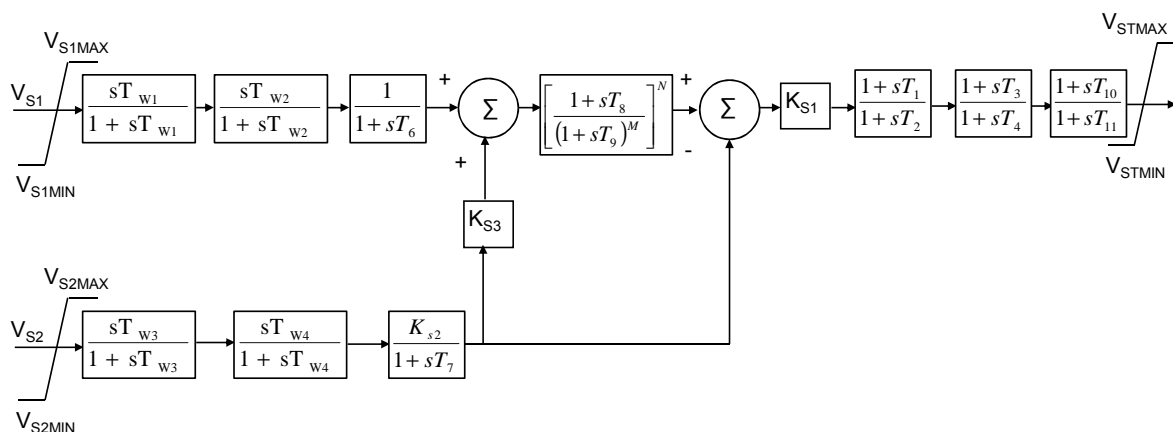
PSS PARAMETERS

		MIN	MAX
Ks1	Total PSS Gain	0	100
Ks2	Power Branch Gain	0	10
Ks3	Gain Mixture Power/Frequency	0	10
Tw1	Washout Time Constant (s)	2	20
Tw2	Washout Time Constant (s)	0	20
T6	LP Filter Time Constant (s)	0	10
Tw3	Washout Time Constant (s)	2	20
Tw4	Washout Time Constant (s)	0	20
T7	LP Filter Time Constant (s)	0	10
T8	Ramp Tracking Filter Time Constant (s)	0	2
T9	Ramp Tracking Filter Time Constant (s)	0	2
M	Grade of Ramp Tracking Filter	1	5
N	Grade of Ramp Tracking Filter	1	2
T1	Phase Lead Time Constant (s)	0	5
T2	Phase Lag Time Constant (s)	0	5
T3	Phase Lead Time Constant (s)	0	5
T4	Phase Lag Time Constant (s)	0	5
T10	Phase Lead Time Constant (s)	0	5
T11	Phase Lag Time Constant (s)	0	10

Note : Actual values should be determined from a power system study.The
instruction manual provides additional information including confirmation of
maximum and minimum values.

Turbine Dynamic Model Block Diagram

IEESGO : IEEE standard turbine-governor model
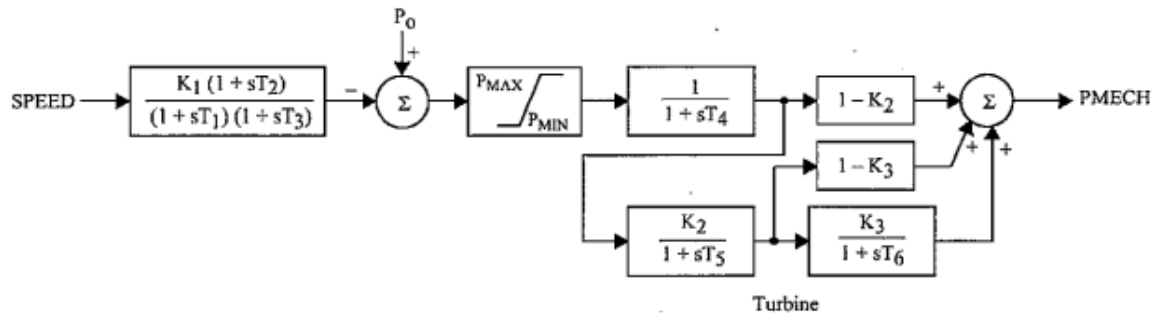
0.004	T_1, Controller Lag (Seconds)
0.02	T_2, Controller Lead (Seconds)
0.35	T_3, Governor Lag (>0) (Seconds)
0.06	T_4, Delay Due To Steam Inlet Volumes Associated With Steam Chest And Inlet Piping (Seconds)
0	T_5, Reheater Delay Including Hot And Cold Leads (Seconds)
0	T_6, Delay Due To IP-LP Turbine, Cross-Over Pipes, And LP End Hoods (Seconds)
20	K_1, 1/Per Unit Regulation
0	K_2, Fraction
0	K_3, Fraction
Max output [MW]	P_{MAX}, Upper Power Limit
0	P_{MIN}, Lower Power Limit

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