Bulk Electric System
Facility Rating Methodology

1.0 Purpose and Scope

The purpose of this document is to summarize JEA's rating methodology for bulk electric system facilities of JEA's solely and jointly-owned facilities for which JEA has responsibility for providing ratings for Bulk Electric System Facilities. For facilities where ownership changes in the line or terminal, JEA rates only those portions of the line or terminal it owns. For jointly owned facilities, JEA provides ratings if JEA is the operator as defined in contractual documents. The scope of this document includes bulk electric system transmission facilities (transmission circuits, autotransformers and capacitor banks that operate at voltages 100kV or higher) and generation facilities interconnected at 100KV or higher.

2.0 General Facility Rating Considerations

This Facility Rating Methodology governing principle is that the Facility Rating respects the most limiting applicable Equipment Ratings that comprises the Facility and shall equal the most limiting applicable Equipment Rating of the individual equipment that makes up the Facility. The Facility Rating Methodology includes both normal and emergency ratings and in some cases includes both summer and winter ratings.

3.0 Facility Ratings

3.1 Generation Facility Ratings

This methodology is for use in determining the normal and emergency facility ratings of JEA's solely and jointly owned generator facilities. JEA's only jointly owned plants are SJRPP and Scherer #4. JEA has the responsibility for the Facility Ratings Methodology and the Facility Ratings for SJRPP. Southern Company has the responsibility for the Facility Ratings Methodology and the Facility Ratings for Scherer #4. JEA's methodology for determining facility ratings for generating facilities is to the point of interconnection to the plant substation and consists of equipment connected serially that may limit the facility rating. The methodology also adheres to the most limiting of applicable equipment ratings (ie, generator, bus duct and flexible jumpers, transformer, overhead and underground conductor, metering and relay protective devices, switches, breakers, current transformers, etc) of serially connected devices that make up the facility. The equipment ratings methodology is described in Section 4.

3.2 Transmission Facility Ratings

This methodology is for use in determining the normal and emergency facility ratings of JEA's solely and jointly owned transmission facilities. JEA's only jointly owned transmission facilities are the Thalman-Duval and Hatch-Duval 500kV transmission lines. FPL has the responsibility for the Facility Ratings Methodology and the Facility Ratings for these transmission lines. JEA's methodology for determining facility ratings for transmission facilities is substation to substation and consists of equipment connected serially that may limit the facility rating. The methodology also adheres to the most limiting of applicable equipment ratings (ie, overhead and underground conductor, metering and relay protective devices, switches, breakers, current transformers, line traps, etc) of serially connected devices that make up the facility. The equipment rating methodology is described in Section 4.

3.3 Series and Shunt Compensation Ratings

This methodology is for use in determining the normal and emergency facility ratings of JEA's solely and jointly owned series and shunt compensation facilities. JEA has no jointly owned series and shunt compensation facilities. JEA only has shunt capacitors installed in the JEA system. JEA's methodology for determining facility ratings for series and shunt compensation facilities is to the substation bus terminal and consists of equipment connected serially that may limit the facility rating. The methodology also adheres to the most limiting of applicable equipment ratings (ie, shunt capacitors, overhead and underground conductor, metering and relay protective devices, switches, breakers, current transformers, etc) of serially connected devices that make up the facility. The equipment rating methodology is described in Section 4.

4.0 Equipment Ratings Methodology

4.1 Generator

4.1.1 Assumptions:

- Design and construction information based on design or construction information, including ratings provided by equipment manufacture, or equipment drawings and or specifications.
- Operational information including commissioning tests, performance testing, historical information and/or engineering analysis.

4.1.2 Considerations:

- Manufacturer Nameplate Data
- Generator Capability Curves
- Winter (24 F) and Summer (98 F) Temperatures
- Operating Limitations – Based on current operating conditions, such as, coolers out of service, etc

4.1.3 Rating Methodology

- Normal ratings are established based on design, test or actual operation; manufacturer nameplate and capability curves.
- There are no ratings above normal ratings. Therefore, the normal and emergency ratings are the same.

4.2 Generator Bus Duct and Flexible Jumper

4.2.1 Assumptions:

- Design and construction information based on design or construction information, including ratings provided by equipment manufacture, or equipment drawings and or specifications.

4.2.2 Considerations:

- Manufacturer Data and Construction Drawings
- Operating Limitations – Based on current operating conditions, if any.

4.2.3 Rating Methodology

- Normal ratings are established based on manufacturer data and/or construction drawings
- There are no ratings above normal ratings. Therefore, the normal and emergency ratings are the same.

4.3 Overhead Conductor

The methodology to establish normal and emergency ratings for overhead conductor are based on manufacturer nameplate, IEEE Standard 738-2006 IEEE Standard for Calculating the Current-Temperature of Bare Overhead Conductors, ambient conditions and operating considerations as follows:

- Design Criteria/Industry Standards – IEEE Standard 738
- Parameters:

Parameters	**Summer**	**Winter**
Conductor Temperature	Varies by Circuit	Varies by Circuit
Ambient Air Temperature	90º F	40º F
Perpendicular Crosswind Velocity	2 Ft/Sec	2 Ft/Sec
Emissivity Constant	0.8	0.8
Absorptivity Constant	0.5	0.5
Atmospheric Conditions	Clear	Clear
Solar Heat Gain	5:00 PM	7:00 AM
Altitude	50 Ft	50 Ft
Conductor Azimuth	0º F	0º F
Local Time	17:00	07:00
Pre-load	50% of Normal Rating	50% of Normal Rating
Emergency Rating Time	10 Minutes	10 Minutes

- Operating Limitations – Contained within ratings
- Rating Methodology – JEA establishes the maximum design operating temperature of the conductor based on the NESC clearances. Summer and winter normal ratings are based on the methodology contained in the standard. The calculation methods used to determine normal and emergency ratings of JEA bare overhead transmission conductor are based on an industry standard rating methodology (published by Southwire Corporation). Summer and winter emergency ratings are based on the breakers' response to a step change in current over its assumed pre-load current over a specified time period.
- Data utilized for conductor parameters to perform conductor calculations is taken from similar resources.

  Operating plans shall be implemented within the time period to reduce the load on the conductor to its normal rating.

4.4 Underground Conductor

The methodology to establish normal and emergency ratings for underground conductor are based on manufacturer specifications, AEIC CG1-07 Guide for Establishing the maximum operating

Temperatures for Impregnated Paper and Laminated Paper Polypropylene Insulated Cable, ambient conditions and operating considerations as follows:

- Design Criteria/Industry Standards – manufacturer specifications, AEIC CG1-07
- Parameters:

Parameters	**Summer/Winter**
Maximum Continuous Conductor Temperature	185º F
Maximum Emergency Conductor Temperature	221º F
Emergency Rating Time	10 Minutes
Ambient Soil Temperature	77º F
Thermal Resistance of Soil	90 Deg C*cm/W
Burial Depth	Min 3.5 ft
Conductor Skin Effect	0.16
Conductor Proximity Effect	0.135

- Operating Limitations – Contained within ratings
- Rating Methodology:

  Pipe-Type Cable - Normal ratings are established using the methodology. The ratings in excess of nameplate were developed and applied conservatively. Emergency ratings have been established at 20% above the normal rating which is within the methodology.

  Other Cable - Normal ratings are established using manufacturer specifications. There are no ratings above these manufacturer specifications. Therefore, the normal and emergency ratings are the same.

4.5 Strain Bus and Jumper Conductor

The methodology to establish normal and emergency ratings for strain bus and jumper conductors utilize the same operating conditions and methodology as overhead conductor (See Section 4.3).

4.6 Rigid Bus Conductor

The methodologies to establish normal and emergency ratings for rigid bus conductor are based on manufacturer nameplate, IEEE Standard 605-2008 IEEE Guide for Bus Design in Air Insulated Substations, ambient conditions and operating considerations as follows:

- Design Criteria/Industry Standards – IEEE Standard 605-2008
- Parameters:

Parameters	**Summer**	**Winter**
Conductor Operating Temperature – Normal	90º C	90º C
Conductor Operating Temperature - Emergency	130º C	130º C

Ambient Air Temperature	90º F	40º F
Perpendicular Crosswind Velocity	2 Ft/Sec	2 Ft/Sec
Emissivity Constant	0.8	0.8
Absorptivity Constant	0.5	0.5
Atmospheric Conditions	Clear	Clear
Suntime	5:00 PM	7:00 AM
Altitude	50 Ft	50 Ft
Conductor Azimuth	0	0
Altitude	30	30
Emergency Rating Time	1 Hour	1 Hour

- Operating Limitations – Contained within ratings
- Rating Methodology – The calculation methods used to determine normal and emergency ratings are based on the methodology contained within the IEEE Guide.
- Data utilized for conductor parameters to perform conductor calculations is taken from similar resources.

4.7 Autotransformer

The methodology to establish normal and emergency ratings for autotransformers are based on manufacturer nameplate, IEEE Standard C57.91-1995 Guide for Loading Mineral Oil Immersed Transformers, ambient conditions and operating considerations as follows:

- Design Criteria/Industry Standards – Manufacturer Nameplate and IEEE Standard C57.91-1995.
- Parameters:

Parameters	**Summer**	**Winter**
Ambient Air Temperature	90º F	40º F
Initial Load	0.5 pu	0.5 pu
Emergency Rating Time	6 Hour, 10 minutes	6 Hour, 10 Minutes
Top-Oil Temperature	Varies	
Hot Spot Temperature	Varies	
Total Losses	Varies	
Gallon of Oil	Varies	
Weight of Tank & Fittings	Varies	

- Operating Limitations – All of JEA's autotransformers have temperature indicating devices that generate alarms to the JEA Control Center when temperature limits are exceeded. Operating plans shall be implemented within the time period to reduce the load on the autotransformer to its normal rating when the temperature alarms are indicated at the control center.
- Rating Methodology – Autotransformers normal summer ratings are determined by the equipment manufacturer and listed on the transformer nameplate and based on IEEE Standard C57.91-1995 winter ratings are 110% of nameplate. Typically, ratings for the JEA system autotransformers are specified as ONAN/ONAF/ONAF. Normal winter and emergency ratings were developed consistent with IEEE Standard C57.91-1995 Guide for Loading Mineral Oil Immersed Transformers. The ratings in excess of nameplate were developed and applied conservatively to ensure less than 1% loss of life over a 24-hour period based on assumed summer and winter load and

temperature. This yields the summer and winter emergency ratings of 130% of the normal ratings for six hours and 10 minutes.

4.8 Generator Step Up Transformer

The methodology to establish normal and emergency ratings for generator step-up transformers are based on manufacturer nameplate, IEEE Standard C57.91-1995 Guide for Loading Mineral Oil Immersed Transformers, ambient conditions and operating considerations as follows:

- Design Criteria/Industry Standards – Manufacturer Nameplate and IEEE Standard C57.91-1995.
- Parameters: None other than nameplate
- Operating Limitations – Contained within ratings
- Rating Methodology – Normal ratings are established using manufacturer nameplate. There are no ratings above nameplate. Therefore, the normal and emergency ratings are the same.

4.9 Capacitor Bank Rating

The methodology to establish normal and emergency ratings for capacitor banks are based on manufacturer nameplate, IEEE Standard 18-2002 IEEE Standard for Shunt Power Capacitors, ambient conditions and operating considerations as follows:

- Design Criteria/Industry Standards – Manufacturer Nameplate and IEEE Standard 18-2002
- Parameters: 1.0 pu Voltage
- Operating Limitations – Contained within ratings
- Rating Methodology – Normal ratings are established using manufacturer nameplate. There are no ratings above nameplate. Therefore, the normal and emergency ratings are the same.

4.10 Line Trap

The methodology to establish normal and emergency ratings for line traps are based on manufacturer nameplate, Industry Standard ANSI C93.3-1995, Standard Requirements for Power Line Carrier Line Traps, ambient conditions and operating considerations as follows:

- Design Criteria/Industry Standards – Manufacturer Nameplate and ANSI C93.3-1995
- Parameters: None but nameplate
- Operating Limitations – Contained within ratings
- Rating Methodology – Normal ratings are established using manufacturer nameplate. There are no ratings above nameplate. Therefore, the normal and emergency ratings are the same.

4.11 Circuit Breaker

The methodology to establish normal and emergency ratings for circuit breakers are based on manufacturer nameplate, IEEE Standard C37.010-1999 IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis, ambient conditions and operating considerations as follows:

- Design Criteria/Industry Standards – Manufacturer Nameplate and IEEE Standard C37.010-1999 IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
- Parameters:

Parameters	**Summer**	**Winter**
Ambient Air Temperature	90º F	40º F
Emergency Rating Time	10 Minutes	10 Minutes

- Operating Limitations – Contained within ratings
- Rating Methodology – Summer and winter normal ratings are based on nameplate adjusted for ambient design temperatures consistent with the standard (105% for summer, 120% for winter). The ratings in excess of nameplate were developed and applied conservatively. Summer and winter emergency ratings are based on the methodology and should not exceed 2X breaker rating (200%).

4.12 Switch Rating

The methodology to establish normal and emergency ratings for circuit breakers are based on manufacturer nameplate, IEEE Standard C37.37-1996 IEEE Loading Guide for AC High-Voltage Air Switches, ambient conditions and operating considerations as follows:

- Design Criteria/Industry Standards – Manufacturer Nameplate and IEEE Standard C37.37-1996
- Parameters:

Parameters	**Summer**	**Winter**
Ambient Air Temperature	90º F	40º F

- Operating Limitations – Contained within ratings
- Rating Methodology – Summer and winter normal ratings are based on nameplate adjusted for ambient design temperatures consistent with the standard (110% for summer, 130% for winter). The ratings in excess of nameplate were developed and applied conservatively. Summer and winter emergency ratings are based on the methodology (130% for summer and 130% for winter).

4.13 Current Transformer

JEA utilizes current transformers that are contained in bushings of generators, transformer and circuit breakers. The ratings of these devices are assumed to be the same as the generator, transformer or circuit breaker that are contained elsewhere in this document. This section deals with free-standard current transformer and the methodology to establish normal and emergency ratings for instrument transformer are based on manufacturer nameplate, IEEE C57.13-2008 IEEE Standard Requirements for Instrument Transformers, ambient conditions and operating considerations as follows:

- Design Criteria/Industry Standards – Manufacturer Nameplate and IEEE Standard C37.010-1999 IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
- Parameters: None but nameplate
- Operating Limitations – Contained within ratings

- Rating Methodology – Summer and winter normal ratings are based on nameplate. There are no ratings above nameplate. Therefore, the normal and emergency ratings are the same.

4.14 Metering and Relay Protective Devices

Metering and Relay protective devices receive input from current transformer that are free standing or contained in generators, transformers and circuit breakers. The methodology to establish normal and emergency ratings for Relay Protective Devices are based on manufacturer nameplate, IEEE Standard C37.90-2005 IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus, ambient conditions and operating considerations as follows:

- Design Criteria/Industry Standards – Manufacturer Nameplate and IEEE Standard C37.90-2005
- Parameters: None
- Operating Limitations – Contained within ratings
- Rating Methodology – The normal and emergency ratings of metering and relay protection devices are equal to the normal and emergency ratings to their connecting instrument transformers.

5.0 Establishing and Communicating of Transmission and Generation Facility Ratings

Based on the methodology contained in this document and a review of element documentation including site inspections, transmission and generation facilities shall be updated and published in the event any addition of new facilities, existing facilities, modifications to existing facilities and re-ratings of existing facilities.

JEA Bulk Power Operations shall forward a completed ratings report to Electric System Planning.

JEA Bulk Power Operations shall incorporate the ratings into JEA's operational models and communicate to FRCC as set forth by FRCC Data Sharing and Modeling, Coordination and Communication Requirements (ie, equipment status report) the changes to JEA's ratings. This ensures all operating entities are aware of the changes.

JEA Electric System Planning shall incorporate the ratings into JEA's planning models and communicate to FRCC per the annual FRCC databank work the changes to JEA's ratings. This ensures all planning entities are aware of the changes.

SIGNED: GARRY BAKER

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0	5/6/2002	Creation	LCR	VAB
3	10/6/2005	Reviewed	TDW	VAB
4	10/10/2006	Reviewed	TDW	VAB
5	6/12/2007	Reviewed	TDW	VAB
6	3/1/2008	Reviewed	WGB	WGB
7	11/1/2009	Reviewed and Updated	WGB	WGB
8	6/1/2011	Added Winter Ratings and Updated Emergency Ratings	WGB	WGB
9	1/1/2013	For FAC-008-3	WGB	WGB
10	7/28/2014	Updated for Bus Elements	WGB	WGB
11	2/9/2018	Updated for site visits	WGB	WGB