Maximum Ambient Temperature		ACCC Designation										
		Q0$_3$3	PO$_2$2	NO1	RO4	SO5	TO6	UO7	VO8	WO9	XO10	YO11
°C	°F											
60	140	1.00	1.00	1.00	1.03	1.04	1.08	1.08	1.11	1.13	1.15	1.17
50	122	1.22	1.18	1.15	1.17	1.16	1.18	1.18	1.19	1.20	1.20	1.24
40	104	1.41	1.34	1.29	1.29	1.27	1.28	1.26	1.27	1.25	1.25	1.24
35	95	1.50	1.41	1.35	1.35	1.33	1.32	1.30	1.30	1.28	1.27	1.26
30	86	1.58	1.48	1.35	1.35	1.33	1.32	1.30	1.30	1.28	1.27	1.26
25	77	1.66	1.55	1.47	1.46	1.42	1.41	1.38	1.37	1.34	1.31	1.30
20	68	1.73	1.61	1.53	1.51	1.47	1.45	1.42	1.41	1.36	1.33	1.31
10	50	1.87	1.73	1.63	1.61	1.56	1.53	1.49	1.47	1.41	1.38	1.35
0	32	2.00	1.84	1.73	1.70	1.64	1.60	1.56	1.54	1.46	1.42	1.38
-10	14	2.00	1.95	1.83	1.78	1.72	1.67	1.63	1.60	1.51	1.46	1.41
-20	-4	2.00	2.00	1.92	1.87	1.80	1.74	1.69	1.65	1.56	1.50	1.44
-30	-22	2.00	2.00	2.00	1.95	1.87	1.80	1.76	1.71	1.60	1.54	1.47

Table C-6: Enclosed Indoor Outdoor Switches
Switch Part Emergency Loadability Factors (ELF) for Various Ambient Temperatures

10.4 WAVE TRAPS

Wave trap ratings are discussed in several sources. The ratings for the older wave traps in which the main coil is designed as a single-phase, air-cored inductor of the dry type are discussed in ANSI C93.3-1981, **Requirements for Power-Line Carrier Line Traps** and in Westinghouse Electric's Curve No. 511545. The ratings of the newer type of wave traps consisting of a coil of wire encapsulated in an epoxy resin are not covered in an ANSI/IEEE standard. The ratings for this type of wave trap were developed based upon guidelines supplied by the manufacturer, Trench Electric. In general, the rated continuous current for wave traps is based on the maximum permissible temperature rise limitations of the wave trap when it is carrying rated current at an ambient temperature of 40°C. The total temperature of the wave trap under service conditions depends both on the actual load current and the actual ambient temperature. It is, therefore, possible to operate at a current higher than rated continuous current when ambient temperature is less than 40°C, provided that the allowable total temperature rise limitation is not exceeded.

Ambient-compensated continuous current ratings will be used for the normal seasonal circuit ratings of both types of wave traps. These seasonal ratings will be based on the nameplate rating of the wave trap with an adjustment made for changes in the rated continuous current due to changes in the ambient air temperature. The ambient-compensated normal loadability factors for Dry-Type, Air-Cored Inductor wave traps are given in Table D-1 and were obtained from Westinghouse Electric's Curve No. 511545. The ambient- compensated loadability factors for Epoxy-Encapsulated Inductor wave traps were developed from Trench Electric's loadability curves and are given in Table D-2. To determine the normal seasonal circuit rating, simply multiply the wave trap's nameplate rating by the appropriate normal loadability factor. Interpolation may be used to obtain loadability factors at ambients other than those specified in the tables.

Normal life expectancy will occur with a wave trap operated at or below its ambient-compensated normal current rating. Any value of currents in excess of the ambient-compensated normal current ratings may cause the designed temperature rise to be exceeded and may shorten the life expectancy of the wave trap. For wave traps utilizing an air-cored inductor, an acceptable level of emergency overload current has been determined and is specified in ANSI Standard C93.3-1981, **Requirements for Power-Line Carrier Line Traps**. Ambient-compensated emergency current ratings will be used for the emergency seasonal circuit ratings of wave traps utilizing an air-cored inductor. These seasonal ratings will be based on the Four-Hour Emergency Overload Current-Carrying capability of the wave trap with an adjustment made for changes in the continuous current due to changes in the ambient air temperature. The wave traps may be loaded to this emergency level for a maximum of four hours per cycle. Before an emergency load cycle, the wave trap loading must be at or below the normal seasonal loading level for at least two hours.

The emergency seasonal circuit rating can be developed by simply multiplying the wave trap's nameplate rating by the appropriate emergency loadability factor. The ambient-compensated emergency loadability factors for Dry-Type, Air-Cored Inductor wave traps are given in Table D-1 and were obtained from ANSI Standard C93.3-1981, Requirements for Power-Line Carrier Line Traps. Interpolation may be used to obtain loadability factors at ambients other than those specified in the tables.

Average Ambient Air Temperature	Loadability Factors	
	Normal	4-Hour Emergency
40°C	1.00	1.10
20°C	1.05	1.15
0°C	1.10	1.20
-20°C	1.10	1.25

Table D-1: Loadability Factors for Dry-Type Air-Cored Inductor Wave Traps

Average Ambient Air Temperature	Loadability Factors	
	Normal	4-Hour Emergency
40°C	1.00	N/A
20°C	1.13	N/A
0°C	1.25	N/A
-20°C	1.36	N/A

Table D-2: Loadability Factors for Epoxy-Encapsulated Inductor Wave Traps

Trench Electric, the manufacturer of the newer type of wave traps which consist of a coil of wire encapsulated in an epoxy resin, has stated that no overload capability is available on this type of wave trap. For this reason, no separate emergency rating will be assigned to this type of wave trap and the ambient-compensated current rating will be used for both the circuit's normal and emergency ratings.

July 16, 1985

Westinghouse Electric Corporation

Subject: Line Trap Loadings

Attached is one copy of the Appendix to ANSI Standard C93.3-1981 titled "Guide for Emergency Overload Current Capability of Line Traps".

This guide is current and, all Westinghouse traps built since 1970 conforms to the overload capability designated therein.

The Curve No. 511545 supplied applies to Westinghouse Line Traps built prior to 1970. Note that the overload capability of traps 2000 amperes and below on this curve are the same as that specified in the Standard. The larger traps were modified in design in order to conform to the Standard requirement.

July 25, 1985

Trench Electric

Attached are three copies of the overload current U.S. temperature curves. General Electric did not send any such information when we purchased their Line Trap division but the curves should be approximately the same.

10.5 CURRENT TRANSFORMERS

Current transformer ratings are discussed in ANSI/IEEE C57.13 **IEEE Standard Requirements for Instrument Transformers** and in Westinghouse Electric's technical paper titled **"Memorandum on Thermal Current Characteristics of Current Transformers Used With Power Circuit Breakers and Power Transformers"**. In general, the rated continuous current for current transformers is based on the maximum permissible temperature limitations of the various parts of the current transformer when it is carrying rated current at a 24-hour average ambient temperature of 30°C (with. a maximum hourly temperature of 40°C). The total temperature of these parts under service conditions depends both on the actual load current, the actual average ambient temperature, and the service environment of the current transformer. Depending on the environment, it is, therefore, possible to operate at a current higher than rated continuous current when the average ambient temperature is less than 30 °C, provided that the allowable total temperature limit is not exceeded. Similarly, when the average ambient temperature is greater than 30°C, the current must be reduced to less than rated continuous current to keep total temperatures within allowable limits.

The environment in which a current transformer operates has a large effect on the current-carrying capability of the current transformer. Separately mounted current transformers have been assigned rated primary and secondary currents and continuous-thermal-current rating factors by the manufacturer. Separately mounted current transformers are designed to meet these characteristics by the independent control of such parameters as: current density in the primary and secondary windings, geometry, area of radiating surfaces, and heat transfer characteristics. Permissible loading as a function of ambient temperatures and continuous-thermal-current rating factors, and permissible overloading under emergency conditions, is covered in **ANSI/IEEE C57.13 IEEE Standard Requirements for Instrument Transformers**.

Bushing current transformers mounted in power circuit breakers and power transformers differ from separately mounted current transformers in that the design parameters cannot be independently controlled since they are restricted by the characteristics of the power apparatus in which they are mounted. Bushing current transformers, when attached to various power apparatus, are subjected to wide variations in their environmental ambient temperature. This variation is dependent upon the thermal characteristics of the power apparatus and the relative current loading with respect to the rated current of the power apparatus and its bushing current transformer. For this reason, continuous-thermal-current rating factors are not typically calculated by the manufacturer for bushing current transformers. Instead, the continuous-thermal-current rating factors must be determined for each application. Permissible loading and permissible overloading of bushing current transformers is covered in Westinghouse Electric's technical paper titled **"Memorandum on Thermal Current Characteristics of Current Transformers Used With Power Circuit Breakers and Power Transformers"**.

Rating Separately Mounted Current Transformers: The maximum continuous-thermal-current ratings for separately-mounted current transformers designed for 55°C temperature rise above 30°C average ambient air temperature will vary according to actual ambient cooling air temperature. The adjusted continuous current ratings will be based on three items:

1) The nameplate primary and secondary current ratings at the ratio setting being used.
2) The average cooling air temperature at which the rating is being calculated. Note: The maximum cooling air temperature must not exceed the average cooling air temperature by more than 10°C.

3) The ambient-adjusted Continuous-Thermal-Current rating factor from Table E-1. The value used from this table is based upon the nameplate Continuous-Thermal-Current rating factor of the current transformer and the average ambient air temperature.

Average Cooling Temperature	Nameplate Continuous Thermal Current Rating Factor					
	1.00	1.33	1.50	2.00	3.00	4.00
60°C	0.65	0.85	1.00	1.35	2.00	2.70
50°C	0.80	1.05	1.20	1.60	2.40	3.20
40°C	0.90	1.20	1.35	1.80	2.70	3.65
30°C	1.00	1.33	1.50	2.00	3.00	4.00
20°C	1.05	1.45	1.65	2.20	3.30	4.35
10°C	1.20	1.55	1.75	2.35	3.50	1.70
0°C	1.30	1.65	1085	2.45	3.70	5.00

Table E-1:_ Ambient-Adjusted Contınuous-Thermal-Current Rating Factors

The ambient-adjusted continuous-thermal-current rating of a separately-mounted current transformer ıs equal to the ambient adjusted continuous-thermal-current rating factor multiplied by rated primary current of the current transformer at the ratio specified. According to ANSI/IEEE C57.13-1978, IEEE Standard Requirements for Instrument Transformers, no overload capability is available on separately- mounted current transformers. For this reason, normal rating of the separately-mounted current transformer will be used for both the normal seasonal circuit rating and the emergency seasonal circuit rating.

Example: The following example should serve to clarify thıs process:

Problem:

1) Determine the summer seasonal normal and emergency ratings for a separately-mounted current Transformer operating on a 2000:5 amp ratio with a nameplate Continuous-Thermal-Current rating of 1.50. Assume the average ambient air temperature is 30°C with a maximum temperature of 40°C for the summer period.
2) Determine the winter seasonal normal and emergency ratings for this same separately-mounted current · transformer assuming an average ambient air temperature of 0°C with a maximum temperature of 10°C for the winter period.

Solution

1) From Table E-1, the 30°C ambient-adjusted Continuous-Thermal-Current rating factor for a separately-mounted current transformer with a nameplate Continuous-Thermal-Current rating factor of 1.50 is 1.50 (They are the same due to the fact that the nameplate C-T-C rating factor is developed at an average ambient of 30°C). The normal and emergency summer ratings would then be equal to:

Ambient-Adjusted C-T-C R.F. @ 30°C • Rated Primary Current of CT Ratio or

1.50 • 2000 amps = 3000 amps

For operation at 30°C, both the Summer Normal and Emergency ratings of current transformer would be 3000 amps. Note: When the primary current is 3000 amps, the secondary current would be 7.5 amps due to the 2000:5 ratio used in the current transformer.

2) From Table E-1, the 0°C ambient-adjusted Continuous-Thermal-Current rating factor for a separately-mounted current transformer with a nameplate Continuous-Thermal-Current rating factor of 1.50 is 1.85. The normal and emergency summer ratings would then be equal to:

Ambient-Adjusted C-T-C R.F. @ 0°C *Rated Primary Current of CT Ratio or

1.85 * 2000 amps = 3700 amps

For operation at 0°C, both the Winter Normal and Emergency ratings of current transformer would be 3700 amps. Note: When the primary current is 3700 amps, the secondary current would be 9.25 amps due to the 2000:5 ratio used in the current transformer.

Rating Bushing Current Transformers Mounted in Power Apparatus: The continuous current rating of current transformers mounted in power circuit breakers or power transformers is determined as follows:

1) When the bushing current transformer ratio being used has the same primary current rating as the breaker continuous current rating or the power transformer rated current, the continuous current rating factor of the current transformer is 1.0 (unity).
2) When the primary current rating of the ratio being used on the current transformer is greater than the continuous current rating of the breaker or greater than the power transformer rated current, then the maximum load current is limited by the breaker or power transformer rating, whichever is applicable.
3) When the primary current rating of the ratio being used is less than the continuous current rating of the breaker or the power transformer rated current, then the maximum load current is limited by the continuous thermal current rating of the current transformer when operating on that ratio. Under these conditions, the temperature rises of the current transformer and the power apparatus would be lower, and therefore, the current transformer can be operated at a continuous thermal rating factor greater than 1.0. In this situation, the permissible continuous -thermal-current rating factor is calculated based upon constant maximum power dissipation, using the following equation:

$$R.F = \sqrt{\frac{I_{pa}}{I_{ct}}}$$

where,

R.F. =Continuous-thermal-current rating factor
I_{pa}= Power apparatus continuous current rating (amps)

I_{ct} = Primary current rating of bushing current transformer ratio used (amps)

The results calculated from this equation should be so limited that the maximum rating factor does not exceed 2.0 and that the continuous current rating of the breaker or the rated current of the power transformer is not exceeded.
Note: The situation, in which the primary current rating of the current transformer ratio being used is less than the continuous current rating of the breaker or the power transformer rated current, is an unusual case and should be viewed as the exception rather than the rule.

The normal rating of a bushing current transformer is equal to the continuous-thermal-current rating factor multiplied by rated primary current of the current transformer at the ratio specified.

Some short-term emergency overload capability is typically available on bushing current transformers mounted on power circuit breakers and power transformers. However, w he n utilizing this emergency overload capability, care must be taken to coordinate the loading limit of the current transformer with the overall application limitations of the other equipment affected by the current transformer loading. Particular care should be taken to avoid exceeding the maximum metering capability of metering equipment attached to the current transformer secondary.

10.6 CIRCUIT BREAKERS

Circuit breaker ratings are discussed in ANSI/IEEE C37.010, **IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis** and in ANSI/IEEE C37.010b, **IEEE Standard for Emergency Load Current-Carrying** Capability. These standards discuss the development of ratings for circuit breakers from the standpoint of the manufacturers. From a practical standpoint, the application of the methods discussed in these standards to circuit breakers in operation will be very difficult, due to the fact that this application would require contacting the manufacturer for detailed design information for each circuit breaker being rated. Therefore, it is recommended that for any circuit breakers which do not limit flows on the transmission system, the nameplate rated continuous current be used as the circuit breaker's normal and emergency circuit ratings. For circuit breakers which limit flows on the transmission system, the manufacturer could be consulted and ambient-compensated normal and emergency ratings could be developed for the circuit breaker using the methods described in the ANSI/IEEE Standards. These methods are described in the remainder of this section.

In general, the rated continuous current for circuit breakers is based on the maximum permissible temperature limitations of the various parts of the circuit breaker when it is carrying rated current at an ambient temperature of 40°C. The total temperature of these parts under service conditions depends both on the actual load current and the actual ambient temperature. It is, therefore, possible to operate at a current higher than rated continuous current when ambient temperature is less than 40°C, provided that the allowable total temperature limit is not exceeded. Similarly, when the ambient temperature is greater than 40°C, the current must be reduced to less than rated continuous current to keep total temperatures within allowable limits.

Ambient-compensated continuous current ratings will be used for the normal seasonal circuit ratings of outdoor circuit breakers. These seasonal ratings will be based on the nameplate rating of the circuit breaker with an adjustment made for changes in the rated continuous current due to changes in the ambient air temperature. The seasonal loading limit shall be coordinated with the overall application limitations of the other equipment affected by the loading of the circuit breaker, such as cables and current transformers. (See other appropriate appendices to determine limitations on the other equipment.) For circuit breakers used in metal-clad switchgear, no seasonal ratings will be calculated. Instead, the loading limit shall be coordinated with the overall application limitations of the switchgear.

The seasonal normal circuit breaker ratings can be determined in the following manner:

1) A circuit breaker's rated continuous current is based on the maximum permissible total temperature limitations, $Ø_{max}$, and $Ø_r$, of the various parts of the circuit breaker when it is carrying rated current at an ambient temperature of 40°C. The constructional features of a circuit breaker dictate the appropriate values of $Ø_{max}$ and $Ø_r$, to be used in the calculation of ambient-compensated ratings. The major components of a circuit breaker have several different temperature limitations which are shown in Table F-1. In order that none of these temperature limitations be exceeded when the load current is adjusted to the value permitted by the actual ambient temperature, the values of $Ø_{max}$ and $Ø_r$, should be determined as follows:

    (a) If the actual temperature is less than 40°C, the applicable component with the highest specified values of allowable temperature limitations should be used for determining $Ø_{max}$ and $Ø_r$,

    (b) If the actual temperature is greater than 40°C, the applicable component with the lowest specified values of allowable temperature limitations should be used for determining $Ø_{max}$ and $Ø_r$,

Component Description	Limit of Temperature Rise, °C $\emptyset_r$	Limit of Total Temperature, °C $\emptyset_r$
Circuit breaker parts handled by the operator in the normal course of his duties	10	50
Copper contacts, coper-to-copper conducting joints, external surfaces accessible to the operator in the normal course of his duties, external terminal connected to bushing	30	70
Top oil	40	80
Breaker terminal to be connected to 85°C	45	85
Hottest spot temperature of parts where they contact oil; silver (or equal) contacts in oil; silver (or equal) conduction joints in oil	50	90
Silver (or equal) contact in air; silver (or equal) conducting joints in air; hottest spot of bushing conductor or of bushing metal parts in contact with Class A insulation or with oil; hottest spot winding temperature 55°C rise of current transformers	60	105
External surfaces not accessible to an operator in the normal course of his duties	70	110
Hottest spot winding temperature of 80°C dry type current transformers	110	150

Table F-1 Summary of Temperature Limitations for Circuit Breaker Components

2) The continuous current which a circuit breaker can carry at a given ambient temperature without exceeding its total temperature limitations is given by the formula:

$$I_a = I_r\left(\frac{\emptyset_{max} - \emptyset_a}{\emptyset_r}\right)$$

where,

I_a = allowable continuous load current, in amperes, at the actual ambient temperature Θ_a (I_a is not to exceed two times I_r)
I_r = rated continuous current, in amperes
Θ_{max} = allowable hottest spot total temperature ($\Theta_{max} = \Theta_r$ + 40°C), in degrees Celsius
Θ_a = actual ambient temperature expected (between -30°C and 60°C), in degrees Celsius
Θ_r = allowable hottest spot temperature rise at rated current, in degrees Celsius

3) The ambient-compensated allowable continuous load current, Ia. calculated in Step 2 will be treated as the seasonal normal rating of the circuit breaker.

Normal life expectancy will occur with a circuit breaker operated at continuous nameplate rating. When operated for one or more load cycles above nameplate rating, the material used in manufacturing the circuit breaker deteriorates at a faster rate than normal. The rate of deterioration is commonly expressed as a percentage loss of life. According to ANSI/IEEE C37.010b- **IEEE Standard for Emergency Load Current-Carrying Capability**, a circuit breaker can experience operation at 10°C above the limits of total temperature for which the circuit breaker was designed for up to two periods of an emergency cycle of eight hours before an unreasonable loss of life occurs and maintenance is required. Inspection and maintenance must be performed in accordance with manufacturer's recommendations before the circuit breaker can be subjected to additional emergency cycles. In addition, following each emergency cycle, the load current shall be limited to 95% of the rated continuous current as modified by ambient compensation for a minimum of two hours.

Ambient-compensated emergency current ratings will be used for the emergency seasonal circuit ratings of outdoor circuit breakers. These seasonal ratings will be based on the Eight-Hour Emergency Load Current-Carrying capability of the circuit breaker with an adjustment made for changes in the continuous current due to changes in the ambient air temperature. The seasonal emergency loading limit shall be coordinated with the overall application limitations of the other equipment affected by the loading of the circuit breaker, such as cables and current transformers.

The seasonal emergency circuit breaker ratings can be determined in the following manner:

1) Emergency load current-carrying capability factors with ambient temperatures at 40°C are listed in Table F-2 for each limiting temperature of various circuit breaker components. The factors have been selected to allow operation at 10°C above the limits of total temperature for an emergency period of eight hours. The factors are expressed as the ratio of emergency load current allowed at an ambient temperature of 40°C, I_e, to the rated continuous current, I_r, and can be applied with the following restrictions:

    (a) The circuit breaker component with the highest values of limiting temperature, Θ_{max}, and Θ_r, shall be used to select the proper emergency load current-carrying capability factor from Table F- 2.

    (b) The Eight-Hour factor shall be used for a cycle of operation consisting of separate periods of no longer than eight hours each, with not more than two such occurrences before maintenance.

    (c) Each cycle of operation is separate, and no time-current integration is permissible to increase the number of periods within a given maintenance cycle.

Limiting Temperatures of (°C) of Different Breaker Components							
Θ_{max}	70	80	85	90	105	110	150
Θ_r	30	40	45	50	65	70	110
	1.17	1.13	1.11	1.10	1.08	1.07	1.05

Table F-2: Emergency Load Current. Carrying Capability Factor (I_e/I_f)

2) The emergency load current, I_{ea} of a circuit breaker operating at an ambient temperature other than 40°C can be calculated by this equation:

$$I_{ea} = I_r \left(\frac{\emptyset_{max} - \emptyset_a}{\emptyset_r} + \left(\frac{I_e}{I_r} \right)^{1.8} - 1 \right)^{\frac{1}{1\,8}}$$

where

I_{ea} = emergency load current, in amperes, at the actual ambient temperature Θ_a (I_{ea} is not to exceed two times I_r)
I_r = rated continuous current in amperes
I_e = emergency load current, in amperes, at 40°C ambient temperature
Θ_a = actual ambient temperature expected (between -30°C and 60°C) in degrees Celsius
Θ_r = allowable hottest spot temperature rise at rated current, in degrees Celsius
I_e/I_r = emergency load current-carrying capability factor from Table F-2

3) The ambient-compensated emergency load current, I_{ea}• calculated in Step 2 will be treated as the seasonal emergency rating of the circuit breaker.

11. GENERATOR REPORTING FORMS

Southwest Power Pool

Generator Owner/Operator Excitation System Summary Report

Instructions: Generator Owner/Operator shall fill out summary information for all units under your control concerning the number of hours the Excitation System was not operated in Automatic Voltage Control Mode.

Generator Owner/Operator	
Month Reporting Data	
Contact Name	
Contact Phone	

Station	**Unit #**	**# Hours Excitation System not operated in Automatic Voltage Control Mode**

Dev. February, 2001
By SPP GWG

Southwest Power Pool

Generator Unit Excitation System Status Report

Instructions: Generator Owner/Operator shall fill out information concerning the frequency and duration of events of a particular generating unit's excitation system not being operated in automatic voltage control mode.

Generator Owner/Operator	
Generating Unit	
Month Reporting Data	
Contact Name	
Contact Phone	

Date (unit not operated in automatic mode)	**Unit #**	**Reason unit's excitation system was operated out of automated voltage control mode**

Dev. February, 2001
By SPP GWG

Southwest Power Pool

Generator Owner/Operator Voltage Schedule Requirements

Instructions: Control Area Operator shall specify voltage schedule to be maintained by each Generator Owner/Operator's units at a specified bus.

Generator Owner/Operator	
Control Area	
Voltage Schedule Date	
Contact Name (Control Area)	
Contact Phone (Control Area)	

Station	Unit #	Specified Voltage	Specified Bus

Dev. February, 2001
By SPP GWG

Southwest Power Pool

Generator Unit Voltage Schedule Status Report

Instructions: Generator Owner/Operator shall fill out information concerning the frequency and duration of periods in which particular generating units did not adhere to control area's prescribed voltage schedule. If event was approved by control area operator, please attach written approvals.

Generator Owner/Operator	
Generating Unit	
Month Reporting Data	
Contact Name	
Contact Phone	

Date	**Duration (hr:min)**	**Reason unit did not adhere to voltage schedule**	**Approved (yes/no)**

Dev. February, 2001
By SPP GWG

Southwest Power Pool

Control Area's List of Exempt Generators

Instructions: Control Area Operator shall list units in their area of responsibility that are exempt from following prescribed Control Area Voltage Schedules.

Control Area Operator	
Last Updated	
Contact Name	
Contact Phone	

Generator Owner/Operator	**Generating Station**	**Unit**

Dev. February, 2001
By SPP GWG

Southwest Power Pool

Generator Unit Transformer Tap Setting Report

Instructions: Generator Owner/Operators shall fill out information concerning the tap settings and impedances of all GSU and AUX transformers under their control.

Generator Owner/Operator	
Generating Station	
Last Updated	
Contact Name	
Contact Phone	

GSU/AUX Transformer I.D.	**Current Tap Setting**	**Tap Setting Range**	**Transformer Impedance (OA Base)**

Dev. February, 2001
By SPP GWG

Southwest Power Pool

Transformer Tap Setting Change Request

Instructions: Control Area Operator shall complete information necessary to let affected Generator Owner/Operator know of needed Generator Unit Transformer settings changes.

Generator Owner/Operator	
Generating Station	
Control Area	
Date	
Contact Name (Control Area)	
Contact Phone (Control Area)	

GSU/AUX Transformer I.D.	**Current Tap Setting**	**New Tap Setting**	**Technical Justification for Tap Setting Change**

Dev. February, 2001
By SPP GWG

Southwest Power Pool

Generator Units Exempt from Tap Setting Reporting Procedures

Instructions: Generator Owner/Operators shall fill out information for all units under their control that are exempt from Transformer Tap Setting Procedures. The criteria that is met must also be documented

Generator Owner/Operator	
Control Area	
Date	
Contact Name (Control Area)	
Contact Phone (Control Area)	

Generating Station	**Unit #**	**Exemption Criteria Met**

Dev. February, 2001
By SPP GWG

Southwest Power Pool

Voltage Regulator Control Setting Status Report

Instructions: Generator Owner/Operators shall fill out information for all units under their control.

Generator Owner/Operator	
Generating Unit	
Date	
Contact Name	
Contact Phone	

Generating Control	**Control Setting**	**Generator Short Term Capability**	**Protective Relay Setting**
Overexcitation Limiter			
Underexcitation Limiter			
Volts/Hertz Limiter			

Dev. February, 2001
By SPP GWG

Southwest Power Pool

Generator Governor Characteristic Reporting

Instructions: Generator Owner/Operators shall fill out information for all units under their control.

Generator Owner/Operator	
Generating Unit	
Last Updated	
Contact Name	
Contact Phone	

Governor Control	**Control Setting**
Speed Regulation	

Dev. February, 2001
By SPP GWG

Southwest Power Pool

Non-Functioning Governor Controls

Instructions: Generator Owner/Operators shall fill out information for all units under their control that has a non-functioning or a blocked speed/load governor control.

Generator Owner/Operator	
Last Updated	
Contact Name	
Contact Phone	

Generating Station	**Unit**	**Governor Status (Blocked/Non-functioning)**

Dev. February, 2001
By SPP GWG

12. SPP MISOPERATION REPORT

Reporting Utility: ______________________________ Date:

______________________________ Contact Person:

Name	
Phone	
Fax	
Email	
Address	

Equipment Category and Operating Voltage:

DME (Yes/No)	TPS (Yes/No)	GCP (Yes/No)
SPS (Yes/No)	UFLS (Yes/No)	UVLS (Yes/No)
ARL (Yes/No)		Voltage (kV)

Time, Equipment Location & Description:

Incident Date:	Incident Time	Time Zone:
Relay MFGR:	Relay Type:	Relay Flags:
Substation Name/Number:	Line/Bus/Auto/Unit Name/No:	Circuit Breaker Numbers:

Description of Misoperation/Failure:

Investigation Results

Corrective Action

Target Date to Complete Recommendations

Recommendations

Person verifying that all Corrective Actions and Recommendations have been completed

Name:	Title:	Date:

Note: Equipment categories include DME – Disturbance Monitoring Equip, TPS – Transmission Protection Systems, GCP – Generator Control & Protection, SPS – Special Protection Systems, UFLS – Under Frequency Load Shedding, UVLS – Under Voltage Load Shedding

13. RESPONSE FACTOR THRESHOLDS

Factor	Short-term	Long-term *	Date Approved	Comments
PTDF	3%	3%	4/27/2004	
OTDF	3%	3%	4/27/2004	
PTVF	0.02 p.u.	0 02 p u.	12/12/2001	
TRM		0%	12/12/2001	See SPP website for short-term TRM
* Long-term factors apply to all elements above 60kV.				

14. INTERCONNECTION REVIEW PROCESS DETAILS

This section shall be subject to review and approval of the Transmission Working Group (TWG). Given the limited amount of time during a regular TWG meeting, and given the need for timely responses, the majority of the interconnection review process will take place outside of a regular meeting. A Transmission Assessment Report will be prepared by the parties to the proposed interconnection and presented to the TWG for review. Once received, the TWG will review the information provided in the assessment of impacts on the interconnected system. This section details the technical requirements which shall be the minimum necessary.

14.1 COORDINATION

1) The party proposing the interconnection shall appoint a person who will serve as the primary contact with the TWG staff secretary.
2) The primary contact shall ensure that all affected parties are identified. This includes but is not limited to notification through the TWG Exploder and requesting any affected parties identify themselves, shall provide a proposed timeline for the studies, shall ensure that all affected parties are notified of and kept informed of progress, and shall provide the opportunity to review all study results prior to submission to the TWG.
3) The primary contact shall coordinate any joint studies that may be necessary and shall report the results to all affected parties.
4) All affected parties shall cooperate in joint planning efforts.
5) All affected parties will work together to develop an estimated timeline for the completion of the study.
6) SPP shall coordinate activities that affect other regions pursuant to an applicable seams agreement.

14.2 PRIOR TO THE REVIEW

Affected parties shall jointly develop and evaluate both the proposed interconnection and any mitigation plans. The primary contact shall submit a request for review of the interconnection request to the TWG through the group's staff secretary. The request for review shall include the following:

1) A list of all affected parties and the contact person at each affected party. The rationale for determining affected parties shall be included.
2) A brief summary of the results of planning studies. Each affected party shall provide a copy of its own planning criteria as documentation of the need of mitigations that exceed regional requirements.
3) A detailed description of the project including: in-service date; design information; ratings of the interconnection; a geographic map of the interconnection area; electrical one-line diagrams of the facilities being connected.
4) A summary of the results of power flow, short-circuit, and dynamic analyses in accordance

with NERC Reliability Standards, SPP Criteria, other regional requirements, and affected party planning criteria.

5) 5Appropriate program files and program automation files to allow SPP staff to reproduce the studies performed.
6) Details of any required mitigation plans including identification of the parties responsible for mitigation. The detailed description of mitigation plans shall include such information as detailed in Item 3 above.
7) Any comments of the affected parties.

14.3 TECHNICAL STUDY REQUIREMENTS

Impact analysis shall be performed to assess the system with and without the interconnection to determine if the interconnection causes any adverse effects to the system.

The following are minimum requirements for power flow analysis:

1) A contingency assessment consistent with Integrated Transmission Planning Manual in the entire first-tier area of the combined areas which the proposed interconnection connects. This area maybe expanded or reduced as mutually agreed upon. The rationale for expansion or reduction of the study area shall be documented and agreed upon by all affected areas.
2) A review of impacts shall utilize all applicable Scenario Cases developed by the SPP extending to the planning horizon year.
3) If, at any time, impacts are identified affecting a nuclear power plant, it shall be included separately as an affected party.
4) Affected parties shall report adverse impacts and required mitigations.

The TWG may request additional studies at its discretion. The rationale for requesting additional studies shall be provided to all affected parties. If the proposed interconnection was previously evaluated by SPP and included in the most recent STEP, the power flow analysis described here does not need to be repeated.

The following are minimum requirements for short-circuit analysis:

1) Analysis shall be consistent with the Integrated Transmission Planning Manual. The model(s) assessed shall be determined by the affected parties. The rationale for the model(s) assessed shall be included.
2) Assessment shall consist of 3-phase and phase-to-ground faults applied at the buses of the proposed interconnection plus all first-tier buses to the interconnection.
3) Additional buses may be studied as mutually agreed upon and documentation for including such additional buses shall be included.
4) Assessments shall document the before and after fault currents on all monitored busses.
5) Affected parties shall report adverse impacts and the required mitigation.

The following are minimum requirements for transient stability analysis:

1) Analysis shall be performed using a contingency assessment. The model(s) and contingencies

assessed shall be determined by the affected parties. Consideration shall be applied for evaluating impactful contingent events from neighboring SPP or non-SPP systems. The rationale for the model(s) and contingencies assessed shall be included. If no transient stability analysis is performed the rationale for not performing such studies shall be provided.

2) The assessments performed shall be determined by the affected parties. The rationale for the assessments shall be included.
3) Assessments shall document the before and after post disturbance performance on all monitored buses consistent with Section 5.4 of this Criteria.
4) Affected parties shall report adverse impacts and the required mitigation.

If the interconnection is to be made at 345 kV or higher voltage, affected parties shall determine if additional study work is needed to assess reactive power impacts and management. If the affected parties determine additional study work is required, results of these studies shall be provided for review. Additional study work may include but is not limited to steady state, transient (including electromagnetics transient studies), surge impedance loading for long lines, insulation coordination, or switching studies clearly indicating any required levels of shunt compensation. If no additional study work is performed for 345 kV or higher interconnections, the rationale for not performing such studies shall be provided.

14.4 DISPUTE RESOLUTION

All disputes between SPP members shall be resolved using the procedures of Section 3.13 of the SPP Bylaws.

14.5 REVIEW AND BALLOT BY THE TRANSMISSION WORKING GROUP

1) The TWG Secretary shall review the request for interconnection for completeness.
2) Any deficiencies shall be reported to the primary contact.
3) Once a complete request is received, it shall be forwarded to the TWG for a 14 day review and comment period.
4) The primary contact shall be responsible for coordinating any response necessary to comments and questions raised by the TWG.
5) The TWG shall schedule a ballot to accept or to reject the interconnection request.
6) Any action taken by the TWG will be included in the minutes.

14.5.1 TRANSMISSION INTERCONNECTION REVIEW DATA CHECKLIST

1) Primary contact and all affected parties' contact information.
2) Overview of the proposed interconnection and its need.
3) Estimated or proposed in-service date.
4) List of all studies run by season.
    (a) Power flow studies minimum requirements met.
    (b) Short-circuit studies minimum requirements met.
    (c) Transient studies minimum requirements met.
5) Affected parties planning criteria, if applicable.
6) A detailed description of the proposed interconnection.
    (a) In- service date

(b) Design information
(c) Ratings of the interconnection
(d) A geographic map of the interconnection area
(e) Electrical one-line diagrams of the facilities being connected.

7) Appropriate program files and program automation files to allow SPP staff to reproduce the studies performed.
8) Details of any required mitigation plans including identification of the affected parties responsible for mitigation.
   (a) In-service date
   (b) Design information
   (c) Ratings of the facilities
   (d) A geographic map of the facility area
   (e) Electrical one-line diagrams of the facilities being connected.
9) Comments of affected parties covering agreement or points of disagreement of the proposed interconnection, if any.

The TWG shall review and modify this section as needed but not less frequently than once every 3 years.

Southwestern Electric Power Company
TCRF Revenue Requirement Calculation
For the Year Ending September 30, 2018

Line No.	(A) Component	(B) Transmission Total Company	(C) Texas Retail Transmission Function	(D) Texas Retail Trans Amount Included in SWEPCO Base Rates Docket No. 46449	(E) Net Change Not Included In Base Rate Order (C - D)
1	**TIC:**				
2	Transmission Plant in Service	$1,805,659,249	$710,197,756	$578,810,052	$131,387,704
3	Accumulated Depreciation	(547,978,331)	(215,395,573)	(196,049,290)	(19,346,283)
4	Net Plant in Service	$1,257,680,917	$494,802,182	$382,760,762	$112,041,420
5					
6	Accumulated Deferred Taxes	(274,882,178)	(108,048,945)	(88,349,265)	(19,699,680)
7					
8	**Total TIC**	$982,798,739	$386,753,237	$294,411,497	$92,341,740
9					
10	WACC	7 18%	7 18%	7 18%	
11					
12	**Return on TIC**	$70,541,559	$27,759,678	$21,131,739	$6,627,939
13					
14					
15					
16	**Investment-Related Expenses:**				
17	Depreciation Expense	$36,954,970	$14,526,026	$12,543,415	$1,982,611
18	Income Tax Expense - Note 1	11,206,626	4,693,856	3,548,358	1,145,498
19	Other Associated Taxes	63,653,439	5,063,426	3,745,805	1,317,621
20	Revenue Credits	(203,220,343)	(79,880,565)	(60,242,621)	(19,637,944)
21	**Total Investment-Related Expenses**	($91,405,308)	($55,597,257)	($40,405,043)	($15,192,214)
22					
23	**Revreqt (line 12 + line 21)**	($20,863,749)	($27,837,580)	($19,273,305)	($8,564,275)
24					
25	ATC:				
26	SPP Charges and Fees	$200,961,524	$77,379,409	$56,214,726	$21,164,683
27	Wheeling Expense	513,035	171,035	161,208	9,827
28	Other Transmission Charges	1,068,854	420,138	394,452	25,687
29	**Total ATC**	$202,543,413	$77,970,583	$56,770,386	$21,200,197
30					
31	**RR (line 23 + line 29)**	$181,679,664	$50,133,003	$37,497,081	$12,635,922
32					
33	Settlement Adjustments	$0	$0	$0	$0
34					
35	Adjusted TCRF Revenue Requirement	$181,679,664	$50,133,003	$37,497,081	$12,635,922

Southwestern Electric Power Company
TCRF Revenue Requirement Calculation
For the Test Year Ending March 31, 2020

Line No.	(A) Component	(B) Total Company	(C) Texas Retail Transmission Function	(D) Texas Retail Amount Included in SWEPCO Base Rate Order	(E) Net Change Not Included In Base Rate Order (C - D)
1	TIC:				
2	Transmission Plant in Service	$2,066,218,993	$904,072,262	$904,072,262	$0
3	Accumulated Depreciation	(570,785,047)	(249,746,484)	(249,746,484)	0
4	Net Plant in Service	$1,495,433,946	$654,325,778	$654,325,778	$0
5					
6	Accumulated Deferred Taxes	(208,942,255)	(91,422,496)	(91,422,496)	0
7					
8	**Total TIC**	$1,286,491,691	$562,903,283	$562,903,283	$0
9					
10	WACC	7 22%	7 22%	7 22%	
11					
12	**Return on TIC**	$92,935,304	$40,663,759	$40,663,759	$0
13					
14					
15					
16	**Investment-Related Expenses.**				
17	Depreciation Expense	$47,933,847	$20,973,412	$20,973,412	$0
18	Income Tax Expense - Note 1	34,779,087	16,544,686	16,544,686	0
19	Other Associated Taxes	67,742,851	6,447,554	6,447,554	0
20	Revenue Credits	(172,655,780)	(75,666,738)	(75,666,738)	0
21	**Total Investment-Related Expenses**	($22,199,994)	($31,701,086)	($31,701,086)	$0
22					
23	**Revreqt (line 12 + line 21)**	$70,735,310	$8,962,673	$8,962,673	$0
24					
25	ATC:				
26	SPP Charges and Fees	$157,881,876	$68,652,821	$68,652,821	$0
27	Non-SPP Charges	6,005,430	2,631,891	2,631,891	0
29	Other Transmission Charges	914,530	400,795	400,795	0
32	**Total ATC**	$164,801,836	$71,685,507	$71,685,507	$0
33					
34	**RR (line 23 + line 32)**	$235,537,145	$80,648,180	$80,648,180	$0

Note (1) Income Tax Expense is calculated for the Texas Retail Transmission Function

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