AUSTIN ENERGY'S 2022 BASE RATE REVIEW	§ § §	**BEFORE THE CITY OF AUSTIN** **IMPARTIAL HEARING EXAMINER**

AUSTIN ENERGY'S SUPPLEMENTAL RESPONSE TO NXP SEMICONDUCTORS' THIRD REQUEST FOR INFORMATION

Austin Energy files this Supplemental Response to NXP Semiconductors' ("NXP") Third Request for Information ("RFI") submitted on May 26, 2022.

Respectfully submitted,

LLOYD GOSSELINK ROCHELLE & TOWNSEND, P.C.
816 Congress Avenue, Suite 1900
Austin, Texas 78701
(512) 322-5800
(512) 472-0532 (Fax)

THOMAS L. BROCATO
State Bar No. 03039030
tbrocato@lglawfirm.com

TAYLOR P. DENISON
State Bar No. 24116344
tdenison@lglawfirm.com

ATTORNEYS FOR THE CITY OF AUSTIN D/B/A AUSTIN ENERGY

NXP 3-11: Please provide a copy of AE's distribution system planning manuals, guidelines, instructions, criteria, and other similar documents.

ANSWER: See Attachment NXP 3-11.

Prepared by: JL

Sponsored by: Thomas Pierpoint

AUSTIN ENERGY

DISTRIBUTION PLANNING CRITERIA

Prepared by

Planning and Regulatory Engineering

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Exceptions to the Planning Criteria

1.01. Planning Criteria as Guidelines

The Planning Criteria are intended to be guidelines. Exceptions to the Planning Criteria may be approved in appropriate circumstances.

1.02. Minor Violations

Some Planning Criteria violations are minor, and eliminating the violation may not provide a cost-effective solution.

1.03. Temporary Conditions

Occasionally, operation in violation of the Planning Criteria is necessary because of unexpected events, such as long-term forced outages of equipment, unforeseen load changes, and delays in project completion. If a Planning Criteria violation will exist for a short period of time only, *i.e.*, one to two years, it may be possible to delay construction with operational solutions.

General Provisions

2.01. Objectives of the Planning Criteria

a) The Distribution System Planning Criteria provide the guidelines followed by Austin Energy to provide a cost-effective and reliable plan for accommodating the changes in distribution system load.

b) The Planning Criteria will be applied in distribution capacity planning studies to identify problem areas, plan new facilities, and recommend distribution system improvements or retirements.

2.02. Review and Revisions to the Planning Criteria

a) Austin Energy personnel will review the Planning Criteria periodically (approximately every three (3) years) and recommend revisions as necessary.

b) Revisions to the Planning Criteria require the approval of the Senior Vice President of Electric Service Delivery.

2.03. System Conditions

a) Distribution capacity studies assume summer peak conditions to determine substation peak loading. Weather adjusted summer peak loads are used when appropriate.

b) Winter peak and seasonal minimum conditions are considered when such conditions constitute a significant reliability threat for distribution system loads.

2.04 Contingency Levels

a) “Normal” means the steady state condition of the distribution system with all facilities in service and all loads being served.

b) “Level A contingency,” means the steady-state condition of the distribution system following the outage of any single distribution circuit. Level A contingency conditions are preceded by Normal conditions.

c) "Level B contingency" means the steady-state condition of the distribution system following an outage caused by a single event resulting in the loss of any:

   1) overhead double-circuited distribution line,
   2) distribution substation switch-gear,
   3) distribution substation transformer,

   Level B contingency conditions are preceded by Normal conditions.

d) "Level C contingency" means the steady-state condition of the distribution system following a common mode failure of an entire distribution substation or a duct bank that results in the loss of more than three distribution circuits.

2.05. Facility Ratings

The loading on all distribution facilities and distribution substation facilities should be reduced to or below the normal equipment ratings within twenty-four hours to limit loss of equipment life and to prevent additional contingencies.

The methodology and assumptions used for setting normal and emergency ratings for distribution and substation facilities are described in the appendices.

2.06. SCADA Limits

Distribution Planning shall have the responsibility for assigning the SCADA alarm settings for each circuit. These settings will be reviewed annually and adjusted as needed.

The purpose of the SCADA alarm system is to allow operators sufficient warning to minimize overloads on the distribution system. The SCADA alarm settings may be adjusted as necessary to allow for practical operational considerations and flexibility. Such adjustments shall not impair reliable service to customer loads.

The first alarm limit, LIM1, shall generally be the normal rating of the feeder get-a-way cables. The second alarm limit, LIM2, shall generally be 50 amps less than the emergency rating of the feeder get-a-way cables.

When the overhead conductor is the limiting factor, the first SCADA limit, LIM1, shall be 100A less than the (75° C) rating of the overhead conductor. The second SCADA limit, LIM2 shall be 50A less than the (75° C) rating of the overhead conductor.

Planning Criteria for Distribution Circuits

3.01. Maximum Loading on Distribution Facilities

a) Under Normal conditions, no distribution facility shall be loaded greater than its normal rating.

b) Under contingency conditions following service restoration switching, no distribution facility shall be loaded greater than its emergency rating.

c) Steady state loading on all distribution facilities should be reduced to or below the normal rating within twenty-four hours for contingency levels A and B.

d) Service shall be restored to all outaged distribution facilities following:

   1) normal automatic operation of protective equipment, or

   2) manual switching within twenty-four hours, or

   3) placement and connection of the mobile substation transformer within twenty-four hours.

3.02. Maximum Voltage Drop on Distribution Circuits

a) The maximum voltage drop shall not exceed 6 V (5%) on a 120 V base under Normal conditions.

b) The maximum voltage drop shall not exceed 10 V (8%) on a 120 V base under all contingency conditions following service restoration switching.

3.03. Service Restoration Switching

a) Switching to restore service to non-faulted circuits or sections following a Level A contingency should require no more than two hours.

b) Switching to restore service to non-faulted circuits or sections following a Level B contingency should require no more than twenty-four hours.

c) Switching to restore service to non-faulted circuits or sections following a Level C contingency could take in excess of twenty-four hours.

NOTE: This section does not apply if AE's distribution system is subject to a "Major Event" as defined by Texas Public Utility Commission's Reliability and Continuity of Service Rule 25.52

3.04. Power Factor on Overhead Distribution Circuits

a) The power factor on an overhead distribution circuit shall be as close to unity as practicable at summer peak load; and,

b) The combined power factor of all overhead distribution circuits connected to the same substation transformer bus should not be below 97% lagging.

3.05. Service to Large Distribution Customers

Customers with loads in excess of 4,000 kVA (185 A) at 12 kV should be requested to split their loads into approximately equal parts between two feeds if practicable.

3.06. Installation of New Pole-Top Switches

A new pole-top switch shall be considered when four or more pole-top switches must be operated to isolate a section under Level A contingency conditions.

Planning Criteria for Automatic Load Transfers

4.01. Automatic Load Transfer Placement

The routing of multiple feeds to an automatic load transfer service must be such that the distribution dispatcher can make full use of associated distribution circuits for normal and emergency service.

4.02. De-rating of Facilities

Facilities used to provide automatic load transfer service to customers should be de-rated as follows:

a) The load on the circuit providing the alternate feed to an automatic load transfer service should be limited to the emergency rating minus the anticipated maximum demand of the automatic load transfer.

b) The load on the substation transformer serving the alternate feed to the automatic load transfer should be limited to the emergency rating minus the anticipated maximum demand of the automatic load transfer.

c) Planned load transfer will be limited to the maximum contracted reserve capacity (anticipated maximum demand).

4.03. Limitations of Automatic Load Transfers

Transfer from the backup circuit back to the primary circuit shall be manual and coordinated through the Energy Control Center.

Planning Criteria for Distribution Substations

5.01. Transmission System Connection Criteria

a) After the outage of any single transmission facility that serves a distribution substation facility, service shall be restored to all distribution facilities that are served by the substation facility following either:

1) normal automatic operation of protective equipment; or
2) manual switching that does not exceed two hours.

b) Distribution substation connections to transmission sources shall preclude a single transmission line outage, followed by normal automatic sectionalizing and switching, from outaging both the primary substation transformer and its alternate.

5.02. Maximum Loading on Substation Transformers

a) Under Normal conditions, no substation transformer shall be loaded to greater than its normal rating (100 % full load or 95 degree Celsius top oil temperature).

d) Under a Level B contingency, no substation transformer shall be loaded to greater than its twenty-four hour emergency rating (107% of full load or 110 degree Celsius top oil temperature).

e) Under a Level C contingency, no substation transformer shall be loaded greater than its twenty-four hour emergency rating, 107% of full load. However, the transformer may be loaded at this level in excess of twenty-four hours.

Note: For Austin Energy's typical 30 MVA substation transformer, the normal rating would be 1,400 amps full load or 95 degree Celsius top oil temperature. Its twenty four hour emergency rating would be 1,500 amps or 110 degree Celsius top oil temperature.

Definitions

a) Automatic transfer service is the extension of two or more separate distribution feeders to the customer's site and the installation of load transfer equipment such that when the primary source of power is interrupted, the load is transferred to the secondary source of power.

b) "Distribution facility" means any Austin Energy equipment used to distribute electric energy to the public at a nominal line-to-line voltage of 34.5 (35) kV or below, excluding distribution substation facilities.

c) "Distribution substation facility" means a facility used to connect distribution facilities to a transmission (138KV, or 69KV) source. This includes all equipment and facilities between the high side bus of the power transformer through the low side switchgear.

d) "Protective equipment" means breakers, relays, or sectionalizing switches.

e) "Section" means a portion of a distribution circuit that is bounded by switching devices.

f) "Switching devices" means switches or breakers.

g) "Transmission facility" means any facility used to transmit electrical energy to a substation facility at a nominal line-to-line voltage of 69 kV or greater, excluding substation facilities.

h) **Major events** — Interruptions that result from a catastrophic event that exceeds the design limits of the electric power system, such as an earthquake or an extreme storm. These events shall include situations where there is a loss of power to 10% or more of the customers in a region over a 24-hour period and with all customers not restored within 24 hours. *(Texas Public Utility Commission's Reliability and Continuity of Service Rule 25.52)*

APPENDIX

Appendix A --- Distribution Planning Criteria

Distribution Planning Criteria

System Condition	Maximum Facility Loading	Maximum Voltage Drop	Restoration Time (Non-Faulted Sections)
Normal	Normal Equipment Ratings	6 Volts (5%) on a 120 volt basis	N/A
Level A	Emergency Equipment Ratings	10 Volts (8%) on a 120 volt basis	Two Hours
Level B	Emergency Equipment Ratings	10 Volts (8%) on a 120 volt basis	Twenty-four Hours
Level C	Emergency Equipment Ratings	10 Volts (8%) on a 120 volt basis	Exceeds Twenty-four Hours

(Meets with ANCI C84.1 1989 , red book page 69-70)

a) "Normal" means the steady state condition of the distribution system with all facilities in service and all loads being served.

b) "Level A contingency," means the steady-state condition of the distribution system following the outage of any single distribution circuit. Level A contingency conditions are preceded by Normal conditions.

c) "Level B contingency" means the steady-state condition of the distribution system following an outage caused by a single event resulting in the loss of any:

   1. overhead double-circuited distribution line,

   2. distribution substation switch-gear,

   3. distribution substation transformer,

d) Level B contingency conditions are preceded by Normal conditions.

e) "Level C contingency" means the steady-state condition of the distribution system following a common mode failure of an entire distribution substation or a duct bank that results in the loss of more than three distribution circuits.

Appendix B --- Distribution Substation Loading Limits

Normal limit = 95 degrees Celsius

Emergency limit = 110 degrees Celsius

Example:

30MVA Transformer
Rated for 65 degree Celsius temperature rise above ambient
Assume ambient = 30 degrees Celsius (C) (86 degrees Fahrenheit)

V = 12.47kV

Therefore:

I full load = 30Mva/(sqrt(3)*12.47kV)
I full load = 1389 amps (approx. 1400 amps)

Assumming that a 65 degree Celsius temperature rise occurs at full load

Then:

A temperature vs. current characteristic curve can be derived which is shifted up or down depending on the ambient temperature.

TCC = 1389 amps/65C = 21.37 amps/C

Therefore:

For Normal = 95C max. limit @ ambient = 30C,
I full load = 1389 amps (approx. 1400 amps)

The emergency = 110C @40C ambient
I full load =(21.37amps/C)(110C-40C) = 1495.9 (approx. 1500)amps

Appendix C --- Circuit Get-A-Way Ampacity Limits

The allowable ampacity for individual underground circuit get-a-ways shall be determined by the following factors:

- Cable size and composition.
- The maximum number of circuits in a common duct bank.
- The number, size, and arrangement of conduits in the common duct bank.
- The configuration of the cables in the common duct bank.
- The load profile served by each circuit.
- The seasonal timing of the maximum circuit demand.

The load profile will generally fall into one of four categories:

Urban – High density, mixed commercial and residential.
Suburban – Lower density, mixed commercial and residential.
Network – Underground network system serving the Central Business District.
Industrial – Large industrial or commercial customers with a high load factor.

The maximum demand for most circuits will occur during periods of extreme heat, when air conditioning usage is at a peak (summer peaking circuits). The maximum demand on some circuits may occur during periods of extreme cold, due to high concentrations of residential and commercial customers with electric heating (winter peaking circuits). The AE system as a whole usually sees two system peaks, a summer peak in the July-August time frame, and a winter peak in the December-January time frame.

The load profiles for summer and winter seasonal peaks may be significantly different, depending on the type of load served. Generally, using the winter load profile will result in more conservative circuit ratings, as the winter curve is flatter, permitting the cable less time to cool. To insure that the cable ratings assigned to system circuits are somewhat conservative, ratings analysis should use the following guidelines:

Type	**Load Curve**
Urban	Winter*
Suburban	Summer
Network	Winter
Industrial	Winter

* - The summer load curve may be used for urban circuits where the summer peak exceeds the winter peak by 25% or more.

For the purposes of assigning ratings, it is assumed that all of the circuits in the common duct bank are equally loaded. This is rarely the case in reality, but this assumption provides an additional safety margin in the calculations. The load profiles for circuits at or above 85% of their rated capacity should be reviewed on an annual basis, to determine if changes in circuit configuration or customer loads have affected the circuit ratings.

Normal Ratings: During normal conditions, underground circuit get-a-ways shall be limited to a normal operating temperature of 90^0 C (105^0 C for 105^0 C cable).

Emergency Ratings: During emergency conditions, substation feeder cables may be allowed to operate at a 130° C temperature (140° C temperature for 105^0 C cable) with the assumption that only one feeder per duct bank may attain this limit. Emergency ratings may be assigned using the same load profiles as the normal rating, with exceptions for circuits that normally serve urban or suburban loads that may pick up industrial loads during emergency conditions.

Calculating the Ratings: The ratings are calculated by Distribution Planning using the program "ETAP". Unless specific data is known, the following assumptions are made:

1) All conduits 5-inch, PVC schedule 40 with 2 inch spacing (from edges).
2) 25^o C ambient temperature.
3) Soil Rho of 90.[1]
4) Fill Rho of 44.[1]
5) Average dry soil
6) Heavy aggregate fill
7) Burial depth of thirty six inches to top of duct bank[2]
8) All cables BICC Unishield power cable, 133% insulation, 15 kV.
9) All circuits equally loaded.

[1] *Typical values of Thermal Resistivity as per Appendix B 1996 NEC Handbook*
[2] *Assumed depth unless duct bank profiles available.*

Conservative Ratings: In situations where a quick conservative cable rating is needed, the table on the next page is taken from the Duke Engineering and Services study "Cable Rating Study" dated January 1998. Please note the assumptions following the table.

Nine-Way Duct Bank One Circuit Per Conduit[A]

# Circuits in Bank	500 MCM Normal	500 MCM Emergency	1000 MCM Normal	1000 MCM Emergency
1	540	653	790	956
2	500	620	720	900
3	450	581	640	838
4	420	563	590	808
5	400	544	560	784
6	380	536	540	767
7	370	525	520	754
8	350	522	500	740

[A] Taken from DE&S “Cable Rating Study” dated January 1998

1) All conduits 5-inch, PVC schedule 40 with 2 inch spacing (from edges).
2) 20^{o} C ambient tempature.
3) Soil and fill Rhos of 90.
4) Average dry soil
5) Heavy aggregate fill
6) Burial depth of two feet to top of duct bank
7) All cables BICC Unishield power cable, 133% insulation, 15 kV.
8) All circuits equally loaded.
9) All circuits utilize winter urban load curve
10) Normal ratings based on conductor temperature of 90^{o} C.
11) Emergency ratings based on conductor temperature of 130^{0} C.

Appendix D --- Overhead Conductor Loading Limits

Table 6.1.1 Types of Overhead Wires and Conductors

Conductor Size and Stranding (AWG, kcmil or inch)	Type	Code Word	Austin Energy Stock Number	Ampacity ~1	Overall Diameter (inch)	Weight (lb/ft)	Ultimate Breaking Strength (lb)
Bare All Aluminum Overhead Conductor							
4/0, 7~4	AAC	OXLIP	0000000851	380	0.5220	0.1987	3,830.00
795, 37~2	AAC	ARBUTUS	0000004530	900	1.0260	0.7464	13,900.00
Bare ACSR Aluminum Overhead Conductor							
1/0, 6/1~4	ACSR	RAVEN	0000004537	230	0.3980	0.1453	4,380.00
4/0, 6/1	ACSR	PENGUIN	0000004538	340	0.5630	0.2911	8,350.00
336, 26/7	ACSR	LINNET	0000004540	530	0.7200	0.4625	14,100.00
795, 26/7	ACSR	DRAKE	0000004539	900	1.1080	1.0940	31,500.00
Bare Copper and Copperweld Conductor							
# 6, 1	Solid MHD Bare		0000004523	120	0.1620	0.0795	1,010.00
# 6, 1	Solid SD Bare		0000004527	120	0.1620	0.0795	762.90
# 4, 1	Solid MHD Bare		0000004522	170	0.2043	0.1264	1,584.00
# 2, 7	Stranded SD Bare		0000004533	230	0.2920	0.2049	2,007.00
# 2, 1	Solid MHD Bare		0000004521	220	0.2576	0.2009	2,450.00
1/0, 19	Stranded MHD Bare		0000004524	310	0.3730	0.3257	3,803.00
2/0, 19	Stranded SD Bare		0000001211	360	0.4190	0.4109	4,025.00
4/0, 19	Stranded MHD Bare		0000004525	480	0.5280	0.6533	7,479.00
2A	Copperweld		0000000710	240	0.3660	0.2568	5,876.00
6A	Copperweld		0000004529	140	0.2300	0.1016	2,585.00

The ampacity is based on a conductor temperature of 75.0 deg. C, 25.0 deg. C ambient temperature, 2 ft/sec cross wind, 0.5 Emissivity,