



*Southern Company Power Quality Policy*

# **Southern Company**

# **Power Quality**

# **Policy**



**Southern Company**

**Alabama Power**  
**Georgia Power**  
**Mississippi Power**

# Table of Contents:

SCOPE.....	1
DEFINITIONS.....	2
I. HARMONICS .....	7
II. VOLTAGE FLUCTUATIONS .....	13
III. VOLTAGE IMBALANCE.....	16
IV. ADHERENCE AND ENFORCEMENT .....	17
V. REFERENCES .....	19

## *Southern Company Power Quality Policy*

### **Scope**

This document provides the policy pertaining to power quality issues affecting the Electric Supply System (ESS). The term ESS, when used in this document, pertains to either the Southern Company Transmission System (SCTS) or its interconnected distribution system. The policy contained in this document is intended to ensure that the integrity and power quality of the ESS are maintained.

The Owners of the ESS are: Alabama Power Company, Georgia Power Company, and Mississippi Power Company. The Owners of the ESS are referenced collectively as “Owners” or individually as “Owner”. This document shall not be construed to waive, modify, or alter the contract for electric service between any Owner and any User connected to the ESS. Where a conflict exists between this document and the contract for electric service, the contract for electric service will govern.

This Policy supersedes the previous version of this Southern Company Power Quality Policy (March 15, 2018).

### **Purpose**

This document sets forth Southern Company’s policy with respect to the issues of Harmonic Distortions, Voltage Fluctuations, and Voltage Imbalances (“Policy”). It is the goal of Southern Company and the Owners to provide a supply voltage to all Users that is within the limits referenced in this document. This Policy provides performance criteria to which all Users’ facilities must adhere, as well as procedures on how to monitor and verify performance.

## **Definitions**

For the purpose of this Policy, the following definitions and abbreviations apply:

### **Disturbing Load:**

Any load capable of producing Harmonic Distortion, Flicker or other voltage disturbance that could have an adverse effect on the ESS.

### **Electric Supply System (ESS):**

All lines, switchgear, and transformers of the Southern Company Transmission system and distribution systems.

### **Flicker:**

A change in electric light source intensity due to fluctuations of the input voltage. For purposes of this Policy, the definition of Flicker, lamp Flicker, and voltage Flicker shall be considered equivalent.

### **Flicker Emission Limit:**

The 95<sup>th</sup> percentile  $P_{st}$  and  $P_{lt}$  Flicker quantity values that a User shall not exceed based on a measurement period of one (1) week or of sufficient duration to characterize the Disturbing Load as determined by the Owner at the PCC or equivalent.

### **Fundamental Frequency:**

The fundamental frequency is sixty (60) cycles per second (Hz).

### **Harmonic Distortion:**

The deviation of the AC voltage and/or current from the fundamental frequency sinusoidal waveform(s).

### **Harmonics and Individual Harmonics:**

A sinusoidal component of a periodic wave or quantity having a frequency that is an integer multiple of the fundamental frequency.

### **Individual Harmonic Distortion (IHD):**

The individual harmonic component expressed as a percentage of the fundamental frequency component.

### **Interharmonics:**

A sinusoidal component of a periodic wave or quantity having a frequency that is a non-integer multiple of the fundamental frequency.

### **Inverter-based Resource (IBR):**

Any source of electric power that is connected to the Owner's system via power electronic interface, and that consists of one or more IBR unit(s) capable of exporting active power from a primary energy source or energy storage system to the Owner's system.

## *Southern Company Power Quality Policy*

### **Line Voltage Notch:**

The sub-cycle dip in the System voltage due to the high rates of change in User load current caused by the momentary short circuit of the AC lines during a commutation interval of a converter.

### **Maximum Voltage Deviation ( $\Delta V_{\max}/V$ ):**

The maximum Voltage Fluctuation allowed on the System, at the PCC, as a result of a User's individual and combined Disturbing Load(s).

### **Normal System Configuration:**

Conditions under which the System is configured and operated the majority of the time.

### **Owner:**

The operating company (Alabama Power Company, Georgia Power Company, or Mississippi Power Company) of Southern Company that owns the ESS from which the User is served.

### **Point of Common Coupling (PCC):**

The electrical point on the Owner's System closest to the User under consideration from which another User is or could be connected. It is the location where adherence with this Policy is determined. The Owner will define this point for a User. The delineation of facility ownership does not necessarily define the PCC. This term is applicable for loads.

### **Point of Interconnection (POI):**

The electrical point where the interconnection system connects an inverter-based resource (IBR) to the electric supply system (ESS). It is the location where adherence with this Policy is determined.

### **P<sub>st</sub>:**

The short-term evaluation of Flicker severity is given by P<sub>st</sub> and is based on a ten (10)-minute time interval.

### **P<sub>lt</sub>:**

The long-term evaluation of Flicker severity is given by P<sub>lt</sub>; a calculation based upon twelve (12) consecutive P<sub>st</sub> values.

$$P_{lt} = \sqrt[3]{\frac{\sum_{i=1}^{12} P_{st_i}^3}{12}}$$

### **Rapid Voltage Change (RVC):**

A quick transition in *rms* voltage occurring between two steady-state conditions.

## ***Southern Company Power Quality Policy***

### **Rated Generator Current:**

Current supplied by the generator at rated voltage and rated volt-amperes (VA).

### **Rated Load Current ( $I_L$ ):**

The maximum demand steady-state load current (fundamental frequency component) at the PCC as determined under normal load operating conditions.

### **Resonance:**

A condition where the inductance and capacitance of the System results in either a high impedance (parallel resonance) or a low impedance (series resonance) to the flow of current. Resonance conditions can result in excessive voltage distortion and/or an increase in current flow at a particular frequency.

### **Root Mean Square (rms):**

The Root Mean Square value of a sinusoidal voltage or current waveform is the square root of the mean value of the square of the voltage or current waveform during a complete cycle.

### **Short Circuit Current ( $I_{sc}$ ):**

The Short Circuit Current available at a given System location. For this Policy, the Short Circuit Current will be the maximum three phase short circuit available at the PCC under normal System operating conditions and/or under contingency conditions as determined by the Owner.

### **Steady State Load Current:**

The average of the maximum *rms* current, including Harmonics, over the demand intervals that represent the User's load profile the majority of the time, as determined by the Owner.

### **Steady State Voltage (V):**

The value of the RMS voltage that is normally within the nominal voltage ranges as specified by American National Standards Institute, ANSI C84.1-2020

NOTE: For RVC detection and evaluation the steady state voltage is reduced in duration to be a one second average value of RMS voltage in which none of the 1 cycle RMS voltage values exceeds the RVC limit.

### **Study:**

Evaluation by Owner of power quality impact in a proposed new User facility, in a proposed modification to existing User facility equipment or operations, or in operation of an existing User facility. The evaluation will model planned User operations, or will analyze existing User operational data, and their effect on the System in terms of power quality.

## *Southern Company Power Quality Policy*

### **System:**

The electrical facilities and associated equipment of the generation, transmission, and distribution systems of the ESS.

### **System Contingency:**

A condition in which the System is operated in a non-typical configuration for a period of time due to reasons such as normal maintenance, storm restorations, equipment failure, etc.

### **Total Demand Distortion (TDD):**

The ratio of the root mean square of the harmonic content, considering harmonic components up to the 50<sup>th</sup> order and specifically excluding interharmonics, expressed as a percent of the maximum demand current,  $i_L$ . Harmonic components of order greater than 50 may be included when deemed necessary by Owner(s). This index is applicable for loads.

$$\% TDD = \frac{\sqrt{\sum_{k=2}^N i_k^2}}{i_L} \times 100\%$$

where  $N$  is the highest order harmonic that is considered in the calculation.

### **Total Rated Harmonic Distortion (TRHD):**

The ratio of the root mean square of the harmonic content, considering harmonic components up to the 50<sup>th</sup> order and specifically excluding interharmonics, expressed as a percent of the IBR plant rated current capacity based on IBR plant MVA rating at the POI,  $i_R$ . Harmonic components of order greater than 50 may be included when deemed necessary by Owner(s). This index is applicable for IBRs.

$$\% TRHD = \frac{\sqrt{\sum_{k=2}^N i_k^2}}{i_R} \times 100\%$$

where  $N$  is the highest order harmonic that is considered in the calculation.

### **Total Harmonic Distortion (THD):**

The voltage Total Harmonic Distortion as defined by

$$\% THD = \frac{\sqrt{\sum_{i=2}^N v_i^2}}{v_1} \times 100\%$$

where  $N$  is the highest order harmonic that is considered in the calculation.

## *Southern Company Power Quality Policy*

**User:**

Any customer, distributor, wholesaler, retailer, generator (small or large), broker, etc. (not including the Owners) who receives power through or injects power into the ESS.

**Voltage Flicker:**

See Flicker.

**Voltage Fluctuation:**

A series of voltage changes or a cyclic variation of the voltage envelope.

**Voltage Imbalance:**

The ratio of the negative sequence voltage to the positive sequence voltage, usually expressed as a percentage [8].

$$\text{Voltage Imbalance} = 100\% \frac{V_{neg}}{V_{pos}}$$

Also, this term can be defined as the maximum deviation from the average phase Steady State Voltage (line-to-line) expressed as a percentage of average phase Steady State Voltage [1].

$$\text{Voltage Imbalance} = 100\% \frac{\text{maximum deviation from average}}{\text{average voltage}}$$

$$\text{Average Voltage} = \frac{V_{ab} + V_{bc} + V_{ca}}{3}$$

## **I. Harmonics**

### **Introduction**

Many electrical devices can generate harmonic currents, and consequently, affect the voltage of the ESS. These Harmonics should be managed and mitigated because of the potential they have to cause problems such as telecommunication interference, increased network losses, increased thermal heating in transformers and rotating machinery, mis-operation of protective relays and User equipment, and resonant overvoltages.

### **General**

Control of Harmonics is the joint responsibility of the User and the Owner as per IEEE 519 – 2022[3]. In order to properly manage ESS Harmonics, the User must communicate to the Owner any change, addition, and/or expansion proposed, or made to an existing User's facility.

Voltage distortion is generally caused by harmonic currents flowing through the System impedance. This Policy places responsibility for the limits of Total Harmonic Distortion and voltage Individual Harmonic Distortion levels upon both the Owner and the User. This Policy places responsibility for the limits of Total Demand Distortion and current Individual Harmonic Distortion upon the User. It is the responsibility of the User to ensure the User's facility operates in adherence with this Policy.

Considerable effort should be spent, and a Study conducted, if appropriate, in the planning and design phase of User and Owner facilities to limit the level of voltage and current harmonics. In any event, unique problems can arise after the User facility is in operation. To this end, the Owner may periodically verify ongoing adherence through the use of field measurements taken at the PCC, POI or other suitable location as determined by the Owner.

### **Measurement**

Unless specified otherwise by the Owner, measurements to evaluate adherence with this Policy will be taken at the PCC for loads and POI (Point of Interconnection) for IBRs. If measurements cannot be made at the PCC or POI they may be taken at the

## *Southern Company Power Quality Policy*

closest practical location. Voltage and current harmonic levels at the PCC or POI can be calculated from these measurements.

For purposes of assessing harmonic levels as provided in this Policy, instruments should comply with IEC 61000-4-7[4] and IEC 61000-4-30[5]. Circumstances may require alternate metering and analytical methods to properly capture the impact of some non-linear loads. A brief summary of some of the relevant portions of those IEC specifications include:

- The measurement window width should be 12 cycles (200 milliseconds).
- Very short time harmonics equate to 3 second intervals based upon an rms aggregate of 15 consecutive 12-cycle windows.
- Short time harmonics equate to 10-minute intervals based upon an rms aggregate of 200 consecutive very short time values.
- Daily 99<sup>th</sup> percentile values should be statistically obtained for very short time (3 sec) harmonics.
- Weekly 95<sup>th</sup> percentile values should be statistically obtained for short time (10 minute) harmonics.
- Weekly 99<sup>th</sup> percentile values should be statistically obtained for short time (10 minute) harmonics.

### **Harmonic Limits**

The current harmonic limits for load facilities are included in Tables I-1, I-2 and I-3 based on the rated system voltage at PCC:

<b>TABLE I-1: Harmonic Current Limits for Loads for Systems Rated 120 V –69 kV</b>						
	<b>Individual Harmonic Order</b>					
<b>I<sub>sc</sub> /I<sub>L</sub></b>	<b>h &lt; 11</b>	<b>11 ≤ h &lt; 17</b>	<b>17 ≤ h &lt; 23</b>	<b>23 ≤ h &lt; 35</b>	<b>35 ≤ h ≤ 50</b>	<b>TDD</b>
< 20	4.0	2.0	1.5	0.6	0.3	5.0
20 – 50	7.0	3.5	2.5	1.0	0.5	8.0
50 – 100	10.0	4.5	4.0	1.5	0.7	12.0
100 – 1000	12.0	5.5	5.0	2.0	1.0	15.0
> 1000	15.0	7.0	6.0	2.5	1.4	20.0

Table I-1 Notes:

- For  $h \leq 6$ , even harmonics are limited to 50% of the harmonic limits shown in the Table
- Limits are a percent of maximum demand current
- Current distortions that result in a dc offset are not allowed.

**Southern Company Power Quality Policy**

<b>TABLE I-2: Harmonic Current Limits for Loads for Systems Rated 69.001 kV –161 kV</b>						
	<b>Individual Harmonic Order</b>					
<b>I<sub>sc</sub> /I<sub>L</sub></b>	<b>h &lt; 11</b>	<b>11 ≤ h &lt; 17</b>	<b>17 ≤ h &lt; 23</b>	<b>23 ≤ h &lt; 35</b>	<b>35 ≤ h ≤ 50</b>	<b>TDD</b>
< 20	2.00	1.00	0.75	0.30	0.15	2.50
20 – 50	3.50	1.75	1.25	0.50	0.25	4.00
50 – 100	5.00	2.25	2.00	0.75	0.35	6.00
100 – 1000	6.00	2.75	2.50	1.00	0.50	7.50
> 1000	7.50	3.50	3.00	1.25	0.70	10.00

Table I-2 Notes:

- For  $h \leq 6$ , even harmonics are limited to 50% of the harmonic limits shown in the Table
- Limits are a percent of maximum demand current
- Current distortions that result in a dc offset are not allowed.

<b>TABLE I-3 Harmonic Current Limits for Loads for Systems Rated Greater than 161 kV</b>						
	<b>Individual Harmonic Order</b>					
<b>I<sub>sc</sub> /I<sub>L</sub></b>	<b>h &lt; 11</b>	<b>11 ≤ h &lt; 17</b>	<b>17 ≤ h &lt; 23</b>	<b>23 ≤ h &lt; 35</b>	<b>35 ≤ h ≤ 50</b>	<b>TDD</b>
≤25*	1.0	0.5	0.38	0.15	0.1	1.5
25 < 50	2.00	1.00	0.75	0.30	0.15	2.5
≥50	3.00	1.50	1.15	0.45	0.22	3.75

Table I-3 Notes:

- For  $h \leq 6$ , even harmonics are limited to 50% of the harmonic limits shown in the Table
- Limits are a percent of maximum demand current
- Current distortions that result in a dc offset are not allowed.

Tables I-1, I-2, I-3 are applicable to six-pulse rectifiers and general distortion situations. When phase shift transformers or converters with pulse numbers ( $q$ ) higher than six are used, the limits for the characteristic harmonic orders are increased by a factor equal to  $\sqrt{\frac{q}{6}}$ . In order for the limits to be increased by the factor, a significant portion of the facility load would need to be comprised of the higher pulse order equipment. The Owner reserves the right to make that determination.

The current harmonic limits for facilities with inverter-based resources are included in the Tables I-4a and I-4b. These limits are adopted from IBR interconnection standards IEEE Std 1547-2018 [10] and IEEE Std 2800-2022 [11]. These current harmonic limits shall be applicable only if the ESS voltage harmonics prior to the IBR plant connection are below the limits specified in Table I-5.

*Southern Company Power Quality Policy*

<b>TABLE I-4a: Harmonic Current Limits for Inverter-based Resources</b>				
	<b>Individual Harmonic Order</b>			
<b>POI LL Voltage (kV)</b>	<b>h &lt; 11</b>	<b>11 ≤ h &lt; 17</b>	<b>17 ≤ h ≤ 50</b>	<b>Total Rated Harmonic Distortion (TRHD)</b>
< 69	4.0	2.0	1.5	5.0
69.001 – 161	2.0	1.0	1.0	2.5
> 161	1.5	1.0	1.0	2.0

<b>TABLE I-4b: Certain Even Harmonics Current Limits for Inverter-based Resources</b>		
<b>Certain Even harmonic Order</b>		
<b>h = 2</b>	<b>h=4</b>	<b>h=6</b>
1.0	2.0	3.0

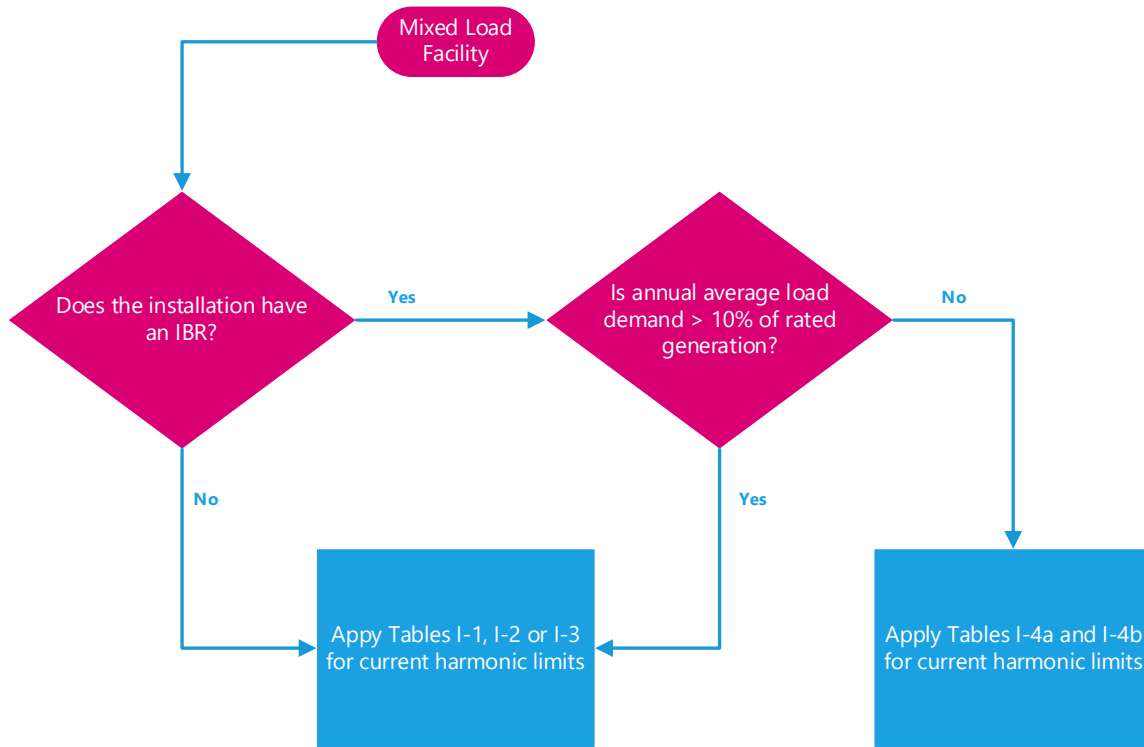
Tables I-4a and I-4b Notes:

- Limits are a percent of Rated Generator Current
- Current distortions that result in a dc offset are not allowed.
- Current distortion at the 2<sup>nd</sup>, 4<sup>th</sup> and 6<sup>th</sup> harmonics shall be lesser of the values specified in Table I-4a and Table I-4b

For facilities where there is a mix of both loads and inverter-based resources, the decision tree in Figure 1 needs to be used to decide which current harmonic limit tables shall apply at the PCC or POI.

*Southern Company Power Quality Policy*

**Figure 1 – Decision Tree for Applying Current Harmonic Limits at PCC or POI**



Harmonic voltage distortion limits at PCC or POI are provided in Table I-5.

<b>TABLE I-5: Harmonic Voltage Distortion Limits</b>		
<b>Bus Voltage at PCC</b>	<b>Individual Harmonic Voltage Distortion (%)</b>	<b>Total Voltage Distortion THD (%)</b>
≤ 1 kV	5.0	8.0
1.001 kV through 69 kV	3.0	5.0
69.001 kV through 161kV	1.5	2.5
161.001 kV and above	1.0	1.5
<ul style="list-style-type: none"> <li>• Limits are a percent of nominal fundamental frequency voltage line-to-neutral at the PCC or POI.</li> <li>• High voltage systems (greater than 161kV) can have up to 2.0% THD where the cause is an HVDC terminal that will attenuate by the time it is tapped for a User.</li> </ul>		

## *Southern Company Power Quality Policy*

<b>TABLE I-6: Distribution System Line Voltage Notch Limits</b>			
	<b>Special Applications*</b>	<b>General System</b>	<b>Dedicated System †</b>
Notch Depth	10%	20%	50%
THD (Voltage)	3%	5%	10%
Notch Area ( $A_N$ )‡	16,400	22,800	36,500

NOTE – The value of  $A_N$  for other than 480 V System should be multiplied by  $V / 480$

\*Special applications include hospitals and airports.

†A dedicated System is exclusively dedicated to the converter load.

‡In volt-microseconds at rated voltage and current.

### **Interharmonic Limits**

Interharmonic current and voltage components whose frequencies are not integer multiples of 60 Hz shall be limited so as to not produce undesirable effects on the System and connected equipment. Limiting values and appropriate statistical indices will be developed on a case-by-case basis by the Owner considering the specifics of the System.

### **Application of Harmonic Limits**

The following stipulations apply regarding proper application of Tables I-1, I-2, I-3, I-4a and I-4b:

- Daily 99<sup>th</sup> percentile very short time (3 sec) harmonic currents should be less than 2.0 times the values given in the tables.
- Weekly 99<sup>th</sup> percentile short time (10 min) harmonic currents should be less than 1.5 times the values given in the tables.  
Weekly 95<sup>th</sup> percentile short time (10 min) harmonic currents should be less than the values given in the tables.
- The values refer to harmonic currents whose frequencies are integer multiples of 60 Hz.

The following stipulations apply regarding Table I-5:

- Daily 99<sup>th</sup> percentile very short time (3 sec) harmonic values should be less than 1.5 times the values given in the table.
- Weekly 95<sup>th</sup> percentile short time (10 min) harmonic values should be less than the values given in the table.
- All values should be in percent of line-to-neutral 60 Hz voltage as measured at the PCC or POI.
- The values refer to harmonic voltages whose frequencies are integer multiples of 60 Hz.

## *Southern Company Power Quality Policy*

Special requirements may be necessary between the User and the Owner to address abnormal configurations that may be possible due to either ESS contingency situations or unusual circumstances regarding the operation of a User's equipment.

### **Resonance**

When shunt capacitors are used, resonant conditions can occur that may result in high levels of harmonic voltage and current distortion. This is primarily a concern only when the resonant condition is accompanied by a harmonic current of the same frequency. In some cases, resonance can cause a PCC or POI to no longer adhere to this Policy. This problem can manifest itself as a violation of either the current limits or voltage limits. Resonance conditions will need to be evaluated on a case-by-case basis by the Owner considering the specifics of the System.

## **II. Voltage Fluctuations**

### **Introduction**

It is the goal of Southern Company to provide to all Users a power supply System that meets or exceeds electric utility standards with regards to fluctuations in supply voltage. This Policy is based on IEEE Standard 1453-2022[2].

### **General**

This Policy establishes limits on the amount of voltage fluctuations that any one User can cause on the ESS. Sources of voltage fluctuations include but are not limited to:

- Motor operations (starting, jogging, extreme load variations)
- Shunt capacitor or harmonic filter switching
- Transformer energizations
- Processes involving an electrical arc
- Welding operations

The severity of voltage fluctuations caused by these sources can be evaluated in terms of flicker limits identified as  $P_{st}$ ,  $P_{lt}$ , and Rapid Voltage Changes (RVCs) limits in terms of Maximum Voltage Deviation ( $\Delta V_{max}/V$ ). In most cases, the System can supply a large number of Users without having adverse effects; however, in some situations special provisions may be necessary between a User and the Owner.

A  $P_{st95\%}$  value of 1.0 is defined as the Compatibility Level at which objectionable light Flicker can occur in a low voltage (LV) System. The Flicker Planning Levels described in Table II-1 establish System design levels of allowable Voltage Flicker created by the combination of all fluctuating loads that will still ensure compatibility with LV Systems. The Flicker Planning Levels of Table II-1 represent the cumulative effect of all Users served by the ESS, and are not Flicker Emission Limits for any individual User.

## Southern Company Power Quality Policy

<b>Table II-1: System Design Flicker Planning Level</b>		
<b>Flicker Quantity</b>	Flicker Planning Level ( $P_{st95}$ )	
	$\leq 35$ kV	$> 35$ kV
<b>Pst</b>	0.9	0.8
<b>Plt</b>	0.7	0.6

The Minimum Flicker emission limits provided in Table II-2 apply to all Users unless specified otherwise in writing by the Owner. The Owner will determine whether these limits may be exceeded under special circumstances, so long as no other User is adversely impacted. IEEE Std. 1453-2022[2] will be used to establish individual Flicker emission limits.

<b>Table II-2: Voltage Flicker Emission Limit</b>			
<b>Flicker Quantity</b>	Operational Flicker Limit (Based on 95 <sup>th</sup> percentile)		
	$V \leq 1$ kV	$1$ kV $< V \leq 35$ kV	$V > 35$ kV
<b>Pst</b>	0.6	0.4	0.35
<b>Plt</b>	0.5	0.3	0.25

To reduce overall voltage fluctuation impact to the System, considerable effort should be spent, and a Study conducted, if appropriate, in the planning and design phase of User and Owner facilities, and during the equipment installation phase. In any event, many unique problems can arise after the facility and equipment are in operation. Therefore, the Owner may periodically verify ongoing adherence through the use of field measurements taken at the PCC, POI or other suitable location as determined by the Owner. User installations must satisfy the Flicker emission limits agreed to by the Owner and the User.

When voltage fluctuations are created by rapid changes in voltage (e.g., motor starting, transformer energization or capacitor switching), it is more appropriate to use Maximum Voltage Deviation as opposed to  $P_{st}$ . The System Design Planning Level for Users that create RVCs are provided in Table II-3. Again, the values in Table II-3 represent the cumulative limits for all Users served by the ESS, and are not RVC Emission Limits for any individual User.

**Southern Company Power Quality Policy**

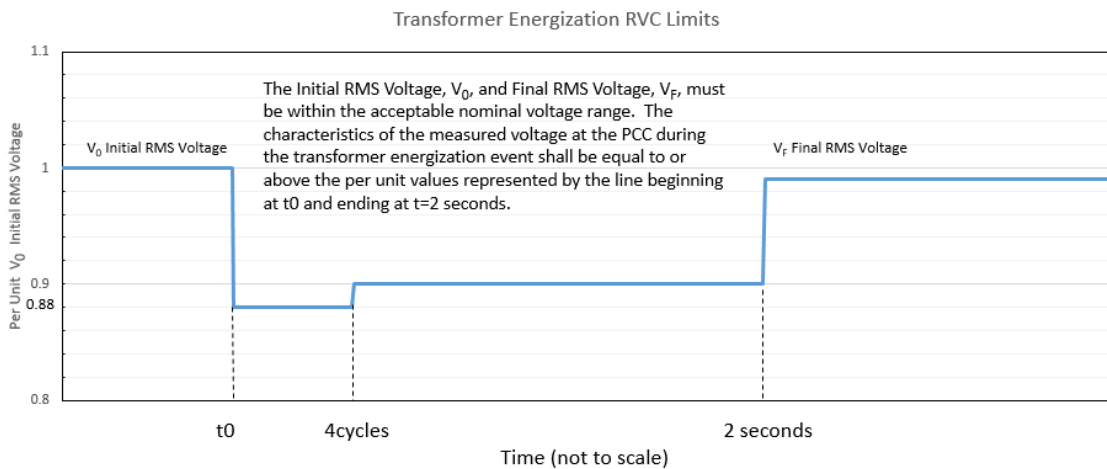
<b>Table II-3: System Design Planning Level for RVCs</b>		
<b>Number of Changes N</b>	<b>(<math>\Delta V_{max}/V</math>) %</b>	
	$\leq 35kV$	$> 35kV$
$n \leq 4$ per day	5-6	3-5
$n \leq 2$ per hour and $> 4$ per day	4	3
$2 < n \leq 10$ per hour	3	2.5

When the number of voltage changes falls outside the ranges specified in Table II-3 (e.g., more than 10 motors starting within an hour), it is more appropriate to use  $P_{st}$  to determine Flicker severity.

Note that the limits in Table II-3 should not be applied for infrequent transformer energization events due to commissioning, fault restoration, or maintenance typically not planned for more than once per year [9]. For such infrequent transformer energization events, Figure 2 illustrates the allowable RVC limit characteristics, which include:

- The minimum voltage resulting from the transformer energization, as measured at the PCC or POI, shall be no less than 0.88 x the initial voltage.
- After 4 cycles, the minimum voltage shall be no less than 0.9 x the initial voltage.
- The initial and final RMS voltage at the PCC or POI associated with a transformer energization event should be within the Owner’s contractual and/or regulatory required service voltage limits.

**Figure 2 – Minimum Acceptable Voltage due to Infrequent Transformer Energization**



**NOTE :** Transformer energization events in which the  $\Delta V_{max}/V$  change exceeds 4% shall be limited to 6 events in 24 hours and to no more than 2 events in any hour.

## *Southern Company Power Quality Policy*

### **Measurement**

Unless specified otherwise by the Owner, measurements to evaluate adherence with this Policy will be performed at the PCC or POI, using an IEC 61000-4-15 [7] compliant flickermeter. If it is not practical to obtain measurements at the PCC or POI, they may be taken at the closest available location and the corresponding Flicker emission at the PCC or POI will then be calculated from those measurements. The monitoring period will be of sufficient duration to characterize the variable nature of the User's load profile, which, for Flicker evaluations will generally be at least one week.

## **III. Voltage Imbalance**

### **Introduction**

Voltage Imbalance can cause excessive stator currents in polyphase induction machines. These excessive currents can potentially cause motor performance degradation and permanent damage. This Policy references ANSI C84.1-2020[1] and ANSI/NEMA MG 1 -2011[6].

### **General**

The limit described in this Policy establishes a System limit for Voltage Imbalance before it is of sufficient level to cause problems with polyphase induction machines. Considerable effort should be spent, and a Study conducted, if appropriate, in the planning and design phase of service to an individual User with imbalanced loads.

The design and operation of the ESS are such that the maximum Voltage Imbalance is 3%, as recommended by ANSI C84.1 [1]. The imbalanced loads of any single User should not cause the phase voltages to differ by more than 1%. The Owner may verify adherence through the use of field measurements taken at the PCC, POI or equivalent location as determined by the Owner.

### **Measurement**

Unless specified otherwise by the Owner, measurements to evaluate adherence with this Policy will be performed at the PCC or POI. If measurements are not practical at the PCC or POI, they may be taken at the closest available location and Voltage Imbalance values at the PCC or POI will then be calculated from those measurements. The monitoring period will be of sufficient duration to characterize the variable nature of the User's load profile.

The preferred measurement method is the ratio of negative sequence voltage to positive sequence voltage. An alternate method that may be used is the maximum

## *Southern Company Power Quality Policy*

deviation from the average phase Steady State Voltage (line-to-line), expressed as a percentage of average phase Steady State Voltage. Circumstances also may require other alternate metering and analytical methods to properly capture the imbalance.

### **IV. Adherence and Enforcement**

#### **Adherence**

The Owner is responsible for evaluating adherence with this Policy as it applies to Users served from its ESS. A User that is not adhering with this Policy will potentially create service issues for the User, other Users, and/or the ESS. These service issues include, but are not limited to: equipment damage, process disruption, communication issues, excessive voltage distortion on the ESS, or service complaints from other Users.

As discussed in the applicable section of this Policy, the evaluation of a User's adherence with this Policy will be performed, as deemed appropriate, by the Owner. For planned facilities, or planned modifications to existing facilities or operations, the Study will model the interaction of the anticipated operations with the System. For existing User facilities and operations, measured data, taken at the User's PCC, POI, or other suitable location, will be the basis for determining adherence with this Policy. The data collected will be over time periods deemed necessary to characterize the impact of the User on the ESS.

#### **Probationary Period**

If Study results (whether for planned facilities or actual operations) produce inconclusive results regarding the need for mitigation equipment or mitigation measures, the User may be allowed a probationary period at the Owner's sole discretion. The probationary period is not to exceed a period of time as determined by the Owner, during which field measurements can be made to evaluate adherence or during which alternate mitigation methods can be evaluated. If the probationary results show that the User is not adhering to this Policy, the Owner may proceed as provided below in *Enforcement*.

#### **Enforcement**

If Study results for planned facilities indicate that the potential User will not be in adherence with this Policy, the User will be required to engineer, design, and install necessary mitigation equipment, at the User's expense, prior to interconnecting to the ESS.

If Study results, or results of probationary operations, indicate that an existing User is not adhering with this Policy, the Owner will notify the User in writing. The Owner will specify a reasonable date for Policy adherence, which may be based on the severity and impact to other Users and/or the ESS or on availability of necessary mitigation equipment.

## *Southern Company Power Quality Policy*

The Owner may require temporary corrections or mitigation efforts, until permanent corrections can be made to achieve Policy adherence. Temporary mitigation could be a reduction in operating levels, eliminating the operation of certain equipment, or discontinuation of service consistent with policies of any applicable state or federal regulatory agency.

If a User does not achieve adherence with a permanent solution within a reasonable period of time as determined by the Owner, the Owner may determine and implement necessary mitigation corrections including, but not limited to, discontinuation of service consistent with policies of any applicable state or federal regulatory agency. If the User refuses to make appropriate corrections or mitigation efforts and the Owner must install equipment to mitigate the User's Disturbing Load, the User will be responsible for reimbursing the Owner.

## **V. References**

1. **ANSI C84.1-2020** *American National Standard for Electric Power Systems and Equipment -Voltage Ratings (60Hz) (Current edition)*
2. **IEEE 1453-2022** *IEEE Standard for Measurement and Limits of Voltage Fluctuations and Associated Light Flicker on AC Power Systems*
3. **IEEE 519-2022** *IEEE Standard for Harmonic Control in Electric Power Systems.*
4. **IEC 61000-4-7:2019** *Electromagnetic compatibility (EMC) –Part 4-7: Testing and measurement techniques – General guide on Harmonics and Interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*
5. **IEC 61000-4-30:2025** *Electromagnetic compatibility (EMC) - Part 4-30: Testing and measurement techniques - Power quality measurement methods*
6. **ANSI/NEMA MG 1-2011** *American National Standard Motors and Generators*
7. **IEC 61000-4-15:2019** *Electromagnetic compatibility (EMC)—Part 4-15: Testing and measurement techniques—Flickermeter—Functional and design specifications*
8. **IEC 61000-3-13:2013** *Electromagnetic compatibility (EMC)—Part 3-13: Limits – Assessment of emission limits for the connection of unbalanced installations to MV, HV and EHV power systems*
9. **National Grid GC0076 2015** *Grid Code Limits on rapid Voltage Changes, Stage 03: Report to the Authority*
10. **IEEE Std 1547-2018** *IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces*
11. **IEEE Std 2800-2022** *IEEE Standard for Interconnection and Interoperability of Inverter Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems*