June 4, 2019

IEEE PES Switchgear Committee Position Paper Against the Increasing of Maximum Voltage Levels in ANSI C84.1

The members of the IEEE Power and Energy Society (PES) Switchgear Committee are providing this letter to voice concern regarding a proposed revision to ANSI C84.1 "Standard for Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)". The proposed revision involves raising the upper limit of the voltage range tables by an extra 5%. The proposed change would allow the maximum operating voltage to be 10% above the nominal voltage levels. There are numerous equipment and operational consequences to increasing the upper limit of the voltage ranges. These consequences must be evaluated before allowing any increase on voltage range. The consequences of this change are most significant for the huge installed base of electrical equipment that was not designed to operate with the new limit. Some of the areas of concern are listed below:

1. **Insulation systems**—For products in the installed base, the maximum voltage is based on the historic value of 5% above nominal. The insulation systems and capabilities of electrical products are tested based on maximum voltage ratings. The ANSI C84.1 proposal appears to assume that another 5% increase would not be a problem. While some of the products involved are designed with margin to withstand some period at voltages above their maximum voltage rating, they may not be designed to withstand the overvoltage on a continuous basis, as the design margin may be intended to allow for aging over the installed life of the apparatus. Additionally, over time the insulation of electrical/electronic equipment degrades so there is the concern of accelerated aging and premature breakdown of the insulation in this equipment.

2. **Short-circuit ratings**—Circuit breakers, switches, and other switching/protective devices are tested for short-circuit interrupting capability at the present maximum voltage. There has been no investigation into the effects on short-circuit interrupting ratings of switching devices at a 5%

higher maximum voltage. Changing the maximum voltage in the ANSI C84.1 table removes correlation between ANSI C84.1 and the tested and published short-circuit interrupting capability of the switching device. Increasing the value in the ANSI C84.1 table may cause the user of the switching device to erroneously believe the device is rated higher than currently tested/specified.

3. **Transient recovery voltage (TRV)** —A higher maximum voltage will increase the TRV of a circuit compared to TRV expected for the present maximum voltages. This increase of maximum voltage rating and the corresponding increase in TRV can potentially affect insulation systems, transformers, and interrupting capability of switching and protective devices.

4. **Surge Arresters**— Users may be required to use surge arresters with a higher voltage rating. The increase in arrester voltage rating may mitigate the effects of the higher allowed maximum voltage, but the higher voltage rated arresters will provide reduced transient overvoltage protection for the equipment.

5. **Ancillary devices**— Electrical equipment within the scope of IEEE PES Switchgear Committee (switchgear, reclosers, and circuit breakers) relies on proper functioning of ancillary devices including but not limited to control relays, protective relays, and motors. There have been no long-term studies of the effects of higher voltages on these ancillary devices.

6. **Fuses**—Fuse standards do not include demonstration of capabilities of fuses at voltages higher than their rated maximum voltage, and fuses may not operate properly when applied at these higher voltages. Current-limiting fuses are designed to specific voltages due to the nature of the interruption mechanism. The additional 5% voltage range will cause a decrease in performance of all current-limiting fuses, and may cause some fuse ratings to no longer be permissible for use in certain applications. Expulsion fuses are very sensitive to TRV, and a 5% increase in peak voltage can cause issues with all existing designs.

7. **Power transformers and Shunt Reactors**—Transformer cores are rated for a maximum of 5% over nominal voltage at rated kVA and may be subject to failure if exposed to prolonged overvoltage conditions beyond their ratings. Oversizing these types of equipment for 110% of nominal voltage will likely result in larger components, which will not fit within the space constraints of existing unit substations. Continued use of existing transformers and shunt reactors may affect the long-term reliability as well as increase the operating losses and hydrogen gas generation.

8. **Capacitors**— Application of capacitors at higher than their maximum rated voltage would need to be reviewed. Capacitors applied at voltages higher than their maximum rated voltage may fail prematurely.

9. **Corona and Radio Influence Voltage (RIV)**— For products rated above 100 kV corona and RIV test levels are based on a factor of 110% of the line to ground value of the rated maximum voltage. Increasing maximum voltages above the values currently defined by industry standards could result in the need to retest and possible modification of existing designs, as well as increasing the potential for undesirable corona and/or RIV noise on existing systems.

10. **Operator safety/incident energy**—There is great concern that altering the applied voltage, as described, will raise the incident energy of an internal arcing fault enough to change the Hazard Risk Category for the equipment and increase the PPE requirements. Provisions and safeguards defined in IEEE C2, National Electrical Safety Code (NESC), may also be significantly affected.

The above list is only a partial compilation of concerns created by increasing the maximum voltage to 110% of nominal voltage in industrial control and utility applications. Beyond what has been discussed here, the potential effects are even more significant on residential circuits, and consumer electrical and electronic devices must be investigated.

Electrical equipment is rated and tested in accordance with long-established maximum voltage ratings. We do not feel that any change to the maximum voltage levels listed in ANSI C84.1 should be made without first holistically addressing the types of concerns described above.

It is the opinion of the IEEE PES Switchgear Committee that the increase of maximum voltage levels is premature at this time and requires significantly more investigation and planning for the unintended consequences possible outside the scope of ANSI C84.1.

The members of the IEEE PES Switchgear Committee voted and approved this position statement.

Respectfully,

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