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Inventor(s)	Sapp; Dennis Wayne et al.

Voltage Transformer Disconnect Switch For Utility Metering Sections Of A Medium Voltage Switchgear

Abstract

A voltage transformer switch assembly (VTSA) including a voltage transformer disconnect switch (VTDS) for a utility metering section of a medium voltage switchgear, is provided. The VTDS includes one switch blade for each phase of a voltage transformer switch input bus. Upper and lower clips allow a tight connection to the switch blades for connecting the VTDS to a main bus or a ground bus. A switch handle operates the VTDS via a drive system. An upper fuse clip bus is connected to the VTDS in a connected ON position using braided copper elements or fuse clips. The fuse clips installed on upper and lower fuse clip buses allow a convenient installation of fuses of a voltage transformer. The VTSA is adapted for a low current rating and multiple voltage ratings. The VTSA is disposed in an enclosure that meets multiple electrical enclosure requirements and that withstands stringent rain tests.

Inventors: **Sapp; Dennis Wayne (Manteca, CA), Kulkarni; Ashok (Fremont, CA), Gonzalez; Jose (Stockton, CA)**

Applicant: **IEM NEW SUB 2, LLC** (Fremont, CA)

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Background/Summary

BACKGROUND

[0001] A utility metering section of a medium voltage switchgear typically comprises current transformers and voltage transformers for customer metering and meter sockets for installing a power meter. Based on the operating voltage, the utility metering section of the medium voltage switchgear is often divided into multiple medium voltage switchgear classes. The medium voltage switchgear is divided, for example, into 5-kilovolt (kV), 15 kV, 27 kV, and 38 kV voltage classes. To optimize cost, most manufacturers combine 5 kV and 15 kV voltage classes into one design, thereby rendering three medium voltage switchgear designs: 5/15 kV, 27 kV, and 38 kV.

[0002] Conventional load interrupter switches available at 5 kilovolts (kV), 15 kV, 27 kV, and 38 kV voltage have higher current ratings, for example, 150 amperes (150 A), 300 amperes (300 A), 600 amperes (600 A), and 1200 amperes (1200 A). In utility metering sections of switchgears, a voltage transformer requires a disconnect switch for safety reasons and for maintenance. The disconnect switch does not need a high current rating. A disconnect switch that is rated, for example, about 20 amperes (20 A), would be more than sufficient for a voltage transformer disconnection application. Furthermore, the disconnect switch does not have to be a load break switch since the disconnect switch is only opened when the power is turned off. Consequently, there is a need for a low-cost switch that is optimized as a voltage transformer disconnect switch at a low current rating; that can be fabricated easily for supply chain reasons; and that meets dimensional and safety requirements of electric utilities.

[0003] A large number of electric utilities are members of the Electric Utility Service Equipment Requirements Committee (EUSERC). The EUSERC promotes uniform electric service requirements among member utilities, publishes existing utility service requirements for electric service equipment, and provides direction for the development of future metering technology. Furthermore, the EUSERC supports the development of safe and cost-effective metering and service equipment for member utilities, and establishes manufacturing and installation requirements for the metering and service equipment that is acceptable to all member utilities. Underwriters Laboratories (UL) is an associate member of the EUSERC and testing requirements are considered when developing EUSERC utility metering section requirements. A number of utilities that are not members of the EUSERC may have minor requirements that may be slightly different from the EUSERC requirements. A utility metering section of the medium voltage switchgear needs to meet predefined utility requirements, for example, the EUSERC requirements, without affecting the design of the voltage transformer switch. For example, the design of the voltage transformer disconnect switch must meet the following design features: [0004] 1. Size and spacings: The voltage transformer disconnect switch at various operating voltages must withstand both dielectric and lightning impulse voltages that depend on the operating voltage. The following table summarizes the required withstand voltages. Basic insulation level (BIL) in the following table refers to a level of insulation that can withstand a lightning impulse with a peak voltage that depends on the voltage class of the voltage transformer disconnect switch as shown in the table below. The dielectric test voltage at a power frequency of, for example, about 60 Hertz (Hz), also depends on the voltage class and is applied for one minute in a typical design and production test to ensure there is no breakdown of insulation. When designs for 5 kV and 15 kV voltage classes are combined into a single product, the combined design must meet the requirements for a 15 kV voltage class.

TABLE-US-00001 Lightning Impulse Dielectric Voltage Voltage or Withstand Class, kV BIL, peak kV Voltage, kV 5 60 19 15 95 36 27 125 60 38 150 80 [0005] 2. Current ratings: Typical medium voltage load interrupter switches are rated 300 amperes (A), 600 A, and 1200 A. There is a need for a low-cost, easy-to-manufacture, and optimized voltage transformer disconnect switch that carries a low current, and is not required to open when energized, thereby requiring a low current rating. [0006] 3. Enclosure test requirements: The voltage transformer disconnect switch is required to meet Underwriters Laboratories (UL) safety requirements for mechanical and environmental factors. The voltage transformer disconnect switch must pass UL rain tests and UL mechanical and electrical safety tests. [0007] 4. Mechanical endurance: The voltage transformer disconnect switch must be able to operate 500 cycles continuously without failure in conjunction with safety interlocks to meet UL safety requirements. [0008] 5. The voltage transformer disconnect switch must meet specific requirements of utilities. Typically, most utilities follow the Electric Utility Service Equipment Requirements Committee (EUSERC) guidelines for a utility switch. There is a need for a voltage transformer disconnect switch that follows the EUSERC guidelines and accommodates minor changes, for example, enclosure dimensional changes, number of current transformers connected therewithin such as three (3) current transformers instead of two (2) current transformers, etc., required by other utilities that are not members of the EUSERC. [0009] 6. Basic switch design: Since the basic insulation level (BIL) and dielectric test voltages are different, the clearance and creepage distances required are also different. Therefore, sizes of the enclosures for different voltage classes are also different. A 38 kV voltage transformer disconnect switch is much larger than a 15 kV voltage transformer disconnect switch or a 27 kV voltage transformer disconnect switch. Consequently, an enclosure for a 15 kV voltage transformer disconnect switch is the smallest of the enclosures of the three voltage transformer disconnect switch designs.

[0010] The enclosures for the voltage transformer disconnect switches are typically classified into the following three different categories depending on their use. [0011] 1. Category A: Category A is the most stringent category. Category A enclosures are intended to provide a degree of protection against contact with enclosed equipment in ground-level installations that are subject to deliberate unauthorized acts by members of the unsupervised general public. Category A utility metering switch enclosures must meet stringent Institute of Electrical and Electronics Engineers (IEEE)/National Electrical Manufacturers Association (NEMA) 3R test requirements. In addition to a stringent rain test that simulates rain driven by 30 miles per hour (mph) wind at the rate of 0.2 inch per minute per vertical surface for 5 minutes, mechanical tests for the enclosure and door handles must be met for category A enclosures. For safety, an outer door or a lockable barrier must protect all viewing windows. Furthermore, an electrical rod entry test needs to be performed to ensure that a 0.5-inch or 13-millimeter (mm) diameter rod inserted through any opening in the enclosure does not touch any live parts inside the voltage transformer disconnect switch enclosure. [0012] 2. Category B: Category B enclosures are intended for use in installations that are not subject to deliberate unauthorized acts by members of the unsupervised general public, primarily to provide a degree of protection to unauthorized and untrained personnel against accidental contact with enclosed equipment. [0013] 3. Category C: Category C enclosures provide a degree of protection against contact with enclosed equipment in secured installations intended to be accessible only by authorized persons.

[0014] Furthermore, there are many challenges in preventing entry of rain into an enclosure of a large and wide utility metering section of a medium voltage switchgear, especially in the rear of the utility metering section. The large and wide utility metering section typically requires two rear doors and there are difficulties in preventing rain from seeping between the two rear doors and coming in contact with live parts in the enclosure. Water that leaks in may touch a ground bus at the bottom in the rear of the enclosure. American National Standards Institute (ANSI)/the Institute of Electrical and Electronics Engineers (IEEE) rain tests typically simulate wind gusts of 30 miles per hour (mph) at the enclosure and require three jets, each at 60 per square inch (psi), spraying water on each side of the enclosure at three different heights.

[0015] Hence, there is a long-felt need for a voltage transformer disconnect switch assembly comprising a low-cost, easy-to-manufacture, voltage transformer disconnect switch with a low current rating and housed in an enclosure that meets the above-disclosed requirements and design safety tests for utility metering sections of a medium voltage switchgear.

SUMMARY OF THE INVENTION

[0016] This summary is provided to introduce a selection of concepts in a simplified form that are further disclosed in the detailed description of the invention. This summary is not intended to determine the scope of the claimed subject matter. The terms “first” and “second” are used herein for descriptive purposes only and are not to be construed to indicate or imply relative importance.

[0017] The system disclosed herein addresses the above-recited need for a voltage transformer disconnect switch assembly comprising a low-cost, easy-to-manufacture, voltage transformer disconnect switch with a low current rating and housed in an enclosure that meets the above-disclosed requirements and design safety tests for utility metering sections of a medium voltage switchgear. The voltage transformer disconnect switch is a low-cost switch that is optimized at a low current rating of, for example, about 20 amperes, which covers all switch ratings; that is fabricated easily for supply chain reasons; and that meets dimensional and safety requirements of electric utilities. In an embodiment, a utility metering section of the medium voltage switchgear is configured as a utility metering cabinet comprising a voltage transformer switch compartment, a fuse compartment, and a current transformer and cable compartment. In an embodiment, the voltage transformer switch compartment is disposed in a front, upper location of the utility metering section; the fuse compartment is disposed in a front, bottom location of the utility metering section; and the current transformer and cable compartment is disposed in a rear location of the utility metering section. The voltage transformer switch compartment is configured to house the voltage transformer disconnect switch of the voltage transformer switch assembly disclosed herein. The fuse compartment is configured to accommodate a voltage transformer and input fuses of the voltage transformer. The current transformer and cable compartment is configured to house current transformers and a main bus. The main bus is a multi-phase, main medium voltage bus.

[0018] The voltage transformer switch compartment, the fuse compartment, and the current transformer and cable compartment are arranged to meet predefined utility requirements comprising, for example, Electric Utility Service Equipment Requirements Committee (EUSERC) requirements for the utility metering section of the medium voltage switchgear. The voltage transformer switch assembly is disposed in an enclosure configured to meet predefined electrical enclosure requirements comprising, for example, National Electrical Manufacturers Association (NEMA) 3R requirements and the American National Standards Institute (ANSI)/the Institute of Electrical and Electronics Engineers (IEEE) Category A requirements. The voltage transformer switch assembly is adapted for a substantially low current rating of, for example, about 20 amperes (A), and multiple voltage ratings comprising, for example, 5 kilovolts (kV), 15 kV, 27 kV, and 38 kV.

[0019] The voltage transformer switch assembly disclosed herein comprises a voltage transformer disconnect switch, multiple clips, and a switch handle assembly. The voltage transformer disconnect switch is housed in the voltage transformer switch compartment of the utility metering section of the medium voltage switchgear. The voltage transformer disconnect switch comprises multiple switch blades, one for each phase of a voltage transformer switch input bus. The voltage transformer switch input bus is a multi-phase, medium voltage bus. The switch blades are mounted between insulators in the voltage transformer switch compartment. In an embodiment, the voltage transformer switch assembly further comprises pin members, for example, spring pins, configured to snap into place and secure the insulators to the switch blades sandwiched therebetween in the voltage transformer switch compartment. In an embodiment, the voltage transformer switch assembly with a 38 kV voltage transformer disconnect switch further comprises support clamps bolted between the insulators. The support clamps are configured to support the insulators within the voltage transformer switch assembly. In an embodiment, the support clamps comprise U-shaped openings configured to accommodate and support the insulators. The switch blades are connected to a ground bus to ground the voltage transformer disconnect switch for safety during maintenance and service. Upper parts of the switch blades are configured to connect to: (a) the voltage transformer switch input bus that connects a voltage transformer to the main bus of the utility metering section via cables; or (b) the ground bus for safety.

[0020] The clips of the voltage transformer switch assembly are configured to connect the voltage transformer disconnect switch to the main bus via the voltage transformer switch input bus by insulated cables or to the ground bus. The clips are configured for a tight connection to the switch blades, when the switch blades are engaged with the clips. The clips comprise upper main power clips and lower grounding clips. Upper parts of the switch blades are configured to engage with the upper main power clips for connections to the voltage transformer switch input bus, herein referred to as “input bus connections”. Furthermore, the upper parts of the switch blades are configured to engage with the lower grounding clips for connections to the ground bus, herein referred to as “ground bus connections”. In an embodiment, the voltage transformer switch assembly further comprises first fuse clips disposed in the fuse compartment of the utility metering section. In an embodiment, lower parts of the switch blades are configured to engage with the first fuse clips for lower bus connections in the fuse compartment. In an embodiment, the voltage transformer switch assembly further comprises second fuse clips installed on fuse clip buses disposed in the fuse compartment of the utility metering section. The fuse clip buses are configured to connect the voltage transformer disconnect switch to the second fuse clips. The second fuse clips are configured to connect the input fuses of the voltage transformer to the voltage transformer switch input bus. In an embodiment, the lower parts of the switch blades are connected to upper fuse clip buses in the fuse compartment using the first fuse clips. In another embodiment, the lower parts of the switch blades are connected to the upper fuse clip buses in the fuse compartment using braided copper elements, for example, braided copper wires or cables.

[0021] The switch handle assembly is operably connected to the voltage transformer disconnect switch via a drive system. The switch handle assembly comprises a switch handle configured to operate the voltage transformer disconnect switch. In an embodiment, the drive system is a chain drive comprising a chain wrapped around a first sprocket wheel and a second sprocket wheel. The first sprocket wheel is connected to the switch handle assembly, and the second sprocket wheel is operably connected to an end insulator to facilitate smooth motion of the voltage transformer disconnect switch and the switch handle. The second sprocket wheel is further operably connected to a fixed bracket and a moving bracket via a shaft configured to facilitate motion of the switch handle. The moving bracket is operably connected to the end insulator via an arm of the voltage transformer switch assembly. The arm is configured as a sheet metal bracket comprising grooves cut thereinto. The grooves of the arm are configured to restrict motion of the moving bracket, for example, to only about 90 degrees, via bushings moving within the grooves of the arm. In an embodiment, the arm and the moving bracket define an interface between the drive system and the voltage transformer disconnect switch to prevent the switch handle from operating, for example, more than about 180 degrees from a top position to a bottom position. The grooves of the arm are configured to transfer motion between the moving bracket and the voltage transformer disconnect switch. In an embodiment, the moving bracket is configured to move, for example, only about 90 degrees about the shaft to move the switch blades from a connected ON position to a grounded position.

[0022] In an embodiment, the voltage transformer switch assembly further comprises safety interlocking devices connected to the switch handle assembly and to a door of the fuse compartment of the utility metering section. The safety interlocking devices are configured to provide safety for opening and closing of the fuse compartment, ensuring that the voltage transformer disconnect switch is grounded before the fuse compartment is opened for maintenance.

[0023] In an embodiment, rails and mounting brackets are disposed at a bottom end of the fuse compartment of the utility metering section. The rails and the mounting brackets are configured to

mount the voltage transformer in the fuse compartment in accordance with predefined utility requirements, for example, Electric Utility Service Equipment Requirements Committee (EUSERC) requirements.
[0024] In an embodiment, the enclosure that houses the voltage transformer switch assembly is further configured to withstand predefined stringent rain tests comprising, for example, the Institute of Electrical and Electronics Engineers (IEEE) rain test, the American National Standards Institute (ANSI) rain test, etc., by using a rain shield assembly. In an embodiment, the rain shield assembly comprises a first shield and a second shield. The first shield is configured to prevent water from entering the enclosure from the top of the enclosure. The second shield is configured with a gasket to prevent water directed at the enclosure via wind gusts.
[0025] In one or more embodiments, related systems comprise circuitry for executing the methods disclosed herein. The circuitry is configured to execute the methods disclosed herein depending upon the design choices of a system designer. In an embodiment, various structural elements are employed depending on the design choices of the system designer.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0026] The foregoing summary, as well as the following detailed description of the invention, is better understood when read in conjunction with the appended drawings. For illustrating the embodiments herein, exemplary constructions of the embodiments are shown in the drawings. However, the embodiments herein are not limited to the specific structures and components disclosed herein. The description of a structure or a component referenced by a numeral in a drawing is applicable to the description of that structure or component shown by that same numeral in any subsequent drawing herein. The terms “front”, “rear”, “side”, “top”, “bottom”, “upper”, “lower”, “inner”, “outer”, etc., are based on an orientation or a positional relationship shown in the appended drawings, and are recited merely for describing the embodiments herein, rather than indicating or implying that the device, component, or structure referenced must have a particular orientation or position or must be constructed and operated in a particular orientation, and therefore should not be construed as limiting the embodiments herein.
[0027] FIG. **1**A illustrates a top perspective view of an embodiment of a 15-kilovolt (kV) voltage transformer disconnect switch.
[0028] FIG. **1**B illustrates a top plan view of the embodiment of the 15 kV voltage transformer disconnect switch shown in FIG. **1**A.
[0029] FIG. **1**C illustrates a front elevation view of the embodiment of the 15 kV voltage transformer disconnect switch shown in FIG. **1**A.
[0030] FIG. **1**D illustrates a perspective, exploded view of the embodiment of the 15 kV voltage transformer disconnect switch shown in FIG. **1**A.
[0031] FIG. **2** illustrates a side elevation view of an embodiment of a switch blade of the 15 kV voltage transformer disconnect switch shown in FIG. **1**A.
[0032] FIGS. **3**A-**3**C illustrate a left-side perspective view, a front elevation view, and a left-side elevation view, respectively, of an embodiment of a spring pin configured to secure insulators to switch blades of the 15 kV voltage transformer disconnect switch.
[0033] FIGS. **4**A-**4**B illustrate perspective views of opposing arms of the 15 kV voltage transformer disconnect switch.
[0034] FIG. **5**A illustrates a top perspective view of an embodiment of a voltage transformer switch assembly comprising the 15 kV voltage transformer disconnect switch shown in FIG. **1**A.
[0035] FIG. **5**B illustrates a front elevation view of the embodiment of the voltage transformer switch assembly shown in FIG. **5**A.

[0036] FIG. **5**C illustrates a top plan view of the embodiment of the voltage transformer switch assembly shown in FIG. **5**A.

[0037] FIG. **5**D illustrates a right-side elevation view of the embodiment of the voltage transformer switch assembly shown in FIG. **5**A.

[0038] FIGS. **6**A-**6**C illustrate a perspective view, a side elevation view, and a top plan view, respectively, of an embodiment of a clip configured to connect the 15 kV voltage transformer disconnect switch to a main bus via a voltage transformer switch input bus or to a ground bus.

[0039] FIG. **7**A illustrates a front elevation view of an embodiment of a 15 kV utility metering cabinet, showing front outer doors open and compartment doors closed.

[0040] FIG. **7**B illustrates a front perspective view of the embodiment of the 15 kV utility metering cabinet shown in FIG. **7**A, showing a voltage transformer switch compartment, a fuse compartment, and a switch handle assembly thereof with the compartment doors open.

[0041] FIG. **7**C illustrates a front elevation view of the embodiment of the 15 kV utility metering cabinet shown in FIG. **7**A, showing the voltage transformer switch compartment, the fuse compartment, and the switch handle assembly thereof.

[0042] FIG. **7**D illustrates a front elevation view of the embodiment of the 15 kV utility metering cabinet shown in FIG. **7**A, showing the 15 kV voltage transformer disconnect switch housed in the voltage transformer switch compartment.

[0043] FIG. **7**E illustrates a rear elevation view of the embodiment of the 15 kV utility metering cabinet shown in FIG. **7**A, showing a current transformer and cable compartment where riser buses are prepared for installing two current transformers.

[0044] FIG. **7**F illustrates a partial, rear perspective view of the embodiment of the 15 kV utility metering cabinet shown in FIG. **7**A, showing the riser buses prepared for installing three current transformers in the current transformer and cable compartment.

[0045] FIG. **7**G illustrates a partial, rear perspective, cutaway view of the embodiment of the 15 kV utility metering cabinet shown in FIG. **7**A, showing the main bus at the top of an enclosure of the 15 kV utility metering cabinet.

[0046] FIG. **7**H illustrates a partial, right-side perspective, cutaway view of the embodiment of the 15 kV utility metering cabinet shown in FIG. **7**A, showing the switch handle assembly operably connected to the 15 kV voltage transformer disconnect switch via a drive system.

[0047] FIGS. **7**I-**7**L illustrate partial, cutaway, perspective views of the drive system in the voltage transformer switch assembly of the embodiment of the 15 kV utility metering cabinet shown in FIG. **7**A.

[0048] FIGS. **8**A-**8**B illustrate embodiments of safety interlocking devices connected to the switch handle assembly and a door of the fuse compartment of the embodiment of the 15 kV utility metering cabinet shown in FIGS. **7**A-**7**B.

[0049] FIG. **9**A illustrates a front elevation view of the 15 kV voltage transformer disconnect switch, showing the switch blades in a connected ON position.

[0050] FIG. **9**B illustrates a perspective view showing switch blades of the 15 kV voltage transformer disconnect switch in a grounded position, where upper parts of the switch blades are connected to lower grounding clips.

[0051] FIG. **9**C illustrates a perspective view showing a switch blade of the 15 kV voltage transformer disconnect switch in a grounded position, where a lower part of the switch blade is connected to a fuse clip.

[0052] FIG. **10** illustrates a perspective view of the fuse compartment of the 15 kV utility metering cabinet shown in FIG. **7**B, showing fuse clips, rails, and mounting brackets for a voltage transformer.

[0053] FIGS. **11**A-**11**B illustrate perspective views of an embodiment of the 15 kV voltage transformer disconnect switch, showing switch blades mounted between alternative insulators in a grounded position and a connected ON position, respectively.

[0054] FIGS. **11**C-**11**D illustrate perspective views showing a lower part of the switch blade of the 15 kV voltage transformer disconnect switch connected to an upper fuse clip bus in the fuse compartment using a braided copper element.
[0055] FIG. **12** illustrates a top perspective view of an embodiment of a 27-kilovolt (kV) voltage transformer disconnect switch.
[0056] FIG. **13**A illustrates a top plan view of an embodiment of a voltage transformer switch assembly comprising the 27 kV voltage transformer disconnect switch shown in FIG. **12**.
[0057] FIG. **13**B illustrates a front elevation view of the embodiment of the voltage transformer switch assembly shown in FIG. **13**A.
[0058] FIG. **13**C illustrates a right-side elevation view of the embodiment of the voltage transformer switch assembly shown in FIG. **13**A.
[0059] FIG. **14** illustrates a side elevation view of an embodiment of a switch blade of the 27 kV voltage transformer disconnect switch shown in FIG. **12**.
[0060] FIGS. **15**A-**15**C illustrate a left-side perspective view, a front elevation view, and a left-side elevation view, respectively, of an embodiment of a spring pin configured to secure insulators to switch blades of the 27 kV voltage transformer disconnect switch and a 38 kV voltage transformer disconnect switch.
[0061] FIGS. **16**A-**16**B illustrate perspective views of opposing arms of the 27 kV voltage transformer disconnect switch.
[0062] FIG. **17**A illustrates a front elevation view of an embodiment of a 27 kV utility metering cabinet, showing front outer doors closed.
[0063] FIG. **17**B illustrates a front elevation view of the embodiment of the 27 kV utility metering cabinet shown in FIG. **17**A, showing open front outer doors, a closed door of a fuse compartment, and the 27 kV voltage transformer disconnect switch with switch blades in a grounded position in a voltage transformer switch compartment.
[0064] FIG. **17**C illustrates a front elevation view of the embodiment of the 27 kV utility metering cabinet shown in FIG. **17**A, showing the fuse compartment and the 27 kV voltage transformer disconnect switch with the switch blades in an intermediate position in the voltage transformer switch compartment.
[0065] FIG. **17**D illustrates an enlarged view of the voltage transformer switch compartment, showing the 27 kV voltage transformer disconnect switch with the switch blades in the intermediate position.
[0066] FIG. **17**E illustrates an enlarged view of the voltage transformer switch compartment, showing the 27 kV voltage transformer disconnect switch with the switch blades in the connected ON position.
[0067] FIG. **17**F illustrates a front elevation view of the fuse compartment of the 27 kV utility metering cabinet shown in FIGS. **17**A-**17**C.
[0068] FIG. **17**G illustrates a rear perspective view of the embodiment of the 27 kV utility metering cabinet shown in FIG. **17**A, showing rear outer doors closed.
[0069] FIG. **17**H illustrates a partial, rear perspective view of the embodiment of the 27 kV utility metering cabinet shown in FIG. **17**A, showing a riser bus disposed in a current transformer and cable compartment.
[0070] FIG. **17**I illustrates a partial, rear perspective view of the embodiment of the 27 kV utility metering cabinet shown in FIG. **17**A, showing voltage transformer cable connections to the riser bus in the current transformer and cable compartment.
[0071] FIG. **17**J illustrates a perspective, partial view of the current transformer and cable compartment, showing cable connections to a main, multi-phase cross bus via a riser bus.
[0072] FIG. **18**A illustrates a top perspective view of an embodiment of a 38-kilovolt (kV) voltage transformer disconnect switch.
[0073] FIG. **18**B illustrates a top plan view of the embodiment of the 38 kV voltage transformer

disconnect switch shown in FIG. **18**A.

[0074] FIG. **18**C illustrates a front elevation view of the embodiment of the 38 kV voltage transformer disconnect switch shown in FIG. **18**A.

[0075] FIG. **18**D illustrates a right-side elevation view of the embodiment of the 38 kV voltage transformer disconnect switch shown in FIG. **18**A.

[0076] FIG. **19** illustrates a side elevation view of an embodiment of a switch blade of the 38 kV voltage transformer disconnect switch shown in FIG. **18**A.

[0077] FIGS. **20**A-**20**B illustrate perspective views of opposing arms of the 38 kV voltage transformer disconnect switch.

[0078] FIGS. **21**A-**21**C illustrate a perspective view, a side elevation view, and a top plan view, respectively, of an embodiment of a clip configured to connect the 38 kV voltage transformer disconnect switch to a main bus via a voltage transformer switch input bus or to a ground bus.

[0079] FIGS. **22**A-**22**C illustrate enlarged, perspective views of support clamps configured to support the insulators within the 38 kV voltage transformer disconnect switch.

[0080] FIG. **23**A illustrates a front perspective view of an embodiment of a 38 kV utility metering cabinet, showing front outer doors closed.

[0081] FIG. **23**B illustrates a front perspective view of the embodiment of the 38 kV utility metering cabinet shown in FIG. **23**A, showing open doors of a voltage transformer switch compartment and a fuse compartment.

[0082] FIG. **23**C illustrates a rear perspective view of the embodiment of the 38 kV utility metering cabinet, showing rear outer doors closed.

[0083] FIG. **23**D illustrates a front perspective view of the embodiment of the 38 kV utility metering cabinet, showing the switch blades of the 38 kV voltage transformer disconnect switch in the connected ON position in the voltage transformer switch compartment.

[0084] FIG. **23**E illustrates a partial, front perspective view of a fuse compartment of the 38 kV utility metering cabinet shown in FIG. **23**A.

[0085] FIG. **23**F illustrates a partial, rear perspective view of the 38 kV utility metering cabinet shown in FIG. **23**A, showing a phase current transformer and cable bus and a ground bus in a current transformer and cable compartment.

[0086] FIG. **23**G illustrates a partial, right-side perspective view of the 38 kV utility metering cabinet shown in FIG. **23**A, showing a direct connection of a voltage transformer switch input bus to a main bus.

[0087] FIG. **24**A illustrates a rear, side perspective view of the 38 kV utility metering cabinet shown in FIG. **23**A, showing a rain shield assembly configured to prevent water from entering the 38 kV utility metering cabinet.

[0088] FIG. **24**B illustrates an enlarged view of a portion marked A in FIG. **24**A, showing the rain shield assembly.

[0089] FIG. **25** illustrates a schematic showing an arrangement of nozzles for performing stringent rain tests on an enclosure of the utility metering cabinet of the medium voltage switchgear.

DETAILED DESCRIPTION OF THE INVENTION

[0090] Disclosed herein is a voltage transformer switch assembly for a utility metering section of a medium voltage switchgear. In an embodiment, the medium voltage switchgear is a medium voltage, metal-enclosed switchgear. The voltage transformer switch assembly is adapted for a substantially low current rating of, for example, about 20 amperes (20 A). Furthermore, the voltage transformer switch assembly is adapted for multiple voltage ratings comprising, for example, 5 kilovolts (kV), 15 kilovolts, 27 kilovolts, and 38 kilovolts by adjusting length of insulators and insulation components in the voltage transformer switch assembly. The voltage transformer switch assembly comprises a voltage transformer disconnect switch housed in a voltage transformer switch compartment of the utility metering section of the medium voltage switchgear. In an embodiment, the utility metering section of the medium voltage switchgear is configured as a utility metering cabinet, for example, a medium voltage, metal-enclosed utility metering cabinet, comprising the voltage transformer switch compartment, a fuse compartment, and a current transformer and cable compartment as disclosed in the descriptions of FIGS. **7**A-**7**G, FIGS. **17**A-**17**J, and FIGS. **23**A-**23**G. Since the 15 kV, 27 kV, and 38 kV voltage transformer disconnect switches require different phase-to-phase clearance and creepage distances, the design of each voltage transformer disconnect switch is configured to accommodate electrical safety distances required.

[0091] FIG. **1**A illustrates a top perspective view of an embodiment of a 15-kilovolt (kV) voltage transformer disconnect switch **100**. The voltage transformer disconnect switch **100** comprises multiple switch blades **101**, for example, three switch blades **101**, one for each phase of a voltage transformer switch input bus **510**, as illustrated in FIG. **1**A and FIGS. **5**A-**5**B. The voltage transformer switch input bus **510** is a multi-phase, medium voltage bus comprising three input buses **510***a*, **510***b*, and **510***c* as illustrated in FIGS. **5**A-**5**B. The switch blades **101** are made, for example, of ¼-inch thick aluminum. FIG. **1**B and FIG. **1**C illustrate a top plan view and a front elevation view, respectively, of the embodiment of the 15 kV voltage transformer disconnect switch **100** shown in FIG. **1**A. The switch blades **101** are disposed in a space **109** defined by opposing channels **103** and **104** and opposing arms **105** and **106**. The opposing channels comprise a rear support channel **103** and a ground bus support channel **104**. In an example, the length of the rear support channel **103** is about 56.875 inches; the height of the rear support channel **103** is about 6.0625 inches; the width of the rear support channel **103** is about 2 inches; and the thickness of the rear support channel **103** is about 0.188 inches. A metal sheet with an overall length of about 56.875 inches and an overall width of about 9.375 inches is used to construct the rear support channel **103**. The ground bus support channel **104** is configured to support a ground bus **506** as illustrated in FIG. **5**A. In an example, the length of the ground bus support channel **104** is about 41 inches; the height of the ground bus support channel **104** is about 3.9375 inches; the width of the ground bus support channel **104** is about 1 inch; and the thickness of the ground bus support channel **104** is about 0.105 inches. A metal sheet with an overall length of about 41 inches and an overall width of about 5.5 inches is used to construct the ground bus support channel **104**. The channels **103** and **104** are configured to provide structural support to the voltage transformer disconnect switch **100**. Furthermore, the channels **103** and **104** and the arms **105** and **106** provide ground (GRD) planes in the voltage transformer switch assembly **500** illustrated in FIGS. **5**A-**5**D. The rear support channel **103** is made, for example, from a pickled and oiled (P&O) carbon steel sheet of 7 gauge (ga) size. The ground bus support channel **104** is made, for example, from a P&O carbon steel sheet of 12 ga size. In an embodiment, the channels **103** and **104** and the arms **105** and **106** are generally rectangular-shaped sheet metal pieces.

[0092] The switch blades **101** are mounted between insulators **102** in a voltage transformer switch compartment **707** of a 15 kV utility metering cabinet **700** illustrated in FIGS. **7**A-**7**D. In an embodiment, each of the switch blades **101** is configured as a generally L-shaped structure comprising an upper part **101***a* and a lower part **101***b*. The insulators **102** that sandwich the switch blades **101** provide sufficient electrical insulation by increasing the creepage distances between each phase to ground, and between phases to withstand peak lightning impulse voltages. The insulators **102** are made, for example, of glass polyester. FIGS. **1**A-**1**C also illustrate a sprocket wheel **110***a* of a chain drive **110** configured to drive a switch handle assembly **513** shown in FIG. **5**A, FIG. **5**D, and FIGS. **7**G-**7**K, which operates the voltage transformer disconnect switch **100**, for example, to one of two positions, namely, a connected ON position and a grounded position. The connected ON position is referred to as a closed position of the voltage transformer disconnect switch **100**. The grounded position is referred to as an open position of the voltage transformer disconnect switch **100**. In an embodiment, the arm **106** is configured as a sheet metal bracket comprising grooves **106***a* cut thereinto. The grooves **106***a* of the arm **106** are configured to restrict motion of a moving bracket **108**, and in turn, a switch handle **514** of the switch handle assembly

513 shown in FIG. **5**D and FIGS. **7**G-**7**K. One face of the sprocket wheel **110***a* is connected to the arm **106** via the movable bracket **108**, while the other face of the sprocket wheel **110***a* is connected to a fixed bracket **107** that extends substantially perpendicularly from the rear support channel **103**.

[0093] FIG. **1**D illustrates a perspective, exploded view of the embodiment of the 15 kV voltage transformer disconnect switch **100** shown in FIG. **1**A. As illustrated in FIG. **1**D, the voltage transformer disconnect switch **100** comprises three switch blades **101**, each sandwiched between a pair of insulators **102**. In an example, the switch blades **101** proximal to the arms **105** and **106** are each sandwiched between a 6-inch insulator **102***a* and an 8.75-inch insulator **102***b*, while the central switch blade **101** is sandwiched between two 8.75-inch insulators **102***b*. That is, the insulators **102***b* between phases are 8.75 inches long and the insulators **102***a* at the ends on each side connected to the frame of the 15 kV utility metering cabinet **700** illustrated in FIGS. **7**A-**7**D, are 6 inches long. That is, the distance between an outside A or C phase and the frame of the 15 kV voltage transformer disconnect switch **100**, that is, the phase-to-ground distance, is about 6 inches. The insulators **102** are made, for example, of flame-resistant, fiberglass-reinforced, thermoset polyester molding compounds. The insulators **102***b* are, for example, Glastic® standoff insulators. In another example, the 6-inch insulators **102***a* and the 8.75-inch insulators **102***b* are manufactured by H-J International, Inc.

[0094] Each of the switch blades **101** is connected to a corresponding pair of insulators **102** using pin members, for example, spring pins **112**. The spring pins **112** are configured to snap into place and secure the insulators **102** to the switch blades **101** sandwiched therebetween. To secure each switch blade **101** between two insulators **102**, holes **102***c* of the insulators **102** are first aligned with the holes **101***c* of each switch blade **101**. The spring pins **112** are inserted into the aligned holes **102***c* and **101***c*. The diameter of the spring pins **112** is slightly larger than the diameter of the holes **102***c* and **101***c*. The spring pins **112** are compressed when inserted into the aligned holes **102***c* and **101***c*. In an embodiment, each of the spring pins **112** comprises a longitudinal slot **112***a* as illustrated in FIGS. **3**A-**3**C. As the spring pins **112** are inserted into the aligned holes **102***c* and **101***c*, the slots **112***a* allow the spring pins **112** to expand slightly, which creates a snug fit within the aligned holes **102***c* and **101***c*. This expansion generates a radial force that holds the spring pins **112** in place and prevents the spring pins **112** from falling out. An interference fit between the spring pins **112** and the aligned holes **102***c* and **101***a* provides a form of retention, thereby securely connecting the switch blades **101** to the insulators **102**.

[0095] The arm **105** is configured as a sheet metal control bracket with a generally circular hole **105***a*. The generally circular hole **105***a* of the arm **105** is configured to receive a fastener, for example, a ½-inch bolt, to connect the 6-inch insulator **102***a* to the arm **105**. The sprocket wheel **110***a* of the chain drive **110** illustrated in FIG. **5**D and FIGS. **7**G-**7**K is operably connected to the fixed bracket **107** and the moveable bracket **108** via a shaft **113** illustrated in FIGS. **7**I-**7**L. In an example, the shaft **113** is a ½-inch bolt with flat and lock washers. Another fastener, for example, a ½-inch bolt **114** illustrated in FIG. **7**J and FIG. **7**L, connects the other end or side **108***a* of the moveable bracket **108** to the insulator **102** via a generally circular hole **106***b* disposed between the two slots or grooves **106***a* of the arm **106**. The shaft **113**, that is, the ½-inch bolt, allows the sprocket wheel **110***a* to rotate the insulator-switch-blade assembly. In an embodiment as illustrated in FIG. **1**D, the moveable bracket **108** is connected to the insulator **102** using fasteners, for example, four hollow, generally cylindrical bushings **111** and two ⅜″ bolts (not shown). The bushings **111** are configured to facilitate rotation of the switch blades **101**, in communication with the switch handle assembly **513** and the chain drive **110** disclosed in the descriptions of FIGS. **5**A-**5**D and FIGS. **7**G-**7**L. In an embodiment, two hollow, generally cylindrical bushings **111** are disposed in series for each groove **106***a* of the arm **106** to increase the length. In another embodiment, a single long bushing is used for connecting the moveable bracket **108** to the insulator **102***a*. The hollow, generally cylindrical bushings **111** move within the grooves **106***a* of the arm **106** to provide a smooth motion and to limit the motion of the insulator-switch-blade shaft to 90 degrees while a switch handle **514** of the switch handle assembly **513** shown in FIG. **5**D and FIGS. **7**G-**7**H moves from a top position to a bottom position or an equivalent of 180 degrees. In an example, the dimensions of the bushings **111** are about 0.50 inches×0.375 inches.

[0096] FIG. **2** illustrates a side elevation view of an embodiment of a switch blade **101** of the 15 kV voltage transformer disconnect switch **100** shown in FIG. **1**A. The switch blade **101** comprises an elongate upper part **101***a* and a wide lower part **101***b* as illustrated in FIG. **2**. In an example, the length of the switch blade **101** is about 16 inches; the thickness of the switch blade **101** is about 0.125 inches; the width of the upper part **101***a* of the switch blade **101** is about 2 inches; and the width of the lower part **101***b* of the switch blade **101** is about 5 inches. The switch blade **101** is made, for example, from an ¼-inch aluminum sheet.

[0097] FIGS. **3**A-**3**C illustrate a left-side perspective view, a front elevation view, and a left-side elevation view, respectively, of an embodiment of the spring pin **112** configured to secure the insulators **102** to the switch blades **101** of the 15 kV voltage transformer disconnect switch **100** shown in FIG. **1**A. In an embodiment, the spring pin **112** comprises a longitudinal slot **112***a* defined along a length of the spring pin **112**. In an example, the length of the spring pin **112** is about 1.5 inches, the diameter of the spring pin **112** is about 0.313 inches, and thickness of the spring pin **112** is about 0.062 inches. In an example, the diameter of the spring pin **112** is about 0.312 inches. The spring pin **112** snaps into place and secures the insulators **102** to the switch blades **101** sandwiched therebetween in the voltage transformer switch compartment **707** as disclosed in the description of FIG. **1**D. The spring pin **112** is made, for example, from steel. In an embodiment, the 15 kV voltage transformer disconnect switch **100** uses two spring pins **112** at each connection of the insulators **102** to the switch blade **101**.

[0098] FIGS. **4**A-**4**B illustrate perspective views of the opposing arms **105** and **106** of the 15 kV voltage transformer disconnect switch **100** shown in FIG. **1**A. The arm **105** is configured as a sheet metal control bracket with a generally circular hole **105***a* as illustrated in FIG. **4**A. The generally circular hole **105***a* is substantially centrally disposed on the arm **105**. In an embodiment, the 6-inch insulator **102***a* proximal to the arm **105** as illustrated in FIG. **1**D, is connected to the arm **105**, for example, using a ½-inch bolt inserted through the generally circular hole **105***a* of the arm **105**. In an example, the length of the arm **105** is about 21.5 inches; the height of the arm **105** is about 6 inches, and the width of the arm **105** is about 1.9375 inches. A metal sheet with an overall length of about 23.1875 inches and an overall width of about 9.375 inches is used to construct the arm **105**. The arm **106** is configured as a sheet metal control bracket with grooves **106***a* disposed around a generally circular hole **106***b* as illustrated in FIG. **4**B. In an embodiment, the 6-inch insulator **102***a* proximal to the arm **106** as illustrated in FIG. **1**D, is connected to the arm **106**, for example, using a ½-inch bolt **114** inserted through the generally circular hole **106***b* of the arm **106** as illustrated in FIG. **7**J and FIG. **7**L. In an example, the length of the arm **106** is about 21.3125 inches; the height of the arm **106** is about 6 inches, and the width of the arm **106** is about 1.9375 inches. A metal sheet with an overall length of about 23.1875 inches and an overall width of about 9.375 inches is used to construct the arm **106**. Each of the arms **105** and **106** is made, for example, from a pickled and oiled (P&O) carbon steel sheet of 12 gauge (ga) size.

[0099] FIG. **5**A illustrates a top perspective view of an embodiment of the voltage transformer switch assembly **500** comprising the 15 kV voltage transformer disconnect switch **100** shown in FIG. **1**A. The voltage transformer switch assembly **500** further comprises multiple clips **507** and **508** configured to connect the voltage transformer disconnect switch **100** to a main bus **519** illustrated in FIG. **7**G via a voltage transformer switch input bus **510**, or to a ground bus **506**. The main bus **519** is a multi-phase, main medium voltage bus disposed in a current transformer and cable compartment **710** of the utility metering cabinet **700** as illustrated in FIG. **7**G. The clips **507** and **508** are made, for example, of copper. The clips **507** and **508** are configured for a tight connection to the switch blades **101**, when the switch blades **101** are engaged with the clips **507** or **508**. The clips comprise upper main power clips **507** and lower grounding clips **508**. The upper parts **101***a* of the switch blades **101** are configured to connect to (a) the voltage transformer switch input bus **510** that connects a voltage transformer (not shown) to the main bus **519** of the utility metering cabinet **700** illustrated in FIGS. **7**A-**7**K via cables **520** illustrated in FIG. **11**A; or (b) the ground bus **506** for safety.

[0100] The ground bus **506** is attached to the ground bus support channel **104** of the voltage transformer disconnect switch **100**. As illustrated in FIG. **5**A, the switch blades **101** are connected to the ground bus **506** to ground the voltage transformer disconnect switch **100** for safety during maintenance and service. The upper parts **101***a* of the switch blades **101** are configured to engage with the upper main power clips **507** for input bus connections in the utility metering cabinet **700** and with the lower grounding clips **508** for ground bus connections in the utility metering cabinet **700**. As used herein, “input bus connections” refer to connections to the voltage transformer switch input bus **510**. Also, as used herein, “ground bus connections” refer to connections to the ground bus **506**. The input bus connections comprise connections to the voltage transformer switch input bus **510** and in turn, to the main bus **519** via a riser bus **518** illustrated in FIG. **7**G. That is, the voltage transformer switch input bus **510** is connected to the riser bus **518** using insulated cables **520**. The riser bus **518** is in turn connected to the main bus **519** as illustrated in FIG. **7**G. The upper main power clips **507** are connected to the voltage transformer switch input bus **510** which connects to the main bus **519** via the cables **520** connected to the rear riser bus **518**. The upper main power clips **507** connect the voltage transformer disconnect switch **100** to the main bus **519** via the voltage transformer switch input bus **510** using the insulated cables **520**. The ground bus connections comprise connections to the ground bus **506** attached to the ground bus support channel **104** of the voltage transformer disconnect switch **100**.

[0101] The voltage transformer switch assembly **500** further comprises fuse clips **509***a* as illustrated in FIGS. **5**A-**5**B and FIG. **5**D. FIGS. **5**B-**5**C illustrate a front elevation view and a top plan view, respectively, of the embodiment of the voltage transformer switch assembly **500** shown in FIG. **5**A. The fuse clips **509***a* are disposed in a fuse compartment **709** of the utility metering cabinet **700** illustrated in FIGS. **7**B-**7**D. In an embodiment, the lower parts **101***b* of the switch blades **101** are configured to engage with the fuse clips **509***a* as illustrated in FIGS. **5**A-**5**B, FIG. **5**D, FIG. **7**I, and FIG. **7**K, for lower bus connections in the fuse compartment **709**. The lower bus connections comprise connections to upper fuse clip buses **512** in the fuse compartment **709** as illustrated in FIG. **5**B and FIG. **5**D. The upper fuse clip buses **512** are connected to the voltage transformer disconnect switch **100** in the connected ON position via either braided copper elements, for example, braided copper wires **523** illustrated in FIG. **11**C-**11**D, or braided copper cables, or via the fuse clips **509***a*. Input fuses of a voltage transformer (not shown) are attached to fuse clips **509***b* that are installed on the fuse clip buses **512** and **516** illustrated in FIG. **5**B and FIG. **11**D, in the fuse compartment **709** by the utility. The voltage transformer is connected from the lower fuse clip buses **516** via short cables by the utility.

[0102] The voltage transformer switch assembly **500** further comprises a rear barrier **501**, an insulating barrier **502** disposed between the voltage transformer switch compartment **707** illustrated in FIGS. **7**A-**7**D and the fuse compartment **709**, a control cable bushing **503**, wall bushings **504** for the input cables **520**, phase barriers **505**, the voltage transformer switch input bus **510** comprising input buses **510***a*, **510***b*, and **510***c*, standoff insulators **511***a*, **511***b*, and **511***c*, and fuse clip buses **512** and **516** as illustrated in FIGS. **5**A-**5**B and FIG. **5**D. The rear barrier **501**, the insulating barrier **502** disposed between the voltage transformer switch compartment **707** and the fuse compartment **709**, and the phase barriers **505** are made, for example, of thermoset fiberglass-reinforced polyester insulating materials, for example, Glastic GPO-3 materials produced by the Glastic company. The rear barrier **501** is a Glastic insulator configured to provide improved insulation for lightning impulse voltages by enhancing the creepage distance between phase input cables **520** and the ground. The insulating barrier **502** separates and insulates the voltage transformer switch compartment **707** from the fuse compartment **709**. The control cable bushing **503** provides an opening for a conduit **524** used for conveying control cables of meters used in the utility metering cabinet **700** as illustrated in FIG. **11**B. The wall bushings **504** are disposed on the rear barrier **501**. The wall bushings **504** provide a controlled and insulated passage for electrical conductors, cables, and busbars to pass through the rear barrier **501**. The wall bushings **504** insulate the cables **520** that connect the voltage transformer switch input bus **510** to the main bus **519** via the riser bus **518** in the current transformer and cable compartment **710**. The wall bushings **504** are made, for example, of glass polyester or porcelain. The wall bushings **504** along with the rear barrier **501** also provide sufficient insulation to withstand peak lightning impulse voltages. Since the metal of an enclosure **701** of the utility metering cabinet **700** illustrated in FIGS. **7**A-**7**G is at ground voltage, the rear barrier **501** provides sufficient creepage distance from a phase voltage level of the cable connection to the ground.

[0103] The phase barriers **505** extend substantially perpendicularly to the rear barrier **501**. The phase barriers **505** are attached to the rear barrier **501** using fasteners, for example, L-shaped, angle bracket clamps **525**. In an embodiment, the phase barriers **505** comprise U-shaped cutouts or openings **505***a* configured to accommodate the insulators **102** as illustrated in FIG. **5**A and FIG. **7**K. The phase barriers **505** separate the input buses **510***a*, **510***b*, and **510***c* that connect to the main bus **519** via a cable connection from the voltage transformer switch input bus **510** to the riser bus **518** in the current transformer and cable compartment **710** and in turn to the main bus **519** at the top of the enclosure **701**. The phase barriers **505** serve as insulating barriers between the input buses **510***a*, **510***b*, and **510***c* and prevent electrical arcing or short circuits between adjacent phases within the voltage transformer switch assembly **500**. In addition, the phase barriers **505** provide additional insulation, both clearance or through air, and creepage, required to withstand peak lightning impulse voltages between phases. When the upper parts **101***a* of the switch blades **101** are engaged with the upper main power clips **507**, the input buses **510***a*, **510***b*, and **510***c* connect the switch blades **101** to the riser bus **518** in the current transformer and cable compartment **710** via the cables **520**, which connects the voltage transformer to the main bus **519** of the utility metering cabinet **700**.

[0104] The standoff insulators **511***a*, **511***b*, and **511***c* are provided for the voltage transformer switch input bus **510**, the upper fuse clip buses **512**, and the lower fuse clip buses **516**, respectively. The standoff insulators **511***a*, **511***b*, and **511***c* provide sufficient electrical insulation by increasing the creepage distances between each phase to ground, and between phases to withstand peak lightning impulse voltages. The fuse clip buses **512** and **516** are made, for example, of copper. The upper and lower fuse clip buses **512** and **516** provide a convenient method for a utility to insert suitable fuses in the fuse compartment **709** illustrated in FIG. **5**B and FIGS. **7**B-**7**D. That is, the fuse clips **509***b* installed in the upper and lower fuse clip buses **512** and **516** allow the utility to conveniently install suitable fuses in the fuse compartment **709**. The ground bus **506**, the voltage transformer switch input buses **510***a*, **510***b*, and **510***c*, and the upper and lower fuse clip buses **512** and **516** are made, for example, of copper. The ground bus **506** and the voltage transformer switch input buses **510***a*, **510***b*, and **510***c* are made, for example, of 2″×¼″ copper.

[0105] FIG. **5**D illustrates a right-side elevation view of the embodiment of the voltage transformer switch assembly **500** shown in FIG. **5**A. The voltage transformer switch assembly **500** further comprises a switch handle assembly **513** operably connected to the voltage transformer disconnect switch **100** via a drive system, for example, a chain drive **110**. The switch handle assembly **513** comprises a switch handle **514** configured to operate the voltage transformer disconnect switch **100**. In an embodiment, the switch handle assembly **513** is a standard, off-the-shelf, commercially available switch handle assembly that is used for load interrupter switches. The switch handle assembly **513** is, for example, the PowerCon® switch handle assembly A013-039. Alternative switch handle assemblies from other manufacturers, for example, Asea Brown Boveri (ABB) Ltd., can also be used. The chain drive **110** comprises a chain **110***b* wrapped around a first sprocket wheel **110***c* and a second sprocket wheel **110***a*. The first sprocket wheel **110***c* is connected to the switch handle assembly **513**. The second sprocket wheel **110***a* is operably connected to an end insulator **102***a* illustrated in FIG. **5**C and FIGS. **7**I-**7**K, to facilitate smooth motion of the voltage transformer disconnect switch **100** and the switch handle **514**. The second sprocket wheel **110***a* is further operably connected to the fixed bracket **107** and the moveable bracket **108** via the shaft **113**, for example, the ½-inch bolt with flat and lock washers, as disclosed in the description of FIG. **1**D. The shaft **113** is configured to facilitate motion of the switch handle **514**.

[0106] The moving bracket **108** is operably connected to the end insulator **102***a* via the arm **106** of the voltage transformer switch assembly **500**. The grooves **106***a* of the arm **106** illustrated in FIG. **1**D and FIG. **7**L, are configured to restrict motion of the moving bracket **108**, for example, to only about 90 degrees via the bushings **111** moving within the grooves **106***a* of the arm **106**. The arm **106** and the moving bracket **108** define an interface between the chain drive **110** and the voltage transformer disconnect switch **100** to prevent the switch handle **514** from operating, for example, more than about 180 degrees from a top position to a bottom position. The grooves **106***a* of the arm **106** are configured to transfer motion between the moving bracket **108** and the voltage transformer disconnect switch **100**. The hollow cylindrical bushings **111** illustrated in FIG. **1**D move within the grooves **106***a* to provide a smooth motion and to limit the motion of the moving bracket **108** to 90 degrees about the shaft **113**, while the switch handle **514** moves from the top position to the bottom position or moves an equivalent of 180 degrees. The moving bracket **108** moves, for example, only about 90 degrees about the shaft **113** to move the switch blades **101** from a connected ON position to a grounded position. In FIGS. **5**A-**5**D, the switch handle **514** is shown in a downward position, which renders the switch blades **101** of the voltage transformer disconnect switch **100** in the grounded position.

[0107] In an embodiment as illustrated in FIGS. **5**A-**5**D, the voltage transformer switch assembly **500** further comprises safety interlocking devices **515** and **517** connected to the switch handle assembly **513** and to a door **706** of the fuse compartment **709** of the utility metering cabinet **700** illustrated in FIGS. **7**A-**7**D, respectively. The safety interlocking devices **515** and **517** are, for example, KIRK® keys of Kirk Key Interlock Company, LLC. The safety interlocking devices **515** and **517** are configured to provide safety for opening and closing of the fuse compartment **709**, ensuring that the voltage transformer disconnect switch **100** is grounded before the fuse compartment **709** is opened for maintenance. The safety interlocking devices **515** and **517** execute key interlocking between the voltage transformer disconnect switch **100** and the door **706** of the fuse compartment **709** so that, for personal safety, the fuse compartment **709** cannot be entered until the following conditions are met: [0108] (a) the voltage transformer disconnect switch **100** is fully open and visibly grounded; (b) when the voltage transformer disconnect switch **100** is fully open, the switch blades **101** are grounded automatically; and (c) the voltage transformer disconnect switch **100** is locked open with the safety interlocking device **515**. The safety interlocking devices **515** and **517** prevent closing of the voltage transformer disconnect switch **100** without first closing and locking of the fuse compartment **709**. In an embodiment, the switch handle **514** of the switch handle assembly **513** is pad-lockable in the closed position. The door **706** of the fuse compartment **709**, when opened, provides unobstructed access to the voltage transformer and fuses. In an embodiment, the voltage transformer disconnect switch **100** has a minimum voltage rating equal to the supplied customer equipment.

[0109] FIGS. **6**A-**6**C illustrate a perspective view, a side elevation view, and a top plan view, respectively, of an embodiment of a clip **507**/**508** configured to connect the 15 kV voltage transformer disconnect switch **100** to the main bus **519** shown in FIG. **7**G via the voltage transformer switch input bus **510**, or to the ground bus **506** shown in FIG. **5**A. A pair of clips **507**/**508** of the type shown in FIGS. **6**A-**6**C, is attached back to back such that their curved upper ends **507***a*/**508***a* abut each other to allow a tight engagement with the switch blades **101** as illustrated in FIG. **5**A. Bases **507***b*/**508***b* of each clip **507**/**508** are attached to the voltage transformer switch input bus **510** or to the ground bus **506** as illustrated in FIG. **5**A, to allow a tight connection of the switch blades **101** to the upper main power clips **507** and the lower grounding clips **508**, when the switch blades **101** are engaged with the clips **507** or **508**. In an example, the length of each clip **507**/**508** is about 1.5 inches, the height of each clip **507**/**508** is about 2.875 inches, the width of the base **507***b*/**508***b* of each clip **507**/**508** is about 0.97 inches, and the thickness of each clip **507**/**508** is about 0.045 inches. The clip **507**/**508** is made, for example, from a beryllium sheet of 18 gauge (ga) size.

[0110] FIG. **7**A illustrates a front elevation view of an embodiment of a 15 kV utility metering cabinet **700**, showing front outer doors **702** and **703** open and compartment doors **704***a* and **706** closed. The utility metering cabinet **700** comprises an enclosure **701** configured to meet predefined electrical enclosure requirements comprising, for example, National Electrical Manufacturers Association (NEMA) 3R requirements and the American National Standards Institute (ANSI)/the Institute of Electrical and Electronics Engineers (IEEE) Category A requirements. For example, the enclosure **701** is designed for outdoor NEMA 3R and meets IEEE C37.20.3 Category A requirements. The voltage transformer switch assembly **500** comprising the voltage transformer disconnect switch **100** illustrated in FIGS. **1**A-**1**D and the switch handle assembly **513** with the switch handle **514** is disposed in an upper part of the enclosure **701** of the utility metering cabinet **700**, that is, in the voltage transformer switch compartment **707** of the enclosure **701**. In an embodiment, the outer doors **702** and **703** comprise gaskets (not shown) and louvers **702***a* and **703***a*. The louvers **702***a* and **703***a* comprise filters **702***b* and **703***b*, respectively, as illustrated in FIGS. **7**A-**7**B. The outer doors **702** and **703** are secured using latches, for example, **703***c*. The latches **703***c* are, for example, 3-point door latches and are secured at the top and bottom of the door **703** with a pair of rollers that secure the door **703** to a frame **701***a* of the enclosure **701**.

[0111] The voltage transformer switch compartment **707** comprises an outer door **704***a* and an inner door **704***b* as illustrated in FIG. **7**B. In an embodiment, the outer door **704***a* of the voltage transformer switch compartment **707** is hinged in two places to provide flexibility. The outer door **704***a* accommodates Underwriters Laboratories (UL)-recognized meter sockets **705***a* and spaces **705***b* for test switches (not shown). Utility meters (not shown) are plugged into the meter sockets **705***a* by a utility. A 5 kV utility metering cabinet is similar to the 15 kV utility metering cabinet **700**. In an embodiment, a 5 kV utility metering cabinet with the voltage transformer disconnect switch **100** is constructed identical to the 15 kV utility metering cabinet **700** with the voltage transformer disconnect switch **100**. The voltage transformer disconnect switch **100** is more compact and the width of the enclosure of the 5 kV utility metering cabinet is less than the width of the enclosure **701** of the 15 kV utility metering cabinet **700**. For example, the width of the 5 kV utility metering cabinet is about 48 inches, and the width of the 15 kV utility metering cabinet **700** is about 60 inches. In an example, the dimensions of the 5 kV utility metering cabinet with the voltage transformer disconnect switch **100** are 48″ W×48″ D×90″ H, and the dimensions of the 15 kV utility metering cabinet **700** with the voltage transformer disconnect switch **100** are 60″ W×48″ D×90″ H, where W denotes width, D denotes depth, and H denotes height. Shorter insulators are used for the voltage transformer disconnect switch **100** in the 5 kV utility metering cabinet and the switch blades **101** are identical for both the 5 kV and 15 kV voltage transformer disconnect switches. In an example, the basic insulation level (BIL) of the 5 kV/15 kV utility metering cabinet is about 95 kV; the dielectric voltage rating of the 5 kV/15 kV utility metering cabinet is about 36 kV; and the current ratings of the 5 kV/15 kV utility metering cabinet and the associated metal-enclosed switchgear are about 600 A, 1200 A, 2000 A, and 3000 A.

[0112] FIG. **7**B illustrates a front perspective view of the embodiment of the 15 kV utility metering cabinet **700** shown in FIG. **7**A, showing a voltage transformer switch compartment **707**, a fuse compartment **709**, and the switch handle assembly **513** thereof with the compartment doors **704***a* and **706** open. In an embodiment as illustrated in FIG. **7**B, the voltage transformer switch compartment **707** is disposed in a front, upper location of the utility metering cabinet **700**, and the fuse compartment **709** is disposed in a front, bottom location of the utility metering cabinet **700**.

The inner door **704***b* of the voltage transformer switch compartment **707** is, for example, a bolted sheet metal door with viewing windows or ports **708** configured to allow viewing of an open position or a closed position of the voltage transformer disconnect switch **100** illustrated in FIGS. **1**A-**1**D, ensuring safety of the utility metering cabinet **700** during maintenance. The viewing windows **708** allow an operator to view the position of the switch blades **101** and determine whether the switch blades **101** are in a connected ON position or in a grounded position. In an embodiment, a Lexan® barrier is fixed inside the inner door **704***b* of the voltage transformer switch compartment **707**. The Lexan® barrier provides additional safety for the voltage transformer disconnect switch **100**. In another embodiment, the inner door **704***b* is a Lexan® inner door configured to execute both a protection function as well as a viewing function. The Lexan® inner door is free of viewing windows and provides a full view of the voltage transformer disconnect switch **100** and the position of the switch blades **101** for operational safety.

[0113] The fuse compartment **709** is configured to accommodate a voltage transformer (not shown) and input fuses (not shown) of the voltage transformer. The fuse compartment **709** houses fuses for protection of the voltage transformer in front and the voltage transformer that is mounted at the bottom. The fuse compartment **709** contains fuses for the input of the voltage transformer. FIG. **7**C illustrates a front elevation view of the embodiment of the 15 kV utility metering cabinet **700** shown in FIG. **7**A, showing the voltage transformer switch compartment **707**, the fuse compartment **709**, and the switch handle assembly **513** thereof. Also illustrated in FIGS. **7**B-**7**C are fuse clips **509***b* configured to connect to input fuses of the voltage transformer and to connect the input fuses of the voltage transformer to the voltage transformer switch input bus **510**, and in turn, to the main bus **519**. The fuse clips **509***b* are installed on the upper and lower fuse clip buses **512** and **516** disposed in the fuse compartment **709** of the utility metering cabinet **700**. A utility connects the lower fuse clip bus **516** to the input of the voltage transformer using a cable (not shown) from the lower fuse clip bus **516**. The cable connects to a mechanical lug **526** disposed, for example, at the right side of the lower fuse clip bus **516** as illustrated in FIGS. **7**C-**7**D and FIG. **11**D.

[0114] FIG. **7**D illustrates a front elevation view of the embodiment of the 15 kV utility metering cabinet **700** shown in FIG. **7**A, showing the 15 kV voltage transformer disconnect switch **100** housed in the voltage transformer switch compartment **707**. FIG. **7**D illustrates the switch blades **101** of the voltage transformer disconnect switch **100** in a grounded position. In the grounded position, the switch handle **514** of the switch handle assembly **513** is in a downward position or a down position and the upper parts **101***a* of the switch blades **101** are engaged with the lower grounding clips **508** of the voltage transformer switch assembly **500** as shown in FIG. **5**A. The insulators **102** illustrated in FIG. **7**D are manufactured, for example, by H-J International, Inc.

[0115] FIG. **7**E illustrates a rear elevation view of the embodiment of the 15 kV utility metering cabinet **700** shown in FIG. **7**A, showing a current transformer and cable compartment **710** where a riser bus **518** comprising riser phase buses, namely, an A-phase bus **518***a*, a B-phase bus **518***b*, and a C-phase bus **518***c*, are prepared for installing two current transformers (not shown). FIG. **7**E also illustrates rear doors **716** and **717** of the 15 kV utility metering cabinet **700** in an open condition, providing access to the current transformer and cable compartment **710**. The riser buses **518***a*, **518***b*, and **518***c* connect to the main bus **519** at the top of the enclosure **701** illustrated in FIG. **7**G. The riser bus **518** is located in the rear current transformer and cable compartment **710**. The riser bus **518** has provisions for mounting two or three bar type current transformers and supports incoming cable connections. In an embodiment, there is a second riser bus that connects to the main bus **519** if the main bus **519** is in the middle of the rear current transformer and cable compartment **710**. The current transformer and cable compartment **710** is disposed in a rear location of the utility metering cabinet **700**. The current transformer and cable compartment **710** is configured to house the current transformers. The current transformer and cable compartment **710** houses the main bus **519** where the current transformers are connected. The main bus **519** is brought out for current transformer and cable connections in the rear location of the utility metering cabinet **700**. The main bus **519** is also connected to the voltage transformer disconnect switch **100** illustrated in FIGS. **1**A-**1**D, via cables **520** and the riser buses **518***a*, **518***b*, and **518***c* illustrated in FIG. **11**A and FIGS. **7**E-**7**G. The riser buses **518***a*, **518***b*, and **518***c* are, for example, copper (Cu) buses. In an example, the main bus sizes comprise: one 600 A copper bus of size ¼″×2″; one 1200 A copper bus of size ¼″×4″; two 2000 A copper buses, each of size ¼″×4″, or one 2000 A copper bus of size ⅜″×6″; and three 3000 A copper buses, each of size ¼″×4″, or two 3000 A copper buses, each of size ¼″×6″. The current transformer and cable compartment **710** contains cable connections at the bottom of the three bus bars, that is, the three riser buses **518***a*, **518***b*, and **518***c*. The current transformers are installed by a utility and hence are not supplied by a manufacturer of the medium voltage switchgear. The current transformers used by the utility are, for example, bar type current transformers. The utility mounts two current transformers, that is, phases A and C, to bridge the gaps in the phase buses A **518***a* and C **518***c* illustrated in FIG. **7**E.

[0116] FIG. **7**F illustrates a partial, rear perspective view of the embodiment of the 15 kV utility metering cabinet **700** shown in FIG. **7**A, showing the riser buses **518***a*, **518***b*, and **518***c* prepared for installing three current transformers (not shown) in the current transformer and cable compartment **710**. As some utilities may elect to use three current transformers instead of two current transformers, a link **518***d* of the B-phase bus **518***b* is removed to install a third current transformer (not shown) as illustrated in FIG. **7**F. In an example, a bar type current transformer is installed for B-phase, if needed, by supplying the utility metering cabinet **700** with a B-phase bus link **518***d* as illustrated in FIG. **7**E, that can be removed easily. The current transformers are mounted in the current transformer and cable compartment **710** in accordance with the Electric Utility Service Equipment Requirements Committee (EUSERC) mounting guidelines. The input connections to the voltage transformer disconnect switch **100** illustrated in FIGS. **1**A-**1**D, are cable connected using a high voltage cable with phases A, B, and C. Due to large distances through air between the phases, a lower voltage-rated cable, that is, a kV-rated cable is used for the input connections. For example, a 5 kV-rated cable is used for the 15 kV voltage transformer disconnect switch **100**, a 15 kV-rated cable is used for the 27 kV voltage transformer disconnect switch **1200** illustrated in FIG. **12**, and a 27 kV-rated cable is used for the 38 kV voltage transformer disconnect switch **1800** illustrated in FIGS. **18**A-**18**D. Furthermore, since the phase-to-phase and phase-to-ground distances for the cables **520** are large, in an embodiment, 600V AC-rated cables are used for the input connections. For example, a stiff 600V AC-rated cable with a polyvinyl chloride (PVC) insulation manufactured by Grayline, LLC, that is easy to route inside the enclosure **701** and maintain a proper distance between the phases is used to provide a reliable connection that saves cost. FIG. **11**A illustrates a 600V-rated cable **520***b* with a PVC insulation for the B-phase. The 600V-rated cable **520***b* is small in diameter. The 600V-rated cable **520***b* is stiff and easy to route inside a medium voltage utility metering cabinet. In an embodiment, a braided copper wire with no insulation is used for switch-to-fuse bus connections. These cable connections are basic insulated level (BIL) and dielectric safety tested by Underwriters Laboratories to ensure that there is no flash-over. The cables (not shown in FIG. **7**F) that connect the voltage transformer switch input bus **510** illustrated in FIG. **7**D to the riser buses **518***a*, **518***b*, and **518***c* illustrated in FIGS. **7**E-**7**F, are secured to Glastic supports **521** with cable ties. The Glastic supports **521** maintain a suitable distance between phase cables. Also illustrated in FIG. **7**F are ground studs **711** with insulating covers **712** configured to facilitate equipment grounding before performing service or maintenance of the current transformer and cable compartment **710** as disclosed in the description of FIG. **9**B.

[0117] The voltage transformer switch compartment **707**, the fuse compartment **709**, and the current transformer and cable compartment **710** illustrated in FIGS. **7**B-**7**F, are arranged to meet predefined utility requirements comprising, for example, Electric Utility Service Equipment Requirements Committee (EUSERC) requirements for the utility metering cabinet **700** of the medium voltage switchgear. The voltage transformer disconnect switch **100** illustrated in FIGS.

1A-**1**D follows the EUSERC guidelines and accommodates minor changes, for example, enclosure dimensional changes, number of current transformers connected therewithin such as three (3) current transformers instead of two (2) current transformers, etc., required by utilities that are not members of the EUSERC.

[0118] FIG. **7**G illustrates a partial, rear perspective, cutaway view of the embodiment of the 15 kV utility metering cabinet **700** shown in FIG. **7**A, showing the main bus **519** at the top of the enclosure **701** of the 15 kV utility metering cabinet **700**. The riser buses **518***a*, **518***b*, and **518***c* disposed in the current transformer and cable compartment **710** connect to the main bus **519** at the top of the enclosure **701**. Three upper main power clips **507** illustrated in FIG. **5**A connect the voltage transformer disconnect switch **100** to the main bus **519** via the 3-phase riser buses **518***a*, **518***b*, and **518***c* as follows. The upper main power clips **507** are connected to the voltage transformer switch input bus **510** comprising the input buses **510***a*, **510***b*, and **510***c* illustrated in FIG. **5**A, which are cable connected to the riser buses **518***a*, **518***b*, and **518***c* disposed in the current transformer and cable compartment **710**. The riser buses **518***a*, **518***b*, and **518***c* are in turn connected to the main bus **519** at the top of the enclosure **701** as illustrated in FIG. **7**G. Also illustrated in FIG. **7**G is the chain drive **110** comprising the chain **110***b* wrapped around the first sprocket wheel **110***c* and the second sprocket wheel **110***a* in the voltage transformer switch compartment **707**.

[0119] FIG. **7**H illustrates a partial, right-side perspective, cutaway view of the embodiment of the 15 kV utility metering cabinet **700** shown in FIG. **7**A, showing the switch handle assembly **513** operably connected to the 15 kV voltage transformer disconnect switch **100** via a drive system, that is, the chain drive **110**. At one end, for example, the right end, of the 15 kV voltage transformer disconnect switch **100**, the switch handle **514** is connected to the switch handle assembly **513** via the chain drive **110**. The sprocket wheel **110***a* is attached to the moving bracket **108**, which in turn, connects to an end insulator **102***a* proximal to the arm **106** illustrated in FIGS. **7**I-**7**K, via the hollow, generally cylindrical bushings **111** illustrated in FIG. **1**D. The hollow, generally cylindrical bushings **111** move within the grooves **106***a* of the arm **106** to provide a smooth motion and to limit the motion of the insulator-switch-blade shaft and in turn the moving bracket **108** to 90 degrees while the switch handle **514** of the switch handle assembly **513** moves from a top position to a bottom position or an equivalent of 180 degrees. The motion of the switch handle **514** is restricted by the grooves **106***a* cut in the arm **106**. In an embodiment, two ⅜-inch screws connect the sprocket wheel **110***a* to the insulator **102***a* of the voltage transformer disconnect switch **100** to facilitate smooth motion for the voltage transformer disconnect switch **100** and the switch handle **514** that operates the voltage transformer disconnect switch **100**. The switch handle assembly **513** comprises a circular knob **513***a* as illustrated in FIG. **7**H and FIG. **8**A, configured to be pulled out to operate the switch handle **514**. The circular knob **513***a* ensures that the switch handle **514** is not accidently operated when the power is on.

[0120] The switch handle **514** of the switch handle assembly **513** is shown in a downward position or a bottom position in FIG. **7**H. When the switch handle **514** is in the downward position, the upper parts **101***a* of the switch blades **101** of the voltage transformer disconnect switch **100** are engaged with the lower grounding clips **508** that are connected to the ground bus **506** as illustrated in FIG. **5**A, thereby grounding the voltage transformer disconnect switch **100**. The insulator-switch-blade shaft and in turn the moving bracket **108** moves only about 90 degrees to move the switch blades **101** from a connected ON position to a grounded position.

[0121] FIGS. **7**I-**7**L illustrate partial, cutaway, perspective views of the drive system, that is, the chain drive **110**, in the voltage transformer switch assembly **500** of the embodiment of the 15 kV utility metering cabinet **700** shown in FIG. **7**A. When the switch handle **514** moves in an upward direction from the bottom position, the first sprocket wheel **110***c* that is connected to the switch handle **514** rotates, for example, in a clockwise direction, causing the second sprocket wheel **110***a* to also rotate in a clockwise direction by the transfer of motion from the chain **110***b* of the chain drive **110**. The rotation of the second sprocket wheel **110***a* in the clockwise direction causes the moving bracket **108** to rotate about 90 degrees in a clockwise direction about the shaft **113** from a vertical position illustrated in FIGS. **7**G-**7**K to a horizontal position as illustrated in FIG. **7**L. The rotation of the moving bracket **108** is restricted by the grooves **106***a* cut into the arm **106** of the voltage transformer disconnect switch **100** illustrated in FIG. **7**H and FIG. **7**J. The bushings **111** connected to one end **108***a* of the moving bracket **108** illustrated in FIG. **1**D, move within and are restricted by the grooves **106***a* to restrict the motion of the moving bracket **108** and in turn the switch handle **514** via the chain drive **110**. Similarly, when the switch handle **514** moves in a downward direction from the top position, the first sprocket wheel **110***c* that is connected to the switch handle **514** rotates, for example, in a counter clockwise direction, causing the second sprocket wheel **110***a* to also rotate in a counter clockwise direction by the transfer of motion from the chain **110***b* of the chain drive **110**. The rotation of the second sprocket wheel **110***a* in the counter clockwise direction causes the moving bracket **108** to rotate about 90 degrees about the shaft **113** in a counter clockwise direction from the horizontal position illustrated in FIG. **7**L to the vertical position illustrated in FIGS. **7**G-**7**K. The rotation of the moving bracket **108** about the shaft **113** is restricted by the grooves **106***a* cut into the arm **106** of the voltage transformer disconnect switch **100**. The bushings **111** move within and are restricted by the grooves **106***a* to restrict the motion of the moving bracket **108** and in turn the switch handle **514** via the chain drive **110**.

[0122] FIGS. **8**A-**8**B illustrate embodiments of safety interlocking devices **515** and **517** connected to the switch handle assembly **513** and a door **706** of the fuse compartment **709** of the embodiment of the 15 kV utility metering cabinet **700** shown in FIGS. **7**A-**7**B. The safety interlocking devices **515** and **517** are, for example, KIRK® keys. All utilities require that the fuse compartment **709** cannot be opened when the voltage transformer disconnect switch **100** illustrated in FIGS. **1**A-**1**D, is in the connected ON position, for safety. The safety interlocking devices **515** and **517** are provided to ensure that the fuse compartment **709** is not opened when the main bus **519** is energized and the fuse compartment **709** has high voltage at the fuse clip buses **512** and **516** illustrated in FIGS. **7**C-**7**D. The safety interlocking devices **515** and **517** ensure that the fuse compartment **709** can be opened only when the switch blades **101** of the voltage transformer disconnect switch **100** are connected to the ground bus **506** as illustrated in FIG. **5**A. To open the door **706** of the fuse compartment **709**, the power is first disconnected to terminate the flow of power to the voltage transformer switch compartment **707** illustrated in FIG. **7**D. A switch knob **513***a* is then pulled to operate the switch handle assembly **513** and the voltage transformer disconnect switch **100** is opened, that is, the voltage transformer disconnect switch **100** is grounded. At this point, a key **517***a* from the safety interlocking device **515** attached to the top of the switch handle assembly **513** can be removed, and the same key **517***a* is used to open the door **706** of the fuse compartment **709** as illustrated in FIG. **8**B. FIG. **8**B illustrates the key **517***a* used to open the door **706** of the fuse compartment **709**. When the voltage transformer disconnect switch **100** is in the closed position, that is, the connected ON position, the key **517***a* cannot be removed and therefore the fuse compartment **709** cannot be opened, thereby ensuring safety of the voltage transformer disconnect switch **100**.

[0123] FIG. **9**A illustrates a front elevation view of the 15 kV voltage transformer disconnect switch **100**, showing the switch blades **101** in a connected ON position. As used herein, “connected ON position” refers to a state of the voltage transformer disconnect switch **100** when the voltage transformer (not shown) is actively connected to an electric circuit within the utility metering cabinet **700** shown in FIG. **7**A and provides voltage measurements. In the connected ON position, the switch handle **514** of the switch handle assembly **513** is in an upward position or a top position and the upper parts **101***a* of the switch blades **101** are engaged with the upper main power clips **507** of the voltage transformer switch assembly **500** shown in FIG. **5**A. When the voltage transformer disconnect switch **100** is in the connected ON position, the voltage transformer disconnect switch **100** provides a direct electrical connection between the voltage transformer and the monitored electric circuit, thereby allowing the voltage transformer to accurately measure a voltage level of the electric circuit and provide the voltage level information, for example, to protective relays, meters, or other monitoring devices.

[0124] FIG. **9**B illustrates a perspective view showing the switch blades **101** of the 15 kV voltage transformer disconnect switch **100** in a grounded position, where the upper parts **101***a* of the switch blades **101** are connected to the lower grounding clips **508**. The lower grounding clips **508** are attached to the ground bus **506** using fasteners, for example, screws, bolts, etc. The ground bus **506** is disposed on and supported by the ground bus support channel **104**. When the medium voltage switchgear is shut down for maintenance or service, the voltage transformer disconnect switch **100** is grounded for safety by connecting the upper parts **101***a* of the switch blades **101** to the ground bus **506** via the lower grounding clips **508** as illustrated in FIG. **9**B. The voltage transformer disconnect switch **100**, when in the grounded position, serves the purpose of grounding the voltage transformer (not shown) to provide safety for personnel and equipment, particularly during maintenance or troubleshooting activities of a voltage transformer section. While the voltage transformer is safely serviced by the voltage transformer disconnect switch **100** in the grounded position, there is a need for servicing the current transformer and cable compartment **710** in the back of the enclosure **701** illustrated in FIGS. **7**E-**7**F. In an embodiment, servicing of the current transformer and cable compartment **710** is accomplished by ground studs **711** that are used to connect the riser buses **518***a*, **518***b*, **518***c* to the ground bus **713** at the bottom of the enclosure **701** as illustrated in FIG. **7**F. The ground studs **711** are used for safely connecting the riser buses **518***a*, **518***b*, and **518***c* or the main bus **519** to the ground bus **713** for equipment grounding before performing service or maintenance. When the current transformers are installed in the current transformer and cable compartment **710**, the riser buses **518***a*, **518***b*, and **518***c* are connected to the main bus **519** and the main bus **519** is grounded while performing service or maintenance. If the current transformers are not yet installed in the current transformer and cable compartment **710**, both sides of the riser buses **518***a*, **518***b*, and **518***c* are grounded for safety. In an embodiment, each of the ground studs **711** is covered with an insulating cover or cap **712** when not used, that is, when the equipment is energized. In an embodiment, the insulating cover **712** is snap-fit connected to each of the ground studs **711**. The insulating cover **712** is a flexible, non-conductive cover that prevents flashover on the ground studs **711**. In an example, the insulating cover **712** is made of a plastisol material that has strong insulation properties.

[0125] When grounding is required, a grounding device (not shown) with four clamps, for example, is used to connect all phase buses to the ground bus **713**. The riser buses **518***a*, **518***b*, **518***c* connect to the main bus **519** and hence, all the phase buses are connected to the ground. The clamps of the grounding device attach to the ground studs **711** to ensure safety of the current transformer and cable compartment **710** for maintenance and service. When the current transformer is not installed and the B-phase bus link **518***d* illustrated in FIG. **7**E is removed, both sides of the current transformer connection are grounded by the ground studs **711** on both sides of the riser buses **518***a*, **518***b*, and **518***c* which in turn connect to the main bus **519**.

[0126] FIG. **9**C illustrates a perspective view showing a switch blade **101** of the 15 kV voltage transformer disconnect switch **100** in a grounded position, where a lower part **101***b* of the switch blade **101** is connected to a fuse clip **509***a*. In the grounded position, the upper parts **101***a* of the switch blades **101** of the voltage transformer disconnect switch **100** engage inside the lower grounding clips **508** attached to the ground bus **506** and in an embodiment, the lower parts **101***b* of the switch blades **101** connect to the first fuse clips **509***a* as illustrated in FIG. **9**C. The first fuse clips **509***a* connect the switch blades **101** to the upper fuse clip buses **512** illustrated in FIGS. **5**A-**5**B, FIGS. **7**C-**7**D, and FIG. **7**J. When the medium voltage switchgear is operational, the upper parts **101***a* of the switch blades **101** of the voltage transformer disconnect switch **100** engage inside the upper main power clips **507** for input bus connections as illustrated in FIG. **9**A and in an embodiment, the lower parts **101***b* of the switch blades **101** connect to the upper fuse clip buses

512 via the first fuse clips **509***a* shown in FIG. **9**C. The upper fuse clip buses **512** connect the switch blades **101** to the second fuse clips **509***b* installed on the upper fuse clip buses **512**. The second fuse clips **509***b* installed on the upper and lower fuse clip buses **512** and **516** illustrated in FIG. **5**B, FIG. **5**D, and FIGS. **7**C-**7**D, connect the input fuses of the voltage transformer to the voltage transformer switch input bus **510** illustrated in FIG. **9**A. The upper fuse clip buses **512** are always connected to the switch blades **101**. The upper parts **101***a* of the switch blades **101** either connect to the voltage transformer switch input bus **510** or to the ground bus **506** for safety. The voltage transformer switch input bus **510** connects the voltage transformer to the riser bus **518** in the back via cables (not shown) as illustrated in FIGS. **7**E-**7**F, which in turn connects to the main bus **519** at the top of the enclosure **701** as illustrated in FIG. **7**G. In an embodiment, instead of the fuse clips **509***a* illustrated in FIG. **9**C, a bare copper cable or wire **523** inside a cable bushing **522** is used to connect the lower part **101***b* of each switch blade **101** to the upper fuse clip bus **512** as illustrated in FIGS. **11**C-**11**D.

[0127] FIG. **10** illustrates a perspective view of the fuse compartment **709** of the 15 kV utility metering cabinet **700** shown in FIG. **7**B, showing fuse clips **509***b*, rails **715**, and mounting brackets **714** for a voltage transformer (not shown). The fuse compartment **709** accommodates the fuse clips **509***b* for the input fuses of the voltage transformer. The fuse clips **509***b* are installed on the upper fuse clip buses **512** illustrated in FIGS. **7**C-**7**D and on the lower fuse clip buses **516** illustrated in FIGS. **7**B-**7**D, FIG. **7**H, and FIG. **10**. In an embodiment, rails **715** and mounting brackets **714** are disposed at a bottom end **709***a* of the fuse compartment **709** of the utility metering cabinet **700**. The mounting brackets **714** are attached to opposing sides **709***b* and **709***c* of the bottom end **709***a* of the fuse compartment **709**. The rails **715** are disposed substantially perpendicular to the mounting brackets **714** as illustrated in FIG. **10**. The rails **715** and the mounting brackets **714** at the bottom are configured to mount the voltage transformer in the fuse compartment **709** in accordance with predefined utility requirements, for example, Electric Utility Service Equipment Requirements Committee (EUSERC) requirements. The mounting brackets **714** meet utility requirements as defined by the EUSERC or another specific utility if the utility is not a member of the EUSERC.

[0128] FIGS. **11**A-**11**B illustrate perspective views of an embodiment of the 15 kV voltage transformer disconnect switch **100**, showing the switch blades **101** mounted between alternative insulators **102***a* and **102***b* in a grounded position and a connected ON position, respectively. The alternative insulators **102***a* and **102***b* illustrated in FIGS. **11**A-**11**B, are made, for example, by Polycast Industrial Products Ltd. In an embodiment, the 15 kV voltage transformer disconnect switch **100** comprises three ¼-inch thick, aluminum switch blades **101** that are tin-plated. The central switch blade **101** is sandwiched between the insulators **102***b* that are 8.75″ long with two spring pins **112** illustrated in FIG. **1**D and FIGS. **3**A-**3**C, at the joint. At each end, a 6-inch long insulator **102***a* is installed between the arm **105**/**106** connected to the frame of the voltage transformer switch compartment **707** and one aluminum switch blade **101** as illustrated in FIGS. **11**A-**11**B. The arms **105** and **106** are made, for example, of sheet metal. The insulators **102***a* and **102***b* are secured with two spring pins **112** at each junction and the aluminum switch blades **101** are sandwiched between two insulators **102***b* for the middle B-phase and between the insulators **102***a* and **102***b* for A-phase and C-phase as illustrated in FIG. **1**D and FIG. **11**A. The insulators **102***a* at the ends are secured to the arms **105** and **106** that are connected to the frame of the voltage transformer switch compartment **707**, for example, using steel fasteners. Also illustrated in FIG. **11**A are the input cables **520** that connect the voltage transformer switch input bus **510** to the main bus **519** via the riser bus **518** in the rear current transformer and cable compartment **710** as illustrated in FIGS. **7**E-**7**G. Also illustrated in FIG. **11**B is a conduit **524** for conveying control cables of meters used in the utility metering cabinet **700** illustrated in FIG. **7**A. The conduit **524** is inserted through the control cable bushing **503** configured in the rear barrier **501** illustrated in FIG. **5**A.

[0129] FIGS. **11**C-**11**D illustrate perspective views showing a lower part **101***b* of the switch blade

101 of the 15 kV voltage transformer disconnect switch **100** connected to an upper fuse clip bus **512** in the fuse compartment **709** using a braided copper element, for example, a braided copper cable or wire **523**. FIG. **11**D illustrates the upper and lower fuse clip buses **512** and **516** and the fuse clips **509***b* installed thereon in the fuse compartment **709**. The upper fuse clip buses **512** are configured to connect the voltage transformer disconnect switch **100** to the fuse clips **509***b*. In this embodiment, the braided copper cables or wires **523** connected through cable bushings **522** are used to make the lower bus connections that connect to the fuse clips **509***b* as illustrated in FIGS. **11**C-**11**D. A suitable fuse for the voltage transformer is installed on the fuse clips **509***b* by a utility by pressing a cylindrical medium voltage fuse rated to protect the voltage transformer. The utility also makes a cable connection from the lower fuse clip buses **516** to the voltage transformer.

[0130] FIG. **12** illustrates a top perspective view of an embodiment of a 27-kilovolt (kV) voltage transformer disconnect switch **1200**. The voltage transformer disconnect switch **1200** comprises multiple switch blades **1201**, for example, three ¼-inch thick aluminum switch blades **1201**, one for each phase of a multi-phase, main medium voltage bus, as illustrated in FIG. **12**. The switch blades **1201** are disposed in a space **1221** defined by opposing channels, namely, a rear support channel **1203** and a ground bus support channel **1204**, and opposing arms **1205** and **1206**. In an example, the length of the rear support channel **1203** is about 56.875 inches; the height of the rear support channel **1203** is about 6 inches, and the width of the rear support channel **1203** is about 2 inches. The rear support channel **1203** is made, for example, of a steel sheet of 7 gauge (ga) size. The ground bus support channel **1204** is configured to support a ground bus **1217** as illustrated in FIG. **12**. In an example, the length of the ground bus support channel **1204** is about 44.5 inches; the height of the ground bus support channel **1204** is about 3.875 inches, and the width of the ground bus support channel **1204** is about 1 inch. The ground bus support channel **1204** is made, for example, of a steel sheet of 12 ga size.

[0131] The switch blades **1201** are mounted between insulators **1202** in a voltage transformer switch compartment **1706** of a 27 kV utility metering cabinet **1700** illustrated in FIGS. **17**A-**17**I. In an embodiment, each of the switch blades **1201** is configured as a generally rectangular-shaped structure comprising an upper part **1201***a* and a lower part **1201***b*. The insulators **1202** are, for example, 10.5-inch insulators manufactured by Polycast Industrial Products Ltd. A moving bracket **1208** is operably connected to one end insulator **1202***a* via the arm **1206**. Multiple clips **1215** and **1216** are configured to connect the voltage transformer disconnect switch **1200** to a main, multi-phase cross bus **1715** illustrated in FIG. **17**J, or to the ground bus **1217**. The clips **1215** and **1216** are made, for example, of beryllium. The clips **1215** and **1216** are configured for a tight connection to the switch blades **1201**, when the switch blades **1201** are engaged with the clips **1215** or **1216**. The clips comprise upper main power clips **1215** and lower grounding clips **1216**. The upper parts **1201***a* of the switch blades **1201** are configured to connect to (a) a voltage transformer switch input bus **1211** that connects a voltage transformer (not shown) to the main, multi-phase cross bus **1715** of the utility metering cabinet **1700** via cables **1222**; or (b) to the ground bus **1217** for safety. In an embodiment, the structure of each of the clips **1215** and **1216** used to connect the 27 kV voltage transformer disconnect switch **1200** to the main, multi-phase cross bus **1715** via the voltage transformer switch input bus **1211** or to the ground bus **1217** shown in FIG. **12**, are similar to or the same as the clip **507**/**508** illustrated in FIGS. **6**A-**6**C.

[0132] The ground bus **1217** is attached to the channel **1204** of the voltage transformer disconnect switch **1200**. As illustrated in FIG. **12**, the switch blades **1201** are connected to the voltage transformer switch input buses **1211***a*, **1211***b*, and **1211***c* via the upper main power clips **1215**. The upper parts **1201***a* of the switch blades **1201** are configured to engage with the upper main power clips **1215** for input bus connections in the utility metering cabinet **1700** and with the lower grounding clips **1216** for ground bus connections in the utility metering cabinet **1700**. The input bus connections comprise connections to the voltage transformer switch input bus **1211** and in turn, to the main, multi-phase cross bus **1715** via a riser bus **1711** illustrated in FIGS. **17**H-**17**J. That is,

the voltage transformer switch input bus **1211** is connected to the vertical riser bus **1711** using insulated cables **1222**. The riser bus **1711** is in turn connected to the main, multi-phase cross bus **1715** as illustrated in FIG. **17**J. The upper main power clips **1215** connect the voltage transformer disconnect switch **1200** to the main, multi-phase cross bus **1715** via the voltage transformer switch input bus **1211** using insulated cables **1222**. The ground bus connections comprise connections to the ground bus **1217** attached to the ground bus support channel **1204** of the voltage transformer disconnect switch **1200**. When the upper parts **1201***a* of the switch blades **1201** are engaged with the upper main power clips **1215**, the input buses **1211***a*, **1211***b*, and **1211***c* of the voltage transformer switch input bus **1211** connect the switch blades **1201** to the riser buses **1711***a*, **1711***b*, and **1711***c* via the cables **1222**. The voltage transformer switch input bus **1211** connects the voltage transformer to the main, multi-phase cross bus **1715** of the utility metering cabinet **1700** via the cables **1222** and the riser bus **1711**. The lower parts **1201***b* of the switch blades **1201** are connected to upper fuse clip buses **1212** illustrated in FIG. **13**B, using braided copper elements, for example, braided copper wires **1219**. Each upper fuse clip bus **1212** is configured to connect the voltage transformer disconnect switch **1200** to fuse clips **1228** illustrated in FIG. **17**C and FIG. **17**F.
[0133] Also illustrated in FIG. **12** are a rear barrier **1229**, an insulating barrier **1209** disposed between the voltage transformer switch compartment **1706** and the fuse compartment **1707** illustrated in FIGS. **17**B-**17**C, wall bushings **1210**, phase barriers **1223**, the input buses **1211***a*, **1211***b*, and **1211***c*, a standoff insulator **1218**, and the upper fuse clip buses **1212**, the positions and functions of which are similar to respective components **501**, **502**, **504**, **505**, **510***a*, **510***b*, **510***c*, **511***b*, and **512** as disclosed in the descriptions of FIGS. **5**A-**5**C. The rear barrier **1229**, the insulating barrier **1209**, and the phase barriers **1223** are made, for example, of Glastic® GPO-3 materials. The length of the rear barrier **1229** is, for example, about 56.750 inches. The phase barriers **1223** are attached to the rear barrier **1229** using fasteners, for example, L-shaped, angle bracket clamps **1207**. In an embodiment, the phase barriers **1223** comprise U-shaped cutouts or openings **1223***a* configured to accommodate the insulators **1202** as illustrated in FIG. **12**. The standoff insulator **1218** is, for example, an 8.75-inch insulator manufactured by Polycast Industrial Products Ltd. The upper fuse clip buses **1212** are made, for example, of copper. Also illustrated in FIG. **12** is a switch handle assembly **1213** operably connected to the voltage transformer disconnect switch **1200** via a drive system, for example, a chain drive **1220**. The switch handle assembly **1213** comprises a switch handle **1214** configured to operate the voltage transformer disconnect switch **1200**. The switch handle assembly **1213** is, for example, the PowerCon® switch handle assembly A013-039. The switch handle assembly **1213** that operates the 27 kV voltage transformer disconnect switch **1200** and the chain drive **1220** are substantially similar to the switch handle assembly **513** and the chain drive **110** of the 15 kV voltage transformer disconnect switch **1200** illustrated in FIGS. **5**A-**5**D, with suitable changes made at the switch end to accommodate the 27 kV switch handle assembly **1213**. The chain drive **1220** is substantially similar in structure and function to the chain drive **110** disclosed in the description of FIG. **5**D.
[0134] FIG. **13**A illustrates a top plan view of an embodiment of a voltage transformer switch assembly **1300** comprising the 27 kV voltage transformer disconnect switch **1200** shown in FIG. **12**. In an example, the width of the space **1221** defined by the opposing channels **1203** and **1204** and the opposing arms **1205** and **1206** illustrated in FIG. **12**, is about 28.313 inches.
[0135] FIG. **13**B illustrates a front elevation view of the embodiment of the voltage transformer switch assembly **1300** shown in FIG. **13**A. In an example, the distance between the input buses **1211***a*, **1211***b*, and **1211***c* is about 10.625 inches. FIG. **13**B illustrates the braided copper elements, for example, the braided copper wires **1219**, configured to connect the lower parts **1201***b* of the switch blades **1201** to the upper fuse clip buses **1212**.
[0136] FIG. **13**C illustrates a right-side elevation view of the embodiment of the voltage transformer switch assembly **1300** shown in FIG. **13**A. The side elevation view shows the chain drive **1220** used to drive the operation of the switch handle assembly **1213** and in turn the operation

of the 27 kV voltage transformer disconnect switch **1200** shown in FIG. **12**.

[0137] FIG. **14** illustrates a side elevation view of an embodiment of a switch blade **1201** of the 27 kV voltage transformer disconnect switch **1200** shown in FIG. **12**. In an example, the length of the switch blade **1201** is about 20.375 inches, the width of the switch blade **1201** is about 2.5 inches, and the thickness of the switch blade **1201** is about 0.25 inches. The switch blade **1201** is made, for example, from aluminum.

[0138] FIGS. **15**A-**15**C illustrate a left-side perspective view, a front elevation view, and a left-side elevation view, respectively, of an embodiment of a spring pin **1224** configured to secure the insulators **1202** to the switch blades **1201** of the 27 kV voltage transformer disconnect switch **1200** shown in FIG. **12** and a 38 kV voltage transformer disconnect switch **1800** shown in FIGS. **18**A-**18**D. The spring pin **1224** comprises a longitudinal slot **1224***a* defined along a length of the spring pin **1224**. In an example, the length of the spring pin **1224** is about 1.75 inches, the diameter of the spring pin **1224** is about 0.313 inches, and the thickness of the spring pin **1224** is about 0.062 inches. The spring pin **1224** snaps into place and secures the insulators **1202** to the switch blades **1201** sandwiched therebetween as disclosed in the description of FIG. **1**D. The spring pin **1224** is longer than the spring pin **112** used in the 15 kV voltage transformer disconnect switch **100** shown in FIG. **1**D and FIGS. **3**A-**3**C, but secures the switch blades **1201** and the insulators **1202** in a similar fashion. A longer spring pin **1224** secures the switch blade-insulator assembly tightly since the 27 kV voltage transformer disconnect switch **1200** is larger and the 27 kV voltage transformer disconnect switch forces during open/close operation are higher than that of the 15 KV voltage transformer disconnect switch **100**. The spring pin **1224** is made, for example, from steel. In an embodiment, while the 15 kV voltage transformer disconnect switch **100** uses two spring pins **112** at each connection of the insulators **102** to the switch blade **101** illustrated in FIGS. **1**A-**1**D and FIGS. **3**A-**3**C, the 27 kV voltage transformer disconnect switch **1200** and the 38 kV voltage transformer disconnect switch **1800**, each uses four spring pins **1224** at each connection of the insulators **1202**/**1802** to the switch blade **1201**/**1801** to provide the required strength and rigidity to the respective voltage transformer switch assemblies.

[0139] FIGS. **16**A-**16**B illustrate perspective views of the opposing arms **1205** and **1206** of the 27 kV voltage transformer disconnect switch **1200** shown in FIG. **12**. The arm **1205** is configured as a sheet metal control bracket with a generally circular hole **1205***a* as illustrated in FIG. **16**A. In an embodiment, the insulator **1202***a* proximal to the arm **1205** as illustrated in FIG. **12**, is connected to the arm **1205**, for example, using a ½-inch bolt inserted through the generally circular hole **1205***a* of the arm **1205**. The arm **1206** is configured as a sheet metal control bracket with grooves **1206***a* disposed around a generally circular hole **1206***b* as illustrated in FIG. **16**B. In an embodiment, the insulator **1202***a* proximal to the arm **1206** as illustrated in FIG. **12**, is connected to the arm **1206**, for example, using a ½-inch bolt inserted through the generally circular hole **1206***b* of the arm **1206**. In an example, the length, height, and width of the arms **1205** and **1206** are about 28.5 inches, about 6 inches, and about 2 inches, respectively. Each of the opposing arms **1205** and **1206** is made, for example, from a steel sheet of 11 gauge (ga) size.

[0140] FIG. **17**A illustrates a front elevation view of an embodiment of a 27 kV utility metering cabinet **1700**, showing front outer doors **1702** and **1703** closed. The utility metering cabinet **1700** comprises an enclosure **1701** configured to meet predefined electrical enclosure requirements comprising, for example, National Electrical Manufacturers Association (NEMA) 3R requirements and the American National Standards Institute (ANSI)/the Institute of Electrical and Electronics Engineers (IEEE) Category A requirements. For example, the enclosure **1701** is designed for outdoor NEMA 3R and meets IEEE C37.20.3 Category A requirements. In an embodiment, the doors **1702** and **1703** comprise gaskets (not shown) and louvers **1702***a* and **1703***a* with filters **1702***b* and **1703***b*, respectively, as illustrated in FIG. **17**A and FIG. **17**C. A voltage transformer switch compartment **1706**, a fuse compartment **1707**, and a current transformer and cable compartment **1710** are housed in the enclosure **1701** of the 27 kV utility metering cabinet **1700** as illustrated in FIGS. **17**B-**17**F and FIGS. **17**H-**17**J. In an example, the dimensions of the 27 kV utility metering cabinet **1700** with the 27 kV voltage transformer disconnect switch **1200** are 60″ W×102″ D×105″ H. In an embodiment, the layout of the 27 kV voltage transformer disconnect switch **1200** illustrated in FIG. **12** is substantially identical to that of the 15 kV voltage transformer disconnect switch **100** illustrated in FIGS. **1**A-**1**D. Since the 27 kV voltage transformer disconnect switch **1200** has to withstand a higher basic insulation level (BIL) and dielectric voltages, the spacing between phases and phase to ground are larger than that of the 15 kV voltage transformer disconnect switch **100**.

[0141] FIG. **17**B illustrates a front elevation view of the embodiment of the 27 kV utility metering cabinet **1700** shown in FIG. **17**A, showing open front outer doors **1702** and **1703**, a closed door **1705** of the fuse compartment **1707**, and the 27 kV voltage transformer disconnect switch **1200** with the switch blades **1201** in a grounded position in the voltage transformer switch compartment **1706**. FIG. **17**B also illustrates an open door **1704** of the voltage transformer switch compartment **1706**, which provides access to the 27 kV voltage transformer disconnect switch **1200**. The voltage transformer switch assembly **1300** comprising the voltage transformer disconnect switch **1200** illustrated in FIG. **12** and FIGS. **13**A-**13**C and the switch handle assembly **1213** with the switch handle **1214** is disposed in the enclosure **1701** of the utility metering cabinet **1700**. Also illustrated in FIG. **17**B are safety interlocking devices **1225** and **1226** connected to the switch handle assembly **1213** and to a door **1705** of the fuse compartment **1707** of the utility metering cabinet **1700** illustrated in FIG. **17**C. The safety interlocking devices **1225** and **1226** are, for example, KIRK® keys of Kirk Key Interlock Company, LLC. The safety interlocking devices **1225** and **1226** are configured to provide safety for opening and closing of the fuse compartment **1707**, ensuring that the voltage transformer disconnect switch **1200** is grounded before the fuse compartment **1707** is opened for maintenance. The safety interlocking devices **1225** and **1226** ensure that the door **1705** of the fuse compartment **1707** cannot be opened unless the switch blades **1201** of the voltage transformer disconnect switch **1200** are in a grounded position and the fuse compartment **1707** is not energized. In the grounded position, it is safe for the safety interlocking device **1225** on the switch handle assembly **1213** to be released so that the door **1705** of the fuse compartment **1707** can be safely opened for inspection or maintenance.

[0142] FIG. **17**C illustrates a front elevation view of the embodiment of the 27 kV utility metering cabinet **1700** shown in FIG. **17**A, showing the fuse compartment **1707** and the 27 kV voltage transformer disconnect switch **1200** with the switch blades **1201** in an intermediate position in the voltage transformer switch compartment **1706**. The door **1705** is opened to provide access to the fuse compartment **1707**.

[0143] FIG. **17**D illustrates an enlarged view of the voltage transformer switch compartment **1706**, showing the 27 kV voltage transformer disconnect switch **1200** with the switch blades **1201** in the intermediate or mid position. The construction of the 27 kV voltage transformer disconnect switch **1200** is substantially similar to the 15 kV voltage transformer disconnect switch **100** illustrated in FIGS. **1**A-**1**D. Since the rated voltage is higher for the 27 kV voltage transformer disconnect switch **1200**, the 27 kV voltage transformer disconnect switch **1200** is configured to withstand higher basic insulation level (BIL) and dielectric voltages. The length of the insulators **1202***b* between phases is, for example, about 10.75 inches, and the length of the insulators **1202***a* at the ends is about 8.75 inches. In an example, the distance between an outside A or C phase and the frame of the 27 kV voltage transformer disconnect switch **1200**, that is, the phase-to-ground distance, is about 8.75 inches.

[0144] FIG. **17**E illustrates an enlarged view of the voltage transformer switch compartment **1706**, showing the 27 kV voltage transformer disconnect switch **1200** with the switch blades **1201** in the connected ON position. The switch handle **1214** of the switch handle assembly **1213** is moved to the upward or top position to render the 27 kV voltage transformer disconnect switch **1200** in the connected ON position. In the connected ON position, the switch blades **1201** of the voltage transformer disconnect switch **1200** engage with the upper main power clips **1215** for connections to the voltage transformer switch input bus **1211**. The voltage transformer switch input bus **1211** connects a voltage transformer (not shown) to the main, multi-phase cross bus **1715** of the 27 kV utility metering cabinet **1700** illustrated in FIGS. **17**A-**17**C via the cables **1222** and the riser bus **1711** illustrated in FIGS. **17**H-**17**J.

[0145] FIG. **17**F illustrates a front elevation view of the fuse compartment **1707** of the 27 kV utility metering cabinet **1700** shown in FIGS. **17**A-**17**C. The fuse clips **1228** are installed on the fuse clip buses **1212** and **1227** disposed in the fuse compartment **1707** of the utility metering cabinet **1700**. The fuse clips **1228** are configured to connect input fuses (not shown) of the voltage transformer (not shown) to the voltage transformer switch input bus **1211** illustrated in FIGS. **17**B-**17**E. A utility typically installs the fuses, and therefore, the utility metering cabinet **1700** from a manufacturer is supplied without the fuses.

[0146] FIG. **17**G illustrates a rear perspective view of the embodiment of the 27 kV utility metering cabinet **1700** shown in FIG. **17**A, showing rear outer doors **1708** and **1709** closed.

[0147] FIG. **17**H illustrates a partial, rear perspective view of the embodiment of the 27 kV utility metering cabinet **1700** shown in FIG. **17**A, showing the riser bus **1711** disposed in the current transformer and cable compartment **1710**. The rear outer doors **1708** and **1709** of the 27 kV utility metering cabinet **1700** are opened to expose and provide access to the current transformer and cable compartment **1710**. The riser bus **1711** comprises three riser phase buses **1711***a*, **1711***b*, and **1711***c* that connect to the main, multi-phase cross bus **1715** of the 27 kV utility metering cabinet **1700** illustrated in FIG. **17**J. The riser bus **1711** is used for cable and current transformer connections. FIG. **17**H also illustrates a ground bus **1712** disposed in the current transformer and cable compartment **1710**. The ground bus **1712** provides a path for fault current to safely dissipate into the ground, thereby preventing excessive current from flowing through conductive components in the enclosure **1701**, minimizing the risk of overheating, fires, and equipment damage in the 27 kV utility metering cabinet **1700**. FIG. **17**H also illustrates connections of the cables **1222** from the voltage transformer switch input bus **1211** illustrated in FIGS. **17**B-**17**E, to the riser bus **1711**.

[0148] FIG. **17**I illustrates a partial, rear perspective view of the embodiment of the 27 kV utility metering cabinet **1700** shown in FIG. **17**A, showing voltage transformer cable connections to the riser bus **1711** in the current transformer and cable compartment **1710**. The cables **1222** from the voltage transformer switch input bus **1211** illustrated in FIGS. **17**B-**17**E, are connected to the riser bus **1711** as illustrated in FIG. **17**I. The cables **1222** are secured to Glastic supports **1714** with cable ties **1713** as illustrated in FIG. **17**I. Since the phase-to-phase and phase-to-ground distances for the cables **1222** are large, in an embodiment, a stiff 600V AC-rated cable **1222***b* with a polyvinyl chloride (PVC) insulation manufactured, for example, by Grayline, LLC, for the B-phase is used for input connections. The 600V AC-rated cable **1222***b* is easy to route inside the enclosure **1701** of the 27 kV utility metering cabinet **1700** shown in FIG. **17**A and to maintain a proper distance between the phases, which provides a reliable connection that saves cost.

[0149] FIG. **17**J illustrates a perspective, partial view of the current transformer and cable compartment **1710**, showing cable connections to the main, multi-phase cross bus **1715** via the riser bus **1711**. The input cables **1222** that connect the voltage transformer switch input bus **1211** illustrated in FIGS. **17**B-**17**E, to the main, multi-phase cross bus **1715** via the riser bus **1711** in the rear current transformer and cable compartment **1710** are illustrated in FIG. **17**J. The phase distance between the riser buses **1711***a*, **1711***b*, and **1711***c* is, for example, about 18 inches. In an embodiment, the main, multi-phase cross bus **1715** is coated with epoxy. The width of each of the buses of the main, multi-phase cross bus **1715** is, for example, about 4.25 inches. The spacing between the buses of the main, multi-phase cross bus **1715** is, for example, about 10 inches to about 11 inches. The spacing is required if switchgear sections connected to the utility metering cabinet **1700** illustrated in FIGS. **17**A-**17**C and FIG. **17**G, contain vacuum breakers. The main, multi-phase cross bus **1715** connects the enclosure **1701** containing the 27 kV voltage transformer disconnect switch **1200**, the voltage transformer (not shown), the current transformers (not shown), and the meters, to a metal-enclosed switchgear that contains main load interrupter (LI) switches and/or vacuum breakers for medium voltage power distribution. Instead of being positioned at the top of the enclosure **701** as illustrated in FIG. **7**G, in an embodiment, the main bus of the 27 kV utility metering cabinet **1700**, that is, the main, multi-phase cross bus **1715**, is disposed in the middle of the current transformer and cable compartment **710** as illustrated in FIG. **17**J.

[0150] The utility metering section, for example, the 27 kV utility metering cabinet **1700**, is typically one section of a typical multi-section, medium voltage, metal-enclosed switchgear line-up. The utility metering section is connected to load interrupter (LI) switch sections or vacuum circuit breaker sections along with other customer sections that contain voltage transformers and current transformers for measurement, relaying, and control. In addition, there may be control power transformers to supply control power to relays and meters installed in the switchgear line-up. In an embodiment, there are multiple input load interrupter switches or vacuum breakers and multiple output load interrupter switches or vacuum breakers for various connected loads. The main, multi-phase cross bus **1715** conveniently connects all the switchgear compartments in the utility metering section.

[0151] FIG. **18**A illustrates a top perspective view of an embodiment of a 38-kilovolt (kV) voltage transformer disconnect switch **1800**. The voltage transformer disconnect switch **1800** comprises multiple switch blades **1801**, for example, three switch blades **1801**, one for each phase of a voltage transformer switch input bus **1811** as illustrated in FIG. **18**A. In an example, the switch blades **1801** are made of ¼-inch thick aluminum. The switch blades **1801** are disposed in a space **1826** defined by opposing channels, namely, a rear support channel **1803** and a ground bus support channel **1804**, and opposing arms **1805** and **1806**. In an example, the length of the rear support channel **1803** is about 73.375 inches; the height of the rear support channel **1803** is about 6 inches, and the width of the rear support channel **1803** is about 2 inches. The rear support channel **1803** is made, for example, of a steel sheet of 11 gauge (ga) size. The ground bus support channel **1804** is configured to support a ground bus **1817** as illustrated in FIG. **18**A. In an example, the length of the ground bus support channel **1804** is about 73.625 inches; the height of the ground bus support channel **1804** is about 4.375 inches, and the width of the ground bus support channel **1804** is about 2.562 inches. The ground bus support channel **1804** is made, for example, of a steel sheet of 7 ga size.

[0152] The switch blades **1801** are mounted between insulators **1802** in a voltage transformer switch compartment **2308** of a 38 kV utility metering cabinet **2300** illustrated in FIGS. **23**A-**23**D. The insulators **1802** comprises end insulators **1808** and central insulators **1809** connected between the end insulators **1808**. In an embodiment, each of the switch blades **1801** is configured as a generally rectangular-shaped structure comprising an upper part **1801***a* and a lower part **1801***b*. Multiple clips **1815** and **1816** are configured to connect the voltage transformer disconnect switch **1800** to a main bus **1831** illustrated in FIG. **23**D and FIG. **23**G via the voltage transformer switch input bus **1811**, or to the ground bus **1817**. The clips **1815** and **1816** are made, for example, of phosphor bronze. The clips **1815** and **1816** are configured for a tight connection to the switch blades **1801**, when the switch blades **1801** are engaged with the clips **1815** or **1816**. These clips comprise upper main power clips **1815** and lower grounding clips **1816**. The upper parts **1801***a* of the switch blades **1801** are configured to connect to (a) the voltage transformer switch input bus **1811** that connects a voltage transformer (not shown) to the main bus **1831** of the utility metering cabinet **2300** via cables (not shown); or (b) the ground bus **1817** for safety. The ground bus **1817** is attached to the ground bus support channel **1804** of the voltage transformer disconnect switch **1800**.

[0153] As illustrated in FIG. **18**A, the switch blades **1801** are connected to the input buses **1811***a*, **1811***b*, and **1811***c* via the upper main power clips **1815**. The upper parts **1801***a* of the switch blades **1801** are configured to engage with the upper main power clips **1815** for input bus connections in the utility metering cabinet **2300** and with the lower grounding clips **1816** for ground bus connections in the utility metering cabinet **2300**. The input bus connections comprise connections to the voltage transformer switch input bus **1811** and in turn, to the main bus **1831**. In an embodiment, the voltage transformer switch input bus **1811** connects directly to the main bus **1831** as illustrated in FIG. **23**D and FIG. **23**G. In an embodiment (not shown), the voltage transformer switch input bus **1811** connects to the main bus **1831** via cables (not shown). The upper main power clips **1815** connect the voltage transformer disconnect switch **1800** to the main bus **1831** via the voltage transformer switch input bus **1811**. The ground bus connections comprise connections to the ground bus **1817** attached to the ground bus support channel **1804** of the voltage transformer disconnect switch **1800**. The input buses **1811***a*, **1811***b*, and **1811***c* and the ground bus **1817** are made, for example, of copper.

[0154] When the upper parts **1801***a* of the switch blades **1801** are engaged with the upper main power clips **1815**, the input buses **1811***a*, **1811***b*, and **1811***c* connect the switch blades **1801** to the main bus **1831**, thereby connecting the voltage transformer to the main bus **1831** of the utility metering cabinet **2300**. The lower parts **1801***b* of the switch blades **1801** are connected to upper fuse clip buses **1832** in the fuse compartment **2309** using braided copper elements, for example, braided copper wires **1819** as illustrated in FIG. **23**E. The upper and lower fuse clip buses **1832** and **1833** illustrated in FIG. **23**E, allow a utility to install fuses at the two fuse clips **1834** for each phase. The utility uses a short cable (not shown) to connect the voltage transformer to the lower fuse clip bus **1833**. The upper fuse clip buses **1832** are configured to connect the voltage transformer disconnect switch **1800** to the fuse clips **1834** illustrated in FIG. **23**E, and in turn, to the input fuses of the voltage transformer.

[0155] Also illustrated in FIG. **18**A are insulating barriers **1818** and **1827** between the voltage transformer switch compartment **2308** and the fuse compartment **2309** illustrated in FIGS. **23**D-**23**E, standoff insulators **1807**, **1808**, and **1809**, wall bushings **1810**, insulators **1812**, support clamps **1821** and **1822** for the insulators **1802**, phase barriers **1823**, support rods **1824**, and an angle bracket **1825** for the support clamps **1821** and **1822**. The insulating barriers **1818** and **1827** and the phase barriers **1823** are made, for example, of thermoset fiberglass-reinforced polyester insulating materials, for example, Glastic GPO-3 materials produced by the Glastic company. The insulating barriers **1818** and **1827** provide sufficient clearance and creepage distances required at 38 kV class in the rear and bottom of the voltage transformer switch compartment **2308**. An insulating barrier **1818** is configured to isolate the voltage transformer switch compartment **2308** from the fuse compartment **2309** for safety. The phase barriers **1823** provide sufficient clearance and creepage distances required at 38 kV class between phases. The stand-off insulators **1807**, **1808**, and **1809** provide more creepage for a given height since the insulator skirts multiply the effective creepage distance. The phase barriers **1823** are secured and supported by the support clamps **1821** and **1822** and the support rods **1824**. For 38 kV, a larger creepage distance is required since the basic insulation level (BIL) is 150 kV. The 38 kV voltage transformer disconnect switch **1800** is made substantially compact by using Glastic barriers **1818**, **1827**, and **1823**, the wall bushings **1810**, and the standoff insulators **1807**, **1808**, and **1809**. The standoff insulators **1807**, **1808**, and **1809** provide electrical insulation and prevent direct contact between different phases of conductive components such as busbars, circuit breakers, and other equipment within the utility metering cabinet **2300**. The stand-off insulators **1807**, **1808**, and **1809** provide large creepage distances that are required to withstand a 150 kV lightning impulse voltage for a 38 kV switchgear. The lengths of the standoff insulators **1807**, **1808**, and **1809** are, for example, about 3.5 inches, 10.5 inches, 11 inches, and 12.75 inches, respectively. The standoff insulators **1807**, **1808**, and **1809** are, for example, manufactured by Polycast Industrial Products Ltd. The insulators **1812** disposed below the ground bus **1817** separate and keep the ground bus **1817** away from the painted metal surface of the ground bus support channel **1804**. The insulators **1812** disposed below the ground bus **1817** are made, for example, of glass polyester. The length of the insulators **1812** is, for example, about 1.375 inches. A bus **1835** on the left side of the ground bus **1817** is configured to be connected to the ground bus

2312 disposed at the bottom in the rear current transformer and cable compartment **2310** illustrated in FIG. **23**F. The ground bus **1817** is configured to be connected to the ground bus **2312**, which in turn, is connected to the building or service ground.

[0156] The wall bushings **1810** are disposed on the bottom Glastic insulating barrier **1827** of the voltage transformer switch compartment **2308**. The wall bushings **1810** provide insulation for cables by increasing the creepage distance between a phase and the ground. In an embodiment, the wall bushings **1810** are installed in the Glastic insulating barrier **1827** to provide a better creepage distance between phase cables and the ground. The wall bushings **1810** provide a controlled and insulated passage for the braided copper wires **1819** to pass through the Glastic insulating barrier **1827** into the fuse compartment **2309** and connect to the upper fuse clip buses **1832** illustrated in FIG. **23**E. The wall bushings **1810** are made, for example, of glass polyester or porcelain. The phase barriers **1823** extend substantially perpendicularly to the rear support channel **1803**. The phase barriers **1823** are configured to accommodate the insulators **1809** as illustrated in FIG. **18**A. The phase barriers **1823** separate the input buses **1811***a*, **1811***b*, and **1811***c* of the voltage transformer switch input bus **1811**. The phase barriers **1823** serve as insulating barriers between the input buses **1811***a*, **1811***b*, and **1811***c* and prevent electrical arcing or short circuits between adjacent phases by increasing clearance and creepage distances within the voltage transformer disconnect switch **1800**. The support rods **1824** are connected to the phase barriers **1823** as illustrated in FIG. **18**A. The support rods **1824** provide support to the phase barriers **1823** within the voltage transformer disconnect switch **1800**. The support rods **1824** are made, for example, of glass polyester, nylon, etc.

[0157] The clamps **1821** and **1822** and the angle bracket **1825** for the clamps **1821** and **1822** are made, for example, of thermoset fiberglass-reinforced polyester insulating materials, for example, Glastic GPO-3 materials produced by the Glastic company. The structure and function of the clamps **1821** and **1822** and the angle bracket **1825** for the clamps **1821** and **1822** are disclosed in the description of FIGS. **22**A-**22**C. The spring pins **1224** illustrated in FIGS. **15**A-**15**C are also used in the 38 kV voltage transformer disconnect switch **1800** for securing the insulators **1802** to the switch blades **1801** of the 38 kV voltage transformer disconnect switch **1800** as disclosed in the description of FIGS. **15**A-**15**C. Also illustrated in FIG. **18**A is a switch handle assembly **1813** operably connected to the voltage transformer disconnect switch **1800** via a drive system, for example, a chain drive **1820**. The switch handle assembly **1813** comprises a switch handle **1814** configured to operate the voltage transformer disconnect switch **1800**. In an embodiment, the switch handle assemblies **1213** and **1813** of the 27 kV voltage transformer disconnect switch **1200** and the 38 kV voltage transformer disconnect switch **1800** illustrated in FIG. **12** and FIG. **18**A, respectively, are of a larger size and weight than the switch handle assembly **513** of the 15 kV voltage transformer disconnect switch **100** illustrated in FIG. **8**A, thereby requiring a larger bolt of high strength.

[0158] FIG. **18**B illustrates a top plan view of the embodiment of the 38 kV voltage transformer disconnect switch **1800** shown in FIG. **18**A. FIG. **18**C illustrates a front elevation view of the embodiment of the 38 kV voltage transformer disconnect switch **1800** shown in FIG. **18**A.

[0159] FIG. **18**D illustrates a right-side elevation view of the embodiment of the 38 kV voltage transformer disconnect switch **1800** shown in FIG. **18**A. The right-side elevation view shows the switch handle assembly **1813** operably connected to the voltage transformer disconnect switch **1800** via the chain drive **1820**. The switch handle assembly **1813** is, for example, the PowerCon® switch handle assembly A013-039. The chain drive **1820** is similar in structure and function to the chain drive **110** disclosed in the description of FIG. **5**D.

[0160] FIG. **19** illustrates a side elevation view of an embodiment of a switch blade **1801** of the 38 kV voltage transformer disconnect switch **1800** shown in FIG. **18**A. In an example, the length of the switch blade **1801** is about 23.875 inches, the width of the switch blade **1801** is about 2.5 inches, and the thickness of the switch blade **1801** is about 0.25 inches. The switch blade **1801** is made, for example, from aluminum.

[0161] FIGS. **20**A-**20**B illustrate perspective views of the opposing arms **1805** and **1806** of the 38 kV voltage transformer disconnect switch **1800** shown in FIG. **18**A. The arm **1805** is configured as a sheet metal control bracket with a generally circular hole **1805***a* as illustrated in FIG. **20**A. In an embodiment, the insulator **1808** proximal to the arm **1805** illustrated in FIG. **18**A, is connected to the arm **1805**, for example, using a ½-inch bolt inserted through the generally circular hole **1805***a* of the arm **1805**. The arm **1806** is configured as a sheet metal control bracket with grooves **1806***a* disposed around a generally circular hole **1806***b* as illustrated in FIG. **20**B. In an embodiment, the insulator **1808** proximal to the arm **1806** illustrated in FIG. **18**A, is connected to the arm **1806**, for example, using a ½-inch bolt inserted through the generally circular hole **1806***b* of the arm **1806**. In an example, the length, height, and width of the arms **1805** and **1806** are about 34.5 inches, about 6 inches, and about 2 inches, respectively. Each of the opposing arms **1805** and **1806** is made, for example, from a steel sheet of 11 gauge (ga) size.

[0162] FIGS. **21**A-**21**C illustrate a perspective view, a side elevation view, and a top plan view, respectively, of an embodiment of a clip **1815**/**1816** configured to connect the 38 kV voltage transformer disconnect switch **1800** shown in FIG. **18**A, to the main bus **1831** or to the ground bus **1817** shown in FIG. **23**D. A pair of clips **1815**/**1816** of the type shown in FIGS. **21**A-**21**C is attached back to back such that their curved front ends **1815***a*/**1816***a* abut each other to allow a tight engagement with the switch blades **1801** as illustrated in FIG. **18**A. Bases **1815***b*/**1816***b* of each clip **1815**/**1816** are attached to the voltage transformer switch input bus **1811** or the ground bus **1817** as illustrated in FIG. **18**A, to allow a tight connection of the upper main power clips **1815** and the lower grounding clips **1816** to the corresponding switch blades **1801**. In an example, the length of each clip **1815**/**1816** is about 1 inch, the height of each clip **1815**/**1816** is about 2.011 inches, the width of the base **1815***b*/**1816***b* of each clip **1815**/**1816** is about 1.05 inches, and the thickness of each clip **1815**/**1816** is about 0.05 inch. The clip **1815**/**1816** is made, for example, from a phosphor bronze sheet of 17 gauge (ga) size.

[0163] FIGS. **22**A-**22**C illustrate enlarged, perspective views of support clamps **1821** and **1822** configured to support the insulators **1802** and **1807** within the 38 kV voltage transformer disconnect switch **1800** shown in FIG. **18**A. The support clamps **1821** and **1822** are bolted between the insulators **1802** and **1807**. The support clamps **1821** and **1822** are configured to support the insulators **1802** and **1807** within the voltage transformer switch assembly. In an embodiment, the support clamps **1821** and **1822** comprise U-shaped openings **1821***a* and **1822***a*, respectively, configured to accommodate and support the insulators **1802**. In an embodiment, the support clamps **1821** and **1822** are two Glastic pieces with U-shaped cutouts or openings **1821***a* and **1822***a*, respectively. The support clamps **1821** and **1822** are disposed flush against each other in opposite directions, such that their U-shaped openings **1821***a* and **1822***a* are aligned with each other to accommodate the insulators **1802**. The support clamps **1821** and **1822** are bolted to the standoff insulator **1807** using the angle bracket **1825**. In an embodiment, the angle bracket **1825** is an L-shaped Glastic bracket as illustrated in FIGS. **22**A-**22**C. Two bolts, for example, ⅜-inch steel bolts **1825***b*, one of which is illustrated in FIG. **22**B, are inserted into openings **1825***a* of the angle bracket **1825**, one of which is illustrated in FIG. **22**A, for securing the support clamps **1821** and **1822** to the standoff insulator **1807**. The angle bracket **1825** bolted to the standoff insulator **1807** supports both the support clamps **1821** and **1822** with the U-shaped openings **1821***a* and **1822***a*, respectively. Also illustrated in FIGS. **22**A-**22**C is a switch blade **1801** sandwiched between the insulators **1802** and a braided copper wire **1819** attached to the lower part **1801***b* of the switch blade **1801**.

[0164] The two support clamps **1821** and **1822** provide additional strong support required by the 38 kV voltage transformer disconnect switch-insulator assembly which is long and heavy. The support clamps **1821** and **1822** are disposed at a point with the smallest diameter, that is, in between the two skirts of the insulators **1802**. The steel bolts **1825***b* used for securing the two support clamps

1821 and **1822** to the standoff insulator **1807** provide strength and rigidity to the support. The steel bolts **1825***b* get charged when a high lightning impulse voltage of, for example, about 150 kV, is applied to the 38 kV voltage transformer disconnect switch **1800**. The switch blades **1801** of the 38 kV voltage transformer disconnect switch **1800** are charged and that charge, in turn, charges the steel bolts **1825***b*. In an embodiment, a barrier is disposed between the steel bolt **1825***b* and the adjacent phase switch blade **1801** to preclude occurrence of a flash-over, thereby ensuring safety. Furthermore, since sufficient distance is provided between two switch blades **1801** with a Glastic phase barrier **1823** between phases as illustrated in FIG. **18**A, the charged steel bolts **1825***b* do not have any ground or phase nearby to discharge, thereby ensuring safety. The 38 kV voltage transformer disconnect switch **1800** is fully tested at 150 kV lightning impulse voltages. In an embodiment, for added safety, an insulating cap made, for example, of a plastisol material is disposed over each steel bolt **1825***b* on both sides for the nut and the bolt.

[0165] FIG. **23**A illustrates a front perspective view of an embodiment of the 38 kV utility metering cabinet **2300**, showing front outer doors **2302** and **2303** closed. The utility metering cabinet **2300** comprises an enclosure **2301** configured to meet predefined electrical enclosure requirements comprising, for example, National Electrical Manufacturers Association (NEMA) 3R requirements and the American National Standards Institute (ANSI)/the Institute of Electrical and Electronics Engineers (IEEE) Category A requirements. For example, the enclosure **2301** is designed for outdoor NEMA 3R and meets IEEE C37.20.3 Category A requirements. In an embodiment, the doors **2302** and **2303** comprise gaskets (not shown) and louvers **2302***a* and **2303***a* with filters (not shown). A voltage transformer switch compartment **2308**, a fuse compartment **2309**, and a current transformer and cable compartment **2310** are housed in the enclosure **2301** of the 38 kV utility metering cabinet **2300** as illustrated in FIGS. **23**D-**23**F. The enclosure **2301** of the 38 kV utility metering cabinet **2300** is larger than the enclosures **701** and **1701** of the 15 kV utility metering cabinet **700** and the 27 kV utility metering cabinet **1700** illustrated in FIGS. **7**A-**7**D and FIGS. **17**A-**17**C, respectively. In an example, the dimensions of the 38 kV utility metering cabinet **2300** with the voltage transformer disconnect switch **1800** are 74″ W×98″ D×122″ H. While the width of the enclosure of the utility metering cabinet is optimized for each kV rating due to the phase-to-phase and phase-to-ground distances required at each voltage rating, the depth and the height of the enclosure of the utility metering cabinet is configured to be flexibly adjusted to meet space requirements of various utilities for installation.

[0166] FIG. **23**B illustrates a front perspective view of the embodiment of the 38 kV utility metering cabinet **2300** shown in FIG. **23**A, showing open doors **2304** and **2305** of the voltage transformer switch compartment **2308** and the fuse compartment **2309**, respectively. Also illustrated in FIG. **23**B are safety interlocking devices **1828** and **1829** connected to the switch handle assembly **1813** and to the door **2305** of the fuse compartment **2309** of the utility metering cabinet **2300**. The safety interlocking devices **1828** and **1829** are, for example, KIRK® keys of Kirk Key Interlock Company, LLC. The safety interlocking devices **1828** and **1829** are configured to provide safety for opening and closing of the fuse compartment **2309**, ensuring that the voltage transformer disconnect switch **1800** illustrated in FIGS. **18**A-**18**D is grounded before the fuse compartment **2309** is opened for maintenance. In an embodiment, multiple viewing windows **2304***a*, for example, six Lexan© windows, are disposed on the door **2304** of the voltage transformer switch compartment **2308**, two for each phase, to view the position of the voltage transformer disconnect switch **1800** and to visually ensure that the switch blades **1801** of the voltage transformer disconnect switch **1800** are grounded before attempting to open the door **2305** of the fuse compartment **2309** with the safety interlocking device **1829**, thereby providing an added level of safety for field personnel.

[0167] FIG. **23**C illustrates a rear perspective view of the embodiment of the 38 kV utility metering cabinet **2300**, showing rear outer doors **2306** and **2307** closed. In an embodiment, the doors **2306** and **2307** comprise gaskets (not shown) and louvers **2306***a* and **2307***a* with filters (not shown). In an embodiment as illustrated in FIG. **23**C, a safety interlocking device **1830**, for example, a KIRK® key of Kirk Key Interlock Company, LLC, is used for securing the rear outer doors **2306** and **2307** of the 38 kV utility metering cabinet **2300**. The safety interlocking device **1830** is used to ensure that the rear outer doors **2306** and **2307** are not opened unless the voltage transformer disconnect switch **1800** illustrated in FIGS. **18**A-**18**D is in the grounded position and the utility metering cabinet **2300** is not energized.

[0168] FIG. **23**D illustrates a front perspective view of the embodiment of the 38 kV utility metering cabinet **2300**, showing the switch blades **1801** of the voltage transformer disconnect switch **1800** in the connected ON position in the voltage transformer switch compartment **2308**. The voltage transformer switch input bus **1811** comprising the input buses **1811***a*, **1811***b*, and **1811***c* illustrated in FIG. **18**A, is connected to the main bus **1831** as illustrated in FIG. **23**D. In an embodiment, the voltage transformer switch input bus **1811** serves as a riser bus that directly connects to the main bus **1831**, without a cable connection. Also illustrated in FIG. **23**D are the upper main power clips **1815** engaging the upper parts **1801***a* of the switch blades **1801** in the connected ON position, and the lower grounding clips **1816** attached to the ground bus **1817** of the 38 kV voltage transformer disconnect switch **1800** in the voltage transformer switch compartment **2308**. The construction of the 38 kV voltage transformer disconnect switch **1800** is similar to that of the 27 kV voltage transformer disconnect switch **1200** illustrated in FIG. **12**, except that the switch blades **1801** of the 38 kV voltage transformer disconnect switch **1800** are longer than the switch blades **1201** of the 27 kV voltage transformer disconnect switch **1200** illustrated in FIG. **12**. To accommodate the longer switch blades **1801**, stronger clips **1815** and **1816** are utilized in the 38 kV voltage transformer disconnect switch **1800** for securing the switch blades **1801** in their closed or connected ON position and the open or grounded position, respectively. To accommodate longer distances within the 38 kV voltage transformer disconnect switch **1800**, the switch blades **1801** are sandwiched between longer insulators **1802** that those of the 27 kV voltage transformer disconnect switch **1200**. For example, the insulators **1808** at the ends of the 38 kV voltage transformer disconnect switch **1800** are about 11 inches long and the insulators **1809** between phases are about 12.75 inches long. The mechanisms of the switch handle assembly **1813** and the chain drive **1820** in the 38 kV voltage transformer disconnect switch **1800** are similar to those of the 27 kV voltage transformer disconnect switch **1200** with accommodations made for the larger 38 kV voltage transformer disconnect switch **1800**.

[0169] FIG. **23**E illustrates a partial, front perspective view of the fuse compartment **2309** of the 38 kV utility metering cabinet **2300** shown in FIG. **23**A. The fuse compartment **2309** accommodates the fuse clip buses **1832** and **1833** configured to connect the voltage transformer disconnect switch **1800** shown in FIGS. **18**A-**18**D to the fuse clips **1834**. The fuse clips **1834** are configured to connect the input fuses of the voltage transformer to the multi-phase, main medium voltage bus. Since the 38 kV voltage transformer fuses are longer that those of the 15 kV voltage transformer or the 27 kV voltage transformer, the fuse clip buses **1832** and **1833** are longer and the fuse clips **1834** are larger to accommodate larger fuses. Utilities typically supply their own fuses that vary from utility to utility and, therefore, the fuses are not supplied by a manufacturer of the medium voltage switchgear.

[0170] FIG. **23**F illustrates a partial, rear perspective view of the 38 kV utility metering cabinet **2300** shown in FIG. **23**A, showing a phase current transformer and cable bus **2311** and a ground bus **2312** in the current transformer and cable compartment **2310**. The phase current transformer and cable bus **2311** connects to the main bus **1831** illustrated in FIG. **23**G via the voltage transformer switch input bus **1811** illustrated in FIG. **18**A and FIG. **23**D which serves as a riser bus. The main bus **1831** is disposed at the top of the enclosure **2301** as illustrated in FIG. **23**D and FIG. **23**G. The voltage transformer switch input bus **1811** is behind the metal barrier **2313** illustrated in FIG. **23**F. The main bus **1831** in turn connects to adjacent medium voltage, metal-enclosed switchgear sections (not shown) that incorporate either a load interrupter (LI) switch or a vacuum circuit breaker. The rear outer doors **2306** and **2307** of the 38 kV utility metering cabinet **2300** illustrated in FIG. **23**C, are opened to expose the current transformer and cable compartment **2310**. In an embodiment, the phase bus **2311** comprises three phase buses **2311***a*, **2311***b*, and **2311***c*. The ground bus **2312** provides a path for fault current to safely dissipate into the ground, thereby preventing excessive current from flowing through conductive components in the enclosure **2301**, minimizing the risk of overheating, fires, and equipment damage in the 38 kV utility metering cabinet **2300**. Proper grounding also prevents any electric shock or injury for personnel touching the enclosure **2301** if there is a short circuit or an electrical fault, for example, a phase-to-ground fault. The ground bus **1817** illustrated in FIG. **18**A is directly connected to the ground bus **2312** of the enclosure **2301** by a copper bus **1835** illustrated in FIG. **18**A. The current transformer connections and the cable connections are housed in the current transformer and cable compartment **2310**.

[0171] FIG. **23**G illustrates a partial, right-side perspective view of the 38 kV utility metering cabinet **2300** shown in FIG. **23**A, showing a direct connection of the voltage transformer switch input bus **1811** to the main bus **1831**. In this embodiment, the voltage transformer switch input bus **1811** serves as a riser bus that directly connects to the main bus **1831**, without a cable connection.

[0172] FIG. **24**A illustrates a rear, side perspective view of the 38 kV utility metering cabinet **2300** shown in FIG. **23**A, showing a rain shield assembly **2314** configured to prevent water from entering the 38 kV utility metering cabinet **2300**. The enclosure **2301** of the 38 kV utility metering cabinet **2300** is configured to withstand predefined stringent rain tests comprising, for example, the Institute of Electrical and Electronics Engineers (IEEE) rain tests by using the rain shield assembly **2314**.

[0173] FIG. **24**B illustrates an enlarged view of a portion marked A in FIG. **24**A, showing the rain shield assembly **2314**. In an embodiment, the rain shield assembly **2314** comprises a first shield **2315** and a second shield **2316** with a gasket **2316***a*. The first shield **2315** is configured to prevent water from entering the enclosure **2301** from the top of the enclosure **2301**. The first shield **2315** prevents water from entering the enclosure **2301** from the top of the enclosure **2301** during an American National Standards Institute (ANSI) rain test as disclosed in the description of FIG. **25**. The second shield **2316** with the gasket **2316***a* is configured to prevent water directed at the enclosure **2301** via wind gusts. The second shield **2316** with the gasket **2316***a* prevents rain entering during an IEEE rain test that simulates, for example, about 30 miles per hour (mph) wind gusts.

[0174] The large 74-inch wide 38 kV utility metering cabinet **2300** prevents water from entering the enclosure **2301**. The inner doors **2304** and **2305** in the 38 kV utility metering cabinet **2300** illustrated in FIG. **23**B prevent water from entering the front of the enclosure **2301**. The rain shield assembly **2314** prevents entry of rain into the enclosure **2301** in the rear of the 38 kV utility metering cabinet **2300**. The rain shield assembly **2314** prevents rain from seeping between the rear doors **2306** and **2307** of the 38 kV utility metering cabinet **2300**, coming in contact with live parts, and touching the ground bus **2312** at the bottom in the current transformer and cable compartment **2310** at the rear of the 38 kV utility metering cabinet **2300** illustrated in FIG. **23**F. The rain shield assembly **2314** has been successfully proven to pass the stringent ANSI/IEEE rain tests performed on the enclosure **2301** of the 38 kV utility metering cabinet **2300**.

[0175] FIG. **25** illustrates a schematic showing an arrangement of nozzles **2501** for performing a stringent rain test on the enclosure **2301** of the 38 kV utility metering cabinet **2300** of the medium voltage switchgear shown in FIGS. **23**A-**23**D and FIG. **23**F. In an example, the American National Standards Institute (ANSI) rain test requires three nozzles **2501** at three different heights spraying jets of water, each at 60 pounds per square inch (psi), on each side of the enclosure **2301** of the 38 kV utility metering cabinet **2300** as illustrated in FIG. **25**. The nozzles **2501** are spaced, for example, about 7 feet apart from each other. The 38 kV utility metering cabinet **2300** of the medium voltage switchgear is at a distance of, for example, about 10 feet away from the nozzles

2501. The rain shield assembly **2314** of the 38 kV utility metering cabinet **2300** illustrated in FIGS. **24**A-**24**B has successfully proven to pass the stringent ANSI rain test performed on the enclosure **2301** of the 38 kV utility metering cabinet **2300**.

[0176] The voltage transformer switch assembly disclosed herein provides a medium voltage transformer disconnect switch for a 5 kV, 15 kV, 27 kV, and 38 kV utility metering section of a medium voltage, metal-enclosed switchgear. The unified design of the voltage transformer disconnect switch is adapted for different voltage ratings by suitable changes in the length of the insulators used and the components used for insulation such as Glastic© GPO-3 barriers. The voltage transformer switch assembly disclosed herein uses a standard off-the-shelf switch handle assembly and a chain drive that are adapted to operate the voltage transformer disconnect switch efficiently. The clips in the voltage transformer switch assembly are shaped such that there is a tight connection when the switch blades are engaged in the clips. The voltage transformer switch assembly utilizes spring pins to secure the insulator and switch blade assembly that snap into place without additional hardware and assembly time. The chain drive of the voltage transformer disconnect switch interface prevents the switch handle of the switch handle assembly from operating more than 180 degrees top to bottom by a suitable slot or groove in the arm for the transfer of motion between the switch handle and the voltage transformer disconnect switch. The safety interlocking devices, for example, the KIRK® keys, incorporated in the enclosure of the utility metering section provide safety for opening and closing of the fuse compartment, thereby ensuring that the voltage transformer disconnect switch is grounded before the fuse compartment can be opened for maintenance. Furthermore, the enclosure is configured to meet National Electrical Manufacturers Association (NEMA) 3R Category A requirements and withstand IEEE stringent rain tests. The voltage transformer switch compartment, the fuse compartment, and the current transformer and cable compartment in the enclosure of the utility metering section of the medium voltage switchgear are arranged to meet Electric Utility Service Equipment Requirements Committee (EUSERC) requirements and are flexible to meet other utility requirements for the utility metering section of the medium voltage switchgear. The rain shield assembly for the wide 38 kV utility metering section prevents water from entering the enclosure via a gap between the twin doors in the rear of the enclosure.

[0177] The utility metering section of the medium voltage switchgear disclosed herein meets predefined utility requirements, for example, the Electric Utility Service Equipment Requirements Committee (EUSERC) requirements, without affecting the design of the voltage transformer disconnect switch. The voltage transformer disconnect switch at various operating voltages withstands both dielectric and lightning impulse voltages that depend on the operating voltage. When designs for 5 kV and 15 kV voltage classes are combined into a single product, the combined design meets the requirements for a 15 kV voltage class. Since the voltage transformer disconnect switch disclosed herein carries a low current, and is not required to open when energized, a low current rating of, for example, about 20 amperes (20 A) is more than sufficient, thereby rendering a low-cost, optimized design that is simple and easy to manufacture for utility metering.

[0178] The voltage transformer disconnect switch meets Underwriters Laboratories (UL) safety requirements for mechanical and environmental factors. The voltage transformer disconnect switch passes all UL rain tests and UL mechanical and electrical safety tests. The voltage transformer disconnect switch operates 500 cycles continuously without failure in conjunction with the safety interlocking devices to meet UL safety requirements. The voltage transformer disconnect switch follows the Electric Utility Service Equipment Requirements Committee (EUSERC) guidelines and accommodates minor changes, for example, enclosure dimensional changes, number of current transformers connected therewithin such as three (3) current transformers instead of two (2) current transformers, etc., required by other utilities that are not members of the EUSERC. Since the basic insulation level (BIL) and dielectric test voltages are different, the clearance and creepage distances required are also different. Therefore, sizes of the enclosures for different voltage classes are also different. The 38 kV voltage transformer disconnect switch is much larger than the 15 kV voltage transformer disconnect switch or the 27 kV voltage transformer disconnect switch. Consequently, the enclosure for the 15 kV voltage transformer disconnect switch is the smallest of the enclosures of the three voltage transformer disconnect switch designs.

[0179] The voltage transformer disconnect switch disclosed herein meets Category A safety requirements. As the enclosure of the voltage transformer disconnect switch is designed to meet Category A requirements, the enclosure also meets the requirements of Category B and Category C by elimination of some design features that are not necessary. In addition to a stringent rain test that simulates rain driven by 30 miles per hour (mph) wind at the rate of 0.2 inch per minute per vertical surface for 5 minutes, the enclosure of the utility metering section that houses the voltage transformer disconnect switch meets the mechanical tests for the enclosure and door handles. For safety, the outer doors of the enclosure protect all viewing windows. Furthermore, the enclosure passed an electrical rod entry test that was performed to ensure that a 0.5-inch or 13-millimeter (mm) diameter rod inserted through any opening in the enclosure does not touch any live parts inside the enclosure. The voltage transformer disconnect switch disclosed herein is a simple, low-cost, easy-to-build, and easy-to-manufacture switch that is fully tested to all applicable safety standards defined, for example, by the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), the Underwriter Laboratories (UL), and the Canadian Standards Association (CSA). The enclosure that houses the voltage transformer disconnect switch fulfils stringent ANSI test requirements and meets ANSI/IEEE Category A requirements for safety. The voltage transformer disconnect switch has an optimal design with a low current rating of, for example, about 20 amperes, for voltage transformer disconnection applications.

[0180] The utility metering section, for example, the medium voltage, metal-enclosed utility metering cabinet, of the medium voltage switchgear disclosed herein provides flexibility and cost savings of a completely factory-assembled, primary utility metering cabinet, where a customer can choose voltage transformers and current transformers to be incorporated therein. A utility typically installs the voltage transformers and the current transformers in the utility metering cabinet onsite. A manufacturer, therefore, supplies the utility metering cabinet without the voltage transformers and the current transformers. Provisions are made such that the mounting brackets provided at the bottom end of the enclosure meet utility requirements as defined by the Electric Utility Service Equipment Requirements Committee (EUSERC) or a specific utility if the utility is not a member of the EUSERC. Moreover, the customer is provided the flexibility of choosing between three distinct voltage transformer disconnect switches, that is, the 5 kV/15 kV voltage transformer disconnect switch, the 27 kV voltage transformer disconnect switch, and the 38 kV voltage transformer disconnect switch based on required features and advantages. The open/closed position of the voltage transformer disconnect switch is easily viewable through viewing windows, ensuring safety of the utility metering section during maintenance.

[0181] The foregoing examples and illustrative implementations of various embodiments have been provided merely for explanation and are in no way to be construed as limiting the embodiments disclosed herein. Dimensions of various parts of the voltage transformer switch assembly and the utility metering section disclosed above are exemplary, and are not limiting of the scope of the embodiments herein. While the embodiments have been described with reference to various illustrative implementations, drawings, and techniques, it is understood that the words, which have been used herein, are words of description and illustration, rather than words of limitation. Furthermore, although the embodiments have been described herein with reference to particular means, materials, techniques, and implementations, the embodiments herein are not intended to be limited to the particulars disclosed herein; rather, the embodiments extend to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims. It will be understood by those skilled in the art, having the benefit of the teachings of this specification, that the embodiments disclosed herein are capable of modifications and other embodiments may be effected and changes may be made thereto, without departing from the scope and spirit of the embodiments disclosed herein.

Claims

1. A voltage transformer switch assembly for a utility metering section of a medium voltage switchgear, the voltage transformer switch assembly comprising: a voltage transformer disconnect switch housed in a voltage transformer switch compartment of the utility metering section of the medium voltage switchgear, wherein the voltage transformer disconnect switch comprises a plurality of switch blades, one for each phase of a voltage transformer switch input bus, wherein the switch blades are mounted between insulators in the voltage transformer switch compartment; a plurality of clips configured to connect the voltage transformer disconnect switch to one of a main bus via the voltage transformer switch input bus, and a ground bus, wherein the clips comprising upper main power clips and lower grounding clips are configured for a tight connection to the switch blades, when the switch blades are engaged with the clips; and a switch handle assembly operably connected to the voltage transformer disconnect switch via a drive system, wherein the switch handle assembly comprises a switch handle configured to operate the voltage transformer disconnect switch.
2. The voltage transformer switch assembly of claim 1, further comprising pin members configured to snap into place and secure the insulators to the switch blades sandwiched therebetween in the voltage transformer switch compartment.
3. The voltage transformer switch assembly of claim 1, wherein the switch blades are connected to the ground bus to ground the voltage transformer disconnect switch for safety during maintenance and service.
4. The voltage transformer switch assembly of claim 1, wherein upper parts of the switch blades are configured to connect to one of: (a) the voltage transformer switch input bus that connects a voltage transformer to the main bus of the utility metering section via cables; and (b) the ground bus for safety.
5. The voltage transformer switch assembly of claim 1, wherein upper parts of the switch blades are configured to engage with the upper main power clips for connections to the voltage transformer switch input bus and with the lower grounding clips for connections to the ground bus.
6. The voltage transformer switch assembly of claim 1, wherein the utility metering section comprises a fuse compartment disposed in a front, bottom location of the utility metering section, wherein the fuse compartment is configured to accommodate a voltage transformer and input fuses of the voltage transformer.
7. The voltage transformer switch assembly of claim 6, further comprising first fuse clips disposed in the fuse compartment of the utility metering section, wherein lower parts of the switch blades are configured to engage with the first fuse clips for lower bus connections in the fuse compartment.
8. The voltage transformer switch assembly of claim 7, further comprising second fuse clips installed on fuse clip buses disposed in the fuse compartment of the utility metering section, wherein the fuse clip buses are configured to connect the voltage transformer disconnect switch to the second fuse clips, and wherein the second fuse clips are configured to connect the input fuses of the voltage transformer to the voltage transformer switch input bus.
9. The voltage transformer switch assembly of claim 8, wherein lower parts of the switch blades are connected to upper ones of the fuse clip buses in the fuse compartment using the first fuse clips.
10. The voltage transformer switch assembly of claim 8, wherein lower parts of the switch blades are connected to upper ones of the fuse clip buses in the fuse compartment using braided copper elements.
11. The voltage transformer switch assembly of claim 6, further comprising safety interlocking

devices connected to the switch handle assembly and to a door of the fuse compartment of the utility metering section, wherein the safety interlocking devices are configured to provide safety for opening and closing of the fuse compartment, ensuring that the voltage transformer disconnect switch is grounded before the fuse compartment is opened for maintenance.
12. The voltage transformer switch assembly of claim 6, wherein rails and mounting brackets are disposed at a bottom end of the fuse compartment of the utility metering section, wherein the rails and the mounting brackets are configured to mount the voltage transformer in the fuse compartment in accordance with predefined utility requirements.
13. The voltage transformer switch assembly of claim 6, wherein the utility metering section further comprises a current transformer and cable compartment disposed in a rear location of the utility metering section and configured to house current transformers and the main bus, wherein the voltage transformer switch compartment disposed in a front, upper location of the utility metering section, the fuse compartment, and the current transformer and cable compartment are arranged to meet predefined utility requirements comprising Electric Utility Service Equipment Requirements Committee (EUSERC) requirements for the utility metering section of the medium voltage switchgear.
14. The voltage transformer switch assembly of claim 1, wherein the drive system is a chain drive comprising a chain wrapped around a first sprocket wheel and a second sprocket wheel, wherein the first sprocket wheel is connected to the switch handle assembly, and the second sprocket wheel is operably connected to an end one of the insulators to facilitate smooth motion of the voltage transformer disconnect switch and the switch handle.
15. The voltage transformer switch assembly of claim 14, wherein the second sprocket wheel is further operably connected to a fixed bracket and a moving bracket via a shaft configured to facilitate motion of the switch handle, wherein the moving bracket is operably connected to the end one of the insulators via an arm of the voltage transformer switch assembly, wherein the arm is configured as a sheet metal bracket comprising grooves cut thereinto, and wherein the grooves of the arm are configured to restrict motion of the moving bracket to only about 90 degrees via bushings moving within the grooves of the arm.
16. The voltage transformer switch assembly of claim 15, wherein the arm and the moving bracket define an interface between the drive system and the voltage transformer disconnect switch to prevent the switch handle from operating more than about 180 degrees from a top position to a bottom position, wherein the grooves of the arm are configured to transfer motion between the moving bracket and the voltage transformer disconnect switch, and wherein the moving bracket is configured to move only about 90 degrees about the shaft to move the switch blades from a connected position to a grounded position.
17. The voltage transformer switch assembly of claim 1, further comprising support clamps bolted between the insulators and configured to support the insulators within the voltage transformer switch assembly, wherein the support clamps comprise U-shaped openings configured to accommodate and support the insulators.
18. The voltage transformer switch assembly of claim 1 disposed in an enclosure configured to meet predefined electrical enclosure requirements comprising National Electrical Manufacturers Association (NEMA) 3R requirements and the American National Standards Institute (ANSI)/the Institute of Electrical and Electronics Engineers (IEEE) Category A requirements.
19. The voltage transformer switch assembly of claim 18, wherein the enclosure is further configured to withstand predefined stringent rain tests comprising the Institute of Electrical and Electronics Engineers (IEEE) rain test and the American National Standards Institute (ANSI) rain test by using a rain shield assembly, wherein the rain shield assembly comprises: a first shield configured to prevent water from entering the enclosure from top of the enclosure; and a second shield with a gasket configured to prevent water directed at the enclosure via wind gusts.
20. The voltage transformer switch assembly of claim 1 adapted for a substantially low current

rating and a plurality of voltage ratings comprising 5 kilovolts, 15 kilovolts, 27 kilovolts, and 38 kilovolts.