# GENERAL

### The requirements of the Contract, Division 1, and Division 16 apply to work in this Section.

## SECTION INCLUDES

### Low voltage, front/rear-accessible, ANSI/IEEE rated metal enclosed switchgear line-up with drawout ANSI/IEEE rated low voltage power circuit breakers in an integrated system as specified below and shown on the contract drawings.

### This specification and associated drawings describe for 600VAC ReliaGear LV SG Low Voltage Draw-out Switchgear assemblies constructed to ANSI/IEEE C37.20.1 standards.

## RELATED SECTIONS

### [26 24 13 Surge Protective Devices]

## REFERENCES

### The ReliaGear LV SG equipment lineup and low voltage power circuit breakers in this specification shall be designed, tested and manufactured according to latest revision of the following standards, unless otherwise noted.

### ANSI/IEEE C37.16 , Low Voltage Power Circuit Breakers and AC Power Circuit Protectors- Preferred Ratings, Related Requirements, and Application Recommendations

### ANSI/IEEE C37.17, American National Standard for Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers

### ANSI C37.50, Switchgear - Low Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures

### ANSI/IEEE C37.51, American National Standard for Switchgear - Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies - Conformance Test Procedures

### ANSI C39.1, Requirements for Electrical Analog Indicating Instruments

### ANSI/IEEE C37.13, Low - Voltage AC Power Circuit Breakers Used in Enclosures

### ANSI/IEEE C37.20.1, IEEE Standard for Metal-Enclosed Low Voltage (1000 VAC and below, 3200VDC and below) Power Circuit Breaker Switchgear

### ANSI/IEEE C37.27, IEEE Standard Application Guide for Low-Voltage AC Non-Integrally Fused Power Circuit Breakers (Using Separately Mounted Current Limiting Fuses)

### ANSI/IEEE C57.13, IEEE Standard Requirements for Instrument Transformers

### ANSI/IEEE C37.90.2, IEEE Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

### UL 1066, Standard for Low Voltage AC and DC Power Circuit Breakers Used in Enclosures

### UL 1558, Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear

## SYSTEM DESCRIPTION

### The switchgear shall be rated at [208] [240] [480] [600] volts, three phase, [3] [4] wire, [60] [50] Hertz power system having a short circuit availability [42] [50] [65] [85] [100] kilo-Amperes RMS symmetrical.

## SUBMITTALS

### The contractor/installer shall provide the following documents as APPROVAL drawings to the engineer/owner for review and evaluation. The equipment manufacturer shall provide the factory shop drawings as detailed below. Manufacturing of the equipment will not begin until the submitted documents are acknowledged “APPROVED” or “APPROVED AS NOTED” by the engineer/owner and officially released for manufacture by the contractor/installer/distributor/owner.

#### Shop drawings of the designed equipment including:

##### Breaker Options Summary Sheets

##### Detailed Bill of Material for Installed Component Devices

##### Nameplate Engraving Sheets

##### Equipment ratings (short circuit, voltage, continuous current)

##### [Key Interlock ordering Sheets – If required]

##### Summary of Equipment Options Sheets

##### [Special Requirements Sheets – If required]

##### Equipment One Line Bussing Diagram

##### Front View (Elevation View)

##### Floor Plan

##### Top View

##### Electrical Schematic drawings

##### Plan View showing Power Cable Conduit Areas and Control/Signal Conduit Areas

##### Typical Section Side View showing breaker compartment and bus/cable compartment details

##### Panel Layouts for each section and cubicle showing component device location

##### Drawing Legend Sheet

##### 3 Line Power Elementary Diagrams

##### Control Circuit Wiring Diagrams

##### [Control Power Throwover Diagram – If applicable]

##### [HMI Circuit Diagram – if applicable]

##### Device Communication Diagrams

##### [Zone Definition Diagrams -if applicable]

##### [Product data sheets – if required]

##### [Heater Circuit and Auxiliary Circuit Diagrams – If applicable]

##### [Busway connection – if applicable]

### Product information sheets for the major/key installed component devices. Major components to include but at engineer’s discretion not limited to:

#### Circuit breakers

#### Instrument transformers, including CTs or Rogowski coils for circuit breakers

#### Trip, protective relays or similar electronics devices

#### Electronic devices used for communications

#### Electronic devices used for control such as computers or PLCs

#### Control devices such as HOA switches, ON/OFF switches, Test blocks, etc.

#### UPS (required for control power in specifications to follow)

### The contractor/installer shall provide the following documents as Record Drawings to the engineer/owner after the equipment has shipped. These drawings will reflect the “AS BUILT” condition of the specified equipment.

#### Shop drawings of the manufactured equipment shall include all the same information as the APPROVAL drawings plus the following:

#### Point-to-Point Wiring Diagrams for each section cubicle

#### Equipment & breaker instruction books.

#### Instruction books for major component devices installed by the manufacturing factory.

#### Installation publications and drawings.

### The manufacturer shall provide drawings in the following format. Refer to the SUBMITTALS section for the specific documentation requirements.

#### Approval and Record documentation shall be supplied in an all [electronic][and][or][paper] format as detailed below:

##### Electronic equipment mechanical and electrical drawings shall be provided in [Adobe PDF formats] [AutoCAD dwg] [ dxf].

##### [Electronic general information details (nameplate schedules, material lists, etc.) shall be provided in Adobe PDF format.]

##### [Other information (data sheets, standard typical diagrams, etc.) shall be provided in Adobe PDF format.]

##### [Paper documentation shall be provided on size “A” (8.5” x 11”) or size “B” (11” x 17”) paper to facilitate easy copying.]

##### Submittal and record documents shall include a list of potential spare parts to include all trip devices, protective relays, meters, instrument transformers for meters and relays, communicating devices and control devices.

##### [Insert quantity of paper copies] copies shall be provided.

### Factory certified test reports [are not required as normal factory testing procedures are acceptable.][shall be issued at the conclusion of the factory testing. The format of the information shall be the same as described in the “Approval and Record documentation” section above.]

### Manufacturer shall provide [3] [digital] copies of installation, operation and maintenance procedures to owner in accordance with general requirements of Division [1] [01] and Division [16] [26].

## QUALITY ASSURANCE (QUALIFICATIONS)

### The manufacturer shall have specialized in the manufacture and assembly of low voltage switchgear for at least 20 years and shall have at least 5 years’ experience incorporating intelligent electronic devices (PLCs, Multifunction Meters, Communicating Trip Units, etc.) as functioning systems into the equipment lineup. If requested to do so, the manufacturer shall provide a listing of projects demonstrating their compliance to the engineer/owner.

### The manufacturer shall be ISO 9001 certified.

### The equipment shall be manufactured in accordance with standards listed in the REFERENCES Section of this specification.

### The switchgear lineup shall be constructed [to regular design parameters, the project has no building code seismic requirements] [to meet seismic qualifications of IBC-2018/CBC-2019 and IEEE-693].

## DELIVERY, STORAGE, AND HANDLING

### Ambient temperature of the area where the equipment will be installed must be between minus 30 degree C (minus 22-degree F) and plus 40 degrees C (104-degree F) and shall be protected to prevent moisture from entering enclosure [see circuit breaker temperature de-rating factors above 40 degree C per manufacture’s requirements].

### The equipment shall be shipped FCA Sellers facility or FCA Buyers/FF Warehouse. It is the responsibility of the contractor/installer to inspect and report any damage to a manufacturer’s representative who shall handle any freight damage claim.

### Within 24 hours of receiving the equipment, the contractor/installer shall heat the equipment enclosures with a temporary heat source to prevent condensation per the storage instructions of the equipment manufacturer.

### The contractor/installer shall handle the equipment in accordance with all appropriate NEMA, ANSI/IEEE, UL, and manufacturer's written instructions to avoid damaging the equipment, installed devices and finish.

### The contractor/installer shall protect and handle the equipment in accordance with recommended practices listed in manufacturer's installation publications and/or maintenance manuals. When stored, the equipment shall be located in a clean, dry space and shall maintain factory protection or cover the equipment with heavy canvas to keep out dirt, water, construction debris, and traffic.

### The contractor/installer shall follow all appropriate standards and service conditions before, during and after the equipment installation.

### The final location of the equipment shall be in a well-ventilated area, free from excess humidity, dust and dirt and away from hazardous materials.

## WARRANTY

### The manufacturer warrants the low voltage metal-enclosed switchgear to be free from defects in materials and workmanship for 1 year from date of installation or 18 months from date of shipment, whichever occurs first. The equipment must be received, stored and installed in accordance with the manufacturer’s installation publications and/or maintenance manuals to avoid nullifying this warranty.

### In the event that any warranty work needs to be performed, a representative of the manufacturer shall be notified in writing of the problem. The manufacturer’s factory will then issue instructions and any materials to correct the problem. All warranty work must be performed by the manufacturer at the manufacturer’s discretion in order to maintain the manufacturer’s warranty.

1. [An extra one year warranty shall be provided when the manufactures’ field service organization performs start-up and commissioning services detailed in Part 3.]

## FIELD MEASUREMENTS

### The contractor/installer shall make all necessary field measurements to verify that the low voltage switchgear lineup shall fit in allocated space in full compliance with minimum required clearances recommended by the manufacturer, specified in National Electrical Code and required by any applicable local/facility requirements.

# PRODUCTS

## MANUFACTURER

### ABB ReliaGear LV SG low voltage metal enclosed switchgear has been used as the basis for design for this project. Other manufacturers' products of equivalent quality, dimensions and operating features that could be considered “as equal” must comply with all requirements specified in these specifications and as indicated in the project contract drawings.

### Any and all exceptions to the requirements detailed below shall be included in the contractor’s proposal so that the engineer or owner’s representative can easily make a comparison to this base-line specification document. The contractor shall document in their proposal that the manufacturer provided detailed information to support exceptions or substituted products.

### If no exceptions or qualifications are contained in the alternate contractor’s and manufacturer’s proposal, the alternate manufacturer shall provide exactly what is detailed in both this specification and the project contract documents. Failure to meet this requirement will result in the rejection of the proposal based on non-compliance with the technical performance requirements of this specification.

### The first source of general information shall be these general specifications; however, detailed and specific information contained in the drawings will take precedence over these general specifications as the drawings contain project specific information. In the event of a conflict between the plans and specifications, the owner/engineer will determine which is correct.

## GENERAL

### The ABB ReliaGear LV SG low voltage metal-enclosed switchgear is the basis for design. The switchgear system lineup shall be completely factory assembled and shall contain upper, lower and side metal compartmentalized units for removable low voltage power circuit breakers. The switchgear assemblies and circuit breakers shall be constructed by the same manufacturer.

### The ABB Emax2 circuit breakers are used as the basis for design. The Low Voltage Power Circuit Breakers (air circuit breakers) shall be UL listed per UL 1066 and built to pertinent ANSI/IEEE specifications. Use of, or substitution by UL 489 listed molded case circuit breakers (MCCBs) or insulated case circuit breakers (ICCBs) or any protective device is unacceptable and will be rejected by the owner/engineer.

### The low voltage switchgear shall be rated [208] [240] [480] [600] volts, 3 phase, [3-wire] [4-wire] with [50 percent neutral] [100 percent neutral], [50] [60] HZ.

### The overall short circuit value of the switchgear lineup shall be rated and labeled as [42,000 Amperes @ rated voltage][50,000 Amperes @ rated voltage][65,000 Amperes @ rated voltage] [85,000 Amperes @ rated voltage][100,000 Amperes @ rated voltage][shown on the project drawings]. .

## STRUCTURE

### The low voltage metal enclosed switchgear lineup shall be engineered and fabricated to meet the specific project electrical distribution, protection and control requirements as detailed in this specification. The specific equipment lineup properties are listed below.

### ***NOTES TO SPECIFIER: TO OPTIMIZE THE LIFE AND RELIABILITY OF ALL SWITCHGEAR, ABB RECOMENDS THAT SWITCHGEAR BE ALWAYS INSTALLED INDOORS IN A PERMANENT BUILDING OR SUITABLE E-HOUSE WHERE TEMPERATURE FLUCTUATIONS ARE MINIMIZED. ABB SWITCHGEAR IS FULLY RATED FOR TEMPERATURE RANGES DEFINED IN ALL APPLICABLE STANDARDS.***

### Equipment construction shall house all live components in a grounded metal enclosure 92 inches high with a code gauge modular designed steel frame with removable plates. The overall lineup enclosure construction type shall be as (**select one of the four selections below**)[Indoor type NEMA 1. The enclosure is intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment].[Indoor type NEMA 1 Drip proof. The enclosure is intended for indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt. No breaker hoist rails, or breaker hoist can be provided with this equipment configuration]. [NEMA 3R non-walk-in enclosure. The enclosure is intended for outdoor use to provide protection against water intrusion, dirt and wind] [NEMA 3R walk-in enclosure. The enclosure is intended for outdoor use to provide protection against water intrusion, dirt and wind]. [The switchgear shall be enclosed in an outdoor walk-in NEMA 3R enclosure conforming to all applicable requirements of ANSI and UL. The enclosure shall have a roof sloping toward the rear. Outer sections shall be the same widths as indoor structures except the end sections of a walk-in enclosure shall be wider than the inner sections to permit opening the inner door. Each end of the outdoor structure shall have an end trim. Front aisle depth for walk-in structures shall be a minimum of 42 inches.]

### ***NOTES TO SPECIFIER: PLEASE CHECK WITH YOUR ABB REPRESENTATIVE TO CONFIRM THAT THE REQUIRED SIZES CAN BE PROVIDED.***

### [The equipment lineup shall be provided with [no heaters as the equipment is indoor NEMA 1 rated and is located in an electrical room with a temperature range between minus 30 degree C (minus 22 degree F) and plus 40 degrees C (104 degree F)][heaters located in each vertical stack rear cable compartment and the strip heater shall be controlled by the devices listed below].

#### [As no heaters are required there is no need for any heater controlling device.]

#### [The heaters installed in the lineup are required to be controlled by a thermostat][The heaters installed in the lineup are not required to be controlled by an installed thermostat].]

### To accommodate cables and conduits equipment lineup depth [shall be 54 inches deep][shall be 60 inches deep][shall be 67 inches deep][shall be 74 inches deep][shall be as shown on the project drawings]. In all cases sufficient space shall be provided to accommodate conduit openings, cable entrance or bus entrances as indicated on the contract drawings or conductor schedules.

### Incoming Line Section

#### Incoming line section shall be [3- wire] [4-wire], [1600A] [2000A] [3200A] [4000A] [5000A] [6000A] [rated and arranged as indicated on drawings]

#### Incoming line shall be [main cable connection with mechanical lugs.] [Main cable connection with compression lugs.] [Transition to a transformer.] [busway connection which will include cutout in the switchgear top/bottom plate.]

### The switchgear front doors shall [shall have ¼ turn latches to easily secure the front doors in the fully closed position] [shall have ¼ turn latches with padlocking provisions to prevent unauthorized entry into the front compartment (not available in 15” wide section)] ][shall have ¼ turn latches with key locking provisions to prevent unauthorized entry into the front compartment].

### A Service Entrance label and required service entrance provisions [are][are not] required for the equipment.

### A UL 1558 label shall be provided on the equipment verifying that the lineup meets all requirements of UL for metal-enclosed low voltage power circuit breaker switchgear.

### The equipment shall be manufactured to meet the applicable requirements of the governing bodies cited in the REFERENCES section. [No other special/local code regulations are required.][Additionally the low voltage switchgear lineup shall meet the requirements of the California code.][Additionally the low voltage switchgear lineup shall meet the requirements of the Chicago code.][Additionally, the low voltage switchgear lineup shall meet the requirements of the New York City code.]

### Rear floor plates [are not required, provide the standard open rear cable area to facilitate easier installation][are required, provide metal plates in the bottom of the power cable compartment along the floor to seal off the compartment. The installer/contractor shall be responsible for punching the plates to provide access for the conduits].

### Insect screens in the equipment lineup [are not required, provide standard indoor construction][are required as there is a concern of possible rodent/insect migration into the switchgear].

### The equipment line-up shall be provided with [no additional sub base, the standard equipment base assembly shall be provided][no additional sub base, the standard equipment base assembly shall be provided as the lineup will rest on a traditional housekeeping pad][a 4 inch high sub base to raise the equipment lineup off the ground. This subbase shall be bolted to the standard equipment base frame]

### To facilitate the ease of equipment assembly and installation, the maximum equipment shipping split section width shall be [120 inches to minimize the amount of assembly sections.][49 inches to provide individual vertical stacks, which will allow easier egress to the final location.][Insert width of shipping section in inches.]

### When shipped from the factory the packaging shall be standard domestic factory packaging (poly wrapped, cardboard/Styrofoam cushions, etc.), special export packaging is not required.

## BUS

### All bus bars in the switchgear lineup shall be braced and labeled to withstand the short circuit mechanical forces [of 65,000 Amperes @ rated voltage] [100,000 Amperes @ rated voltage] [150,000 Amperes @ rated voltage] [200,000 Amperes @ rated voltage] [as shown on the project drawings].

### The main bus in the switchgear lineup shall be made of copper and shall be rated and labeled to handle an electrical load of [2000 Amperes] [3200 Amperes] [4000 Amperes][5000 Amperes][6000 Amperes][8000 Amperes] [as shown on the project drawings].

### A ground bus shall be secured to each vertical section structure. It shall also extend the entire length of switchgear lineup and shall be equipped with a 4/0 terminal for connection to the building’s ground system. The ground bus in the switchgear lineup shall be made of copper and shall be [one 0.25” x 3” bar][two 0.25” x 3” bars][as shown on the project drawings].

### If provided, the copper neutral bus shall be mounted on standoff insulators to isolate it from ground. The specifics of the equipment neutral bus [do not apply as the equipment power source contains no neutral connection and therefore no neutral bus is required in the equipment lineup] [shall have a full rating (100%) neutral bar, the neutral bus and the phase buses shall be identical in ratings][shall have a half rated (50%) neutral bar, the neutral bus shall be half the rating of the phase buses][shall be as shown on the project drawings].

### To facilitate the ease of dressing the exiting cables [only the ground bus shall be considered as the lineup has no neutral bus][the neutral bus shall be located in an upper location as the majority of cables will exit out the bottom of the equipment][the neutral bus shall be located in a lower location as the majority of cables will exit out the top of the][shall be as shown on the project drawings].

### [The configuration of the system neutral for high resistance grounded systems: [Grounding shall be as indicated on the contract drawings. A CT shall be provided to measure neutral resistor current. Resistor shall be adjustable from 1 to 10 amperes at application voltage].]

### Grounding for solidly grounded WYE systems: The system shall be grounded and bonded as per contract drawings. Where equipment needs to be considered as “Service Entrance Equipment” all applicable requirements of the National Electrical Code as interpreted by the local jurisdiction shall be followed.

### The same material shall be used at the vertical-to-horizontal bus connections and at points where vertical bus connects to bus bars supplying power to circuit breaker compartments. All bus material and plating in the switchgear lineup shall be [copper buses with silver plating][copper buses with tin plating].

### All bus hardware shall be high tensile strength zinc chromate plated steel. [Split washers or similar shall be provided at all bus joints][Belleville washers shall be provided on all bolted bus joints].

### The vertical bus shall be held rigid in support structure of short circuit resistant, molded glass reinforced polyester bases to inhibit the spread of arcing faults. All bus bars shall be arranged to permit the addition of future sections.

### [Furnish an insulated / isolated bus system which fully insulates the horizontal main bus with a fluidized epoxy coating and isolates each phase of the vertical riser bus with molded polyester glass barriers. Main bus joints shall be accessible through removable / replaceable covers. No live connections shall be accessible from the rear except the breaker load side terminals.]

### [Vertical and horizontal buss shall be isolated from cable compartment by glass reinforced polyester barriers. No live connections shall be accessible from the rear except the breaker load side terminals.]

## CABLE COMPARTMENTS

### The switchgear shall have rear cable terminal compartments. The cable bending space shall meet National Electrical Code requirements.

### Conductors shall terminate into [compression lugs – two-hole long barrel type shall be provided for every cable connection. Refer to the project drawings for quantity and size information.][clamp lugs (mechanical type) shall be provided for every cable connection. Refer to the project drawings for quantity and size information.]

### The direction of the cables feeding / being fed from the equipment [is top only][is bottom only][is both top and bottom][is detailed on the project drawings].

### The switchgear lineup shall be provided with [rear cable space, all cables shall enter and exit using the manufacturer defined power cable conduit areas. No additional pull box accessory is required.][a 15 inch high pull box.][a 22 inch high pull box.][a 29 inch high pull box.] As [no pull box is required, no cable supports or section barriers within the pull box are required.][a pull box is being supplied, the interior of this accessory shall be provided with cable supports to aid in wire management.][a pull box is being supplied, the interior of this accessory shall be provided with section barriers to aid in wire containment.][a pull box is being supplied, the interior of this accessory shall be provided with both cable supports and section barriers to aid in wire management and containment.]

### The rear of the switchgear shall be provided with [bolted covers][hinged rear-doors to allow easier access into the rear cable-compartment, in lieu of bolted covers. These doors shall be split height such that they will provide separate access to the upper and lower sections of the rear cable section.][hinged rear doors to allow easier access into the rear cable compartment, in lieu of bolted covers. These doors shall be full height such that they will provide unobstructed access to the entire rear cable section.]

### Access to the rear compartment of the switchgear shall [not require any additional locking provisions][require rear door padlock provisions to provide secured access to the cable section of the equipment lineup] [require rear door keylock provisions to provide secured keyed access to the cable section of the equipment lineup].

### Opening the rear [covers shall be accomplished by removing the corner bolts][doors shall be accomplished using a T-handle mechanism].

### Securing the rear [covers shall be accomplished by tightening the corner bolts][full height doors shall be accomplished using a three point catch to secure the door at the top, bottom and side].

### Service into the rear sections [shall be accomplished by removing the rear covers][shall be accomplished using rear door stops, this will allow the doors to be locked into to open position].

### [Section barriers consisting of metal and polyester-glass vertical barriers between sections shall be provided [between the main and feeder sections][between all sections].]

### [Infrared viewing windows to allow the use of an infrared camera or thermal imager direct line of site to inspect electrical connections without requiring the opening of panels and doors is required. These windows are intended to allow thermographers the ability to inspect the electrical equipment without directly exposing themselves to live electrical components and energized devices.]

## BREAKER COMPARTMENTS

### A true closed-door draw out mechanism shall be employed to permit the circuit breaker to be moved from the connected to disconnected position without opening the cubicle door.

### The draw out mechanism shall provide four distinct positions: connected, test, disconnected, and withdrawn. An indicator shall be provided to show the position status. The cubicle door shall be able to close when circuit breaker is in the connected, test or disconnect position.

### Each circuit breaker compartment/cradle shall have grounded barriers at top, bottom, front and sides. Furnish each compartment/cradle with draw-out rails and the necessary secondary control contact points.

### Padlocking provision shall permit locking the breaker in the test and disconnected positions while in the cubicle.

### Grounding of the breaker frame to the switchgear steel frame shall be maintained throughout the travel of the draw out mechanism.

### Each breaker compartment/cradle shall be designed so that only the frame and short circuit rating for which the compartment/cradle was designed can be inserted. Devices of equal frame and short circuit rating size shall be interchangeable.

### A breaker door interlock [is not required, provide the standard door mechanism assembly][is required as there is a need to prevent the compartment door from opening unless the breaker is in the TEST or DISCONNECT position].

### Drawout compartment shutters used to protect operators from accidental contact with breaker stabs when the breaker is withdrawn from its cubicle shall be provided on all breaker cubicles in the lineup.

### The compartment door shall [be a standard compartment door with no interlock, the door may be opened with the breaker in the connected, test or disconnected position][be provided with a defeatable compartment door interlock to prevent inadvertent opening of the compartment door unless the breaker is in the disconnected position].

### The compartment shall [not be a equipped with a position switch as there is no requirement to communicate if the breaker is in the racked-in or disconnected position][be equipped with a position switch to communicate if the breaker is in the racked-in or disconnected position][be equipped with a position switch that shall signal to the automatic throwover system if the breaker is in the racked-in or disconnected position].

## CIRCUIT BREAKERS

### General Circuit Breaker Requirements

#### The ABB ANSI/IEEE and UL-1066 Emax2 low voltage power circuit breaker product has been chosen as the basis of design given its robust insulated frame construction enabling square ratings and its ability for majority of parts to be replaced resulting in a favorable service cost versus replacement cost impact to the user. Use of, or substitution of, UL489 insulated case circuit breakers or molded case circuit breakers is unacceptable and will be rejected by the owner/engineer.

#### Each breaker shall be a 3-pole, electrically and mechanically trip free unit with self-aligning primary and secondary disconnecting contacts, arc quenchers, position indicator and the necessary hardware to mount on a drawout mechanism in the compartment.

#### All circuit breakers shall be drawout type and the primary connections shall be fully silver-plated copper-to-copper.

#### Manual or electrical closing mechanisms shall use an energy storage spring between the operator and the breaker contacts. This spring shall provide a constant closing speed not influenced by operator speed or control power voltage level.

#### All circuit breaker operating mechanisms are to be stored energy devices with a maximum of 70ms closing time. With the breaker closed and the spring charged, breaker should be able to complete an Open-Close-Open (O-C-O) cycle without recharging.

#### Current-carrying components shall be completely isolated from the accessory mounting area and double insulated from the operator with accessory cover in place.

#### Each phase inside the circuit breaker shall be completely isolated from other phases and grounded by polyester thermoset material.

#### Circuit breaker must be equipped with an interlock to discharge the stored energy spring before the circuit breaker can be withdrawn from its cell. Circuit breaker must provide a positive ground.

#### [Ready-to-close contact must be available to indicate remotely that the circuit breaker is “ready-to-close.” The circuit breaker is ready to close when it is open, spring mechanism is charged, a maintained closing order is not present, a maintained opening order is not present, and the circuit breaker is in an operational position.]

#### Circuit breaker shall be equipped with a contact wear indicator, visible from trip unit display or from a PC using a communication unit.

#### The circuit breaker shall contain a current sensor that matches the frame rating. [The feeder breaker shall contain a 250-ampere sensor to allow use of a 100, 200 or 250 rating plug.]

#### Provide circuit breakers rated as indicated in the single-line diagram.

#### The circuit breaker shall be a non-fused style breaker. The circuit breaker shall have no open fuse lockout device, no integral fuse, nor shall it have an associated fuse truck compartment.

#### Key interlocking, when required, shall be as indicated in the project drawings].

### Main and Tie Circuit Breakers

#### Circuit breaker shall be draw out type, [manually] [electrically] operated.

##### [The breaker closing springs will be charged via a spring charging motor. Control voltage/power of {24-30VAC/VDC}{48-60VAC/VDC}{100-130VAC/VDC}{220-250VAC/VDC} shall be provided on electrically operated breakers].

##### A {24VAC/VDC} {30VAC/VDC} {48VAC/VDC } {60VAC/VDC} {110-120VAC/VDC} {120-127VAC/VDC} {220-240VAC/VDC} {240-250VAC/VDC } shunt trip shall be provided on electrically operated breakers].

#### The circuit breaker shall be provided with a bell alarm to provide an additional signal that the breaker tripped. This bell alarm shall be provided with a lockout function such that the breaker cannot be closed until the lockout has been reset.

#### [An optional circuit breaker mechanical operations counter shall be provided.]

#### Shall refer to drawings for cable requirements.

#### Trip unit requirements:

#### The circuit breaker trip unit shall be [Ekip DIP per paragraph D below] [Ekip Touch/Hi-Touch/G Touch per paragraph E below] in order to provide a wide variety of protective, signaling, and control functions.

### Feeder Circuit Breaker Requirements

#### Feeder circuit breakers shall be draw out type, [manually] [electrically] operated.

##### The breaker closing springs will be charged via a spring charging motor. Control voltage/power of {24-30VAC/VDC}{48-60VAC/VDC}{100-130VAC/VDC}{220-250VAC/VDC} shall be provided on electrically operated breakers].

##### A {24VAC/VDC} {30VAC/VDC} {48VAC/VDC } {60VAC/VDC} {110-120VAC/VDC} {120-127VAC/VDC} {220-240VAC/VDC} {240-250VAC/VDC } shunt trip shall be provided on electrically operated breakers].

#### Feeder breakers shall be provided with a bell alarm to provide an additional signal that the breaker tripped. This bell alarm shall be provided with a lockout function such that the breaker cannot be closed until the lockout has been reset.

#### [An optional circuit breaker mechanical operations counter shall be provided.]

#### Feeder breaker frame sizes shall be as shown on the project drawings.

#### Shall refer to drawings for cable requirements.

#### The circuit breaker trip unit shall be [Ekip DIP per paragraph D below] [Ekip Touch/Hi-Touch/G Touch per paragraph E below] in order to provide a wide variety of protective, signaling, and control functions.

### ***NOTES TO SPECIFIER: STANDARD TRIP UNIT IS “EKIP DIP”. “EKIP TOUCH” OR HIGHER TRIP UNIT IS REQUIRED FOR USING RELT AND/OR ZSI FUNCTIONS, WHICH MAY BE REQUIRED FOR LOADS 1200A AND GREATER.***

### Standard Electronic Trip Units

#### Trip units shall incorporate “True RMS Sensing” and have LED long-time pickup indications.

#### Trip unit shall provide local trip indication; information about which protection function tripped shall be readable at any time after the trip.

#### Standard electronic trip unit must be unaffected by electromagnetic interference in compliance with the EMC directive and Annex F of IEC 60947-2

#### The standard trip unit shall be fitted with a dip switch interface to ensure accuracy while adjusting protection settings.

#### As there is a need to provide a preemptive alert of a critical breaker tripping (abnormal loading / above nominal ampere draw), the breaker shall be provided with an overload pre-alarm. The user adjustable pickup point shall be adjustable from 50-90% of long time setting with a resolution of 1%. The circuit breaker will send a signal when the breaker exceeds the established value.

#### The standard fully adjustable protection for (L) Long Time, (S) Short Time, (I) Instantaneous, [and (G) Ground Fault as indicated on drawings] shall be provided. All protective elements (LSIG) shall be independent of each other. Trip units with dependent settings or limited adjustability such as “adjustable tracking” are not approved. The ability to disable the adjustable instantaneous trip is required. When the instantaneous is disabled, an instantaneous override shall provide protection for the breaker.

#### (L) Long time pickup shall be adjustable from 40% to 100% In at increments of less than 5%.

#### (L) Long time delay shall be inverse time (I2T) adjustable from 3s to 144s in 8 steps.

#### (S) Short time pickup shall be adjustable from 0.6 In to 10 In in 15 steps. (S) protection may be disabled.

#### (S) Short time delay shall be selectable between definite time (I2T off) and inverse time (I2T on). Delay shall be adjustable from 0.1s to 0.8s in 0.1s increments.

#### (I) Instantaneous pickup shall be adjustable from 1.5 In to 15 In in 15 steps. (I) protection may be disabled.

#### [(G) Ground fault protection shall be residual type where the ground current is measured by summing current vectors A,B,C, and N. Ground fault pickup shall range from 0.1 In to 1 In, in 7 steps with a maximum value of 1200A.

#### [(G) Ground fault delay shall be selectable between definite time (I2T off) and inverse time (I2T on). Delay shall be adjustable from 0.1s to 0.8s in 4 steps.

#### ***NOTES TO SPECIFIER: OPTIONAL TRIP UNITS ARE “EKIP TOUCH,” EKIP HI-TOUCH, EKIP G TOUCH, AND EKIP G HI-TOUCH, REQUIRED WHEN USING RELT AND/OR ZSI FUNCTIONS.***

### Advanced Electronic Trip Units

#### Trip unit shall have the ability to be upgraded via downloadable software packages.

#### Trip unit shall be provided with a backlit display with the capability to see all three phases on one screen simultaneously.

#### Trip units shall incorporate “True RMS Sensing” and have LED long-time pickup indications.

#### Trip unit shall provide local trip indication; information about which protection function tripped shall be readable at any time after the trip.

#### As there is a need to provide a preemptive alert of a critical breaker tripping (abnormal loading / above nominal ampere draw), the breaker shall be provided with an overload pre-alarm. The user adjustable pickup point shall be adjustable from 50-90% of long time setting with a resolution of 1%. The circuit breaker will send a signal when the breaker exceeds the established value.

#### Advanced trip system shall be programmable through a color touch-screen HMI.

#### Advanced trip unit protection against overload shall allow fine settings of long-time pickup values (l1) from 0.4 to 1 times the rated current (ln), with a resolution of 0.001 ln. Protection against the overload delay settings shall be available to be chosen from 3 to 144 seconds with a resolution of 1s.

#### Advanced trip unit protection against short circuit, shall allow pickup settings from 0.6 to 10 times ln with a resolution of 0.1 ln. Delays shall be available from 0.05 to 0.8 seconds with a resolution of 0.01s.

#### [Advanced trip unit protection against short circuit, instantaneous shall be available from 1.5 to 15 times ln with a resolution of 0.1 ln.

#### Advanced trip unit protection against ground-fault [is not required on this project and should not be provided][is required and should be provided with adjustable PICKUP from 0.1 to 1 times ln, with a resolution of 0.001 ln. and DELAY from 0.1 to 1 seconds with a resolution of 0.05s. UL Breakers are limited to 1200A max setting for ground fault.][is required as an alarm only function, the breaker will not trip but will signal an alarm that will be displayed on the equipment lineup HMI. It should be provided with adjustable PICKUP from 0.1 to 1 times ln, with a resolution of 0.001 ln. and DELAY from 0.1 to 1 seconds with a resolution of 0.05s. UL Breakers are limited to 1200A max setting for ground fault.][is required as detailed on the project drawings]

#### [Trip units shall have communications capabilities by means of an optional add on module. Communication module may be installed at the factory, time of commissioning or later by the user. [Modbus TCP] [IEC 61850] [Profinet] [EtherNet IP] [Modbus RTU] [Profibus] [DeviceNet] shall be provided.]

#### [Advanced a generator protection (when indicated on drawings) trip unit version should be available with [Ekip G Touch][Ekip G Hi-Touch] ]

#### [A power measurement module shall provide under voltage, under frequency, over frequency, phase sequence and reverse power protection functions. Additionally, this module shall supply power quality metrics including but not limited to THD (e.g., voltage sages, voltage swells). External voltage transformers shall not be required.]

#### [As indicated per the drawings provided, trip unit metering accuracy shall be [1.0% current, 0.5% voltage, 2.0% power/energy, and 0.2% frequency] [0.5% current, 0.5% voltage, 1.0% power/energy, and 0.1% frequency.] These accuracies shall be the accuracy of the entire system including current transformers, potential transformers, etc. [Trip unit shall have metering accuracy compliant with IEC 61557-12. ]

#### [The Ekip trip unit shall contain the data logger option to track and visualize any fault event. It shall register events in all three phases and the neutral. The device shall have a user adjustable sampling rate of 1200, 2400, 4800, 9600 Hz. This allows a maximum of 13.6 seconds of recording time and a recording stop delay of up to 10 seconds.]

#### To provide field coordination flexibility, either the SHORT-TIME or INSTANTANEOUS functions must be capable of being turned off via the HMI.

#### ***NOTE TO SPECIFIER: REDUCED ENERGY LET-THROUGH (RELT), ALSO KNOWN AS A MAINTENANCE SWITCH OR ALTERNATE SETTING GROUP, IS CALLED 2I SETTING IN ABB LITERATURE. A 3-POSITION SWITCH WILL BE PROVIDED THAT ALLOWS TESTING OF CONTROL POWER AND INDICATES TRIP PROTECTIVE STATUS VIA A CONTACT CLOSURE PROVIDED BY THE TRIP UNIT.***

#### [Reduced Energy Let-Through (RELT) or 2I instantaneous trip. When specified, this feature shall be provided on circuit breakers to provide a temporary setting for the instantaneous trip setting of the circuit breaker. Setting shall be adjustable down to 1.5x In and shall be enabled through a switch mounted on front of the switchgear. The switch shall be combined with an indicating light that positively indicates that the Reduced Energy Let-Through or 2I is enabled or disabled.]

#### ***NOTE TO SPECIFIER: ZSI IMPLEMENTATION REQUIRES AT LEAST TWO LEVELS OF CIRCUIT BREAKERS THAT HAVE ZSI CAPABILITY. THE DOWNSTREAM BREAKER THAT SENDS THE SIGNAL AND THE UPSTREAM BREAKER THAT RECEIVES IT AND ADJUSTS ITS PROTECTION TIMING ACCORDINGLY. TMAX XT FRAME CIRCUIT BREAKERS ARE ABLE TO PROVIDE ZSI FOR THE INSTANTANEOUS FUNCTION. INSTANTANEOUS ZSI ENABLES SELECTIVITY BETWEEN THESE MOLDED CASE CIRCUIT BREAKERS AND SIMILARLY EQUIPPED EMAX2 CIRCUIT BREAKERS UP TO THE FULL SHORT CIRCUIT RATING OR WITHSTAND RATING OF THE LINE SIDE DEVICE.***

#### [Zone Selective Interlocking for Short-Time and Ground Fault protection.] [Zone Selective Interlocking for Short-Time, Ground Fault and Instantaneous protection.]

## USER METERING

***SPECIFER NOTE: INSERT SPECIFICATIONS FOR REQUIRED USER METERING HERE. PREFERRED METERS ARE ABB METERS OFFERED BY ELECTRO-INDUSTRY/GAUGETECH.***

## INSTRUMENT TRANSFORMERS

### All instrument transformers shall be UL listed and classified as indicated in drawings.

### Current Transformers shall be as shown on drawings with burden and accuracy to support connected meters and relays as required by [ANSI/IEEE C57.13].

### Potential transformers shall be provided where indicated on drawings with burden and accuracy to support connected meters and relays as required by [ANSI/IEEE C57.13].

## CONTROL POWER AND WIRING

### Control power for the equipment lineup shall be [120 VAC with the power provided from the lineup line-side control power transformer (CPT).][120 VAC with power provided from the lineup line-side control power transformer (CPT) on each source. The CPT circuit shall contain an ANSI 83 function for CPT automatic transfer] [120 VAC with the power provided from the lineup line-side control power transformer (CPT). The details shall be as shown on the project drawings].

### Identification of the control wiring within the equipment lineup shall be provided with wire sleeves. [To assist in tracing circuitry, the sleeves will identify the origin and destination of that specific wire/circuit] [As the control circuitry in the lineup will tie into other control circuits and as there is a need for unique/individual/specific/non-repeating wire tags, the sleeves will follow “steel mill” configuration].

### Wire terminals for the control wiring within the equipment lineup shall be [standard spring spade insulated terminals, except where ring terminals are used to connect CT circuits][special ring insulated terminals, and where ring terminals are used to connect CT circuits][special spring spade non-insulated terminals, except where ring terminals are used to connect CT circuits]

### Minimum wire size for the control wiring within the equipment lineup shall be [No. 16 AWG, extra flexible, stranded, tinned-copper, type SIS cross-linked polyethylene, rated 600 volts, with exception to specific circuits requiring larger wire for higher ampacity draw or smaller wire for device connection terminals][ No. 14 AWG, extra flexible, stranded, tinned-copper, type SIS cross-linked polyethylene, rated 600 volts, with exception to specific circuits requiring larger wire for higher ampacity draw or smaller wire for device connection terminals] .

### Wire terminals for the CTs (current transformers) within the equipment lineup shall be [crimp-type, insulated ring terminals][crimp-type, non-insulated ring terminals].

### Minimum wire size for the CTs (current transformers) with 5 ampere secondary, within the equipment lineup, shall be No. 14 AWG, extra flexible, stranded, tinned-copper, type SIS cross-linked polyethylene, rated 600 volts.

### Short circuit terminal blocks shall be provided for all current transformer connections. The screw terminals shall have no more the 2 wires under a single screw to allow field swapping of wires (6 screw block for 3 C/Ts with no neutral circuit / 8 screw block for 3 C/Ts with a neutral circuit. Short circuit terminal blocks are not required if the current transformers are utilized for circuit breaker ground fault protection or are provided with integral open circuit protection.

## ACCESSORIES

### A test kit [is not required][shall be provided to independently test breaker tripping and operational readiness].

### A remote racking mechanism [is not required, provide the standard local manual racking wrench and a portable manual racking handle as the breaker can be racked in/out in front of the equipment with the door closed] [is required for E2.2 through E6.2 Emax2 breakers as there is a need to minimize arc flash opportunity. This will allow the operator to rack a breaker in/out up to 30 feet away from the front of the equipment].

### A test cabinet for the circuit breakers (Emax2) [is not required as the testing of the breaker charging, tripping and closing functions can occur in the test position of the breaker in the lineup][is required to test the breaker charging, tripping and closing functions external to the lineup].

### The equipment lineup [requires no hoist rails or hoist mechanism][is an indoor type NEMA 1 drip-proof assembly, as such no hoist rails or hoist mechanism can be provided][ is an outdoor non-walk in type NEMA 3R assembly, as such no hoist rails or hoist mechanism can be provided][is a NEMA 1 enclosure that requires a set of circuit breaker hoist rails on top of the switchgear lineup, a compact and integral system to lift the fully withdrawn circuit breakers off their rail assemblies and a hoist unit shall be supplied which will serve as the lifting mechanism. If required, a spreader-lifting unit shall be supplied for lifting every circuit breaker frame size contained in the lineup.] [is a protected aisle NEMA 3R assembly that requires a circuit breaker hoist rail system above the protected aisle, a compact and integral system to lift the fully withdrawn circuit breakers off their rail assemblies and a hoist unit shall be supplied which will serve as the lifting mechanism. If required, a spreader-lifting unit shall be supplied for lifting every circuit breaker frame size contained in the lineup.]

### The equipment lineup [requires no external hydraulically operated crane or lift truck][is an indoor type NEMA 1 drip-proof or outdoor NEMA 3R assembly, and as there is a need to provide a device to lift the fully withdrawn circuit breakers off their rail assemblies a portable hydraulically operated crane lifting device shall be provided. The device shall be capable of rolling on the floor and shall be hand operated. If required, a spreader-lifting unit shall be supplied for lifting every circuit breaker frame size contained in the lineup]

### [A transfer truck shall also be supplied to provide a convenient method to transport the removed circuit breakers].

### Provide surge protective devices (SPD) as indicated on drawings and complying with section 26 43 13. SPDs shall be mounted in the cable compartment to minimize lead length of connections to primary conductors. The SPD display shall be connected by an umbilical harness and mounted on the front cover of an auxiliary compartment.

### [No mimic bus requirement is needed.][A mimic bus shall be provided on the front of the equipment to diagrammatically show the internal bus structure of the lineup. Mimic bus material shall be [adhesive vinyl][laminated plastic strips]. The details of the mimic bus shall be as defined below:

#### The laminated plastic strip mimic bus shall be mounted to the equipment using [standard screws][stainless steel screws].

#### The mimic bus size shall be [3/8 inch wide][1/2 inch wide].

#### The mimic bus color shall be [red][orange][brown][green][blue][black][yellow][white] [Insert special mimic bus color].

## FINISH

### All non-plated ferrous parts shall be painted using a multi-step cleaning and powder painting process.

### Finished parts shall have an average paint thickness of 2-3 mils and shall withstand 600 hours of salt spray (per ASTM B 117 and ASTM D 1654) as well as 1000 hours of 100% humidity at 45 degrees Centigrade.

### Finished parts shall also meet the requirements of ASTM D 3359 for adhesion and ASTM B 117 / ASTM D 1654 for UV-A gloss retention.

## FACTORY TESTING

### Manufacturer shall perform the following production tests on the assembled switchboard

#### Device check – visual inspection of device catalog number to verify compliance to specification

#### Control lead check – continuity test to ensure correctness of all wiring

#### Instrument transformer ground test – verify that instrument transformer frame is grounded

#### Meter and relay check - induce current on the secondary side of current and voltage transformers to verify device functionality

#### Control power check – apply power to control circuits

#### Bus check – visual check of phase, neutral, and ground buses in accordance with switchboard one-line diagram

#### Clearance check – inspect buses and devices for proper electrical clearances

#### Connection test – check tightness of all bolted connections

#### Nameplate check – verify nameplate engraving and location are per drawings

#### Current and voltage transformer polarity check – visually inspect transformer polarities are in accordance with drawings

#### Secondary high potential test – 1500vAC for 1 minute on control wiring

#### Primary high potential test – 2200vAC for 1 minute on bus system

#### Power management communication test – verify all devices are able to communicate on the switchboard communication bus

### Factory witness testing [is not required as normal factory testing procedures are acceptable.][shall be provided.] The manufacturer shall notify the owner/engineer at least 2 weeks in advance of the test date. The test shall demonstrate the successful operation of the equipment as it [will be operated in the owner’s facility.] [shall be provided via video stream.] The manufacturer shall notify the owner/engineer at least 2 weeks in advance of the test date. [The test shall remotely demonstrate the successful operation of the equipment as it will be operated in the owner’s facility.]

### Customer inspection [is not required as normal factory testing procedures are acceptable.][shall be provided so that the owner/engineer/owner’s representative can visit the factory and view the assembled equipment prior to shipment to visually confirm the correctness of the final product prior to shipment.] The manufacturer shall notify the owner/engineer at least 2 weeks in advance of the final assembly date] [shall be provided via video stream such that the owner/engineer/owner’s representative can virtually visit with the factory and remotely view the assembled equipment prior to shipment to confirm the correctness of the final product prior to shipment. The manufacturer shall notify the owner/engineer at least 2 weeks in advance of the final assembly date]

# EXECUTION

## EXAMINATION

### The contractor/installer shall verify that the ABB RELIAGEAR LV SG low voltage metal enclosed switchgear lineup is ready to install before installing.

### The contractor/installer shall examine the installation area to assure there is enough clearance to install the low voltage switchgear such that it will fit in the allocated space in full compliance with the minimum required clearances recommended by the manufacturer, specified in National Electrical Code and required by any applicable local/facility constraints.

### The contractor/installer shall check concrete pads for uniformity and level surface.

### The contractor/installer shall verify that the field measurements are as shown on drawings.

### The Contractor/Installer shall verify that required utilities are available, in proper location and ready for use.

### Beginning of installation means installer accepts conditions.

## LOCATION

### Refer to the site drawings for details.

## INSTALLATION

### The contractor/installer shall furnish and completely install RELIAGEAR LV SG low voltage metal enclosed switchgear lineup as shown on the drawings and per manufacturer's installation instructions.

### After the lineup has been completely assembled, an ABB start-up service engineer shall provide factory startup/commissioning.

### The contractor/installer shall provide and install any required safety labels.

## FIELD QUALITY CONTROL

### The contractor/installer shall inspect the installed low voltage switchgear lineup for proper anchoring, alignment and grounding as well as inspecting for any internal and external physical damage.

### The contractor/installer shall check tightness of all accessible mechanical and electrical connections with a calibrated torque wrench. Minimum acceptable values are specified in the manufacturer's instructions.

### The contractor/installer shall refer to manufacturer's instruction books for any other equipment requirements.

### The contractor/installer shall test the main-tie-main automatic breaker transfer system for proper functioning and accurate sequence of operation if such a system is provided.

### The contractor/installer shall test each key interlock system for proper functioning if keyed interlocks are provided.

## ADJUSTING

### The contractor/installer shall adjust all access doors and operating handles for free mechanical and electrical operation as described in the manufacturer's instructions.

### The contractor/installer shall refer to the manufacturer's instruction book to make adjustments to mechanisms, doors, handles, interlocks, etc. as required.

### The contractor/installer shall return "odd/extra-startup" key interlock keys to the engineer before energizing equipment.

### As part of the manufacturer-provided start-up services, the manufacturer’s service engineer shall set all adjustable protective devices to the values recommend in the coordination study - refer to the separate “Short Circuit and Coordination Study” specification contained in this project specification document for additional information.

## CLEANING

### The contractor/installer shall clean the interior and exterior of the switchgear to remove construction debris, dirt, and shipping materials.

### The contractor/installer shall repaint scratched or marred exterior surfaces to match original finish.

## TRAINING

### Provide the services of a factory trained field engineer for training at owner's job site. Training shall include instructions on adjusting, servicing and maintaining the ABB RELIAGEAR LV SG low voltage metal enclosed switchgear and switchgear assemblies. The field engineer shall be at the site for a single eight-hour shift.

END OF SECTION