

Schneider Learning Series – ASCO Offer

Low Voltage Construction

27th April 2021

ASCO Power
Technologies™

Presented by: Pete Rossomando – Director of PCS Applications Engineering



Learning Objectives

- 1 Switchgear Design Features**
- 2 General Cubicle Dimensions**
- 3 Cubicle Modular Construction**
- 4 Conduits and Cable Considerations**
- 5 Switchgear Options**
- 6 Breaker Stacking Arrangements**
- 7 Seismic Considerations**
- 8 UL 891 & UL 1558**

This webinar will be recorded and made available through our website.

Please use the “Q&A” feature to ask technical questions.

Low Voltage Construction

• **Switchgear Design Features**

- **General Cubicle Dimensions**
- **Cubicle Modular Construction**
- **Conduits and Cable Considerations**
- **Switchgear Options**
- **Breaker Stacking Arrangements**
- **Seismic Considerations**
- **UL 891 & UL 1558**

Low Voltage Construction – Current Design

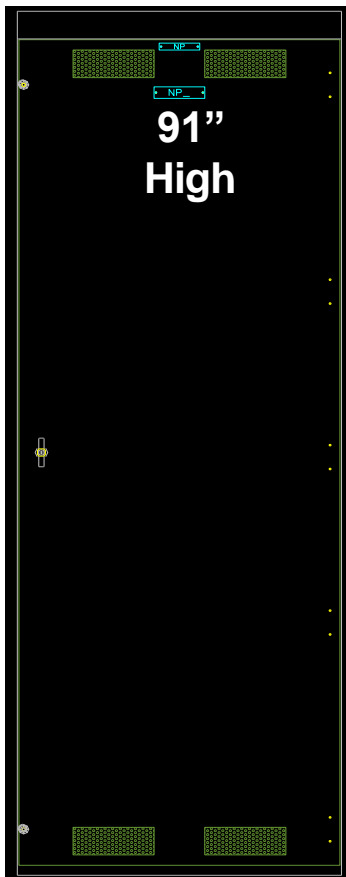
- All 11 Gauge Steel
- All silver plated copper bus (tin plated available if specified)
- Modular Cubicle design
- Standardized parts and section dimensions
- Standardized bus configurations
- Seismic Design Standard
- Lug pads designed for use with either mechanical or compression lugs
- Standard modular conduit area
- Rear Doors Standard
- All cubicles designed for either top or bottom cable entry
- Design Based on Square D NW/MTZ circuit breakers
- Common UL 891 & UL 1558 Structural Design

Low Voltage Construction

- Switchgear Design Features
- **General Cubicle Dimensions**
- Cubicle Modular Construction
- Conduits and Cable Considerations
- Switchgear Options
- Breaker Stacking Arrangements
- Seismic Considerations
- UL 891 & UL 1558

Low Voltage Construction - Mechanical Layout....How wide?

General Switchgear Widths



3" Wire
Duct

91"
High

*26", 32", 36" & 40" are standard widths
others are custom*

*Widths apply to Generator, Distribution,
Tie and Utility Sections.*

26", 32", 36", 40" Wide

What's in the 3" wire way?

- Cubicle Interconnect harnesses
- No interwiring between cubicles, plug and jack connections
- DC Bus – Distributes DC Power to each switchgear section

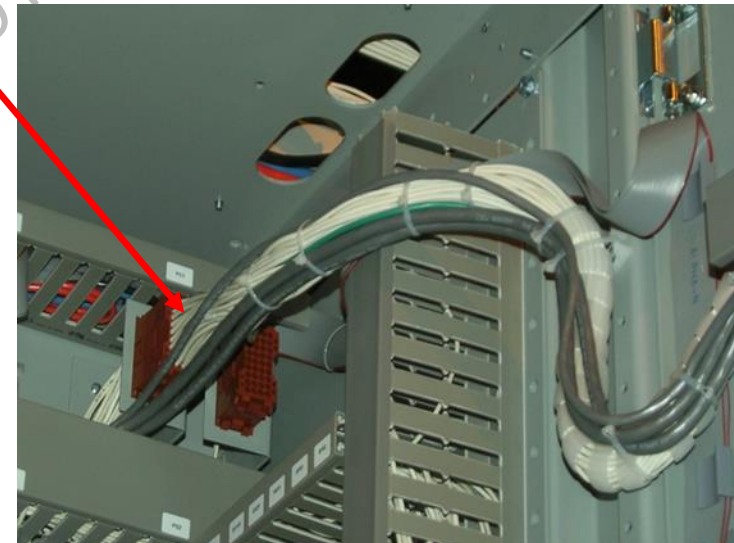
Interconnect Control Wires



Red, Blue, Black Wires are DC bus

Plug and Jack Connections

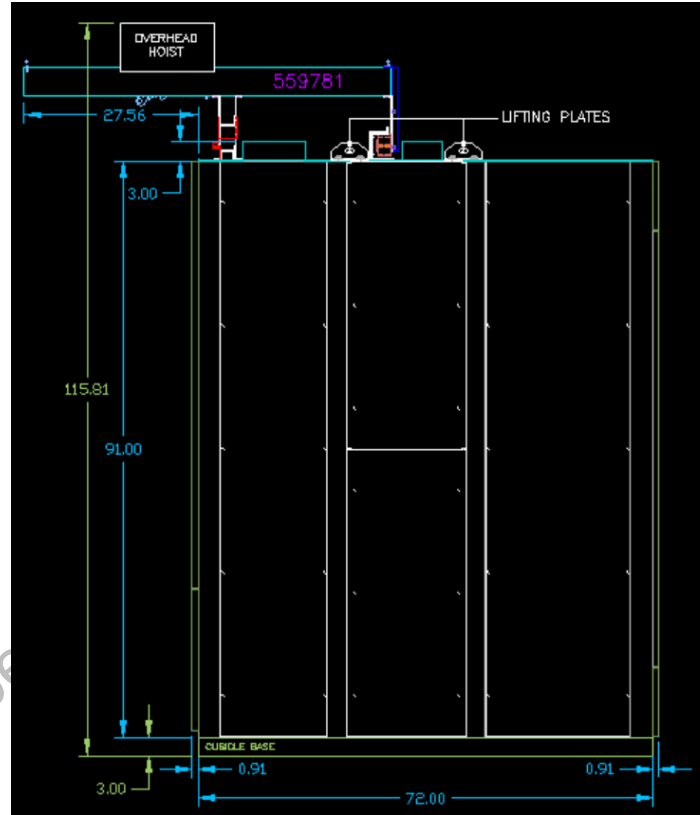
- Cubicle Interconnect harnesses
- No interwiring between cubicles, plug and jack connections
- Makes life easy for the contractor



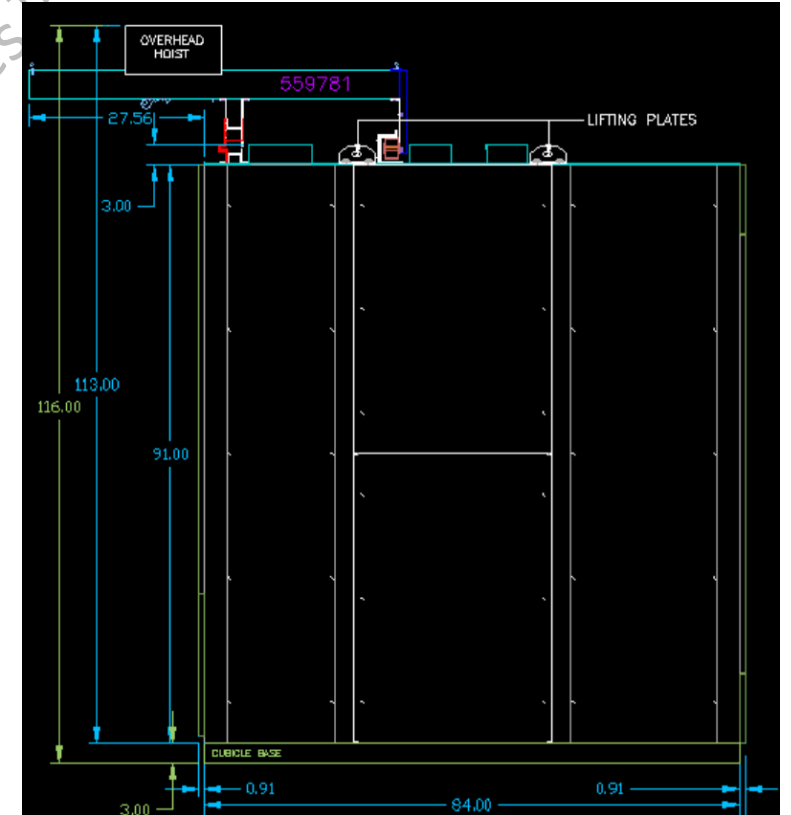
Low Voltage Construction - Section Depths

Section Depth is Determined by Main Bus Ampacity

Main Bus Ampacity	Section Depth
Controls Only	24"-30"
3000A – 6000A	72"
8000A – 10,000A	84"



72" Deep



84" Deep

Low Voltage Construction

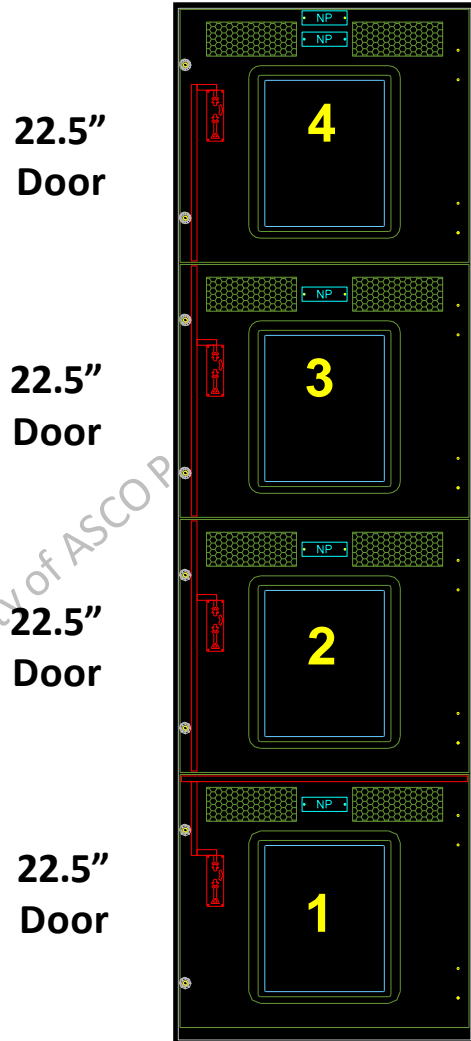
- Switchgear Design Features
- General Cubicle Dimensions
- *Cubicle Modular Construction*
- Conduits and Cable Considerations
- Switchgear Options
- Breaker Stacking Arrangements
- UL 891 & UL 1558

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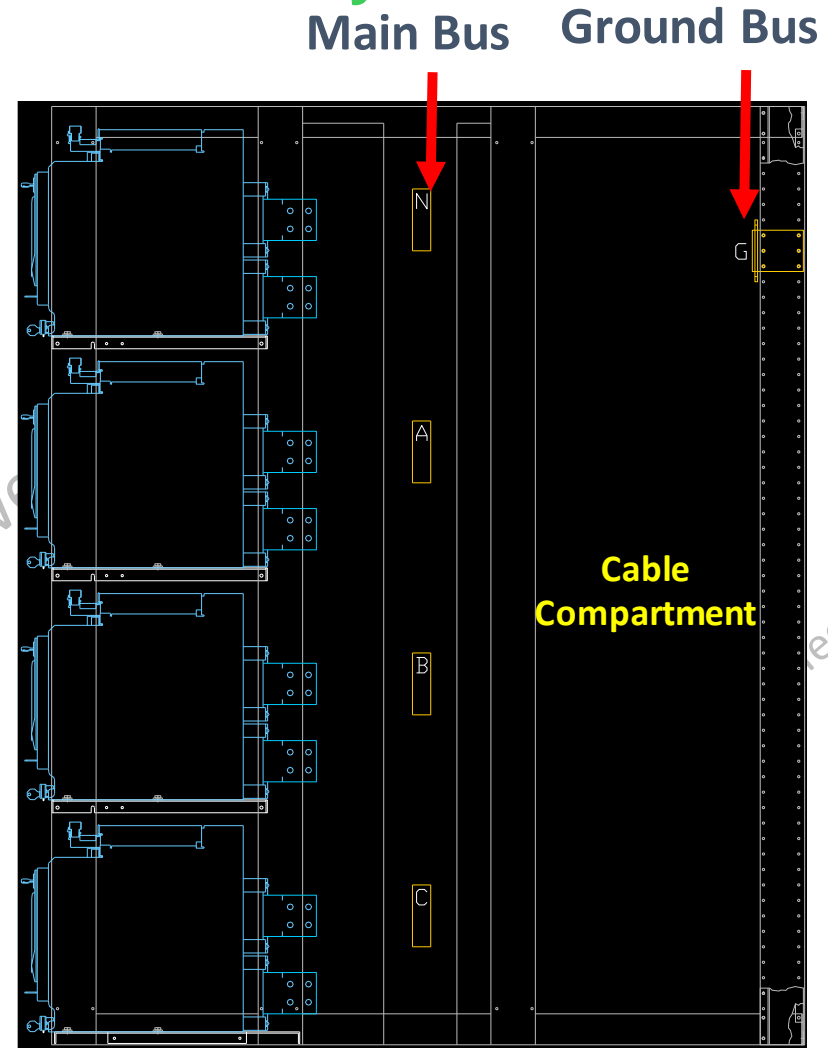
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Low Voltage Construction - Cubicle/Compartment Layout



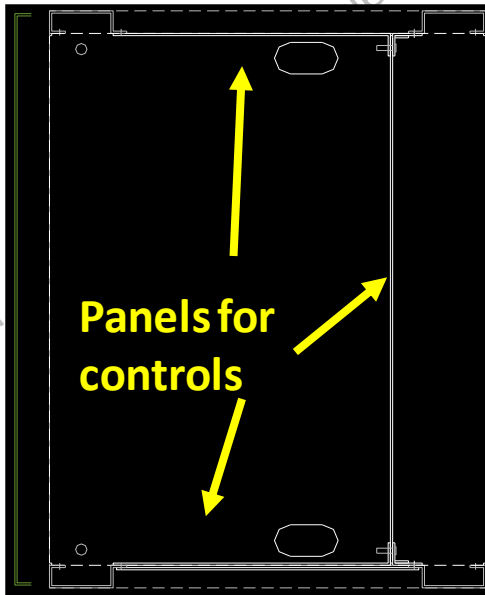
Note: #2 or #3 breaker compartment can be replaced with controls – CB control switches, metering, control power transformers, I/O



Low Voltage Construction – Modular Cubicle Design

Front – Breaker and/or Control Section

24"



Front Door

Middle - Bus Section

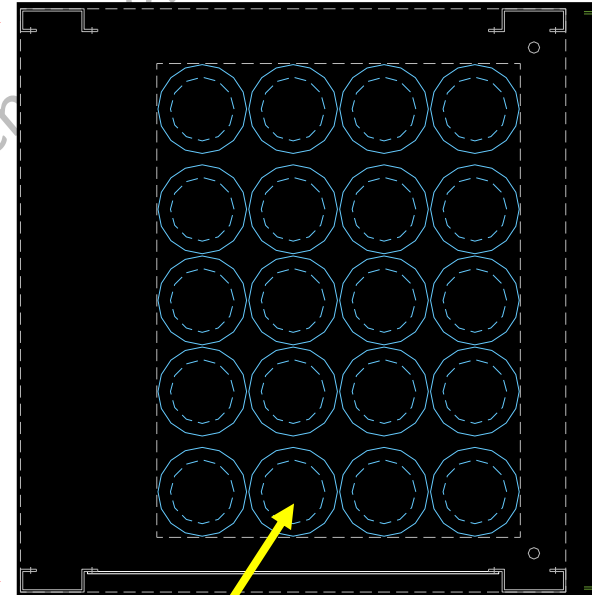
18" up to 6000A
30" 8000A & 10,000A



Side Barriers

Rear – Cable Section

30"



Conduits - Up to 16 3-1/2" conduits for 26"W section, 20 for 32"W section

Rear Door

Low Voltage Construction

- Switchgear Design Features
- General Cubicle Dimensions
- Cubicle Modular Construction
- *Conduits and Cable Considerations*
- Switchgear Options
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Low Voltage Construction – Standard Conduit Design

Typical Cables if cable schedule not known

Breaker Frame Size	# of cables/ Phase & N
800AF	3
1200AF	4
1600AF	5
2000AF	6
2500AF	7
3000AF	8
3200AF	8
4000AF	12
5000AF	15

Low Voltage Construction – Cable Entry & Lugs

- All Switchgear cubicles designed for top or bottom cable entry – No dimensional changes, just specify what’s required
- Mechanical Lugs Provided as standard
- Optional Compression Lugs provided if specified
- Optional Inspection windows provided if specified
- All lugs are two hole anti-turn type
- Bus Lug pads designed to accommodate either Mechanical or Compression lugs
- Cable entry area does not change based on lug type
- Unlike some ATS, dimensions do not change based on lug size or type
- Lug type can be either, we just need to know which.



2 hole mechanical screw type lug



2 hole long barrel compression lug

Low Voltage Construction

- Switchgear Design Features
- General Cubicle Dimensions
- Cubicle Modular Construction
- Conduits and Cable Considerations
- *Switchgear Options*
- Breaker Stacking Arrangements
- UL 891 & UL 1558

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Low Voltage Construction Switchgear Options

Optional Features

Options	Master/Control	Generators	Distribution
Overhead Lifting Device	X	X	X
Portable Lifting Device	NA	X	X
Steel & Glastic Side Barriers	X	X	X
Glasic Rear Barriers/Isolated bus	X	X	X
Mimic Bus	X	X	X
Mechanical/Compression Lugs	NA	X	X
IR Viewing Ports	X	X	X
3" Steel Cubicle Base	X	X	X
System SPD	X	NA	NA
Bus Duct Risers	X	X	X
200K AIC bus bracing	X	X	X

Low Voltage Construction - Options

Overhead Circuit Breaker Lifting Device



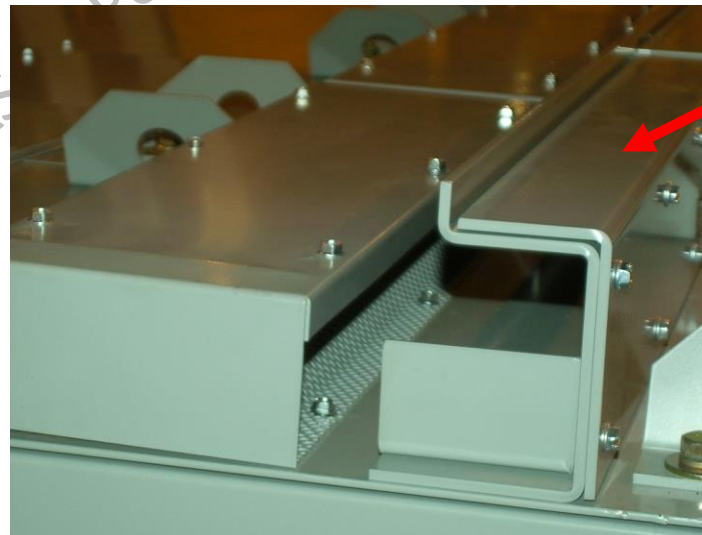
Rail mounted

Ships separately and mounted in field

Can be provided on projects with bus risers

IBC 2018 Seismic Certified

Adds 18" to overall height



Rails

Low Voltage Construction - Mechanical Layout

Square D NW or MTZ 3 Pole Circuit Breakers

Total section width with various stacking arrangements are determined by the width of the largest individual breaker

Frame Size	Section Widths		
	65KAIC - 100KAIC	150KAIC	200KAIC
800AF-1600AF	26"	26"	26"
2000AF	26"	32"	32"
2500AF-3000AF	26"	32"	32"
3200AF	32"	36"	36"
4000AF	36"	36"	36"
5000AF	36"	36"	36"
6000AF	40"	40"	40"

Low Voltage Construction

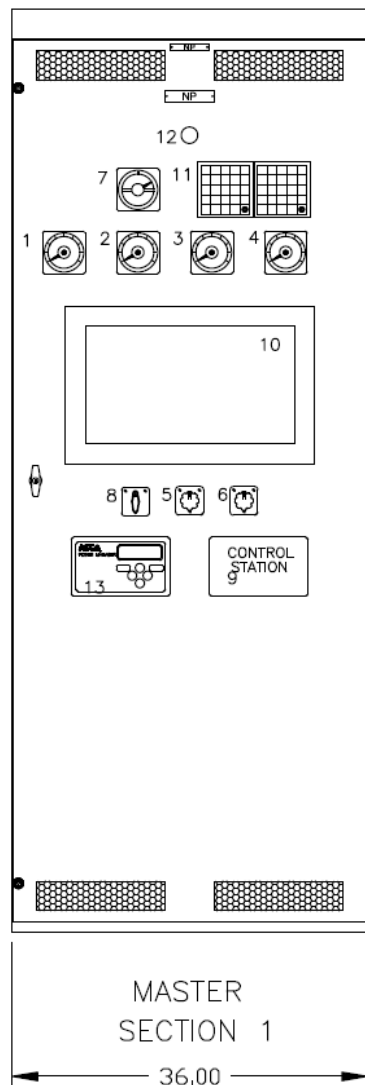
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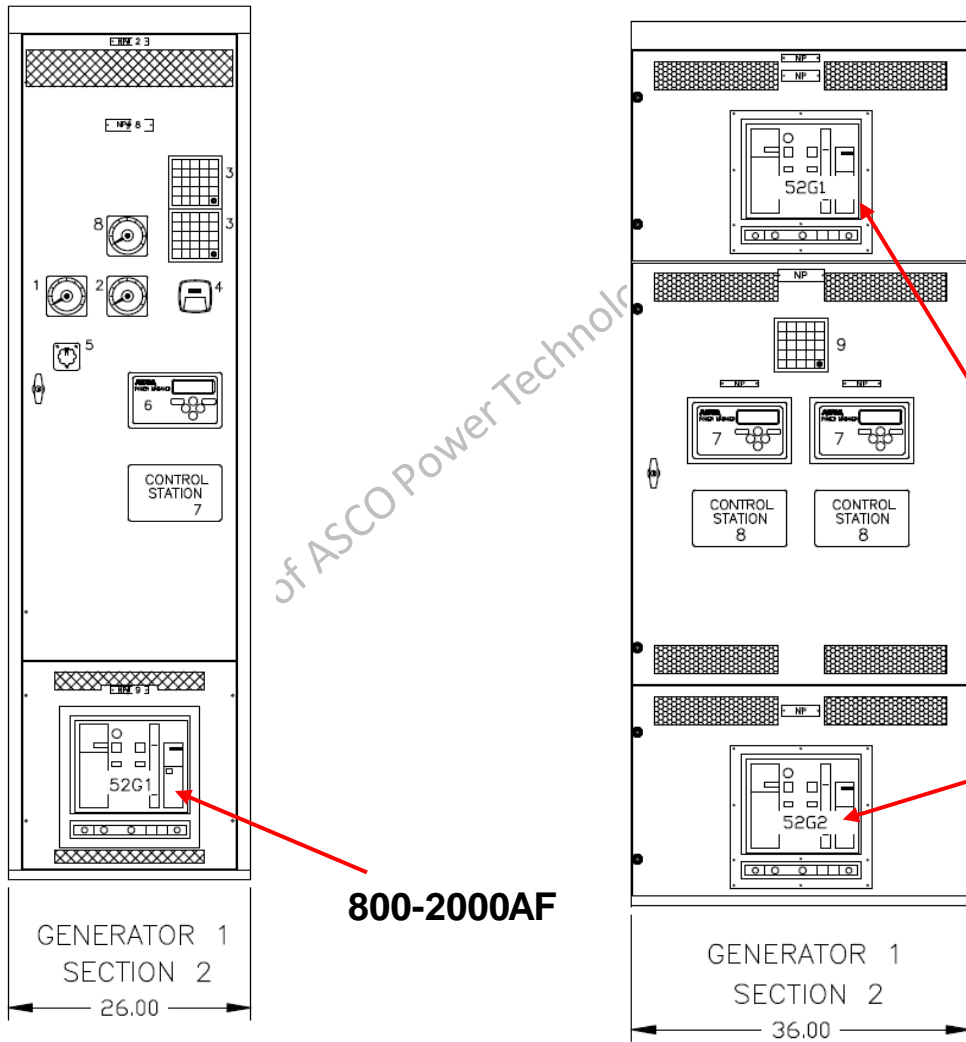
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Low Voltage Construction Mechanical Layout – Master Control Section



- Standard Master Section 36” wide
- PLC Redundancy does not change width
- Circuit Breakers typically **can not** be mounted in Master Section due space required for controls
- SPD can be mounted in rear
- Standard Master OIT is 24” Wonderware
- Typically an Aux Master is required when **redundant I/O** is required, adds an additional 36” wide Auxiliary Section or I/O can be mounted in the rear of the section.

Low Voltage Construction Mechanical Layout – Generator Sections



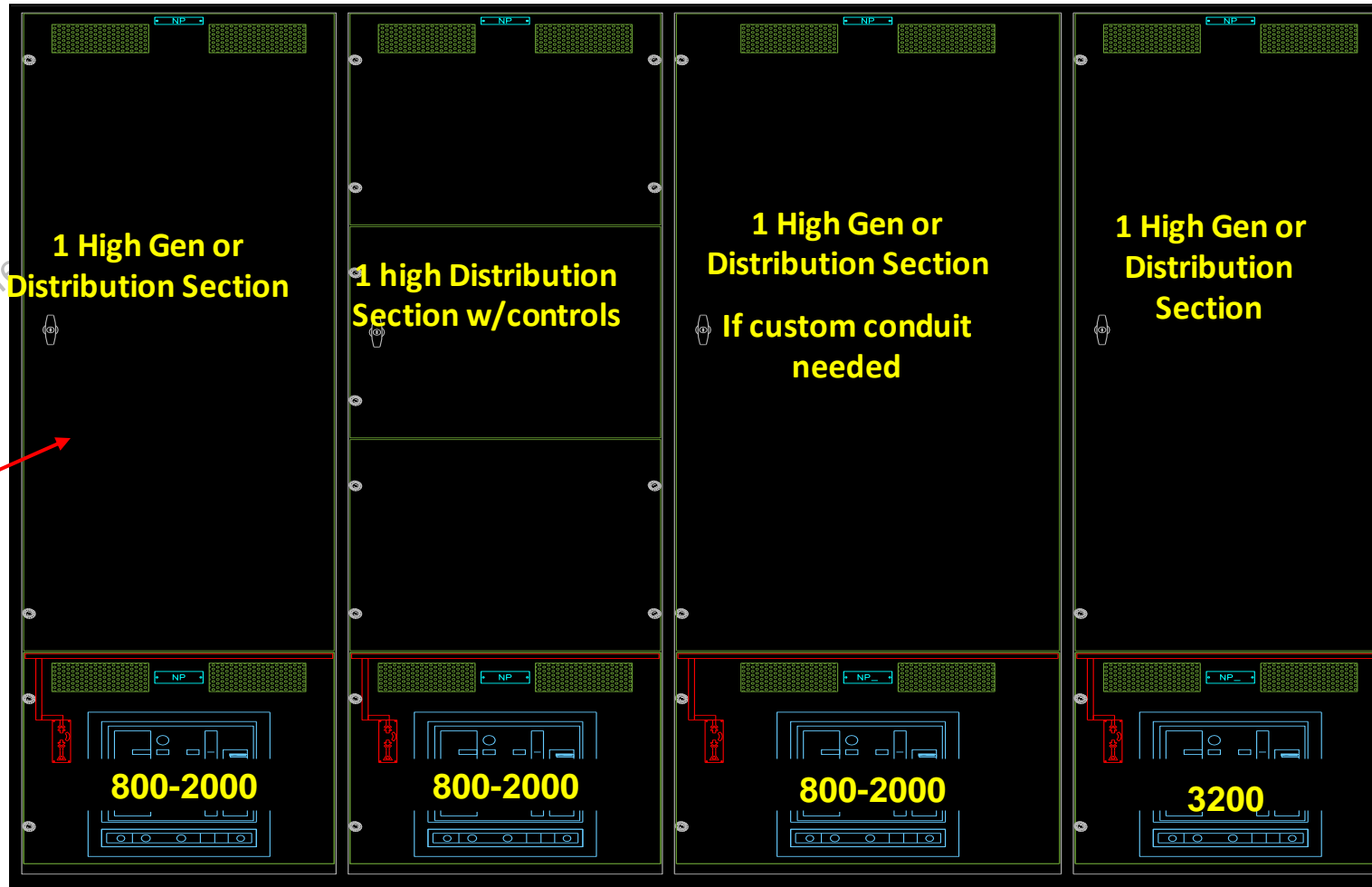
- Generator Section widths vary based on breaker size - 26" up to 2000AF circuit breaker
- Dual Gen Sections available always a minimum of 36"W

Up to (2)
3200AF

800-2000AF

Low Voltage Construction - 1 High NW/MTZ 800 – 3200A Breaker Sections

Standard Sections for Generators or Distribution – 100KAIC



■ Width increases to 32" for 3200AF CB



Typical Generator Controls

26" Wide

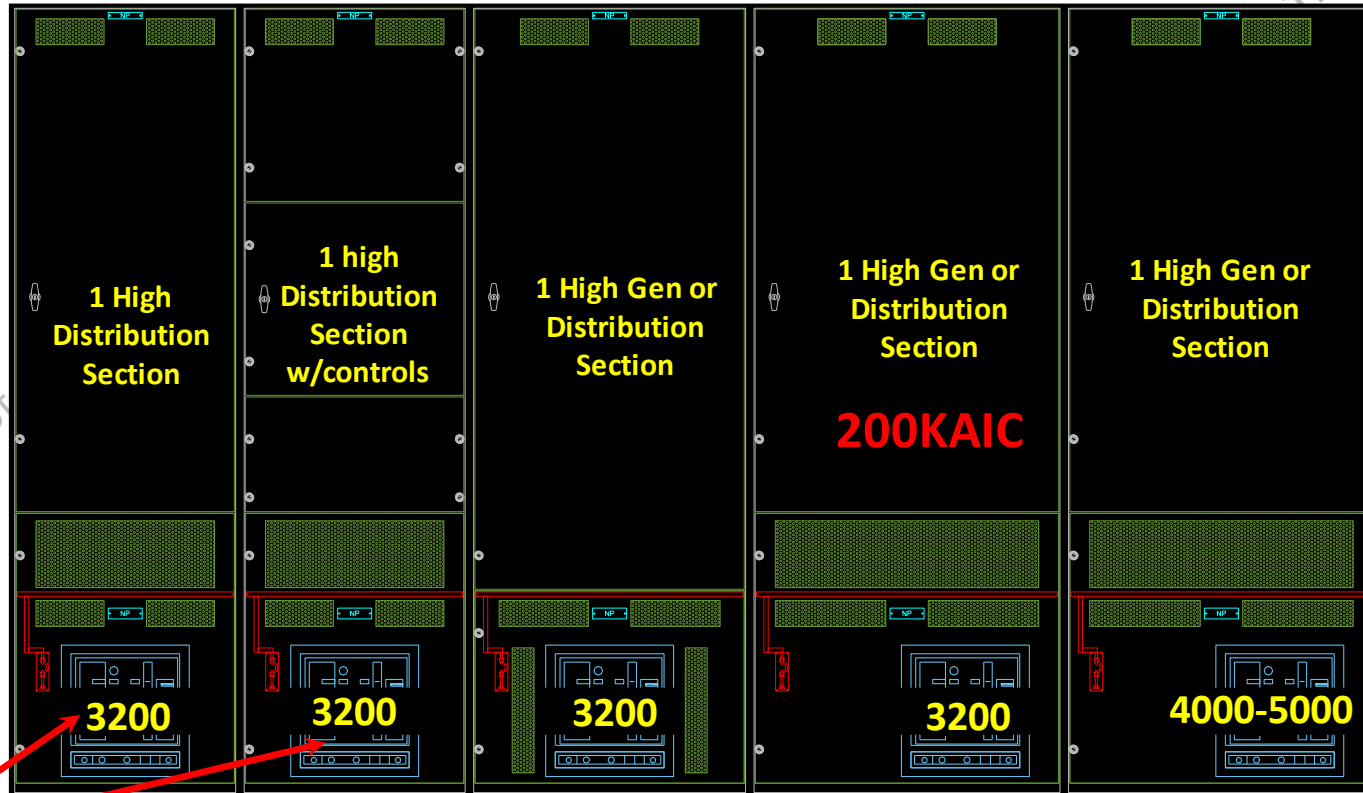
26" Wide

32" Wide

32" Wide

Low Voltage Construction Breaker Sections 3200 & 4000AF Breakers

NW/MTZ 1-High Sections for Generator or Distribution Sections



- Width increases to 36" for 3200AF CB @ 200KAIC
- Door height increases for more venting at 3200AF and above @200KAIC

Higher Door

26" Wide

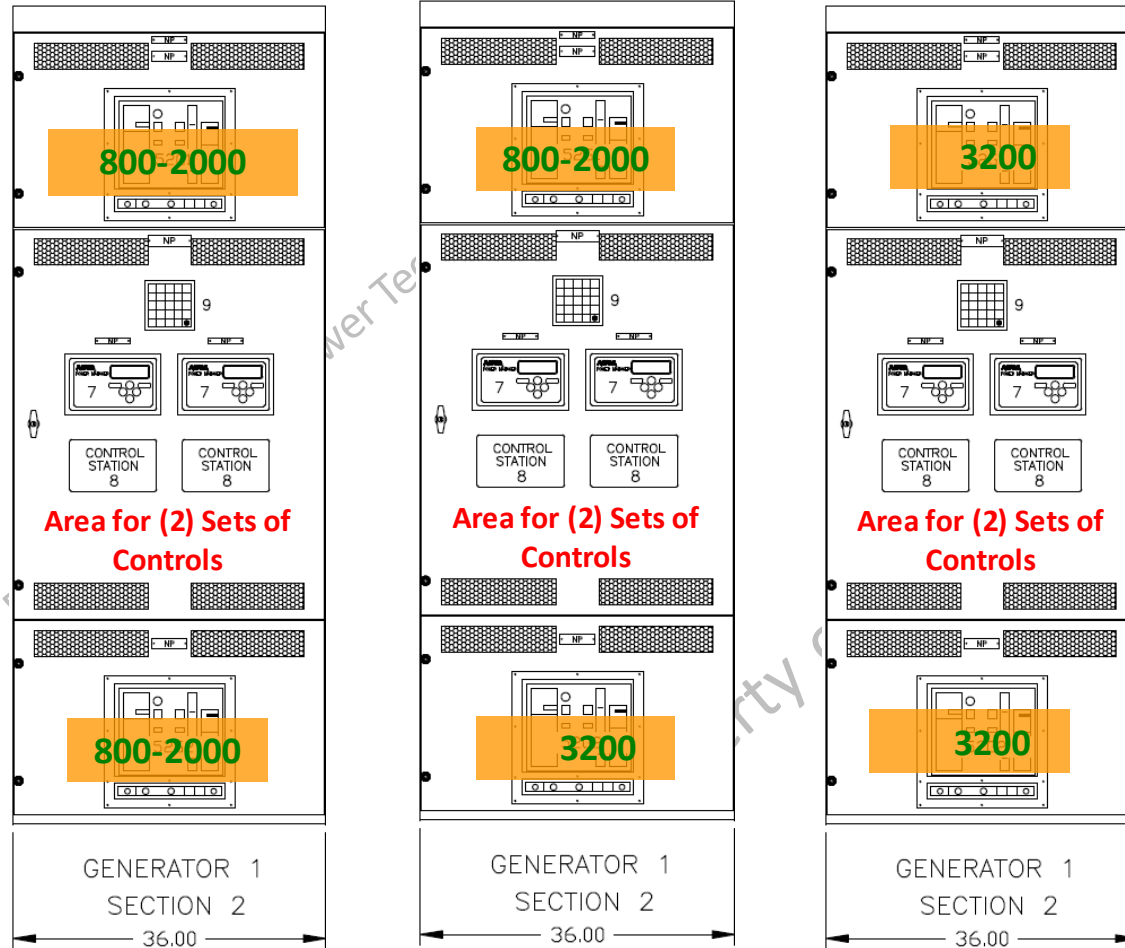
26" Wide

32" Wide

36" Wide

36" Wide

Low Voltage Construction 2 High NW/MTZ Breaker Sections 800AF – 3200AF Dual Generator Sections -100KAIC Only



- **Dual Generator Design available up to (2) 3200AF circuit breakers @100KAIC**
- **Sections always 36" wide**

Low Voltage Construction 2 High NW/MTZ Breaker Sections – Up to 100KAIC



- Width increases to 32" for 3200AF CB @ 100KAIC
- Width increase to 36" for 4000AF CB @100KAIC



Typical Controls

26" Wide

26" Wide

32" Wide

36" Wide

Low Voltage Construction 2 High NW/MTZ Breaker Sections

Distribution Sections – 150-200KAIC



- Width increases to 32" for 2000AF CB @ 200KAIC
- Width increases to 36" for 4000AF CB @100KAIC

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Low Voltage Construction 3 High NW/MTZ Distribution Sections

Distribution Sections up to 100KAIC



26" Wide

26" Wide

26" Wide

26" Wide

32" Wide

- Width remains at 26" on all 3 high combinations 800AF – 2000AF
- Width increase to 32" with 3200AF breaker included

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Low Voltage Construction - 3 High NW/MTZ Distribution Sections

Distribution Sections up to 150-200KAIC



26" Wide

26" Wide

32" Wide

32" Wide

- Width remains at 26" on all 3 high combinations 800AF – 1600AF 2 200KAIC
- Width increase to 32" with 2000AF breaker included

Low Voltage Construction - 4 High NW/MTZ Distribution Sections 800-2000AF

Distribution Sections – Up to 200KAIC

- 4 high Sections are **26"W** for manually operated breaker
- **32"W** for electrically operated



26" – 32" Wide

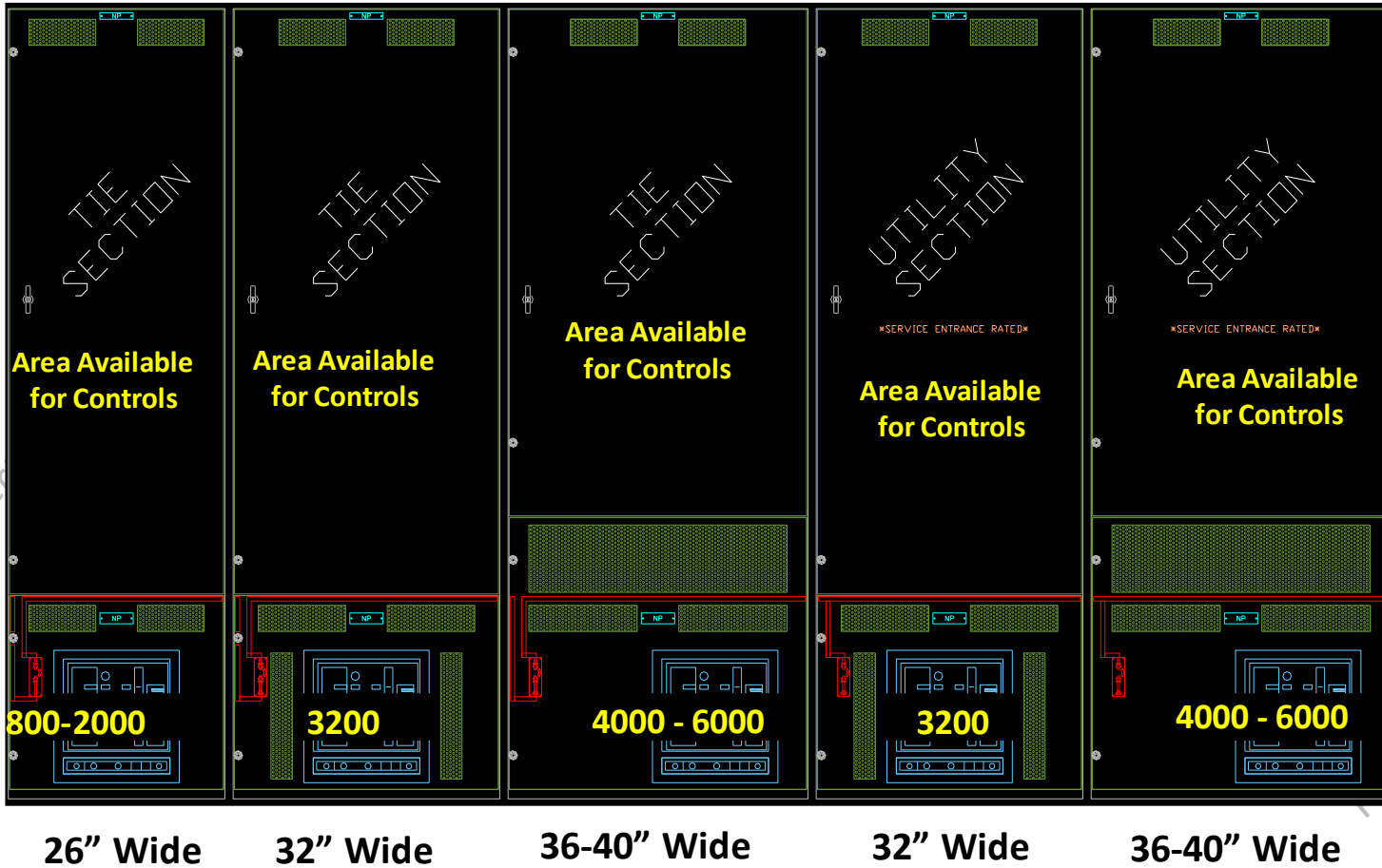
26" – 32" Wide

- Electrically operated requires additional room for CPTs and CB control switches



Low Voltage Construction - Tie and Utility Sections NW/MTZ 800AF to 6000AF

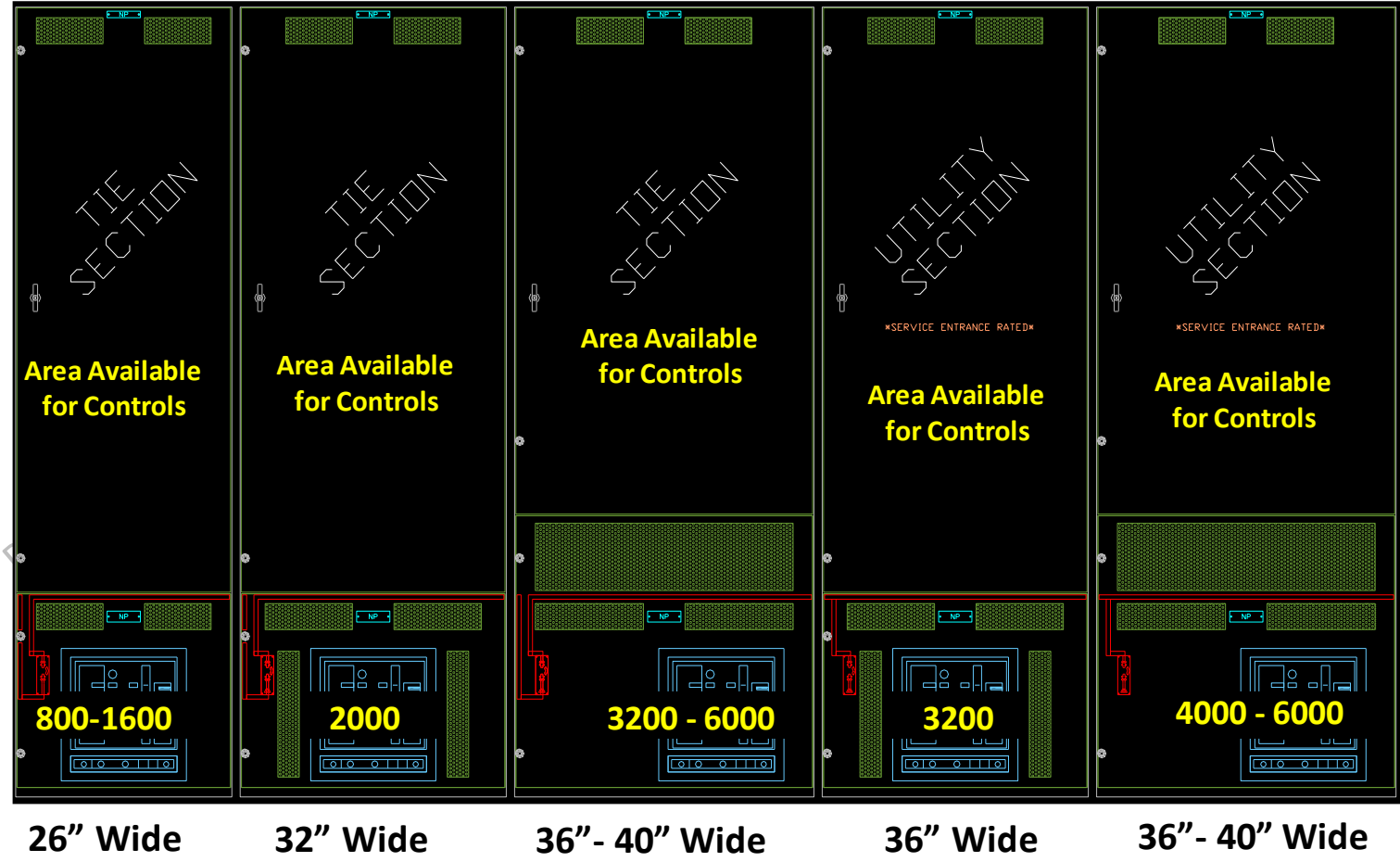
Sections – Up to 100KAIC



- Width remains at 26" up to 2000AF
- Width increase to 32" with 3200AF breaker
- Width increases to 36" for 4000 & 5000AF
- Width increases to 40" for 6000AF

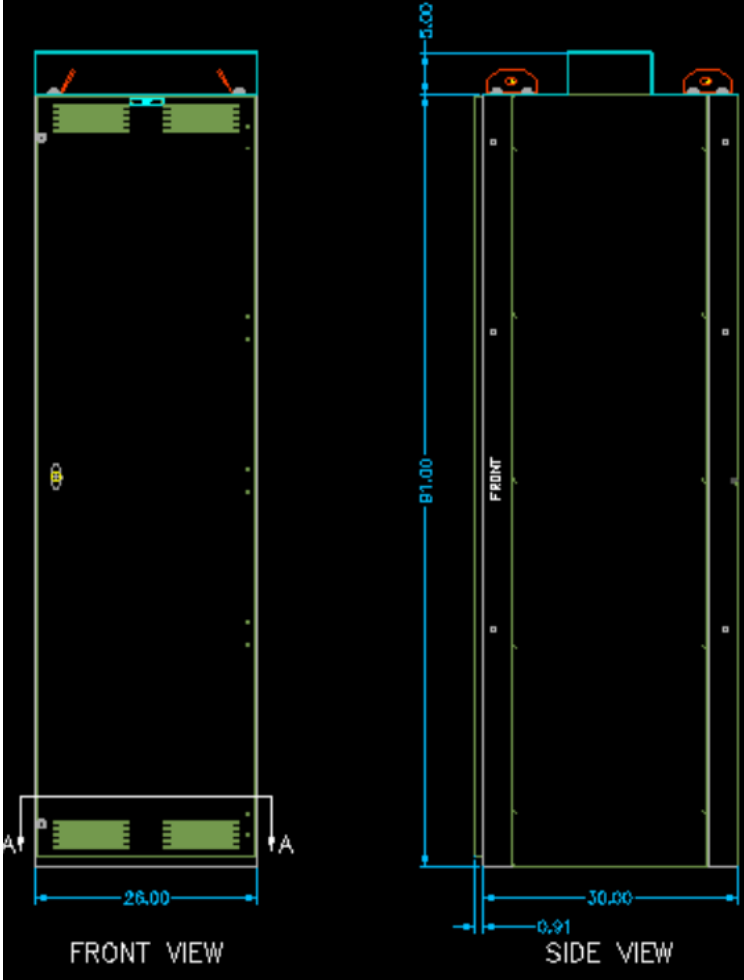
Low Voltage Construction - Tie and Utility Sections NW/MTZ 800AF to 6000AF

Sections – Up to **150-200KAIC**



- Width remains at 26" up to 1600AF
- Width increases to 32" for 2000AF breaker
- Width increases to 36" for 3200 - 5000AF
- Width increases to 40" for 6000AF

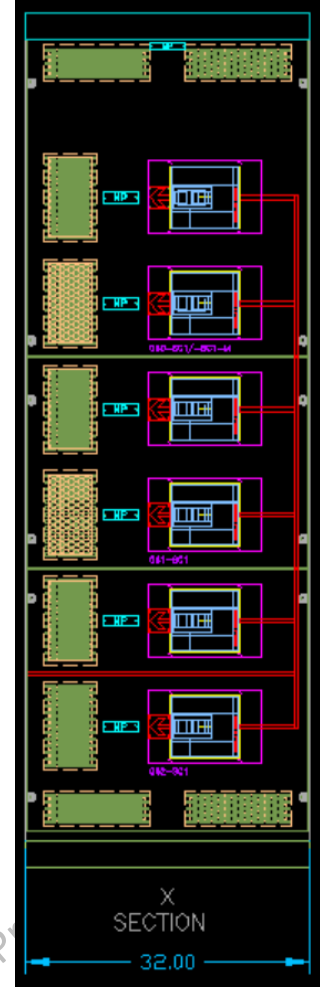
Low Voltage Construction – Additional Sections



Controls Only Section

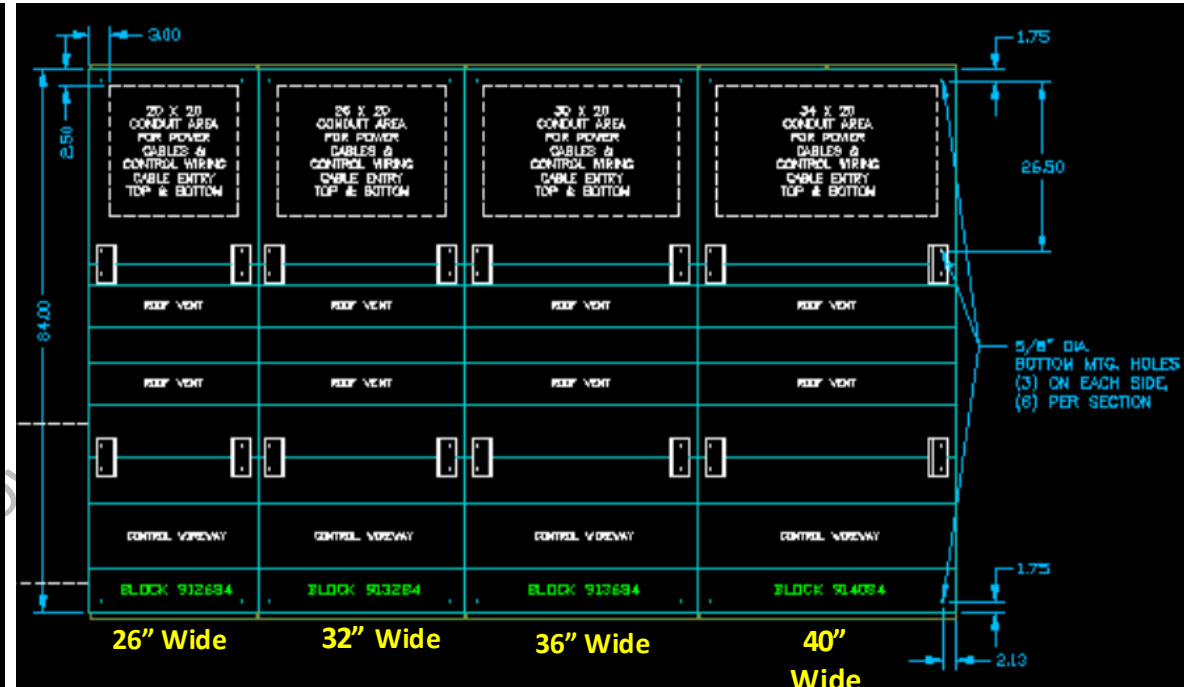
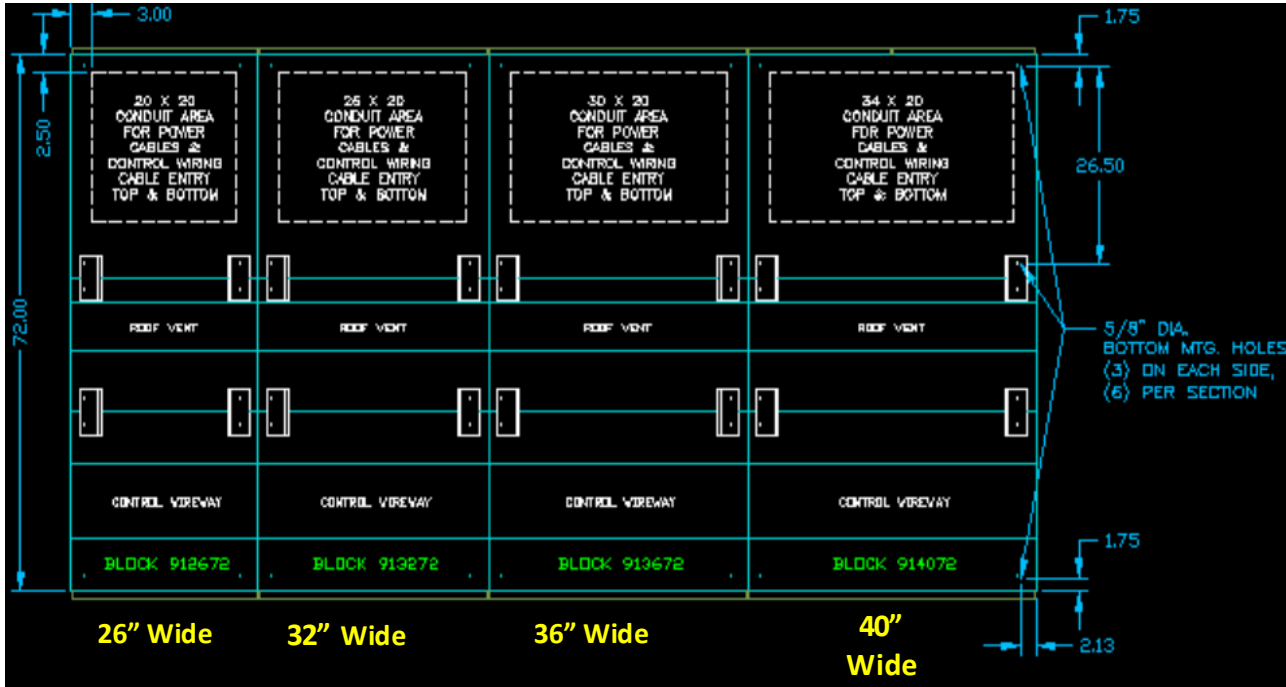


1 Line Panelboard Section



6 High 1200AF P Frame

Low Voltage Construction – Depths and Conduit Areas

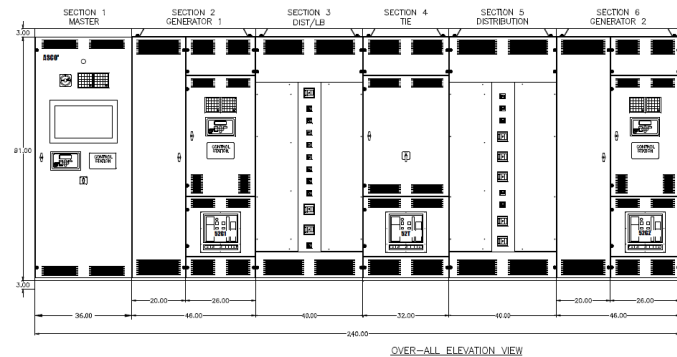
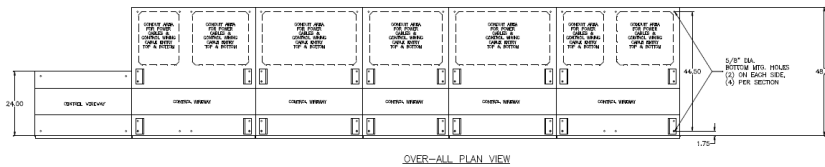


- Up to 6000A Main Bus
- 72" Depth
- UL 891 or UL 1558 Design

- Up to 8000A – 10000A Main Bus
- 84" Depth
- UL 891 or UL 1558 Design

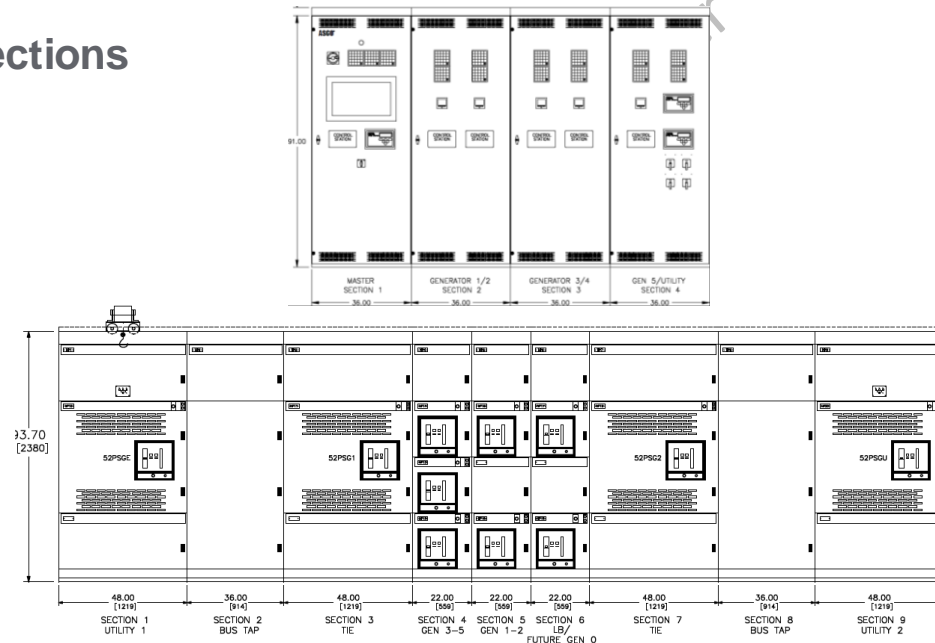
Low Voltage Construction– Front Connected Switchgear

- Designed/listed to UL 891
- Bus Bracing - 100k Max
- Main Bus Max - 4000A
- Up to 3000A Drawout UL489 NW/MTZ Breakers
- 48” Depth, Top or Bottom Cable entry
- Section Types -1 – 4 high NW/MTZ, Tie & I Line Panelboard



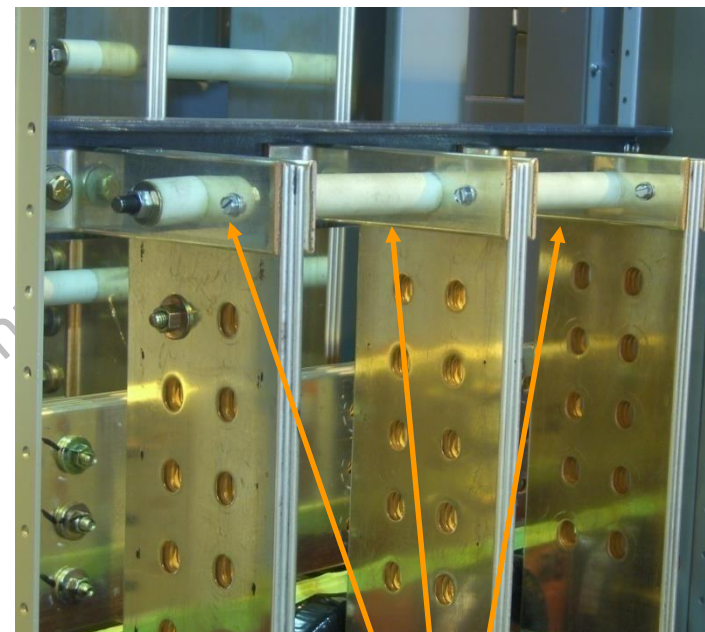
Low Voltage Construction – Insulated Bus

- Insulated Bus is not required by any UL or ANSI low voltage standard
- Some customers have moved to insulated bus for perceived safety reasons – Government, US Embassies, Water Treatment
- Insulated bus applications utilize Square D PZ4 type Switchgear
- UL1558 listed
- Bus Bracing – up to 200k
- Main Bus Max - 5000A
- Includes separate control sections



Low Voltage Construction – Bus and Bracing

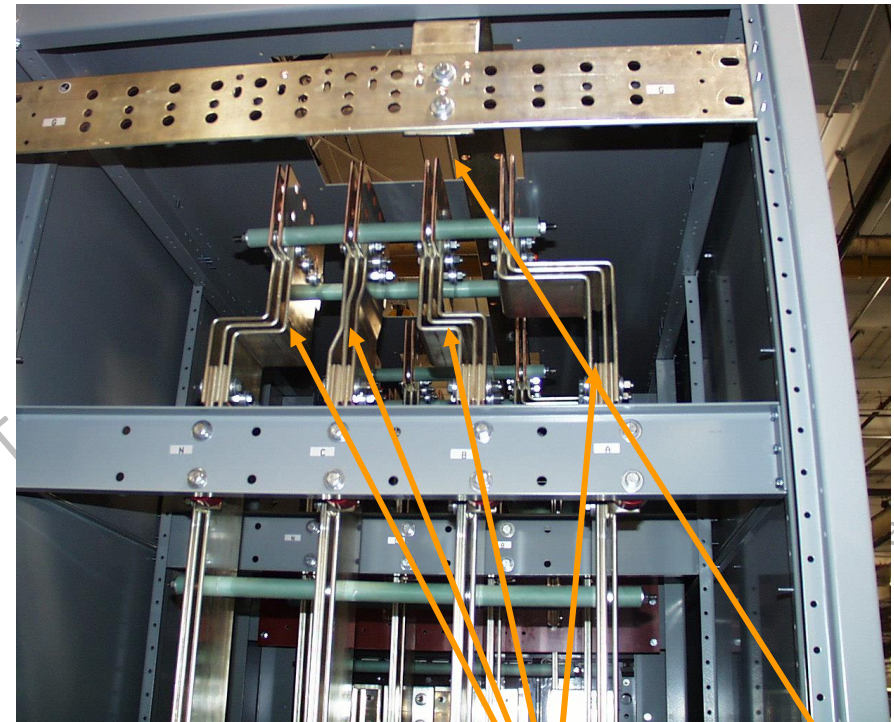
- All bus designed at minimum 1000A/Square inch current density. UL rating based on current density not thermal rating– NYC requires some different current density (700A/Square Inch) – Requires more copper.
- There's lots of industry bus bracing levels – 50K, 65K, 85K, 100K, 150K, 200K
- ASCO provides two bus bracing designs – 100K and 200K
- Switchgear obtains label based on rating of lowest rated device.
- That means the switchgear can have bus bracing of 200K but be labeled 100K if the breakers are rated 100K. Occurs more than you may think based on spec requirements. *Ex: 100K rated Generator Breakers with 200K Distribution Breakers*



Bus bracing

Low Voltage Construction – Bus Risers

- Up to 2 Risers per section
- Cubicle dimensions (width and/or depth) can change based on bus duct flange
- Bus Duct Flange drawings required to make accurate drawings and complete design
- SqD, Siemens, GE, CH all have different flanges with different dimensions
- ASCO doesn't supply the flange or associated mounting hardware
- Flanges can be shipped to manufacturing facility for fitting on riser.



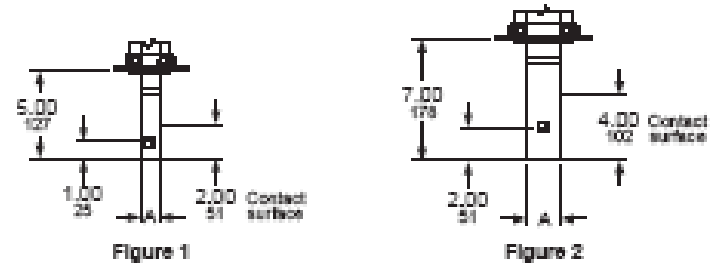
**Phase Orientation
NCBA Left to Right
(Rear View)**

**Roof Cut
Outs**

Low Voltage Construction – Bus Risers

Need to know the flange type and specific drawing for proper design

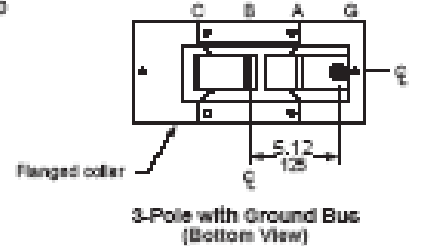
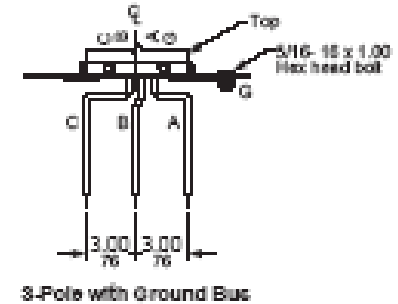
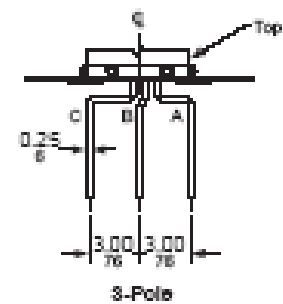
Flanged End Details



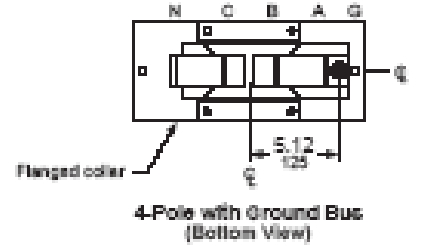
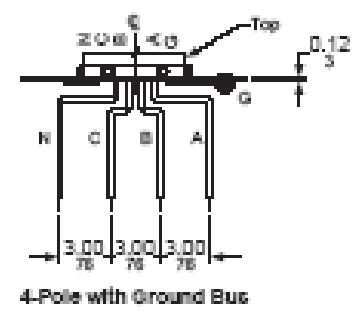
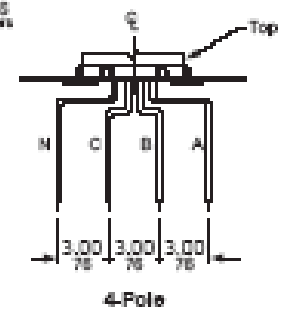
Ampere Rating		Fig.	A	
Aluminum	Copper		IN	mm
225	225	1	0.94	24
400	400	2	2.00	51
...	600	2	2.00	51
600	...	2	3.38	86

Most flanges look like this

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Dual Dimensions: INCHES / MILLIMETERS

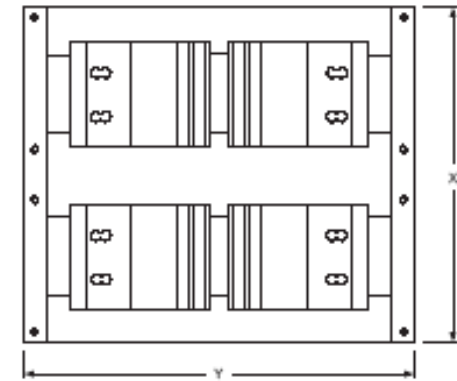
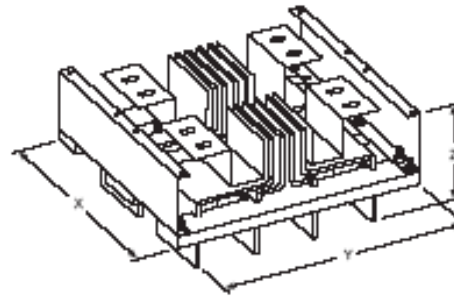


Low Voltage Construction – Bus Risers

- But some look like this
- The Square D Qwik Flange
- Mounts differently than a flanged end
- Requires custom engineering design
- Can physically mount internal to switchgear

Busway Systems
800 A–5000 A Catalog Numbering System/Physical Data

Qwik Flange (Indoor Only)



Catalog Number Suffix –QF

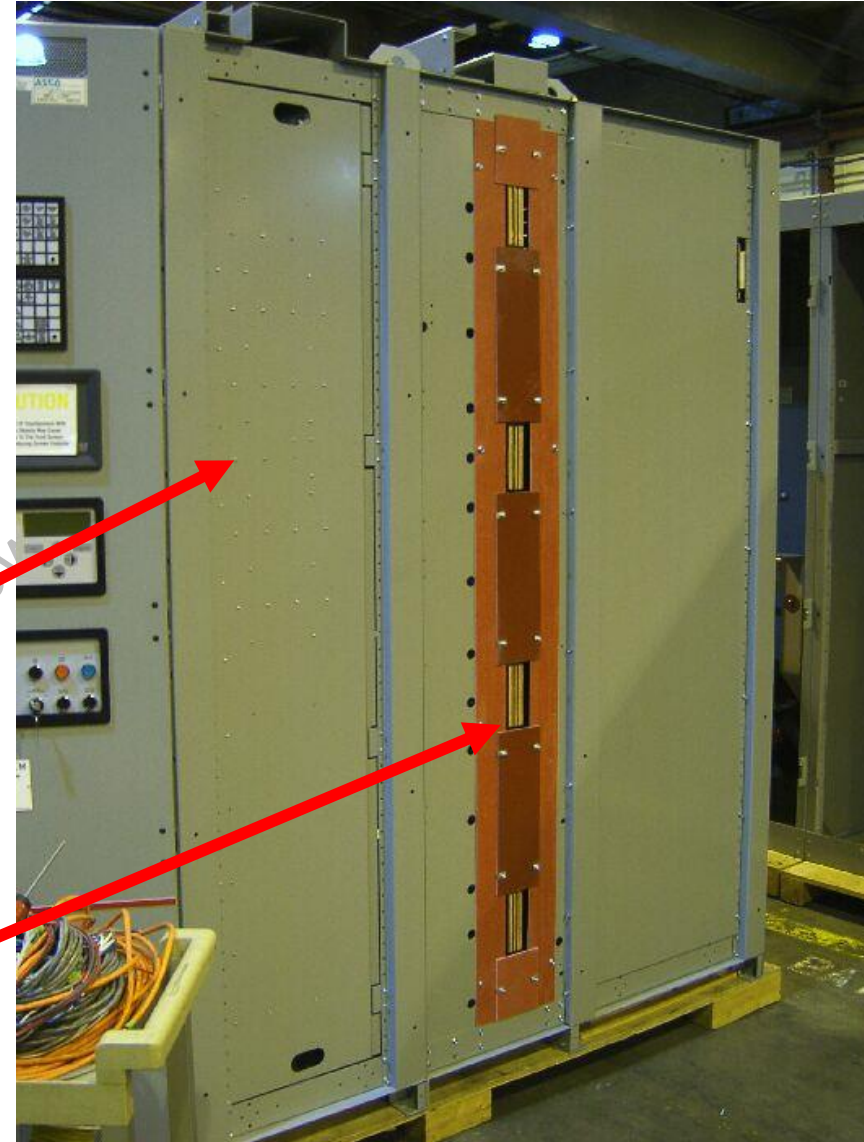
Amperage Ratings		X				Y		Z	
Aluminum	Copper	3-Pole		4-Pole		IN	mm	IN	mm
		IN	mm	IN	mm				
...	800	10.50	207	10.50	207	16.26	413	7.50	190
...	1000	10.50	207	10.50	207	16.26	413	7.50	190
1000	1200	10.50	207	10.50	207	16.26	413	7.50	190
...	1350	10.50	207	10.50	207	16.26	413	7.50	190
1200	...	10.50	207	10.50	207	16.26	413	7.50	190
...	1600	10.50	207	10.50	207	16.26	413	7.50	190
1350	...	10.50	207	10.50	207	16.26	413	7.50	190
...	2000	10.50	207	10.50	207	16.26	413	7.50	190
1600	...	10.50	207	10.50	207	16.26	413	7.50	190
2000	2500	14.34	354	14.34	354	16.26	413	7.50	190
2500	...	17.84	453	17.84	453	16.26	413	7.50	190
...	3000	16.84	428	16.84	428	16.26	413	7.50	190
3000	...	20.34	517	20.34	517	16.26	413	7.50	190
...	4000	25.22	641	25.22	641	16.26	413	7.50	190
4000	...	27.22	691	27.22	691	16.26	413	7.50	190
...	5000	26.72	679	26.72	679	16.26	413	7.50	190

Low Voltage Construction – Side Barriers

- Barriers provided between sections if specified – required by code in some areas – Ex: NYC
- Sectional Barriers are steel and glastic
- **Not** a UL1558 requirement

Steel Side Barriers at control and cable compartments

Glasic Side Barriers around bus compartment



Low Voltage Construction – Rear Barriers

- Barriers provided to isolate main bus from cable compartment
- Rear Barriers are glastic
- Rear Barriers are vented for heat rise purposes

Glastic Rear Barriers to prevent contact with main bus



Low Voltage Construction – Lifting Means

- How do we pick this thing up?
- Are their lifting eyes?
- Is sling rigging required?
- ASCO gear at one time had to be sling rigged per NEMA PB-2 Guidelines

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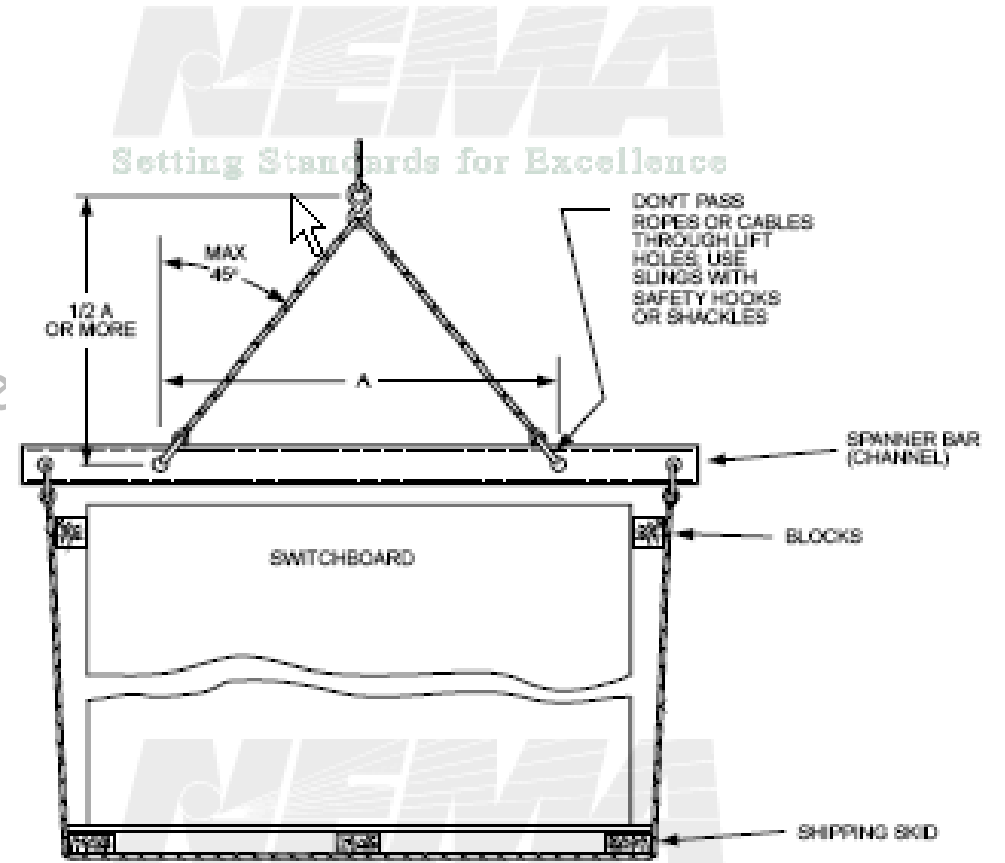
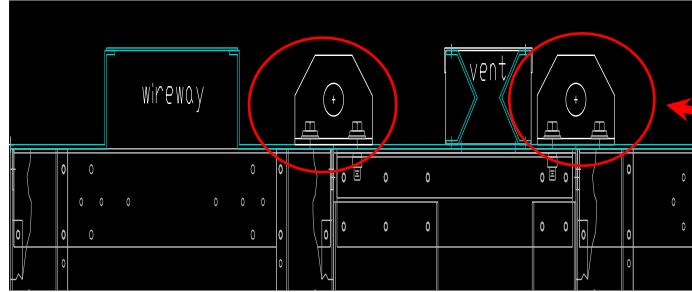


Figure 2-3
LIFTING WITH SLING RIGGING

Low Voltage Construction – Lifting Means



**Bolted on
Lifting Plates**



**Bolted on
Lifting Plates**

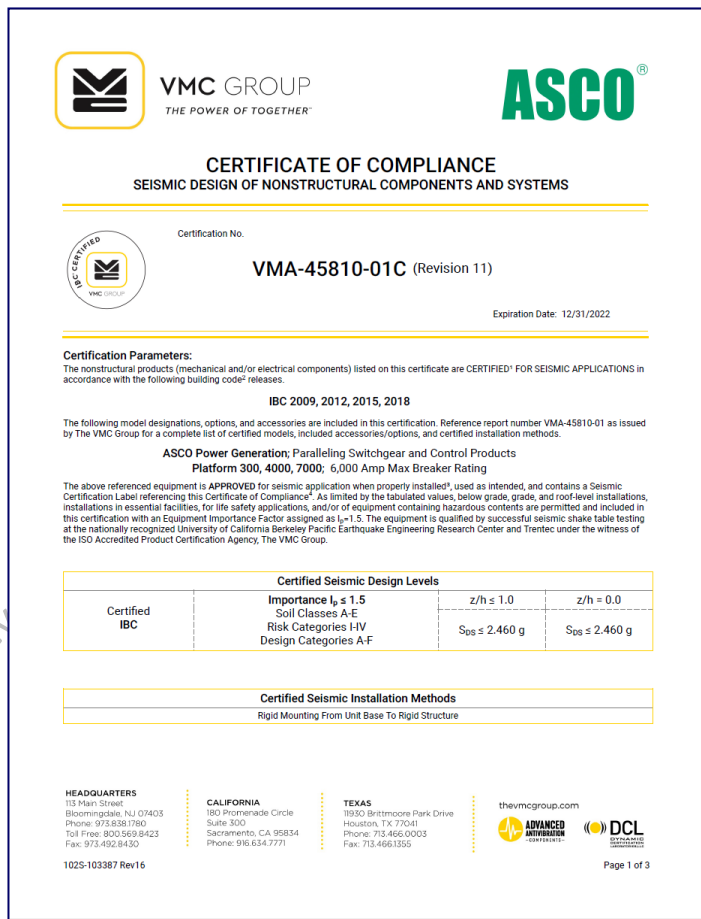
Low Voltage Construction

- Switchgear Design Features
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- *Seismic Considerations*
- UL 891 & UL 1558

Low Voltage Construction - Seismic Requirements

- All ASCO 4000 & 7000 Series Low Voltage Switchgear has been shake table tested to IBC and OSHPD requirements
- All ASCO 4000 & 7000 Series Low Voltage Switchgear is in compliance with **IBC 2018** when using Square D, 3 Pole circuit breakers
- All other breaker manufacturers are in compliance with **IBC 2009**
- All ASCO 4000/7000 Power Control Systems are constructed to these requirements
- Not all Systems are shipped with Seismic labels, it has to be specified or requested. New ASCO Guide Spec includes Seismic Label on all switchgear
- All ASCO Switchgear is Seismic Certified to **OSHPD** (California) requirements

ASCO SEISMIC Compliance - IBC



Seismic Certificate of Compliance

Certificate of Compliance available at www.ibcapproval.com



Scanning Barcode will bring you to our Certificate of Compliance

Seismic Equipment Label

SEISMIC Code Requirements (OSHPD)

- **What is OSHPD?**
 - **Office of Statewide Health Planning and Development**
 - **OSHPD is one of 13 departments within the California Health and Human Services Agency**
 - **The Facilities Development division is responsible for approval of special seismic certification for hospitals and skilled nursing facilities**
 - **Applicable Codes:**
 - **CBC - California Building Code**
 - **IBC - International Building Code**
 - **ICC – ES AC156 (Seismic Qualification by Shake Table Testing)**

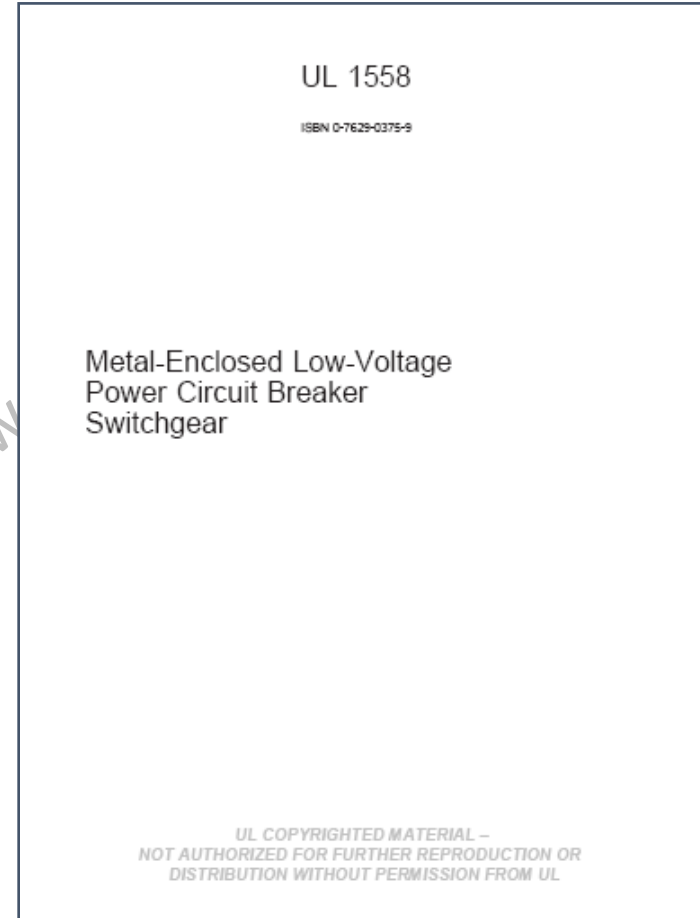
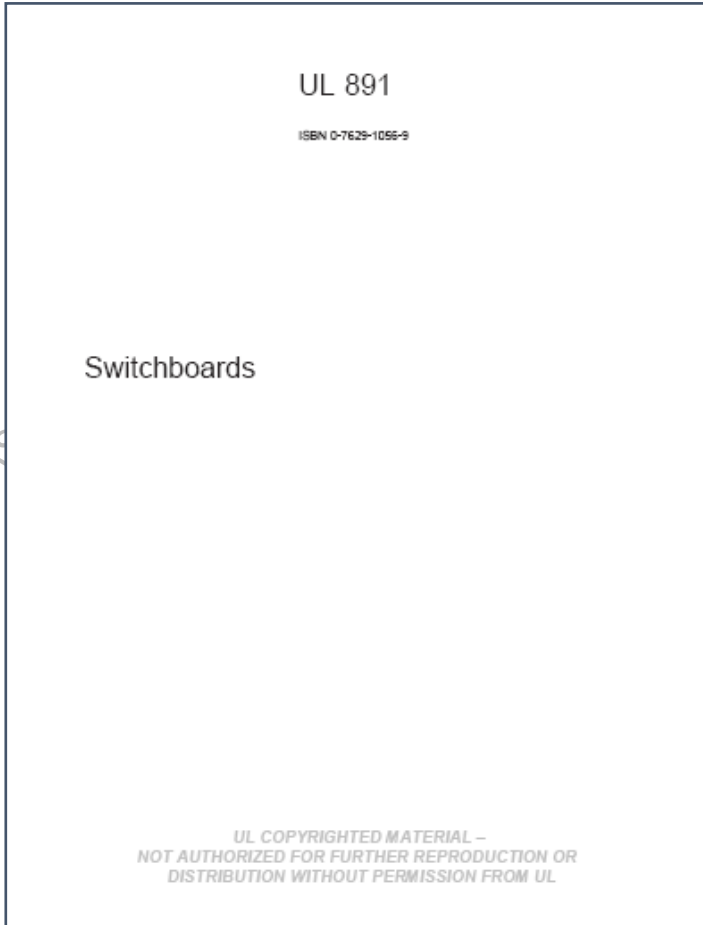
Low Voltage Construction

- Switchgear Design Features
- General Cubicle Dimensions
- Cubicle Modular Construction
- Conduits and Cable Considerations
- Switchgear Options
- Breaker Stacking Arrangements
- Seismic Considerations
- **UL 891 & UL 1558**

Property of ASCO Power Technologies™

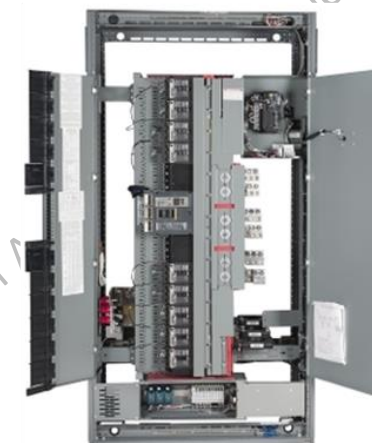
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UL 891 and UL 1558



Power Control Systems Standards– UL891

- Developed from NEMA Standards – Dead Front Switchboard Construction in accordance with NEC
- Molded Case, Panelboards, Insulated case breakers as defined in **UL 489** allowed
- Fusible Switches allowed
- ANSI Rated Breakers as defined by **ANSI 37.16, ANSI 37.13** and **UL1066**
- 3 cycle short circuit rating/test
- No barriers or compartmentalization required
- Typical AIC ratings 42KAIC, 50KAIC, 65KAIC, 100KAIC & 150KAIC. Can go up to 200KAIC
- Defines an interrupting current rating for the breaker



Power Control Systems Standards– UL 1558

- Based on ANSI Standard **C37.20.1** for Metal Enclosed Low Voltage Circuit Breaker switchgear
- Drawout Power circuit breakers as defined in UL 1066 and ANSI are the only type allowed
- **4 cycle** short circuit rating/test
- 30 or optional 60 cycle short time test
- Panelboards, UL489 listed circuit breakers and fusible switches can **NOT** be used in UL 1558 switchgear
- Complete breaker compartmentalization required
- Typical AIC ratings (65KAIC, 85KAIC, 100KAIC & 200KAIC)
- Defines an interrupting current rating and short time rating (30 cycle rating) for circuit breakers
- ASCO UL1558 listing is for up to 200KAIC for 4 cycles and 85KAIC for 60 cycles



Low Voltage Standards FAQ's

- **FAQ: When I buy UL 1558 labeled switchgear I get full depth barriers between sections right?**
- **Answer – No, UL 1558 does not require full depth barriers between sections, it requires compartmentalization.**
- **FAQ: What's the difference between UL891 design and 1558 design?**
- **Answer – UL 891 is switchboard construction (Fixed group mounting) & UL 1558 is Switchgear Construction (Individually compartmentalized draw-out type breakers).**
- **FAQ: Aren't UL 891 designs less expensive than UL 1558?**
- **Answer – Not necessarily, it depends on several variables including breaker type and AIC rating.**
- **FAQ: UL 1558 requires insulated bus right?**
- **Answer – UL 1558 does not require insulated bus**



Figure 2: Each draw-out breaker is compartmentalized by grounded barriers.

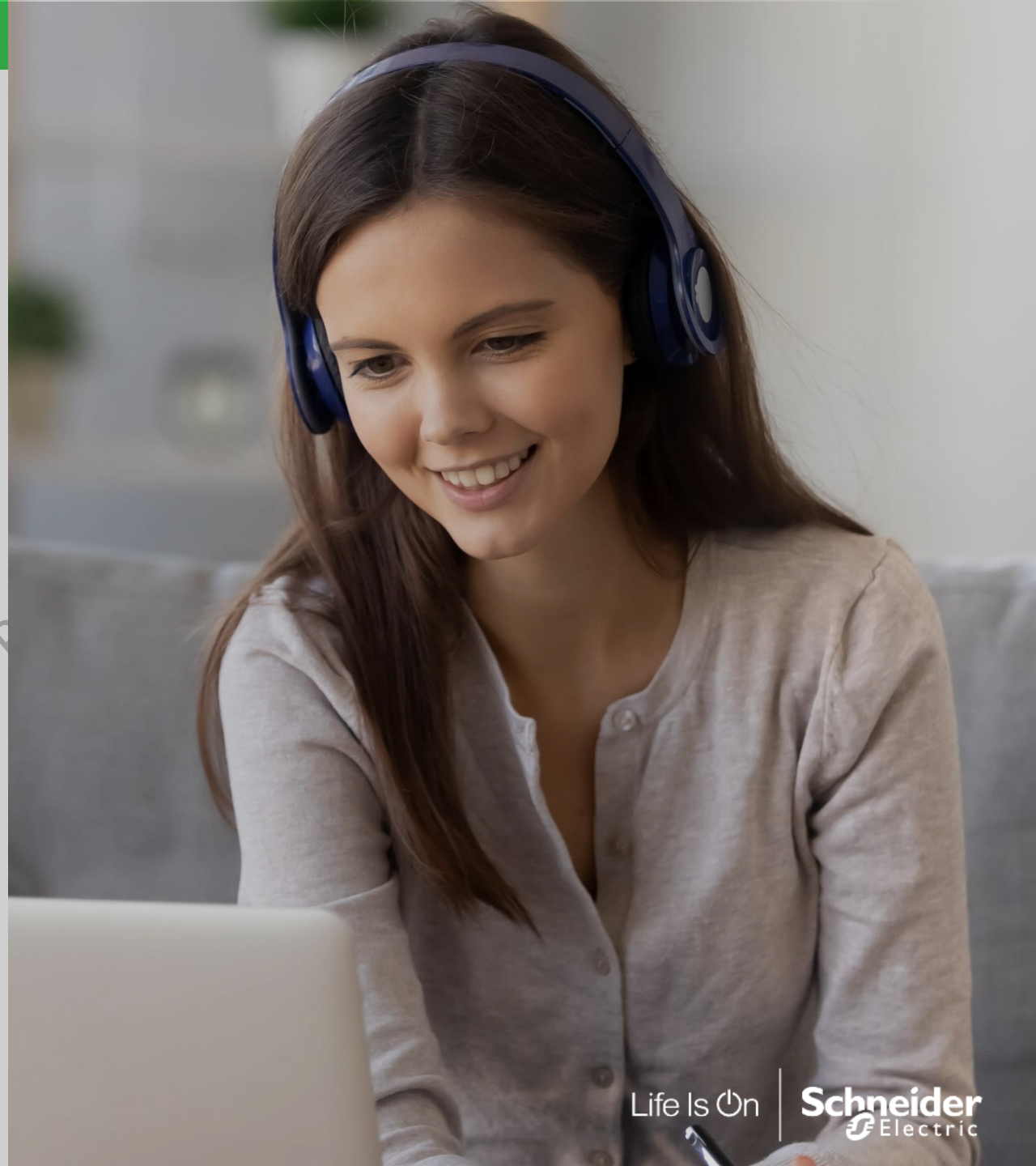
For further information

- Quiz, PDH and CEU certificates

All attendees will receive an email an hour after the webinar with instructions regarding the link to download your PDH certificate and Quiz Questions for you to receive your CEU certificate.

- **Speaker's contact**
Feel free to reach out to the speaker by email should you have any questions

pete.rossomando@ascopower.com



Thank You!

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