

Automatic Transfer Switches

ASCO 2023 Engineering Seminar
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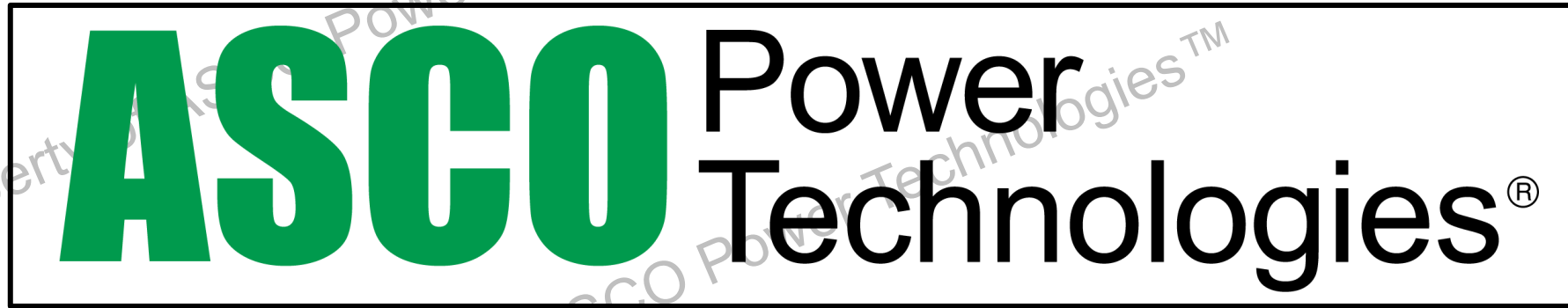
Schneider
 **Electric**

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Technologies®



Automatic Switch Company (ASCO) Power Technologies



#1 World Manufacturer of Power Transfer Switches

#1 North American Manufacturer of Critical Power Control Systems

#1 Power Transfer Services Organization

Overview

- | | |
|---|-------------------------------|
| 1 | ATS Basics |
| 2 | ATS Operation |
| 3 | Codes & Standards |
| 4 | Types of Transfer Switches |
| 5 | Transition Types |
| 6 | Bypass/Isolation |
| 7 | SER Transfer Switches |
| 8 | Withstand and Close-On Rating |

Product Offerings

Transfer Switches



- Automatic Transfer Switches (40A -4000A)
- Manual Transfer Switches
- Bypass-Isolation Transfer Switches
- Service Entrance Transfer Switches
- Custom Transfer Switches

Switchgear



- Generator Paralleling
- Low-Voltage Systems
- Medium-Voltage Systems
- UL 891: Switchboard Construction
- UL 1558: Switchgear Construction

Power Panels & Docking Stations



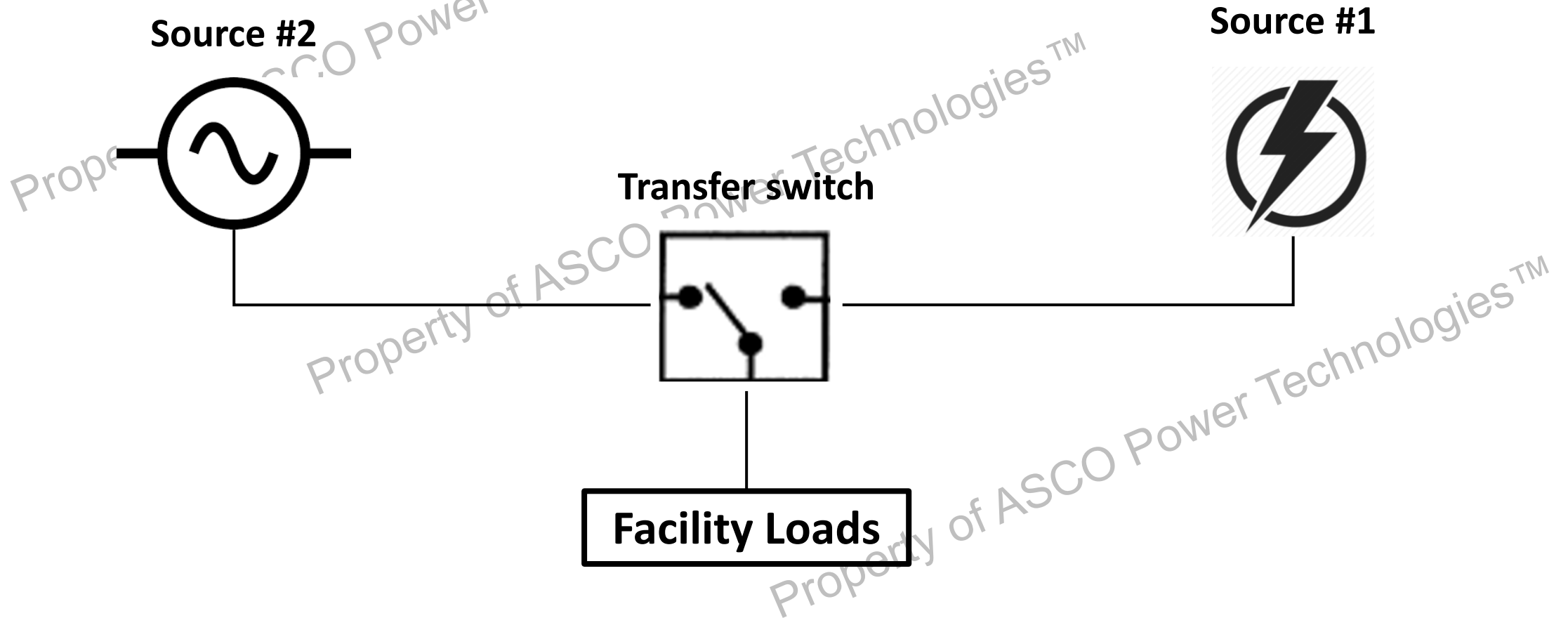
- Quick Connect Panels
- Quick Connect Manual Transfer Switches
- Quick Connect Power Panels w/ Breakers
- Dual Purpose Quick Connect Panels

Critical Power Control

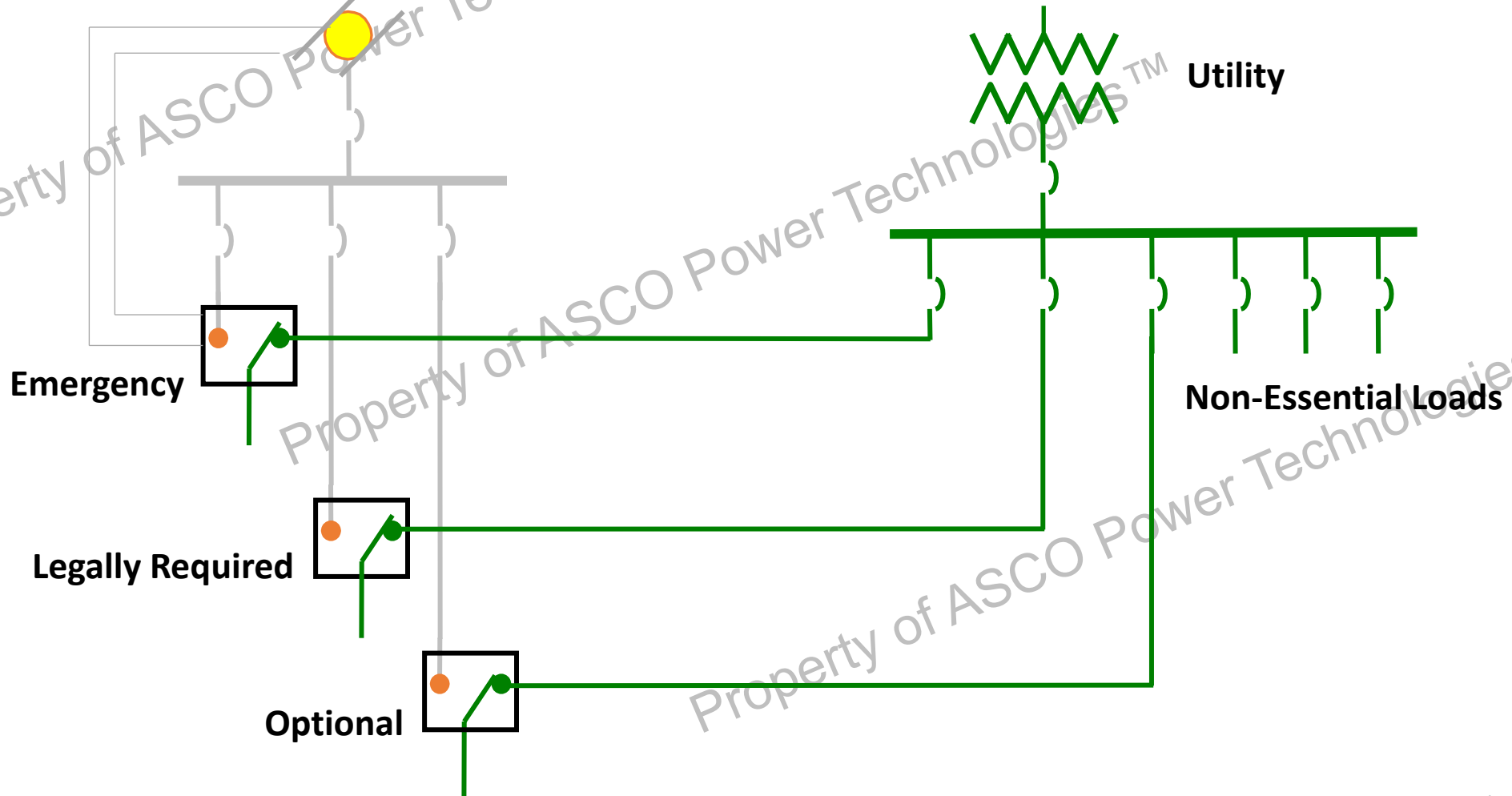


- Critical Power Management Systems
- Annunciators & Meters
- Load & Engine Monitoring
- Load Management Units
- Industrial Controls

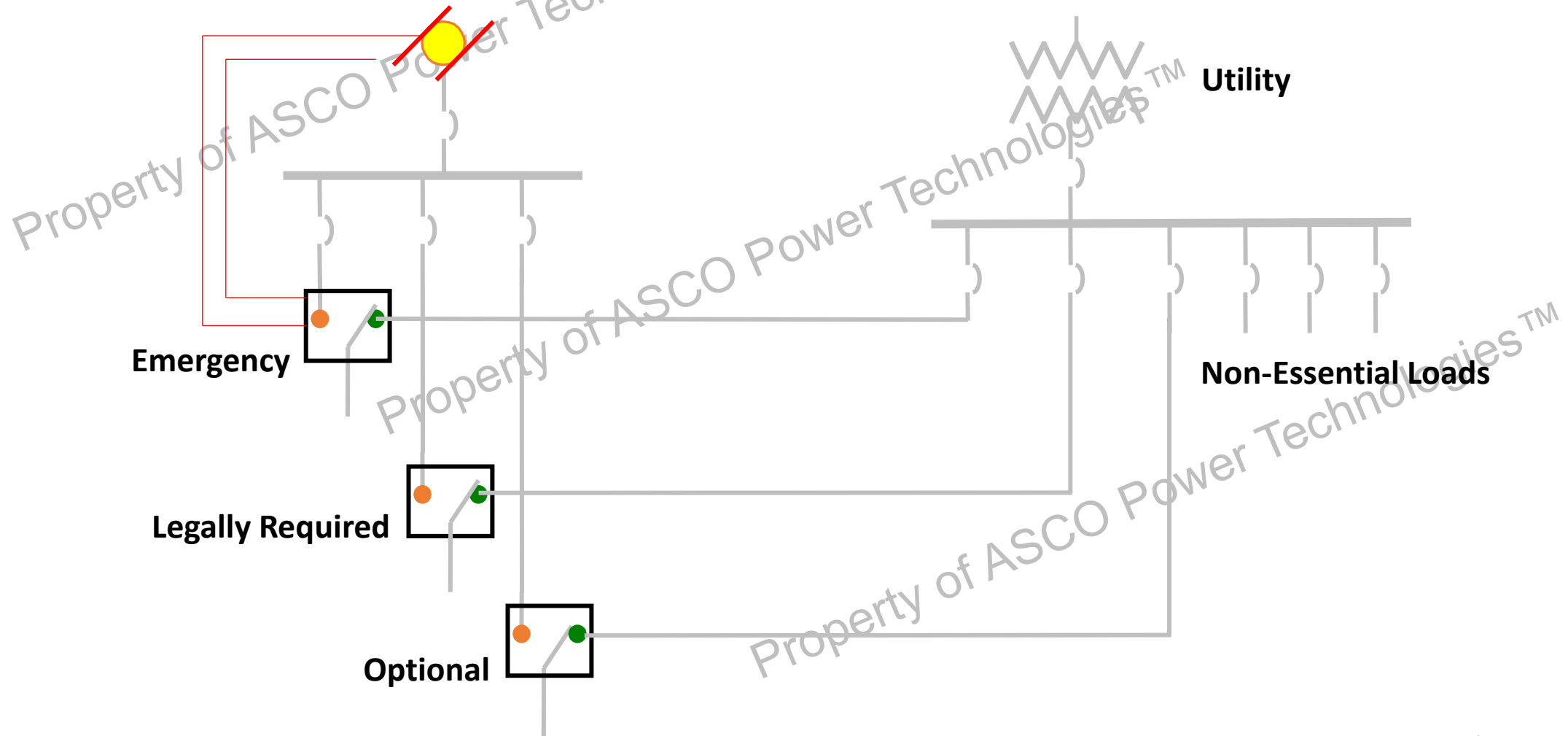
Transfer switches transfer facility loads from one power source to another



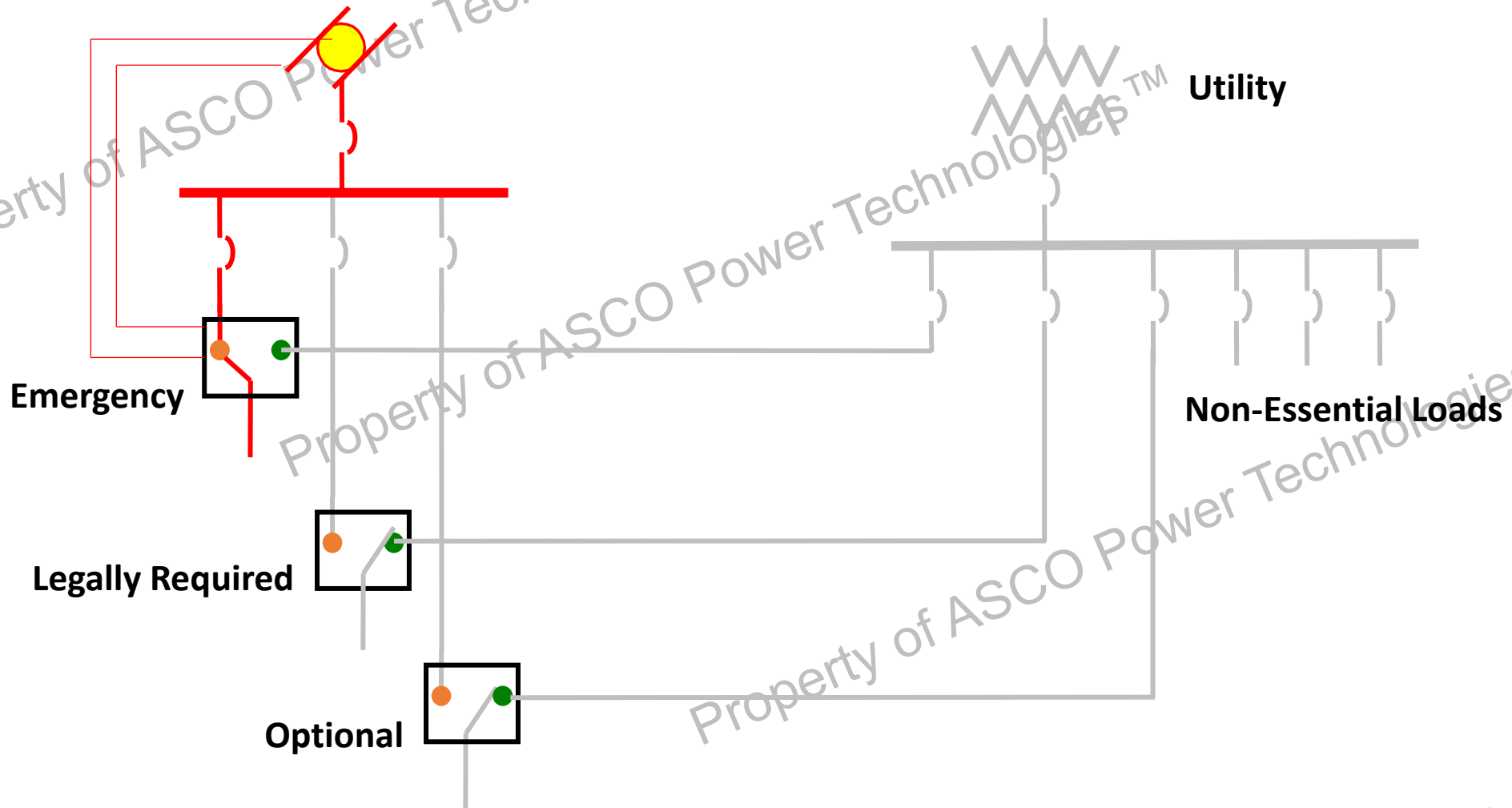
2. Transfer Switch Functions: Detect Power Failures



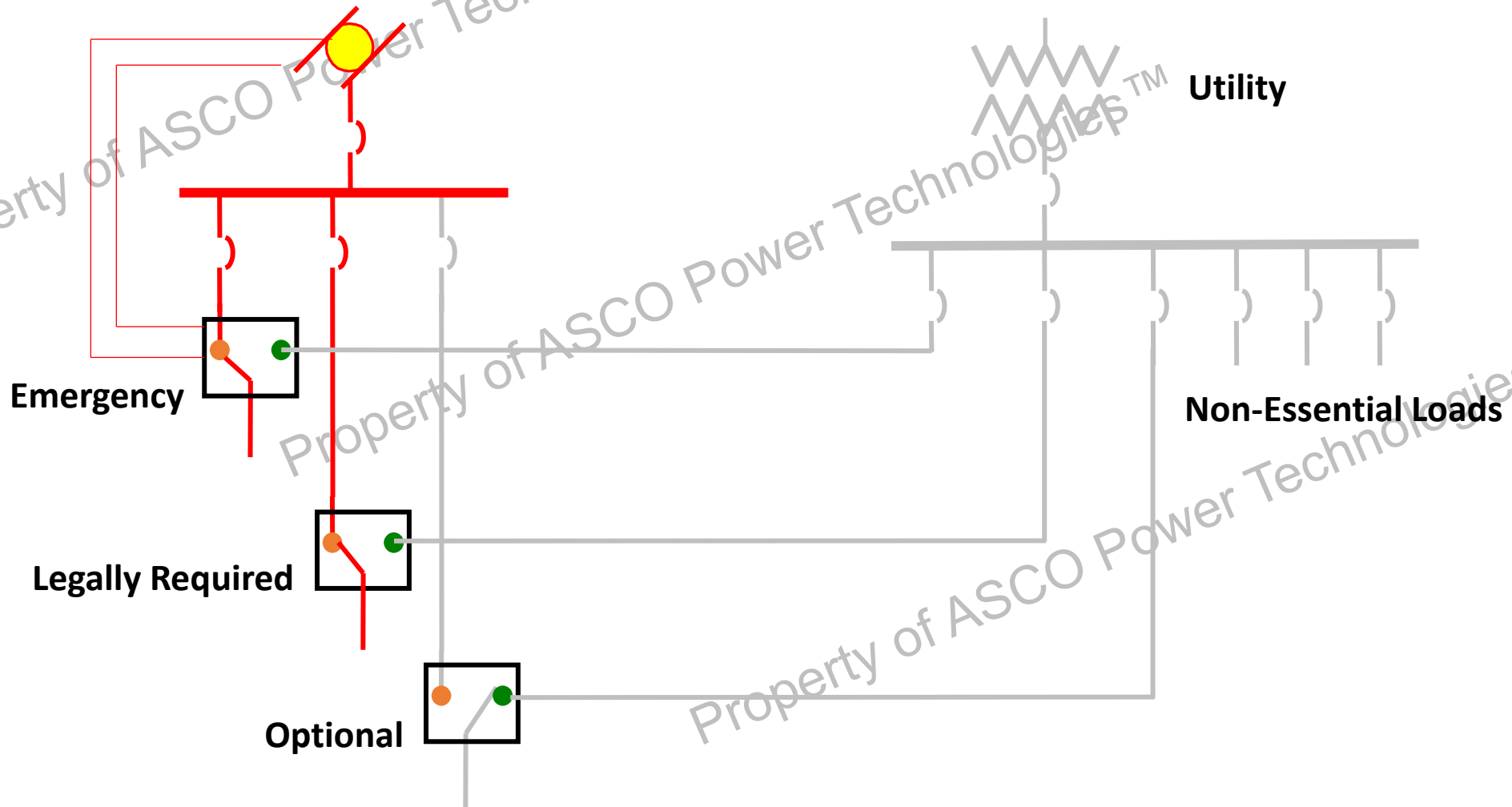
3. Transfer Switch Functions: Initiate Alternate Source



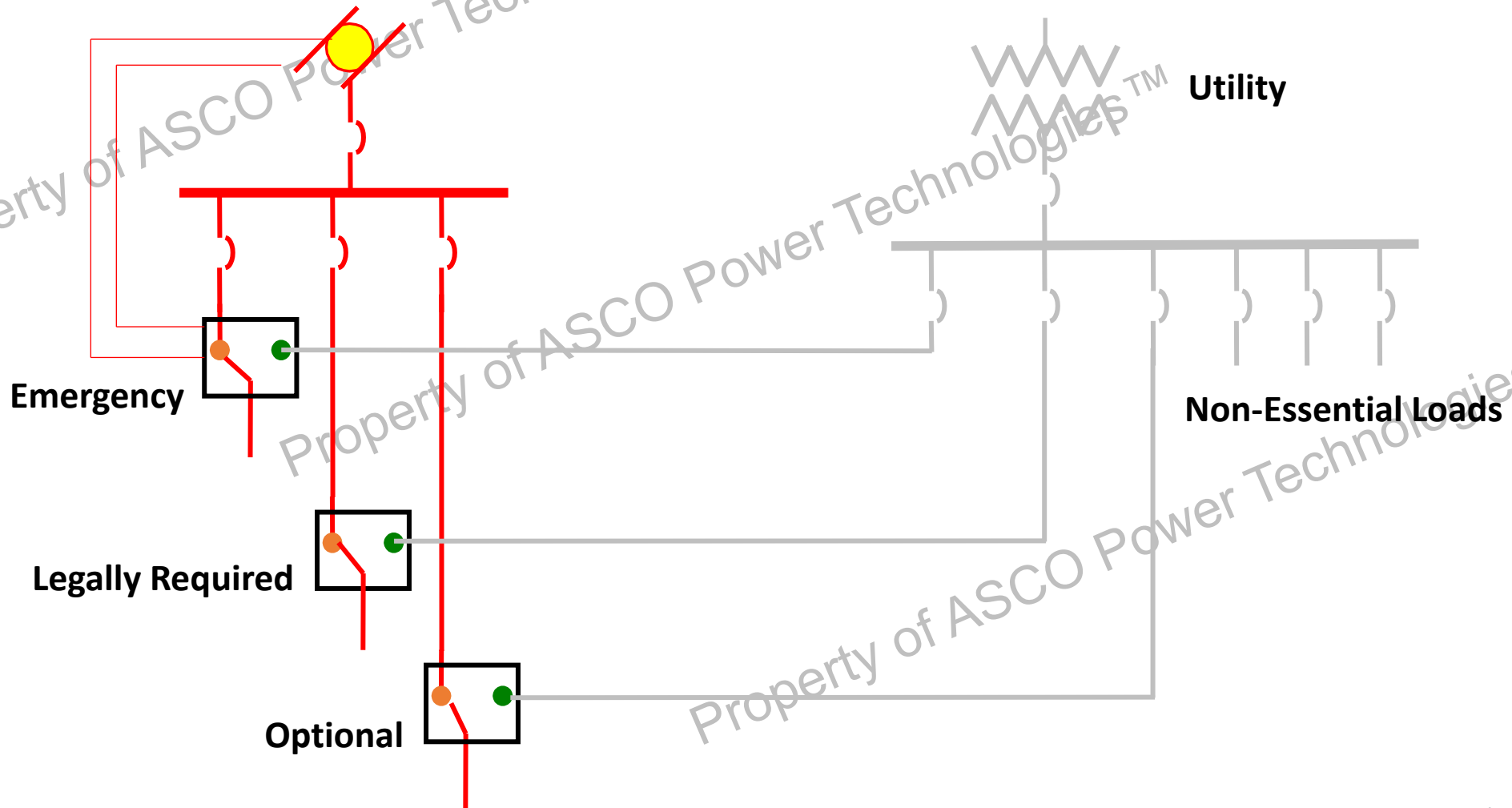
4. Transfer Switch Functions: Transfer Load



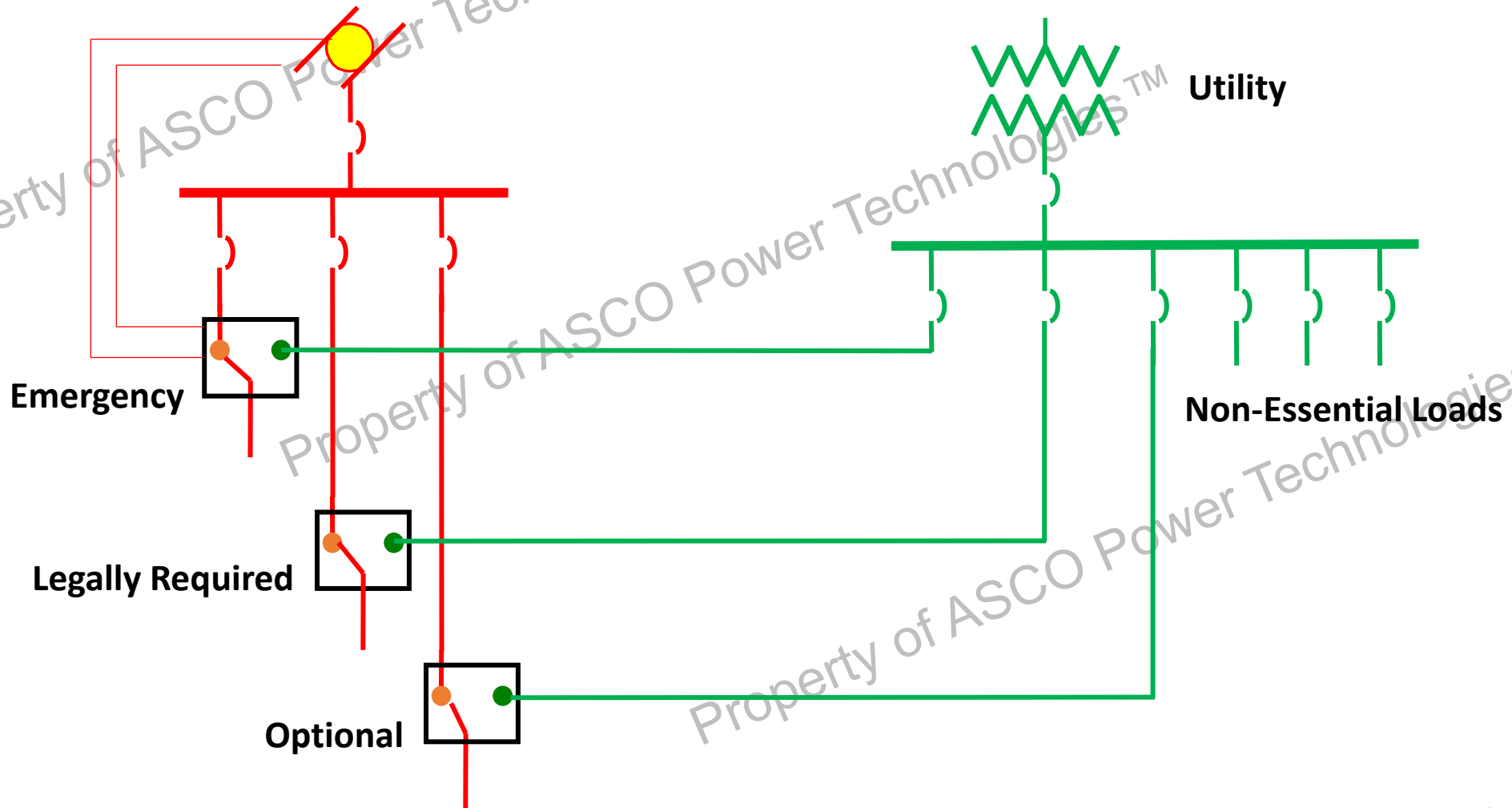
4. Transfer Switch Functions: Transfer Load



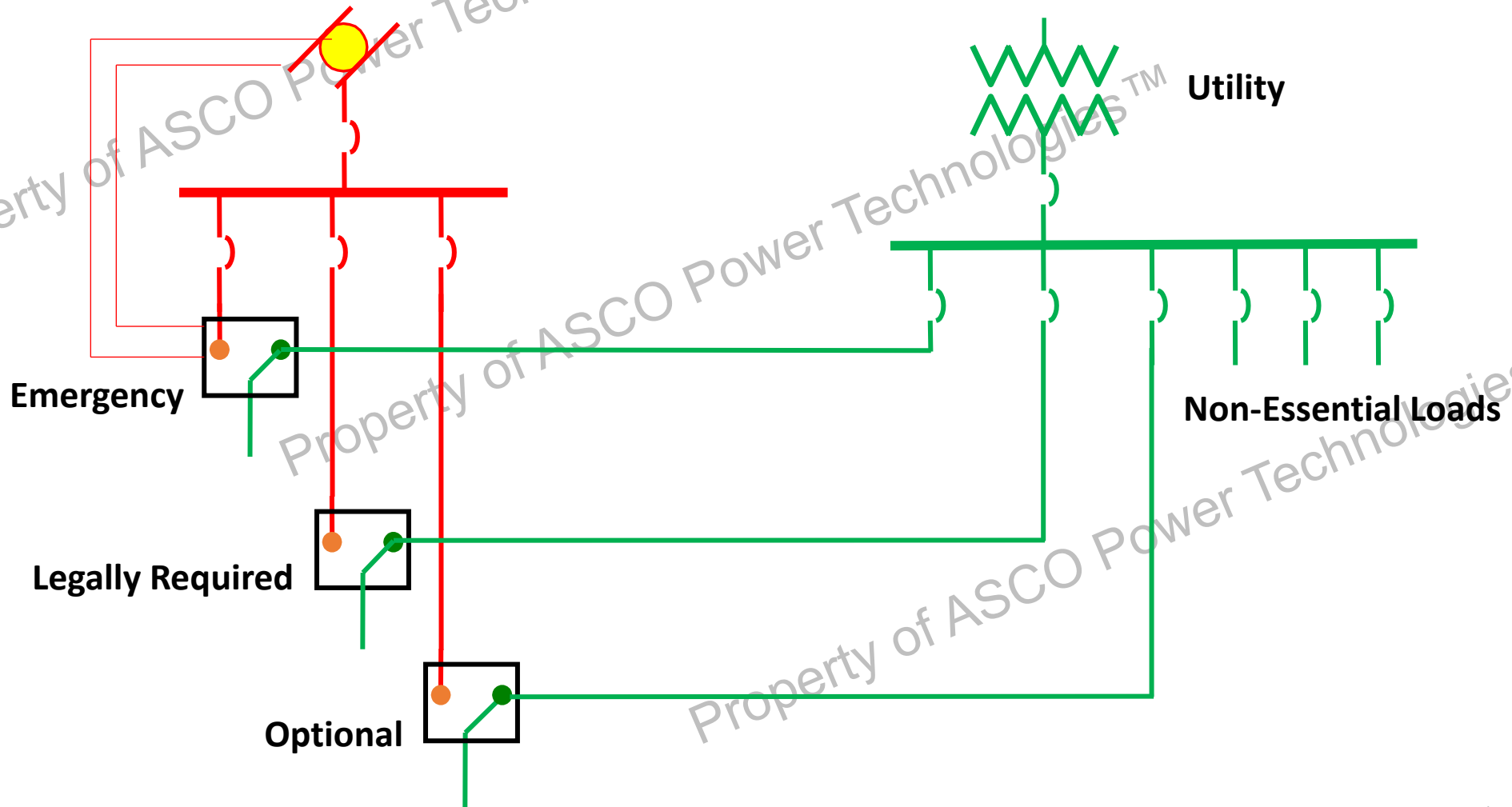
4. Transfer Switch Functions: Transfer Load



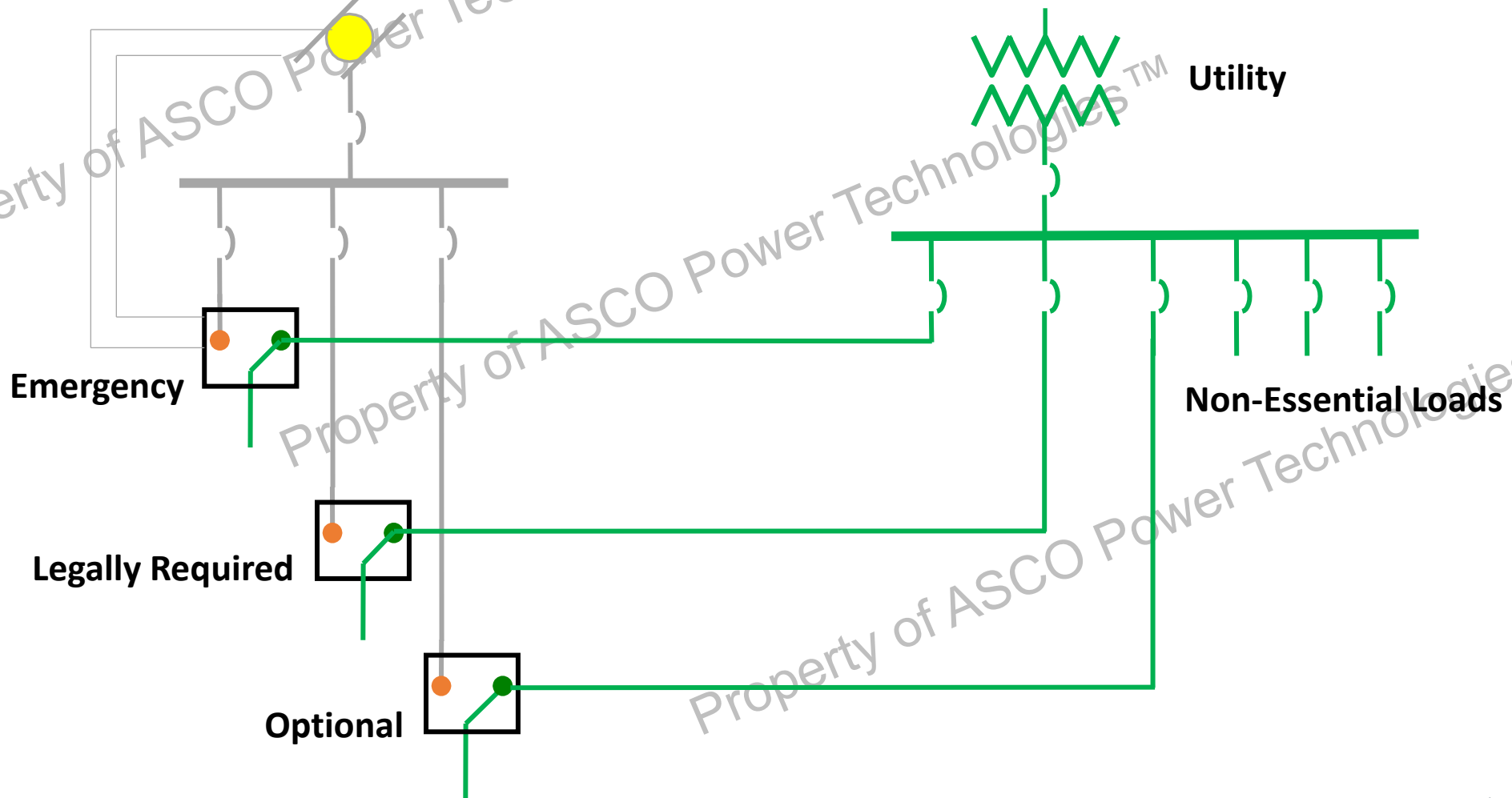
5. Transfer Switch Functions: Sense Restoration of Normal



6. Transfer Switch Functions: Retransfer Load to Normal



7. Transfer Switch Functions: Withstand and Close On Faults



Transfer Switch Codes and Standards

- NFPA 70 – National Electric Code
 - Article 700 – Emergency Systems – **Automatic Transfer Switch**
 - Article 701 – Legally Required Standby Systems – **Automatic Transfer Switch**
 - Article 702 – Optional Standby Systems – **Manual or Automatic Transfer Switch**
 - If Automatic Transfer Switch is Used:
 - Generator Must be sized to handle full load
 - OR automatic load shedding shall be employed
 - Article 708 – Critical Operations Power Systems (COPS) – **Automatic Transfer Switch**
 - Article 517 – Health Care Facilities
- NFPA 99 – Health Care Facilities
- NFPA 110 – Emergency & Standby Systems

Construction – UL-1008

- Transfer switch construction dictated by UL-1008 (1000V and below):
 - Mechanical Construction criteria
 - Rigorous testing requirements for endurance, overload, and interruption
- UL-1008 is designed to ensure reliability of devices responsible for maintaining power to critical loads
- UL-1008A covers transfer switches above 1000V
- UL-1008S covers solid-state (static) transfer switches

Construction – UL-1008

- 3 Main Types of Transfer Switches:
 - Contactor – Utilizes specially designed mechanical contactors driven by solenoid or motor to operate
 - Breaker – Utilizes combination of two breakers (One opening/One closing) to operate
 - Static – Utilizes semiconductor to permissively allow current flow (No mechanical components)
- For cost and reliability reasons, most power source switching is performed with Contactor-based switches

Transfer Switch Switching Types

Contactor

Uses mechanical contactors driven by solenoid or motors to operate



Breaker

Uses a combination of (2) breakers (open/closes) to operate



Static

Uses semiconductor to permissively allow current flow



Automatic vs. Non-Automatic vs. Manual Transfer Switch

Automatic (ATS) Electrically Operated NO user intervention required	Non-Automatic (NTS) Electrically Operated User intervention required	Manual (MTS) NO Electrical Operation User intervention required
	 	

Transfer Switch Construction

Transfer Switch

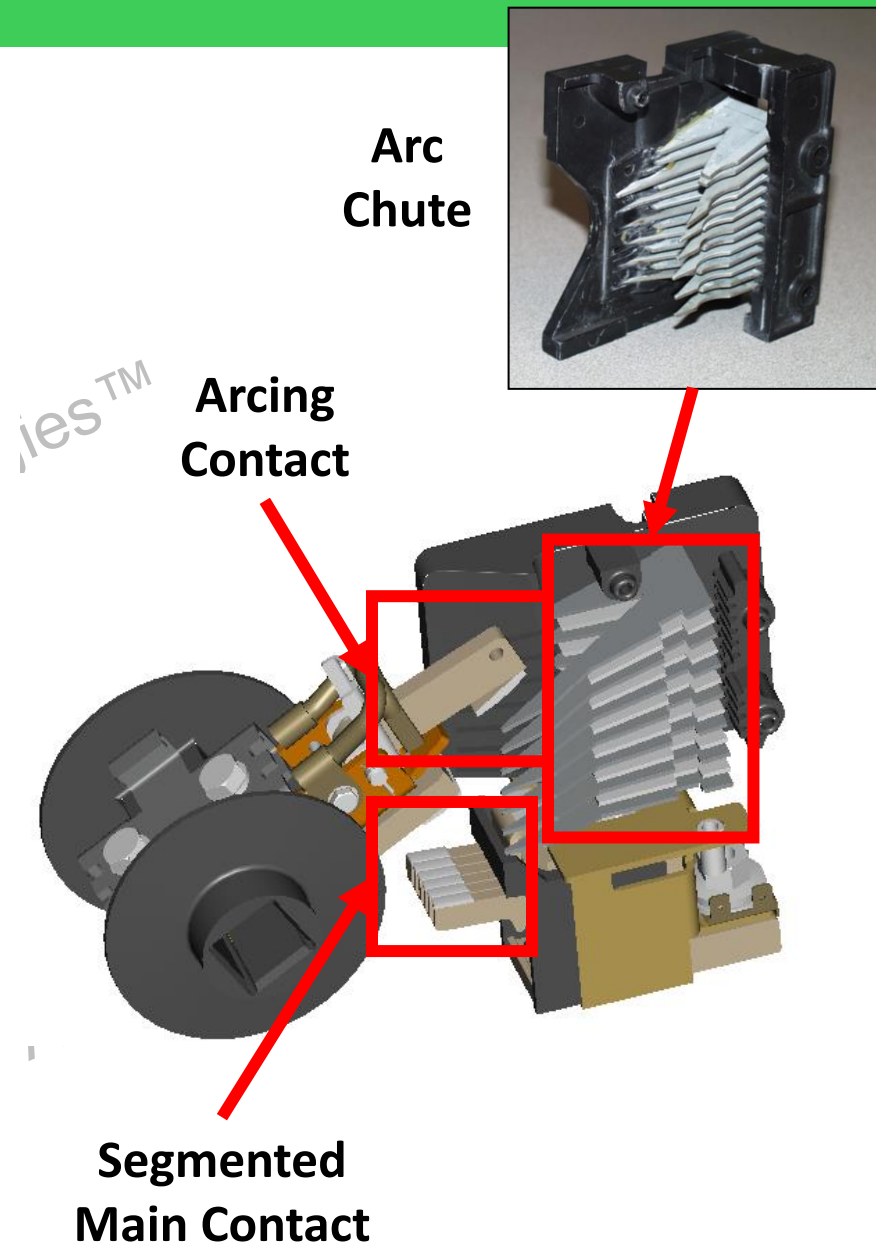
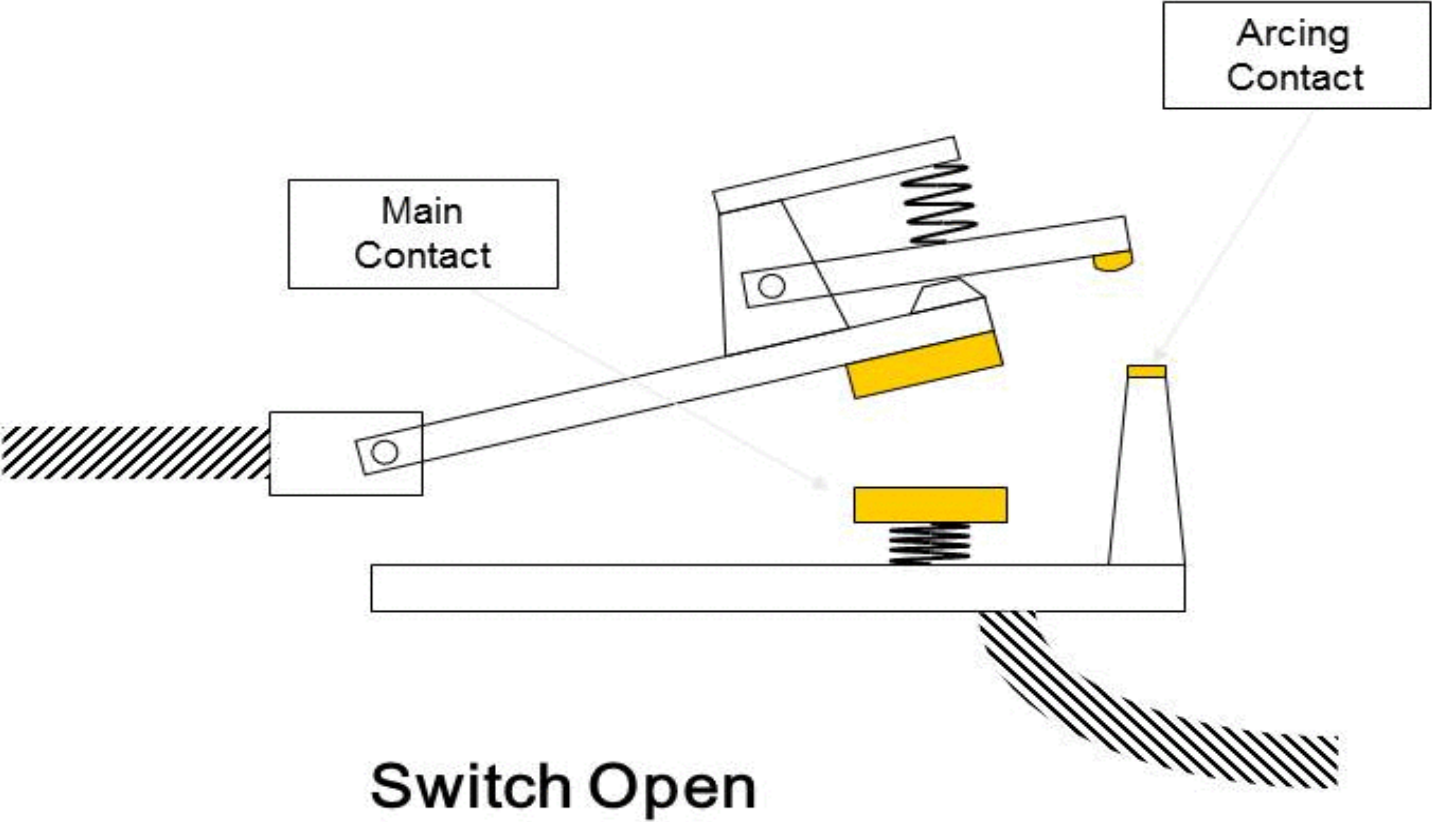
- Main and Arcing Contacts
- Solenoid Operator
- Power connections



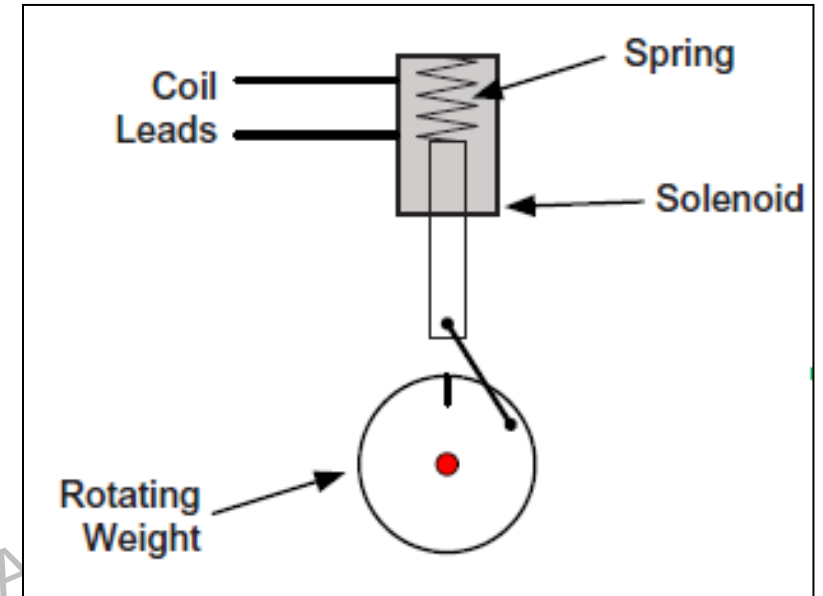
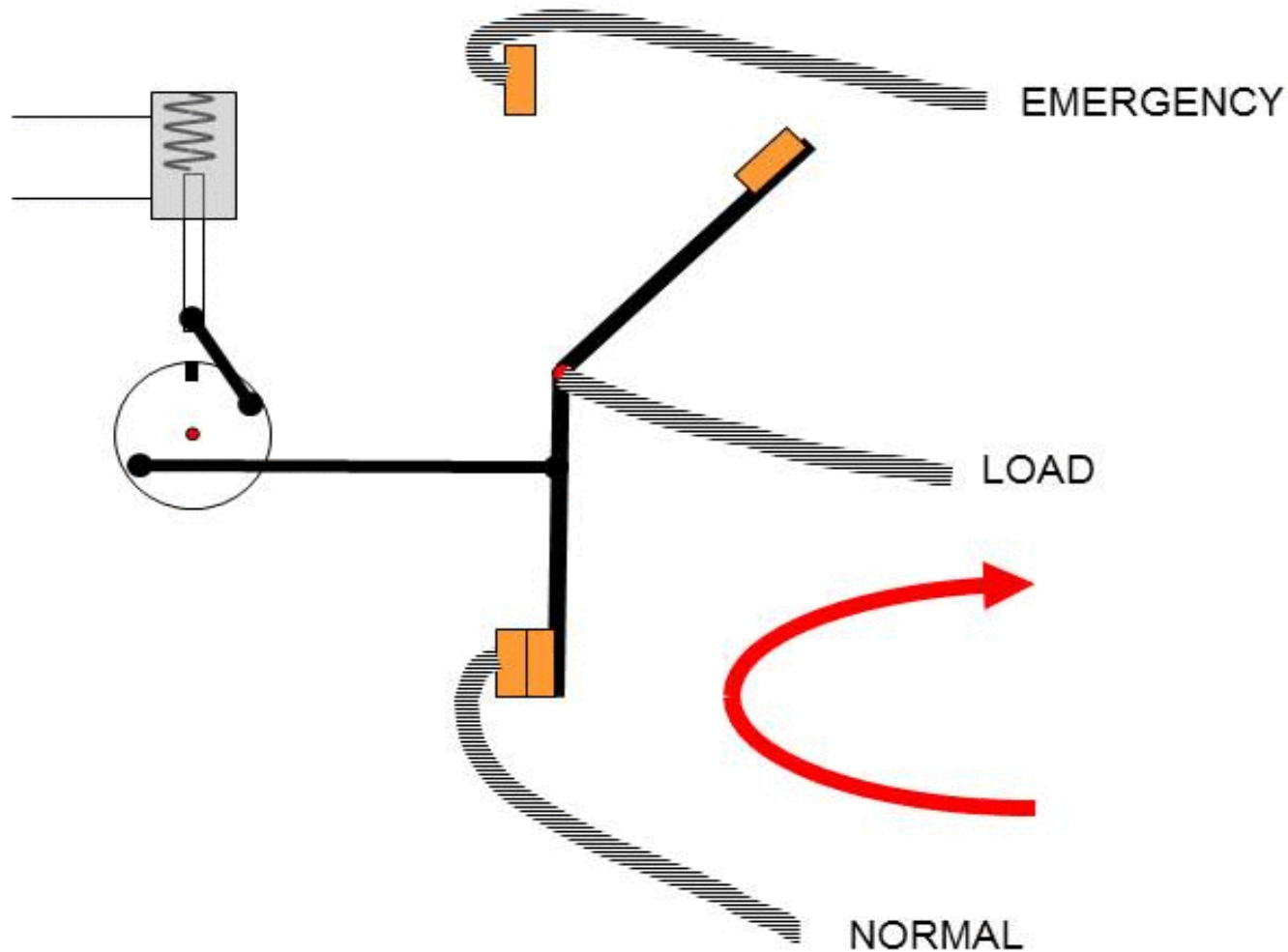
Controller

- Source Monitoring
- Time Delays
- Transfer Control

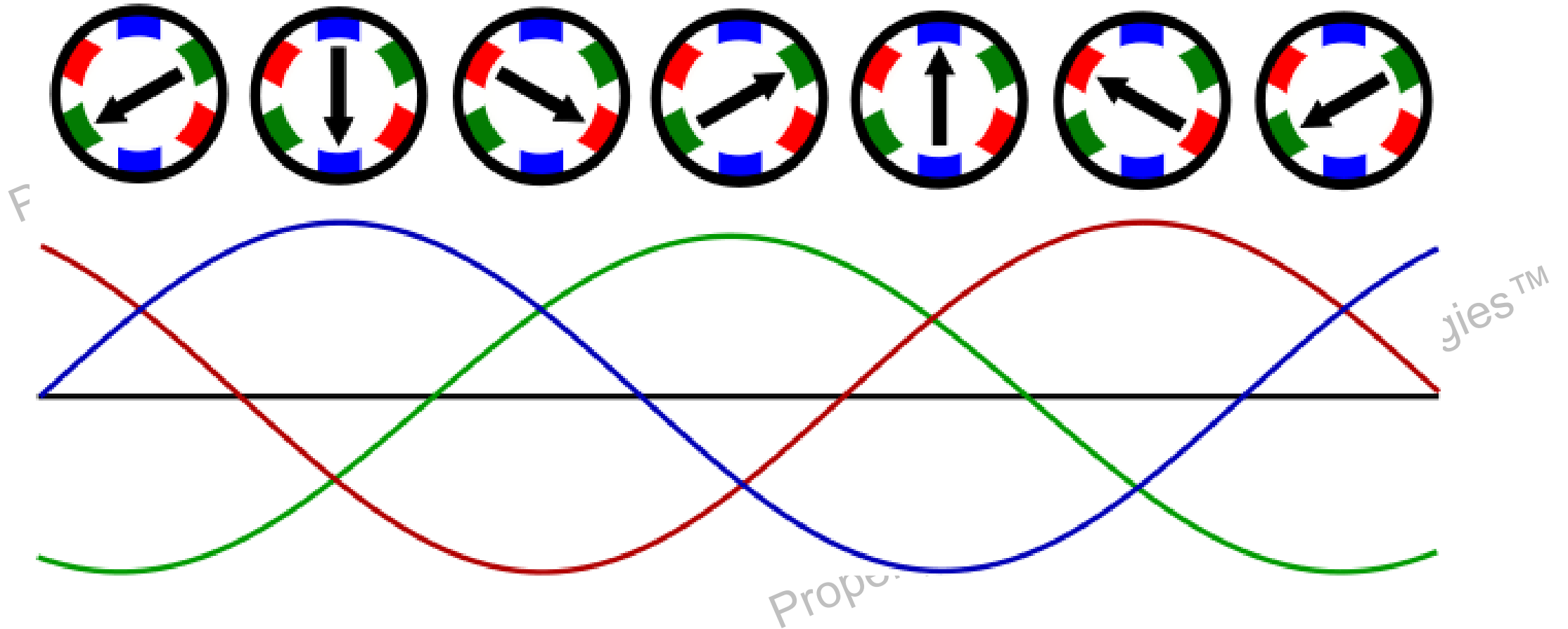
Contactor-Based Transfer Switch



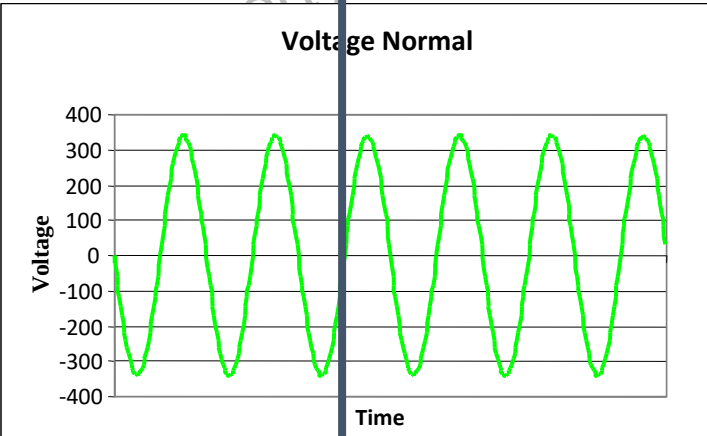
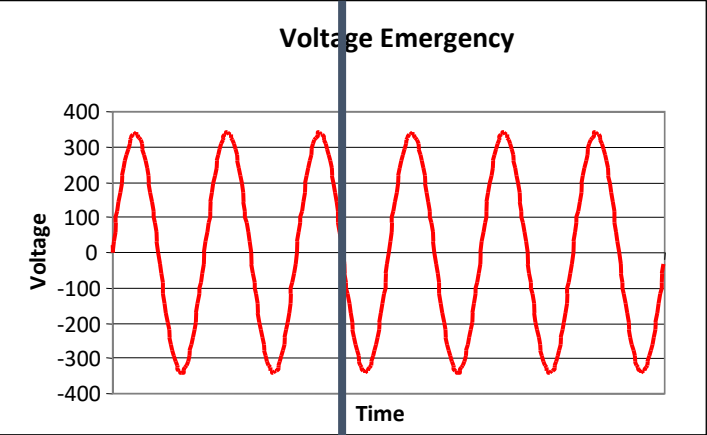
Contactor-Based Transfer Switch



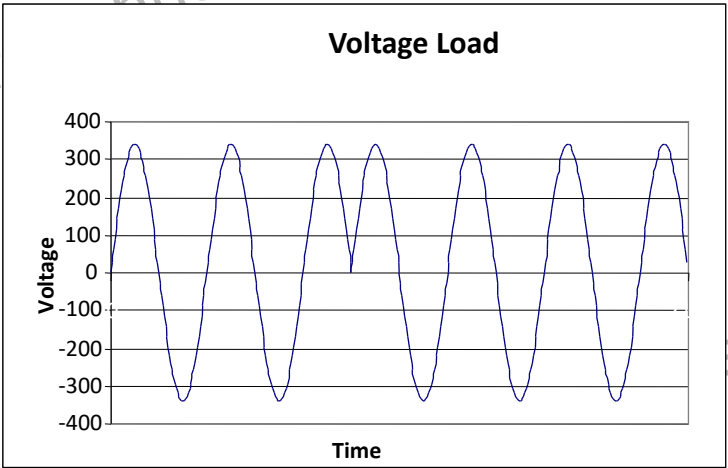
Out of Phase Transfers



Out of Phase Transfers

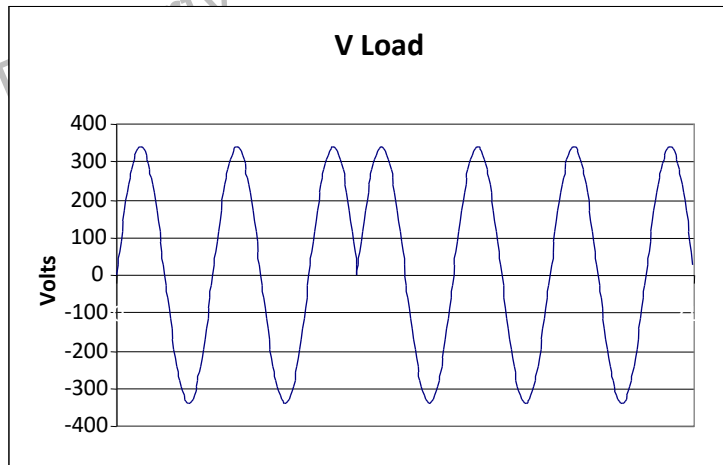


**Switch
Point**



Switching Methods and Solutions

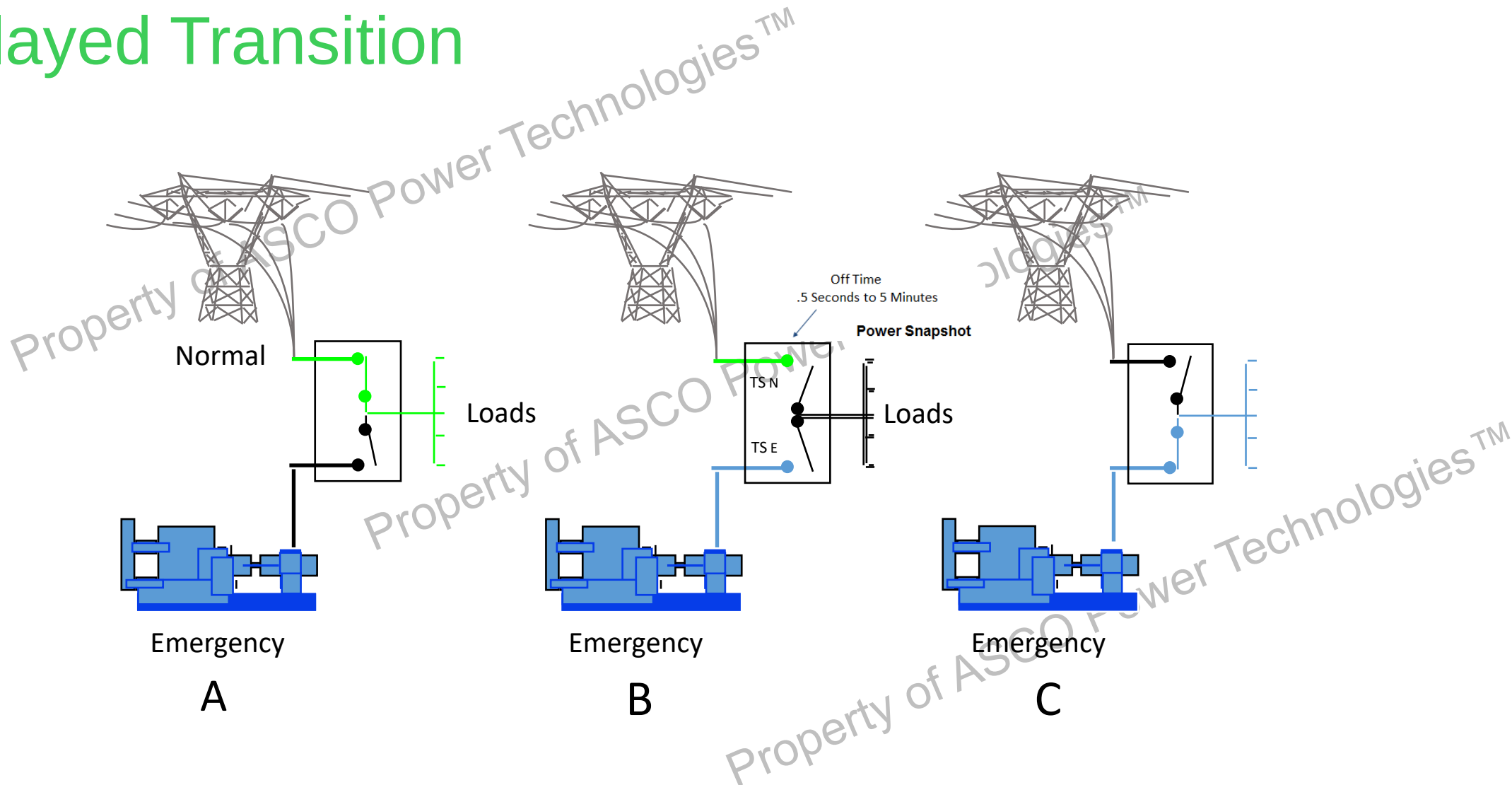
- Out of Phase Transfers can lock up a motor, leading to damage:



Switching Methods and Solutions

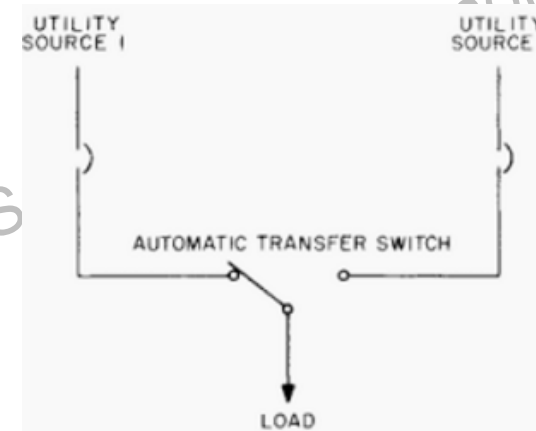
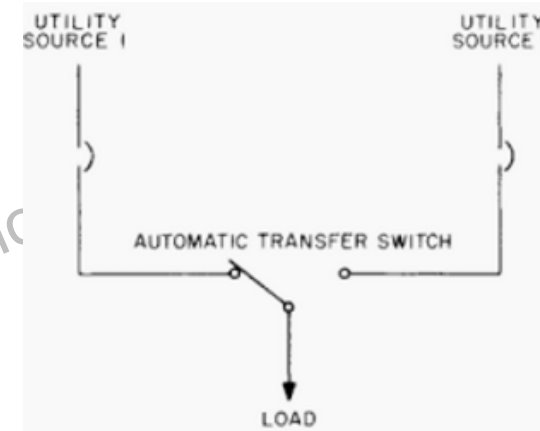
- Solutions to switching inductive loads between sources include:
 - Delayed Transition
 - Selective Load Disconnect Circuit
 - Open Transition with In-phase monitor
 - Closed Transition

Delayed Transition

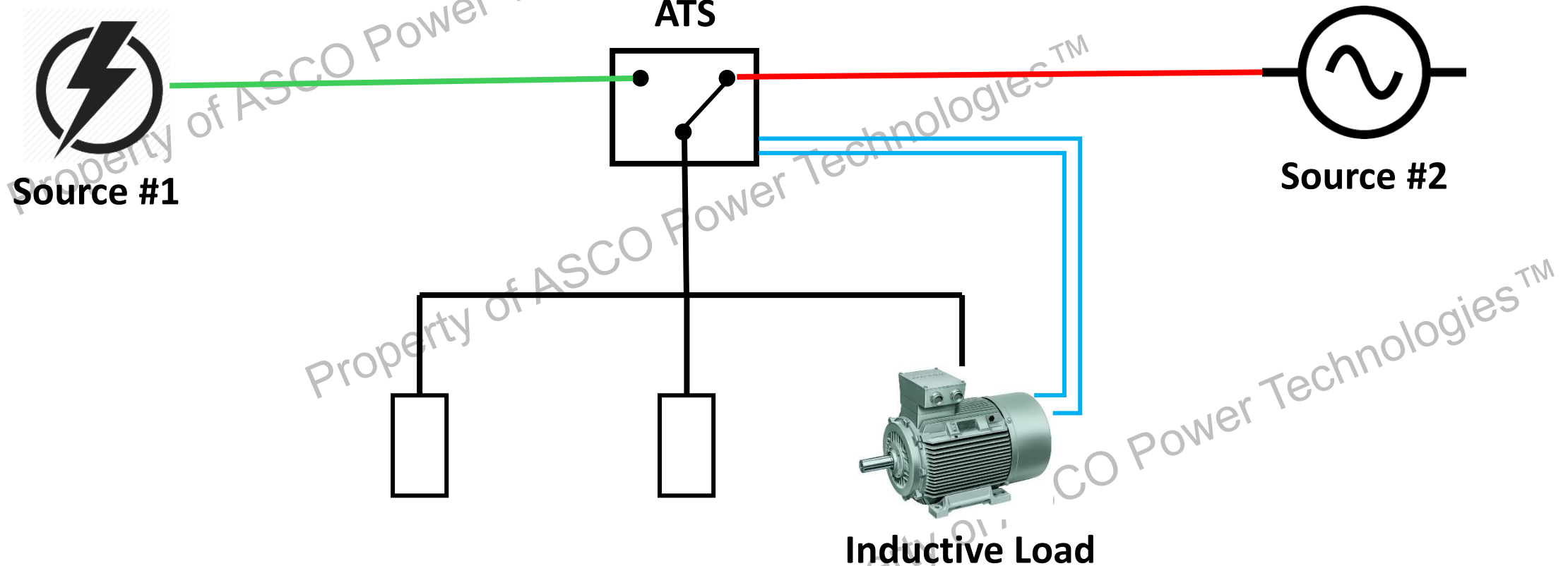


Delayed Transition Applications

- Utility to utility applications where both utilities are forever out of phase and random transfer not acceptable
- Loads with large transformers because the residual voltage on primary side when the sources are disconnected is not predictable and budget will not allow closed transition



Selective Load Disconnect Circuit

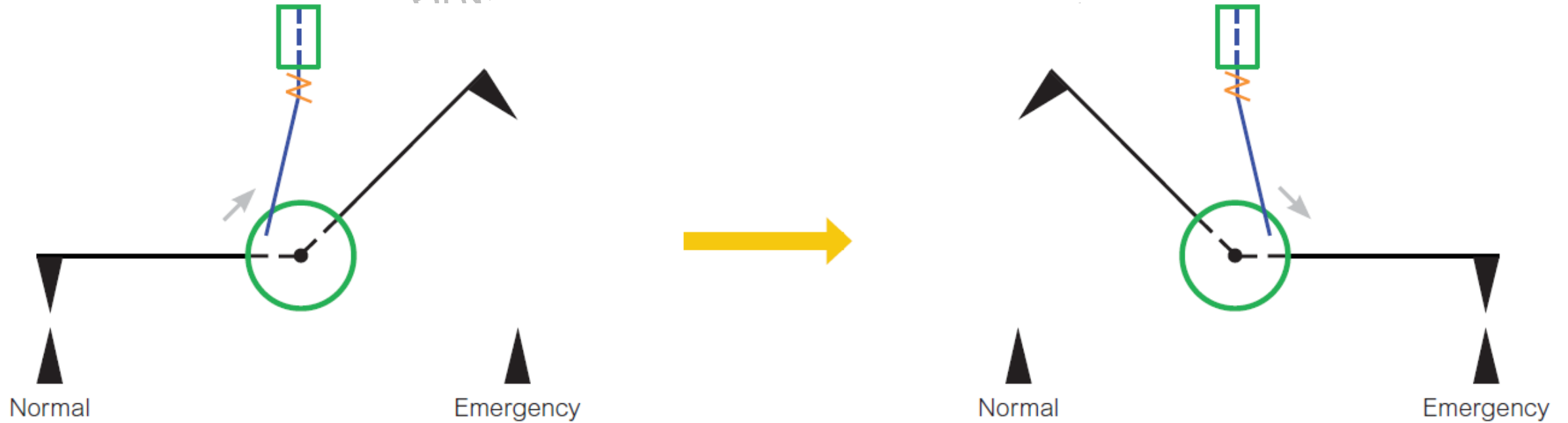


Selective Load Disconnect Circuit

- Advanced Signal of Transfer
 - Often required by elevator controllers
- Requires motor load time constant analysis
 - How long does the motor need to be disconnected in order to dissipate the stored energy?
- Subjects motor to increased number of inrush currents
 - on/off/on when transferred and re-transferred
- Can be utilized regardless of transfer mode of operation



Open Transition with an In-Phase Monitor



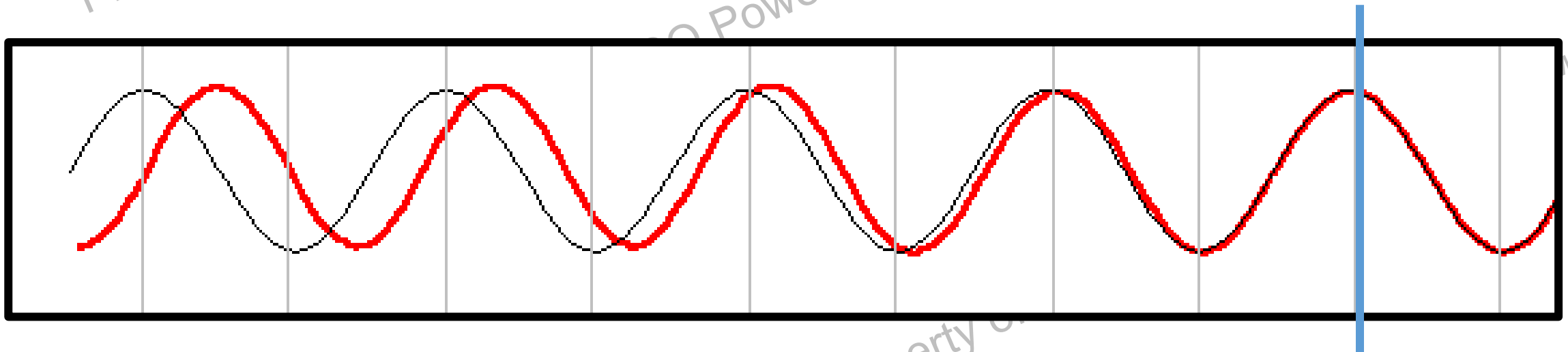
Synchronization of Sources

The sources are operating within a give tolerance of parameters:

Voltage: $\pm 5\%$

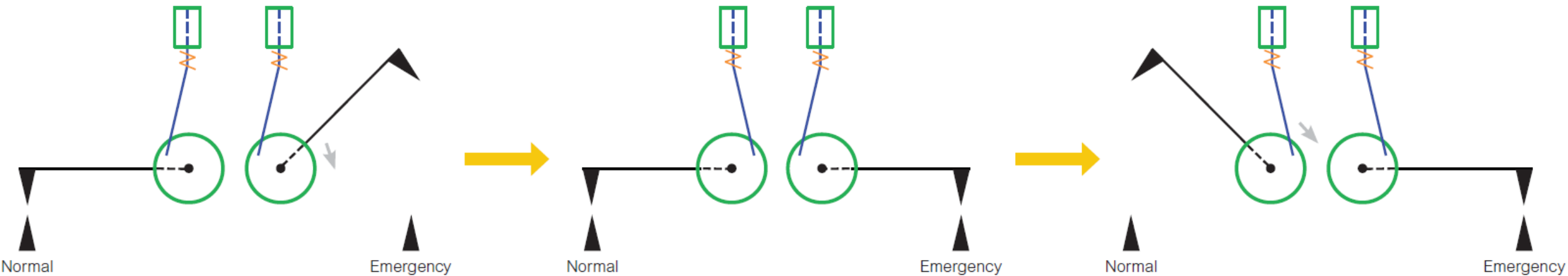
Frequency: $\pm 0.2\text{Hz}$

Phase Angle: ± 5 electrical degrees



Transfer Point

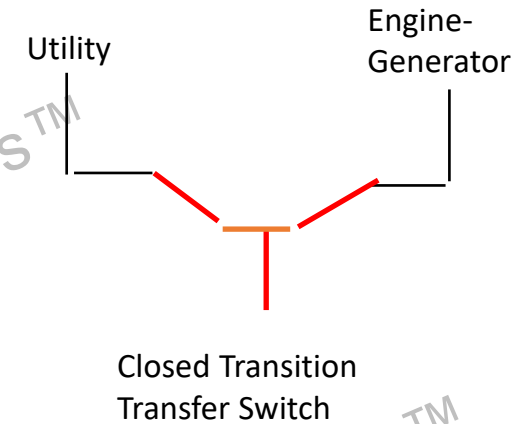
Closed Transition with an In-Phase Monitor



Switch Basics	Switching Methods	Neutral Configuration	WCR	Applications
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Closed Transition

- No disruption of power to load (when both sources available)
- Reduces stress on UPS's batteries
- Promotes periodic testing of the entire emergency power system
- Motors do not need to be disconnected
- Motors are not subjected to “on/off/on” cycles
- Eliminates transients caused by transformer switching



Bypass/Isolation ATS

150-600A

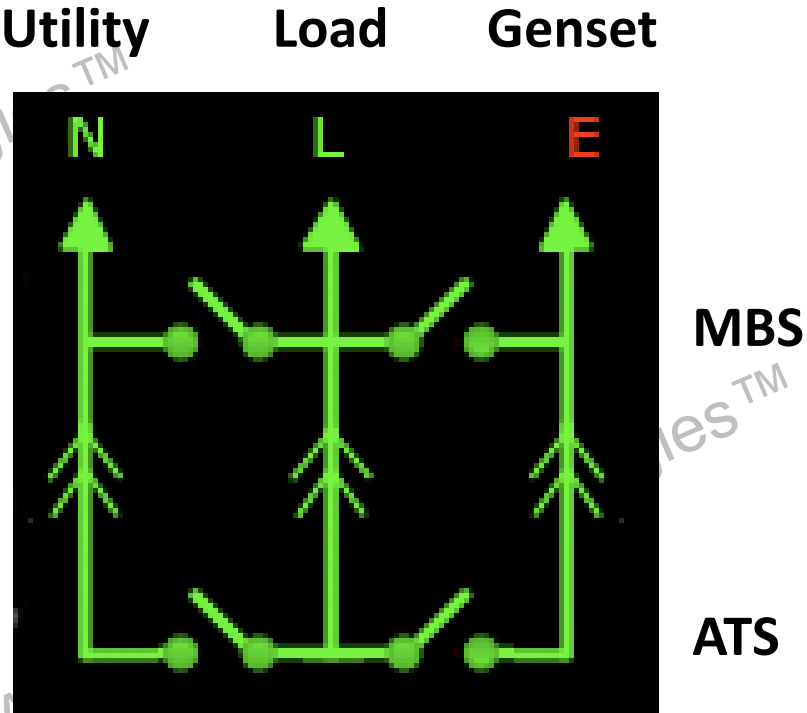
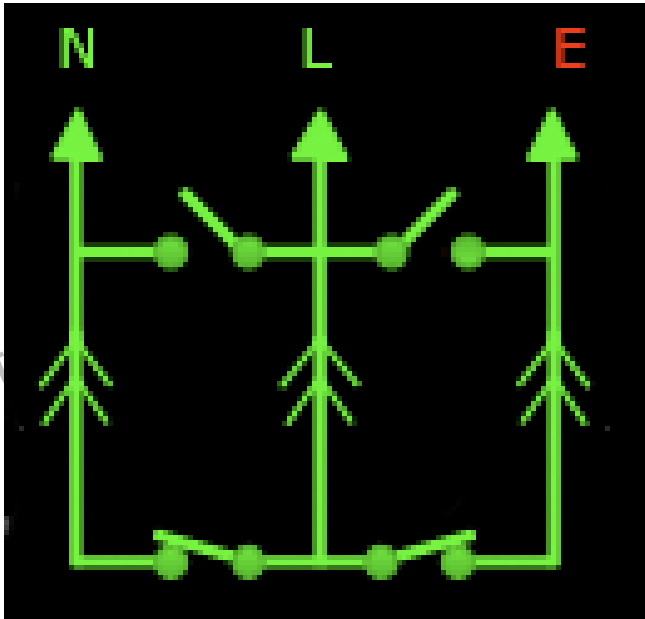
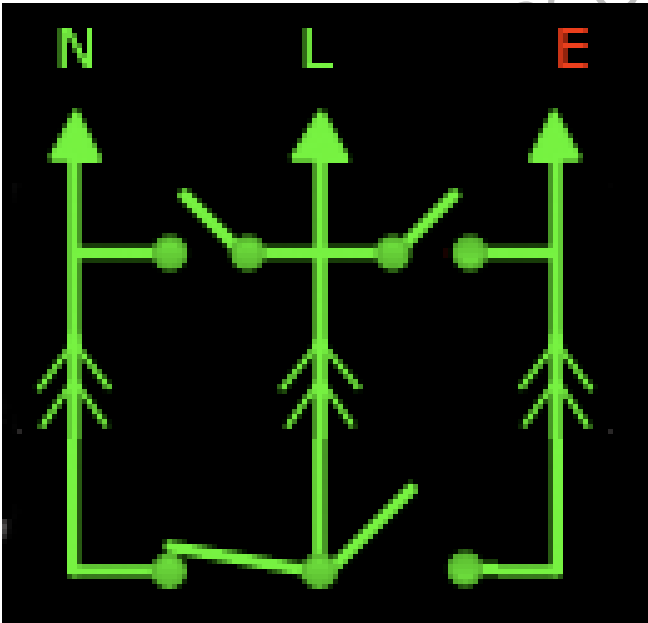
600-1200A

1000-3000A

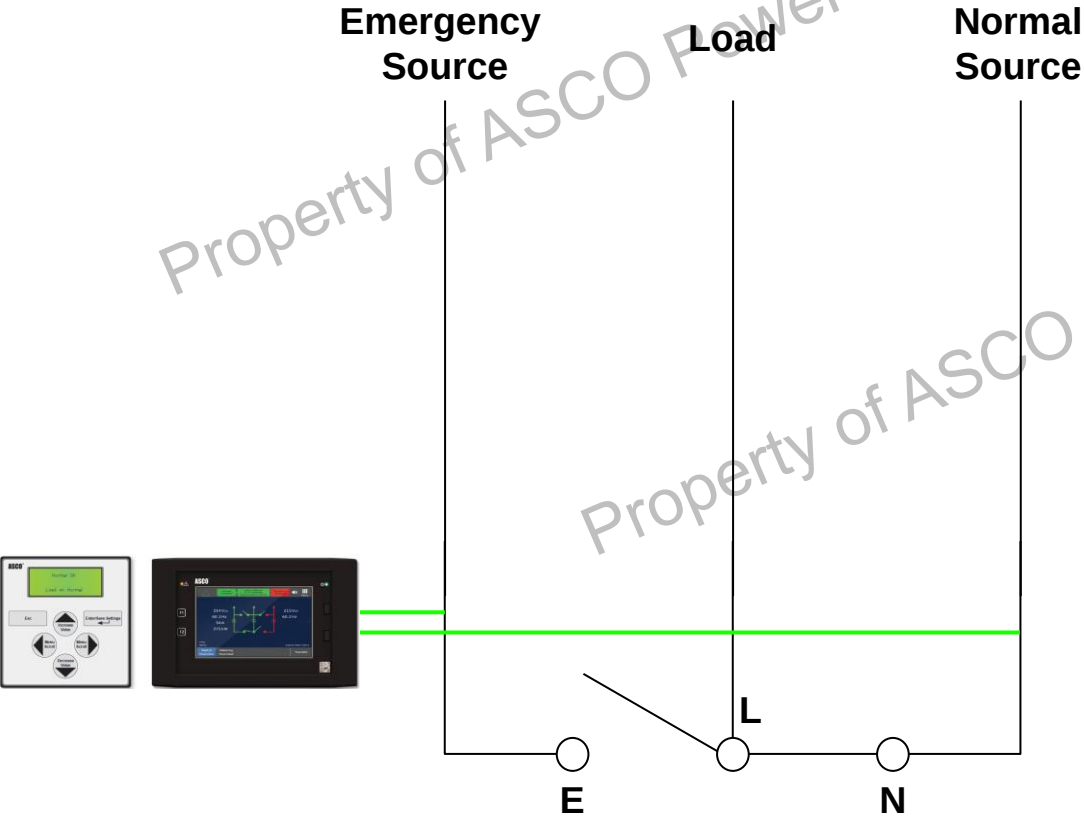
4000A



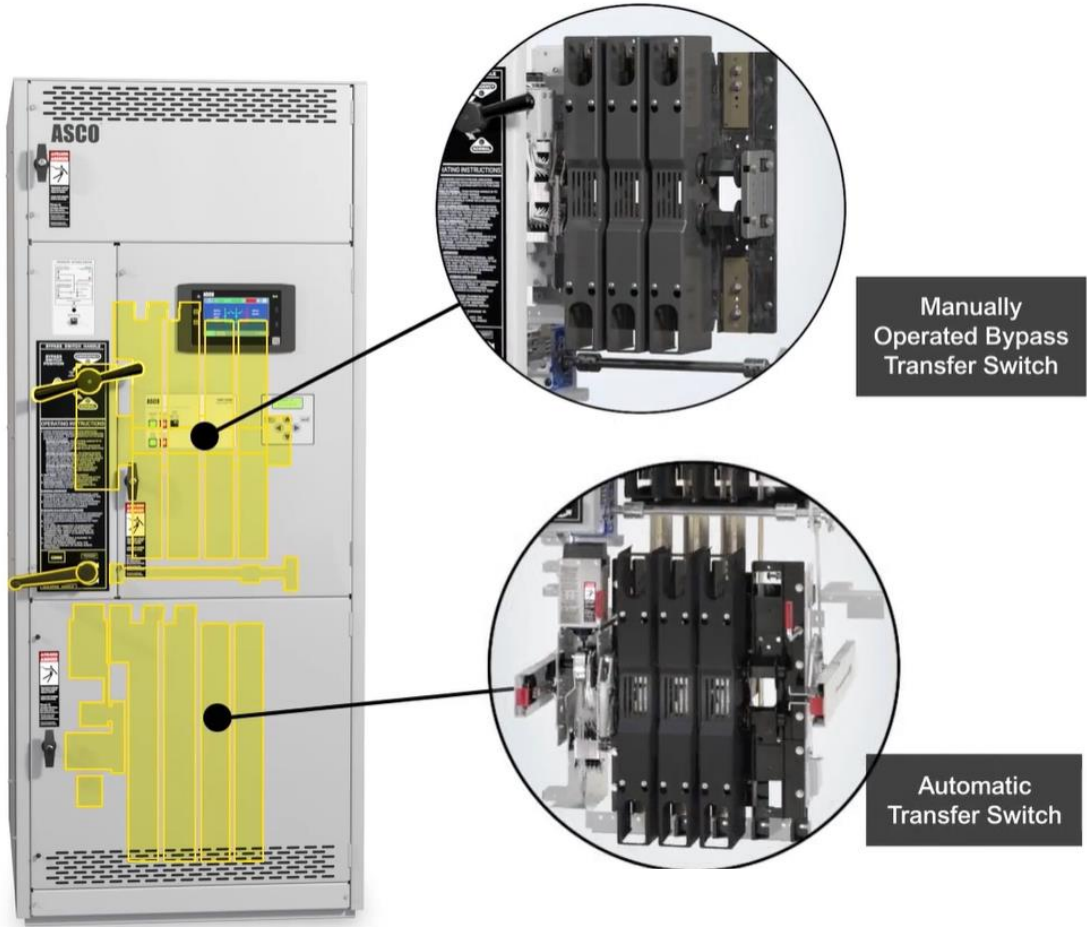
Bypass/Isolation ATS



Bypass/Isolation ATS

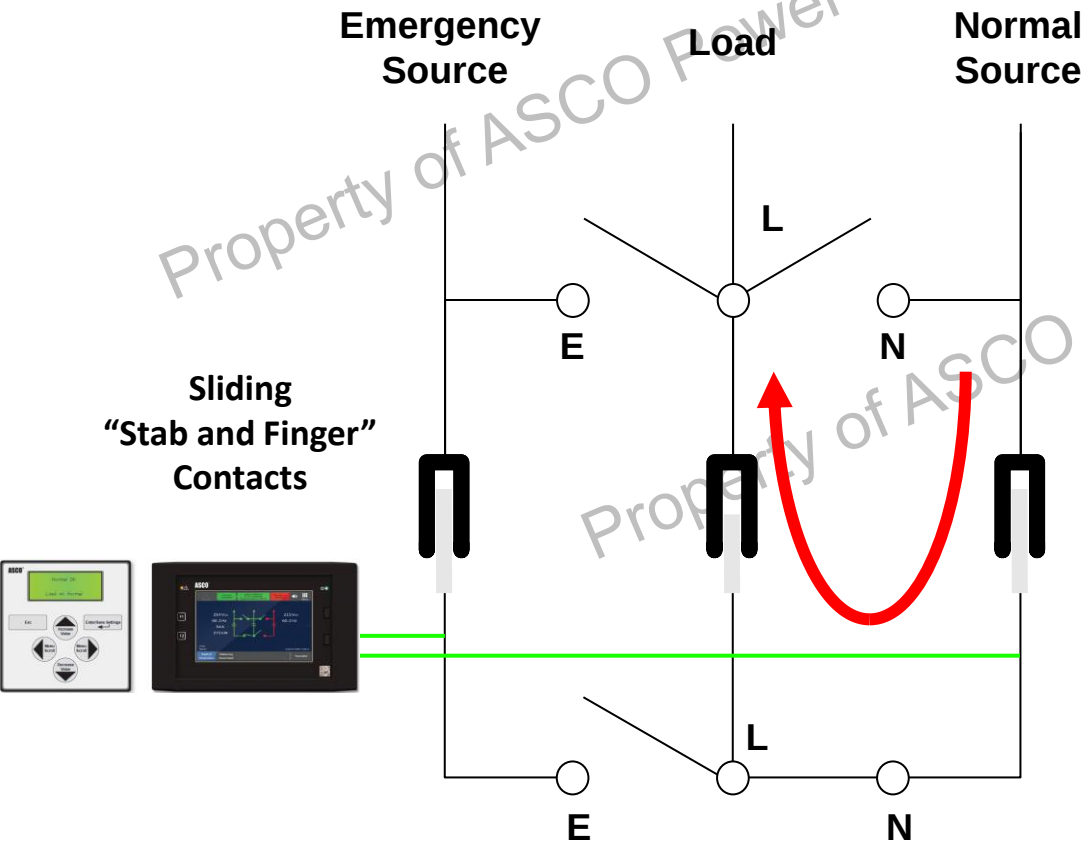


Bypass/Isolation Switch

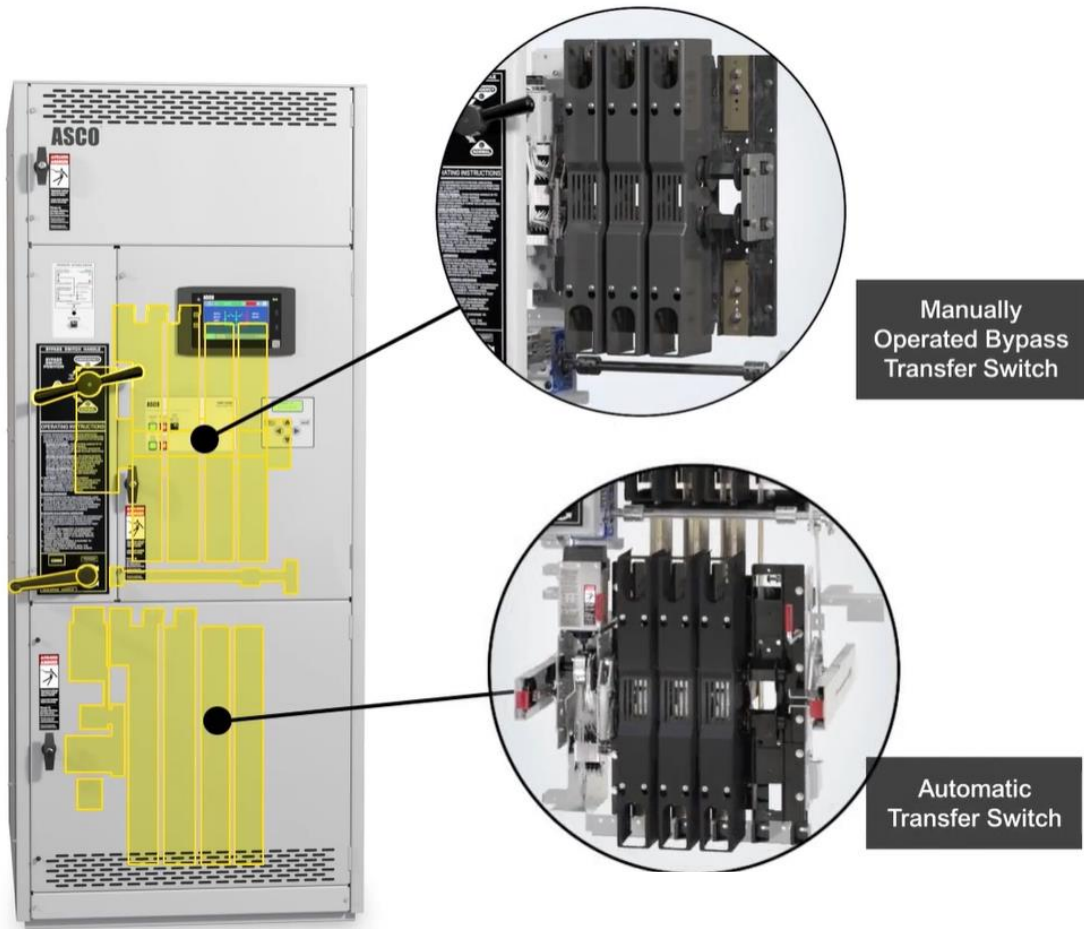


ATS with the load connected to the normal source

Bypass/Isolation ATS



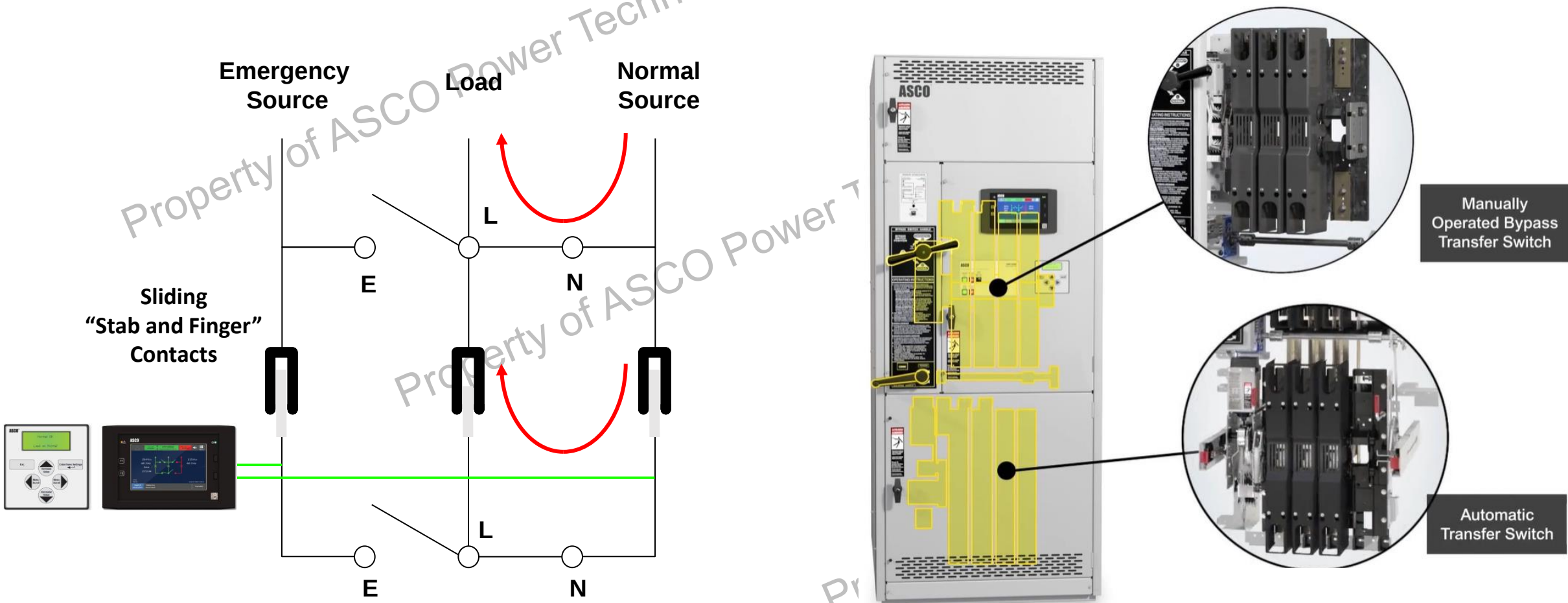
Bypass/Isolation Switch



Current from the normal source flows through the **ATS** to the load

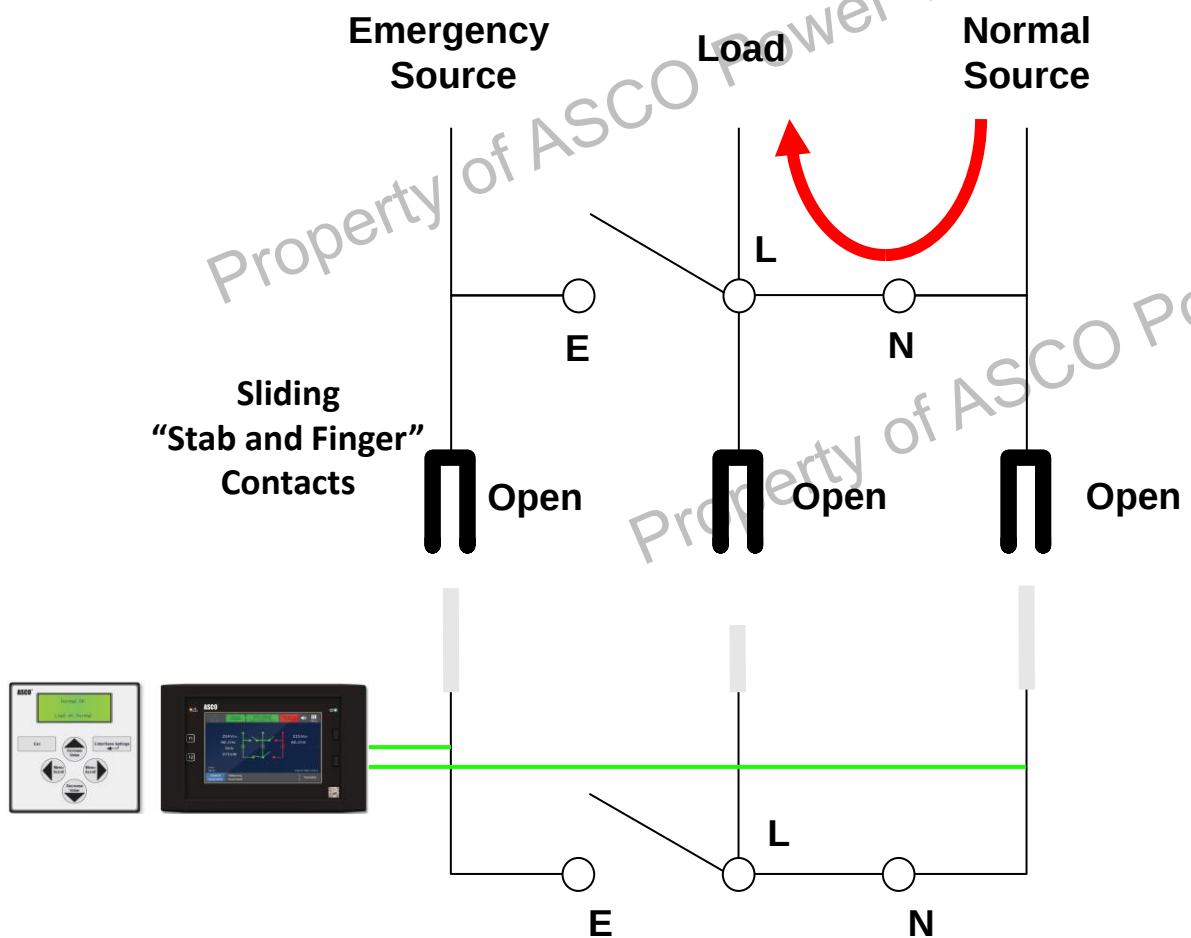
Bypass/Isolation ATS

Bypass/Isolation Switch

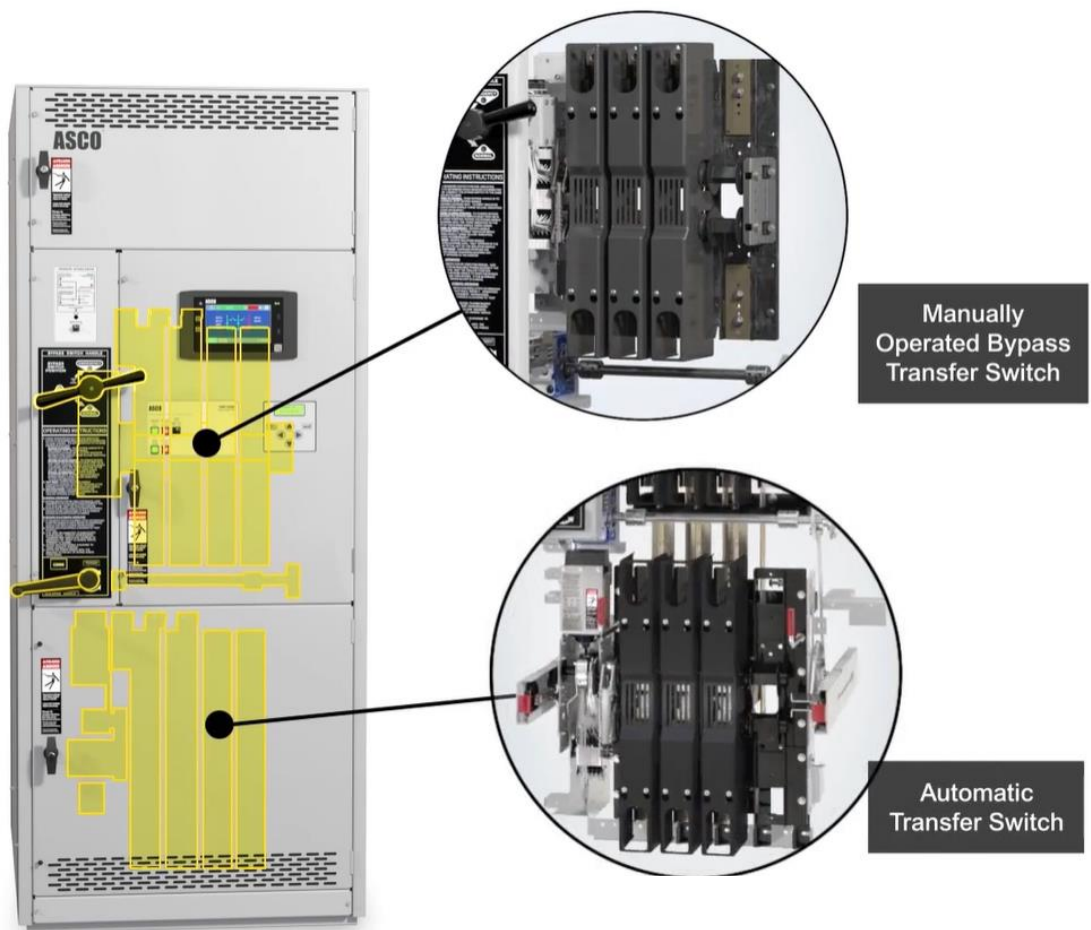


Current from the normal source flows through the **MBS/ATS** to the load

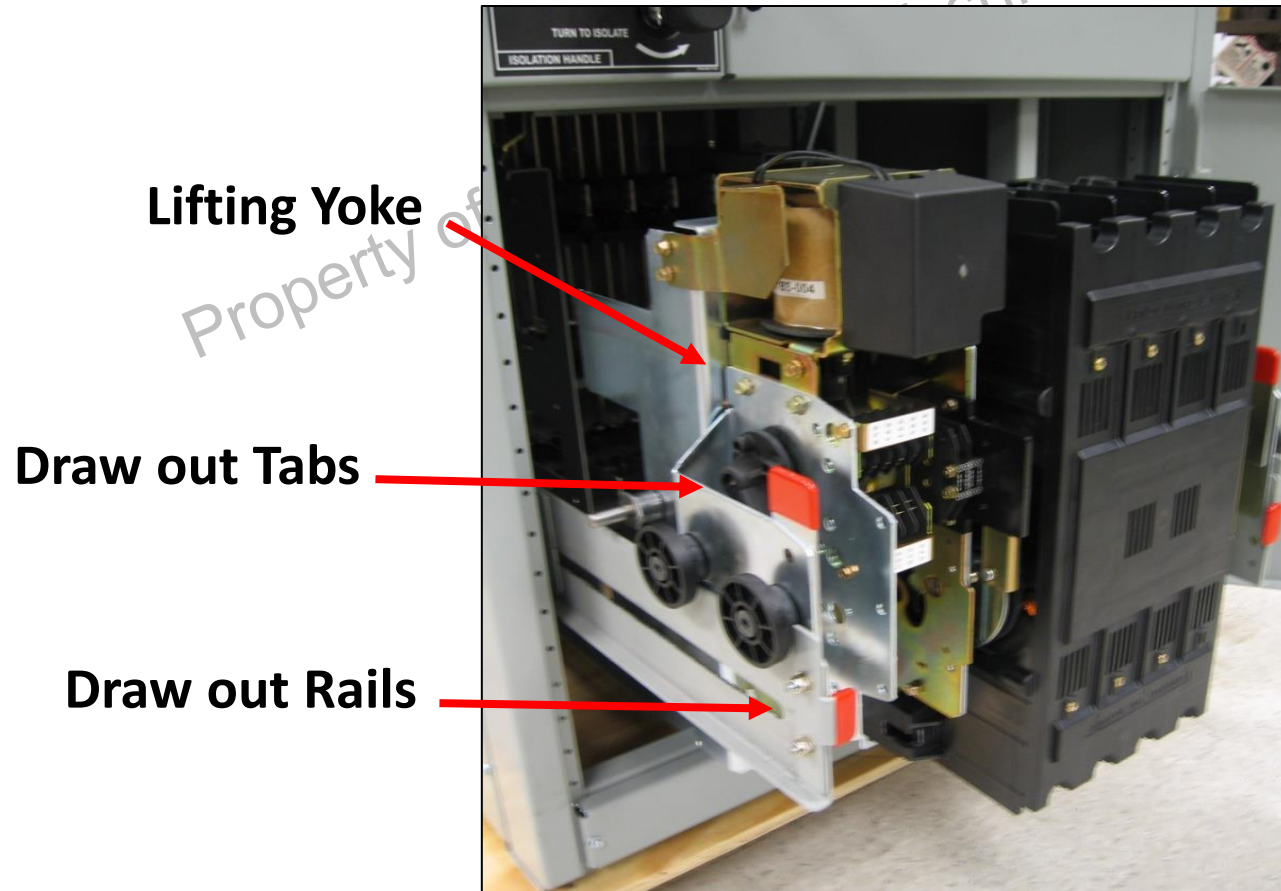
Bypass/Isolation ATS



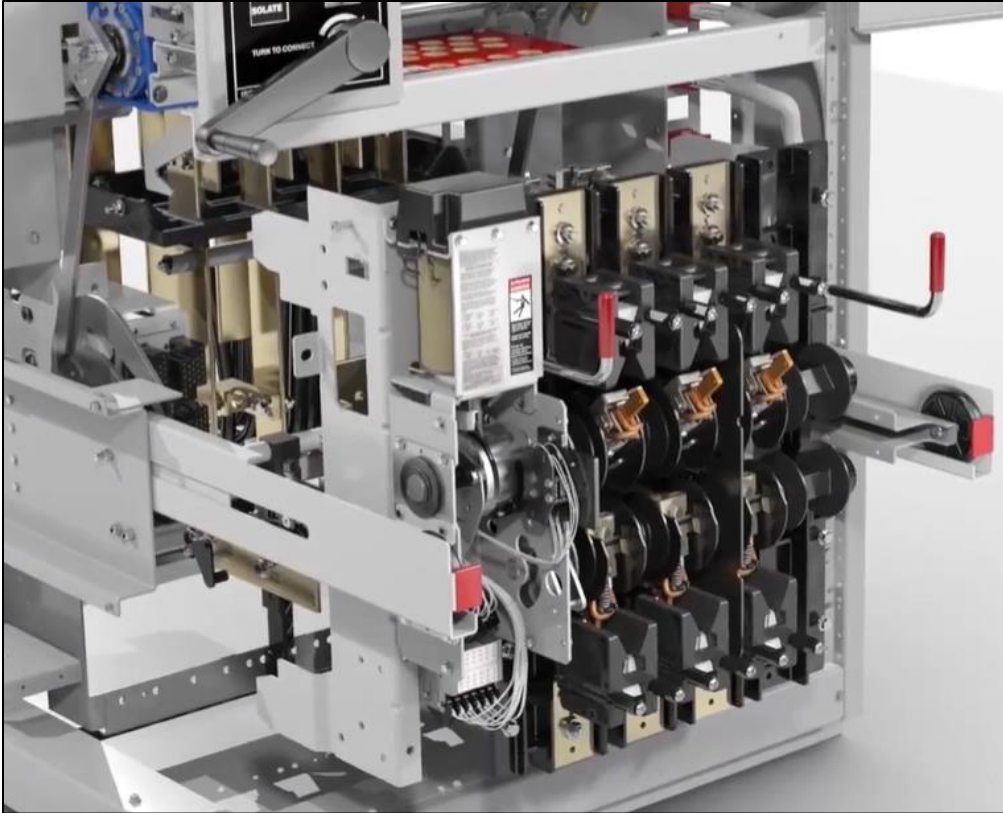
Bypass/Isolation Switch



Bypass/Isolation ATS

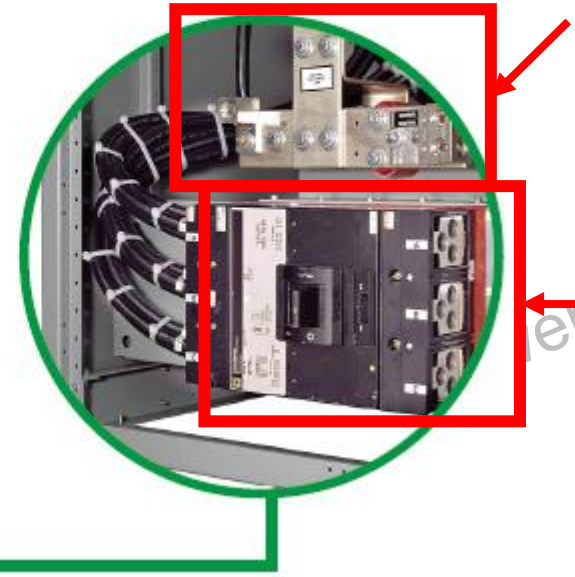


Bypass/Isolation ATS



Service Entrance Rated (SER) ATS

ATS includes integral SER breaker on Normal and/or Emergency Source



**Ground And Neutral
Disconnect Links**

**Externally Operable
Disconnect**

What is WCR?

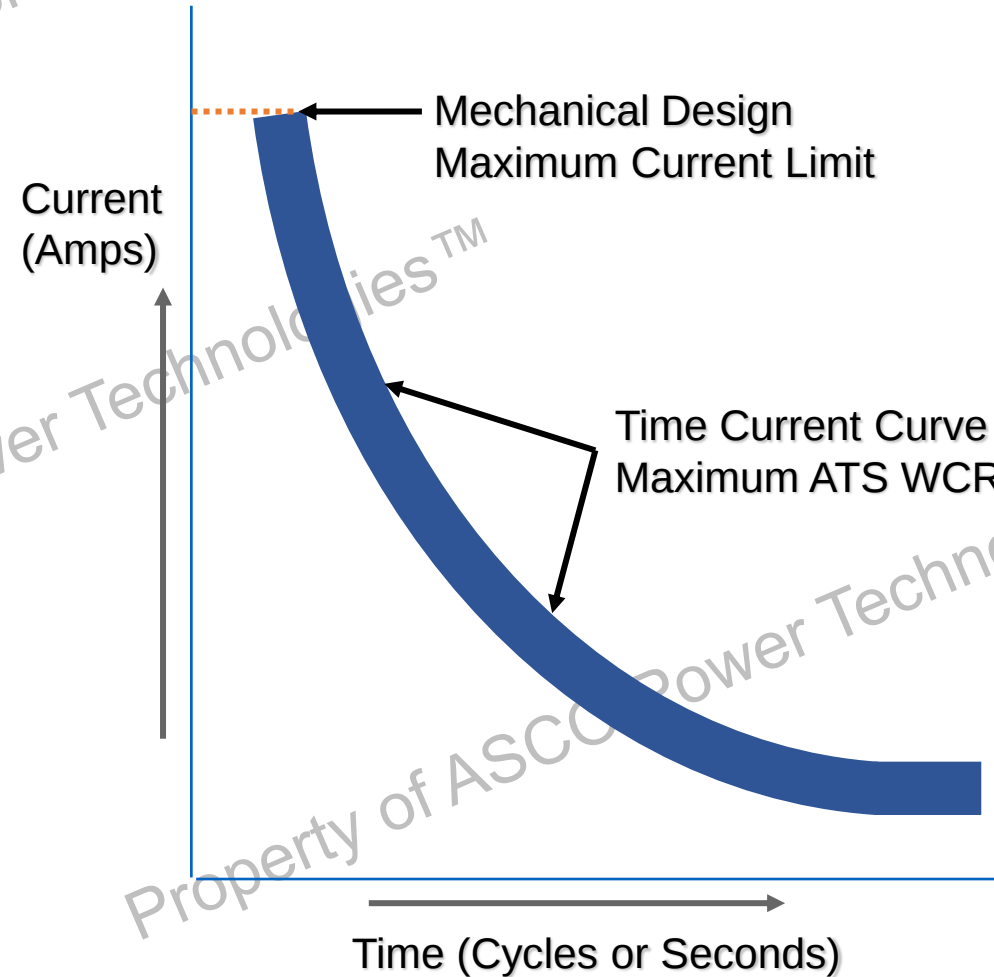
Circuit Breakers (AIC) vs. Transfer Switches (WCR)

- ❑ **Ampere Interrupting Capacity (AIC)** - Capability to safely interrupt or break short circuit currents and disconnect the power source from the load under overcurrent conditions.
- ❑ **Withstand Closing Rating (WCR)** - Capability to safely endure and close-on short circuit currents until overcurrent conditions are interrupted. These WCR ratings are based on either:
 - ❑ Specific time durations (time based)
 - ❑ Coordination with specific circuit breaker or fuse types (series rating)



Withstand and Closing Rating (WCR)

- WCR of an ATS has an inverse relationship to the length of fault time - the longer the fault time, the lower the current it can withstand and close-on
- Typical Clearing Times
 - Fuses - 1/4 to 1/2 cycle
 - Thermal Mag Type MCBs - 1.5 to 2 cycles
 - MCCBs w/Electronic Trip – 2 to 3 Cycles
 - Power Breakers – 3 to 30 Cycles



Withstand and Closing Ratings (WCR)

Current Limited Fuses



Specific Breaker



Time Based



Withstand and Closing Ratings (WCR) – UL 1008 Evolution

WCR based on fuse and specific breaker ratings only

1972



Added an optional “Any Breaker” WCR

1989



Added an optional “Short-Time” WCR

2002



2014

- **2014 - 7th Edition of UL 1008 (Current)**

- Because of the stricter requirements for approving a specific breaker for an ATS WCR, the list of acceptable breakers has shortened.
- “Any” circuit breaker ratings and short-time ratings (where applicable) were replaced with time duration markings shown in seconds rather than cycles.

History of Changes to UL1008 Short Circuit Testing Requirements

- **1972 - Original UL1008 Standard** was issued in 1972 with short circuit testing based on fuse and specific breaker ratings only
- **1989 - 4th Edition:** Added an optional “Any Breaker” withstand and closing rating (WCR)
- **1993 – Selective coordination requirements** added to the NEC
- **2002 - 5th Edition:** Added optional “Short-Time Current Rating Test”
- **2014 - 7th Edition of UL 1008** became effective November 1, 2014
 - Defined detailed guidelines for extending specific breaker qualifications
 - “Any” circuit breaker ratings were replaced with time duration markings shown in seconds rather than cycles.
 - Short-time ratings (where applicable) were replaced with time duration markings shown in seconds rather than cycles.
 - More descriptive text was added regarding how the ratings should be applied in selecting appropriate over-current protection.

2014 UL1008, 7th Edition

- The 7th Edition of UL 1008 has resulted in significant changes to short-circuit testing ratings shown on the transfer switch:
 - Specific guidelines were added for qualifying additional circuit breakers to be shown on the short circuit label markings.
 - The "Any" circuit breaker ratings were replaced by “time based” ratings shown in seconds rather than cycles.
 - Short-time ratings (where applicable) are also shown in “seconds” instead of “cycles”.
 - More descriptive statements have been added regarding how the ratings should be applied in selecting appropriate over-current protection.

Withstand and Closing Ratings: ASCO

Frame	Switch Rating (Amps)		Current Limiting Fuses				Specific Breaker			Time Based				Short Time Ratings ³ (sec)							
	Transfer Switches	Bypass Switches												480V Max.				600V Max.			
			480V Max.	600V Max.	Max Size, A	Class	240V Max.	480V Max.	600V Max.	Time (sec)	240V Max.	480V Max.	600V Max.	.13	.2	.3	.5	.1	.13	.3	.5
D	30	-	100kA	-	300	J	22kA	22kA	10kA	0.025	10kA	10kA	10kA	-				-			
			200kA	35kA	200	J															
			35kA	35kA	200	RK1															
D	70, 100	-	35kA	35kA	200	RK1	150kA	85kA	25kA	0.025	10kA	10kA	10kA	-				-			
			200kA	35kA	200	J															
			35kA	35kA	200	RK1															
D	150	-	200kA	35kA	200	J	150kA	85kA	25kA	0.025	10kA	10kA	10kA	-				-			
			35kA	35kA	200	RK1															
D	200	-	200kA	-	200	J	200kA	85kA	14kA	0.025	10kA	10kA	10kA	-				-			
D	230	-	100kA	-	300	J	200kA	85kA	14kA	0.025	10kA	10kA	-	-				-			
E	260, 400	-	200kA	-	600	J	65kA	42kA	35kA	0.05	35kA	35kA	22kA	-				-			
J	150, 200, 260	150, 200, 230, 260	200kA	200kA	600	J	200kA	200kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA		-		-			
			800	L																	
J	400	400	200kA	200kA	600	J	65kA	50kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA		-		-			
					800	L															
J	600	600	200kA	200kA	800	L	65kA	50kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA ⁹		-		-			
					600	J															
H ³	600	600	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		-		36kA		-	
P ³	600	600	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		30kA		36kA		-	
P ³	800	800 - 1200	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		30kA		36kA		-	
H	800 - 1200	800 - 1200	200kA	200kA	1600 ⁴	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		-		36kA		-	
Q ³	600-1600	600-1600	200kA	200kA	2000	L	65kA	65kA	65kA	0.05	65kA	65kA	65kA	50kA				50kA			
S ³	800 - 1200	800 - 1200	200kA	200kA	2500	L	100kA	100kA	65kA	0.05	100kA	100kA	65kA	65kA				65kA			
G ³	1000 - 1200	1000 - 1200	200kA	200kA	2000	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	-				-			
G	1600 - 2000 (Front Connected TS Only)		200kA	200kA	2500	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	42kA		36kA		-			
G ³	1600 - 2000	1600 - 2000	200kA	200kA	3000	L	125kA ⁵	125kA ⁵	100kA	0.05	100kA	100kA	100kA	42kA		36kA		42kA		-	
S ³	1600 - 2000	1600 - 2000	200kA	200kA	2500	L	100kA	100kA	85kA	0.05	100kA	100kA	85kA	85kA		65kA		85kA		65kA	
G	2600 - 3000	2600 - 3000	200kA	200kA	4000	L	100kA	100kA	100kA	0.05	100kA	100kA	100kA	42kA		36kA		42kA		-	
G ³	3200	-	200kA	-	4000	L	100kA	100kA	-	0.05	100kA	100kA	-	-				-			
G	4000	4000	200kA	200kA	5000	L	100kA	100kA	100kA	0.05	100kA	100kA	100kA	85kA	65kA		65kA				
U ³	2600 - 4000	2600 - 4000	200kA	200kA	5000	L	125kA	125kA	125kA	0.05	125kA	125kA	125kA	100kA				100kA			

Withstand and Closing Ratings: ASCO (Specific Breaker)

Frame	Switch Rating (Amps)		Current Limiting Fuses				Specific Breaker			Time Based				Short Time Ratings ³ (sec)							
	Transfer Switches	Bypass Switches												480V Max.				600V Max.			
			480V Max.	600V Max.	Max Size, A	Class	240V Max.	480V Max.	600V Max.	Time (sec)	240V Max.	480V Max.	600V Max.	.13	.2	.3	.5	.1	.13	.3	.5
D	30	-	100kA	-	300	J	22kA	22kA	10kA	0.025	10kA	10kA	10kA	-				-			
			200kA	35kA	200	J															
			35kA	35kA	200	RK1															
D	70, 100	-	35kA	35kA	200	RK1	150kA	85kA	25kA	0.025	10kA	10kA	10kA	-				-			
			200kA	35kA	200	J															
			35kA	35kA	200	RK1															
D	150	-	200kA	35kA	200	J	150kA	85kA	25kA	0.025	10kA	10kA	10kA	-				-			
D	200	-	200kA	-	200	J	200kA	85kA	14kA	0.025	10kA	10kA	10kA	-				-			
D	230	-	100kA	-	300	J	200kA	85kA	14kA	0.025	10kA	10kA	-	-				-			
E	260, 400	-	200kA	-	600	J	65kA	42kA	35kA	0.05	35kA	35kA	22kA	-				-			
J	150, 200, 260	150, 200, 230, 260	200kA	200kA	600	J	200kA	200kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA	-		-				
J	400	400	200kA	200kA	800	J	65kA	50kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA	-		-				
			200kA	200kA	600	J	65kA	50kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA ⁹	-		-				
H ³	600	600	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		-		36kA		-	
P ³	600	600	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		30kA		36kA		-	
P ³	800	800 - 1200	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		30kA		36kA		-	
H	800 - 1200	800 - 1200	200kA	200kA	1600 ⁴	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		-		36kA		-	
Q ³	600-1600	600-1600	200kA	200kA	2000	L	65kA	65kA	65kA	0.05	65kA	65kA	65kA	50kA				50kA			
S ³	800 - 1200	800 - 1200	200kA	200kA	2500	L	100kA	100kA	65kA	0.05	100kA	100kA	65kA	65kA				65kA			
G ³	1000 - 1200	1000 - 1200	200kA	200kA	2000	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	-				-			
G	1600 - 2000 (Front Connected TS Only)		200kA	200kA	2500	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	42kA		36kA		-			
G ³	1600 - 2000	1600 - 2000	200kA	200kA	3000	L	125kA ⁵	125kA ⁵	100kA	0.05	100kA	100kA	100kA	42kA		36kA		42kA		-	
S ³	1600 - 2000	1600 - 2000	200kA	200kA	2500	L	100kA	100kA	85kA	0.05	100kA	100kA	85kA	85kA		65kA		85kA		65kA	
G	2600 - 3000	2600 - 3000	200kA	200kA	4000	L	100kA	100kA	100kA	0.05	100kA	100kA	100kA	42kA		36kA		42kA		-	
G ³	3200	-	200kA	-	4000	L	100kA	100kA	-	0.05	100kA	100kA	-	-				-			
G	4000	4000	200kA	200kA	5000	L	100kA	100kA	100kA	0.05	100kA	100kA	100kA	85kA	65kA		65kA				
U ³	2600 - 4000	2600 - 4000	200kA	200kA	5000	L	125kA	125kA	125kA	0.05	125kA	125kA	125kA	100kA				100kA			

Withstand and Closing Ratings: ASCO (Current Limiting Fuses)

Frame	Switch Rating (Amps)		Current Limiting Fuses				Specific Breaker			Time Based				Short Time Ratings ³ (sec)							
	Transfer Switches	Bypass Switches												480V Max.				600V Max.			
			480V Max.	600V Max.	Max Size, A	Class	240V Max.	480V Max.	600V Max.	Time (sec)	240V Max.	480V Max.	600V Max.	.13	.2	.3	.5	.1	.13	.3	.5
D	30	-	100kA	-	300	J	22kA	22kA	10kA	0.025	10kA	10kA	10kA	-				-			
			200kA	35kA	200	J															
			35kA	35kA	200	RK1															
D	70, 100	-	35kA	35kA	200	RK1	150kA	85kA	25kA	0.025	10kA	10kA	10kA	-				-			
			200kA	35kA	200	J															
			35kA	35kA	200	RK1															
D	150	-	35kA	35kA	200	RK1	150kA	85kA	25kA	0.025	10kA	10kA	10kA	-				-			
			200kA	35kA	200	J															
D	200	-	200kA	-	200	J	200kA	85kA	14kA	0.025	10kA	10kA	10kA	-				-			
D	230	-	100kA	-	300	J	200kA	85kA	14kA	0.025	10kA	10kA	-	-				-			
E	260, 400	-	200kA	-	600	J	65kA	42kA	35kA	0.05	35kA	35kA	22kA	-				-			
J	150, 200, 260	150, 200, 230, 260	200kA	200kA	600	J	200kA	200kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA	-		-				
J	400	400	200kA	200kA	600	J	65kA	50kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA	-		-				
			800	L																	
J	600	600	200kA	200kA	800	L	65kA	50kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA ⁹	-		-				
			200kA	200kA	600	J															
H ⁸	600	600	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		-		36kA		-	
P ⁸	600	600	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		30kA		36kA		-	
P ⁸	800	800 - 1200	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		30kA		36kA		-	
H	800 - 1200	800 - 1200	200kA	200kA	1600 ⁴	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		-		36kA		-	
Q ⁸	600-1600	600-1600	200kA	200kA	2000	L	65kA	65kA	65kA	0.05	65kA	65kA	65kA	50kA				50kA			
S ⁸	800 - 1200	800 - 1200	200kA	200kA	2500	L	100kA	100kA	65kA	0.05	100kA	100kA	65kA	65kA				65kA			
G ⁸	1000 - 1200	1000 - 1200	200kA	200kA	2000	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	-				-			
G	1600 - 2000 (Front Connected TS Only)		200kA	200kA	2500	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	42kA		36kA		-			
G ⁸	1600 - 2000	1600 - 2000	200kA	200kA	3000	L	125kA ⁵	125kA ⁵	100kA	0.05	100kA	100kA	100kA	42kA		36kA		42kA		-	
S ⁸	1600 - 2000	1600 - 2000	200kA	200kA	2500	L	100kA	100kA	85kA	0.05	100kA	100kA	85kA	85kA		65kA		85kA		65kA	
G	2600 - 3000	2600 - 3000	200kA	200kA	4000	L	100kA	100kA	100kA	0.05	100kA	100kA	100kA	42kA		36kA		42kA		-	
G ⁸	3200	-	200kA	-	4000	L	100kA	100kA	-	0.05	100kA	100kA	-	-				-			
G	4000	4000	200kA	200kA	5000	L	100kA	100kA	100kA	0.05	100kA	100kA	100kA	85kA	65kA		65kA				
U ⁸	2600 - 4000	2600 - 4000	200kA	200kA	5000	L	125kA	125kA	125kA	0.05	125kA	125kA	125kA	100kA				100kA			

Withstand and Closing Ratings: ASCO (Time Based)

Frame	Switch Rating (Amps)		Current Limiting Fuses				Specific Breaker			Time Based				Short Time Ratings ³ (sec)							
	Transfer Switches	Bypass Switches												480V Max.				600V Max.			
			480V Max.	600V Max.	Max Size, A	Class	240V Max.	480V Max.	600V Max.	Time (sec)	240V Max.	480V Max.	600V Max.	.13	.2	.3	.5	.1	.13	.3	.5
D	30	-	100kA	-	300	J	22kA	22kA	10kA	0.025	10kA	10kA	10kA	-	-	-	-	-	-	-	-
			200kA	35kA	200	J															
			35kA	35kA	200	RK1															
D	70, 100	-	35kA	35kA	200	RK1	150kA	85kA	25kA	0.025	10kA	10kA	10kA	-	-	-	-	-	-	-	-
			200kA	35kA	200	J															
D	150	-	35kA	35kA	200	RK1	150kA	85kA	25kA	0.025	10kA	10kA	10kA	-	-	-	-	-	-	-	-
			200kA	35kA	200	J															
D	200	-	200kA	-	200	J	200kA	85kA	14kA	0.025	10kA	10kA	10kA	-	-	-	-	-	-	-	-
D	230	-	100kA	-	300	J	200kA	85kA	14kA	0.025	10kA	10kA	-	-	-	-	-	-	-	-	-
E	260, 400	-	200kA	-	600	J	65kA	42kA	35kA	0.05	35kA	35kA	22kA	-	-	-	-	-	-	-	-
J	150, 200, 260	150, 200, 230, 260	200kA	200kA	600	J	200kA	200kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA	-	-	-	-	-	-	-
					800	L															
J	400	400	200kA	200kA	600	J	65kA	50kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA	-	-	-	-	-	-	-
					800	L															
J	600	600	200kA	200kA	800	L	65kA	50kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA ⁹	-	-	-	-	-	-	-
			200kA	200kA	600	J															
H ³	600	600	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA	-	-	36kA	-	-	-	-
P ³	600	600	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA	30kA	36kA	36kA	-	-	-	-
P ³	800	800 - 1200	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA	30kA	36kA	36kA	-	-	-	-
H	800 - 1200	800 - 1200	200kA	200kA	1600 ⁴	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA	-	-	36kA	-	-	-	-
Q ³	600-1600	600-1600	200kA	200kA	2000	L	65kA	65kA	65kA	0.05	65kA	65kA	65kA	50kA	-	-	50kA	-	-	-	-
S ³	800 - 1200	800 - 1200	200kA	200kA	2500	L	100kA	100kA	65kA	0.05	100kA	100kA	65kA	65kA	-	-	65kA	-	-	-	-
G ³	1000 - 1200	1000 - 1200	200kA	200kA	2000	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	-	-	-	-	-	-	-	-
G	1600 - 2000 (Front Connected TS Only)		200kA	200kA	2500	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	42kA	36kA	-	-	-	-	-	-
G ³	1600 - 2000	1600 - 2000	200kA	200kA	3000	L	125kA ⁵	125kA ⁵	100kA	0.05	100kA	100kA	100kA	42kA	36kA	42kA	42kA	-	-	-	-
S ³	1600 - 2000	1600 - 2000	200kA	200kA	2500	L	100kA	100kA	85kA	0.05	100kA	100kA	85kA	85kA	65kA	85kA	85kA	65kA	65kA	65kA	65kA
G	2600 - 3000	2600 - 3000	200kA	200kA	4000	L	100kA	100kA	100kA	0.05	100kA	100kA	100kA	42kA	36kA	42kA	42kA	-	-	-	-
G ³	3200	-	200kA	-	4000	L	100kA	100kA	-	0.05	100kA	100kA	-	-	-	-	-	-	-	-	-
G	4000	4000	200kA	200kA	5000	L	100kA	100kA	100kA	0.05	100kA	100kA	100kA	85kA	65kA	-	65kA	-	-	-	-
U ³	2600 - 4000	2600 - 4000	200kA	200kA	5000	L	125kA	125kA	125kA	0.05	125kA	125kA	125kA	100kA	-	-	100kA	-	-	-	-

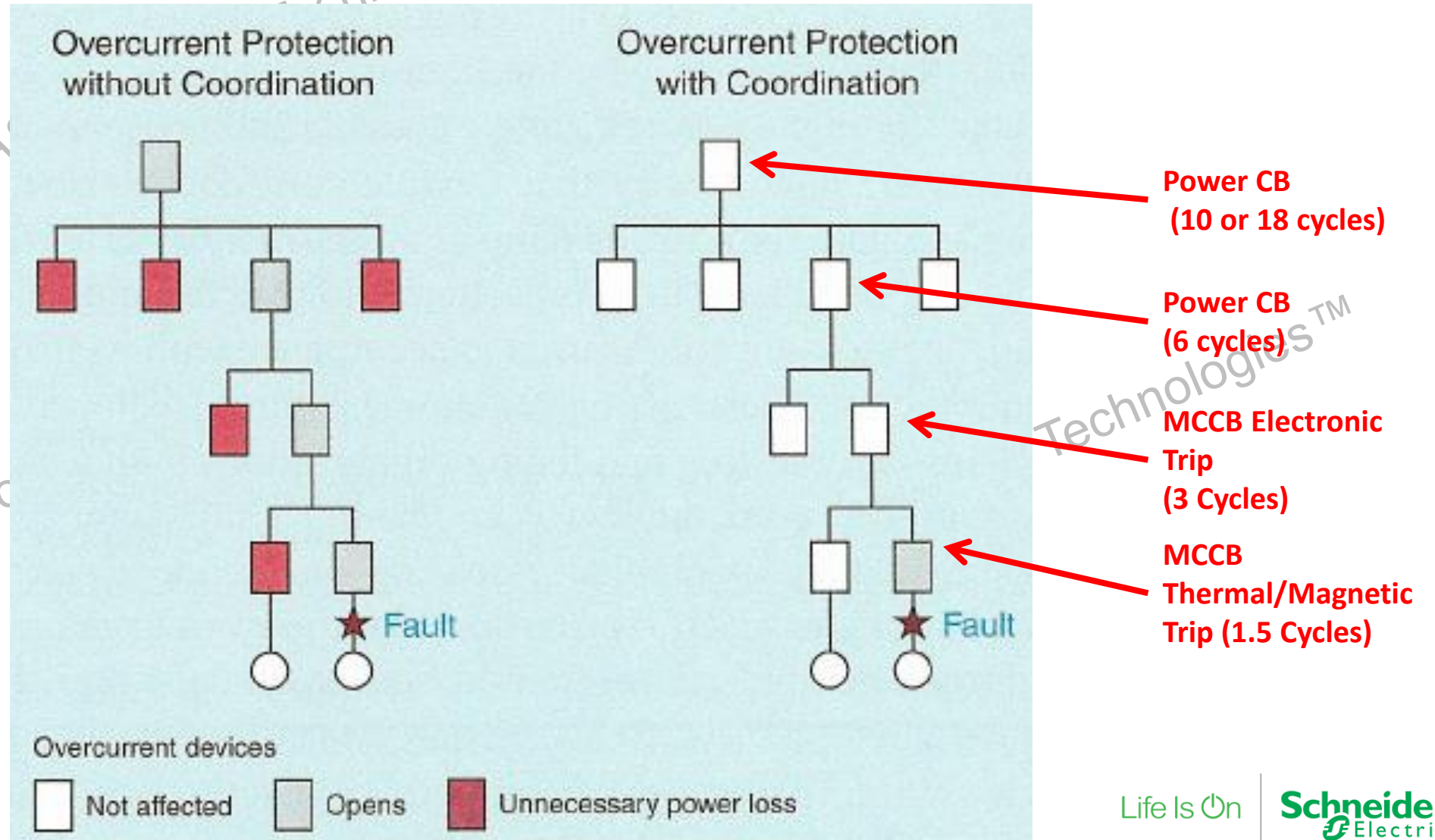
Frame	Switch Rating (Amps)		Current Limiting Fuses				Specific Breaker			Time Based				Short Time Ratings ³ (sec)							
	Transfer Switches	Bypass Switches	480V Max.	600V Max.	Max Size, A	Class	240V Max.	480V Max.	600V Max.	Time (sec)	240V Max.	480V Max.	600V Max.	480V Max.				600V Max.			
														.13	.2	.3	.5	.1	.13	.3	.5
D	30	-	100kA	-	300	J	22kA	22kA	10kA	0.025	10kA	10kA	10kA		-		-				
			200kA	35kA	200	J															
			35kA	35kA	200	RK1															
D	70, 100	-	35kA	35kA	200	RK1	150kA	85kA	25kA	0.025	10kA	10kA	10kA		-		-				
			200kA	35kA	200	J															
D	150	-	35kA	35kA	200	RK1	150kA	85kA	25kA	0.025	10kA	10kA	10kA		-		-				
			200kA	35kA	200	J															
D	200	-	200kA	-	200	J	200kA	85kA	14kA	0.025	10kA	10kA	10kA		-		-			-	
D	230	-	100kA	-	300	J	200kA	85kA	14kA	0.025	10kA	10kA	-		-		-			-	
E	260, 400	-	200kA	-	600	J	65kA	42kA	35kA	0.05	35kA	35kA	22kA		-		-			-	
J	150, 200, 260	150, 200, 230, 260	200kA	200kA	600	J	200kA	200kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA	-		-				
					800	L															
J	400	400	200kA	200kA	600	J	65kA	50kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA	-		-				
					800	L															
J	600	600	200kA	200kA	800	L	65kA	50kA	42kA	0.05	65kA	42kA ⁵	35kA	7.5kA	-		-				
			200kA	200kA	600	J															
H ³	600	600	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		-		36kA		-	
P ³	600	600	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		30kA		36kA		-	
P ³	800	800 - 1200	200kA	200kA	1600	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		30kA		36kA		-	
H	800 - 1200	800 - 1200	200kA	200kA	1600 ⁴	L	65kA	65kA	65kA	0.05	50kA	50kA	50kA	36kA		-		36kA		-	
Q ³	600-1600	600-1600	200kA	200kA	2000	L	65kA	65kA	65kA	0.05	65kA	65kA	65kA		50kA			50kA			
R ³	800 - 1200	800 - 1200	200kA	200kA	2500	L	100kA	100kA	65kA	0.05	100kA	100kA	65kA		65kA			65kA			
G ³	1000 - 1200	1000 - 1200	200kA	200kA	2000	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA		-			-			
G	1600 - 2000 (Front Connected TS Only)		200kA	200kA	2500	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	42kA		36kA		-			
G ³	1600 - 2000	1600 - 2000	200kA	200kA	3000	L	125kA ⁵	125kA ⁵	100kA	0.05	100kA	100kA	100kA	42kA		36kA		42kA		-	
S ³	1600 - 2000	1600 - 2000	200kA	200kA	2500	L	100kA	100kA	85kA	0.05	100kA	100kA	85kA	85kA		65kA		85kA		65kA	
G	2600 - 3000	2600 - 3000	200kA	200kA	4000	L	100kA	100kA	100kA	0.05	100kA	100kA	100kA	42kA		36kA		42kA		-	
C ³	3200		200kA		4000	L	100kA	100kA		0.05	100kA	100kA			-			-			
G	4000	4000	200kA	200kA	5000	L	100kA	100kA	100kA	0.05	100kA	100kA	100kA	85kA		65kA		65kA			
U ³	2600 - 4000	2600 - 4000	200kA	200kA	5000	L	125kA	125kA	125kA	0.05	125kA	125kA	125kA		100kA			100kA			

Withstand and Closing Ratings (WCR)

Selective

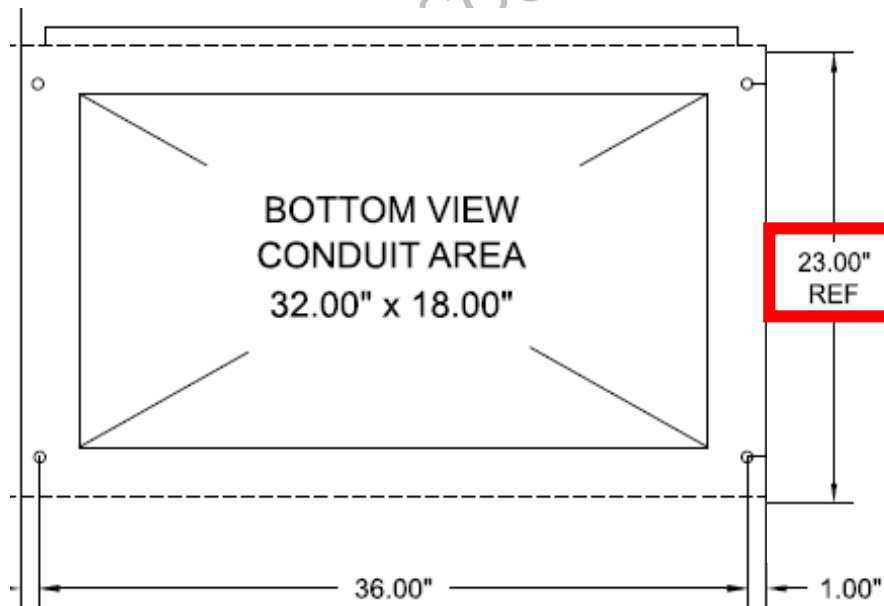
Coordination:

Localization of an overcurrent condition to isolate outages by selecting appropriate protective devices and settings

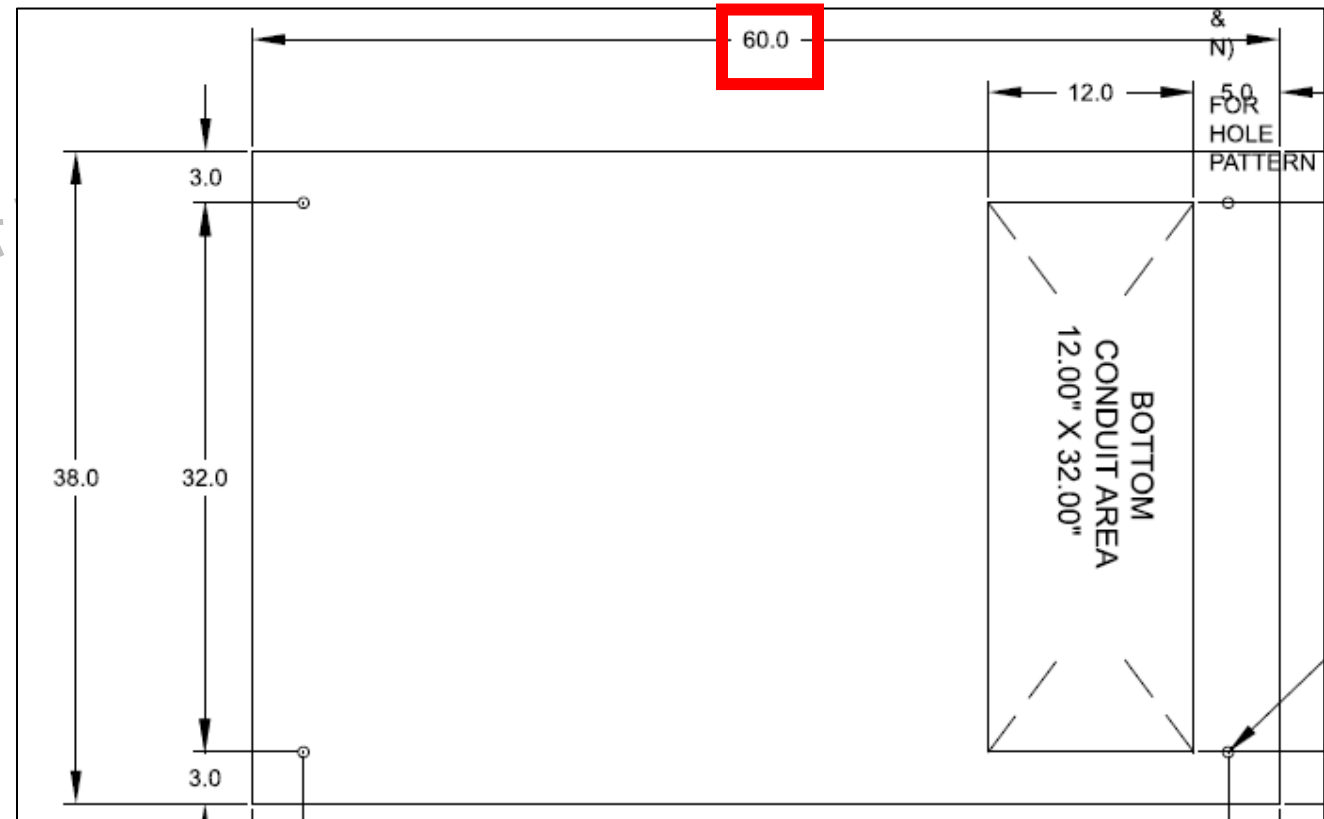


Withstand and Closing Ratings (WCR)

65kA **3-cycle** is 38" W x **23" D**



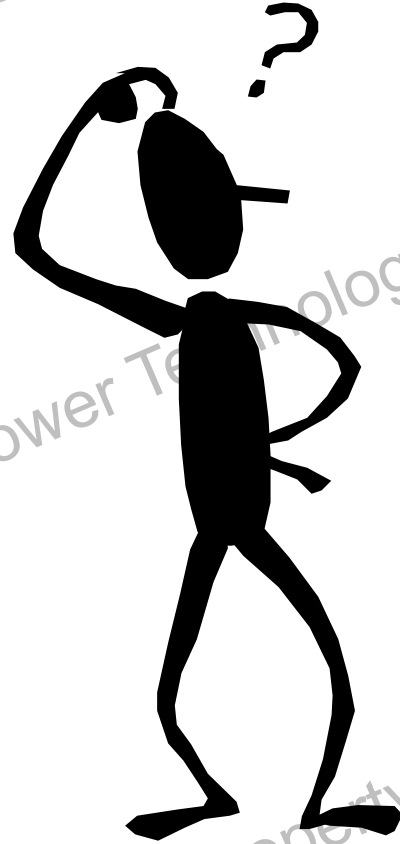
65kA **30-cycle** is 38\" W x **60\" D**



Conclusion

- It is important to note the time based short-circuit and short time ratings are both optional for product qualification under UL1008
- Not all transfer switch manufacturers offer these two optional ratings
- These optional ratings offer more convenience and flexibility in selecting an acceptable circuit breaker to coordinate with the transfer switch WCR
- Must be careful when using a specific breaker only ATS as the list of acceptable breakers is much shorter

Questions?



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