

34.5/115 kV Solar Power Plant & Substation Senior Design Project

Senior Design Team 18 - May 2024

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Agenda

- Safety Moment
- Substation Components
- Key-Plan Update
- One-Line Update
- Bus connections
- Feedback and Updates



Security & Access Control

What are the types?

Discretionary access control (DAC)

Mandatory access control (MAC)

Role-based access control (RBAC)

Rule-based access control (RuBAC)

Who can/how to access?

DAC - multiple administrators

MAC - single administrator

RBAC - assigns users roles to have unique permissions

RuBAC - changes permissions based on underlying factors



Substation Components

- Found products online for PTs, CTs, lightning arresters, circuit switchers, and disconnect switches
- Need to continue research on breakers, transformers, cap banks, and regulators.

- Power transformers
- Tap changing equipment
- Steel structures
- Lightning arresters
- Circuit switchers
- SF₆ circuit breakers
- Oil circuit breakers
- Air circuit breakers
- Vacuum circuit breakers
- Disconnect switches
- Coupling capacitors
- Potential transformers
- Current transformers
- High-voltage fuses
- Metal-clad switchgear
- Shunt reactors
- Meters
- Relays
- Supervisory control
- Remote terminal units
- Digital fault recorders
- Capacitors
- Voltage regulators
- Control house
- Conduits
- Control wires
- Control panels
- Power-line carrier equipment
- Microwave equipment
- Batteries

Substation Components

<https://www.hyee-current-transformer.com/capacitor-voltage-transformer/115kv-capacitor-voltage-transformer.html>

<https://www.hyee-current-transformer.com/current-transformer/115kv-current-transformer/115kv-current-transformer-electric-substation.html>

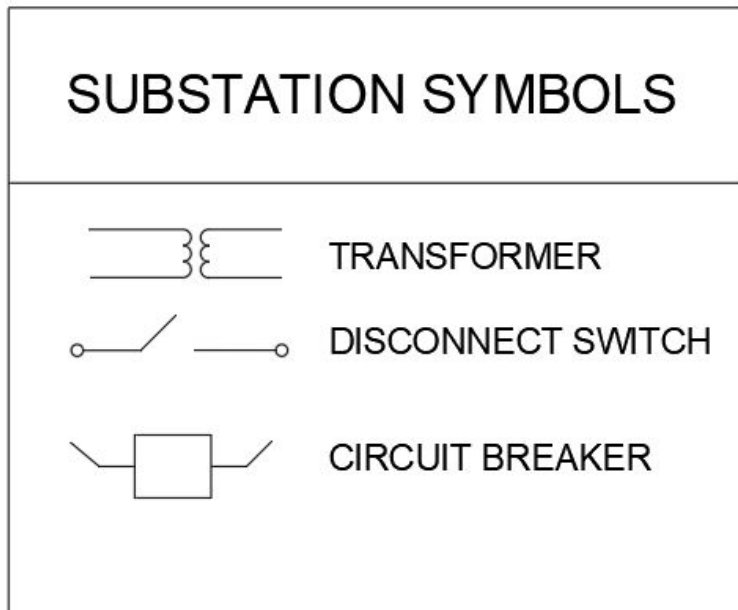
<https://www.sandc.com/en/products--services/products/series-2000-circuit-switcher/>

<https://www.eaton.com/us/en-us/skuPage.AZES013G115144.html>

<http://www.tdproducts.com/files/36371740.pdf>

<https://www.sandc.com/en/products--services/products/line-r/>



























Key Plan and Symbols - Eli & Baylor



- Working on creating a key of symbols and descriptions to use throughout the substation.
- Planning on adding more detailed devices and layout information in the key plan compared to the one-line.



One-Line - Eli & Baylor

ELECTRICAL LEGEND SINGLE LINE & SCHEMATIC SYMBOLS			
ELECTRICAL SYMBOL LEGEND			
SINGLE LINE			
	LOAD BREAK SWITCH		LINE SYMBOLS  CONDUCTOR  UNDERGROUND CONDUCTOR  OVERHEAD CONDUCTOR  TRIPPING OR INTERLOCKING CIRCUIT  EQUIPMENT OUTLINE  KEY INTERLOCKING
	UNFUSED DISCONNECT SWITCH		SWITCH GEAR DEVICE NUMBER AND FUNCTIONS 15 SYNCHRONIZATION CHECK RELAY 27 AC UNDER VOLTAGE 32 DIRECTIONAL POWER RELAY 40 LOSS OF FIELD PROTECTION RELAY 46 PHASE BALANCE CURRENT RELAY 47 PHASE SEQUENCE RELAY 48 INCOMPLETE SEQUENCE RELAY 49 AC THERMAL OVERLOAD RELAY 50 AC INSTANTANEOUS OVERCURRENT RELAY 51 AC TIME DELAY OVERCURRENT RELAY 52 AC CIRCUIT BREAKER 59 AC OVER VOLTAGE RELAY 63 SUDDEN PRESSURE RELAY 78 PHASE ANGLE MEASURING RELAY 81 UNDER FREQUENCY RELAY 86 LOCKOUT RELAY 87 DIFFERENTIAL CURRENT RELAY 92 REVERSE POWER RELAY
	FUSED CUTOFF SWITCH		
	FUSED DISCONNECT SWITCH		
	DISTRIBUTION TRANSFORMER		
	DRAW OUT CIRCUIT BREAKER		
	CIRCUIT BREAKER		
	SHUNT TRIP CIRCUIT BREAKER		
	CIRCUIT BREAKER C/W CURRENT LIMITERS		
	POWER CIRCUIT BREAKER C/W FRAME SIZE INDICATION		
	LIGHTNING ARRESTER		
	SURGE ARRESTER		
	CURRENT TRANSFORMER C/W RATIO AND QUANTITY		
	ZERO SEQUENCE CURRENT TRANSFORMER		
	POTENTIAL TRANSFORMER C/W VOLTAGE RATIO AND QUANTITY		
	CONTACT		
	THERMAL OVERLOAD DEVICE		
	CAPACITOR C/W KVAR RATING		
	DIGITAL METERING		

- Found a free library of symbols we can use for the one-line
- Most symbols won't be used, will trim down the legend towards the end of the semester to avoid confusion



Bus Connections - Eduardo & Bell

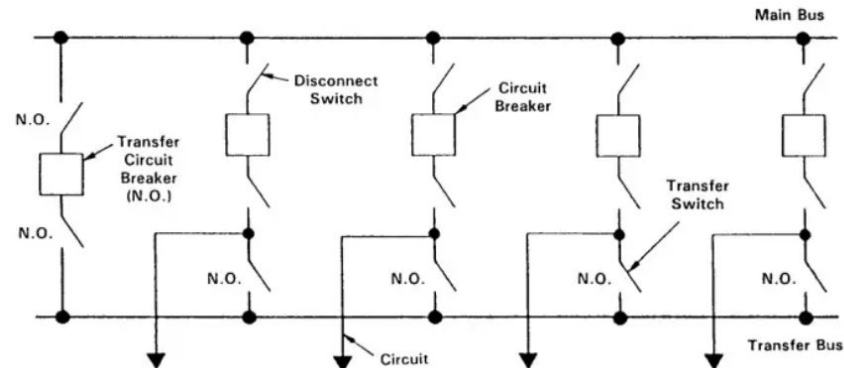
Main and Transfer Bus Advantages

- It takes a small area
- Ease of expansion
- It is flexible
- Any circuit breaker can be removed and be serviced without an outage

Disadvantages

- Cost is increased
- Complexity of operation and protection

Usually used in 161 kV substations



Feedback and Updates

- Tasks: Updates
 - Bell: Feeder connections/circuit
 - Liam: Rest of components/more components
 - Eli: One-Line/Key-Plan
 - Baylor: One-Line/Key-Plan
 - Eduardo: Switchgears
 - Chicheng: Previous group cutsheets/design

