

## Switchgear Class 1 – Drawing Reading Assignment

All questions should be able to be answered using the ANSI Device #'s sheet and the 4 GPO Pre-purchase drawings.

1. Important ANSI/IEEE Device Numbers for electrical switchgear prints (copy definitions here):
  - a. 12    Overspeed  
\_\_\_\_\_
  - b. 21    Distance Relay  
\_\_\_\_\_
  - c. 25    Synch Check  
\_\_\_\_\_
  - d. 27    UV  
\_\_\_\_\_
  - e. 32    Directional Power  
\_\_\_\_\_
  - f. 40    Loss of Field  
\_\_\_\_\_
  - g. 43    Selector Switch  
\_\_\_\_\_
  - h. 46    Reverse Phase or Phase Balance  
\_\_\_\_\_
  - i. 50    Inst O/C  
\_\_\_\_\_
  - j. 51    Time O/C  
\_\_\_\_\_
  - k. 52    AC Ckt Brkr  
\_\_\_\_\_
  - l. 59    OV  
\_\_\_\_\_
  - m. 79    Recloser  
\_\_\_\_\_
  - n. 81    Frequency  
\_\_\_\_\_
  - o. 83    Auto Select or Transfer  
\_\_\_\_\_
  - p. 86    Lockout  
\_\_\_\_\_
  - q. 87    Differential Protection  
\_\_\_\_\_
  
2. Less often used ANSI/IEEE Device Numbers, but may run across them in controls drawings:
  - a. 11    Multifunction Device  
\_\_\_\_\_
  - b. 20    Solenoid Valve  
\_\_\_\_\_
  - c. 23    Thermostat  
\_\_\_\_\_
  - d. 24    Volts/Hertz  
\_\_\_\_\_
  - e. 26    Temp Switch  
\_\_\_\_\_
  - f. 47    Phase Sequence Voltage  
\_\_\_\_\_
  - g. 49    Thermal Relay  
\_\_\_\_\_

- h. 62 Time Delay \_\_\_\_\_
- i. 63 Pressure Switch \_\_\_\_\_
- j. 71 Level Switch \_\_\_\_\_

3. What does GPO stand for? Gov't Printing Office

4. How do you know that the 4 drawings you have are the complete set? Drawing Index on p. 1

5. Who is the design engineering firm for this set of bid drawings? RTKL Associates

6. Where are they located? Bond St. in Baltimore

7. Where is the GPO located? G St between N. Capitol and 1st St, NE

8. Define the following acronyms:

- a. AT, AF Amps Trip, Amps Frame \_\_\_\_\_
- b. AIC Amps Interrupting Capacity \_\_\_\_\_
- c. ATC Air Terminal Chamber \_\_\_\_\_
- d. ATS Automatic Transfer Switch \_\_\_\_\_
- e. CT Current Transformer \_\_\_\_\_
- f. MCB, MLO Main Ckt Brkr, Main Lugs Only \_\_\_\_\_
- g. NC, NO Normally Closed, Normally Open \_\_\_\_\_
- h. NTS Not to Scale \_\_\_\_\_
- i. SA Surge Arrestor \_\_\_\_\_
- j. ST Shunt Trip \_\_\_\_\_
- k. SWBD Switchboard \_\_\_\_\_
- l. SWGR Switchgear \_\_\_\_\_
- m. XFMR Transformer \_\_\_\_\_

9. How can you tell whether a receptacle is wall mounted or ceiling mounted? Ceiling has a box around it.

10. What does DMM in a box mean? Digital Multi-meter

11. What does TVSS in a box mean? Transient Voltage Surge Suppressor

12. How can you tell whether a circuit breaker is drawout or fixed? Drawout has "Veels" line/load: << >>

13. What is an "EO" circuit breaker? Electrically Operated
14. Draw a transformer, then an isolation transformer.
15. How do you tell the difference between a utility meter and a motor? Motor has "tornado" wings, at least @ RTKL
16. How does RTKL distinguish fused from non-fused disconnects? Fused has a diagonal line.
17. How does RTKL distinguish between 480/277V and 208/120V panelboards? LV empty, HV solid filled
18. What is an interlock (answer not on drawings)? Prevents an action unless another action is performed.
19. Where will the new switchgear be located? Basement (almost always is).
20. Substation room is medium voltage (13.2kV) area, Switchgear room is all 480V (low voltage). What is the direction of power flow on the plan view drawings on sheet E-110? Outsided in on top, inside out on bottom.
21. What does "MV CB 'A'" stand for? Medium Voltage, Circuit Breaker "A"
22. What 2 components are in the PEPCO metering cubicles? PT's and CT's
23. What's the ATC for between metering cubicles and transformers? Cable, bus, or braid connections
24. What's the rating of the substation transformers? How can they be dual rated? 2000/3000 kVA
25. What do output breakers "LV-A" and "LV-B" feed? SWGR A and SWGR B
26. Where are the surge arrestors located? At the MV Cable terminations
27. What model number protective relay is specified by the engineer? SEL-751
28. Why is drawing note 4 on sheet E-110 problematic? Fully Rated?, horizontal or vertical bus?
29. What will most commonly be plugged into the ceiling mounted receptacles (not on dwgs)? Vacuum cleaners, why?
30. What does CRAC stand for (not on dwgs)? Computer Room A/C
31. Why would there be 2 CRAC's in the substation room? Redundancy
32. What are the battery racks and chargers be used for? Control Power during utility outage.
33. Assume the higher x'fmr rating (3000kVA). What is the maximum primary current at 13.2kV? ( $VA = V * A * \sqrt{3}$ ) 131 Amps

34. Does your answer make sense, given the trip rating for the primary breakers? Yes, 200AT.
35. Assume 3000kVA x'fmrs again, what's the maximum secondary current at 480V? 3608 Amps
36. Does your answer make sense, given the trip rating for the secondary breakers? Yes, 4000AT.
37. What's the impedance of the substation transformers? 6.2%
38. What's the fault current rating of SWGR A and SWGR B? 100 KAIC
39. How many conduits/conductors are between breakers 52-MA and 52-UA (4000A)? 11 sets of 4-500's, 1-500 Gnd one 3-1/2" conduit each.
40. Why is 52-TA NC, while 52-TB is NO? (Answer not on dwgs) Think about it. Active vs Maintenance Tie Breakers
41. The four 4000A breakers create a Main-Tie-Tie-Main arrangement. Normally this is simplified as merely a M-T-M. Why do we need 2 tie breakers in this case? (Answer not on dwgs) Think about it. Maintenance.
42. A M-T-M (or M-T-T-M) arrangement is also known as a "healthy source selection" or "autothrowover" scheme. This one is automated. What performs the automatic sequencing? PLC.
43. Why are there DMM's when utility metering is already provided? For customer use.
44. What's an EPMS (not on legend, Google it)? Electrical Power Monitoring System
45. How many 4000A breaker pair connections are there that travel outside of equipment? 3 - M, T, M
46. What are the largest frame size load breakers in SWGR A and SWGR B? 1600A F
47. What size are most of the load breakers in SWGR A and SWGR B? 800A F
48. Can the 6-color press and the 7-color press run simultaneously? No, ATS selects only one.
49. What protections are in effect on the MV Circuit Breakers? 50/51, 50N/51N, 27/59, 81, 32, 25, 79
50. What medium voltage cables are specified? General Note 2: Copper conductor with MV-105 133% EPR Insulation
51. What DMM(s) are specified? Square D CM4000T, Siemens 9610, or GE EPM 9650 Power Quality Meter.
52. Why is the N-G bond made ONLY in SWGR A? N-G bond should be made ONLY ONCE.
53. What's wrong with Drawing Note 11? Drawing E-505 is NOT on the Index.
54. What purpose do glow tubes serve? (Not on drawings) Note 13 give a clue. They let the user view whether cables are energized through a view window in the MV gear.