APPALACHIAN UNDERGROUND CORROSION SHORT COURSE

AUCSC

Education and Training for Corrosion Control

Intermediate Course

CHAPTER 7

RECTIFIERS

Appalachian Underground Corrosion Short Course
West Virginia University
Morgantown, West Virginia

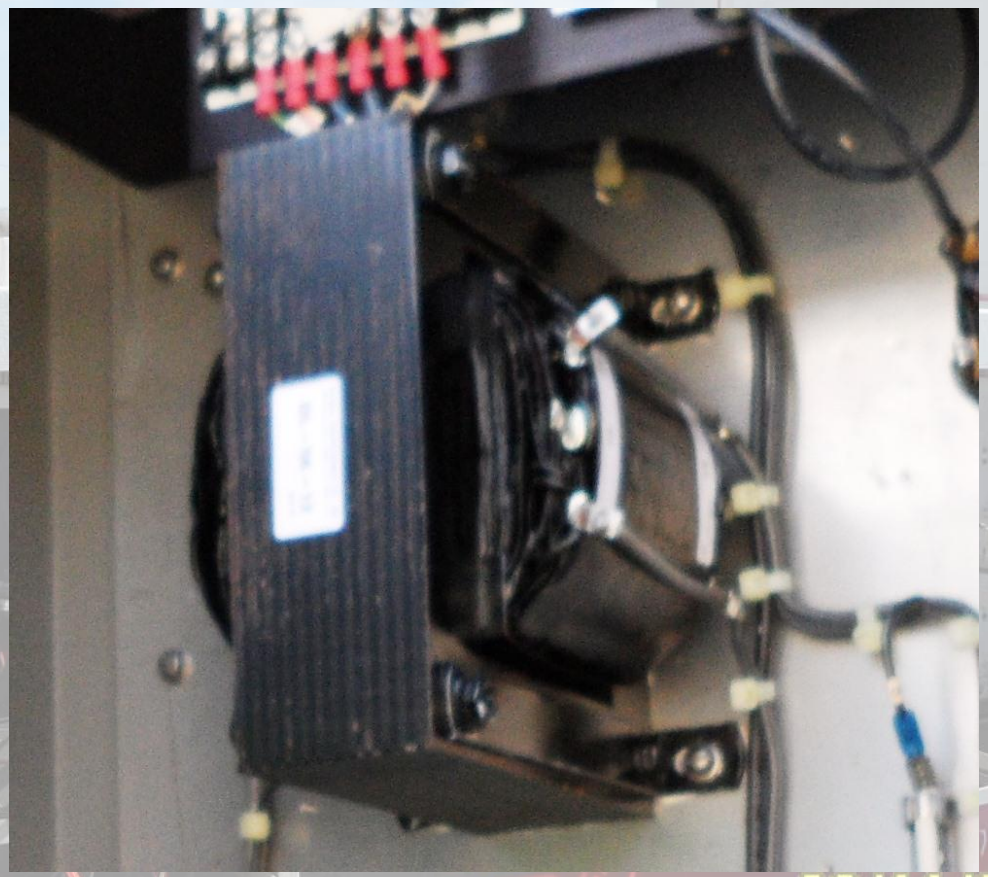
Safety

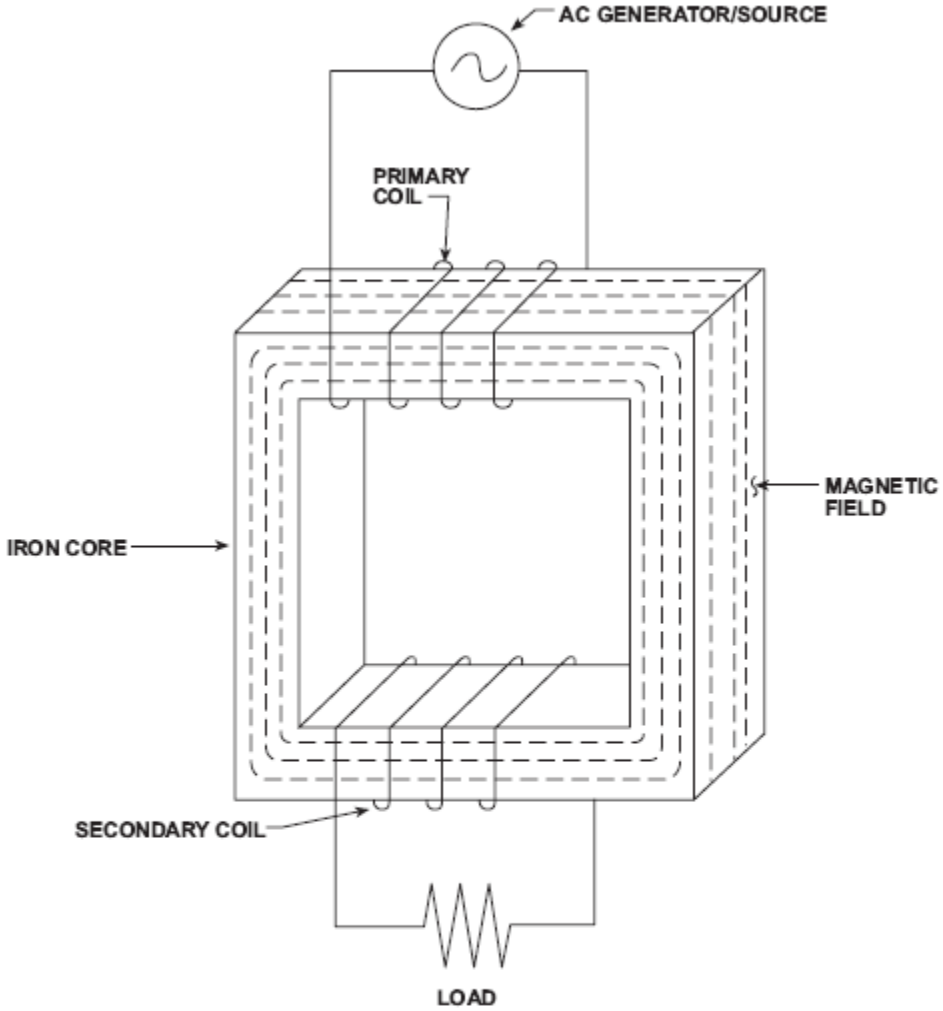
- Visually inspect to commercial power service to pole and service mounted on the pole
- Inspect service disconnect and rectifier ground
- Test rectifier case for voltage prior to unlocking or opening
- Follow your company Lock Out Tag Out procedure, if you have to troubleshoot, repair or replace any components

Transformer/Rectifier Component Review

- Two distinct operations
  - AC Transformer: Allows for the adjustment of the current going to the DC Rectifier element
  - DC Rectifier: Converts the AC current to DC current for application to the cathodic protection system
- Additional components include primary and secondary breakers; lightning protection (AC & DC); filter choke; calibrated shunt; courtesy outlet; and output gauges.

AC Transformer

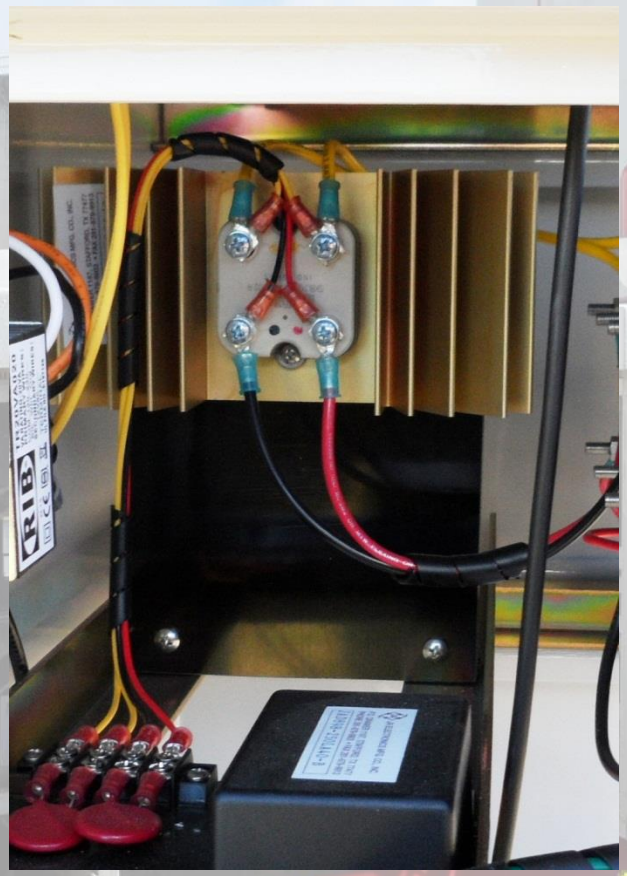




TYPICAL TRANSFORMER DIAGRAM

FIGURE 7-14A

DC Rectifier – Diode Stack



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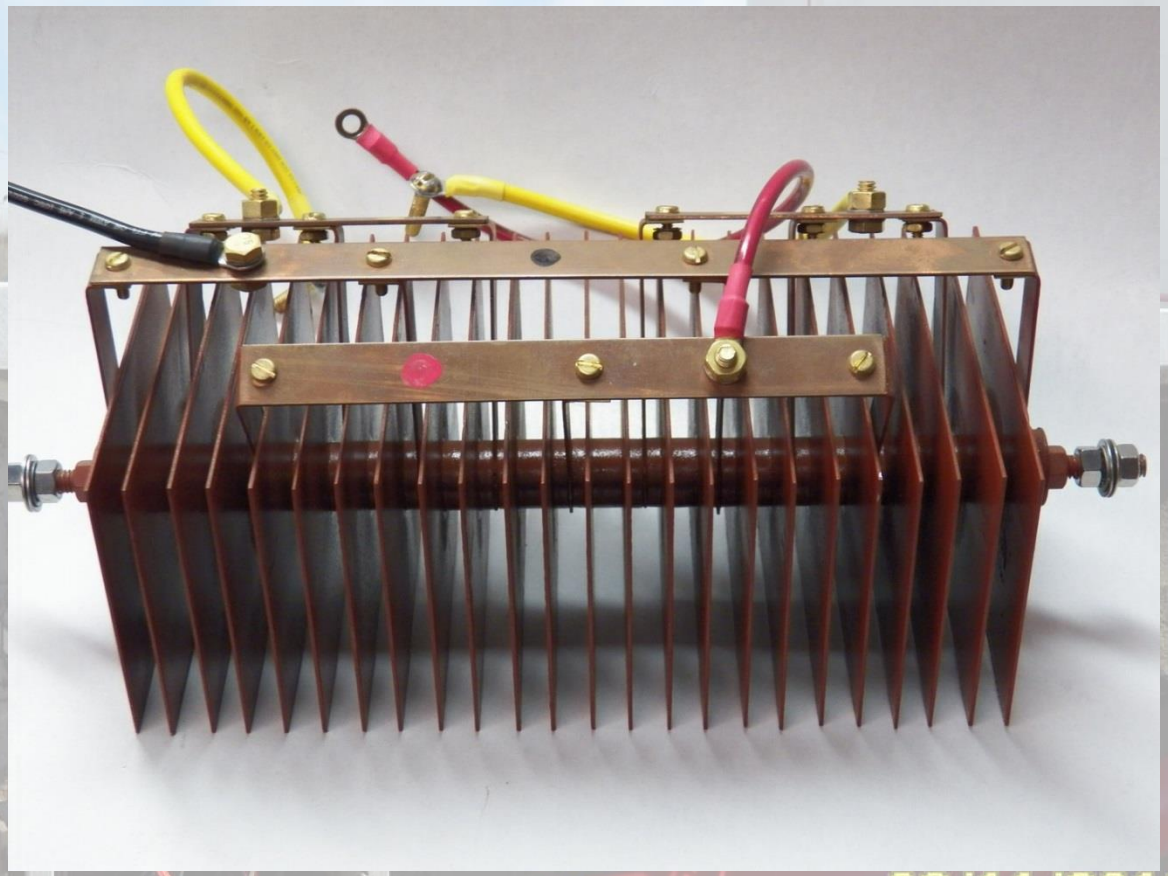
DC Rectifier – Selenium Stack



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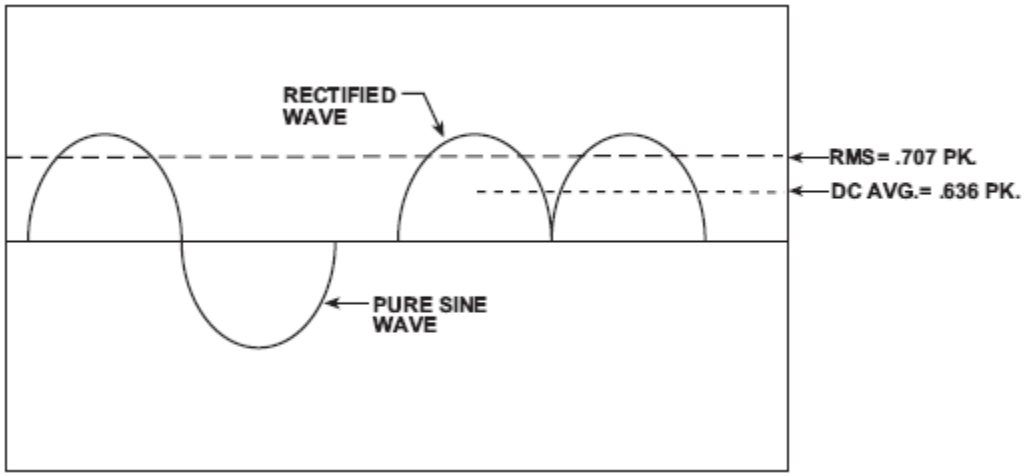
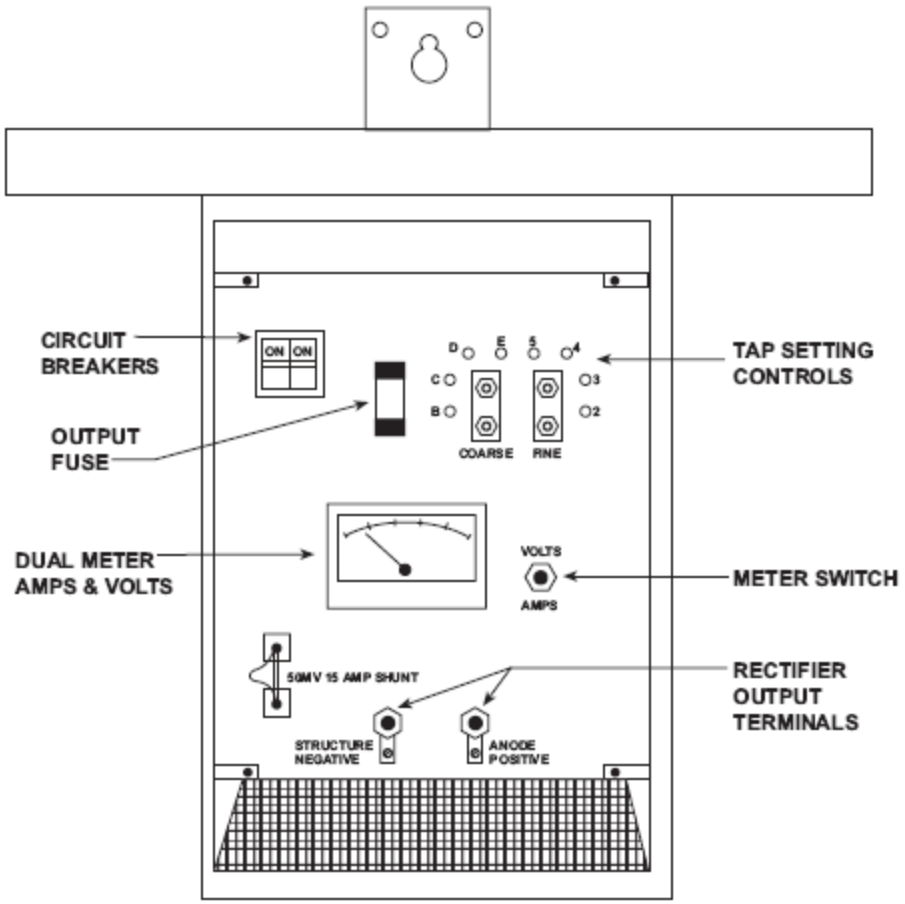


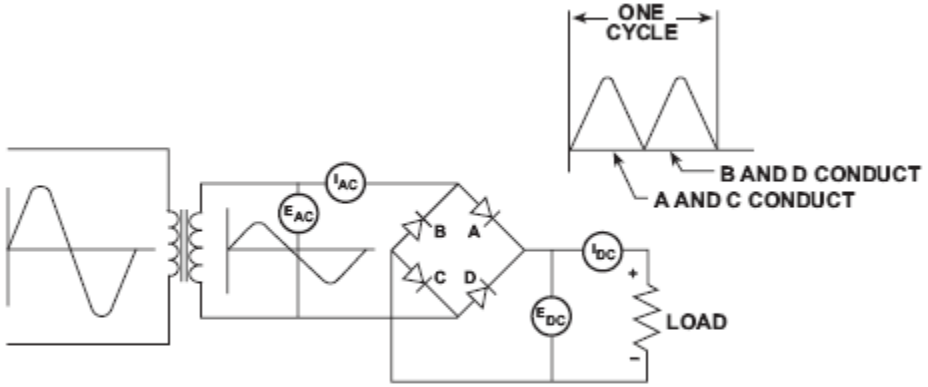
AC RECTIFICATION

FIGURE 7-6

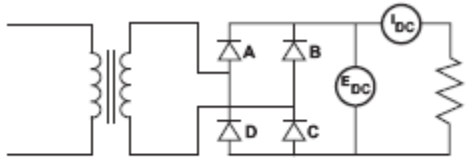


TYPICAL AIR COOLED RECTIFIER

FIGURE 7-17

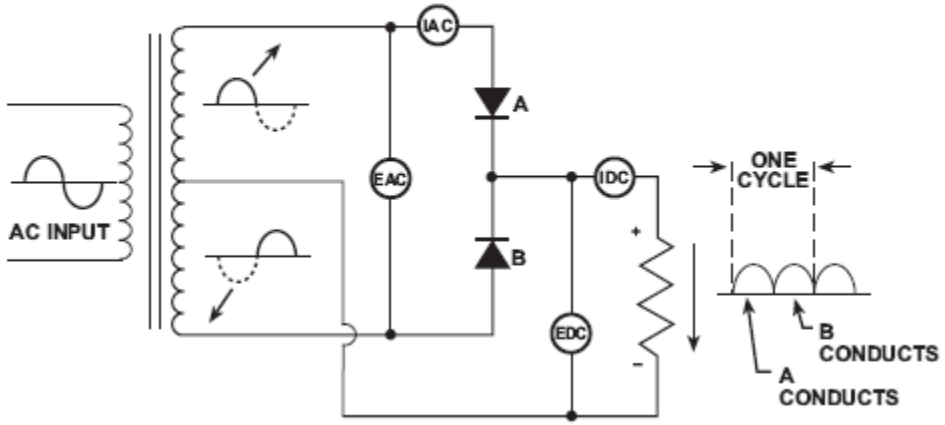


ALTERNATE SCHEMATIC ARRANGEMENT



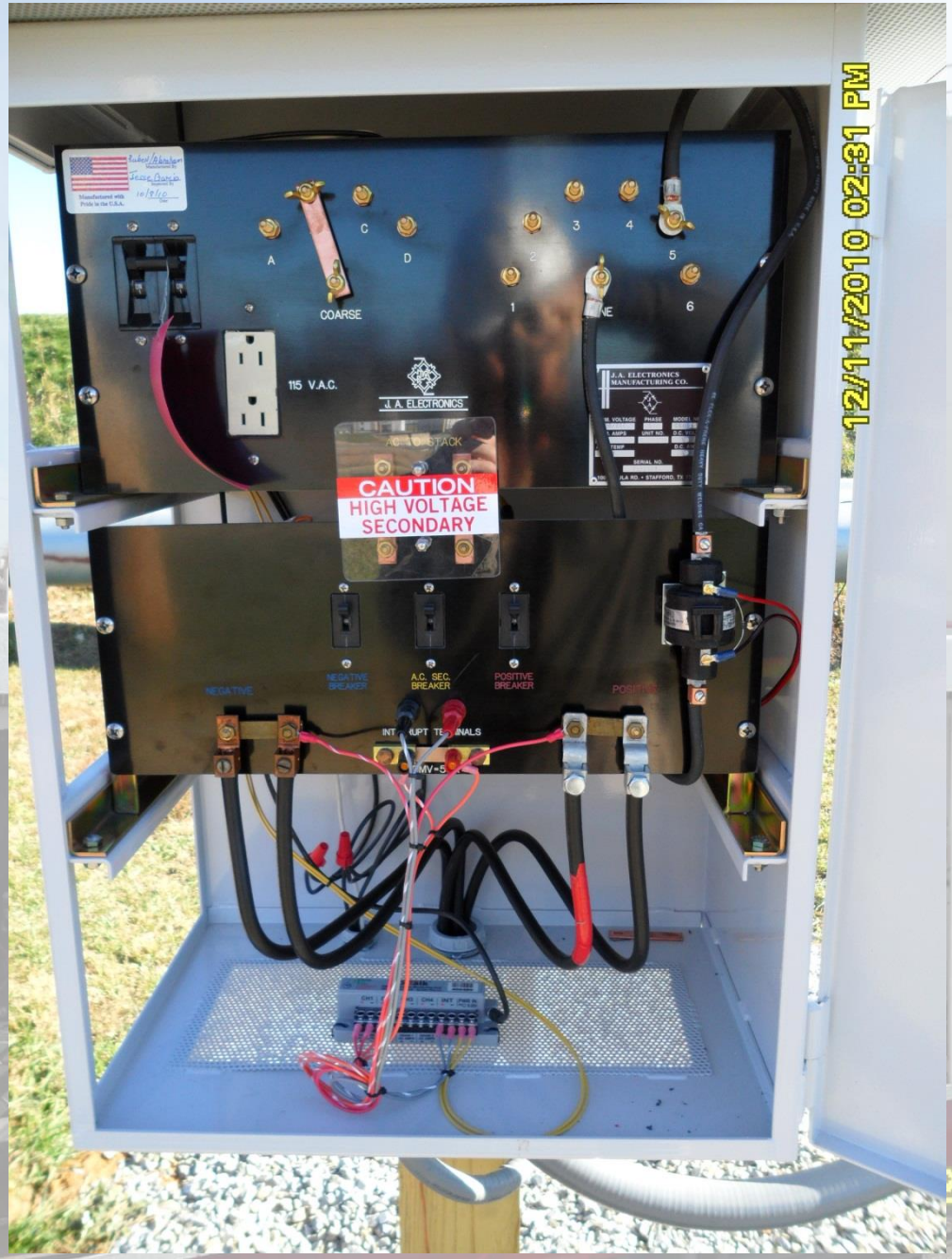
SINGLE PHASE BRIDGE CIRCUIT

FIGURE 7-7



SINGLE PHASE CENTER-TAP CIRCUIT

FIGURE 7-8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A
C
D
COARSE
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115 V.A.C.
J.A. ELECTRONICS
CAUTION
HIGH VOLTAGE
SECONDARY
NEGATIVE
NEGATIVE BREAKER
A.C. SEC. BREAKER
POSITIVE BREAKER
POSITIVE
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COARSE
FINE
Universal
RECTIFIERS, INC.
A.C. SECONDARY BREAKER
25A
115 V.A.C.
POSITIVE
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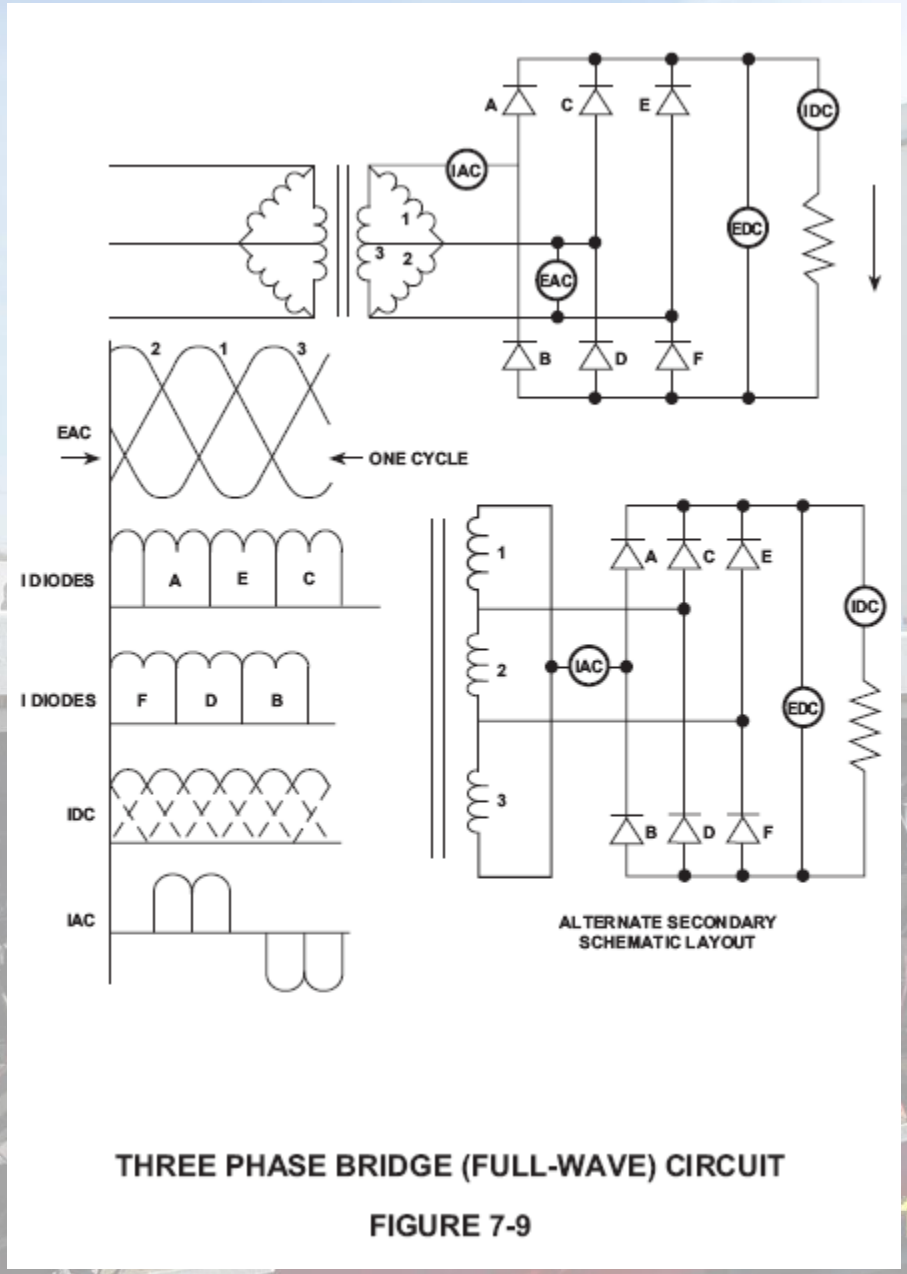
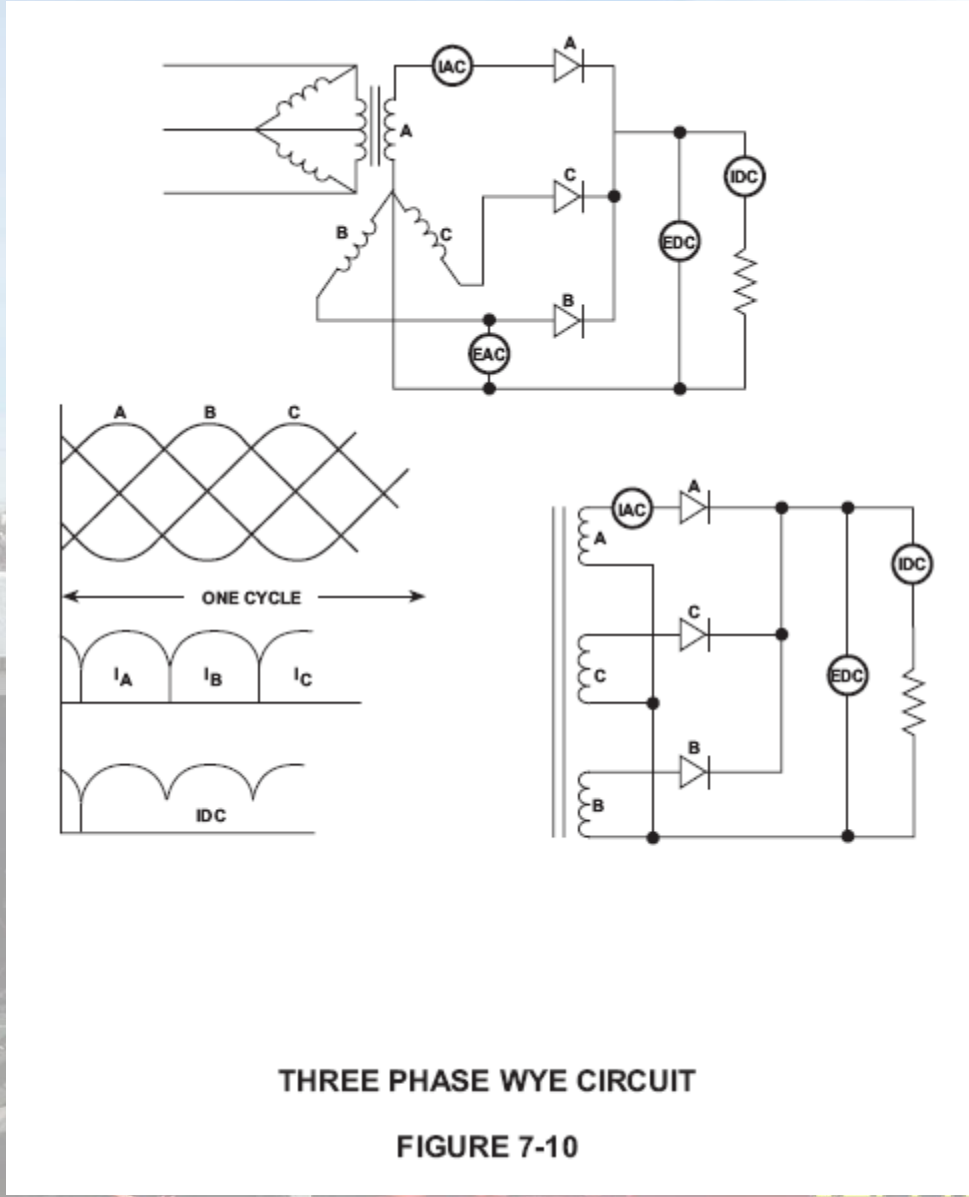


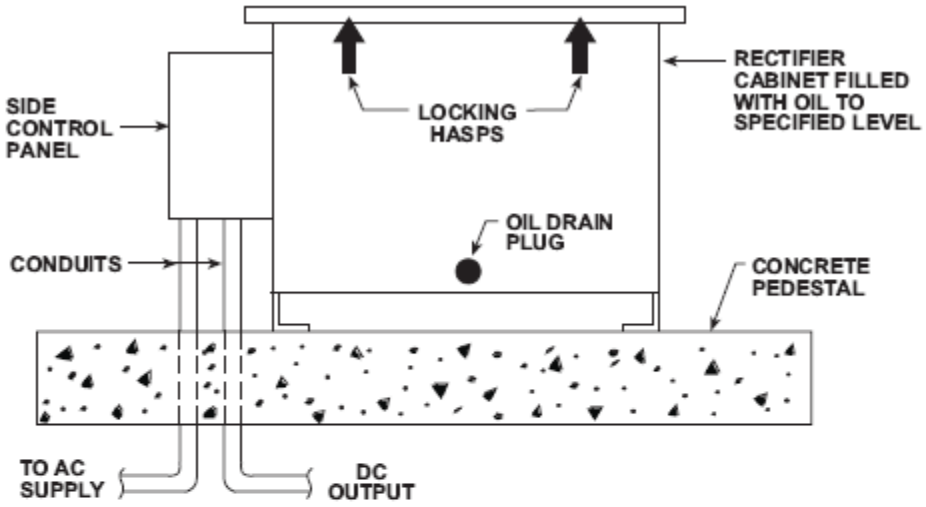
THREE PHASE BRIDGE (FULL-WAVE) CIRCUIT

FIGURE 7-9



THREE PHASE WYE CIRCUIT

FIGURE 7-10



TYPICAL OIL COOLED RECTIFIER

FIGURE 7-18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VOLT
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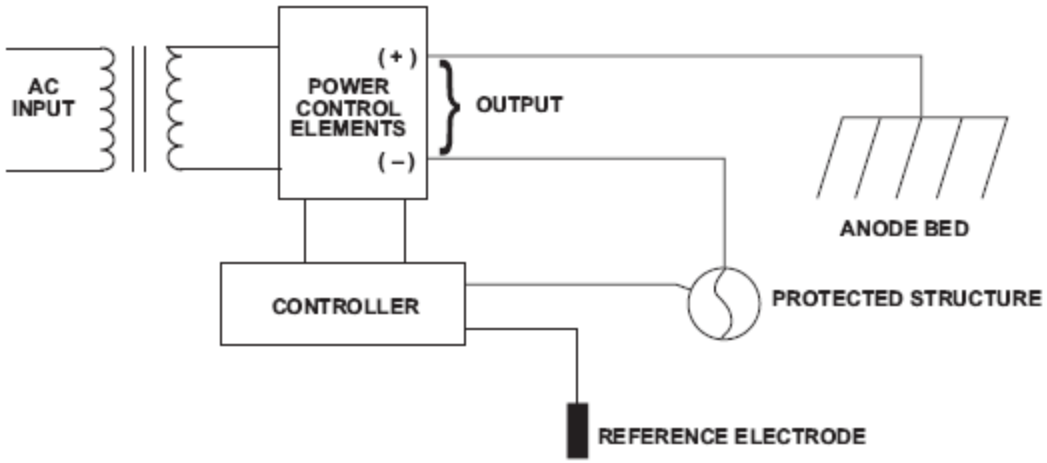
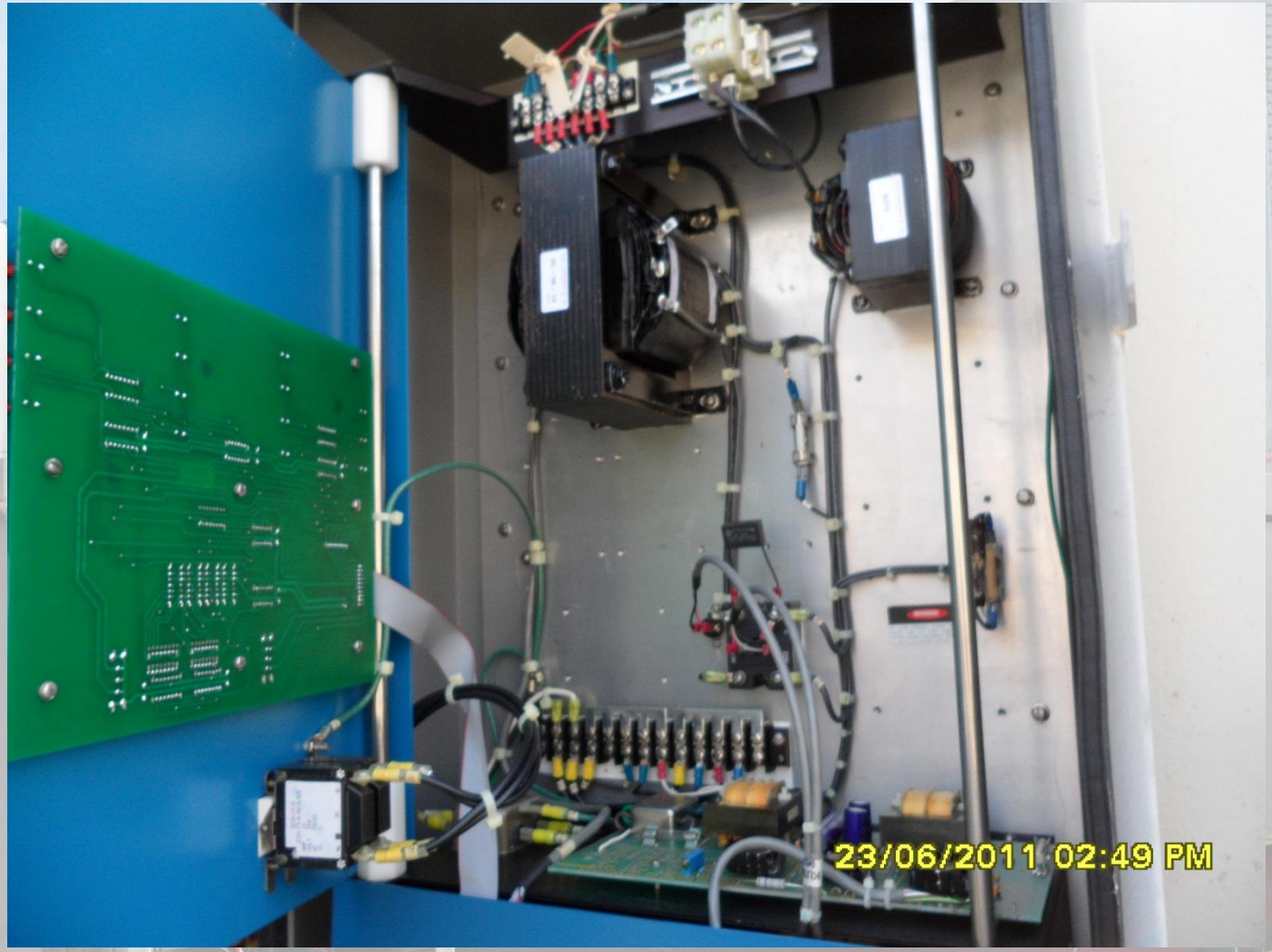


TYPICAL AUTOMATIC POTENTIAL CONTROLLED
RECTIFIER CIRCUIT

FIGURE 7-20



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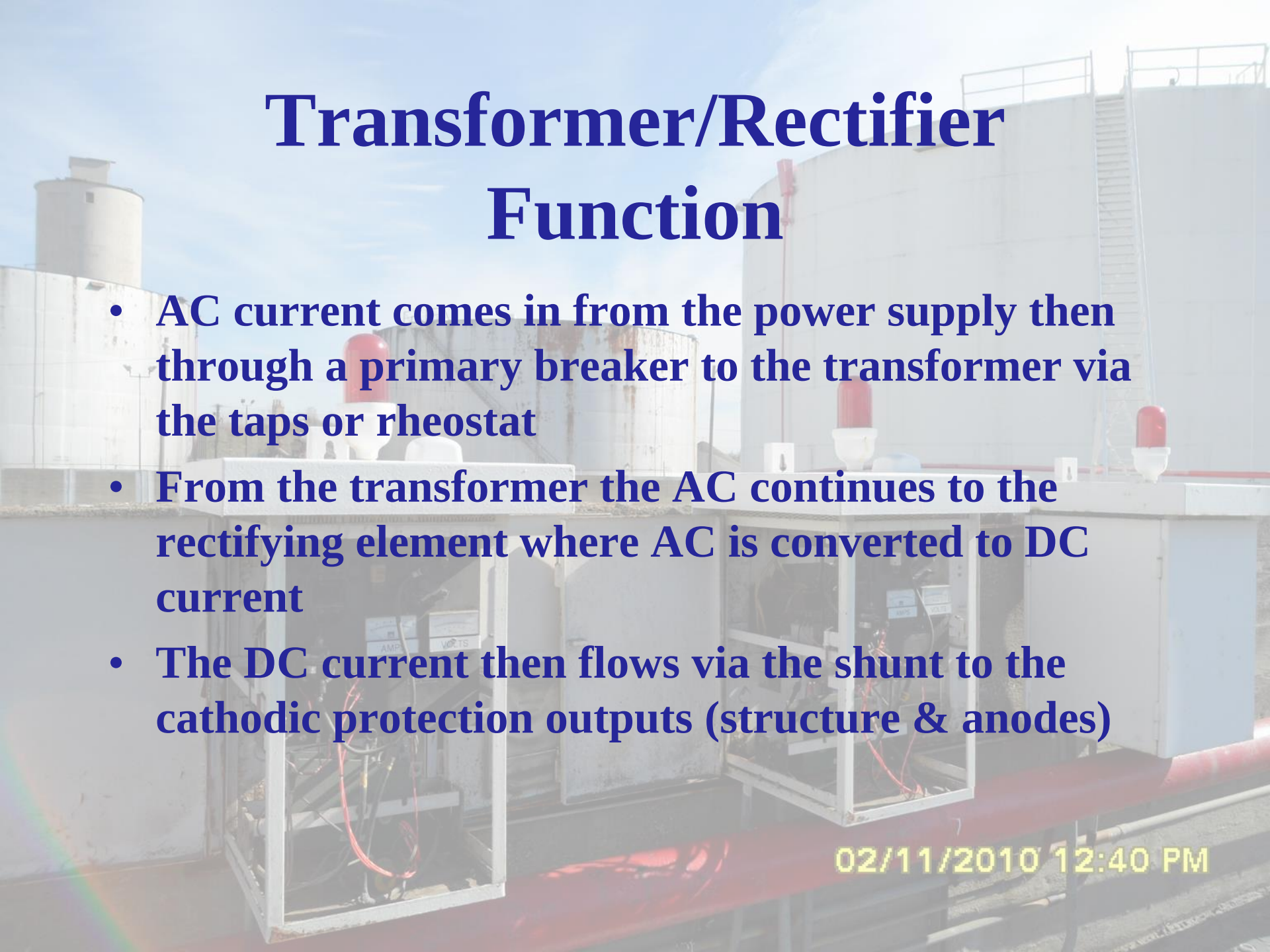
Additional Components

- **Lightning Arrestors – both AC & DC I/O**
- **Filter Chokes – Clean up or smooth out DC**
- **Fuses & Breakers – protect components against unexpected faults**
- **Calibrated Shunt – provides a means to accurately measure the DC cathodic protection current output**
- **Courtesy Outlet – AC power for test equipment (interrupters)**

Transformer/Rectifier Function

- AC current comes in from the power supply then through a primary breaker to the transformer via the taps or rheostat
- From the transformer the AC continues to the rectifying element where AC is converted to DC current
- The DC current then flows via the shunt to the cathodic protection outputs (structure & anodes)



Rectifier Preventative Maintenance

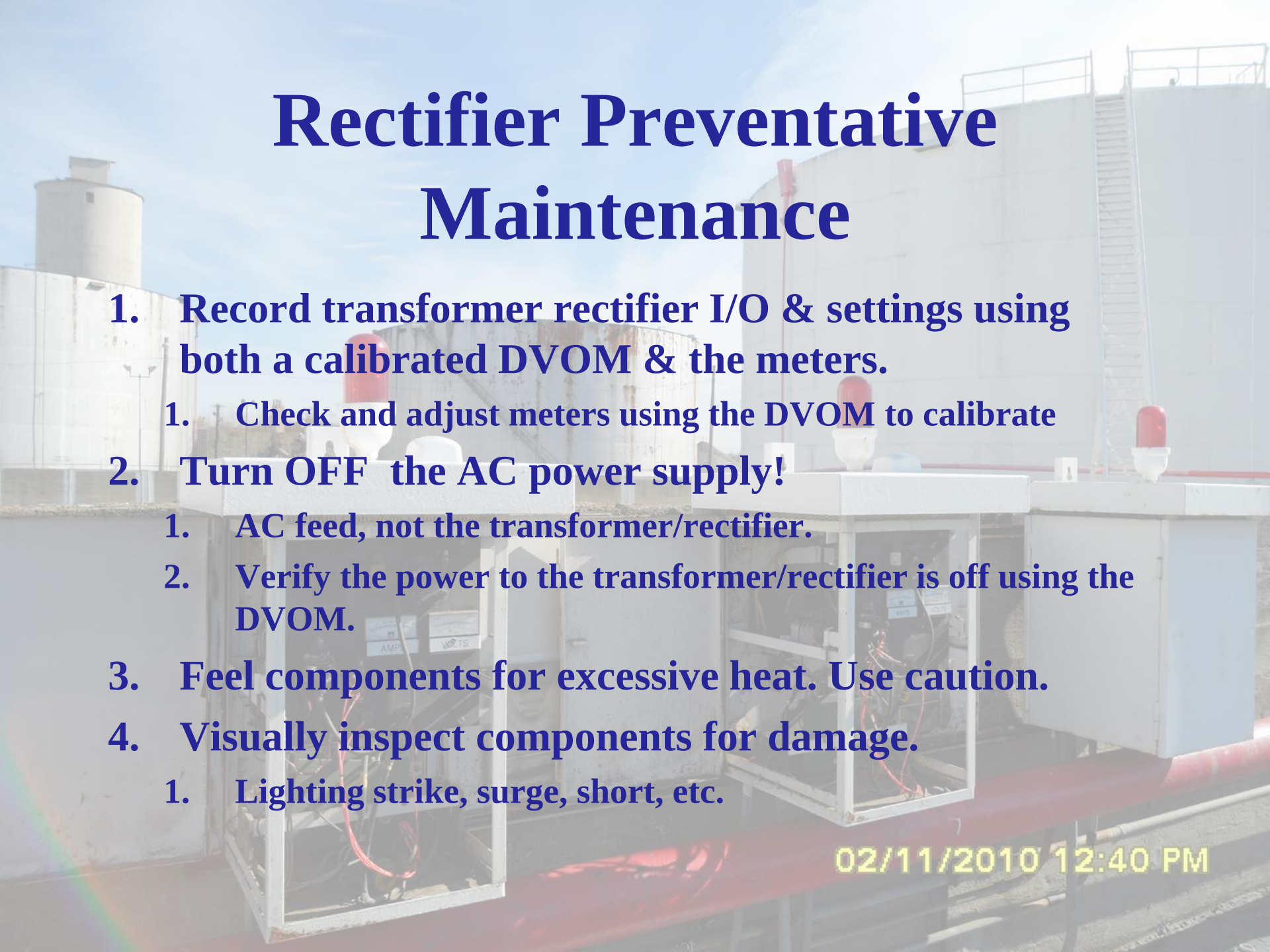
- **SAFETY is often the most disregarded, but most important aspect of performing rectifier maintenance**
  - **Use proper safety practices and equipment**
  - **Use common sense & trust your senses**
  - **Establish safe work habits**
- **DOT regulated systems require transformer/rectifiers to be inspected every 60 days**

Remote Monitoring Units (RMUs)

- **The use of RMUs are a very effective means to monitor the transformer/rectifier I/O.**
- **However, this does <u>not</u> alleviate the need to periodically visit each location to visually inspect and perform PM tasks.**

Rectifier Preventative Maintenance

1. Record transformer rectifier I/O & settings using both a calibrated DVOM & the meters.
    1. Check and adjust meters using the DVOM to calibrate
2. Turn OFF the AC power supply!
    1. AC feed, not the transformer/rectifier.
    2. Verify the power to the transformer/rectifier is off using the DVOM.
3. Feel components for excessive heat. Use caution.
4. Visually inspect components for damage.
    1. Lighting strike, surge, short, etc.

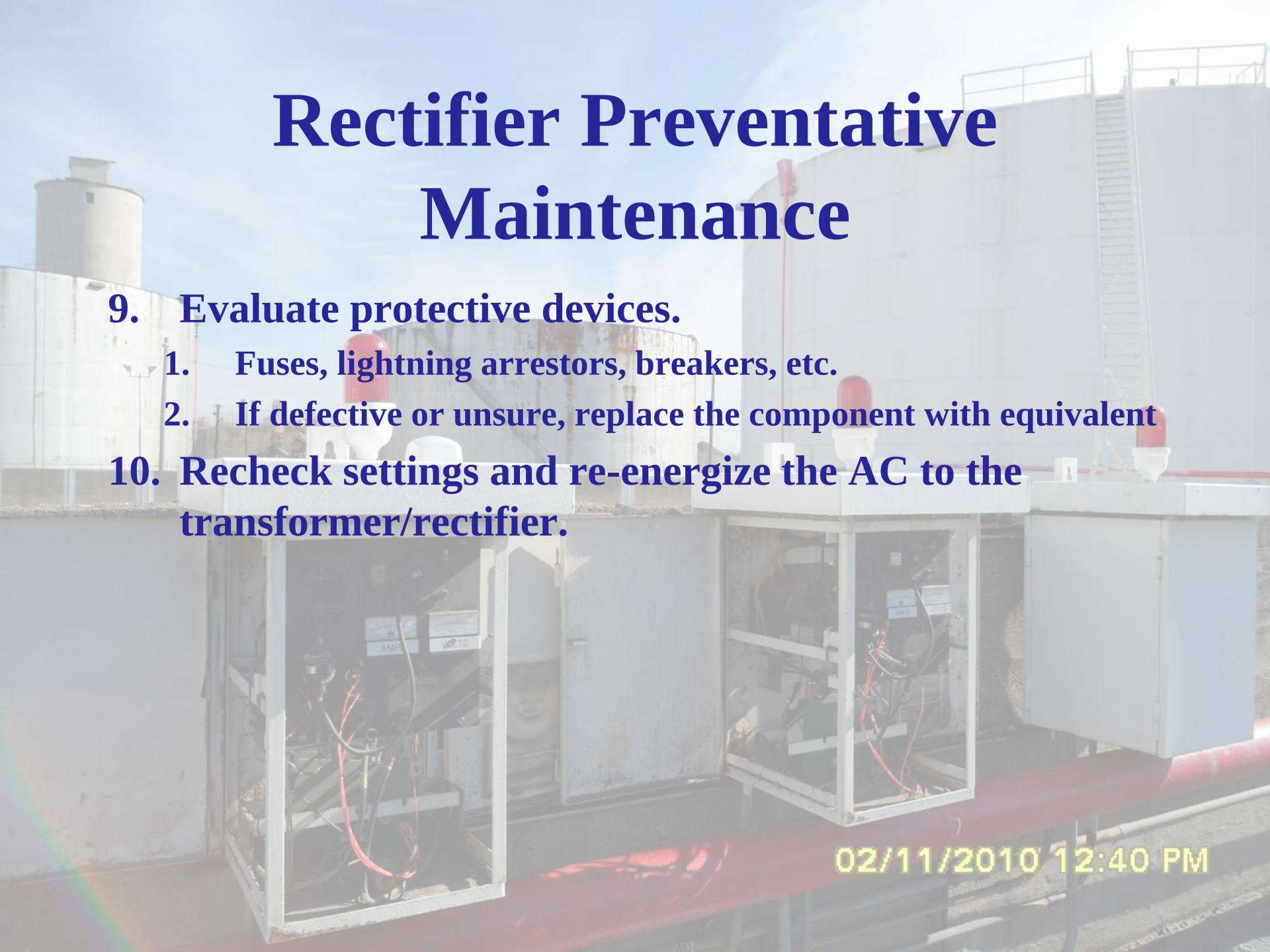


Rectifier Preventative Maintenance

5. Clean, inspect & tighten connections.
    1. This includes cleaning the tap bars and the structure & anode connections.
6. Clean all components with a non-metallic brush (old paint brush).
    1. Air screen, panel, transformer and rectifying element
    2. Plug any extraneous openings
7. Repair or replace damaged connections or insulated wires.
8. Evaluate oil cooled units fluid level and cleanliness.

Rectifier Preventative Maintenance

9. Evaluate protective devices.
    1. Fuses, lightning arrestors, breakers, etc.
    2. If defective or unsure, replace the component with equivalent
10. Recheck settings and re-energize the AC to the transformer/rectifier.



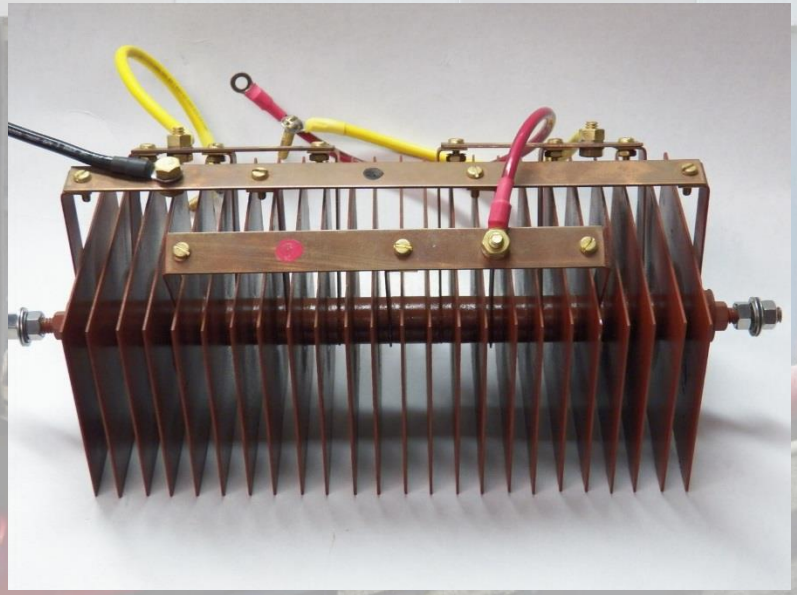
Rectifier Efficiency

$\frac{60 \text{ min}}{1 \text{ hr}} \times \frac{60 \text{ sec}}{1 \text{ min}} = 3{,}600 \text{ sec/hr}$

K watt-hr, N rev, T sec, E_{DC}, I_{DC}

$E_{DC} \times I_{DC} = \text{Watts}$

Efficiency $= \frac{W \times T}{3{,}600 \times K \times N} \times 100 = \%$



Rectifier Selection

There are several requirements that must be considered for the proper selection of a cathodic protection transformer/rectifier.

Selection of a transformer/rectifier should be made by a qualified corrosion engineer.

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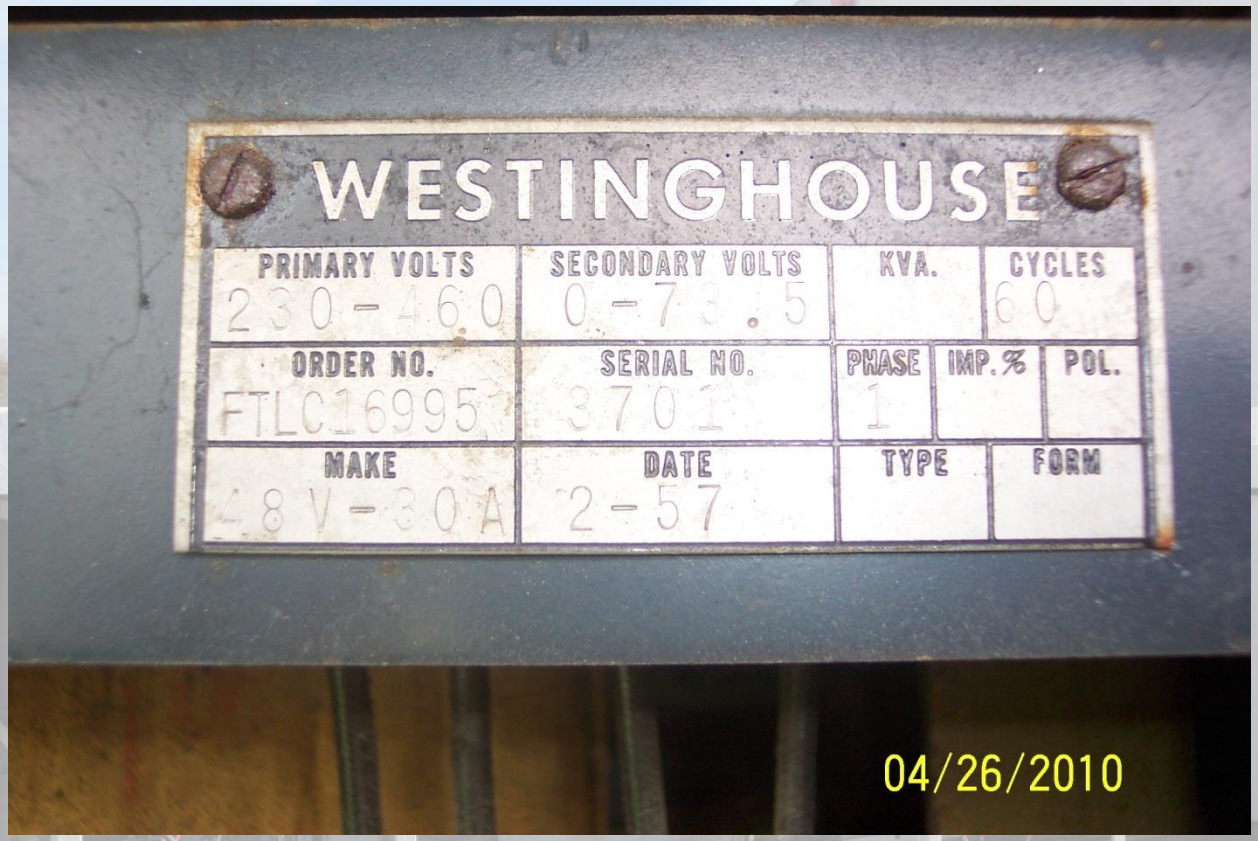

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