PACIFIC GAS AND ELECTRIC COMPANY

PG&E 245 MARKET STREET • SAN FRANCISCO, CALIFORNIA 94106 • (415) 781-4211 • TWX 910-372-6587

September 25, 1979

Local Union No. 1245
International Brotherhood of
Electrical Workers, AFL-CIO
P. O. Box 4790
Walnut Creek, California 94596

Attention: Mr. Dean Cofer, Business Manager

Gentlemen:

Attached are the recently revised copies of the Apprentice Control Technician Qualifying Examinations. This is the first revision since the program was started in 1971. Included are the following:

1. Notification to Prospective Examinees.

2. Part A - Qualifying Examination - Electrician and Instrument Repairman to Apprentice Control Technician, Tests 1 and 2.

3. Part B - Qualifying Examination - Instrument Repairman to Apprentice Control Technician, Tests 1 and 2.

4. Part B - Qualifying Examination - Electrician to Apprentice Control Technician, Tests 1 and 2.

Company proposes adoption of the above tests.

If you are in accord with the foregoing and its attachments and agree thereto, please so indicate in the space provided below and return one executed copy of this letter to Company.

Yours very truly,

PACIFIC GAS AND ELECTRIC COMPANY

By J. W. Boubright
Manager of Industrial Relations

The Union is in accord with the foregoing and its attachments and it agrees thereto as of the date hereof.

LOCAL UNION NO. 1245, INTERNATIONAL
BROTHERHOOD OF ELECTRICAL WORKERS, AFL-CIO

February 27, 1980 ~~1979~~ By Dean Cofer
Business Manager

APPRENTICE CONTROL TECHNICIAN

NOTIFICATION TO PROSPECTIVE EXAMINEES

This notice is to inform prospective candidates for the position of Apprentice Control Technician that a qualification examination will be held:

On _____

At _____

A passing grade of 70% is required on the qualifying examination in order for a successful bidder to be awarded the job.

There are two versions (with alternates) of the Act qualifying exam depending upon whether the candidate is an Electrician or an Instrument Repairman. Both versions of the exam are based upon material contained in the respective apprentice training programs. Therefore, the most appropriate material for a candidate to study would be that provided for the applicable apprenticeship. The current bibliography for these programs is given in the attached table. Most facilities have copies of these books which can be loaned to individuals. If they are not available, see your supervisor.

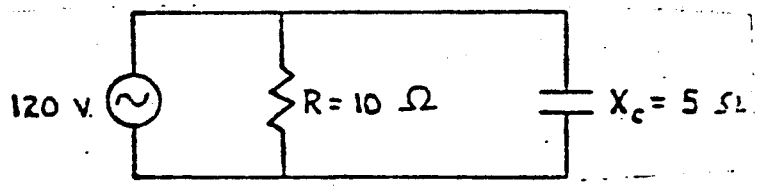
The qualification examination is based upon the first two years of apprenticeship in either the Apprentice Electrician or Apprentice Instrument Repairman classifications. Prospective candidates will be given the appropriate examination for the line of progression they are in. If a candidate is in neither of these lines of progression, he may have his choice of the two examinations, but will be required to take only one.

In order to prepare for the qualifying examination, candidates are advised to review the apprentice training material for their classification. The examination will be closed book. Slide rule or calculator may be used.

Both versions of the examination contain a basic electricity section. Examples of the type of questions found in this portion of the test are given below.

1. What is the total capacitance of two 10 microfarad capacitors in series?

2. What is the total current supplied by the source in the following circuit?



3. Sketch an interference filter and explain how it works.

4. State the Kirchhoff voltage and current laws and explain using appropriate sketches.

5. What voltage is required to produce a current of 10^{-12} amps across a thousand megohm resistor?

The second half of the tests will differ for the two versions, although many common topics will be covered. Example questions for each version are given below:

Electrician

1. How do you calibrate an overcurrent relay that has both inverse time overcurrent and instantaneous overcurrent features?

2. What is meant by the term "magnetic arc suppression"?

3. What is an FET? What is it commonly used for and why?

4. Name the six basic gates used in computer work and draw their truth tables.

5. Sketch a basic Darlington amplifier.

Instrument Repairman

1. Explain how a thermocouple works.

2. Explain lead-lag control on a boiler combustion control.

3. The Bailey standatrol is a proportional plus reset device. Explain how it works or draw and explain the electronic equivalent.

4. Explain how a semiconductor operates.

5. Name the six basic computer gates and draw truth tables for each one.

6. Sketch a simple emitter follower amplifier using an NPN transistor. What is the equivalent vacuum tube circuit called?

APPRENTICE TRAINING PROGRAM TEXT BOOKS

BOOK TITLE	AUTHOR	PG&E CODE #	APP. ELECT.	APP. INST. REP.
Basic Mathematics	PG&E Manual	62-0386	x	x
Basic Mathematics for Electronics	Cooke & Adams	62-0343	x	x
Arithmetic Review for Electronics	Cooke & Adams	62-0316		x
Description and Operation of Power Plant Electrical Equipment (Set of 4)	PG&E Manual	62-0351	x	
Relays and Vectors (Emeryville School Text)	Relays and Vectors Course		x	
General Operating Orders for Steam Power Plants	PGandE Manual		x	x
General Operating Instructions	PGandE Manual		x	
Instrumentation	Kirk & Rambol	62-0315		x
Basic Electricity (Emeryville School Text)	Basic Electricity Course		x	x
Transistor Fundamentals and Servicing Boyd Larson (Emeryville School Text)	Basic Electronics Course		x	x
Brodhead-Garret Co. Manuals				
Electricity, Book II		62-0302	x	x
Electronics, Book III		62-0394	x	x
Transistors, Book IV		62-0395	x	x
Applied Electronics, Book V		62-0396	x	x
Operator Training Program, Vol. I		62-0303		x
Operator Training Program, Vol. II		62-0306		x
Operator Training Program, Lesson Assign., Vol. I		62-0304		x
Operator Training Program, Lesson Assign., Vol. II		62-0308		x

Revised 8/79

F 62-6218 (REV. 8-70)

PG and E

FOR INTRA — COMPANY USES

DIVISION OR DEPARTMENT INDUSTRIAL RELATIONS

FILE NO. 741.1

RE LETTER OF

SUBJECT Guidelines for the Training of Apprentice Control Technicians

PM AWM LEM CMK RLD GW
IRI ESJ JCC FWS BMS WHB
NS STEAM GENERATION LFW
LMX
SEP 23 1971 RCW
RPH

Rush ___ Attach File ___ Return to ___
Note ___ Discuss ___ Other copy to ___
Action ___ Comment ___ File ___

September 20, 1971

MESSRS. W. L. MURRAY
W. D. SKINNER
V. C. NOVARINO
J. G. FOSTER
J. H. BLACK
E. E. FOLEY

Company and Union have negotiated the adoption of the Apprentice Control Technician Training Program, copies of which are available through the General Office Steam Electric Generation Department, and a testing program for entrance into the classification from the Electrician or Instrument Repairman lines of progression.

The test will be given to all qualified bidders. Part A will be given to all bidders regardless of the classification or line of progression from which the employee is bidding. Part B is prepared in two forms to accommodate the lines of progression from which an employee may be bidding. An employee who has not been in either of the above mentioned lines of progression may have his choice of the two Part B's, but will be given only one. The test will cover the first two years of the above apprenticeships.

At least four weeks in advance of giving the qualifying examination, Company will distribute copies of the "Notification to Prospective Examinees for Apprentice Control Technician" which will serve to announce the test and explore the areas to be covered by the examination. A bibliography of textbooks which will cover the subjects to be examined will be attached to this announcement.

An employee will be allowed a maximum of two attempts in which to obtain a passing score on the qualifying examination in accordance with the following schedule:

<u>1st Testing</u> - Four (4) weeks, or thereafter, following announcement of the intent to offer the test.

<u>2nd Testing</u> - Three (3) months, or thereafter, following the date of the first testing.

An employee who fails will be advised when he will be eligible for retest. When again eligible, such employee shall request of his Personnel Department to be retested and his retest shall be scheduled within 14 days of his request.

Company will not be required to give further consideration to the appointment of an employee to fill a job vacancy in the Apprentice Control Technician classification when he has failed for the second time to qualify under this testing program.

The testing program will be administered through the Steam Electric Generation Department. Questions and requests should be directed to Mr. C. E. Franks.

I. WAYLAND BOWBRIGHT

PNLong:RS

cc: CEGinochio
HPBraun
RKMiller
TVAdams
AHEllis
CEFranks
PMatthew
TETemen
Division Steam Superintendents
Division Personnel Managers

TEST #1

PART B - QUALIFICATION EXAMINATION

ELECTRICIAN

TO

APPRENTICE CONTROL TECHNICIAN

FUNDAMENTALS OF AC&DC ELECTRICITY

Name: _____ Plant: _____

Date: _____ Grade: _____

Time:

Procedure: This is a closed book test. Answer questions and show your work in the space provided. (Value as indicated - total 100 points)

1. What test device would you use to check the generator field winding resistance? (Value 3 points)

2. Calculate the synchronous speed of a 3 phase,60 HZ, 2 pole ac motor. (Value 2 points)

3. a) The stator of a 3 phase induction motor can be connected _____ or _____. (Value 3 points)

   b) show the connection diagrams for 3a

4. List the functions of the manually operated ACB used with a linestarter. (Value 2 points)

5. Explain why a circuit breaker should never be closed manually when the breaker is racked into the cell and primary contacts or clusters are connected to the bus. (Value 2 points)

6. A conductor that is exposed with an operating voltage in excess of 750V shall not be worked on until de-energized. (Value 2 points)

   True _____

   False _____

7. If the commutator brush temperature is increased the contact resistance _____ . (Value 3 points)

8. Show a vector diagram of a typical alternating current load. (Value 3 points)

9. The output of an exciter is regulated by the rheostat in the series field. (Value 3 points)

   True _____

   False _____

10. Generator load can only be changed by changing the rate of steam flow to the turbine. (Value 3 points)

    True _____

    False _____

11. Explain why station ungrounded DC systems are equipped with ground detectors? (Value 3 points)

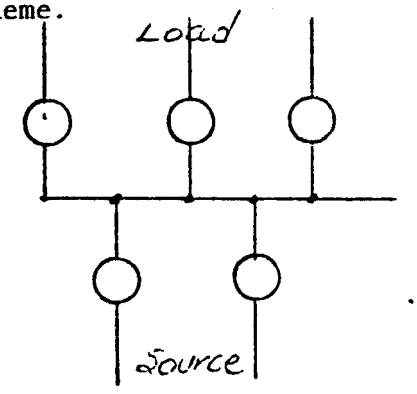
12. Sketch a simple diagram of connections for the ground detector on a 480V load center. (Value 3 points)

13. A 115V AC relay coil will have _____ resistance as compared to a 125V DC relay coil. (Value 2 points)

14. Usually main transformer banks are equipped with a tap changer which can only be changed when the bank is de-energized. (Value 3 points)

    True _____
    False _____

15. Show devices and complete the drawing for the bus differential relay scheme. (Value 4 points)



16. Explain the characteristics of a directional overcurrent relay. (Value 4 points)

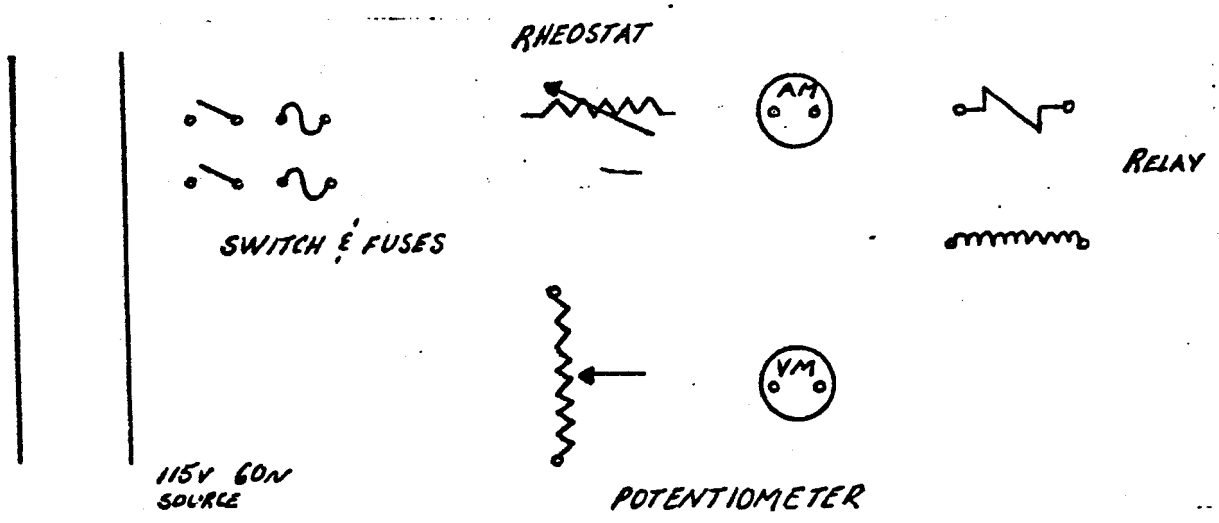
17. What test equip is necessary for testing an overcurrent relay? (Value 4 points)

18. Who can grant permission to make changes in connections or settings of protective devices? (Value 3 points)

19. Under what conditions should electrical equipment be barricaded? (Value 3 points)

20. List the basic steps to be followed in applying portable grounds to de-energized equipment. (Value 3 points)

21. Connect the instruments and equipment shown below so as to apply variable in phase current and voltage to the relay. (Value 3 points)



22. List at lease five precautions which must be observed when using and handling instruments. (Value 3 points)

23. What is the cardinal rule concerning current transformer secondary circuits? (Value 3 points)

24. a) Draw a diagram showing how to check the polarity of a current transformer using a battery and a sensitive d.c. instrument. (Value 3 points)

Explain how you will use this scheme.

25. a) When calibrating an overcurrent relay such as a type CO or IAC, how is the relay's minimum or pickup response changed? (Value 1½ points)

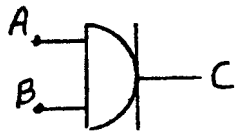
b) How is the relay's speed of travel changed so that the relay performance will match its characteristic ? (Value 1½ points)

26. A 0 to 1 milliammeter has an internal resistance of 46 ohms. What shunt resistance is required to extend the meter to 0 to 50 ma? (Value 3 points)

27. A gas filled tube with heater is known as a _____. (Value 3 points)

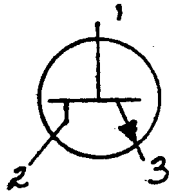
28. How would you determine the magnitude of an ac voltage on an oscilloscope? (Value 3 points)

29. List the output for each of the following input conditions to the logic nand element. (Value 4 points)



	A	B	C
a)	0	1	
b)	0	0	
c)	1	0	
d)	1	1	

30. Classify the transistor shown and identify each element. (Value 3 points)



31. Show the symbol for a diode and identify its elements. (Value 2 points)

32. As frequency increases, what happens to X_L of a coil? (Value 3 points)

33. Most IC circuits can be classed as _____ or _____.
(Value 3 points)

34. a) What is an SCR (Value 1½ points)

b) Show the schematic for an SCR (Value 1½ points)

TEST #2

PART B - QUALIFICATION EXAMINATION

ELECTRICIAN

TO

APPRENTICE CONTROL TECHNICIAN

FUNDAMENTALS OF AC&DC ELECTRICITY

Name: _____ Plant: _____

Date: _____ Grade: _____

Time:

Procedure: This is a closed book test. Answer questions and show your work in the space provided. (Value as indicated - total 100 points)

1. How would you test generator RTDs? (Value 3 points)

2. How do you reverse rotation on the following motors? (Value 4 points)

   a) 3 phase induction

   b) capacitor start

   c) series motor

   d) repulsion - induction motor

Test #2
Qualification Examination
Electrician to
Apprentice Control Technician Part B

3. From the motor nameplate and the plant maintenance card you have collected the following information.

Specifications: Temp. rise - 40°C

Model: 31E336 Frame _____ Type K Serial No. 5719594 HP 2000

Speed: 3585 RPM Volts: 2300 Amps Phase: 3 Cycles: 60

Efficiency at rated conditions 91%. Power Factor at rated conditions 94%.

The rated motor current is unreadable on the nameplate and not on the maintenance card. It is needed for a relay setting. Calculate rated current from available data.

$P = \sqrt{3}\ EI \cos\theta$ 746W = 1 HP (Value 4 points)

4. Explain why a circuit breaker should never be closed manually when the breaker is racked into the cell and primary contacts or clusters are connected to the bus. (Value 2 points)

5. A conductor that is exposed with an operating voltage in excess of 750V shall not be worked on until de-energized. (Value 2 points)

   True _____

   False _____

6. Show a vector diagram of a typical alternating current load. (Value 2 points)

7. List the components of a brushless exciter system. (Value 3 points)

8. Changing the field excitation will change the generator load. (Value 3 points)

   True _____

   False _____

9. Explain why station ungrounded DC systems are equipped with ground detectors. (Value 2 points)

10. Sketch a diagram of connections for a ground detector on a 480V load center. (Value 3 points)

11. List three commonly used system transmission voltages (Value 3 points)

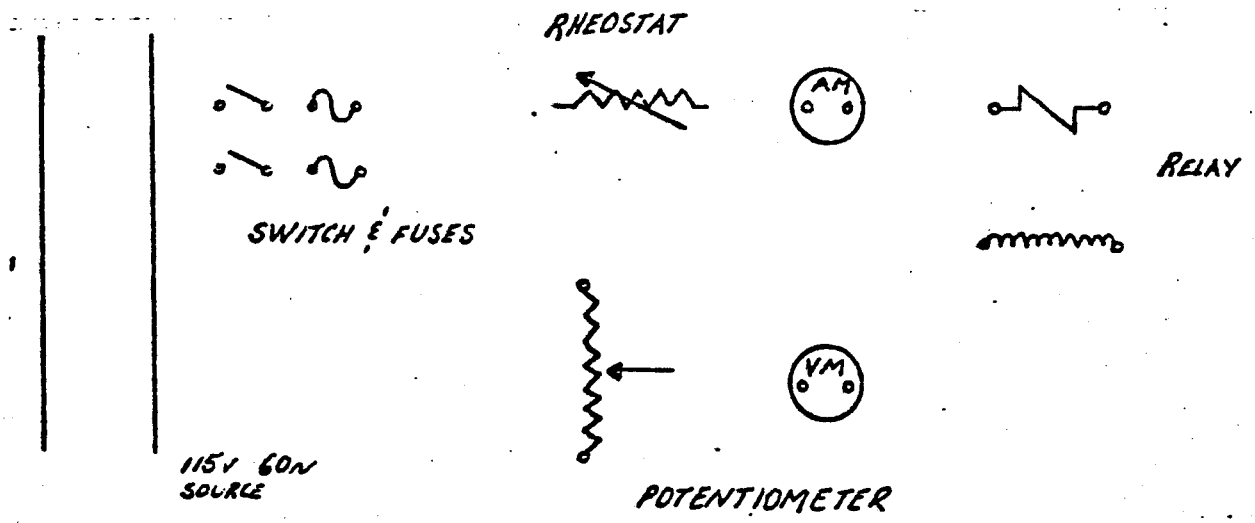
12. Who can grant permission to make changes in connections or settings of protective devices? (Value 2 points)

13. Under what conditions should electrical equipment be barricaded? (Value 3 points)

14. List the basic steps to be followed in applying portable grounds to be de-energized equipmnet. (Value 3 points)

Test #2
Qualification Examination
Electrician to
Apprentice Control Technician Part B

15. Connect the instruments and equipment shown below so as to apply variable in phase current and voltage to the relay. (Value 3 points)



16. List at least five precautions which must be observed when using and handling instruments. (Value 3 points)

17. If the capacitance is cut in half, what happens to the capacitive reactance? (Value 3 points)

18. What is the cardinal rule concerning (Value 3 points)
a) current transformer secondary circuits?

b) why?

19. Draw a diagram showing how you would check a potential transformer for polarity by use of two voltmeters and a low voltage power source. Explain your procedure. (Value 3 points)

Test #2
Qualification Examination
Electrician to
Apprentice Control Technician Part B

20. a) when a calibrating an overcurrent relay such as a type CO or IAC, how is the relays minimum or pickup response changed? (Value 3 points)

b) How is the relays speed of travel changed so that the relay performance will match its characteristic time curve? (Value 3 points)

21 a) a breakdown diode is commonly known as a _____ diode. (Value 3 points

b) as in the case of a gas filled tube, the breakdown diode can be used as a _____.

22. A meter movement with a sesitivity of 50 μa has an internal resistance of 1,770 ohms. How much shunt resistance is required to result in a 0 - 10 milliamp range? (Value 3 points)

23. A directional overcurrent relay depends upon _____ and _____ for operation. (Value 3 points)

24. Which transistor is commonly used as an oscillator? (Value 3 points)

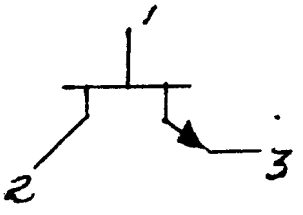
25. The three basic logic gates are: (Value 3 points)

26. The anode on a stud mounted SCR is usually which one of the following? (Value 3 poin

a) the long terminal b) the short terminal
c) the middle terminal d) the case itself

27. An oscilloscope uses what kind of table? (Value 3 points)

28. Classify the transistor shown and identify each element. (Value 4 points)



29. Show the symbol for a diode and identify its elements (Value 3 points)

30. Explain important considerations given to selecting a diode for a particular circuit. (Value 2 points)

31. What indications would be observed on an ohmeter in testing an electrolytic capacitor? (Value 3 points)

32. As frequency increases what happens to X_L of a coil? (Value 3 points)

33. a) what is an SCR (Value 2 points)

b) show the schematic for an SCR (Value 2 points)

34. Name three elements used for semiconductors (Value 3 points)