PACIFIC GAS AND ELECTRIC COMPANY

PG&E 215 MARKET STREET • SAN FRANCISCO, CALIFORNIA 94106 • (415) 972-7000 • TWX 910-372-6587

February 8, 1989

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

Attention: Mr. Jack McNally, Business Manager

Gentlemen:

Company proposes, pursuant to Section 109.2 of the Agreement, to change the Basic Electricity Course effective July 1, 1989 for Apprentice Lineman and Apprentice Cable Splicer. Attached is a detailed course outlines. The course will be reduced from four weeks of centralized training to two weeks of centralized training. The new course is tailored to fit more closely the needs of a Lineman and Cable Splicer.

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

Very truly yours,

PACIFIC GAS AND ELECTRIC COMPANY

By Richard B. Brueck
Manager of Industrial Relations

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

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

Feb 17, 1989

By Jack McNally
Business Manager

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1/1/89

APPRENTICE LINEMAN AND CABLESPLICER

BASIC ELECTRICITY COURSE

ELECTRICAL THEORY COURSE OVERVIEW:

The Basic Electric Theory portion of the underground construction training will be a two week course held at the Learning Center in San Ramon. The course curriculum will include A.C., D.C., generation, safety, electrical equipment and an overview of the P.G.&E. electrical system.

The student will be given classroom instruction followed by lab exercises to demonstrate and reinforce classroom training.

As a means to determine understanding of the material class assignments will be graded, along with lab exercises.

For a student to successfully complete this course they must receive at least a 70% on the final exam. To encourage a student to strive for a higher score than just a pass or fail, their classroom assignment and lab exercises will be added to their final exam scores to give a final grade. The final exam is worth 50%, class assignments 20% and lab 30% of the final score. The final course grade will be determined as follows.

90%----100% = A
78%---- 89% = B
66%---- 77% = C
35%---- 65% = D
0%---- 34% = F

DAY ONE

07:00 TO 08:30
INTRODUCTION

OBJECTIVE:

WELCOME STUDENT TO SCHOOL
PASS OUT SCHOOL POLICY HANDOUTS
HAVE STUDENTS SIGN POLICY HANDOUTS AND RETURN
EXPLAIN CURRICULUM
EXPLAIN GRADING
INSTRUCT STUDENTS ON CLASS AND LAB PROCEDURES

STUDENTS WILL BE EXPECTED TO UNDERSTAND THE ABOVE MATERIAL AND BE ABLE TO FOLLOW ESTABLISHED RULES

UNIT TWO ----- ELECTRICAL SAFETY

08:45 TO 10:30

OBJECTIVE:

AFTER READING TEXT AND GIVEN INSTRUCTION, STUDENTS WILL LIST METHODS TO PREVENT RECEIVING SHOCKS; INCLUDING INSULATION, GROUNDING, PROPER USE OF ELECTRICAL TOOLS, POWER CORDS AND THEY WILL BE ABLE TO RECITE THE AMOUNT OF CURRENT REQUIRED TO STOP THE HUMAN HEART.

CURRICULUM:

HAVE STUDENTS READ TEXT AND ANSWER QUESTIONS ON HAND OUT.

LECTURE:

AREAS TO COVER,

1. PURPOSE OF GROUNDING
   - A. REMOVE POTENTIAL
   - B. PROTECT FROM POTENTIAL
   - C. PROVING CABLE DEENERGIZED
2. METHODS OF INSULATING FROM ENERGY
   - A. ISOLATION
   - B. INSULATION
   - C. DOUBLE INSULATION ON TOOLS EXPLAINED
3. TABLE 2-A EFFECTS OF CURRENT ON HUMANS
   - A. EXPLAIN CHART
   - B. REINFORCE SAFE WORK PRACTICES
4. SAFE TOOL AND WORKING HABITS
   - A. DISCUSS GOOD SAFETY HABITS FROM PG. 16
   - B. DEMONSTRATE PROPER USE OF SKINNING KNIFE
   - C. READ APPROPRIATE A. P. RULES
   - D. USING SECONDARY CONDUCTORS DEMONSTRATE PROPER METHODS TO SPLICE ENERGIZED CONDUCTORS

5. SEMICONDUCTORS
   A. DEFINE AND EXPLAIN HOW USED IN CABLE
   B. STRESS IMPORTANCE IN PRIMARY CABLE
6. D.C.
   A. DEFINE D.C. CURRENT
   B. SINE WAVE
      EXPLAIN PULSATING D.C.
7. A.C.
   A. DEFINE
   B. EXPLAIN SINE WAVE

DEMONSTRATE:

TENNIS BALLS IN PLASTIC PIPE.

1:00 TO 3:00

UNIT 4 ----- PRODUCING ELECTRICITY

OBJECTIVE:

TO SHOW SATISFACTORY KNOWLEDGE OF PRODUCTION OF ELECTRICITY, STUDENT WILL DESCRIBE THREE METHODS OF PRODUCING ELECTRICITY, STATIC, CHEMICAL AND MAGNETIC.

CURRICULUM:

STUDENTS WILL READ UNIT 4 AND ANSWER QUESTIONS IN BACK OF CHAPTER.

LECTURE;

AREAS TO COVER,

1. CHARGED BODIES
   A. EXPLAIN STATIC
   B. RELATE TO LIGHTNING
2. ELECTRIC FIELD OF FORCE
   A. DEFINE
   B. EXPLAIN, USING LIKE POLES OF MAGNET
3. CHEMICAL PRODUCTION OF ELECTRICITY
   A. DEFINE
   B. DEFINE ELECTRODES
   C. DEFINE ELECTROLYTE
   D. RELATE TO CAR BATTERY
   E. SHOW FLOW OF ELECTRONS THROUGH BATTERY AND FOLLOW THROUGH CIRCUIT BACK TO GROUND

DAY TWO

UNIT 5 ----- MAGNETISM AND ELECTRICITY

OBJECTIVE:
STUDENT WILL NAME THREE MAIN CHARACTERISTICS OF MAGNETIC LINES OF FORCE (NEVER CROSSING, CONTINUOUS AND PASSING THROUGH ALL MATERIALS). STUDENTS WILL ALSO DESCRIBE POLARITY, LINES OF FLUX, CONSTRUCTION AND OPERATION OF AN ELECTROMAGNET AND THE OPERATION OF A CIRCUIT BREAKER.

07:00 TO 11:00

CURRICULUM:

STUDENTS WILL READ UNIT 5 AND ANSWER QUESTIONS AT END OF CHAPTER.

LECTURE: AREAS TO COVER

1. NATURAL MAGNETS
   - A. LODESTONES
2. ARTIFICIAL MAGNETS
   - A. DEFINE AND DESCRIBE
     - DESCRIBE HOW TO BUILD MAGNETS
   - B. MAGNETIC MATERIALS
     - DEFINE AND DESCRIBE
     - DESCRIBE HOW SMALL RANDOM MAGNETS ALIGN
   - C. MAGNETIC POLARITY
     - LAW OF MAGNETIC POLES
3. MAGNETIC FIELDS
   - A. DEFINE AND DESCRIBE
     - WHENEVER CURRENT FLOWS A MAGNETIC FIELD EXIST
   - B. STRESS THE FOLLOWING
     - MAG. LINES OF FORCE WILL NEVER CROSS ONE ANOTHER
     - MAG. LINES OF FORCE ARE CONTINUOUS
     - LINES PARALLEL AND TRAVEL IN SAME DIRECTION
     - REPEL
     - LINES TEND TO SHORTEN
     - LINES PASS THROUGH ALL MATERIALS
     - LINES ENTER AT RIGHT ANGLES TO SURFACE
   - C. MAGNETIC FLUX
     - DEFINE AND DESCRIBE
   - D. ELECTROMAGNETS
     - DEFINE AND DESCRIBE
     - DEFINE LEFT HAND RULE
     - EXPLAIN WHAT DETERMINES STRENGTH OF FIELD
       - NUMBER OF TURNS
       - AMOUNT OF CURRENT
       - COILS LENGTH TO WIDTH RATIO
     - DESCRIBE ARMATURE AND ITS USES AS A CIRCUIT BREAKER
   - E. DESCRIBE HOW U.G. CABLE IS DESIGNED TO LIMIT LINES OF FORCE

DAY THREE

UNIT 6 ----- HOW ELECTRICITY IS MEASURED

OBJECTIVE:

STUDENT WILL; NAME AND DIFFERENTIATE THE THREE UNITS OF MEASURING ELECTRICITY (AMPS, VOLTS, OHMS), RECALL FOR PRACTICAL PURPOSES THAT VOLTS, EMF AND POTENTIAL ARE THE SAME THING, LEARN AND PERFORM VOLTAGE AND CURRENT MEASUREMENT, EXPRESS KNOWLEDGE AND UNDERSTANDING OF THE TERMS KILO AND MEGA.

CURRICULUM:

STUDENT TO READ UNIT, HOW ELECTRICITY IS MEASURED AND ANSWER QUESTIONS IN BACK OF CHAPTER.

LECTURE:

AREAS TO COVER

1. DEFINE AND DESCRIBE AMP.
   - A. RELATE TO VOLUME OF GAS
   - B. STATE NUMBER OF ELECTRONS PER SECOND
   - C. DEFINE COULOMB
   - D. DESCRIBE MILLIAMP (mA)
2. DEFINE AND DESCRIBE VOLT
   - A. DEFINE
     - VOLT=MEASUREMENT OF EMF OR POTENTIAL
     - EMF=WHAT IS GENERATED
     - POTENTIAL=DIFFERENCE
   - B. DEFINE
     - VOLTAGE SOURCE
     - VOLTAGE RATING
     - STRESS THE IMPORTANCE OF USING PROPER SOURCE VOLTAGE WITH RATING VOLTAGE
   - C. DESCRIBE KILOVOLT
3. DEFINE AND DESCRIBE OHM
   - A. ELECTRICAL FRICTION
4. INTRODUCE METERS AND DESCRIBE OPERATION
   - A. VOLT
   - B. OHM
   - C. AMP.
   - D. EXPLAIN IMPORTANCE OF PROPER CONNECTION OF METERS TO SOURCE VOLTAGE

LAB

11:30 TO 3:00 P.M.

STUDENTS WILL DEMONSTRATE KNOWLEDGE OF USING METERS BY TAKING MEASUREMENTS ON ELECTRIC CIRCUITS.

1. MEASURE
   - A. RESISTANCE IN VARIOUS LIGHT BULBS
   - B. SINGLE CONDUCTORS, LOOPED CONDUCTORS FOR AMPS
   - C. SINGLE AND PARALLEL CONDUCTORS FOR RESISTANCE

DAY FOUR

UNIT SEVEN -----RESISTANCE

0700 TO 0830

OBJECTIVE:

AS A MEANS TO DETERMINE UNDERSTANDING, THE STUDENT WILL IDENTIFY AND EXPLAIN, FOUR FACTORS THAT AFFECT THE RESISTANCE OF A CONDUCTOR.

CURRICULUM:

HAVE STUDENTS READ TEXT AND ANSWER QUESTIONS IN BACK OF CHAPTER.

LECTURE:

AREAS TO COVER

1. WIRE SIZES PRIMARY AND SECONDARY
   - A. EXPLAIN DIFFERENCE AND REASON FOR DIFFERENT TYPES OF CONDUCTOR
   - B. RESTATE DIFFERENCE IN COPPER AND AL.
   - C. EXPLAIN TRIPLEX SECONDARY CABLE
2. EXPLAIN AND DEMONSTRATE STRANDED CONDUCTOR
3. EMPHASIS A.W.G VS. CIR. MILS
4. EFFECTS OF HEAT
   - A. ECONOMIC WIRE SIZING OF CONDUCTORS
5. LOOSE CONNECTIONS
   - B. EXPLAIN EFFECTS OF LOOSE CONNECTIONS
   - C. DEMONSTRATE HOW TO AVOID LOOSE CONNECTIONS
6. EFFECTS OF OXIDATION ON CONDUCTORS
   - A. DEFINE OXIDATION
   - B. DEMONSTRATE USE OF NO-OXIDE
7. CLARIFY POSITIVE TEMPERATURE COEFFICIENT
8. REVIEW 4 FACTORS THAT EFFECT RESISTANCE IN COND.
   - A. LENGTH
   - B. MATERIAL
   - C. TEMPERATURE
   - D. CROSS SECTIONAL AREA
9. DEFINE CIRCULAR MILLS
   - A. SHOW 250, 500, 700, AND 1000 MCM CABLE
10. EXPLAIN ADVANTAGES OF STRANDED CABLE
    - A. FLEXIBILITY
    - B. INCREASED CONDUCTIVITY

DAY FIVE AND SIX -----BASIC ELECTRICAL CIRCUITS

OBJECTIVE:

STUDENT WILL EXPLAIN THE USE AND CONSTRUCTION OF SERIES, PARALLEL, SHORT AND OPEN CIRCUITS; ALSO SIZING FUSES ON A CIRCUIT WILL BE DEMONSTRATED BY THE STUDENT. STUDENTS WILL ALSO BE ABLE TO PREDICT VOLTAGE READINGS AT VARIOUS POINTS IN CIRCUITS SUCH AS SWITCHES, SHORTS, RESISTORS AND NEUTRALS.

0700 TO 1100

CURRICULUM:

HAVE STUDENTS READ AND ANSWER QUESTIONS IN TEXT UNIT 9.

LECTURE:
AREAS TO COVER

1. DEFINE SERIES CIRCUIT
   - A. BATTERIES IN SERIES
     - COMPARE CURRENT
     - COMPARE VOLTAGES
   - B. RESISTORS IN SERIES
     - COMPARE CURRENT
     - COMPARE VOLTAGES
   - C. VOLTAGE DROPS IN SERIES
     - COMPARE TO SECONDARY CONDUCTORS
     - DISCUSS WIRE SIZING IN SECONDARY RUNS
2. GIVE AND EXPLAIN FORMULA FOR SERIES CIRCUIT
   - A. VOLTAGE DROP
     - ADD DROPS ON EACH RESISTER
   - B. TOTAL RESISTANCE
     - RT=R1+R2+R3 ETC.
3. POWER LOSS
   - A. WHAT DOES IT COST PG&E
4. THE CURRENT IN A SERIES CIRCUIT EQUALS VOLTAGE/RESISTANCE

WRITTEN ASSIGNMENT:
GIVE EACH STUDENT WORK SHEET WITH PROBLEMS INVOLVING SERIES CIRCUITS

LAB

11:30 TO 3:00 P.M.

LAB ASSIGNMENTS INCLUDE:
CONSTRUCT CIRCUITS TO DEMONSTRATE

1. MEASURING VOLTAGES OF BATTERIES IN SERIES
2. MEASURING VOLTAGES ON RESISTORS (LIGHT BULBS) IN SERIES

5. DESCRIBE SHORT CIRCUIT
   A. DESCRIBE FAULT CURRENT

6. DESCRIBE FUSES
   A. OPERATION
   B. LIMITS OF FAULT CURRENT
   C. APPLICATION ON SYSTEM
   D. FUSING CURVE

ASSIGNMENT IN CLASS
   PASS OUT WORKSHEET SOLVING PARALLEL CIRCUIT PROBLEMS

LAB

11:30 TO 3:00 P.M.

STUDENT WILL BUILD PARALLEL CIRCUIT IN LAB AND PERFORM EXPERIMENTS TO ILLUSTRATE THE FOLLOWING

1. USING LIGHT BULBS FOR RESISTORS READ VOLTAGE ON EACH SIDE OF LIGHT BULB
2. ADD LOAD AND MEASURE CURRENT
3. INSTALL SWITCH IN CIRCUIT BRANCH AND MEASURE VOLTAGE ON EACH SIDE OF SWITCH IN OPEN POSITION
4. LOWER VOLTAGE IN CIRCUIT, MEASURE CURRENT
5. DETERMINE CURRENT IN CIRCUIT AND INSTALL IN LINE FUSE OF APPROPRIATE SIZE
6. SHORT CIRCUIT PARALLEL BRANCH OBSERVE FUSE

UNIT ELEVEN -----CAPACITORS

1000 TO 1200

OBJECTIVES:
STUDENT WILL EXPLAIN PURPOSE OF CAPACITORS IN THE PG&E SYSTEM

CURRICULUM:
STUDENTS WILL READ UNIT 11 AND ANSWER QUESTIONS AT END OF TEXT

LECTURE:
AREA OF DISCUSSION
1.EXPLAIN POWER FACTOR
2.EXPLAIN HOW CAPACITORS EFFECT POWER FACTORS
3.CLOSER TO UNITY CAUSES LESS CURRENT LESS LINE LOSSES

LAB

12:00 TO 3:00 P.M.

STUDENTS WILL USE EXISTING TRANSFORMER MODELS
1.TO CALCULATE VARIOUS TURNS RATIO
2.CALCULATE CURRENT RATIO
3.CALCULATE PRIMARY FUSING REQUIREMENTS
4.DEMONSTRATE STEP-UP STEP-DOWN

BUILD AND INDUCTIVE A.C. CIRCUIT
1.INSTALL CAPACITOR IN LINE
MEASURE VOLTAGE AND AMPS

EXPLAIN HOW TRANSFORMERS ARE USED IN PG&E SYSTEM

5. THREE PHASE GENERATORS
   A. DESCRIBE AND EXPLAIN
      THREE SINGLE PHASE WINDINGS
      120 DEGREE WINDINGS
      PHASE DIFFERENCE
      PHASING

6. GENERATOR WINDINGS
   A. DELTA
      USING DIAGRAMS EXPLAIN
   B. WYE
      USING DIAGRAMS EXPLAIN

8. TRANSFORMER CONNECTIONS
   A. SINGLE PHASE XFMR CONNECTIONS

   B. THREE PHASE XFMRS CONNECTIONS PRIMARY
      WYE
      DELTA
   C. THREE PHASE XFMRS CONNECTIONS SECONDARY
      WYE-WYE
      WYE-DELTA
      DELTA-DELTA
      DELTA-WYE

9. ROTATION
   A. DEMONSTRATE ROTATION METER
   B. EXPLAIN ROTATION OF THREE PHASE MOTORS
   C. EXPLAIN STANDARDS FOR VERIFYING ROTATION

10. SERVICE VOLTAGES
   A. DISCUSS VARIOUS SERVICE CONNECTIONS
      SINGLE PHASE 120/240
      THREE PHASE
         120/208V
         120/240V
         240/480V
         277/480V
11. DESCRIBE PHASING IN U.G. SYSTEMS

LAB

11:30 TO 3:00 P.M.

1.STUDENTS USE LAB EQUIPMENT TO BUILD TRANSFORMERS BANKS TO;
   A. VERIFY VOLTAGE
   B. VERIFY ROTATION
   C. CHECK PHASING

SWITCHES

D. SUBSTATIONS
   1. BREAKDOWN COMPONENTS AND EXPLAIN FUNCTION OF
      O.C.B.
      TRANSFORMERS ONE AND THREE PHASE
      REGULATOR
      BUS
      SWITCHES
      PANEL
      RELAYS
       (GROUND, OVERCURRENT, FREQUENCY, RECLOSING)

E. DISTRIBUTION CIRCUIT DESIGN O.H.(OVERVIEW)
   1. SYSTEM VOLTAGES
      VARIOUS VOLTAGES
      HOW TO IDENTIFY
   2. TYPES OF CONSTRUCTION
      CROSS-ARM
      TRIANGULAR
      VERTICAL
      STREAMLINE
   3. TRANSFORMERS
      SINGLE PHASE
      THREE PHASE
      CONVENTIONAL
      SELF PROTECTED
   4. CIRCUIT PROTECTION AND SECTIONALIZING
      SWITCHES
      DISCONNECTS
      FUSES/CUTOUTS
      LIGHTNING ARRESTORS
      RECLOSERS
      SECTIONALIZERS
   5. SECONDARY
      AWAC
      TANGENT
      RACK
   6. SERVICE DROPS
   7. METERING
F. UNDERGROUND DISTRIBUTION
   1. PRIMARY RISERS
      POT-HEAD
      COMBO BRACKETS
      MOULDINGS
      STEPPING POLES
   2. TYPES OF CABLE
      PRIMARY 200 & 600 AMP.
      SECONDARY
      POLY PHASE
   3. TRANSFORMERS
      PADMOUNT
      SUBSURFACE
      VAULT
   4. OPERATING EQUIPMENT