

## PACIFIC GAS AND ELECTRIC COMPANY

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

February 19, 1986

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

Attention: Mr. Jack McNally, Business Manager

Gentlemen:

Due to the fact that the current program material for the Apprentice Control Technician is no longer available from publishers and the material is technically outdated in several electronic areas, such as micro processors, Company proposes the adoption of the revised Apprentice Control Technician Training Program and Guidelines.

Copies of the revised guidelines with their indicated changes together with a complete set of printed materials were sent to you previously.

The amounts of time or units of work as indicated in the schedule are believed sufficient to permit the apprentice to develop proficiency in such duty or work procedures, but should not be considered as inflexible dependent on the demonstrated ability of each individual apprentice.

This agreement, when signed, is effective September 10, 1985.

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

Yours very truly,

PACIFIC GAS AND ELECTRIC COMPANY

By *W. Penbright*  
 Manager of Industrial Relations

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


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

April 25, 1986

By *Jack McNally*  
 Business Manager

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM  
GENERAL OUTLINE OF PROGRAM

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# APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM

## GENERAL OUTLINE OF PROGRAM

### GUIDELINES

#### DEFINITIONS

##### Apprentice Control Technician

An employee engaged in performing Control Technician's work as an assistant to or under the general direction of a Technician. In order to gain experience for advancement to Control Technician, he may work alone or under indirect supervision on jobs for which it has been determined he has been adequately trained and instructed. The employee's education and general qualifications must be such that he is considered capable of obtaining Technician status.

*No change  
this page*

##### Control Technician (Traveling Control Technician)

An employee who, without direct supervision, tests, calibrates, maintains and may install all power plant control, monitoring, computer, alarm and indicating systems and their individual components. These will include, but are not necessarily limited to, digital and analog computer controls, logging or monitoring systems; automatic boiler light-off and combustion control systems; temperature, pressure, level and flow control and indicating systems; radiation measurement and environmental monitoring equipment and accessories; test and laboratory equipment; in addition, he may be required to maintain in-plant electrical protection and communication systems where F.C.C. licensing is not a requirement. He may be required to assist plant engineers in performing and evaluating plant tests. His background of apprenticeship and experience must be such as to qualify him to perform these duties with skill and efficiency.

#### GENERAL

To enter the Apprentice Control Technician classification, an employee will be required to pass a written examination based upon the first two years of apprenticeship in either the Apprentice Electrician or Apprentice Instrument Repairman classification depending upon the line of progression that the candidate is in. If he is in neither of these lines of progression, he may have his choice of the two examinations, but will be given only one.

Written examinations to enter the program:

Part A Qualification Examinations -  
Electrician and Instrument Repairman to Apprentice Control Technician.

Part B Qualification Examination -  
Electrician to Apprentice Control Technician.

Part B Qualification Examination -  
Instrument Repairman to Apprentice Control Technician.

An Electrician or Instrument Repairman who is the successful bidder on a vacancy in the Apprentice Control Technician classification will be placed at the wage rate step applicable at the end of 24 months, and such employee will not have subsequent bids on Control Technician vacancies considered under Subsection 205.7(b) until he has accrued 24 months' classification seniority as an Apprentice Control Technician. In addition, he will not be considered for automatic progression to Unassigned Control Technician under the provisions of the Master Apprenticeship Agreement until he has accrued 30 months' classification seniority as an Apprentice Control Technician.

#### PROGRAM

The Apprentice Control Technician (ACT) Training Program is a two-year program comprised of academic self-study, laboratory experiments, formal schools (classroom/instructor environment), and on-the-job training (OJT).

#### TEXTS

The principal texts used throughout the program are:

- A. Technical Publishing Company (TPC) Training Manuals
- B. Heathkit Training Manuals and Laboratory Experiments
- C. PGandE Training Material

#### GENERAL OUTLINE

This training program is designed to advance the apprentices' knowledge and experience in all necessary facets of electronics in plant protection, control, monitoring and indication systems. The following program outline lists the formalized training, self-study training and generic on-the-job training areas and the approximate time frame within the program that they are to be undertaken.

The program is tailored to meet the training requirements of personnel with two different backgrounds - journeyman electrician and journeyman instrument repairman.

For the electrician background, time is allocated for training in the area of instrumentation and control with emphasis on pneumatic systems and equipment. The apprentice will work in the instrument shop under the supervision of the instrument foreman.

For the instrument repairman background, time is allocated for training in the electrical area with emphasis on traditional electrical equipment. The apprentice will work in the electric shop under the supervision of the electric foreman for this period only. Once completed, the apprentice finishes his/her training under supervision of the instrument foreman.

This cross training for both backgrounds will be completed during the first six months of the apprentice's training.

For the remaining time, both backgrounds receive training on electronics with emphasis on solid state technology and fundamentals of digital applications. This portion of the training program is under the supervision of the instrument foreman.

#### ACADEMIC AND LABORATORY EXPERIMENTS

These two sections of the program are self-study with occasional help from supervisor or other qualified plant personnel.

TPC and Heathkit are the main texts used and are specifically designed for self-study. These texts are commercially available and used throughout industry.

#### FORMAL SCHOOLS

The following are the formal schools included in the program:

- A. Relays and Vectors (for Instrument Repairman background only).
- B. Introduction to Nuclear Power
- C. Digital Fundamentals
- D. Computer Fundamentals

#### ON-THE-JOB-TRAINING

This section of the program is to provide the apprentice the specific training required on a plant-by-plant basis. Each plant will provide specific equipment/component assignments to fulfill the generic on-the-job training guidelines. The on-the-job hours are minimum basis. The apprentice should get OJT training in each of the major categories listed following the distribution of hours as specified.

#### TESTING

Self-check quizzes are provided throughout the academic and laboratory experiments portions to provide the apprentice with direct feedback as to progress and accomplishments.

Progress tests will be given by the foremen as outlined to monitor the apprentices' training progress.

Completion finals will be given after each major section(s) of training, including schools, to certify the apprentices' successful completion of that portion of the training. The minimum passing grade for all finals is 70%.

#### TIME ALLOCATION

The hours allocated to complete this program are:

	ELECTRICIAN	INSTRUMENT REPAIRMAN
A. Academic	158	133
B. Laboratory	448	448
C. Schools	200	320
D. OJT	<u>1772</u>	<u>1772</u>
TOTAL HOURS	2578	2673

74-235 977

PACIFIC GAS AND ELECTRIC COMPANY  
 APPRENTICE CONTROL TECHNICIAN  
 MASTER ASSIGNMENT CHART

NAME: \_\_\_\_\_ SUPT'S INITIAL \_\_\_\_\_  
 PLANT: \_\_\_\_\_ SUPERVISORS INITIAL \_\_\_\_\_  
 STARTING DATE: \_\_\_\_\_ DATE (MONTH-YR) \_\_\_\_\_

ON-THE-JOB-TRAINING

		1	2	3	4	5	6	P.P.	7	8	9	10	11	12	P.P.	13	14	15	16	17	18	P.P.	19	20	21	22	23	24	P.P.	F
INTRODUCTION to NUCLEAR POWER	RQD. HOURS																													
	TOTAL HOURS																													
	AVG. GRADE																													
ELECTRICAL - I.R. only	RQD. HOURS	S.							256																					
	TOTAL HOURS																													
	AVG. GRADE																													
INSTRUMENTATION and CONTROL - E. only	RQD. HOURS	S.							256																					
	TOTAL HOURS																													
	AVG. GRADE																													
ELECTRONIC	RQD. HOURS									S.						208														
	TOTAL HOURS																													
	AVG. GRADE																													
COMPUTER SYSTEMS	RQD. HOURS																													144
	TOTAL HOURS																													
	AVG. GRADE																													
PLANT SPECIFIC	RQD. HOURS	S.							291						291								291						291	1164
	TOTAL HOURS																													
	AVG. GRADE																													

COURSES

RELAYS and VECTORS SCHOOL I.R. only	EXAM DATE																													
	FINAL GRADE																													
INTRODUCTION to NUCLEAR POWER	EXAM DATE																													
	FINAL GRADE																													
DIGITAL FUNDAMENTALS SCHOOL	EXAM DATE																													
	FINAL GRADE																													
COMPUTER FUNDAMENTALS SCHOOL	EXAM DATE																													
	FINAL GRADE																													
ELECTRICAL - I.R. only	COMP. LESSON	S.							F1	F2	F3																			
	STUDY HOURS																													
	P.T. GRADE																													
INSTRUMENTATION and CONTROL - E. only	COMP. LESSON	S.							F1	F2	F3																			
	STUDY HOURS																													
	P.T. GRADE																													
ELECTRONIC	COMP. LESSON									S.						F1	F2													
	STUDY HOURS																													
	P.T. GRADE																													
ELECTRONIC TEST EQUIPMENT LABORATORY	COMP. LESSON									S.						F1														
	STUDY HOURS																													
	GRADE																													
ELECTRONIC LABORATORY	COMP. LESSON															S.							F1	F2						
	STUDY HOURS																													
	GRADE																													
DIGITAL TECHNIQUES LABORATORY	COMP. LESSON																						S.							F1
	STUDY HOURS																													
	GRADE																													

LEGEND: P.P. = PROGRESSION PERIOD      P.T. = PROGRESSION TEST      F = FINAL GRADE

PACIFIC GAS AND ELECTRIC COMPANY  
 APPRENTICE CONTROL TECHNICIAN  
 MASTER SCHEDULE CHART

APPRENTICE CONTROL TECH. TRAINING SCHEDULE		TWO YEAR PERIOD																												
MONTHS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24					
<b>SCHOOLS:</b>	<b>HOURS</b>																													
VECTOR AND RELAYS-I.R. only	120	← DURING →																												
INTRO TO NUCLEAR POWER	120	← DURING →																												
DIGITAL FUNDAMENTALS	40													← DURING →																
COMPUTER FUNDAMENTALS	40													← DURING →																
<b>ACADEMIC:</b>	<b>HOURS</b>																													
ELECTRICAL- I.R. only	88	← →																												
INST. + CONTROLS- E. only	113	← →																												
ELECTRONIC	45							← →																						
<b>LABORATORY EXPERIMENTS:</b>	<b>HOURS</b>																													
ELECTRONIC TEST EQUIP.	120							← →																						
ELECTRONIC CIRCUITS	136													← →																
DIGITAL TECHNIQUES	192																			← →										
<b>ON-THE-JOB-TRAINING</b>	<b>HOURS</b>																													
ELECTRICAL- I.R. only	256	← →																												
INST. + CONTROLS- E. only	256	← →																												
ELECTRONIC	208							← →																						
INTRO TO NUCLEAR POWER		← DURING →																												
COMPUTER SYSTEMS	144													← →																
PLANT SPECIFIC	1164	← →																												

## Section I

### APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM SCHOOL

Course: Relays and Vectors - Three-week course held at the Emeryville Relay and Vector School

Text: Relay and Vector Training Manual - Company prepared material

Scheduled Time For Completion: 120 hours during the first or second six-month period for the Instrument Repairman. An Electrician who has not attended this course during his apprenticeship will also attend the school.

#### Course Content:

##### First Week

1. Graphic Representation of Vectors
2. Introduction to Trigonometry
3. Rectangular Coordinates
4. Trigonometric Functions
5. Solution of Right Triangles
6. Vectors for Three Phase Systems and Transformers
7. Trigonometric Functions for Finding Watts, Vars, Power Factor and Phase Angles

Test

##### Second Week

1. Equipment used for varying Current and Voltage
2. Lab: Description and Demonstration of Equipment used for varying Current and Voltage
3. Lab: Testing of Current and Voltage Devices
4. Lab: Testing of Overcurrent Relays
5. Vectors for Directional Relays
6. Lab: Testing of Directional Relays

Test

##### Third Week

1. Instrument Transformers
2. Protection of Generators and Transformer Banks
3. Vectors for Transformer Differential Relays
4. Bus Differential Relays
5. Lab: Test Current Balance Aux. Transformers
6. Lab: Test Aux. Potential Transformers
7. Lab: Primary Test of C.T. and Wye Connected Relays
8. Lab: Primary Test of C.T. and Delta Connected Relays
9. Lab: Demonstration of Watt and Var Meter Phase Shifting

Final Examination



Section II

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM

CONCENTRATED TRAINING AT NUCLEAR PLANT

COURSE: INTRODUCTION TO NUCLEAR POWER

TEXT: (A) Introduction to Nuclear Power  
(B) Manufacturer's Instructions  
(C) Plant Procedures

SCHEDULED TIME FOR COMPLETION: 120 hours for Instrument Repairman during first or second six month period and 120 hours for Electrician during first or second six month period.

COURSE CONTENT: During this course you will be assigned to a nuclear plant if you are serving your apprenticeship at a conventional fossil fueled plant. The course will be concentrated into a three-week period sometime during your first year for apprentices not serving their apprenticeship at a nuclear plant, but will be integrated into the first year of apprenticeship for apprentices serving their apprenticeship at a nuclear plant. You will be trained in the fundamentals of nuclear power and the instrumentation associated with it. You will also be trained in the fundamentals of radiation protection and the handling of radioactive sources used in instrument calibration. The concentrated course for the apprentice at non-nuclear plants will prepare you for temporary assignments to nuclear plants during periods of major testing, refueling and/or overhaul. Tests will be given periodically to evaluate your progress.

COURSE OUTLINE:

<u>Subject</u>	<u>Text</u>
<u>Academic Training</u>	
Atomic Structure	(A)
Physical Chemistry	(A)
Radioactive Particle Emission	(A)
Mass, Energy and Nuclear Stability	(A)
Nuclear Reactions	(A)
Neutron Behavior	(A)
Nuclear Fission	(A)
Introduction to Nuclear Reactors	(A)
Instrumentation	(A)

Radiation Protection Training will be obtained by attending General Employee Training classes on this subject

On-the-Job Training

Work with experienced journeymen on routine plant surveillance tests, calibrations, troubleshooting and repairs.

COURSE OUTLINE: (continued)

<u>Subject</u>	<u>Text</u>
During the three week period:	
Perform a surveillance test on a plant Protection Set	(C)
Calibrate a Portable Radiation Protection Instrument	(C)
Calibrate a test instrument (e.g., volt meter) in the standards lab	(B)
Also, if plant conditions and scheduling allows, perform a calibration of:	
Nuclear Instrument Channel	(C)
Radiation Monitoring System Channel	(C)

FINAL EXAMINATION

A Final Examination will be given on the material covered in Text (A).  
A Final Examination will be given by General Employee Training personnel on Radiation Protection.  
Both Final Examinations must be passed with 70% or greater.

The course grade for Introduction to Nuclear Power will be determined by averaging the two Final Examination grades.

### Section III

#### APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM SCHOOL

Course: Digital Fundamentals - One Week Course held at the Central School.

Text: Digital Troubleshooting--Richard E. Gasperini

Scheduled Time for Completion: 40 hours during the third or fourth six-month period for the Instrument Repairman and Electrician.

#### Course Content:

##### First Day

1. Pre-test
2. Electronics vs. Numbers
3. Numbering Systems
4. Arithmetic Operations

##### Second Day

1. Review Day 1
2. Test on Day 1
3. Introduction to Logic
4. Logic Simple Circuits
5. DeMorgan's Theorem
6. Lab

##### Third Day

1. Review Day 2
2. Multivibrators
3. Flip-Flops
4. Counters
5. Shift Registers
6. Lab

##### Fourth Day

1. Review Days 2 and 3
2. Test on Days 2 and 3
3. Basic Binary Counter (Review)
4. Basic Shift Register (Review)
5. Basic De-coding
6. Integrated Circuits
7. TTL Examples
8. Lab

##### Fifth Day

1. Review Day 4
2. General Discussion
3. Lab
4. Final Test
5. Critique

Section IV

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM  
SCHOOL

Course: Computer Fundamentals - One Week Course held at the Central School.

Text: Company prepared material

Scheduled Time for Completion: 40 hours during third or fourth six-month period for the Instrument Repairman and Electrician.

Course Content:

First Day:

1. Introductions and objectives of course
2. Pre-test
3. Digital computer theory/history
4. Registers as building blocks
5. Control concepts
6. Bus line/theory
7. Addressing concepts

Second Day:

1. Review day 1 - quiz
2. Hardware/software relationship
3. Programming definitions and techniques
4. Instruction operations/machine language
5. Lab - Introduction to the trainer
6. Lab - Monitor familiarization

Third Day:

1. Review day 2 - quiz
2. Instruction set Part - 1
3. Lab - register operations
4. Instruction Set Part - 2
5. Lab - Arithmetic and processor status

Fourth Day:

1. Review Day 3 - quiz
2. Instruction set analysis
3. Jumps
4. Stack operations
5. Lab - Program writing and execution

Fifth Day:

1. Review day 4 - quiz
2. Lab - input/output (I/O) operation
3. Lab - stack operations
4. Interrupts
5. Final exam

Section Va

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM  
ACADEMIC TRAINING

Course: Electrical

Texts: A. T.P.C. Introduction to Electricity and Electronics  
B. T.P.C. Batteries and D.C. Circuits  
C. T.P.C. Transformers and A.C. Circuits  
D. T.P.C. Electrical Measuring Instruments  
E. T.P.C. Electrical Protective Devices  
F. T.P.C. D.C. Equipment and Controls  
G. T.P.C. Single Phase Motors  
H. T.P.C. Three Phase Motors  
I. T.P.C. A.C. Control Equipment  
J. T.P.C. Electrical Troubleshooting

Scheduled Time for Completion: Eighty-eight hours for Instrument Repairman and zero hours for Electrician to be completed during the first six months.

Course Content: This course provides the basic principles and technical background on electrical equipment and controls associated with power plant systems.

Course Procedure: Read assigned instruction material and answer questions for each lesson in the course outline. Progress tests will be given at one-month intervals. A final examination will also be given.

<u>Unit No.</u>	<u>Subject</u>	<u>T.P.C. Volume</u>	<u>Hours</u>
I	Introduction to Electricity and Electronics	201	8
II	Batteries and D.C. Circuits	202	8
	Progress Test Covering Unit I and II		1
III	Transformers and A.C. Circuits	203	8
IV	Electrical Measuring Instruments	204	8
	Progress Test Covering Units III and IV		1
	Final Examination Covering Units I, II, III and IV		1
V	Electrical Protective Devices	205	8
VI	D.C. Equipment and Controls	206	8
	Progress Test Covering Units V and VI		1

<u>Unit No.</u>	<u>Subject</u>	<u>T.P.C. Volume</u>	<u>Hours</u>
VII	Single Phase Motors	207	8
VIII	Three Phase Motors	208	8
	Progress Test Covering Units VII and VIII		1
	Final Examination Covering Units V, VI, VII and VIII		1
IX	A.C. Control Equipment	209	8
X	Electrical Troubleshooting	210	8
	Progress Test Covering Units IX and X		1
	Final Examination Covering Units IX and X		1
		TOTAL HOURS	88

Section Vb

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM  
ON THE JOB TRAINING

Course: Electrical

Scheduled Time for Completion: Two hundred fifty-six hours for Instrument Repairman to be completed during first six months and zero hours for Electrician.

Course Content: During this course you will learn to test, calibrate, maintain, install and troubleshoot various electrical equipment and controls associated with the main unit and auxiliary systems.

	<u>Hours</u>
A. Electrical Diagrams Interpretation	16
B. Meters	32
C. Motor Testing	16
D. Circuit Breakers	16
E. Transformer and Bus Protection	16
F. Battery Chargers and Inverters	16
G. Ground Detection	16
H. Annunicator Systems	16
I. Relay Testing	40
J. Generator Principles and Protection	32
K. Voltage Regulation and Excitation	40
TOTAL HOURS	256

Section VIa

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM  
ACADEMIC TRAINING

Course: Instrument and Control Fundamentals

- Texts:
- A. T.P.C. Introduction to Process Control
  - B. T.P.C. Foundations of Measurement Instrumentation
  - C. T.P.C. Pressure Measurement
  - D. T.P.C. Force Weight and Motion Measurement
  - E. T.P.C. Flow Measurement No. I
  - F. T.P.C. Flow Measurement No. II
  - G. T.P.C. Level Measurement
  - H. T.P.C. Temperature Measurement
  - I. T.P.C. Final Control Elements
  - J. T.P.C. Basic Hydraulics
  - K. T.P.C. Hydraulic Troubleshooting
  - L. T.P.C. Basic Pneumatics
  - M. T.P.C. Pneumatic Troubleshooting

Scheduled Time for Completion: One hundred thirteen hours for Electrician and zero hours for Instrument Repairman to be completed during first six months.

Course Content: This course provides the basic principles and background on pneumatic, hydraulic, electrical and electronic instruments and control equipment associated with the main process in both fossil fueled and nuclear fueled plants.

Course Procedure: Read assigned instruction material and answer questions for each lesson noted in the course outline. Progress tests will be given at one-month intervals. A final examination will also be given.

<u>Unit No.</u>	<u>Subject</u>	<u>T.P.C. Volume</u>	<u>Hours</u>
I	Introduction to Process Control	221	8
II	Foundations of Measurement Instrumentation	222	8
	Progress Test Covering Units I and II		1
III	Pressure Measurement	223	8
IV	Force, Weight and Motion Measurement	224	8
	Progress Test Covering Units III and IV		1
	Final Examination Covering Units I, II, III and IV		1
V	Flow Measurement Number I	225	8
VI	Flow Measurement Number II	226	8
	Progress Test Covering Units V and VI		1



Apprentice Control Technician Training Program  
Instrument and Control Fundamentals

Page 2

<u>Unit No.</u>	<u>Subject</u>	<u>T.P.C. Volume</u>	<u>Hours</u>
VII	Level Measurement	227	8
VIII	Temperature Measurement	228	8
IX	Final Control Elements	229	8
	Progress Test Covering Units VII, VIII and IX		1
	Final Examination Covering Units V, VI, VII, VIII and IX		1
X	Basic Hydraulics	307	8
XI	Hydraulic Troubleshooting	308	8
	Progress Test Covering Units X and XI		1
XII	Basic Pneumatics	309	8
XIII	Pneumatic Troubleshooting	300	8
	Progress Test Covering Units XII and XIII		1
	Final Examination Covering Units X, XI, XII and XIII		1
		TOTAL HOURS	113

Section VIb

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM  
ON THE JOB TRAINING

Course: Instrument and Control Fundamentals

Scheduled Time for Completion: Two hundred fifty-six hours for Electrician and zero hours for Instrument Repairman to be completed during first six months.

Course Content: During this course you will learn to test, calibrate, maintain and install various pneumatic, hydraulic, and electric instruments and components associated with plant's main process control and auxiliary systems.

	<u>Hours</u>
A. Primary Control Elements and Process Measuring Instruments	104
B. Controllers, Relays, and Selector Stations	48
C. Final Control Elements-Positioners and Actuators	48
D. Plant Control Systems	56
TOTAL HOURS	256

Section VIIa

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM  
ACADEMIC TRAINING

Course: Electronics

Texts: A. T.P.C. Semiconductors  
B. T.P.C. Power Supplies  
C. T.P.C. Amplifiers  
D. T.P.C. Oscillators and Multivibrators  
E. T.P.C. Logic Circuits

Scheduled Time for Completion: Forty-five hours for Instrument Repairman and Electrician to be completed during the second six months.

Course Content: This course provides the basic principles and technical background on electronic equipment associated with power plant systems.

Course Procedure: Read assigned instruction material and answer questions for each lesson in the course outline. Progress tests will be given at one-month intervals. A final examination will also be given.

<u>Unit No.</u>	<u>Subject</u>	<u>T.P.C. Volume</u>	<u>Hours</u>
I	Semiconductors	211	8
II	Power Supplies	212	8
	Progress Test Covering Units I and II		1
III	Amplifiers	213	8
	Progress Test Covering Unit III		1
	Final Examination Covering Units I, II and III		1
IV	Oscillators and Multivibrators	214	8
V	Logic Circuits	215	8
	Progress Test Covering Units IV and V		1
	Final Examination Covering Units IV and V		1
		TOTAL HOURS	45



Section VIII

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM  
LAB EXPERIMENTS

Course: Test Equipment

Texts: A. Heathkit Analog and Digital Meters  
B. Heathkit Oscilloscopes  
C. Heathkit Frequency Measurement and Generation  
D. Heathkit Special Measurement Instruments

Scheduled Time for Completion: One hundred and twenty hours for Electrician and Instrument Repairman to be completed during second six month.

Course Content: This course will provide you with the fundamentals of test equipment operation and measuring techniques by combining study with practical experiments on each subject.

Course Procedure: Read the academic portion of the unit. You will then do the experiments associated with each unit. Your supervisor will talk with you before and after each experiment to assist you in maintaining steady progress throughout the course. A progress test will be given covering each unit plus a final examination.

<u>Unit No.</u>		<u>Texts</u>	<u>Exp. No.</u>
1	Analog Meters	A	1
2	Digital Meters	A	2, 3 and 4
	Progress test covering units 1 and 2		
3	Oscilloscopes	B	5, 6 and 7
	Progress test covering unit 3		
4	Frequency Measurement	C	8, 9 and 10
5	Frequency Generation	C	11, 12 and 13
	Progress test covering units 4 and 5		
6	Special Measuring Instruments	D	14 and 15
	Progress test covering unit 6		
	Final examination covering units 1 through 6		

Section IX

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM  
LAB EXPERIMENTS

Course: Electronics

Texts: A. Heathkit Semiconductor Devices  
B. Heathkit Electronic Circuits

Scheduled Time for Completion: One hundred and thirty-six hours for Electrician and Instrument Repairman to be completed during third six month.

Course Content: This course will provide you with the fundamentals and concepts of electronics by combining study with practical experiment on each subject.

Course Procedure: Read the academic portion of the unit. You will then do the experiments associated with each unit. Your supervisor will talk with you before and after each experiment to assist you in maintaining steady progress throughout the course. A progress test will be given covering each unit plus a final examination.

	<u>Text</u>	<u>Exp. No.</u>
Semiconductor Devices	A.	
Unit No. 1 Semiconductor Fundamentals	A.	
Unit No. 2 Semiconductor Diodes	A.	1 and 2
Unit No. 3 The Zener Diode	A.	3
Unit No. 4 Semiconductor Diodes for Special Applications	A.	
Unit No. 5 Bipolar Transistor Operation	A.	4
Progress Test Covering Units 1 through 5		
Unit No. 6 Bipolar Transistor Characteristics	A.	5
Unit No. 7 Field Effect Transistors	A.	6 and 7
Unit No. 8 Thyristors	A.	8 and 9
Unit No. 9 Integrated Circuits	A.	
Unit No. 10 Optoelectronic Devices	A.	10 and 11
Progress Test Covering Units 6 through 10		
Final Examination Covering Units 1 through 10		

Electronic Circuits	<u>Text</u>	<u>Exp. No.</u>
Unit No. 1 Basic Amplifiers	B	1 and 2
Unit No. 2 Typical Amplifiers	B	3 and 4
Unit No. 3 Operational Amplifiers	B	5, 6, 7 and 8
Unit No. 4 Power Supplies	B	9 and 10
Progress Test Covering Units 1 through 4		
Unit No. 5 Oscillators	B	11, 12, 13 and 14
Unit No. 6 Pulse Circuits	B	15, 16 and 17
Unit No. 7 Modulation	B	
Progress Test Covering Units 5 through 7		
Final Examination Covering Units 1 through 7		

Section X

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM  
LAB - EXPERIMENTS

Course: Digital Techniques

Texts: A. Heathkit Digital Techniques

Scheduled Time for Completion: One hundred and ninety-two hours for Electrician and Instrument Repairman to be completed during fourth six month.

Course Content: This course will provide you with the fundamentals and concepts of digital electronics by combining practical experiments on each subject.

Course Procedure: Read the academic portion of the unit. You will then do the experiments associated with each unit. Your supervisor will talk with you before and after each experiment to assist you in maintaining steady progress throughout the course. A progress test will be given covering each unit plus a final examination.

Digital Techniques

<u>Unit</u>	<u>Text</u>	<u>Exp. No.</u>
1	Introduction to Digital Techniques	A
2	Semiconductor Devices for Digital Circuits	A 1
3	Digital Logic Circuits	A 2, 3 and 4
4	Digital Integrated Circuits	A 5 and 6
5	Boolean Algebra	A 7 and 8
Progress Test Covering Units 1 through 5		
6	Flip-Flops and Registers	A 9, 10 and 11
7	Sequential Logic Circuits	A 12, 13, 14, 15, 16 and
8	Combinational Logic Circuits	A 18, 19, 20, 21 and 22
9	Digital Design	23 and 24
10	Digital Applications	
Progress Test Covering Units 6 through 10		
Final Examination Covering Units 1 through 10		



Section XI

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM  
ON THE JOB TRAINING

Course: Computer Systems

Text: Manufacturer's instructions

Scheduled Time for Completion: One Hundred Forty-Four hours for Electrician and Instrument Repairman, to be completed during the third or fourth six month period.

Course Content: This course will provide the technical background required for proficiency in maintaining computer related hardware.

<u>Course Outline</u>	<u>Hours</u>
A. Computer Main Frame	40
B. Input/Output	32
C. Aux. Memory Devices	24
D. Programmers Console	24
E. Operators Console	24
TOTAL HOURS	144

Section XII

APPRENTICE CONTROL TECHNICIAN TRAINING PROGRAM  
ON THE JOB TRAINING

Course: Specific Plant On-the-Job Training

Hours: One thousand one hundred sixty four

Text: Manufacturer's and Company Instructions

Scheduled Time for Completion: During 24 month period for Instrument  
Repairman and Electrician.

Course Content: This course will provide you with the technical and hands-on  
time required for proficiency in maintaining equipment  
associated with your specific plant.