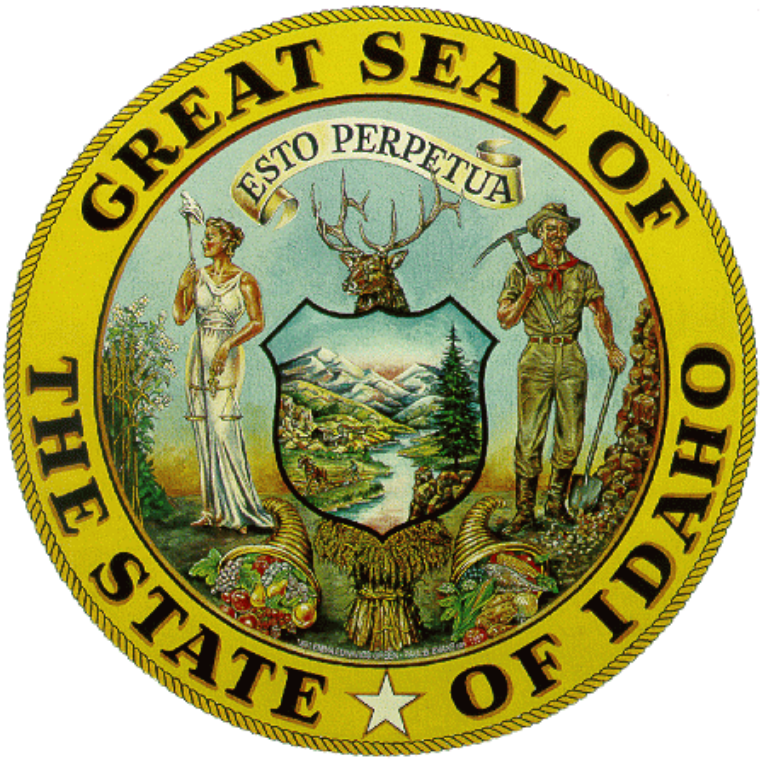
DIVISION OF BUILDING SAFETY

IDAHO ELECTRICAL BOARD
VIDEOCONFERENCE MEETING

OCTOBER 18, 2011



IDAHO ELECTRICAL BOARD

Agenda Item No. 01 **Agenda**

PRESENTER: Bob Scott, Chairman

OBJECTIVE: Approve the agenda for the October 18, 2011 Idaho Electrical Board Videoconference meeting.

ACTION: Consent

BACKGROUND:

PROCEDURAL HISTORY:

ATTACHMENTS: October 18, 2011 Idaho Electrical Board meeting tentative Agenda

TENTATIVE AGENDA

NOTICE OF PUBLIC MEETING

IDAHO ELECTRICAL BOARD
VIDEOCONFERENCE MEETING

Division of Building Safety
1090 East Watertower Street, Suite 150, Meridian, Idaho
1250 Ironwood Drive, Suite 220, Coeur d'Alene, Idaho
2055 Garrett Way, Building 2, Suite 7, Pocatello, Idaho
dbs.idaho.gov – (208) 332-7137

Tuesday, October 18, 2011
9:00 a.m. – 3:00 p.m. (MT)

(Note: Meeting Commences at 8:00 a.m. PT)

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9 a.m. **CALL TO ORDER** – Bob Scott, Chairman

- Roll Call & Introductions
- Open Forum

CONSENT AGENDA

1. Approval of October 18, 2011 Agenda
2. Approval of July 19, 2011 Board Meeting Minutes

ACTION AGENDA

3. Administrative Appeals Hearing – Steve Keys
   a. Robert Loper – NOV ELE1105-0012
   b. Tyler Johnson – NOV ELE1106-0053
   c. Aaron Hatch and Associates – NOV ELE1106-0051
   d. Bruce Steed – NOV ELE1107-0029
4. Electrical Apprenticeship Curriculum – Rosie Rosco, CWI
5. Schedule 2012 Meeting Dates – Bob Scott

INFORMATIONAL AGENDA

6. Insulation Contractors--Blow Insulation Over Knob and Tube Wiring – Thomas Brodbeck
7. Electrical Contractor License and Changes in Business Entities – Steve Keys

8. SAC Update – Aaron White

9. Schooling Update – Irene Vogel

10. Operational Report – Steve Keys

12 p.m. **LUNCH BREAK** *(If needed)*

11. Administrator Report
    a. Financial Report – C. Kelly Pearce and Kirk Weiskircher
    b. Administrator – C. Kelly Pearce

NEW/OLD BUSINESS

EXECUTIVE SESSION *(If needed)*

3 p.m. **ADJOURN**

All times, other than beginning, are approximate and are scheduled according to Mountain Time (MT), unless otherwise noted. Agenda items may shift depending on Board preference. 09/23/11r

IDAHO ELECTRICAL BOARD

Agenda Item No. 02 **Minutes**

PRESENTER: Bob Scott, Chairman

OBJECTIVE: Approve the minutes from the July 19, 2011 Idaho Electrical Board Videoconference meeting.

ACTION: Consent

BACKGROUND:

PROCEDURAL HISTORY:

ATTACHMENTS: July 19, 2011 Idaho Electrical Board draft Minutes

IDAHO ELECTRICAL BOARD VIDEOCONFERENCE MEETING

Tuesday – July 19, 2011 – 9:00 a.m. (MT)

Division of Building Safety
1090 East Watertower Street, Suite 150, Meridian, Idaho
1250 Ironwood Drive, Suite 220, Coeur d'Alene, Idaho
2055 Garrett Way, Building 2, Suite 7, Pocatello, Idaho

***DRAFT MINUTES OF THE JULY 19, 2011 MEETING**

NOTE: The following report is not intended to be a verbatim transcript of the discussions at the meeting, but is intended to record the significant features of those discussions.

Chairman Bob Scott called the meeting to order at 9:00 a.m. (MT).

Board Members Present:
Bob Scott, Chairman
Kreg Davis
Jeff Wheeler
Al Frieze
Allan Perman
Mark LaBolle
Denis Duman

DBS Staff Members Present:
C. Kelly Pearce, Administrator
Steve Keys, Deputy Administrator, Operations
Patrick Grace, Deputy Attorney General
Al Caine, Electrical Program Manager
Kirk Weiskircher, Financial Specialist, Principal
Rod Freligh, Regional Manager, Region 1
Chris Jensen, Regional Manager, Region 3
Renee Bryant, Administrative Assistant 2/Board Secretary

Board Members Absent:
Tim Phillips
Troy Mortensen

Ron Whitney was introduced as the newly appointed Regional Manager, Region 2, for the Division of Building Safety.

- **Open Forum**
  No items or concerns were brought forth.

- **Approval of the July 19, 2011 Agenda**
  MOTION: Denis Duman made a motion to approve the Agenda as presented. Allan Perman seconded. All in favor, motion carried.

- **Approval of the April 21, 2011 Board Meeting Minutes**
  MOTION: Jeff Wheeler made a motion to approve the Minutes as written. Mark LaBolle seconded. All in favor, motion carried.

- **Notice of Violation**
  Live Wire Electric – NOV ELE1105-0076, 1105-0077, and 1105-0078 – There were no representatives for Live Wire Electric at the July 19th Electrical Board meeting. Patrick Grace suggested, and Bob Scott agreed, should Live Wire Electric representatives contact DBS with a reasonable explanation why they were unable to attend the July Board meeting, Deputy

Attorney General Grace will add the topic to the October Meeting Agenda as an action item. If there is no reply, the Board will take default on the NOV penalty.

Live Wire Electric's appeal is unique from other appeals. The Board asked to discuss the situation as a 'general' topic. To not compromise the Live Wire Electric appeal, the topic "Electrical Contractor License and Changes in Business Entities" will be placed as an informational item on the October Electrical Board Meeting Agenda.

***ACTION**:* Deputy Attorney General Grace will either place the Live Wire Electric appeal hearing on the October Board Meeting Agenda as an action item OR create a Notice of Default for Chairman Scott's signature and provide a signed copy to Live Wire Electric.

***ACTION**:* The topic "Electrical Contractor License and Changes in Business Entities" will be placed on the October Agenda as an informational item.

- **Statute Change-Election of Vice Chairman**

  The statute, as currently written, states if the chairman is ever absent, the Board, at that particular meeting, would elect a temporary chairman. At the April meeting, the Board indicated it wanted to have a standing vice chairman on the Board. A proposal was presented to statutorily authorize the Board to elect a vice chairman.

  MOTION: Kreg Davis made a motion to approve the proposal. Denis Duman seconded. All in favor, motion carried.

- **Journeyman Failure Waiting Period**

  At one time, the journeyman exam was administered on a monthly or bi-monthly basis statewide. A rule was created where an applicant receiving less than a passing score on the first or second exam would have to wait 30 days before becoming eligible to retake the exam. With the exams available five days a week in most locations, the 30-day waiting period is now obsolete.

  MOTION: Denis Duman made a motion to adopt the proposed rule change as presented. Allan Perman seconded. All in favor, motion carried.

- **Apprentice Registration**

  In 2010, the Electrical Board discussed amending the electrical rules to prevent apprentices from renewing their registration more than once. Those discussions lead to the Board determining it needed to amend the statutory foundation, which authorizes the Board to make the statutory change first and then proceed with the rule change the following year. The amendment to the statute was adopted by the 2011 legislature. Al Caine reiterated the two proposals before the Board; one for apprentice electricians and one for specialty electrical trainees.

  MOTION: Mark LaBolle made a motion to approve the changes as presented for the Apprentice Electricians and Specialty Electrical Trainees. Denis Duman seconded. All in favor, motion carried.

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- **Adoption of the 2011 NEC**

  As addressed at previous board meetings, the goal of the Board is to get the 2011 NEC approved by the 2012 legislature. The only controversial issue in the 2011 NEC is the Arc Fault Circuit Interrupter (AFCI), which was expanded in the 2008 code and has now been incorporated in the 2011 code. Two draft proposals were included in the Board packet for the Board's review and consideration. Draft one keeps the AFCI requirement "as is" (bedrooms only). Draft two adopts the full requirements for AFCIs found in the 2011 NEC.

  Ed Larsen with Square D-Schneider Electric made a PowerPoint presentation on AFCIs. A lengthy discussion ensued to the safety, statistics, cost, installation, etc., of AFCIs. The National Fire Protection Association codes and standards development process was also addressed.

  Sections of NEMA's 2008 presentation are used as part of Al Caine's code classes. Statistics and charts were created from early documentation in the investigation of 278 fires in regard to AFCI protected circuits. Mr. Caine offered to share, via e-mail, NEMA's documentation with the Board.

  ***ACTION**:* Al Caine will e-mail to the Board NEMA's documentation as it pertains to statistics and AFCI protected circuits.

  MOTION: Kreg Davis made a motion to accept the proposed draft two, which deletes the current exception with regard to AFCIs. Al Frieze seconded. Six ayes, one nay; motion carried.

- **Solar Photovoltaic Specialty License**

  As addressed at previous Board meetings, there has been dramatic growth and interest in solar photovoltaic systems in Idaho; however, the resource of educated individuals qualified to provide the services is limited.

  A draft proposal to create a Solar Photovoltaic specialty license was included in the Board packet for the Board's review and consideration. As with all specialties, journeyman electricians are allowed to do any and all of the specialty work.

  An extensive discussion ensued with the industry voicing pros and cons to the possible creation of a Solar Photovoltaic specialty license.

  MOTION: Al Frieze made a motion to adopt the draft rule; creating a specialty license for Solar Photovoltaic installers. Denis Duman seconded. All in favor, motion carried.

- **Fee for Continuing Education Providers**

  Each year, the Division receives and reviews hundreds of continuing education course and instructor applications throughout the United States. To cover the cost of the lengthy approval process, a proposed rule change was provided to the Board to establish a modest fee.

  MOTION: Denis Duman made a motion to accept the rule proposal as written. Mark LaBolle seconded. All in favor, motion carried.

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- **Curriculum Committee Update**
  Irene Vogel, Professional-Technical Education (PTE), stated the Apprenticeship Curriculum Review project was given to the College of Western Idaho (CWI) to manage. The curriculum has been modified from the 2006 version and is at the committee level for feedback.

- **SAC Update**
  Unable to attend the July Board meeting, Aaron White with IBEW requested the topic "SAC Update" be placed on the October Board Meeting Agenda as an informational item.

- **Departure from DBS -- Al Caine**
  Kelly Pearce expressed pleasure in working with Al Caine over the last several years.

- **Electrical Program Manager Report**
  Compliance – In 2010, the Electrical program issued approximately 300 Notices of Violation and received over $22,000 in civil penalty fees.

- **Operational Report**
  Electrical Program Manager – With Al Caine's impending departure from DBS, Steve Keys acknowledged and praised him and his contributions to the Agency. Until the position is filled, Mr. Keys will take on the responsibilities of the Electrical Program Manager.

  Operational Structure – DBS is moving from a centralized to regional structure. With the continuation of staff reduction, the Division will be required to restrict inspections to certain areas on given days, especially the outlying areas. Management will work with the regional managers to define those days.

- **Administrator Report**
  Financial Report – In April and May 2011, there was an actual increase in Electrical income from previous years.

  Chairmen Meeting – In June, a meeting was held with the chairmen of each board housed under the DBS to explain the Agency's statewide layoff process and vision.

  Statewide Layoff Policy – The Division's layoff policy has changed from geographical regions to statewide. The new policy offers the Division the ability to identify the areas of need for inspectors to fulfill the inspection responsibilities across the state of Idaho.

  Inspections by Zip Code – With the use of electronic systems, staff can now search inspections by zip code; calculating the areas of need for inspectors.

  Assigned Work Stations – In the past, inspectors have worked from their residences. DBS has contracted with IDOL to rent work stations from 12 of their facilities throughout Idaho. The Division's three locations will provide accommodations to inspectors as well. The majority of inspectors will commute, by personal transportation, to their assigned facilities. Work hours will be 8:00 a.m. to 5:00 p.m., Monday through Friday, excluding holidays. During non-business hours, state vehicles will be parked at the designated facilities.

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Chinese Government and U.S. Projects – The Chinese government has stock in the following Idaho-based projects: Hoku, solar cell plant in Pocatello; Southeast Idaho Energy Corp., phosphate plant outside American Falls; electric bus manufacturer plant, Treasure Valley area; and industrial park, south of Boise airport.

To report back to the Governor, Kelly Pearce asked the board members for their thoughts to potential Chinese investments in the United States. The majority of members had no negative opinions on the issue.

- **New/Old Business**
  There was no new/old business to discuss.

- **Executive Session**
  An Executive Session was not required.

MOTION: Mark LaBolle made a motion to adjourn the meeting. Kreg Davis seconded. All in favor, motion carried. The meeting adjourned at 2:20 p.m. (MT).

BOB SCOTT, CHAIRMAN IDAHO ELECTRICAL BOARD	C. KELLY PEARCE, ADMINISTRATOR DIVISION OF BUILDING SAFETY
DATE	DATE

***These DRAFT minutes are subject to possible correction and final approval by the Idaho Electrical Board 09/15/11rb**

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IDAHO ELECTRICAL BOARD

Agenda Item No. 03a **Robert Loper – NOV ELE1105-0012**

PRESENTER: Steve Keys

OBJECTIVE: Administer a ruling on Robert Loper's appeal - NOV ELE1105-0012

ACTION: Affirm, reject, decrease or increase the imposed penalties

BACKGROUND: The Notice of Violation (NOV) was issued based upon a proposed violation to IDAPA 07.01.11.011.01, "Electrical Contractor".

PROCEDURAL HISTORY:

ATTACHMENTS: Documentation from Robert Loper, State Office of the Secretary of State, and DBS

IDAHO ELECTRICAL BOARD

Agenda Item No. 03b **Tyler Johnson – NOV ELE1106-0053**

PRESENTER: Steve Keys

OBJECTIVE: Administer a ruling on Tyler Johnson's appeal - NOV ELE1106-0053

ACTION: Affirm, reject, decrease or increase the imposed penalties

BACKGROUND: The Notice of Violation (NOV) was issued based upon proposed violations to IDAPA 07.01.11.011.01, "Electrical Contractor" and IDAPA 07.01.22.011.02 "Employees".

PROCEDURAL HISTORY:

ATTACHMENTS: Documentation from Tyler Johnson, Pinewood Mobile Home Park, LLC, and DBS

IDAHO ELECTRICAL BOARD

Agenda Item No. 03c Aaron Hatch and Associates – NOV ELE1106-0051

PRESENTER: Steve Keys

OBJECTIVE: Administer a ruling on Aaron Hatch and Associates' appeal - NOV ELE1106-0051

ACTION: Affirm, reject, decrease or increase the imposed penalties

BACKGROUND: The Notice of Violation (NOV) was issued based upon proposed violations to IDAPA 07.01.11.011.01, "Electrical Contractor"; IDAPA 07.01.11.011.03, "License or Registration", and IDAPA 07.01.11.011.07, "Fees and Permits".

PROCEDURAL HISTORY:

ATTACHMENTS: Documentation from Aaron Hatch and Associates and DBS

IDAHO ELECTRICAL BOARD

Agenda Item No. 03d **Bruce Steed – NOV ELE1107-0029**

PRESENTER: Steve Keys

OBJECTIVE: Administer a ruling on Bruce Steed's appeal - NOV ELE1107-0029

ACTION: Affirm, reject, decrease or increase the imposed penalties

BACKGROUND: The Notice of Violation (NOV) was issued based upon proposed violations to IDAPA 07.01.11.011.01, "Electrical Contractor" and IDAPA 07.01.11.011.03 "License or Registration".

PROCEDURAL HISTORY:

ATTACHMENTS: Documentation from Bruce Steed, and DBS

IDAHO ELECTRICAL BOARD

Agenda Item No. 04 **Electrical Apprenticeship Curriculum**

PRESENTER: Rosie Rosco, CWI

OBJECTIVE: Create a standard curriculum for Electrical, HVAC, and Plumbing Licensure Apprenticeship programs in the state of Idaho.

ACTION: Vote to approve, disapprove, or recommend changes to the updated electrical apprenticeship curriculum.

BACKGROUND: In 2010, Irene Vogel, PTE, offered to assemble a committee to review the current curriculum of the Electrical, HVAC and Plumbing apprenticeship programs for changes/updates. A list of prospective individuals from each trade was generated by the Division. In January 2011, Administrator Pearce requested the chairmen of the Electrical, HVAC, and Plumbing Boards review and endorse the list prior to it being sent to Ms. Vogel.

At the July meeting, Irene Vogel stated the Apprenticeship Curriculum Review project was given to the College of Western Idaho (CWI) to manage. The curriculum has been modified from the 2006 version and is at the committee level for feedback.

PROCEDURAL HISTORY:

ATTACHMENTS: Electrical Apprenticeship Curriculum – Years 1-4

Electrical Apprenticeship Curriculum Review
Final Report
Submitted by the Idaho State Division of Professional Technical Education
October, 2011

The Idaho State Electrical Board and the Idaho State Division of Building Safety requested that the Idaho State Division of Professional Technical Education conduct a review, and revise if needed, the Idaho State Electrical Apprenticeship Curriculum. The curriculum was previously approved by the Electrical Board in 2006. IDPTE requested that the College of Western Idaho lead the review process. Jim Webb, CWI Electrical Instructor, created the new document and solicited input from the committee listed below.

Curriculum Review Committee
Todd Wilding – ISU Instructor
Paul Cook, CWI Advisory Committee
Al Cook, LCSC Instructor
Jim Webb, CWI Instructor
Chuck Williams, NIC Instructor
Robert Baird, EITC Instructor
Al Caine, DBS
Bob Scott – Board Member
Tom Brown, Industry Representative
Mike Gregory, Electrical JATC

School Representatives who were consulted as well:
ISU, Joe Fleishman
CWI, Rosie Rosco
EITC, Ken Erickson
LCSC, Linda Stricklin
NIC, Marie Price
CSI, Christy Horton/John Miller

Final Determination:
IDPTE suggests no changes to the document which was approved in 2006. Respectively submitted is a document that meets all of the criteria previously listed and is intended as a clarification of the content & objectives being presented by the six PTE schools statewide. The textbooks are suggested, not mandatory.

CURRICULUM GUIDE

The following curriculum guide has been developed to help curriculum planners and training organizations develop a comprehensive course of study that will encompass the skills necessary for the successful career as an electrical construction worker.

This guide covers the entire set of skills, including core and specialty skills that have been identified from the occupational standards in the prior section.

Curriculum developers and training organizations are encouraged to utilize this guide in their development process. While we believe that this guide will lead to a successful training program and successful career, its inclusion in this document is meant to be illustrative but not compulsory.

The location or space devoted to any particular topic should not be read as an indicator of the importance of that topic to the occupational fitness of the worker.

The organization of the topics is based, to a degree, on increasing complexity; however, it is important to note that there is a high degree of interrelatedness between topics and in developing a curriculum it may be advisable, even necessary, to break topics into components and present them in a differing order.

I. SAFETY

A. General jobsite safety awareness

1. why safety is important
2. key factors involved with safe work practices
3. develop respect for electricity
   a. be aware of dangers of shock
   b. describe locations of potential shock hazards
   c. demonstrate use of no contact voltage indicators and other devices to determine if system is energized
   d. demonstrate techniques for working on energized circuits
4. hazards created by poor housekeeping on the job
5. maintain safe work area and tools
6. be aware of the dangers of falling object
7. respect and obey job safety rules

B. Emergency procedures

1. first aid training
   a. general
   b. emphasis on electrical shock situations
2. CPR
3. means to effect emergency rescues

C. Compliance with OSHA and EPA regulations

1. attend and/or conduct regular safety meeting
2. general OSHA requirements on the jobsite
3. the guidelines for OSHA Assured Equipment Grounding and GFCI usage
4. use of material safety data sheets (MSDS) to identify and properly handle hazardous materials (e.g. cleaning fluids, transformer oils)

D. Substance abuse

1. kinds and effects of drugs
2. identifying and dealing with substance abuse
3. identifying sources of information and help

II. TOOLS, MATERIALS AND HANDLING

A. Proper tool management

1. identify common hand and power tools
2. proper selection and application of hand tools
3. proper selection and application of power tools
4. proper care for tools
5. safe techniques for using ladders
6. defects that make tools unsafe to use
7. use of meters to take readings

B. Proper rigging methods

1. proper knots
2. proper techniques for rigging and hoisting
3. safe capacities for lifting arrangements

C. Proper digging techniques

1. depth and shape of holes for supporting poles
2. proper techniques for digging, grading and leveling trenches for the installation of duct work

D. Proper use of motorized tools (use of platform lifts, bucket trucks, and truck mounted cranes)

E. Proper material management

1. identify commonly used materials by name
2. proper selection and application of materials

III. MATH

Appropriate mathematical calculations to solve for unknowns

1. arithmetic operators
2. solving word problems
3. problems involving fractions
4. reducing fractions to lowest terms
5. converting decimals to fractions and back
6. angles and sides of triangles
7. unknown angles and sides of triangle
8. metric prefixes and converting different prefixes
9. using powers of ten to perform math functions
10. converting from English to metric measurement systems
11. algebraic formulas
12. square roots
13. ratio, percentages, and proportion
14. problems using direct and inverse relationships

IV. ELECTRICAL THEORY

A. Basic electrical theory

1. define terms, units of measure
2. electron flow
3. producing electrical current
4. products (effects) of electrical current

B. Ohm's Law, Kirchoff's Laws, Lenz's Law, Thevenin's and Nortons Theorems

C. Series circuits

1. components
2. resistance of circuits
3. total resistance
4. effects of changing voltage and resistance
5. law of proportion for series voltage divider circuits
6. power used in circuits
   a. by components
   b. wasted power

D. Parallel circuits

1. components
2. differences between series and parallel circuits
3. Ohm's Law
4. circuits
5. total resistance using product-sum and reciprocal methods
6. alternate current paths
7. currents
8. law of proportion
9. power requirements of components

E. Combination circuits

1. combination circuits
2. components
3. equivalent resistance
4. alternate current paths
5. Ohm's Law
6. power use and dissipation

F. Characteristics of voltages in circuits

1. polarity and flow of electrons
2. distribution and voltage drops
3. proper wire size needed to lower losses

G. Characteristics of magnetism/electromagnetism

H. Theory of superposition and solving for multiple voltage source circuits

I. Operation and characteristics of three wire systems

J. Operation and characteristics of three phase systems

1. identify differences between 3 wire single phase and three phase circuits
2. voltage drop and power loss

K. AC Theory

1. terms associated with AC theory
2. currents and voltages for components and circuits
3. conductor size using NEC
4. current and voltage sine waves to demonstrate phase relationships
5. maximum, effective (rms), average, and peak-to-peak voltage and current
6. inductance
   a. factors that affect inductance
   b. behavior of current when inductance is present
   c. relationship between current, applied voltage, and counterelectromotive force
   d. inductive reactance when frequency and inductance are known
   e. inductance, inductive reactance, and unknowns in various circuits
7. capacitance
   a. effects on circuits of capacitance
   b. capacitance, capacitive reactance, and frequency
8. relationships and behaviors of series RL, parallel RL, series RC, parallel RC, series LC, parallel LC, series LCR and parallel LCR circuits
9. function, operation and characteristics of rectifiers
   a. actions of full-wave and half-wave rectifiers
   b. schematics
10. series resonance, parallel resonance and circuits
11. filters
12. Power Factor
   a. watts, vars and volt-amperes
   b. reactive power
   c. proper placement of power factor correction capacitors
   d. procedure to recognize and correct poor power factor arrangements

13. power quality issues
    a. causes of poor power quality
    b. the effects of harmonics
    c. locating harmonics through observation and test equipment
    d. techniques to reduce of eliminate effects of harmonics

L. Use of electronics

1. electron flow through solid state components
2. precautions against electrostatic discharges around semiconductor devices
3. functions, operation and characteristics of diodes and zener diodes
    a. characteristic curves
    b. testing procedures
    c. schematics including diodes
4. functions, operation and characteristics of transducers
    a. operation of transducers
    b. schematics including transducers
5. functions, operation and characteristics of various types of transistors (diacs, triacs, SCRs, etc.)
    a. operation of transistors
    b. current and voltage values
    c. testing procedures
    d. schematics including transistors
6. functions, operations, characteristics and circuit configurations of amplifiers
    a. basic circuit configurations for various types of amplifiers
7. functions, operations and characteristics of integrated circuits (ICs)
    a. schematics of and including ICs
    b. information on data sheets for integrated circuits
8. functions, operations and characteristics of three main categories of photo-operated devices
9. digital and logic circuits
    a. terms associated with digital and logic circuits
    b. types of circuits
    c. the operative symbols for AND, OR, NOT operations
    d. the use of Boolean Algebra equations, laws, operations and theorems
    e. truth tables from Boolean equations and digital switching circuits
    f. gate functions and gate circuits
    g. BUFFER and INVERTER amplifiers and accompanying truth tables
    h. operation and characteristics of NAND and NOR logic and accompanying truth tables
    i. operation and characteristics of XOR and XNOR logic and accompanying truth tables
    j. positive and negative logic and its effect on gate operation
    k. digital logic equivalent circuits
    l. various optoelectronic devices

V. CODE REQUIREMENTS

National Electrical Code and local codes

1. Purpose and intent of electrical codes
2. Scope of NEC and local codes
3. How local codes may differ from NEC
4. Utilizing code book
   a. mandatory rules
   b. Fine Print Rules
   c. "neat and workmanlike"
   d. locate definitions
   e. interpretations
   f. recognize and use exceptions
   g. materials recognized by the NEC
   h. identify code markings
   i. distinguish wet, damp and dry locations
   j. determine if specific installations are acceptable to the Code
   k. requirements for special occupancies and special equipment
   l. answer specific questions
5. Use NEC to calculate various general job requirements
   a. service conductors, feeders, branch circuits
   b. permissible loads on various circuits
   c. allowable cable tray fills
   d. ampacity of various conductors and fill situations
   e. ampacity of various circuits and load types
   f. overload protection for motors, equipment and phase converters
   g. minimum ampacity for motor disconnecting means
   h. horsepower ratings for motors and disconnecting means
   i. grounding requirements
6. Use NEC for hazardous locations
   a. hazardous locations by Class
   b. equipment and wiring methods necessary for particular hazardous locations

VI. CONDUCTORS

A. Various types of conductors

1. types of conductors and insulators
2. why some materials are better conductor or insulators than other
3. effect of heat on insulators
4. sizing and typing of conductors
   a. use letter symbols to identify insulator types
   b. use American Wire Gauge chart
   c. and convert inches, mils, square mils, and circular mils from one to the other
5. differences between aluminum and copper conductors
6. properties of high voltage cable
7. effects of soil conditions on underground cable

B. Conductor installation techniques

1. different wiring methods for particular conductors and situations
   a. wire connectors
   b. types, installation, limitations
2. different methods of installing conductors in conduits, raceways and cable trays
   a. problems which may be encountered
   b. maximum tension allowed
   c. use of pulling machines to assist in installation of wire
3. proper splicing methods and techniques for various conductors and locations

C. Methods for selecting conductors

1. using Code to determine type of conductor to use in particular situation
2. using mathematical calculations to determine current carrying capacity of conductors
3. calculating or selecting cable ampacity from NEC tables
4. loads for sizing conductors
5. Code requirements depending on types of circuits and loads (lighting, appliance, heating, service entrance)

D. Cable fault situations

1. the types and causes of cable faults
2. methods and equipment for locating cable faults including terminal, tracing and magnetic detection

VII. CONDUIT, RACEWAYS, PANELBOARDS AND SWITCHBOARDS

A. Terms associated with conduits and raceways

B. Conduit and wiring support systems recognized by Code

1. select appropriate conduit type
2. select and utilize appropriate connectors
3. select and utilize appropriate fastening devices and reinforcements
4. special considerations

C. Procedures for laying out various types of bends

1. takeup and gain
2. kicks and offsets
3. calculate degrees
4. back-to-back bends
5. determine overall length of conduit for specific situations
6. locating bending points
7. four techniques for segment bending
8. techniques and operations for making concentric bends
9. radius of circle

D. Procedures for making bends when fabricating conduits

1. hand benders to make bends on small diameter conduit
2. power benders to make bends on larger diameter pipe
   a. make offsets using "constants" or "shrink" methods
   b. make bends in proper sequence, direction and with necessary accuracy

E. Fabricating raceways and wiring support systems

F. Cable assembly wiring methods recognized by the Code

F. Function, operation and requirements for various panelboards and switchgear

1. Installation of panels
2. Installation of components
3. Wiring and connections
4. Special considerations and occupancies

VIII.LIGHTING SYSTEMS

A. Function, operation and characteristics of various lighting systems

1. incandescent
2. florescent
3. HID
4. low voltage

B. Lighting distribution and layout

C. Installation and connection of fixtures

IX. OVERCURRENT DEVICES

Function, operation and characteristics of overcurrent protection devices

1. purpose and location of devices
2. three consideration necessary for electrical component protection
3. interrupting ratings
4. short circuit currents
5. overload and overcurrent situations
6. 10 and 25 foot tap rules
7. operation and application of fuses
   a. single element and time delay
   b. the effects of heat
8. operation and application of various types of circuit breakers (e.g. molded case, air break)
9. utilize Peak-Let-Thru charts and table
10. function, operation and characteristics ground fault circuit interrupters
11. function, operation and characteristics surge protectors
12. appropriate devices for situation and according to Code

X. GROUNDING SYSTEMS

A. Functions, operation and characteristics of grounding systems

1. reasons for grounding systems
2. general types of faults
3. grounding electrode systems

B. Sizing, layout and installation of grounding systems

1. NEC requirements and interpretations
2. size of conductors and electrodes
3. installation of electrodes
4. installation of conductors and connections to electrodes
5. the impact of soil conditions on earth grounding systems and equipment
6. principles and procedures of earth resistance testing
7. determine when ground fault protection is required

C. Difference between insulation, isolation and elevation

D. Difference between grounding, grounded, and bonding

E. Special circumstances

1. systems over 1,000 volts
2. separately derived systems
3. buildings sharing service

XI. PRINTS AND SPECIFICATIONS

A. Creation of blueprints, plans, and specifications

1. utilize symbols used in electrical and related trades
2. recognize functions of basic line types
3. identify drawing tools and techniques
   a. orthographic views
   b. types of projections
   c. drafting scales
4. recognize and apply dimensions
5. prepare "as-built" drawings
6. differences between wiring diagrams, line drawings, schematics and ladder diagrams
   a. given schematics complete wiring diagrams
   b. given panels and equipment layouts create drawings showing conduits and conductors using appropriate scale

B. Use of blueprints, plans, and specifications

1. recognize function of various types of plots, sections, details, schedules, specification sheets, addendums and revisions
2. determine devices, locations, quantities, feeds, conduit types and sizes and conductor sizes
   a. parts of the electrical service
   b. identifying special purpose outlets and the loads they serve
   c. completing take-off sheets for ordering material
   d. determine costs for jobs
   e. how costs affect job
3. interpret non-electrical dimensions and considerations
4. relationships between architectural considerations and electrical installations
5. correlate information from other trades plans with electrical plans to determine potential conflicts

XII. MOTORS, MOTOR CONTROLLERS AND PROCESS CONTROLLERS

A. Function, operation and characteristics of various types of motors (AC, DC, dual voltage, repulsion, universal, 3 phase, squirrel cage, synchronous)

1. physical parts of various motors
2. utilize information sheets, plans, schematics, and motor nameplates to gain information
3. motor losses
4. starting and operating characteristics
5. methods to identify windings in DC motors
6. means for providing for field failure, current limit, voltage and speed control
7. block diagrams to demonstrate power supplies, armature, field and control features
8. torque, locked rotor current, no-load speed, and slip
9. reasons for low-voltage starting
10. function, operation and characteristics of stepping motors

B. Proper techniques for motor installations

1. necessary calculations for electrical requirements per Code
2. correct power factor
3. proper wire type and size
4. appropriate connections
5. how various motors can be made to run at different speed or in reverse direction
   a. schematics
   b. connections to reverse or change speeds
6. identify unmarked motor leads
7. steps for proper handling of motors
   a. checks for mechanical defects
   b. factors to be checked when a motor arrives at jobsite
   c. methods for putting motor into storage

C. Function, operation and characteristics of motor controllers, circuits and devices

1. ways and means of starting and stopping motors
2. operation of magnetic coil
3. use of magnetic starters and controllers
4. correct sizing of magnetic starters and controllers
5. difference between starters and contactors
6. function, operation and characteristics of overload protective devices
   a. thermal overload
   b. magnetic overload
7. schematics for various control circuits
8. two-wire control circuits
9. three-wire control circuits
10. interlocking methods

11. reversing and sequential controllers
12. jogging, inching, plugging
13. multiple start-stop controls and selector switches
14. phase failure relays
15. various manual and automatic speed control techniques
16. function, operation and characteristics of variable frequency drives
17. function, operation, characteristics and installation procedures for programmable logic controls
    a. function of central processing unit
    b. memory types and sizes
    c. user and storage memory
    d. back-up batteries
    e. peripheral devices
18. ladder diagrams
19. function, operation and characteristics of timers, counters, sequencers
20. utilize appropriate manuals and information for start-up, maintenance and testing
21. utilize schematics for manual starters, automatic starters, speed regulators and controllers

D. Function, operation and characteristics of switches and relays

1. schematics including switches and relays
2. installation and connection methods for various switch types
3. installation and connection methods for various relays
4. function, operation and characteristics of electronic sensor and pilot devices
5. function, operation and characteristics of control transformers
    a. leads of control transformers
    b. proper sizing of control transformers

E. Mechanical connections to utilize motors

1. operation of mechanical clutches and magnetic drives
2. direct and offset drives
3. proper pulley sizes required

F. Process control systems and devices

1. operating requirements followed by manual and automatic controllers
2. function, operation, characteristics and installation of:
    a. closed loop and open loop systems
    b. feedback control
    c. proportional control
    d. integral control
    e. derivative control
3. block diagrams including control systems and devices
4. the function, operation, and characteristics of sensors and transmitters

XIII. GENERATORS AND POWER SUPPLIES

A. Principles of electromotive force

B. Principles of generating electricity

1. the parts, functions, operation and characteristics of the AC generator
2. the parts, functions, operation and characteristics of the DC generator
3. the "left hand rule" for generators
4. RPM, frequency and number of poles in a given generator
5. 3 phase generation
6. wye and delta windings
7. 3 phase sine wave

C. Types and configurations of uninterruptible power supplies (UPS)

D. Types and configurations of battery systems used for UPS systems

XIV. TRANSFORMERS

A. Function, operation, and characteristics of transformers

1. electrical principles involved in transformer operation
2. transformer classifications and applications
3. transformer losses
4. ratios for voltage and amperage with respect to turns

B. Selection and installation of transformers

1. nameplate information
2. techniques for sizing transformers (one and three phase)
3. determining if given transformer meets voltage, current, and impedance requirements
4. calculating voltages and currents for load and windings
5. determining whether to use wye or delta wiring schemes
6. steps for receiving and preparing transformer for installation
7. necessary tests to assure proper operation
8. proper techniques for connecting power and load conductors
9. methods for determining proper types and values of electrical protective devices
10. proper grounding procedures

C. distribution systems

1. functions, operation and characteristics of various types of distribution systems
2. criteria for selecting particular type of distribution system

XV. PERSONAL DEVELOPMENT

A. Orientation

1. Make up and organization of the industry
   a. Jobsite chain of command
      (1) owner/customer
      (2) architects/engineers
      (3) inspection authorities
      (4) construction managers
      (5) general contractors
      (6) other contractors and trades
2. Organizations within industry
   a. manufacturers
   b. distributors
   c. associations
   d. unions

B. Methods of working with others

1. the three basic theories of motivation
2. need levels of humans
3. the role of supervisors
   a. leadership styles appropriate to certain situations
   b. need for competent supervisors
4. effective communications
   a. importance of communications in the industry and on the job
   b. barriers to communications
   c. keys to effective communications

C. Economic considerations

1. why worker future is tied to employer's
2. responsibilities to employer
   a. keeping skills current
   b. managing your future
3. costs of doing business
4. importance of satisfying customers
5. impact of job performance, behavior and appearance on prospects for future work
6. functions of marketing

XVI. JOBSITE MANAGEMENT

A. Coordinating tool needs with office of other jobs
B. Coordinating schedule with other crafts
C. Developing timetables and progress charts
D. Completing time sheets, logs and other necessary documentation
E. Clearances or permits if necessary
F. Inventory and order necessary equipment according to job needs
G. Developing alternative solutions and choose the best alternative
H. Planning and organizing tasks to meet deadlines
I. Supervising and monitoring others
J. Picturing the way the project will appear when completed

XVII. TESTING

A. Steps used for various testing processes

1. acceptance testing of cables
2. maintenance testing of generators
3. insulation tests using megohmmeter

B. Utilizing the results of testing procedures

1. Special requirements for high voltage testing
2. describe potential safety hazards
3. characteristics and properties of high voltage cable and insulators
4. appropriate tests methods, voltages and equipment

ELECTRICAL APPRENTICESHIP CURRICULUM OUTLINE FY2012
YEAR 1

Electrical Training:	**162 hours**
First Semester & Yearly Final Exams:	**6 hours**
Total Hours:	**168 hours**

Each of the following subjects may take more or less time than is shown but a minimum of 144 hours is required. The instructor should concentrate on the student achieving the basic objectives stated. The math and theory portion should not be hurried as this is foundational for the next four years.

Recommended Textbooks for the PTE Schools:

Delmar's Standard Textbook of Electricity
National Electrical Code (NEC)
Illustrated Guide to the National Electrical Code
Ugly's Electrical Safety and 70E
Ugly's Electrical Reference

Introduction to Electrical Work: Safety

General Safety Rules

On-The-Job Safety

Objectives: 3 hours

At the completion of this lesson the student should be able to:

- State basic on-the-job safety rules
- Explain what a material safety data sheet (MSDS) is and its requirements.
- Explain safety procedures for trenches
- Explain safety for confined space
- Explain lockout and tagout
- Explain protective clothing to include eye and hearing protection
- Explain the use of a safety harness
- Explain safety for ladders and scaffolds
- State the purpose of arc-fault and ground-fault circuit interrupters

Electrical Theory: Atomic Structure, Electrical Qualities, and Ohm's Law.

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Explain the structure of the atom
- Explain electron flow
- State the difference between insulators and semiconductors
- Explain the basic methods of producing electricity
- Describe electrical effects such as magnetism, light, and heat.
- Define a coulomb
- Define an ampere
- Define an ohm
- Define an watt
- Calculate different electrical values using Ohm's law.
- Select the proper Ohm's law formula from a chart.

Static Electricity and Magnetism, and Resistors

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Discuss the nature of static electricity
- Discuss lighting protection
- Give examples of both nuisance and useful static charges
- Discuss the properties of permanent magnets
- Discuss the operation of electromagnets
- Determine the polarity of an electromagnet when the direction of the current is known
- Determine the resistance of a resistor using the color code or an ohmmeter
- Determine whether a resistor is operating within its power rating

Series Circuits

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Discuss the properties of series circuits

- List three rules for solving electrical values of series circuits
- Calculate values of voltage, current, resistance, and power for series circuits

Parallel Circuits

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Discuss the characteristics of parallel circuits
- State three rules for solving electrical values of parallel circuits
- Solve the missing values in a parallel circuit using the three rules and Ohm's law
- Calculate current values using the current divider formula

Combination Circuits

Objectives: 15 hours

At the completion of this lesson the student should be able to:

- Define a combination circuit
- List the rules for parallel circuits
- List the rules for series circuits
- Solve combination circuits using the rules for parallel circuits, rules for series circuits, and Ohm's law

Electrical Testing Equipment

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Use an ohm meter and measure any resistance in electrical equipment or conductor
- Measure voltage between phases and phase to ground
- Take an ampere reading of any load
- Diagram the proper connection of a watt meter
- State the operation characteristics of analog and digital meters
- Recognize the wave form on an oscilloscope

Introduction to the National Electrical Code and Definitions

NEC Articles 90 and 100

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Understand how the NEC began and its purpose
- Understand how changes to the code evolve
- Be familiar with the terminology, presentation, and format of the NEC
- State the roles of nationally recognized testing laboratories, the National Electrical Manufactures Association, and the National Fire Protection Association
- Accurately evaluate a location as accessible, readily accessible, or not readily accessible
- Identify equipment classified as appliances
- State the four categories of branch circuits
- State the difference between a continuous load and a non-continuous load
- State the difference between a branch circuit and a feeder
- State the difference between 'grounded' and 'grounding'
- Define what "in sight" means in the NEC

- Give examples of damp, wet, and dry locations using the code book
- Determine which conductors are the neutral conductors
- Define a separately derived system using the NEC

Boxes and Enclosures

References: Objectives to be taught from NEC Articles 312, 314, 382, and other appropriate NEC sections.

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Determine the cubic inch capacity of boxes when installing conductors # 6 AWG and smaller
- State which items replace volume allowances of conductor fill when calculating box fill
- State how identical switches or receptacles can be mounted side by side in a two gang box can have different cubic-inch volume allowances
- Determine the box size when the number of conductors is known
- Know the minimum conductor length to be left inside a box
- Explain what must be accessible after installation
- State the mounting and supporting provisions for boxes and conduit bodies using the NEC
- Determine the type of box needed for various applications using the NEC
- Calculate for junction box sizing containing #4 AWG and larger conductors using the NEC

Cables

References: Objectives to be taught from NEC Articles 320 through 340 and other appropriate NEC sections.

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- State the distance from the wood framing member a cable can be installed unless a steel plate is installed
- State the requirements for protection of cable in metal framing using the NEC
- State the sealing requirements in fire-resistant-rated construction when electrical penetrations are made
- Identify what cables are permitted in spaces used for environmental air
- Determine the support requirements for MC, AC, and nonmetallic-sheathed cable using the NEC
- Identify the conductors in a cable and us the NEC to state how certain conductors can be re-identified
- Determine underground installation provisions the NEC
- Identify special application cables using the NEC (This is not to be for installation requirements as this is for first year students)

Raceways and Conductors

References: Objectives are based in NEC Sections 110.14, 240.4, 300.19; and NEC Articles 310, 342 through 378, Chapter 9 tables, and other appropriate NEC sections.

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Determine the general provisions for any raceway installation using the NEC
- Determine the type of raceways suited for individual installations
- Determine the support requirements for various raceways using the NEC

- Determine the provisions for nonmetallic and flexible conduit using the NEC
- Successfully calculate the electrical trade size conduit required for any circuit or feeder
- Determine basic conductor properties using the NEC
- Show conductor temperature limitations
- Determine the provisions for conductors connected in parallel
- Apply conductor ampacity correction factors to include continuous loads.

General Provisions for One-Family Dwellings

References: Objectives are based in NEC Articles 210, 250, 314, 402, 404, 406, 410, 422, and other appropriate NEC sections.

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Calculate the minimum number of 15 and 20 amp branch circuits in a one-family dwelling
- Determine the requirements for single receptacles on individual branch circuits
- Determine the branch-circuit ratings allowed for general-purpose receptacles
- Demonstrate the layout of general-purpose receptacles in a dwelling
- Determine the receptacle rating allowed on various size branch circuits using the NEC
- Determine the requirements for wet bar receptacles using the NEC
- Determine the requirements for lighting and switching using the NEC
- Determine how and when to use the white conductor as an ungrounded conductor
- Determine any general requirement for boxes using the NEC
- Determine any illumination requirement for entrances and exits
- Determine the allowable use of vegetation such as trees for the mounting of outlets.

Specific Provisions for One-Family Dwellings

References: Objectives are based in NEC Articles 210, 410, 422, and other appropriate NEC sections.

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Determine the required ampere rating for any receptacle or branch circuit in kitchens, pantries, dining rooms, breakfast rooms, and similar locations
- Determine the requirements for counter top receptacle placement using the NEC.
- State the minimum number of utility circuits required and their application
- Determine the requirements for appliances both cord and plug and permanently connected
- Calculate the load requirements for appliance branch circuits
- State the specific provisions for GFCI placement
- Identify luminaries permitted in closets and its placement
- Define a bathroom by the NEC and discuss the circuit requirements for receptacles, lights and fans
- Determine the requirements for receptacles and lighting in attached garages, detached garages, and basements
- Determine the requirements for laundry rooms to include the clothes dryer
- Determine the lighting and receptacle requirements for attic, crawl space, and HVAC equipment.

Load Calculations for One-Family Dwellings

References: Objectives are based in NEC Articles 210, 220, 310 and other appropriate NEC sections.

Objectives: 12 hours

At the completion of this lesson the student should be able to:

- Calculate the general lighting for a one-family dwelling
- Specify the volt-amp requirements for small appliance and laundry branch circuits
- Apply demand factors to the general lighting load
- Apply demand factors to fastened-in-place appliances
- Calculate feeder demand loads for household clothes dryers
- Calculate feeder demand loads for household cooking equipment
- Calculate feeder demand loads for heating and air conditioning
- Calculate a one-family dwelling or feeder using the standard method
- Calculate a one-family dwelling or feeder using the optional method
- Size service and feeder conductors
- Calculate the minimum size neutral conductor
- Select the proper grounding electrode conductor

Services and Electrical Equipment for One Family Dwellings

References: Objectives are based in NEC Articles 110, 225, 230, 240, 250, 300, 310 and other appropriate NEC sections.

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Determine adequate strength for a mast supporting service-drop conductors
- Explain the use of service-entrance cable, though it is used little in the western U.S.
- Define a service lateral and briefly explain its provisions
- Determine clearances for service and outside overhead wiring
- Determine work space required for electrical equipment, services, and panels
- Define a panelboard, an enclosure, and a cutout box
- Determine the proper application and use of circuit breakers and fuses using the NEC
- Determine the appropriate table (310.15(B)(7) or 310.15(B)(16) for conductor sizing
- Size the grounding electrode conductor, equipment grounding conductor, main bonding jumper, bonding jumpers on the supply side or load side of the main breaker or fuse on any one-family dwelling service
- Properly install grounded and grounding conductors in subpanels
- Prevent objectionable current flow in grounding conductors and equipment
- Properly install a panelboard in a separate building or structure

Comprehensive Provisions for Multifamily Dwellings

References: Objectives are based in NEC Articles 210, 230, 240, 310, Chapter 9, Tables 8 and 9, and other appropriate NEC sections.

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Determine when more than one service can be installed on a multifamily building
- Determine the proper number of disconnects allowed on a service
- Determine proper access to a units disconnecting means by any occupant

- Properly install the grounding electrode conductors to the grounding electrode
- Determine the proper use of tables 310.15(B)(7) and 310.15(B)(16) when sizing service and feeder conductors
- Determine outdoor receptacle placement
- Calculate voltage-drop (The use of Ugly's Electrical Reference is strongly recommend)

Hand Bending Conduit

References: www.mikeholt.com/documents/freestuff/BendingRoundRaceways.pdf or publications from manufactures such as Ideal, Greenlee, etc.

Objectives: 3 hours

At the completion of this lesson the student should be able to:

- Properly use a hand bender
- Create a 90 degree the correct length using a hand bender
- Bend an offset for any measurement
- Create a saddle bend
- Have the confidence to begin running conduit under supervision on the job

Commercial Locations: General Provisions

References: Objectives are based in NEC Articles 210, 220, 310, 410, 600, and other appropriate NEC sections.

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Compare receptacle placement with that of one-family dwellings to show the difference
- Determine the receptacle requirements in a commercial bathroom
- Determine the sign outlet requirements in a commercial installation
- Determine the branch circuit requirements for motors and air conditioning
- Determine the volt-amp ratings for receptacles (single, duplex, quad, etc.)
- Determine the maximum number of receptacles permitted on a 15 amp and 20 amp circuit
- Apply accessibility requirements to receptacles in guest rooms of hotels and motels
- Determine showcase and show window requirements using the NEC
- Calculate general lighting load based on square-foot area
- Determine the provisions for florescent, HID, recessed, and track lighting provisions
- Determine the proper use and restrictions when using luminaries as raceways
- Determine metal pole conductor access requirements

Commercial Locations: Services, Feeders and Provisions

References: Objectives are based in NEC Articles 110, 250, 368, 408, and other appropriate NEC sections.

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Determine minimum vertical clearances for each installation using the NEC
- Apply dedicated space requirements to electrical equipment to include the area that is to be clear of foreign systems unless protection is provided
- Determine the working clearances of any installation using the NEC
- Properly install both grounding and grounded conductors on the line side and load side of the service supply conductors

- Determine the conditions that require ground-fault protection of equipment
- Recognize a transformer and a generator separately derived systems
- Properly ground and bond a separately derived system
- Recognize and explain the use of busways

The following areas of study are to be considered introductory to first year students and should be treated as such.

Hazardous Locations: Overview

References: Objectives are based in NEC Articles 500 through 516

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Explain what a hazardous location is
- Determine if a classified location is Class I, II or III and if it is Division 1 or 2 using the NEC
- Determine the provisions pertaining to commercial garages and repair and storage facilities using the NEC
- Determine the provisions for buildings in which aircraft are stored and repaired
- Determine the provisions for a motor fuel dispensing facility

Health Care

References: Objectives are based in NEC Articles 500 through 516

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Discuss basic health care terminology
- Determine the grounding and bonding requirements of any health care facility
- Identify patient care areas as general care or critical care and their branch circuit requirements
- Determine the tamper-resistant requirements of pediatric facilities
- Define the two types of systems (equipment and emergency)

Special Occupancies

References: Objectives are based in NEC Articles 500 through 516

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Define “places of assembly” according to the NEC
- Determine manufactured building requirements
- Determine agricultural building requirements
- Determine requirements for mobile home parks and recreational vehicle parks

ELECTRICAL APPRENTICESHIP CURRICULUM OUTLINE FY2012
YEAR 2

Electrical Training:	**162 hours**
First Semester & Yearly Final Exams:	**6 hours**
Total Hours:	**168 hours**

Each of the following subjects may take more or less time than is shown, but a minimum of 144 hours is required. The instructor should concentrate on the student achieving the basic objectives stated. The math and theory portion should not be hurried as this is foundational for the next four years.

Recommended Textbooks for PTE Schools:

Delmar's Standard Textbook of Electricity
National Electrical Code (NEC)
Electricians Exam Prep
Ugly's Electrical Safety and 70E
Ugly's Electrical Reference

Safety and NFPA70E

Incorporate discussions and test questions based on electrical safety and NFPA 70E in the following areas of study as is appropriate. This is an extension of the basic safety introduced in year one.

Note: An *asterisk indicates "green" attributes in the studies

REVIEW: Ohm's Law and Series, Parallel and Combination Circuits

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Demonstrate basic competencies in calculating series, parallel, and combination circuits using the Ohm's law wheel

Basis Trigonometry

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Define a right triangle
- Use the Pythagorean theorem to solve problems concerning right triangles
- Solve problems using sines, cosines, and tangents

Alternating Current

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Discuss the difference between AC and DC
- Compute instantaneous values of voltage and current for a sine wave
- Compute peak, RMS, and average values of voltage and current
- Define the phase relationship of voltage and current in a pure resistive circuit

Inductance in AC Circuits

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Define the properties of inductance in an AC circuit
- Discuss inductive reactance
- Calculate the values of inductive reactance and inductance
- Define the relationship of voltage and current in a pure inductive circuit
- Calculate values for inductors connected in series and parallel
- Define reactive power
- Define the Q of a coil

Resistive-Inductive Series Circuits

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Define the relationship of resistance and inductance in an AC circuit
- Define power factor
- Calculate the values of voltage, current, apparent power, true power, reactive power, impedance, resistance, inductive reactance, and power factor in an RL series circuit
- Calculate the phase angle for current and voltage in an RL circuit
- Connect an RL series circuit and take measurements using test instruments

Resistive-Inductive Parallel Circuits

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Define the operation of a parallel circuit containing resistance and inductance

- Calculate the values of voltage, current, apparent power, true power, reactive power, impedance, resistance, inductive reactance, and power factor in an RL parallel circuit
- Connect an RL parallel circuit and measure circuit values using test instruments

<u>*Capacitors</u>

<u>Objectives</u>: 6 hours

At the completion of this lesson the student should be able to:

- List three factors that detriment the capacitance of a capacitor
- Discuss the electrostatic charge
- State the difference between polarized and non-polarized capacitors
- Calculate the values for series and parallel connections of capacitors

*Note that power factor correction is and always has been "green." That is why the studies concerning capacitance are so identified. Though the watts consumed do not change for a facility with, say, 80% power factor, the power company needs to deliver less total volt-amps if it is corrected.

<u>*Capacitance in AC Circuits</u>

<u>Objectives</u>: 6 hours

At the completion of this lesson the student should be able to:

- Explain why current appears to flow through a capacitor when connected to an AC circuit
- Define capacitive reactance
- Calculate the value of capacitive reactance in an AC circuit
- Calculate the value of capacitance in an AC circuit
- Explain the relationship of voltage and resistance in an AC circuit

<u>*Resistive-Capacitive Series Circuits</u>

<u>Objectives</u>: 6 hours

At the completion of this lesson the student should be able to:

- Explain the relationship of resistance and capacitance in an AC series circuit
- Calculate the values of voltage, current, apparent power, true power, reactive power, impedance, resistance, inductive reactance, and power factor in an RC series circuit
- Calculate the phase angle for current and voltage in an RC series circuit
- Connect an RC series circuit and make measurements using test insturments

<u>*Resistive-Capacitive Parallel Circuits</u>

<u>Objectives</u>: 6 hours

At the completion of this lesson the student should be able to:

- Define the operation of a parallel circuit containing resistance and capacitance
- Calculate the values of voltage, current, apparent power, true power, reactive power, impedance, resistance, inductive reactance, and power factor in an RC parallel circuit
- Connect an RC parallel circuit and measure circuit values using test instruments

<u>*Resistive-Inductive-Capacitive Series Circuits</u>

<u>Objectives</u>: 6 hours

At the completion of this lesson the student should be able to:

- Explain AC circuits that contain resistance, inductance, and capacitance connected in series

- Calculate the values of voltage, current, apparent power, true power, reactive power, impedance, resistance, inductive reactance, and power factor in an RLC series circuit

***Resistive-Inductive-Capacitive Parallel Circuits**

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Explain AC circuits that contain resistance, inductance, and capacitance connected in parallel
- Calculate the values of voltage, current, apparent power, true power, reactive power, impedance, resistance, inductive reactance, and power factor in an RLC parallel circuit

Three-Phase Circuits

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Explain the difference between single-phase and three-phase voltages
- Draw a three-phase delta or wye connection
- Calculate the voltage and current values for wye and delta circuits

Single-Phase Transformers

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Explain the difference between an isolation-transformer and an auto-transformer and how they work
- Calculate the values of voltage, current, and turns for a single-phase transformer
- Connect a transformer and test the voltage output of different windings
- Explain the polarity markings

Three-Phase Transformers

Note: Some of following objectives are closely related to the three-phase circuit subject matter already studied. Some of this is like a review and reinforcement

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Connect three single-phase transformers to form a three-phase bank
- Calculate voltage and current for three-phase transformer connections
- Connect two single phase transformers to form a three-phase open-delta connection
- Calculate the values of voltage and current for a three-phase transformer used to supply both three-phase and single-phase loads
- Define what a harmonic is.
- Discuss harmonic problems and their solution.

Three-phase Motors

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Discuss the basis operating principals of a three-phase motor
- Explain a rotating magnetic field
- Discuss the operating principals of a squirrel-cage motor
- Connect dual voltage motors for correct operation on the desired voltage
- Reverse a three-phase motor by changing connections

Single-phase Motors

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Reference the operation of various motor types
- Explain the basic operation of a split-phase motor
- Explain a starting winding and how it works
- Explain the operation of a centrifugal switch
- Recognize the types starting relays

Motor Load Calculations

Objectives: 12 hours

At the completion of this lesson the student should be able to:

- Determine the full load current of any motor according to the NEC
- Size the branch circuit wire size for any motor
- Determine the appropriate circuit protection for any motor
- Use the motor name plate to size overloads
- Explain the difference between overload protection and short-circuit/ground-fault protection
- Size a feeder for any set of motors
- Size the feeder overcurrent device

Box Fill and Junction Box Sizing

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Calculate box fill for any size wire and combination of devices
- Properly size pull and junction boxes

Conductor Ampacity Correction Factors

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Calculate correction factors for temperature
- Calculate correction for raceway fill
- Calculate correction factors for continuous loads
- Calculate correction factors for any combination of the above
- Properly use table 310.15(B)(16) and similar tables
- Properly apply NEC Chapter 9 notes for derate in nipples

Raceway Fill

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Use NEC tables to calculate raceway fill using any combination of wire sizes
- Properly use Annex C tables
- Properly fill conduit nipple

Grounding and Bonding

Objectives: 18 hours

At the completion of this lesson the student should be able to:

- Define objectionable current
- Define a main bonding jumper
- Properly size the grounding electrode conductor
- Properly install the grounding electrode system
- Explain the purpose of bonding
- Properly size equipment grounding conductors
- Use article 250 to properly ground and bond any system
- Effectively use the NEC to answer any grounding question

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ELECTRICAL APPRENTICESHIP CURRICULUM OUTLINE FY2012
YEAR 3

Electrical Training:	**162 hours**
First Semester & Yearly Final Exams:	**6 hours**
Total Hours:	**168 hours**

Each of the following subjects may take more or less time than is shown, but a minimum of 144 hours is required. The instructor should concentrate on the student achieving the basic objectives stated.

Recommended Textbooks for PTE Schools:

***Electrical Wiring Commercial*, ISBN 978-1-4354-9829-7**
***Electricians Exam Prep*, ISBN 978-0-7637-5118-0**
National Electrical Code (NEC)
***Ugly's Electrical Safety and 70E*, ISBN 978-0-7637-6855-3**
***Ugly's Electrical Reference*, ISBN 978-0-7637-9099-8**

Note: An *asterisk indicates "green" attributes in the studies

Safety and NFPA70E

Incorporate discussions and test questions based on electrical safety and NFPA 70E in the following areas of study as is appropriate. This is an extension of the basic safety introduced in year one.

Commercial Building Plans and Specifications

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Review and discuss a review of basic safety rules for electrical systems
- Define the project requirements from the contract documents
- Demonstrate the application of building plans and specifications
- Locate specific information on building plans
- Obtain information from industry-related organizations
- Apply and interchange International System of Units (SI) and English measurements

Reading Working Drawings

(Use any set of commercial prints for classroom training along with text)

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Read and interpret electrical symbols used in construction drawings
- Identify the electrical installation requirements for a building
- Determine elevations
- Determine the installation spaces of all other trades
- Determine construction materials, measurements, and specifications

Calculating the Electrical Load

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Determine the minimum lighting load for a given area
- Determine the receptacle load for a given area
- Determine Equipment loads
- Determine a reasonable calculated load
- Apply the factors for continuous loads
- Apply the factors for non-coincident loads

Branch Circuits

Objectives: 6 hours (review and reinforcement from previous years)

At the completion of this lesson the student should be able to:

- Determine the required number of branch circuits for a set of loads
- Apply adjustment and correction factors
- Apply factors for continuous, motor, and heating loads
- Determine correct rating for branch circuit protective devices
- Determine appropriate wire type
- Determine the proper size
- Explain the heating effect of magnetic flux and how to properly wire to cancel it.

Switches and Receptacles

Objectives: 3 hours

At the completion of this lesson the student should be able to:

- Discuss the various NEMA configurations for receptacles
- Select the proper receptacle for use in hospitals, electronic equipment installations, and ground isolation
- Determine the proper use of switches based on rating and terminations
- Properly use color coding for electrical installations

Cooking Equipment (Based on Exam Prep)
Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Calculate dwelling range loads of the same ratings
- Calculate dwelling range loads of different ratings
- Calculate demand loads for cooking equipment
- Calculate loads for commercial kitchen equipment
- Calculate loads for clothes dryers using the standard method
- Calculate loads for clothes dryers using the optional method
- Calculate neutral loads for cooking equipment and clothes dryers

Commercial Calculations (Based on Exam Prep)
Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Calculate a commercial electrical service load using the standard calculation method of article 220
- Calculate a commercial electrical service load using the optional calculation method of article 220

Wiring Methods (Review and reinforcement from previous years)
Objectives: 3 hours

At the completion of this lesson the student should be able to:

- Select the proper raceway of cable for the conditions
- Identify the installation requirements for a raceway of cable
- Select the proper raceway size, depending on the conductors to be installed
- Properly size outlet, pull, and junction boxes

Motor and Appliance Circuits (Review and reinforcement from previous year)
Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Use and interpret the word *appliance*
- Use and interpret the term *utilization equipment*
- Properly wire and properly install disconnecting means for appliances and motors
- Understand the term *Type 1* and *Type 2* protection
- Define *single phasing*
- Design a motor circuit: calculate proper wire size, overcurrent protection, overload size, disconnect size, feeder size for several motors, feeder overcurrent protection

Feeders
Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Calculate feeder loading

- Calculate the feeder overcurrent device
- Calculate the proper feeder size for any combination of loads
- Calculate correction factors
- Calculate voltage drop
- Calculate the reduced neutral size as is appropriate
- Determine raceway size

Special Systems

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Select and install multi-outlet assemblies
- Calculate the load allowance for multi-outlet assemblies
- Select and install a floor outlet system
- Determine proper wiring for fire alarm installations

Working Drawings-Upper Level

Objectives: 3 hours

At the completion of this lesson the student should be able to:

- Tabulate materials required to install an electrical rough-in
- Select the components to install large equipment such as commercial water heaters, heating, cooling, etc.
- Explain the advantages and disadvantages between single-phase and three-phase systems

Special Circuits

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Describe typical connection schemes for photocells and timers
- Determine the requirements for wiring an elevator
- Properly connect the controls for a sump pump

***Lamps and Ballast for Lighting**

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Understand the technical terms for associated with lamps and ballast
- Identify lamps scheduled to be used in a commercial building
- Understand the basics of incandescent, halogen, fluorescent, LED, and HID lamps
- Understand the practical application of lamps used in a commercial building
- Understand more about energy savings for lamps and ballasts
- Identify lamp types according to characteristics and letter designations
- Be aware of the hazards of disposing lamps and ballasts

***Luminaires**

Objectives: 3 hours

At the completion of this lesson the student should be able to:

- Locate luminaires in a space
- Properly select and install luminaires

- Discuss the attributes of different types of luminaires
- Exercise some control over energy savings by giving proper advice

Overcurrent Protection: Fuses and Circuit Breakers

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- List and identify the types, classes, and ratings of fuses and circuit breakers
- Describe the operation of fuses and circuit breakers
- Develop an understanding of switch sizes, ratings, and requirements
- Define *interrupting rating, short-circuit currents, RMS, and current limitation*
- Use let-through charts

Short-Circuit Calculations and Coordination of Overcurrent Protective Devices

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Perform Short-circuit calculations using the point-to-point method
- Calculate short-circuit currents using the appropriate tables and charts
- Define the terms *coordination, selective systems, and non-selective systems*

***Commercial Utility Interactive Photovoltaic Systems**

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- List the components of a utility interactive solar photovoltaic system
- Describe the function of a utility interactive solar photovoltaic system and components
- Apply the NEC to the design and installation of commercial utility interactive solar photovoltaic system and components
- Interpret a typical utility interactive solar photovoltaic system single line drawing

Basic Principles of Motor Controls

Objectives: 9 hours

At the completion of this lesson the student should be able to:

- Recognize ladder diagrams
- Recognize connection diagrams
- Recognize pictorial diagrams
- Use and interpret definitions, abbreviations, and graphic symbols used on motor control diagrams
- Describe the function of pushbutton stations, solenoids, flow switches, pressure switches, limit switches, and timing relays

Components of Control Circuit Schematics, Magnetic Control

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Use a ladder diagram to illustrate a simple two wire control circuit for a single-phase motor operated by a float switch or similar device
- Use a ladder diagram to illustrate a simple start/stop station operating a motor starter
- Identify circuit types classified by power source—common control circuits, transformer control wiring, and separate control wiring

- Identify control devices and their function
- Identify remote-control circuits and their function
- Use 120 volt control circuit to operate a 480 volt load
- Explain the operation and use of magnetic motor starters

Basic Control Circuits, Overcurrent Protection for Control Circuits

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Design both two-wire and three-wire controls using start/stop stations and other devices such as float switches
- Design a circuit operating a motor starter using two or more start/stop stations
- Use the NEC to properly protect control circuits to include conductor sizes, overcurrent protection, and control transformers

Indicator Lights and Illuminated Pushbuttons, Selector Switch Truth Tables

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Understand the use of illumination in motor controls
- Interpret symbols used on diagrams
- Read truth tables
- Diagram the use of a selector switch on a three-wire control for a jogging application

Reversing Controls for Three-Phase Motors, Reversing Controls with Indicator Lights for Three-Phase Motors, Reversing Controls with Limit Switches for Three-Phase Motors, Reversing Single Phase Motors

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Diagram the operation of a reversing starter
- Diagram the operation of a reversing control station
- Diagram the operation of a reversing control selector switch
- Apply functional indicator lights to reversing controls
- Diagram a limit switch to automatically stop a motor
- Diagram reversing operations using limit switches
- Diagram the operation of a garage door
- Diagram the operation of reversing a single-phase motor

Sequencing Control and Master Stop Function, Introduction to Variable Frequency Drives

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Interpret a diagram showing the sequencing of several motors
- Apply the master stop function to and process using motor controls
- Explain the basic operation of variable frequency drives

Panelboard selection and Installation

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Identify the criteria for selecting a panelboard

- Correctly place and number circuits in a panelboard
- Calculate the proper feeder size for a panelboard
- Determine the correct overcurrent protection for a panelboard
- Prepare a panelboard directory

The Electric Service

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Install power transformers to meet NEC requirements
- Draw the basic transformer connection diagram
- Recognize different service types
- Define the various components of service equipment
- Correctly install service equipment
- Connect metering equipment
- Install the grounding system

Low Voltage Remote-Control

Objectives: 3 hours

At the completion of this lesson the student should be able to:

- Discuss the importance of energy savings and ways to accomplish it.
- List the components of a low-voltage remote-control wiring system
- Select the appropriate NEC sections governing the installation of a low-voltage remote-control wiring system
- Demonstrate the correct connections for wiring a low-voltage remote-control system

Cooling Systems

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- List the parts of a cooling system
- Describe the function of each part in a cooling system
- Calculate the sizes of the electrical components
- Read a typical wiring diagram that shows the operation of a cooling unit

ELECTRICAL APPRENTICESHIP CURRICULUM OUTLINE FY2012
YEAR 4

Electrical Training:	**162 hours**
First Semester & Yearly Final Exams:	**6 hours**
Total Hours:	**168 hours**

Each of the following subjects may take more or less time than is shown, but a minimum of 144 hours is required. The instructor should concentrate on the student achieving the basic objectives stated. This course of study should be backed up by a number of worksheets, quizzes, and exams covering the entire code and not just the subjects at hand. The instructor should add strategic safety questions based on NFPA 70E and general safety from time to time. This course should be based in a "learn by doing" strategy.

Recommended Textbooks for PTE Schools:

Mike Holt Illustrated Guide Understanding NEC 2011 Vol 1 Text ISBN 978-1-932685-51-0
& Workbook, ISBN 978-1-932685-70-1
Mike Holt Illustrated Guide Understanding NEC 2011 Vol 2 Text, ISBN 978-1-932685-59-6
NFPA 70: National Electric Code 2011, ISBN 978-087765914-3
Ugly's Electrical Safety and NEPA 70E, ISBN 978-0-7637-6855-3.

Hazardous Locations: Articles 500 through 504

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine proper wiring of a Class I, Division 1 locations
- Determine proper wiring of a Class I, Division 2 locations
- Determine proper wiring of a Class II, Division 1 locations
- Determine proper wiring of a Class II, Division 2 locations
- Determine proper wiring of a Class III, Division 1 locations
- Determine proper wiring of a Class III, Division 2 locations
- Determine proper wiring of Commercial Garages
- Determine proper wiring of Motor Fuel Dispensing Facilities

Commercial Garages, Motor Fuel Dispensing Facilities: Articles 511 and 514

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Define a major repair garage
- Define a minor repair garage
- Properly classify hazardous areas
- Use the NEC to properly wire a commercial garage of any type
- Define a Motor Fuel Dispensing Facility
- Use the NEC to properly wire Motor Fuel Dispensing Facilities

Health Care Facilities, Assembly Occupancies, Carnivals, Fairs and Similar Events: Articles 517 through 525

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Use the NEC to properly define a health care facility type
- Define General Care Areas and Critical Care Areas
- Discuss Essential Electrical Systems
- Properly wire and ground a health care facility
- Discuss the proper wiring methods for places of assembly
- Discuss the proper wiring of carnivals, fairs, and similar events

Agricultural Buildings, Marinas and Boatyards, Temporary Installations: Articles 547 through 590

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Determine the proper wiring for any agricultural building
- Properly calculate farm loads using the NEC
- Determine marina requirements using the NEC
- Determine and discuss the requirements for temporary installations

Electric Signs and Outline Lighting, Manufactured Wiring Systems, Elevators, Escalators, and Moving Walks: Articles 600 through 620

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine proper installation and requirements of electric signs and associated lighting
- Compare manufactured wiring systems instructions against Article 604 or 605 as is appropriate
- Determine proper installation and requirements of elevators, escalators, and moving walks

Audio Signal Processing, Amplification, Reproduction Equipment, and Information Technology Equipment: Articles 640 and 645

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Apply the goal of reducing the spread of fire and smoke in case of a fire
- Comply with other articles when installing audio equipment
- Reduce shock hazards peculiar to audio equipment
- Determine proper installations in IT rooms

Swimming Pools, Spas, Hot Tubs, Fountains, and Similar Locations: Article 680

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine proper electrical installations for swimming pools
- Determine proper electrical installations for spas and hot tubs
- Determine proper electrical installations for fountains

Emergency Standby Power Systems, Legally Required Power Systems, Optional Standby Power Systems: Articles 700 through 702

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the proper installation of systems deemed essential to protect human life
- Determine the difference between *emergency* stand by, *legally required* standby, and *optional standby* power systems

Remote-Control, Signaling, and Power-Limited Circuits: Article 725

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Define a class 1 circuit
- Define a class 2 circuit
- Define a class 3 circuit
- Determine proper installation and requirements class 1, class 2, and class 3 circuits

Fire Alarm Systems: Article 760

Objectives: 6 hours

At the completion of this lesson the student should be able to:

- Define nonpower-limited fire alarm circuits
- Define power-limited fire alarm circuits
- Determine the proper installation of fire alarm wiring using the NEC
- Determine where the use of GFCI and AFCI are restricted
- Determine environmental air space

Optical Fiber Cables and Raceways, Communications Systems: Articles 770 and 800 through 820

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine proper installation of optical fiber cables
- Properly fire-stop penetrations
- Determine proper grounding of communications wiring and equipment
- Determine proper installations of communication wiring

Requirement for Electrical Installations: Article 110

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the proper termination of conductors
- Determine the kinds of warnings, markings, and identification a given installation requires
- Determine the proper working clearance for any installation
- Determine proper voltage rating
- Determine proper AIC rating

Use and Identification of Grounded Conductors, Branch Circuits, Feeders: Articles 200, 210 and 215

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Properly identify a grounded conductor
- Properly apply the general provisions of Article 210
- Properly apply the branch circuits ratings of Article 210
- Properly install the required outlets of Article 210
- Calculate the minimum size and ampacity of any feeder

Branch Circuit, Feeder, and Service Calculations (review from previous years): Article 220

Objectives: 12 hours

At the completion of this lesson the student should be able to use the NEC to:

- Demonstrate the ability to calculate the loads for a single family dwelling
- Demonstrate the ability to calculate the loads for a multifamily dwelling
- Demonstrate the ability to calculate the loads for a commercial or industrial installation

Outside Branch Circuits and Feeders, Services (review from previous years): Articles 225 and 230

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Properly install conductors and lighting installed outdoors
- Determine vertical and horizontal clearance of overhead conductors
- Determine proper disconnecting means and installation
- Determine the proper installation and protection of “line” and “load” conductors

Overcurrent Protection (critical review from previous years): Article 240

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Properly size a standard overcurrent device to any conductor
- Properly apply the small conductor rules
- Calculate transformer secondary conductor protection
- Reference requirements for appliance protection
- Calculate tap conductor protection
- Reference protection for motors and air conditioners

Grounding and Bonding (critical review from previous years): Article 250

Objectives: 12 hours

At the completion of this lesson the student should be able to use the NEC to:

- Define the difference between grounding and bonding
- Determine the proper grounding and bonding requirements of any system
- Properly size the main bonding jumper
- Properly size the grounding electrode conductor
- Properly size equipment grounding conductors
- Determine the various types of a grounding conductors
- Design a proper grounding electrode system

Surge Protective Devices: Article 285

Objectives: 1.5 hours

At the completion of this lesson the student should be able to:

- Determine the installation requirements SPD's
- Discuss the difference between Type 1, Type 2, and Type 3 SPD's and their use

Wiring Methods, Conductors for General Wiring: Articles 300 and 310

Objectives: 12 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine how to route, splice, protect, and secure conductors and raceways
- Determine the general requirements for conductors such as insulation markings, ampacity ratings, and conductors to use in specific installations
- Properly use the Article 310 tables
- Apply Chapter 9 tables
- Properly derate any conductor based on wire fill, temperature, and continuous load
- Define the meaning of conductor insulation lettering
- Discuss the effects of nonlinear loads on multiwire branch circuit and feeder neutral conductors and if a neutral conductor is to be counted as current carrying.

Cabinets, Cutout Boxes, and Meter Socket Enclosures; Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Handhole Enclosures: Articles 312 and 314

Objectives: 9 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the use of any enclosure based on the conditions of use
- Determine the installation requirements for any enclosure
- Properly use boxes and fittings based on internal volume
- Determine the requirements for fill of boxes and fittings

- Properly size pull and junction boxes for No. 4 AWG conductors and larger

Armored Cable, Metal Clad Cable, Nonmetallic-Sheathed Cable, Service-Entrance Cable, Underground Feeder and Branch-Circuit Cable (Type UF): Articles 320, 330, 334, 338, and 340

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the installation requirements of Armored Cable
- Determine the installation requirements of Metal-Clad Cable
- Determine the installation requirements of Nonmetallic-Sheathed Cable
- Determine the installation requirements of Service-Entrance Cable
- Determine the installation requirements of Underground Feeder and Branch-Circuit Cable (Type UF)
- Relate temperature concerns, derating, etc. to other appropriate articles in the NEC

Intermediate Metal Conduit, Ridged Metal Conduit, Flexible Metal Conduit, Liquidtight Flexible Metal Conduit: Articles 342, 344, 348, and 350

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the installation requirements of Intermediate Metal conduit
- Determine the installation requirements of Ridged Metal Conduit
- Determine the installation requirements of Flexible Metal Conduit
- Determine the installation requirements of Liquidtight Flexible Metal Conduit
- Relate conductor fill, derating, etc. to other appropriate articles in the NEC

Ridged Polyvinyl Chloride Conduit, Liquidtight Flexible Nonmetallic Conduit, Electrical Metallic Tubing, Electrical Nonmetallic Tubing: Articles 352, 356, 358, and 362

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the installation requirements of Ridged Polyvinyl Chloride Conduit
- Determine the installation requirements of Liquidtight Flexible Nonmetallic Conduit
- Determine the installation requirements of Electrical Metallic Tubing
- Determine the installation requirements of Electrical Nonmetallic Tubing
- Relate conductor fill, derating, etc. to other appropriate articles in the NEC

Metal Wireways, Multioutlet Assemblies, Surface Metal Raceways, Cable Trays: Articles 376, 380, 386, 392

Objectives: 3 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the proper installation of a metal wireway
- Calculate the proper conductor fill of a metal wireway
- Calculate the proper size of a metal wireway based on conductor size and conduit entries
- Properly splice conductors in a metal wireway
- Determine the proper installation of multioutlet assemblies
- Determine the proper installation of surface metal raceways
- Determine the proper installation and use of cable trays

Flexible Cords and Flexible Cables, Fixture Wires, Switches, Receptacles, Cord Connectors, and Attachment Plugs: Articles 400, 402, 404, and 406

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Identify requirements, applications, and construction specifications of cords and cables
- Select cords, cables, and fittings listed for specific applications
- Identify requirements and specifications of fixture wires
- Determine types and uses of switches
- Mount receptacles according to the details of 406.4 (A) through (G)
- Following the grounding requirements of the specific device being used

Switchboards and Panelboards, Luminaires, Lampholders, and Lamps: Articles 408 and 410

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the specific requirements for switchboards, panelboards, and distribution boards that control power and lighting circuits
- Properly identify the use of each circuit in a panelboard or switchboard
- Properly terminate conductors in panelboards and switchboards
- Determine the general requirements of Part I of Art. 410
- Determine the location requirements of Part II of Art. 410
- Determine the box and covers requirements of Part III of Art. 410
- Determine the support requirements of Part IV of Art. 410
- Determine the grounding requirements of Part V of Art. 410
- Determine the wiring requirements of Part VI of Art. 410

Lighting Systems Operating at 30 Volts or Less: Article 411

Objectives: 1.5 hours

At the completion of this lesson the student should be able to use the NEC to:

- Explain the potential for fire in low voltage lighting systems because of currents as high as 25 amps
- Explain the need for an isolation transformer
- Discuss the proper wiring method for low voltage lighting

Appliances, Fixed Electric Space Heating Equipment: Articles 422 and 424

Objectives: 6 hours

At the completion of this lesson the student should be able to use the NEC to:

- Calculate and determine proper branch circuit ratings for any appliance
- Calculate and determine proper overcurrent protection for any appliance
- Determine the requirements for nonmotor appliances
- Explain article 430 compliance for motor operated appliances
- Explain article 440 compliance for appliances containing hermetic compressors
- Determine proper disconnecting means
- Determine requirements for heating installations using Article 424, Part I through Part VI
- Understand the content of Article 424, Part VII through IX

Motors, Motor Circuits, and Controllers; Air-conditioning and Refrigeration Equipment, Articles 430 and 440 (review from previous years)

Objectives: 12 hours

At the completion of this lesson the student should be able to use the NEC to:

- Determine the proper conductor size for any motor
- Determine the proper overcurrent protection for any motor
- Explain why the apparent over-fusing of conductors according to table 430.52 is both safe and necessary
- Determine the proper disconnect for any motor
- Determine the proper overload protection for any motor and condition (easy start, hard start, etc.)
- Determine the minimum size feeder for a group of motors
- Determine the feeder overcurrent protection
- Properly size circuits and overcurrent devices for air conditioning and refrigeration equipment
- Determine the requirements for the disconnecting means of refrigeration equipment

IDAHO ELECTRICAL BOARD

Agenda Item No. 05 **Schedule 2012 Meeting Dates**

PRESENTER: Bob Scott

OBJECTIVE: Schedule 2012 meeting dates

ACTION: Vote to accept or reject the 2012 meeting dates as addressed under "Background".

BACKGROUND: The following 2012 dates were selected for the Board's consideration:
January 19th – April 19th – July 19th – October 18th

PROCEDURAL HISTORY:

ATTACHMENTS: 2012 Board Meeting Calendar

DBS BOARD MEETINGS- 2012

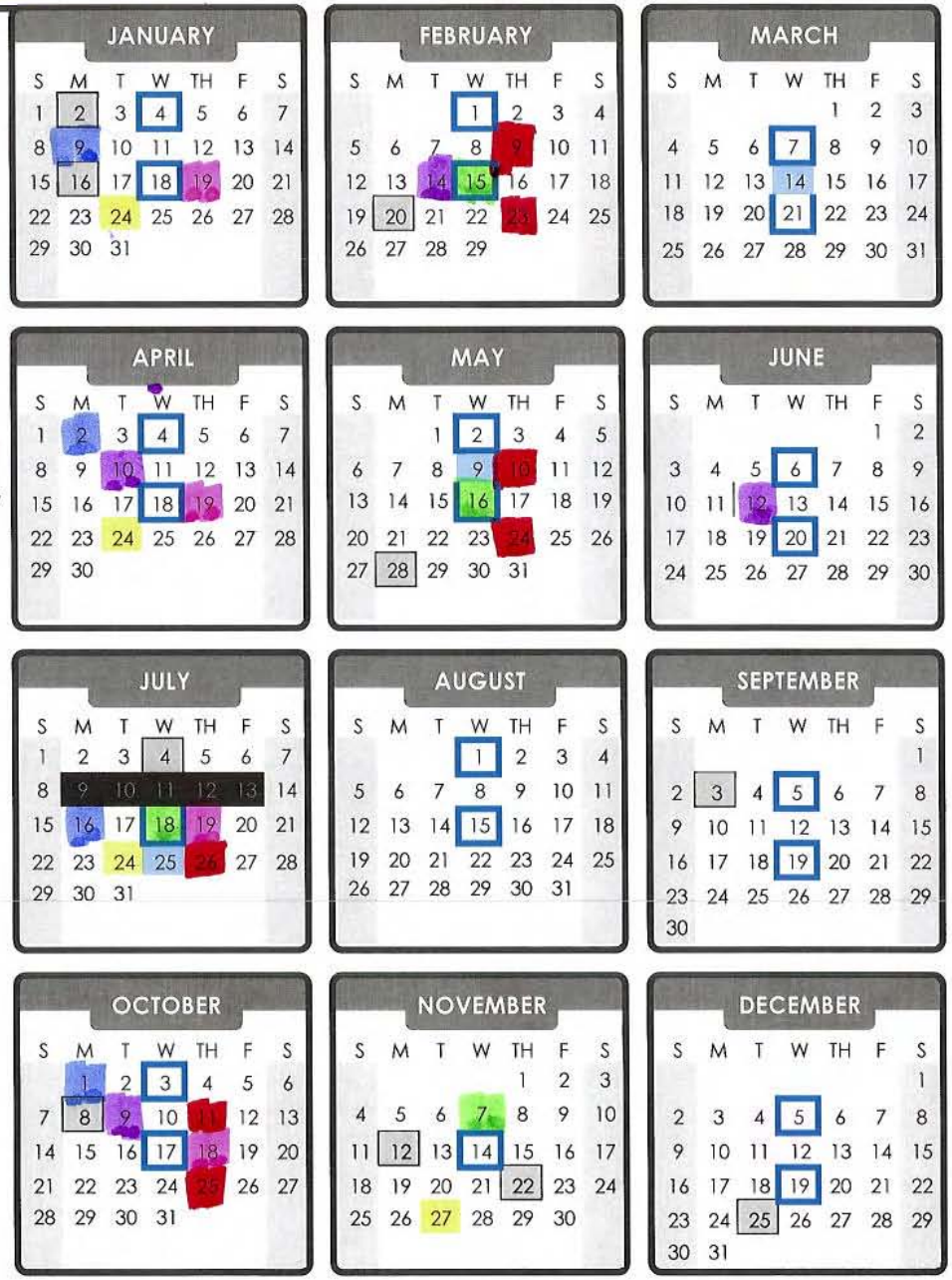
TENTATIVE

2012

Board Meetings will be held at each
Division of Building Safety regional office
either in person or through video conferencing

1090 E WATERTOWER ST SUITE 150 MERIDIAN, ID 83642	1250 IRONWOOD DR SUITE 220 COEUR D'ALENE, ID 83814	2055 GARRETT WAY BLD 2, SUITE 7 POCATELLO, ID 83201

Idaho Building Code Board	Feb 14 - Apr 10 - Jun 12 - Oct 9
Idaho Electrical Board	Jan 19 - Apr 19 - Jul 19 - Oct 18
Idaho HVAC Board	Feb 15 - May 16 - Jul 18 - Nov 7
Manufactured Housing Board	JAN 24 APR 24 JUL 24 NOV 27
Modular Building Advisory Board	MAR 14 MAY 9 JUL 25
Idaho Plumbing Board	Feb 9 or 23 - May 10 or 24 Jul 26 - Oct 11 or 25
Public Works Contractors Licensing Board	Jan 9 - Apr 2 - Jul 16 - Oct 1



Holidays outlined & highlighted in gray
Management meetings outlined in blue
Unavailable dates blacked out

IDAHO ELECTRICAL BOARD

Agenda Item No. 06 Insulation Contractors--Blow Insulation Over Knob and Tube Wiring

PRESENTER: Thomas Brodbeck, Energy Conservation Consultant and Contractor

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OBJECTIVE: Allow Insulation Contractors to blow insulation over knob and tube wiring.

ACTION: Informational

BACKGROUND: Mr. Brodbeck has helped the states of Washington and Oregon get code changes passed and has provided assistance to an additional ten states.

PROCEDURAL HISTORY:

ATTACHMENTS: Supporting documentation on Division's website under the Idaho Electrical Board meetings "special interest" column.
http://dbs.idaho.gov/boards/EBboard/EBmeetings.html

IDAHO ELECTRICAL BOARD

Agenda Item No. 07 Electrical Contractor License and Changes in Business Entities

PRESENTER: Steve Keys

OBJECTIVE: To inform the Board of the problems the Division is experiencing as electrical contractors change their business structure.

ACTION: Informational

BACKGROUND: The business entity is the holder of the electrical contractor license; when the structure of that entity changes from a sole proprietorship to a corporation or LLC, the grandfathering provisions governing the qualifying Master Electrician kick in. The new entity must employ a signing master electrician in lieu of the signing journeyman who may have been grandfathered in under the previous business entity.

PROCEDURAL HISTORY:

ATTACHMENTS: No documentation

IDAHO ELECTRICAL BOARD

Agenda Item No. 08 **SAC Update**

PRESENTER: Aaron White, IBEW

OBJECTIVE: Inform the Board and industry of the networking program through the Idaho State Apprenticeship Committee (SAC)

ACTION: Informational

BACKGROUND: When discussing the topic, "Industry-Related Unemployment Database", at the January 2011 Board meeting, it was brought up that the state of Montana has a SAC. To avoid the privacy laws, SAC has a program that offers out-of-work individuals an opportunity to upload their personal information for contractors to view. Joe Schneehagen, IBEW, stated Idaho's SAC will administer the list, and in all probability come back to the April Idaho Electrical Board meeting with a progress report.

At the April 2011 meeting, Aaron White, IBEW, deferred the topic "SAC Update" to the July meeting due to recent transitions within IBEW.

PROCEDURAL HISTORY:

ATTACHMENTS: No documentation

IDAHO ELECTRICAL BOARD

Agenda Item No. 09 **Schooling Update**

PRESENTER: Irene Vogel, PTE

OBJECTIVE: To update the Board on Professional Technical Education's (PTE) current school activities, enrollments, etc.

ACTION: Informational

BACKGROUND:

PROCEDURAL HISTORY:

ATTACHMENTS: No documentation

IDAHO ELECTRICAL BOARD

Agenda Item No. 10 **Operational Report**

PRESENTER: Steve Keys

OBJECTIVE: Update the Board on the operations of the Electrical Program and Division.

ACTION: Informational

BACKGROUND: This topic is addressed at all regularly scheduled Idaho Electrical Board meetings.

PROCEDURAL HISTORY:

ATTACHMENTS: No documentation

IDAHO ELECTRICAL BOARD

Agenda Item No. 11a **Financial Report**

PRESENTER: C. Kelly Pearce and Kirk Weiskircher

OBJECTIVE: Review the Idaho Electrical Board's Financial Report

ACTION: Informational

BACKGROUND: This topic is addressed at all regularly scheduled Idaho Electrical Board meetings.

PROCEDURAL HISTORY:

ATTACHMENTS: Financial Report

Division of Building Safety

ELECTRICAL BOARD FUND

Fiscal Year 2012 Financial Statements

As of 8/31/2011

Statement of Revenues and Expenditures

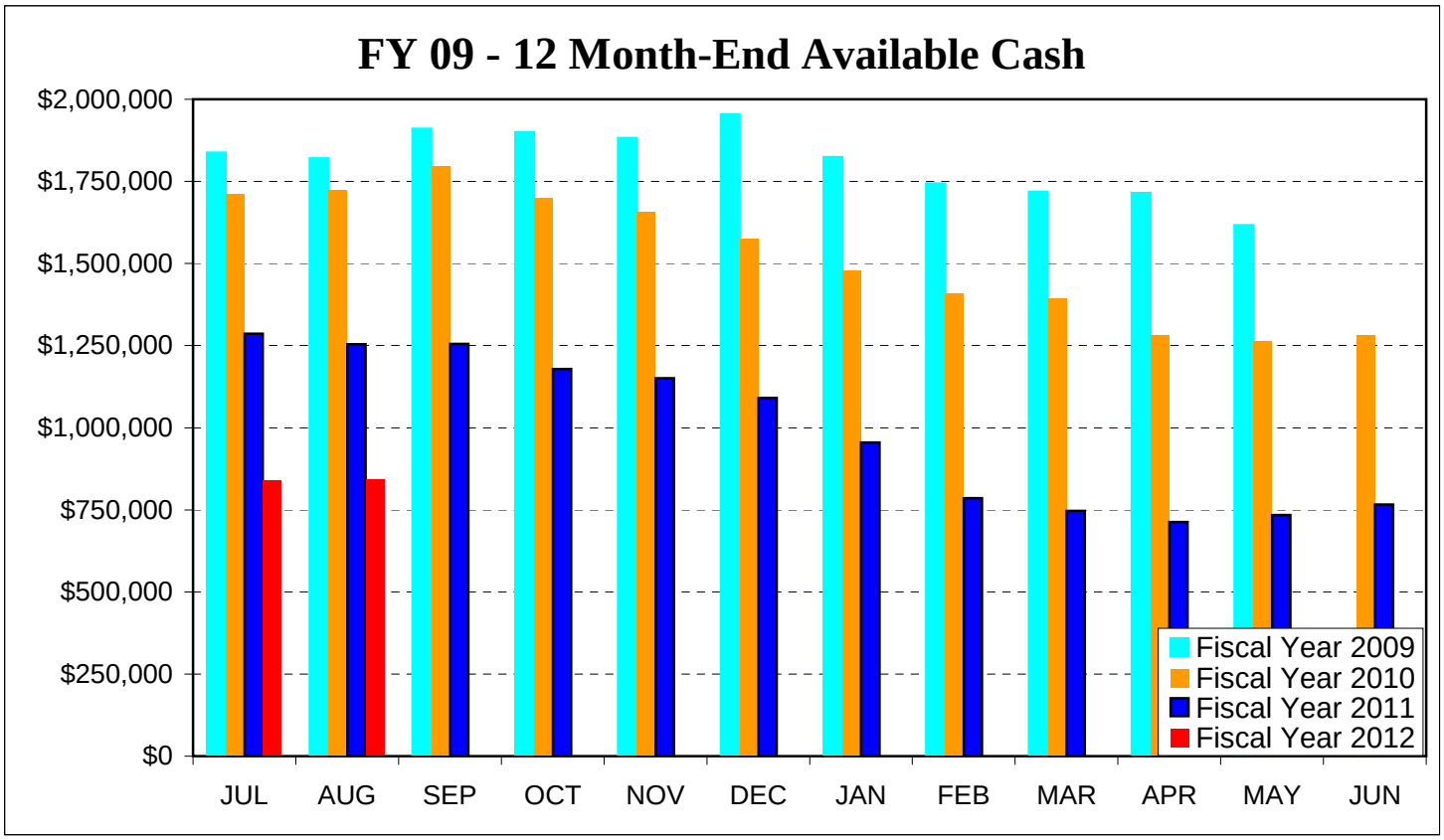
Class	Budget	Fiscal Year To Date	YTD as a % of Budget *	Remaining Budet	Projected for Remainder of Year	Projected Year End Totals	Projected Total as a % of Budget
Revenues:	2,555,000	613,163	24.0%	1,941,837	2,055,000	2,668,163	104.4%
Expenditures							
Personnel:	1,900,000	381,442	20.1%	1,518,558	1,602,300	1,983,742	104.4%
Operating:	505,000	133,726	26.5%	371,274	400,000	533,726	105.7%
Capital:	82,000	-	0.0%	82,000	82,000	82,000	100.0%
Total Expenditures	2,487,000	515,169	20.7%	1,971,831	2,084,300	2,599,469	104.5%
Net for FY 2012	68,000	97,994			(29,300)	68,694	

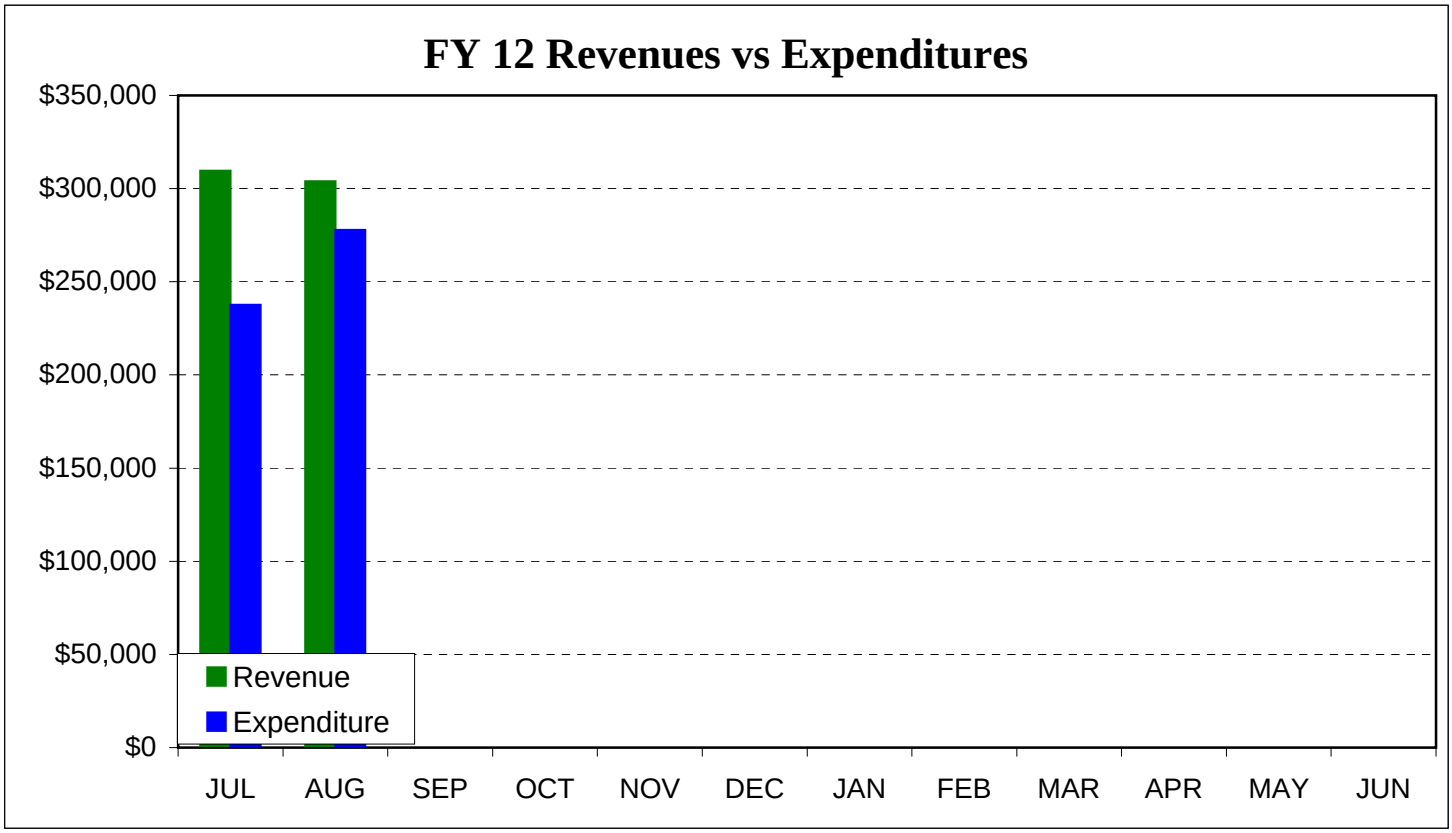
Statement of Cash Balance

July 1, 2010 Beginning Cash Available	Fiscal Year to Date Revenues	Fiscal Year to Date Expenditures and Encumbrances	Other Changes in Cash	Available Cash as of November 30, 2010	Projected Change in Cash for Remainder of Year	Projected Year End Available Cash
763,150	613,163	(515,169)	(18,844)	842,300	(29,300)	813,000

Date Prepared: 10/4/2011

ELECTRICAL BOARD FUND

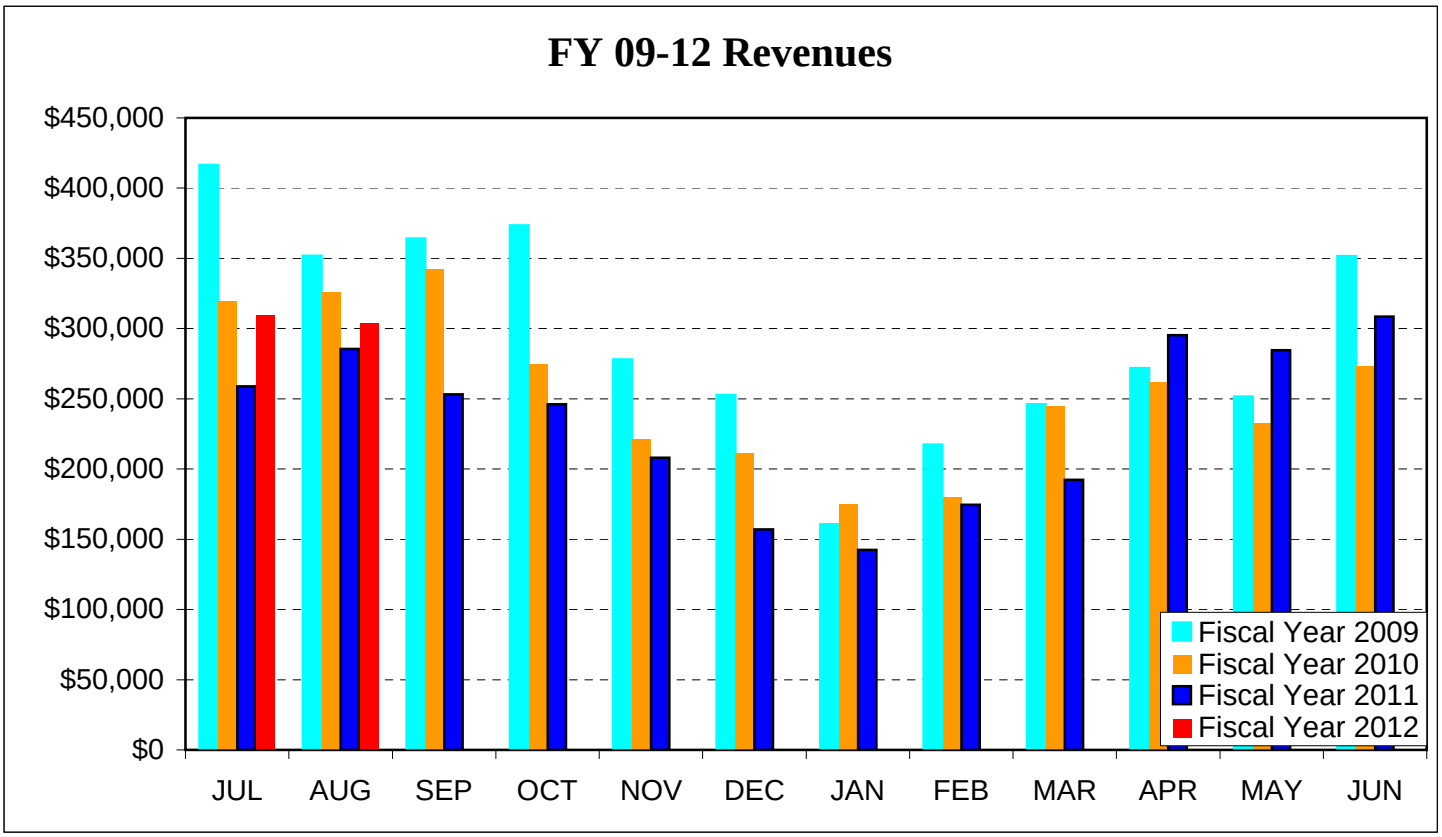


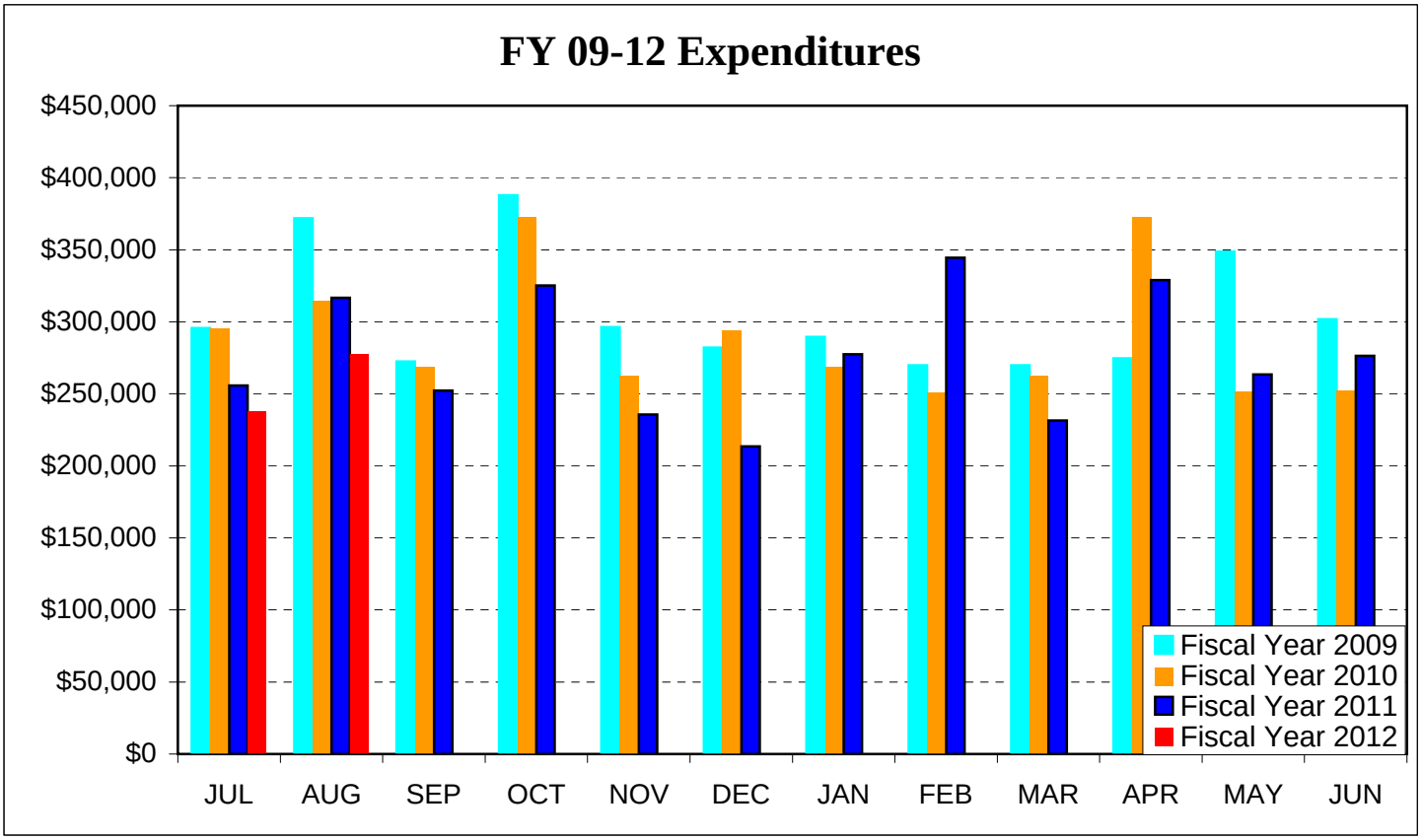


FUND 2291 As of August 31, 2011

Date Prepared: 10/4/2011

ELECTRICAL BOARD FUND





FUND **2291** As of August 31, 2011

IDAHO ELECTRICAL BOARD

Agenda Item No. 11b **Administrator**

PRESENTER: C. Kelly Pearce

OBJECTIVE: Provide the Board with an overview of the Division's current activities.

ACTION: Informational

BACKGROUND: This topic is addressed at all regularly scheduled Idaho Electrical Board meetings.

PROCEDURAL HISTORY:

ATTACHMENTS: No documentation