



High Current  
Testing of  
Molded Case  
Breakers with  
the CB 8130  
Test Set

# EDTECH 503

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## PART 1: TOPIC

### PART 1A. STATED LEARNING GOAL:

Upon completion of this lesson, the learner will be able to perform high current testing on a molded case circuit breaker in accordance with C MP 782AE, "Testing of Molded Case Circuit Breakers," Sections 4.1, 4.2 and 4.6 using the Multi-amp CB 8130, while adhering to all station safety standards and utilizing station Human Performance tools.

### PART 1B. DESCRIPTION OF AUDIENCE:

A fully qualified Electrician at Millstone is defined to be a Level 1 Electrician. This means that this individual is qualified to work in the plant independently. Currently, at Millstone, there are a number of electricians who do not fully understand the concepts behind high current testing of circuit breakers. Every electrician should know, at a minimum, how to test molded case circuit breakers. The targeted learners for this unit will be Level 1 qualified Electricians who lack specific circuit breaker testing qualifications.

### PART 1C. RATIONALE:

Currently, at Millstone, two different types of test equipment are used to perform high current testing on circuit breakers. The first, the Multi-amp MS-2, is small and portable and is used to test most circuit breakers. Because of its portability, this is the test set which is used during circuit breaker training. The second, the Multi-amp CB 8130, is a larger unit with more capacity and is used to test larger molded case circuit breakers and also the metal clad breakers used in load centers. Because of this, generally speaking, only those individual qualified to perform maintenance on metal clad breakers understand the use of the CB 8130. This leaves a large subset of workers who are qualified to test large molded case circuit breakers, but who are not familiar with the Multi-amp CB 8130. This presentation will eliminate that subset and will result in all electricians who are qualified to test circuit breakers fully proficient in both pieces of high current testing test equipment.

The overall strategy for this instruction is one hundred percent supplantive. Because of the nature of the nuclear power industry, all individual learners must conform to written procedures and guidelines. These documents make up a station standard to which all workers must adhere. In nuclear power, each task must be performed the same way by each person on site to ensure that the intent and

specifications for the maintenance has been met. For the purposes of this presentation, the instructor will present all materials to the learners and then evaluate the learners for their understanding of the material and their ability to perform the task as required per the station procedure.

My instructional strategy will be one for principle learning and will be using an expository approach. While this approach may seem odd for a class covering the procedural testing of a piece of equipment, it is important to remember that the learner is not actually learning the procedure. In nuclear power, the procedure is always present and always available for reference. In fact, during the performance of the maintenance, the technician is required to circle a procedural step, perform the step and then mark off the step after it has been completed. Given these requirements, it is not necessary that the learner memorize, or even learn the procedure. It is more important that the student learn about the breaker and how to apply the procedure to any circuit breaker encountered. Therefore, the students will be taught the concepts behind testing circuit breakers and then apply those concepts when testing the breakers with the CB 8130 test set.

## PART 2: ANALYSIS REPORT

### PART 2A. DESCRIPTION OF NEED:

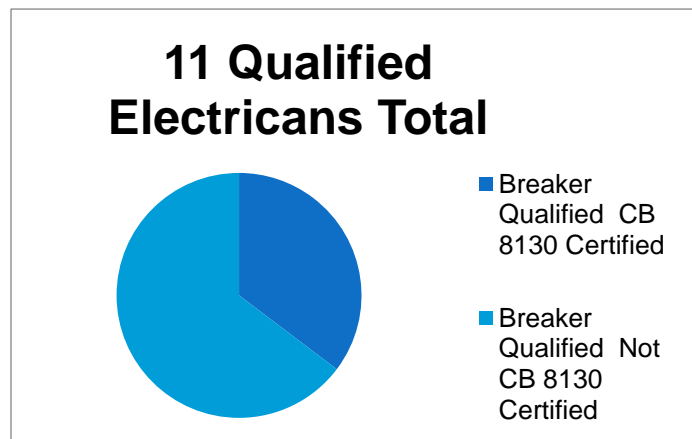
#### *PART 2A.1. NEEDS ANALYSIS SURVEY*

I distributed a hard copy needs analysis survey to the Electrical Maintenance Shop at lunch time on Monday. I provided pizza for lunch and explained the purpose of the survey to the workers. The surveys were not anonymous as I have a good rapport with the electricians having once been one. A total of 18 surveys were distributed and then picked up at lunch on Thursday. One survey was drawn at random and the individual received a ten dollar gift card to the local watering hole. Two members of the group did not participate as they were on vacation for the week. All of the workers felt they had sufficient time to complete the survey, and all expressed the desire that some sort of training be developed from the survey. As a side note, this was the first time that the workers had been polled for the purpose of developing training.

#### *PART 2A.2. NEEDS ANALYSIS DATA REPORT*

##### **Qualifications:**

The chart on the right shows the lack of CB 8130 proficiency. Over fifty percent of breaker qualified electricians are not certified to use the CB 8130 test set. One hundred percent of these individuals are certified to use the MS-2 test set. This means that there are only five individuals in the shop that are certified to test large amperage



molded case breakers. This might not be a hardship, but these 5 individuals are also the only individuals qualified to work on metal clad circuit breakers. Therefore a case could arise when the CB 8130 certified individuals might be working on a metal clad breaker and thus would affect shop production.

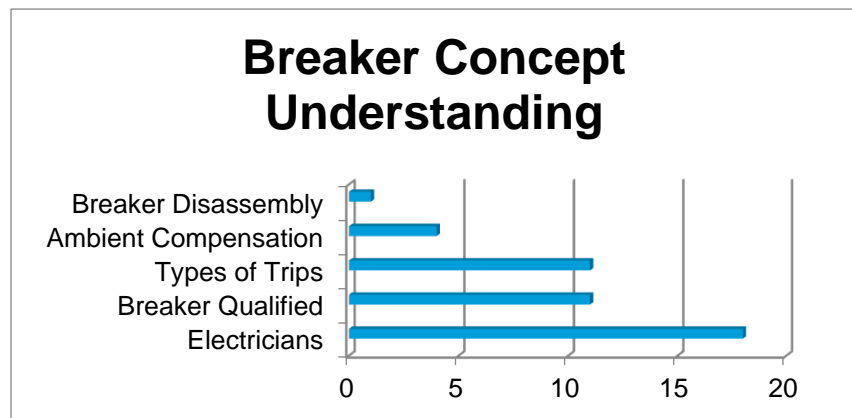
##### **Familiarity:**

The survey also revealed that every individual in the shop has at one time or another been the second man on the job during testing with the CB 8130 test set.

This makes it a perfect topic for Continuing Training. The worker's have been around the equipment as it has been operated and thus bring a level of comfort with them to the training, which will facilitate learning. Additionally, by assisting as the second man on the job, all workers will be familiar with the procedure being used, and the expectations to adhere to plant safety standards.

### Shop Weakness:

Lastly, the survey results confirmed one of my suspicions. The chart on the right points out a tremendous weakness in the area of understanding circuit breaker concepts. Out of the 18 electricians



who took the survey, (including 11 who are fully qualified to maintain circuit breakers) only four understood the concept of ambient compensation and only one had ever taken this type of breaker apart. These concepts should be fundamental knowledge for all electricians and certainly for all electricians who are breaker qualified.

## PART 2B. DESCRIPTION OF LEARNING CONTEXT:

### PART 2B.1. LEARNING CONTEXT:

The instruction will take place in the site's breaker overhaul facility. This site is equipped with general hand tools as well as the specific tools required for circuit breaker maintenance. The facility is equipped with a 480 volt feed which is used to power the CB 8130 test set, and a desktop computer for printing and verifying the procedure revision. The course will be presented via a fifty inch flat screen television connected to the computer. The training will take place during regular working hours. Each group being taught will consist of 4 electricians and an electrical supervisor. An effort shall be made to ensure that there are differing experience levels between the workers, although plant maintenance needs may dictate otherwise. The instructor shall be a qualified INPO (Institute of Nuclear Power Operators) instructor with previous qualification on circuit breakers and CB 8130 certification.

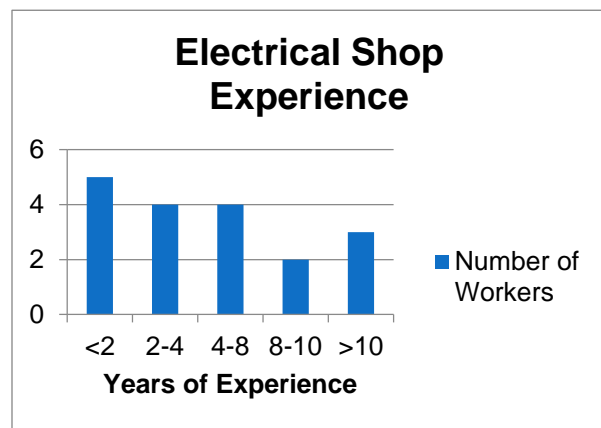
### PART 2B.2. TRANSFER CONTEXT:

As the instruction is taking place in the site's breaker overhaul facility, the workers will be learning in the same location in which they will perform their Task Performance Evaluation. This is also the same location in which they will be performing the majority of their work. During refueling outages, the test set is moved into the radiological controlled area to minimize the time required for transferring breakers.

In each location, the same safety rules apply. In fact, it is most important that the workers practice as they are required to play. Safety and Human Performance Standards must be followed on each job, and it is important that expectations are duplicated in the learning environment. Therefore Personal Protective Equipment shall be worn at all times when working on the breaker. This requirement may be relaxed during the classroom phase of the presentation. These safety rules apply to all personnel who enter the classroom. It is important that any training observer, should they not have the required PPE, be issued this equipment prior to starting their observation.

#### **PART 2C. DESCRIPTION OF LEARNERS:**

For obvious workplace reasons, no inquiries were made as to the ages of the workers. Instead, the workers were questioned as to their years of experience at Millstone Station. Previous experience in the electrical trade was not counted because, in general, the work of a power plant electrician varies greatly from the work of a licensed electrician. As the graph



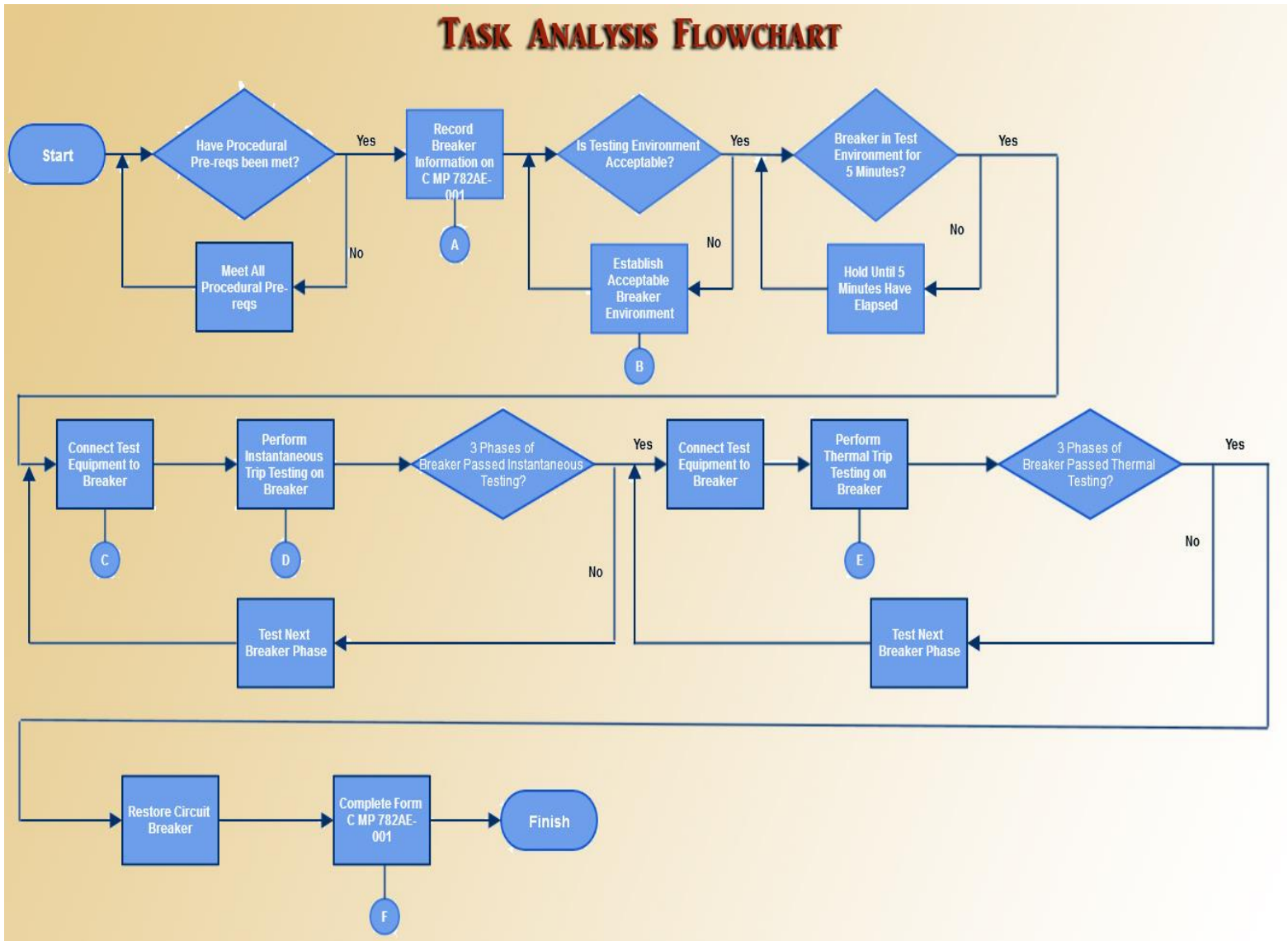
on the right illustrates, the majority of the electricians have less than eight years experience. The reasons for this are twofold. Approximately eight years ago, the company offered a buyout for site personnel. The result was that a number of experienced electricians left the site to be replaced by new hires. This combined with the aging nuclear workforce and normal turnover have left the shop with minimal experience. The workers with less than two years experience have recently completed a 3 month program which introduced them to nuclear power. As previously mentioned, every effort shall be made to include different experience levels in each session. This diversity ensures that pertinent operating experience is passed on to those members of the shop with less experience.

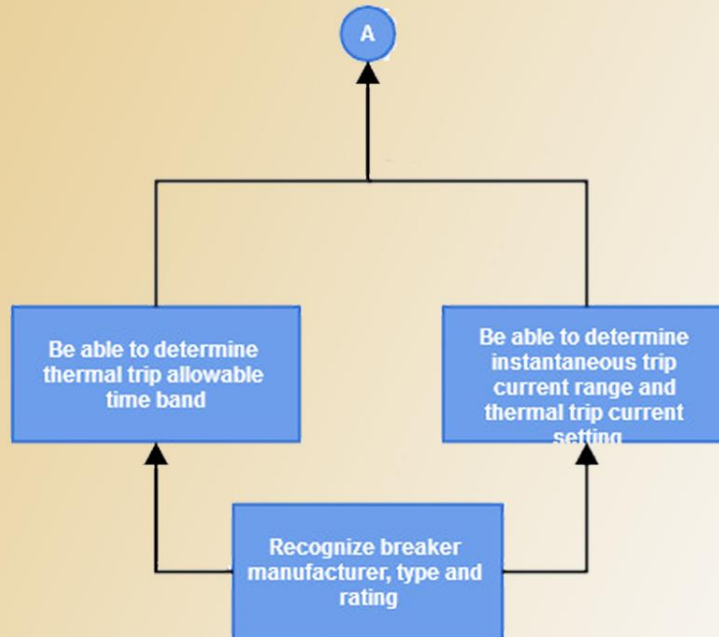
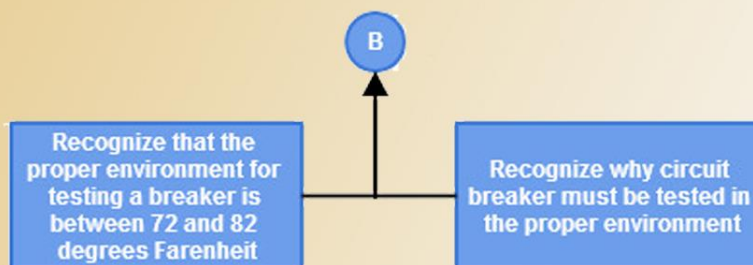
It is important to engage this group with anecdotes. Past personal experiences accomplish two goals. The first is that the instructor will gain the respect of the

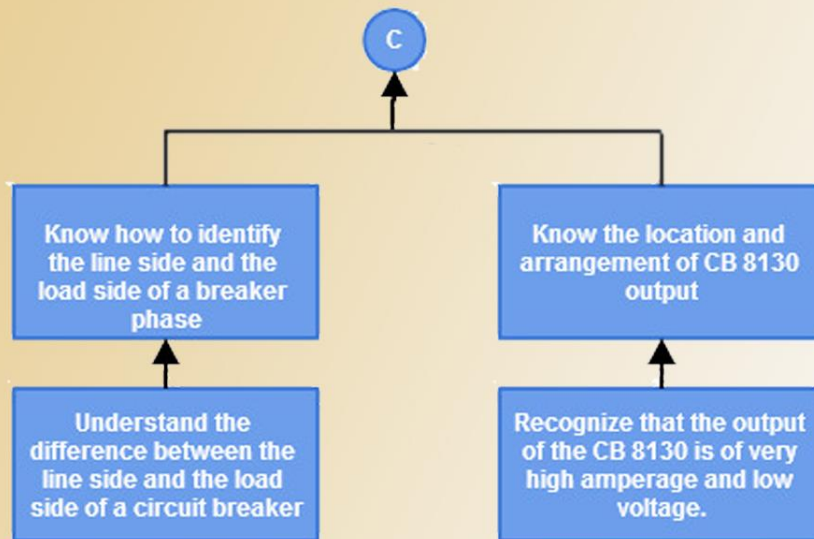
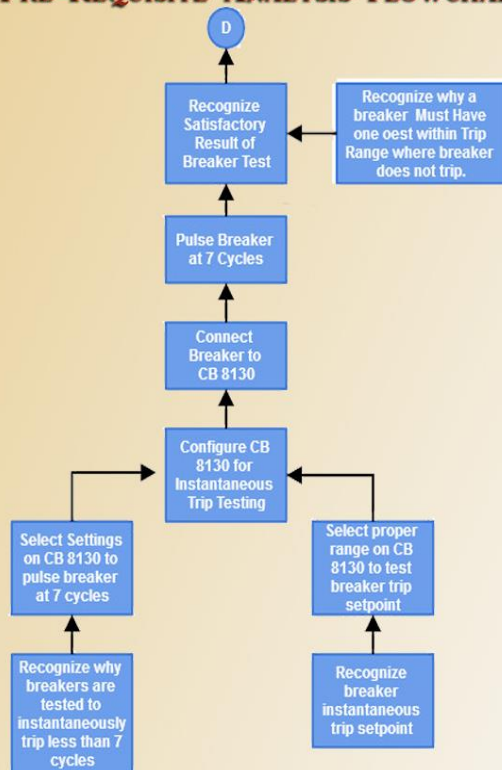
workers because he has done their job before and done it well. The second is that by relating past experiences, the instructor provides insight in what not to do on the job. The “what not to do” factor is important. As always, the goal of the power station is not to make the same mistake twice.

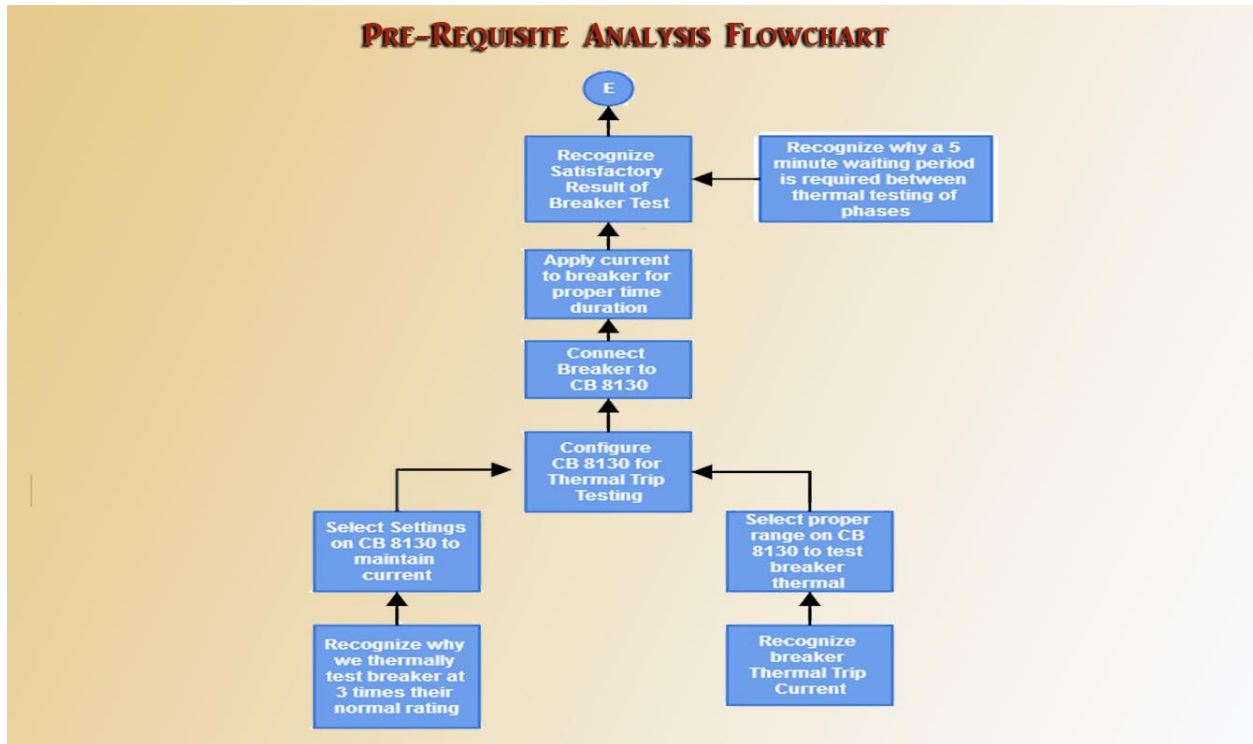
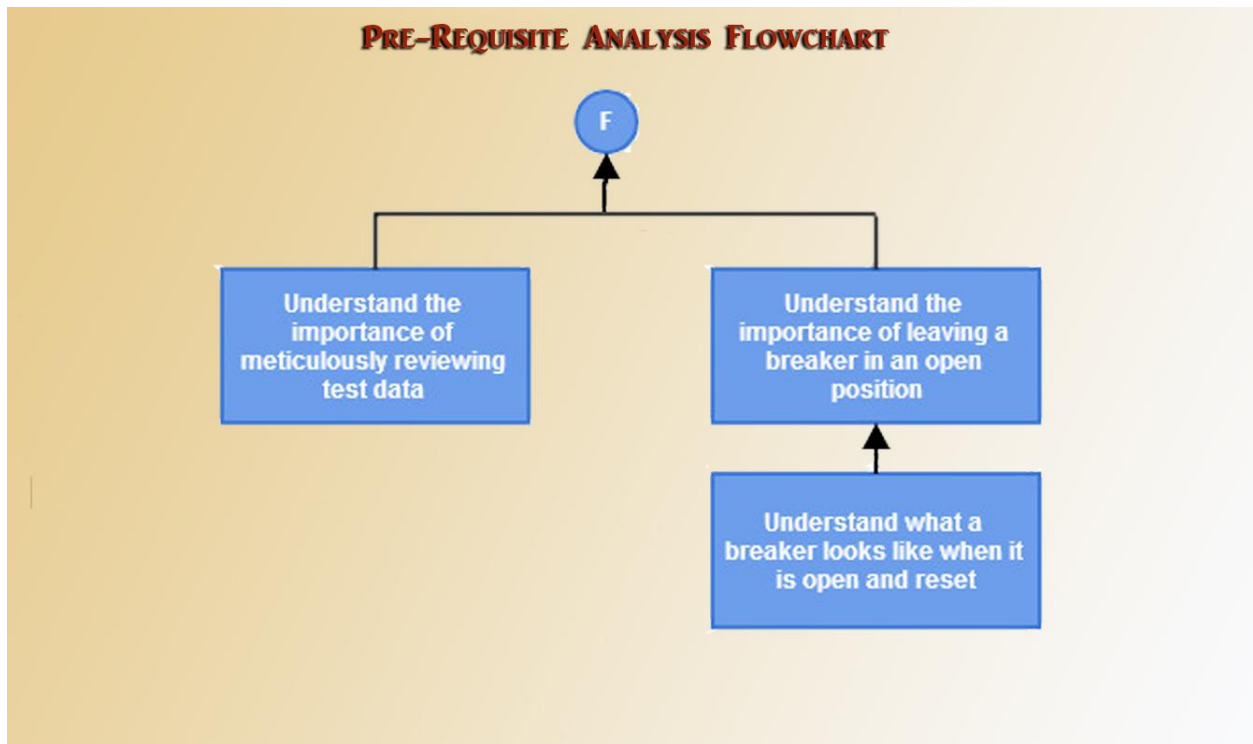


PART 2D. TASK ANALYSIS FLOWCHARTS:



**PRE-REQUISITE ANALYSIS FLOWCHART****PRE-REQUISITE ANALYSIS FLOWCHART**

**PRE-REQUISITE ANALYSIS FLOWCHART****PRE-REQUISITE ANALYSIS FLOWCHART**

**PRE-REQUISITE ANALYSIS FLOWCHART****PRE-REQUISITE ANALYSIS FLOWCHART**

## PART 3: PLANNING

### PART 3A. LEARNING OBJECTIVES LIST:

Upon completion of the modules, the learner will be able to:

1. State the safety precautions which are required when testing molded case circuit breakers.
2. State the faults that are protected against with both thermal and magnetic circuit breaker trips.
3. Explain why a circuit breakers are ambient compensated.
4. Explain the differences between a thermal and magnetic circuit breaker trips.
5. Determine a molded case breaker's rating.
6. Determine the instantaneous trip point of a molded case circuit breaker in accordance with C MP 782AE.
7. Determine the thermal overload test current of a molded case circuit breaker in accordance with C MP 782AE.
8. Describe and demonstrate connecting the Multi-amp CB 8130 to a molded case circuit breaker for circuit breaker high current testing in accordance with C MP 782AE.
9. Describe and demonstrate the setup of the Multi-amp CB 8130 in accordance with C MP 782AE for both thermal and instantaneous circuit breaker high current testing.
10. Explain the purpose of the 5 minute wait between phases during thermal trip testing.
11. Identify the three states of a molded case circuit breaker.
12. Demonstrate the ability to perform high current testing of molded case circuit breakers.

**PART 3B. MATRIX OF OBJECTIVES, BLOOM'S TAXONOMY, AND ASSESSMENT PLAN:**

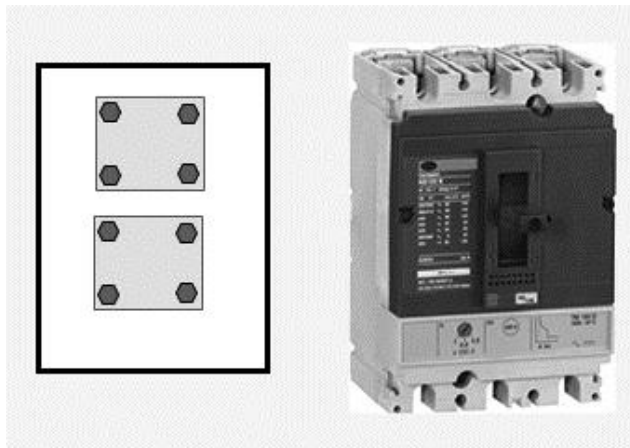
<b>Learning Objectives</b>	<b>Bloom's Taxonomy Classification</b>	<b>Format of Assessment</b>	<b>Description of Test Form</b>	<b>Sample Items (See Below)</b>
<b>1</b>	KNOWLEDGE	Written Exam	Short Answer	1
<b>2</b>	KNOWLEDGE	Written Exam	Fill In The Blanks	2
<b>3</b>	COMPREHENSION	Written Exam	Short Answer	3,4
<b>4</b>	COMPREHENSION	Written Exam	Short Answer	5,6
<b>5</b>	APPLICATION	Performance	Task Performance Evaluation	11
<b>6</b>	APPLICATION	Performance	Task Performance Evaluation	11
<b>7</b>	APPLICATION	Performance	Task Performance Evaluation	11
<b>8</b>	COMPREHENSION / APPLICATION	Written Exam / Performance	Short Answer / Task Performance Evaluation	8,11
<b>9</b>	COMPREHENSION / APPLICATION	Written Exam / Performance	Illustration / Task Performance Evaluation	9,11
<b>10</b>	COMPREHENSION	Written Exam	Short Answer	7
<b>11</b>	COMPREHENSION	Written Exam	Matching	10
<b>12</b>	APPLICATION	Performance	Task Performance Evaluation	11

**Assessment:**

Student assessment will take place in two parts. The first portion will be a ten question test. The second portion will be a formal Task Performance Evaluation. For the written exam, a grade of 80 percent or higher will be considered passing. Anything less than 80 percent correct will be considered a failure. During the Task Performance Evaluation, the only passing result is perfection. The student must follow the procedure to test the breaker observing all applicable station safety and human performance standards.

**Written Exam**

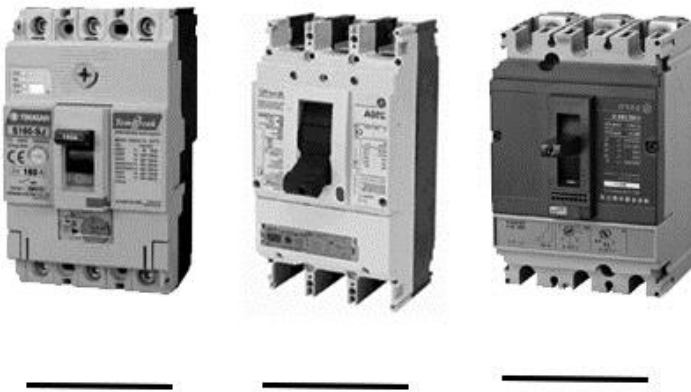
1. What PPE (Personal Protective Equipment) is required when performing High Current Testing on a molded case circuit breaker?
2. Given the following faults, identify the type of trip, thermal or instantaneous, which provides circuit protection.
  - a) Motor Overload
  - b) Short Circuit
  - c) Circuit Ground
  - d) Line Undervoltage
3. Why are circuit breakers ambient compensated?
4. How is ambient compensation accounted for during High Current Testing of molded case circuit breakers?
5. Describe how a short circuit causes a circuit breaker to trip.
6. Describe how a motor overload causes a circuit breaker to trip.
7. When performing thermal overload testing, why is there a 5 minute wait between testing each phase?
8. Given the drawing below, connect the circuit breaker to the Multi-amp CB 8130 for testing.



9. Given a 600 Amp molded case circuit breaker to test. Check all appropriate control buttons to select in order to perform thermal overload testing.

Amperage	Duration	Display
200A _____	Pulse _____	Memory _____
2kA _____	Maintain _____	Continuous _____
20kA _____		Cycles _____
200kA _____		Seconds _____

10. Identify the condition of the circuit breaker from the image.



### Task Performance Evaluation

11. Given a copy of C MP 782AE and a molded case circuit breaker, perform all High Current Testing on that breaker using the Multi-amp CB 8130, while utilizing all safety precautions and applicable Human Performance Tools.



**PART 3C. ARCS TABLE:**

**Project Goal Statement:** Upon completion of this lesson, the learner will be able to perform high current testing on a molded case circuit breaker in accordance with C MP 782AE, "Testing of Molded Case Circuit Breakers," Sections 4.1, 4.2 and 4.6 using the Multi-amp CB 8130, while adhering to all station safety standards and utilizing station Human Performance tools.

**ATTENTION****A.1 Perceptual Arousal**

The Instructor will explain to the students that learning the CB 8130 is the gateway to more qualification. The CB 8130 is the machine used to test all metal clad breakers as well as the larger molded case circuit breakers, and that learning this machine will most certainly lead to eventual metal clad breaker qualification. Explain to the students that more qualification means more money. Additionally, point out to the students that at the end of this course, they will be participating in a TPE for actual certification in the use of the CB8130.

**A.2 Inquiry Arousal**

The Instructor will explain to the students that they are actually going to find out how a molded case circuit breaker works. Inform the students that the results of their survey highlighted that only one of their peers had ever seen the inside of a circuit breaker. Additionally, inform the students that they will be learning how the breaker functions so that they understand the testing process and are not just pushing buttons for results. Lastly, point out that they will be learning a technique in the class which will minimize the time they spend testing any breaker and will add to their efficiency as they perform their work.

**A.3 Variability**

It is important to remember that these are Maintenance Electricians in the classroom. They are, in general, hands on people. If the instructor simply runs through a litany of slides while reading from the lesson plan, they will quickly lose interest and tune out. The instructor should concentrate on getting them out of their seats, on average, every 15 minutes. If a question is raised, remember to show and not tell. Have a molded case circuit breaker front and center in the classroom. Technicians are a "trust but verify" type of learner. They will be skeptical if you merely tell them the answer, but will maintain interest and be incredibly receptive if you show them the answer using the equipment.

**RELEVANCE****R.1 Goal Orientation**

The primary goal of this training is to produce technicians certified to use the CB 8130 High Current Test set, however, it is important to remember that the instructor is teaching for understanding. The procedure, C MP 782AE, will essentially walk the student through testing a circuit breaker. Whereas the procedure will direct the student as to the arrangement of the equipment and the test sequence to follow, it will not explain the reason for each step. It is vital that each student understands the “why” of what they’re doing and are not merely reacting to a set of written instructions. It is important to remember that INPO’s SOER 10-2 advocated that nuclear plant workers be part of an “engaged, thinking organization.”

**R.2 Motive Matching**

The Instructor must remember to encourage peer to peer coaching. Always give the students the first opportunity to coach their fellow workers in the areas of safety and human performance. The concept of “play as you practice must be reinforced. Remind the students that they should consider the classroom as an in plant scenario and all safety and human performance rules apply. If a lapse occurs, give the students an opportunity to coach each other. If coaching does not occur, stop the evolution and ask one of the peers what the performer has done wrong. Then inquire why, if they noticed the lapse, they did not provide coaching. It is vital that the worker’s aversion to peer to peer coaching be overcome. Reinforce to the students that they are not playing “Gotcha” but are simply protecting their co-workers as they would want to be protected.

**R.3 Familiarity**

The instructor should reiterate throughout the class that the methodology to testing a breaker is the same, regardless of the test equipment. Let the students know that their survey results revealed that all of them at one time or another had been present when circuit breakers had been tested. When introducing the CB 8130, remember to relate its controls to that of the MS2 test set. Reinforce that all high current testing equipment essentially have the same controls: a control to select the amperage scale, a selector switch to determine whether a constant current or a current pulse will be applied and a rheostat that adjusts the magnitude of current coming from the machine. In order to maintain the attention of those who are already certified to use the MS 2 machine, the instructor should address that while the machines are similar, there are some differences. Also include that the course is going to cover the inner workings of a circuit breaker that the experienced students may not have seen before.

**CONFIDENCE****C.1 Learning Requirements**

The Instructor should reinforce with the learners that, although the piece of equipment is large and looks imposing, it is no more complicated than the MS 2 test set that most of them regularly use. The instructor should also inform the students that by becoming certified in this equipment, they are adding to the versatility of the shop as a whole. Cite the example that most people qualified to use the CB 8130 are also qualified metal clad breakers which leads to a restriction in shop resources when a metal clad breaker requires maintenance. By adding this certification, they are not only helping themselves, but they are helping their peers as well.

**C.2 Success Opportunities**

The Instructor should use this theme of becoming a shop asset throughout their presentation. The “Help Others” message should be stressed as a number of the students will be new hires with very few qualifications. Point out that by learning to test breakers, their qualifications will allow many jobs to go in parallel and that they will be directly responsible for more work getting done. Also make sure the students not qualified other specific breakers understand that this is their gateway to further qualifications thereby increasing their usefulness to the shop.

**C.3 Personal Control**

The instructor should provide an overview of the TPE process prior to breaking the students up into their lab groups. The fact that the students will be fully certified to work on their own following this TPE should be stressed as well as the fact that they will be required to perform their TPE without any help or peer coaching. Reassure them that they will be complying to safety rules because the instructors will be there, but they should know that they pass or fail based on their own work and knowledge and not the assistance of their partners. Additionally point out that during an outage situation, they may very well be the only individual on a team that is certified to use this equipment, and that for this reason, they are required to perform this TPE solo.

**SATISFACTION****S.1 Natural Consequences**

The instructor should inform the students (and follow up) that they will be reviewing the schedule and making recommendations to Line Supervision as to the availability for the students to follow on and actually perform the work for which they are newly qualified. Also inform them that, as their instructor, you will be performing various job observations to ensure that the training that they have received in this class is germane and adequate. Lastly, inform them that you will be providing feedback to their supervision based on these observations to reaffirm that they are well qualified for the tasks which they are performing.

**S.2 Positive Consequences**

The learner's successes will be reinforced in two ways. The first reinforcement will come when the student successfully passes the TPE and gains certification. More positive reinforcement will come in the form of supervisor praise after they have successfully completed this task on their own. It is vital that the instructor reach out to supervision and provide this feedback. All too often, successful completion of a class is overlooked by the line. It is important that the shop, as a whole, celebrate the successes of the newly trained after they have performed the task for which they were trained.

**S.3 Equity**

During the aforementioned job observations, it is important that the instructor be supportive of the students. Positive feedback should be provided in front of their peers to reinforce the good things that have been taken away from this training. Any deltas to excellence should be fed back privately and only after positive feedback has been given.

## PART 4: INSTRUCTOR GUIDE

### Introduction

#### *Gain Attention*

Open the class with a review of plant status for the day. Be sure to cite the protected train for each unit and ensure that the class repeats back the protected train. Review any pertinent Condition Reports from the night before.

Review the safety expectations for the room. Call on a single student to conduct a two minute timeout which includes the relative hazards in the room, the mitigation strategies and the exit route in the event of an emergency. Relate a personal anecdote on the value of being prepared. Provide a 5 minute break for the students to get up and get coffee.

#### *Inform Learners of Purpose*

Review the Terminal and Enabling Objectives with the student. Be sure to include a slide listing the objectives. It is vital that the instructor face the class while delivering and expanding upon the objectives. This behavior holds true for the entire presentation. Remember that the class is not embedded on the white board, they are in front of you. Nothing will lose a class faster than having an instructor reading the objectives from a board. Be sure to paraphrase the objectives after they are read. Expand upon them to make them personal to the learners.

#### *Arouse Interest and Motivation*

Inform the students that not only will they learn how to perform high current testing by injecting thousands of amps into a circuit breaker, but that they will actually be opening a circuit breaker to examine how the internals of the breaker function. Inform them that at the completion of the course, they will each be certified to test circuit breakers using the CB 8130. Inform them that this certification is the gateway to more qualifications in metal clad breakers and that more qualifications equate to more money.

#### *Preview the Learning Activity*

Explain the class layout to the students.

The first hour of class will be spent discussing circuit breakers in general. Topics to be covered:

- The various faults that circuit breakers protect against and how the breaker provides protection against these faults.
- How a circuit breaker works including the mechanical parts inside of the breaker.
- How a circuit breaker trips to provide protection for the downstream load.
- How one determines a circuit breaker rating and the condition of a breaker.
- What is ambient compensation and why do we ambient compensate our breakers.

The second hour of class will be spent covering high current testing of a circuit breaker using the CB 8130. Topics to be covered:

- Overview of the CB 8130 Test Set
- Determining Instantaneous Current Trip Range and Thermal Test Current
- Connecting a Circuit Breaker to the CB 8130 Test Set
- Performing an Instantaneous Trip Test of a Molded Case Circuit Breaker
- Performing a Thermal Overload Test of a Molded Case Circuit Breaker.

Lastly the students will be testing circuit breakers in a lab environment.

Upon completion of Lab Time, the students will then be asked a TPE on the testing of circuit breakers.

## Body

### *Recall Relevant Prior Knowledge*

#### *Show Slide 1*

Begin with a discussion of the purpose of a circuit breaker. Discuss the following facts:

- Circuit Breakers provide a means of quick current interruption in the event of a fault or overload condition.
- Circuit Breakers provide a means of quenching an arc thus interrupting a current path.
- Circuit Breakers provide a means of resetting and restoring a load after an overload or fault condition occurs.

### *Present Information and Examples*

#### *Show Slide 2*

Discuss and expand upon the types of faults that circuit breakers protect against. Discuss with the students whether each type of fault would be protected by instantaneous or thermal overload protection.

*Show Slide 3*

#### Phase to Phase Short

- Discuss what a phase to phase short is
- Symptoms:
  - High rate of current increase.
  - Damage can occur to cables and the load
  - Catastrophic failure mechanism
- Protective Measures
  - Instantaneous Trip of the circuit breaker

*Show Slide 4*

#### Undervoltage Condition

- Discuss why an undervoltage condition will result in a trip ( $\text{Power} = \text{Volts} \times \text{Amps}$ )
- Symptoms:
  - Load Runs Hot.
  - Damage can occur to and the load
  - Can result in stator winding damage due to expansion of rotor
- Protective Measures
  - Thermal Trip of the circuit breaker

*Show Slide 5*

#### Motor Ground

- Discuss what a ground is and the different indications of a ground in a grounded and ungrounded system.
- Symptoms:
  - High Rate of current increase
  - Damage can occur to cables or the load depending on where the ground occurs
  - Catastrophic failure mechanism in some cases
- Protective Measures
  - Instantaneous Trip of the circuit breaker

*Show Slide 6*

## Motor Overload

- Discuss some things which could cause a motor to become overloaded.
  - Binding of pump shaft
  - Excessive flow in a fan motor
  - Restrictive flow in a fluid system
- Symptoms:
  - Motor runs hot.
  - Damage could occur to the pump or fan
  - Small amounts of binding may lead to a small overcurrent condition which could trip the breaker over time.
- Protective Measures
  - Thermal Trip of the circuit breaker

### *Show Slide 7*

## Thermal Trips

- Discuss what causes a circuit breaker to trip on thermal overload
- Topics
  - What is a bimetallic strip.
  - How does a bimetallic strip cause a circuit breaker to trip
  - Why do we have to wait to reset a breaker after a thermal trip (include 5 minute waiting period when testing circuit breakers)

### *Show Slide 8*

- Testing Mechanism for Thermal Trip Testing
  - Explain a circuit breaker trip curve.
  - Explain why we choose 3X current for thermally testing our breakers.
  - Explain Ambient Compensation

### *Show Slide 9*

## Instantaneous Trips

- Discuss what causes a circuit breaker to trip instantaneously
- Topics
  - Discuss how magnetic field induced in a coil is proportional to the current passing through the wire that generates the field.
  - How does magnetic field cause a circuit breaker to trip
  - Why don't we have to wait to reset a breaker after an instantaneous
  -



*Show Slide 10*

- Testing Mechanism for Instantaneous Trip Testing
  - Explain the two trip minimum for instantaneous testing of circuit breakers.

*Gain Attention*

Gather the class around the front table. Remove the front cover from a 3 pole molded case circuit breaker. Cycle the breaker from open to close to open. Repeat explaining the internals of the breaker. Show the students how the breaker latches closed and how it is manually opened, opened by an instantaneous trip and opened by a thermal trip. Ask them to predict how the breaker will trip when its trip pushbutton is pushed and why.

*10 Minute Break*

*Employ Learning Strategies*

*Show Slide 11*

Determining Circuit Breaker Rating

Place 5 circuit breakers on a table. Have the students determine the following for each breaker and explain their answers

- Breaker Manufacturer
- Breaker Catalog Number
- Number of Poles
- Breaker Voltage Rating
- Breaker Current Rating.
- Condition of the breaker (Open, Closed, Tripped)

Because of the diversified experience level in the class, this is something that the students should be able to do collectively. Ensure that the less experienced take part in the exercise by asking them to justify their peer's responses.

*Show Slide 12*

Given the appropriate appendix from C MP 782AE, have the students determine the following from the procedure.

- Instantaneous Trip Range
- Thermal Test Current

Be sure that the students can justify their answers. Follow up with questions such as, “How would the currents differ if this were a two pole breaker?”

### CB 8130 Setup Training

Show the slide of the CB 8130 controls, step through the slideshow highlighting each one of the controls. Do not forget to point out that the control wheel is bidirectional for current increase. Following this review, ask the students how they would set up the CB 8130 for Instantaneous Testing, For Thermal Testing. Be sure to cover that the breaker’s internal resistance will change during thermal testing making it necessary to adjust the current level manually during the test.

Ask the students how they would connect the breaker to the CB 8130. Discuss the use of welding leads to connect the breaker.

### *Guide Practice*

Give Safety Brief and Task Preview for using the CB 8130. Include notifying peers when energizing the CB 8130.

Divide the class into three groups of two. Base these groups on experience. Each pair should include an experienced individual and a less experienced individual.

The **first group** will complete the data sheet in accordance with the procedure and connect the breaker to the CB 8130. Bring the breaker in from outside the test environment to ensure the students remember the 5 minute waiting period in accordance with the procedure.

The **second group** will perform the instantaneous trip test for each phase. Things to look for in this exercise:

- Improper Place Keeping
- Leaving the breaker open at the end of a trip test resulting in the inability to test the next phase (very common mistake, let them make it so that they learn for themselves. Let them find the answer)
- Lack of notifying the class that the CB 8130 will be energized.
- Not performing the mandatory two tests within the trip range.

The third group will be responsible for performing the thermal current trip testing. Things to look for in this exercise:

- Attempting to reset the breaker too soon.

- Leaving the breaker open at the end of the test resulting in the inability to test the next phase.
- Lack of notifying the class that the CB 8130 will be energized.
- Failure to adjust the current level during the test to maintain a constant test current.
- Incorrect settings on the CB 8130 resulting in the inability to monitor current while test is in progress.

### *Provide Feedback*

First provide opportunities for peer to peer coaching. Ask each group what the other groups did wrong, right. Ask each group to evaluate their performance. Provide feedback for each group.

Repeat this exercise with each group doing a complete test of one phase of a breaker.

Provide feedback as appropriate.

### **Conclusion**

#### *Provide Review*

Provide a brief review of material that was covered. Ensure the material presented covers the objectives in broad scope and the inquiries made to the students cover the specifics. The second portion of the review should be a question and answer format where the instructor asks questions and the students provide answers. Be sure to include questions on the setup of the CB.8130. The last portion of the review should allow the students to ask any questions they have so that points can be clarified, expanded upon.

#### *Enhance Transfer*

Have the students play the Nuclear Squares game on the Nuclear Training.net website. (Note: This is my own website which will have a tic-tac-toe game available to cover the material.)

#### *Remotivate and Close*

Inform the students that they will now take a ten question exam. The instructor should ensure that the students know that there is nothing tricky on the exam, that it is very

straight forward. Also inform the students that following the successful completion of the exam, they will receive a date and time for their Task Performance Evaluation.

*Assess Learning / Provide Feedback and Remediation*

Administer the exam in Section 3B.

Review any missed questions with the individual student, making sure to understand why they answered the question the way they did.

Any student scoring less than 80% will require documented remediation and supervisory notification.

## ATTACHMENT 1

### Survey Questions and Results

1. How many years have you worked at Millstone Power Station?
  - a. Less than two years.
  - b. Two to Four years.
  - c. Four to Eight years.
  - d. Eight to Ten years.
  - e. Greater than Ten years.
2. Are you qualified to perform MCC Starter testing?
  - a. Yes
  - b. No
3. Are you qualified to perform High Current Testing on Molded Case Circuit Breakers?
  - a. Yes
  - b. No
4. Are you qualified to perform maintenance on ABB Metal Clad Circuit Breakers?
  - a. Yes
  - b. No
5. Are you qualified to perform maintenance on GE Metal Clad Circuit Breakers?
  - a. Yes
  - b. No
6. Have you tested molded case circuit breakers using the Multi-amp MS2 (Suitcase) Test Set?
  - a. Yes
  - b. No
7. Have you tested molded case circuit breakers using the Multi-amp CB-8130 (Mule) Test Set?
  - a. Yes
  - b. No
8. Do you understand the different types of circuit breaker trips?
  - a. Yes
  - b. No
9. Do you understand the concept of ambient compensation for circuit breakers?
  - a. Yes
  - b. No
10. Have you ever disassembled a molded case circuit breaker?
  - a. Yes
  - b. No
11. Have you ever been the second man when someone was performing High Current Testing using the CB 8130 test set?
  - a. Yes
  - b. No

Survey Data Table

	Question 1					Question 2		Question 3		Question 4		Question 5	
	<2	2-4	4-8	8-10	>10	Yes	No	Yes	No	Yes	No	Yes	No
Adkins			x				X		X		X		X
Barnett					X	X		X		X			X
A. Campagna			X			X		X		X			X
Falcone			X			X		X		X		X	
Kollar		X					X	X			X		X
Laurion		X					X	X			X	X	
Mandeville		X				X		X			X		X
Moreau					X	X		X		X		X	
Morse		X				X		X			X		X
Rickey				X		X		X			X		X
Roberts				X			X		X		X		X
Seckla			X			X		X			X	X	
Surprenant					X	X		X		X			X
Flynn	X						X		X		X		X
Rizzi	X						X		X		X		X
Campagna	X						X		X		X		X
Domina	X						X		X		X		X
Startz	X						X		X		X		X

	Question 6		Question 7		Question 8		Question 9		Question 10		Question 11	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Adkins		X		X		X		X		X	X	
Barnett	X		X		X			X		X	X	
A. Campagna	X			X	X			X		X	X	
Falcone	X		X		X			X		X	X	
Kollar	X			X	X			X		X	X	
Laurion	X		X		X			X		X	X	
Mandeville	X			X	X			X		X	X	
Moreau	X		X		X		X			X	X	
Morse	X			X	X		X			X	X	
Rickey	X			X	X			X		X	X	
Roberts		X		X		X		X		X	X	
Seckla	X		X		X		X			X	X	
Surprenant	X		X		X		X		X		X	
Flynn		X		X		X		X		X	X	
Rizzi		X		X		X		X		X	X	
Campagna		X		X		X		X		X	X	
Domina		X		X		X		X		X	X	
Startz		X		X		X		X		X	X	