



# Study Guide for System Operator

Test Numbers: 2869 & 4812

Human Resources  
Performance Assessment Services  
Southern California Edison  
An Edison International Company

REV 08/2010

## Introduction

The System Operator Knowledge **Test # 2869** is a job knowledge test designed to cover the major knowledge areas necessary to perform the job. The System Operator Performance **Test # 4812** is a performance test designed to simulate the skills needed by a System Operator.

You will first have to pass the System Operator Knowledge Test # 2869 before you can be scheduled to take the System Operator Performance Test # 4812.

This Guide contains strategies to use for taking tests and a study outline, which includes knowledge categories, major job activities, and study references.

### Test Session

It is important that you follow the directions of the Test Administrator exactly. If you have any questions about the testing session, be sure to ask the Test Administrator before the testing begins. During testing, you may **NOT** leave the room, talk, smoke, eat, or drink. Since some tests take several hours, you should consider these factors before the test begins.

**All cellular/mobile phones, pagers or other electronic equipment will NOT be allowed in the testing area.**

#### System Operator Knowledge Test # 2869

All questions on this test are multiple-choice or hot spot questions. Multiple choice questions have four possible answers. Hot spot questions have a picture, and you must click the correct spot on the picture to answer the question. All knowledge tests will be taken on the computer. For more information on this, please see the next section of this study guide on *Computer Based Testing*.

- The System Operator Knowledge Test # 2869 has a **three hour** time limit. **No test aids are permitted during the test.**

You will receive a Test Comment form so that you can make comments about test questions. Write any comments you have and turn it in with your test when you are done.

#### System Operator Performance Test # 4812

The System Operator Performance Test #4812 will allow you to demonstrate your ability to write programs for routine switching. The test simulates the skills needed by a System Operator, and was based on a thorough analysis of the System Operator job.

The System Operator Performance Test is composed of four program requests that require you to write detailed step-by-step programs for Distribution equipment, Subtransmission equipment, and Transmission equipment.

There may be several ways to write a successful program that satisfies the requirements of the test. Because there are multiple ways to write a successful program, there may be several answers that are all equally correct.

A successful solution is one that:

- ◆ Satisfies the request
- ◆ Does not drop load or jeopardize load
- ◆ Does not jeopardize equipment or integrity of the system
- ◆ Does not violate any standard operating procedures
- ◆ Does not jeopardize safety
- ◆ Uses proper relay protection
- ◆ Provides an adequate explanation, if requested.

- The System Operator Performance Test # 4812 has a **four hour** time limit. You will be allowed to take one break of ten minutes. **No test aids are permitted during the test.**

The test is administered on a computer using Microsoft Word and includes detailed instructions and guidelines for what you will need to do. You will be supplied with scratch paper, pencils, and the maps required for you to write the requested programs. The Test Administrator will be available during the entire test session.

You will receive a Test Comment form so that you can make comments about test questions. Write any comments you have and turn it in with your test when you are done.

### **Study Guide Feedback**

At the end of this Guide you have been provided with a Study Guide Feedback page. If a procedure or policy has changed, making any part of this Guide incorrect, your feedback would be appreciated so that corrections can be made.

## Computer Based Testing

Taking an SCE knowledge test on the computer is simple. You do not need any computer experience or typing skills. You will only use the keyboard to enter your candidate ID and password. You'll answer all questions by pressing a single button on the mouse.

### Log in Screen

You will be seated at a testing station. When you are seated, the computer will prompt you to enter the candidate ID and password you received in your invitation e-mail. You **MUST** have your candidate ID and password or you will be unable to take the test. Once you have confirmed your identity by entering this information, you will see a list of tests available to you.

### Sample/Tutorial

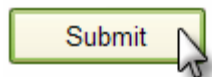
Before you start your actual test, a Sample/Tutorial Test is provided to help you become familiar with the computer and the mouse. From the list of exams that appear when you complete the log in, you will select Sample/Tutorial. You will have up to 10 minutes to take the Sample/Tutorial Test. The time you spend on this Sample Test does **NOT** count toward your examination time. Sample questions are included so that you may practice answering questions. In the Sample/Tutorial Test, you will get feedback on your answers. You will not receive feedback on your actual test.

### Example

During the test, you may see several different types of items. Many of the questions will be multiple choice items. A few items will be pictures, where you'll have to click the spot on the picture that answers the question. Those picture questions are known as "Hot Spot" questions. More information on each type is below.

### Overall Test Information

- When you begin the test, you can see the total time allowed for completion displayed at the top of the screen. You can scroll up to see that information at any time during the test.
- You can change your answers at any time during the test until the time runs out, or you click the "Submit" button. Once you click Submit, you can not change your answers.

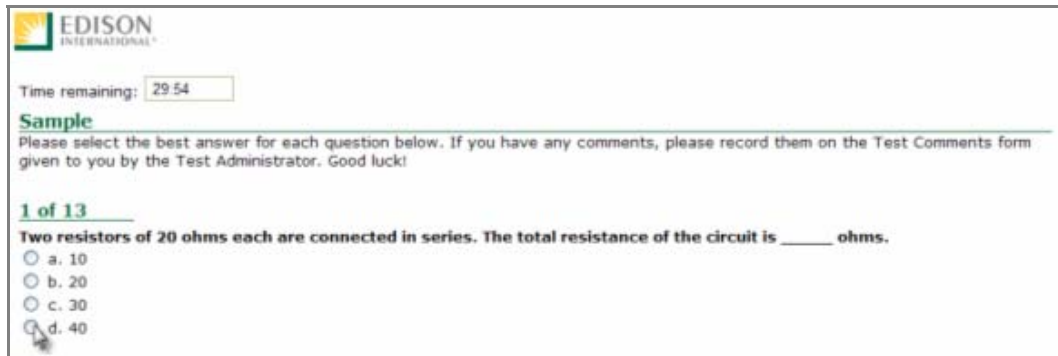


## Multiple Choice Questions

To answer each multiple choice question, you should move the mouse pointer over the circle (radio button) next to the answer of your choice, and click the left mouse button.

A sample is shown below:

1. In order to answer each question, first read the question and determine the response that best answers the question. Put the mouse pointer directly over the circle corresponding to that response.



EDISON INTERNATIONAL

Time remaining: 29:54

**Sample**

Please select the best answer for each question below. If you have any comments, please record them on the Test Comments form given to you by the Test Administrator. Good luck!

1 of 13

Two resistors of 20 ohms each are connected in series. The total resistance of the circuit is \_\_\_\_ ohms.

a. 10

b. 20

c. 30

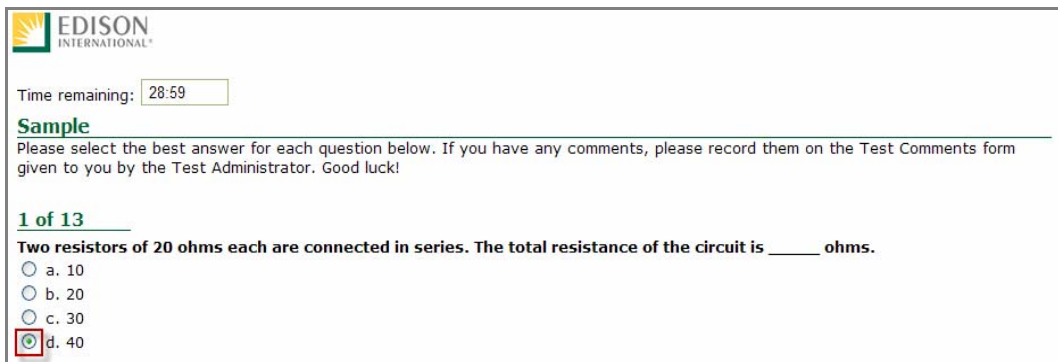
d. 40

2. While the pointer is over the circle corresponding to the best answer, click the left mouse button.



**Click the left button when the pointer icon is over your answer choice.**

3. The answer you selected should now have a green dot in the circle. If you need to select an alternate answer, simply move the pointer over that circle, and click again.



EDISON INTERNATIONAL

Time remaining: 28:59

**Sample**

Please select the best answer for each question below. If you have any comments, please record them on the Test Comments form given to you by the Test Administrator. Good luck!

1 of 13

Two resistors of 20 ohms each are connected in series. The total resistance of the circuit is \_\_\_\_ ohms.

a. 10

b. 20

c. 30

d. 40

## Hot Spot Questions

To answer each Hot Spot question, you should move the mouse pointer over the part of the image that best answers the question, and click the left mouse button. You will see a pointer appear in that spot. If you want to change your answer, simply move the mouse pointer to a new area on the picture and click again. The pointer will move to the new spot.

A sample is shown below:

1. In order to answer each question, first read the question and determine the place on the image that best answers the question. The pointer that will indicate your answer can always be seen in the bottom left of the image. It looks like this:



Put the mouse pointer directly over the spot on the image you want to select, and click the left mouse button.

**1 of 8**

**On the screen below, where would you click to find out how much vacation time you have left?**

### About Me

Welcome to the "About Me" section

"About Me" has information about your benefits, programs that help you in your work and/or home life and more. Click on the links below to access the various areas.

Pointer starts out at the bottom left of the image.

Place the mouse pointer on the spot you want to select, then click on the left button.

**About Me Map**


	<b>Overview</b> An Overview of what's contained in this section of the Portal		<b>Career &amp; Jobs</b> Find out about career information and opportunities at Edison International.
	<b>Pay</b> Find information about base pay, job descriptions, Results Sharing, and recognition awards here.		<b>Time &amp; Attendance</b> Use this section to complete and submit your timesheet for approval, or to view your time-off balances and time

2. The pointer will move from the bottom left of the image and appear over the spot you selected.

1 of 8

**On the screen below, where would you click to find out how much vacation time you have left?**





### About Me



*Welcome to the "About Me" section*

"About Me" has information about your benefits, programs that help you in your work and/or home life and more. Click on the links below to access the various areas.

**About Me Map**

 <b>Overview</b> An Overview of what's contained in this section of the Portal	 <b>Career &amp; Jobs</b> Find out about career information and opportunities at Edison International.
 <b>Pay</b> Find information about base pay, job descriptions, Results Sharing, and recognition awards here.	 <b>Time &amp; Attendance</b> Use this section to complete and submit your timesheet for approval, or to view your time-off balances and time

The pointer now appears over the correct answer.

3. To change your answer, simply move the mouse pointer to the new spot, and click again. The pointer graphic will move to the new spot you've selected. In order for your answer to be considered correct, the center of the pointer (•) must be over the correct spot on the graphic.

## Test Taking Strategies

### Introduction

The System Operator Knowledge Test # 2869 contains multiple-choice questions and may also contain hot spot questions. The purpose of this section is to help you identify some special features of a multiple-choice test and to suggest techniques for you to use when taking one.

Your emotional and physical state during the test may determine whether you are prepared to do your best. The following list provides common sense techniques you can use before the test begins.

<b>Technique</b>	<b>Remarks</b>
<i>Be confident</i>	<ul style="list-style-type: none"><li>- If you feel confident about passing the test, you may lose some of your anxiety.</li><li>- Think of the test as a way of demonstrating how much you know, the skills you can apply, the problems you can solve, and your good judgment capabilities.</li></ul>
<i>Be punctual</i>	<ul style="list-style-type: none"><li>- Arrive early enough to feel relaxed and comfortable before the test begins.</li></ul>
<i>Concentrate</i>	<ul style="list-style-type: none"><li>- Try to block out all distractions and concentrate only on the test. You will not only finish faster but you will reduce your chances of making careless mistakes.</li><li>- If possible, select a seat away from others who might be distracting.</li><li>- If lighting in the room is poor, sit under a light fixture.</li><li>- If the test room becomes noisy or there are other distractions or irregularities, mention them to the Test Administrator immediately.</li></ul>
<i>Budget your times</i>	<ul style="list-style-type: none"><li>- Pace yourself carefully to ensure that you will have enough time to complete all items and review your answers.</li></ul>
<i>Read critically</i>	<ul style="list-style-type: none"><li>- Read all directions and questions carefully.</li><li>- Even though the first or second answer choice looks good, be sure to read all the choices before selecting your answer.</li></ul>
<i>Make educated guesses</i>	<ul style="list-style-type: none"><li>- Make an educated guess if you do not know the answer or if you are unsure of it.</li></ul>

- Changing answers*
- If you need to change an answer, be sure to erase your previous answer completely. On the computer, be sure that the new answer is selected instead of the old one.
- Return to difficult questions*
- If particular questions seem difficult to understand, make a note of them, continue with the test and return to them later.
- Double-check math calculations*
- Use scratch paper to double check your mathematical calculations.
- Review*
- If time permits, review your answers.
  - Do the questions you skipped previously.
  - Make sure each answer bubble is completely filled in. Erase any stray marks on your answer sheet. When testing on the computer, make sure each multiple choice question has a green dot next to the correct answer.

Remember the techniques described in this section are only suggestions. You should follow the test taking methods that work best for you.

## **Job Knowledge Categories for System Operator Knowledge Test # 2869**

Below are the major job knowledge areas (topics) covered on the System Operator Knowledge **Test # 2869** and the associated study references. Listed next to each knowledge category is the number of items on the exam that will measure that topic. You can use this information to guide your studying. Some exams also contain additional pretest items. Pretest items will appear just like all of the other items on your exam, but they will not affect your score. They are an essential part of ensuring the System Operator Knowledge **Test # 2869** remains relevant to successful performance of the job.

There are a total of 109 items on the System Operator Knowledge **Test # 2869** and the passing score is 76%. This score was determined during the test validation process.

### **A. BASIC ELECTRICAL THEORY & APPLIED MATH (3 items)**

Knowledge of DC electrical theory (e.g., ohm's law, voltage, current, and resistance characteristics, etc.). Ability to perform basic mathematic functions (add, subtract, multiply, and divide). Ability to add, subtract, multiply, and divide fractions.

### **B. OPERATING FUNDAMENTALS (8 items)**

Knowledge of how to test and operate communication equipment. Knowledge of substation equipment's basic construction and operation. Knowledge of the types, function, and operation of switching center computer equipment, software and application of communication equipment. Knowledge of the procedures and practices for: maintaining substation log books, maintaining system status on online systems, logging switching center readings, and maintaining abnormal system status report. Knowledge of how to check RTR and CBC test procedure and update as necessary. Knowledge of how to inspect telecommunications equipment, how to interpret faulty telemetry, and how to respond to faulty telemetry. Knowledge of the operation, ratings, construction and types of bus configurations, conductors and grounding equipment. Knowledge of how to inspect bus structures, lightning arresters, dielectric pipe cable, distribution lines and transmission lines.

### **C. PRINTS AND DIAGRAMS (8 items)**

Knowledge of schematics and diagrams including DC schematics, single lines, strip maps, SAS menu trees, etc. Knowledge of procedures and practices for revising prints and diagrams. Knowledge of DC systems and ability to read and interpret DC schematics. Ability to read and interpret single line diagrams. Ability to read and interpret SAS menu trees. Ability to read and interpret block and logic flow diagrams. Ability to read and interpret transmission and distribution strip maps.

### **D. SWITCHING DEVICES (5 items)**

Knowledge of function, operation and rating of the types of substation switching devices, field switching devices, and reclosers. Knowledge of how to inspect Circuit Breaker (CB): operating mechanism, bushings, terminals, oil levels, gas/air pressures, and disconnects.

#### **E. SCE SAFETY PROCEDURES AND REQUIREMENTS (6 items)**

Knowledge of SCE's Accident Prevention Manual, SOB, SOM, and Operators Manual. Knowledge of procedures and practices for conducting a tailboard. Knowledge of procedures and requirements for admitting/escorting outside agency representatives.

#### **F. POWER AND SYSTEM FUNDAMENTALS (11 items)**

Knowledge of principles of voltage control. Knowledge of SCE substations and system configuration. Knowledge of types of equipment tests performed (e.g., ductor, hi-pot, megger, etc.) and effects on system. Knowledge of effects on voltage by load, generation, capacitors, synchronous condensers, etc. Knowledge of effects on power system by weather, load, generation, etc. Knowledge of effects of outages/switching on power flow. Knowledge of effects of outages/switching on customers, generation, Cogens, etc. Knowledge of effects of blackout on power system. Knowledge of how to perform N-I contingency analysis. Knowledge of how to maintain SOBs, SSIs, Substation Operator and Maintenance Manual (SOM), and emergency order bulletins. Ability to trace power flow on prints. Knowledge of power flow theory.

#### **G. SUBSTATION INSTRUMENTATION, ALARMS & AUXILIARY EQUIPMENT INCLUDING TRANSFORMERS AND LTCs (14 items)**

Knowledge of types of transformers and LTCs including function, operation, and ratings. Knowledge of the procedures and requirements for changing transformer power fuses. Knowledge of the procedures and practices for transformer loading and LTC operation. Knowledge of how to inspect transformer nitrogen system, pressure relief devices, pressure monitoring devices, cooling system, and LTC. Knowledge of voltage control equipment including synchronous condensers, capacitors, regulators, and reactors. Knowledge of types of PTs and CTs including their effects on switching/outages. Knowledge of coupled capacitor potential devices, including function and operation. Knowledge of types of alarms, categories, priorities, and equipment processing. Knowledge of procedures and requirements pertaining to auxiliary substation equipment. Knowledge of relays and the procedures and requirements of making protective relays solid/automatic. Knowledge of how to inspect, record and reset protective relays. Ability to read and perform initial assessment of relay targets and analyze relay target information.

#### **H. EMERGENCY AND ABNORMAL OPERATIONS (15 items)**

Knowledge of the procedures and practices for tracking brush fire areas. Knowledge of the procedures and practices for responding to natural disaster emergencies. Knowledge of the procedures and practices for non-system emergencies. Knowledge of the procedures and practices for restoring load and/or load shed operation/restoration. Knowledge of the application and operation of RAS, and techniques and practices for scheduling emergency work. Knowledge of how to recognize abnormal conditions while performing station inspections, identify the reason for an emergency or abnormal condition and operate station entrance gate during loss of power. Ability to troubleshoot and analyze emergency situations using diagrams, manuals, etc. Knowledge of the procedures and practices for implementing emergency preparedness procedures. Knowledge of how to analyze and respond to alarms. Knowledge of the procedures and practices for system restoration following islanding or blackout. Knowledge of the procedures and practices for DC system emergencies.

### **I. NORMAL OPERATIONS (13 items)**

Knowledge of the SCE switching centers jurisdiction and the effects of SCE business goals/priorities on the power system operation. Knowledge of the procedures and requirements for performing substation inspections, for synchronizing and paralleling, and for bypassing regulators and CBs. Knowledge of the procedures and practices for monitoring power system status, of VAR/voltage control, and for scheduling work. Knowledge of the application of planned loading limits and VAR/voltage schedules. Knowledge of how to sectionalize sections of power system. Knowledge of how to isolate sections of power system. Knowledge of bypass CBs and regulators. Ability to interpret historical data. Ability to recognize power flow system conditions. Knowledge of how to bypass regulators and switch line reactors and capacitors.

### **J. SWITCHING, TAGGING AND CLEARANCES (10 items)**

Knowledge of the procedures and requirements for clearances, tags, and warning blocks. Knowledge of the procedures and practices for isolating and grounding substation equipment. Knowledge of the procedures and practices for creating/checking switching programs and issuing switching procedures. Knowledge of the procedures and practices for intercompany switching, processing switching programs and processing outage requests. Ability to analyze the impact of planned switching on the power system. Knowledge of how to identify clearance boundaries, potential hazards, and inspect equipment to be operated. Knowledge of how to record MW, amps, and voltage readings, tap positions or equipment settings. Knowledge of how to positively identify each device before operating/isolating and grounding substation equipment. Knowledge of how to check synchronism and parallel, recognize abnormal situations, issue/release clearances, coordinate switching and confirm operation of equipment as expected. Knowledge of how to perform a final check after completion of switching and tagging activities and verify that equipment has been properly isolated and grounded.

### **K. NON-TECHNICAL PROCESSES (10 items)**

Knowledge of the procedures and practices for equipment maintenance notification (e.g., upcoming, delays, completion). Knowledge of the procedures and requirements for performing shift change. Knowledge of the procedures and requirements for emergency communications. Knowledge of communication procedures with sub-operator during emergency conditions. Knowledge of shift change (communicate system status). Knowledge of the procedures and practices for communicating with substation operators, test/maintenance, personnel, DC&M, system operators, etc. Knowledge of the procedures and practices for communicating with authorities (e.g., GCC, ISO, Chief System Operator, SCE management) (e.g., SOB 12).

### **L. ONLINE SYSTEMS, EQUIPMENT & SOFTWARE (6 items)**

Knowledge of the application and operation of OMS (e.g., check switching programs, DCMS, alarms), of EMS (e.g., switching, trending, notes, alarm prioritizing), SAS, and PC-based switching center software (e.g., Lotus Notes).

## Study References for System Operator Knowledge Test #2869

Knowledge Category	SOB No.	SOM (Substation Ops & Mtnc Policy & Proc) Section	Operators Manual Section	APM (Accident Prevention Manual) Section	Other
A. Basic Electrical Theory and Applied Math			1.2, 3.4, 3.7		
B. Operating Fundamentals	7, 132, 201, 309, 1036	G-5	3.5, 3.7, 3.8, 4.1, 5.4, 5.5, 5.6		Protective Relay Application Guidelines
C. Prints and Diagrams	84, 301, 1025	G-2	2.7, 3.7, 3.9, 4.7, 5.6		
D. Switching Devices	102	102	1.4, 3.1, 3.4, 4.7, 5.5, 5.6, 6.3,		
E. SCE Safety Procedures and Requirements	3, 12, 25, 26, 100, 104, 132, 203, 301, 309, 322, 1004	E-5, G-13, O-5, O-8	1.4, 2.7, 3.4, 3.5, 4.5, 4.7, 5.4, 6.3, 6.11,	Policy Section 20	Operating Characteristics of EHV-500kV System
F. Power and System Fundamentals	1, 15, 21, 32, 104, 115, 301, 510	O-5	1.4, 3.5, 4.1, 4.4, 6.3, 6.6, 6.11, 7.1	700	Synchroscope Handout, Operating Characteristics of EHV-500kV System
G. Substation Instrumentation, Alarms, & Auxiliary Equipment Including Transformers & LTCs	10, 15, 33, 100, 305, 309, 1003, 1004, 1006, 1013, 1014, 1025, 1032	E-3, E-4, MT-1, O-4, O-5, O-6	1.1, 3.1, 3.4, 3.5, 3.7, 3.8, 3.9, 4.1, 4.3, 4.5, 4.6, 4.7, 4.9, 5.5, 5.6, 6.1, 6.3, 7.1		
H. Emergency and Abnormal Operations	1, 26, 33, 115, 132, 309, 322, 1025	E-2, G-14, MT-1, O-4, O-5	3.4, 3.6, 3.7, 4.1, 4.10, 7.1		Characteristics of 500kV writeup
I. Normal Operations	1, 25, 35, 104, 105, 132, 201, 301, 304, 305, 309	G-2, G-3, O-3, O-5, O-6	1.7, 3.5, 4.3, 5.2, 6.1, 6.3, 6.4, 7.1	700	Characteristics of 500kV writeup, OM Synchroscope Section 1.8, SDMS Reference Library
J. Switching, Tagging, and Clearances	3, 37, 100, 104, 115, 131, 132	SF-6	6.1, 6.3, 6.4	412, 700	Synchroscope Handout

<b>Knowledge Category</b>	<b>SOB No.</b>	<b>SOM (Substation Ops &amp; Mtnc Policy &amp; Proc) Section</b>	<b>Operators Manual Section</b>	<b>APM (Accident Prevention Manual) Section</b>	<b>Other</b>
K. Non-Technical Processes	7, 12, 100, 104, 308, 322	O-1	5.3, 6.2, 6.6		Sub-Operator Expectations Document
L. Online Systems, Equipment, & Software	30, 301		5.2, 5.3, 5.4, 6.3		

## Study References for System Operator Performance Test #4812

Knowledge Category	SOB No.	SOM (Substation Ops & Mtnc Policy & Proc) Section	Operators Manual Section	APM (Accident Prevention Manual) Section
Emergency & Operating Procedures	33, 100, 305, 600, 1013, 1025	O-4, O-6	3.8, 4.6, 4.7, 4.9, 5.5, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7	
Electrical & Relay Theory	305, 1013, 1025		2.7, 4.6, 4.7, 4.9, 5.5	
Equipment, Instrumentation, & Terminology	305, 1006, 1013, 1025, 1031	O-6	2.7, 4.5, 4.6, 4.7, 5.5	
Safety & Clearance Procedures	100, 101, 104, 105, 111			400, 700

## Sample Questions

The following sample questions should give you some idea of the form the test will take.

1. Non-directional overcurrent relays are common on the Southern California Edison system and are used for the protection of:
  - a) distribution radial lines.
  - b) receiving end of loop subtransmission line.
  - c) transmission loop lines.
  - d) AA Banks.
  
2. According to SOB 104, in the Normal outage planning process, an outage request is typically INITIATED by:
  - a) Substation Operators.
  - b) Transmission Dispatchers.
  - c) Field personnel.
  - d) Outage Request Coordinators.
  
3. According to System Operating Bulletins 301 and 104, which of the following programs do NOT require 48 hours notice to the Switching Center?
  - a) Programs which require a system parallel
  - b) No Test Order programs
  - c) Main line programs
  - d) Programs which release new equipment for service
  
4. Other than for an emergency, when can an employee enter a barricaded area that has been clearly marked with red barricade tape?
  - a) Never
  - b) When work in progress requires you to
  - c) When work in progress requires you to, but only while you are under continuous observation by another qualified employee
  - d) Anytime, but more cautiously than if the area was not barricaded
  
5. A SCU maintenance switch is found in capacitor Circuit Breakers with synchronized closing capability. When the Circuit Breaker is operated with no load, what position must this switch be in?
  - a) Off position
  - b) Cleared position
  - c) No-load position
  - d) Test position

6. "A" Bank low side breakers only have tripped at your station. You check relay targets and find an INC (46 – negative phase sequence) target on each bank. This indicates a \_\_\_\_\_ operation.
- a) three-phase Bus fault
  - b) bank differential
  - c) local breaker back-up
  - d) Bus-bank
7. In the event of a stuck closed Capacitor Circuit Breaker (CB), what type of device may be used for de-energizing a 220kV capacitor Bank?
- a) Oil CB
  - b) Vacuum CB
  - c) Gas CB
  - d) Hydraulic CB
8. What occurs when current flows through only one terminal of a two point HCB (85) protected line during an internal fault?
- a) Both terminals trip
  - b) Only the terminal reading current trips
  - c) Only the terminal with no current trips
  - d) Neither terminal trips

## Sample Question Answers

1. A
2. C
3. B
4. C
5. D
6. C
7. C
8. A

### Study Guide Feedback

Please use this page to notify us of any changes in policies, procedures, or materials affecting this guide. Once completed, return to:

Southern California Edison  
Human Resources - Performance Assessment Services  
G.O. 4, Ground Floor  
8631 Rush St.  
Rosemead, CA 91770

**Test Name:      System Operator Knowledge Test #2869 / Performance Test #4812**

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