115kV TO 12.47 kV SYSTEM: OVERVIEW AND GENERAL OPERATION OPERATING PROCEDURE

APPLICATION

Overview and operation guidelines for LBNL's 12.47 kV System, including the hazards associated with this system. This procedure is part of the operations manual for the 12.47 kV power system; see ADMN-056-C for an overview of the manual's contents, including related procedures.

SPECIAL INSTRUCTIONS

- Any Facilities personnel performing work on this system must be familiar with the general operating and information procedures regarding this system.
- This work requires a qualified electrician—one who has been instructed and trained to perform certain tasks on the 12.47 kV System and proven through experience that he or she can successfully perform the assigned tasks.

OVERVIEW

Electrical energy is supplied to LBNL by the Western Area Power Administration (WAPA) through the Grizzly Substation from two 115 kV to 12.47 kV power transformers. Transformer Bank No. 1 supplies power to the accelerators and other building loads. Transformer Bank No. 2 supplies power to other laboratory loads. See Drawing 5R-7285, 115 kV / 12.47 kV One Line Diagram.

- **Bank No. 1:** 30/40/50 MVA, OA/FA, 115,000 to 12,470 volts
  7.65 % Impedance, Wye-Delta-Wye connected,
  1000A Resistor Grounded Neutral
- **Bank No. 2:** 30/40/50 MVA, OA/FA/FA. 115,000 to 12,470 volts
  7.50 % Impedance, Wye-Delta-Wye connected,
  1000A Resistor Grounded Neutral

The transformers are tied to the LBNL 12.47 kV bus through 2,000 ampere main vacuum circuit breakers in the LBNL Grizzly Switching Station (SW-A1). Power is distributed through the laboratory at 12.47 kV via an underground 15 kV cable system to local transformer substations. Sectionalizing switches are located at Bldg 50A, 50B, 70, 71, and East Canyon areas. Two (2) 12.47 kV tie lines interconnect Grizzly Switching Station (SW-A1) and UC Hill Area Substation switchgear buses through circuit breakers. The tie lines will provide backup power to LBNL facilities from UC Hill Area Substation, and to University of California Berkeley from Grizzly Substation. One 2-MW diesel-engine driven generator is tied to Bus #1 of Blackberry Canyon Switching Station SW-A6 for operation in parallel with the utility power.

WORKSTEPS I. Checking for Hazardous Materials/Conditions

A. Flash, plasma and flying metal or debris caused by fault.

1. Use appropriate protective clothing/equipment as follows and as required by work to be performed in accordance with OSHA, NFPA 70E, and PUB-3000:
   - Hard hat
   - Safety glasses
   - Hearing protection
   - Safety flash suit with face shield
   - Voltage-rated rubber gloves
   - Insulated floor mats
   - Flame resistant full sleeve overalls
   - Rubber blanket to guard against energized parts.
   - All-natural material work apparel

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- Remove all personal accessories such as metal chains, watch, and rings while performing electrical switching.

2. Position yourself properly, away from the direct path of injury.
3. Follow safe switching procedures. Energize or de-energize through the safest switching point.

B. Electrical shock

1. Maintain barriers and safe physical separation.
2. Follow the switching order as listed on an approved switching tag.
3. Follow the Lock and Tag Procedure as defined in PUB 3000, Chapter 8, Appendix A.
4. Verify the operation of the test instrumentation with a known voltage source, before and after the circuit check.
5. Properly de-energize, test, and ground.
6. Have a qualified “safety watch” watching you.
7. Apply grounding to the bus system as well as line-side / load-side cable terminals in accordance with the switching procedures.
   - USE ONLY ASTM RATED GROUND CABLES.
   - VERIFY FAULT CURRENT RATING OF THE GROUNDS.
   - USE MULTIPLE SET OF GROUNDS IF THE FAULT CURRENT EXCEEDS THE RATING.
8. Always ensure that electrician is working on a grounded system with no possibility of feedback from power or control circuits.

C. Noxious fumes and smoke from burning insulation.

1. Remain clear until the area is ventilated and tested for oxygen content by the Fire Department.

D. Confined spaces (cable vaults and manholes)

1. Test atmosphere and follow established LBNL confined-space procedures.
2. Always have an observer on the outside.

E. PCB Insulating Oil (Polychlorinated Biphenyls)

1. Be aware of and follow EH&S handling, storage, transport, and disposal procedures as defined in PUB 3000, Chapter 5.
2. PCB-contaminated equipment should be labeled. If the equipment is not clearly marked, assume it is PCB contaminated until an analysis is obtained from EH&S.
3. Take every immediate measure available and contain and isolate spills or leaks. Work with EH&S representatives in cleanup and disposal.

F. Asbestos insulation on cable

1. Work with, and be aware of EH&S handling, storage, transport, and disposal procedures.
2. Asbestos containing cable should be labeled. If it is not clearly marked, assume it contains asbestos until verification is received.

G. Solvents

1. Use only with adequate ventilation.
2. Use only approved solvents.
3. Keep only approved amounts in approved containers.
4. Be aware of and follow EH&S handling, storage, transport, and disposal procedures.

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WORK STEPS II. Normal Procedure

1. Switching operations must be performed only by a qualified electrician under the direction of the Facilities electrical superintendent/supervisor or a Facilities electrical engineer.

2. The operator must follow minimum exposure practices and use properly rated safety equipment, per WORKSTEPS I.A.1.

   When switching, the operator must minimize all operational hazards by being properly positioned in regard to the switch structure. The switching device must be operated swiftly to the limits of its activation.

3. **Use switching tag.** Only approved switching tag procedures are to be followed.

4. **Use the 100% Rule.** No switching, isolating, detecting of energized circuits, applying personnel safety grounds, or other work on the 12.47 kV system shall be performed unless two (2) qualified, experienced individuals are in 100% agreement on the work to be performed and the sequence in which it should be done. **IF** there is not 100% agreement, **DO NOT PERFORM ANY WORK.** Consult a third qualified individual. Do not perform any work until all three individuals are in 100% agreement. Continue process until 100% agreement is reached. Analyze the system configuration with all the power sources to the equipment. Refer to all the drawings for high and low voltage isolation.

5. A second qualified electrician must act as standby for purposes of safety and communications during manual operation of any energized switching device.

   A. Should the standby electrician enter the limited approach boundary during switching, then the following properly rated safety equipment as described in WORKSTEPS I.A.1 are required:
      - Hard hat
      - Safety glasses or face shield
      - High voltage gloves
      - Flame resistant full-sleeve overalls

   B. The standby electrician must also follow minimum exposure practices. Position must be no less than 10 feet from, and to the side of the device to be operated. Two-way radio will be used to verify the proper operation of the switching device with the Facilities electrical shift supervisor or other designated individual responsible for the switching operation.

6. A third qualified electrician may be required by the Facilities electrical superintendent/supervisor (determined by job or task).

7. Ensure that no portion of the 12.47 kV feeder cable or associated primary equipment is switched in an attempt to restore power until that portion of the feeder or primary equipment has been determined to be free of fault by inspection and hi-pot testing. No feeder or primary equipment shall be switched from a faulted service, or a feeder that has tripped to another energized source until inspection is complete and hi-pot tested to at least 15 kV for five minutes.

8. Before work is performed on or near energized cables or equipment that could affect the operation of a laboratory building or system, the building manager shall be notified by the responsible electrical engineer or Facilities electrical superintendent before work is begun and upon work completion.

9. All prearranged switching and such emergency switching as is practical must be planned and recorded on an approved **switching tag**. Switching tags may be prepared by O&M or a Facilities electrical engineer, and shall be reviewed and checked for accuracy prior to use by both parties.

10. Where possible, switching tags shall include steps to provide an alternate source of supply when normal or standby power supply is turned off. Include situations when stand-by generators will automatically start.

11. All operations must be performed in order designated on the switching tag, except as noted in Step 12**.**

12. All instructions, indicating operations that are to be performed in a given sequence, must be performed in the documented sequence unless permission to deviate is obtained from the Facilities Electrical Superintendent/Supervisor and/or Facilities Electrical Engineer in charge. It is recognized that during a switching operation, conditions and circumstances may make it necessary to deviate from the

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instructions as written. Any such deviation must be noted on the switching tag and initialed by the superintendent/supervisor or engineer in charge.

13. A separate switching tag must be written for each requested job or task.
14. All switching tags must be kept on file at the Electric Shop office and in the Facilities Engineering Power System Data Book.
15. Operating instructions must be specific. Actual values of voltage, switch numbers, and so forth must be used.
16. Time shall be recorded using the 24-hour clock.
17. Isolate equipment and ensure that all switches are open, locked and tagged, and grounds installed. This is to prevent circuits and equipment from being energized from an alternate source.
18. Any person receiving an unwritten message or order concerning switching, clearances, or other operations-related information shall immediately record the item directly on the switching tag, repeat the information to the sender, and receive an acknowledgment. Orders shall be relayed only when they cannot be sent directly and must be repeated by each party relaying the message.
19. Determine the current to be interrupted by load checks and circuit conditions. Reduce or remove load before sectionalizing device is opened or closed. If necessary, the circuit shall be de-energized from a feeder circuit breaker.
20. Remove load from transformers being energized. Remove as much load as possible from transformers being energized, so that the in-rush current is limited to magnetizing current (i.e., open secondary main and/or sub-main circuit breakers).
21. Verify switch position. After operating any switch with visible contacts, visually confirm that all blades are in the fully open or closed position.

WORK STEPS III. Protective Grounds

CAUTION: If the apparatus or conductor is not grounded, it must be considered energized.

1. After LOTO, test circuit to verify no voltage is present. Install grounds on de-energized apparatus or conductor prior to start of work.
   Use only equipment designed and approved for the purpose.

Remove grounds as required for testing. When testing on de-energized equipment that cannot be performed with personal grounds applied, the grounding must first be done in the prescribed manner, then removed as necessary for testing.

REFERENCES

ADMN-056, 12.47 kV System: Operations Manual

RESPONSIBILITIES AND CONTROLS

Completion of the following signature lines constitutes approval of this procedure:

REV NO.	SME	REVIEWED BY	APPROVED BY / DATE	REVISION DATE
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