STUDY OF 220 KV SUBSTATION

FOR THE

STANFORD LINEAR ACCELERATOR (SLAC)

REPORT TO STANFORD LINEAR ACCELERATOR CENTER - NO. ABA-51

STANFORD UNIVERSITY SUBCONTRACT S-128

UNDER AEC CONTRACT AT(04-3)-400

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PROJECT MASTER SUBSTATION

PRELIMINARY DESIGN REPORT

1. SCOPE This report and the accompanying drawings are issued to establish the basic design concepts for the Project Master Substation, including the general specifications of the major equipment items.

2. GENERAL DESCRIPTION The Master Substation receives power from PG&E at 220 kv over a double-circuit overhead transmission line. This voltage is stepped-down to the 12 kv Project distribution voltage. The initial capacity of the station is 80 mva with provisions for future expansion. The general substation location and approximate size are shown on the attached drawing SK-E-37, Electrical Systems Master Plan. The more specific arrangement of the major equipment items are shown on drawing SK-E-39, Master Substation Area, General Arrangement. Drawing SK-E-38 is the Master Substation, Single Line Diagram.

3. MAJOR EQUIPMENT The initial construction of the Master Substation will include the following list of major items of equipment:

QUANTITY	EQUIPMENT
2	220kv line termination structures
2	220kv oil circuit breakers
1	220kv sectionalized strain-type bus
3	Bus support structures
2	220kv motor-operated gas-blast switches
1	220kv motor-Operated switch

QUANTITY	EQUIPMENT
2	40 mva oil-cooled transformers
1	Switch house
2	12 kv indoor switch gear assemblies
1	Relay and metering panels
1	Control battery and charger

4. STRUCTURES The structures will be designed with flanged steel members. Their height will be designed to minimum clearance consistant with acceptable engineering practice. Due consideration will be given to the aesthetic aspects of the overall substation design.

5. 220kv BREAKERS The 220kv oil circuit-breakers have an interrupting capacity of 10,000 mva based on an estimated ultimate fault duty for both lines operated in parallel of 9080 mva. There will be current and potential devices in the bushings for protective relaying.

6. 220kv SWITCHES The 220 kv motor-operated gas-blast switches are proposed for primary disconnect devices for the transformers. The gas-blast feature permits interuption of the magnetizing current of the transformer. Other switches are the air-break type for disconnect and sectionalizing service. The motor-operators are part of a fast re-energizing scheme after a fault.

7. TRANSFORMERS The transformer shall be provided with under-load tap changer equipment. Transformer impedance is 18% on the 40 mva base. The transformer will be of FOA (forced-oil, air cooled) type using a common cooling unit for the two transformers. With one transformer out of service, but all cooling fans in operation, the common cooling scheme allows some 53 mva out of the one in-service transformer on a continuous basis, or 60 mva to 70 mva on shorter durations.

The transformers shall be rated 750kv BIL on the 220kv side (PG&E practice) and 95kv BIL on the 12kv side. The transformer shall be equipped with station-type lightning arresters.

8. PROTECTIVE RELAYING The general plan on protective relaying is shown on Drawing SK-E-38, Single Line Diagram. The scheme will provide complete protection to the SLAC system and equipment, and will be coordinated with the PG&E system requirements to provide reliable service. The plan utilizing circuit-breakers and motor-operated gas-blast switches will enable fast restoration of service. The plan is to utilize maximum emergency, or short-time rating of equipment. In general each protective relay scheme will have an additional backup system to assure protection. The major systems on the protective relaying scheme are outlined below:

a. Sudden-pressure relays on transformers

b. Differential-protection around each transformer

c. Over-temperature relay on transformer

d. Fault Detection relay scheme in 220kv service.

9. BUILDING The building is proposed to house the 12kv switchgear, metering and relay panels, batteries, maintenance area, future reactors, and the like. The building area is some 60 by 100 ft. with a full basement. Only natural-draft ventilation will be used. The basement, or vault, will house future reactors, tie bus, and cable trays for outgoing 12kv feeders.

10. 12kv SWITCHGEAR The metal clad switchgear shall be of the 15 kv class, rated 500 mva, 95kv BIL. Air circuit breakers shall be used for the dc modulator power-supply rectifiers. Other feeders shall be of the metal-enclosed roll-out fuse and load-break switch assemblies.

11. CIVIL ENGINEERING Adequate individual foundations will be provided for the equipment. The area within the outdoor substations will be covered with 6 inches of base-rock with additional gravel-filled pits to contain the transformers oil in the event of a tank failure. The area will be surrounded by a 6 foot chain-link fence with barbed-wire top and with the necessary truck and man gates.