NEW HIGH VOLTAGE LABORATORY, INDIAN INSTITUTE OF SCIENCE

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The new High Voltage Laboratory of the Power Engineering Department at the Indian Institute of Science has been recently completed. An outside view of the laboratory is shown in Fig. 1.

To provide facilities for research and the training of personnel in High Voltage Technique, funds for establishing the above Laboratory were sanctioned by the Government of India and the construction of the Laboratory was started in February 1948. The Laboratory Building was opened by the President of the Union of India, Dr. Rajendra Prasad, on the 10th of April 1951.

The Laboratory consists of the main hall 85′ × 120′ × 63′ high which houses the main High Voltage Equipment, four smaller halls on the ground floor adjacent to the main hall and 3 smaller rooms each 14′ high on the first floor. See plan (Figs. 2 & 2a).

The walls and the floor of the hall have embedded in them galvanized steel mesh welded to steel frame of the roof to provide electrical shielding. Three galleries at various levels have been provided in the hall for observation of the high voltage phenomena.

The main Surge Generator, Fig. 3, rated 3000 kV, 50 kWs. (Marx circuit), consists of four columns each 30′ high, located on a common base plate (distance between the columns 10′) with 30 capacitors, each rated 0·33 Microfarads 100 kV, separated by textolite spacers. A kenotron rectifier set charges the capacitors in parallel through resistances and the capacitors then discharge in series through sphere gaps mounted in the centre of the four columns.

Tripping of the Main Generator is effected by means of a second small Surge Generator. The auxiliary Surge Generator is tripped by a pulse through a thyratron from the C.R.O.

Any desired wave shape can be obtained from the Generator by proper selection of the resistances and capacitances, in series and parallel with the Generator.

A High Voltage High Speed Cathode Ray Oscillograph is used for the observation and photographic recording of High Speed Transients (Fig. 4).

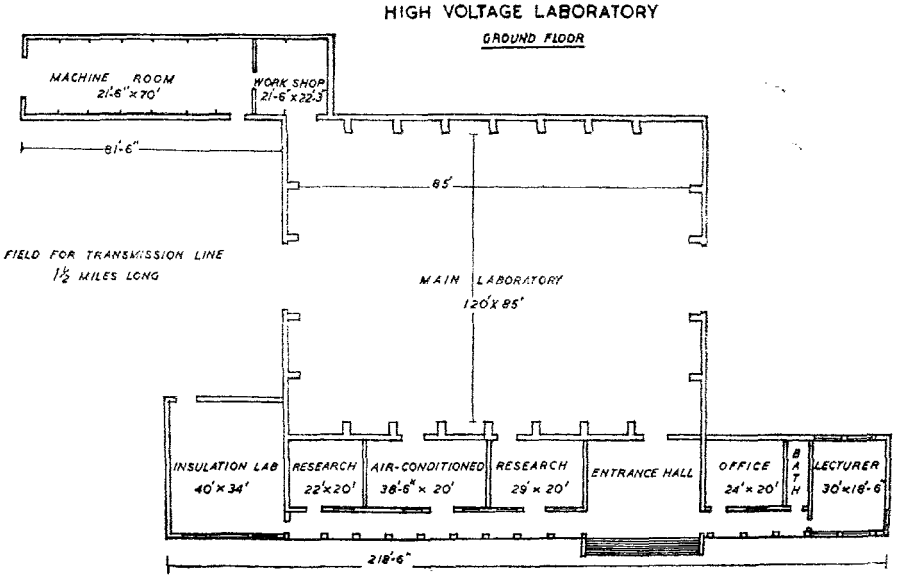
HIGH VOLTAGE LABORATORY
GROUND FLOOR
MACHINE ROOM
21'-6" x 70'
WORK SHOP
21'-6" x 22'-3"
81'-6"
85'
FIELD FOR TRANSMISSION LINE
1½ MILES LONG
MAIN LABORATORY
120' x 85'
INSULATION LAB
40' x 34'
RESEARCH
22' x 20'
AIR-CONDITIONED
38'-6" x 20'
RESEARCH
29' x 20'
ENTRANCE HALL
OFFICE
24' x 20'
BATH
LECTURER
30' x 18'-6"
218'-6"

FIG. 2

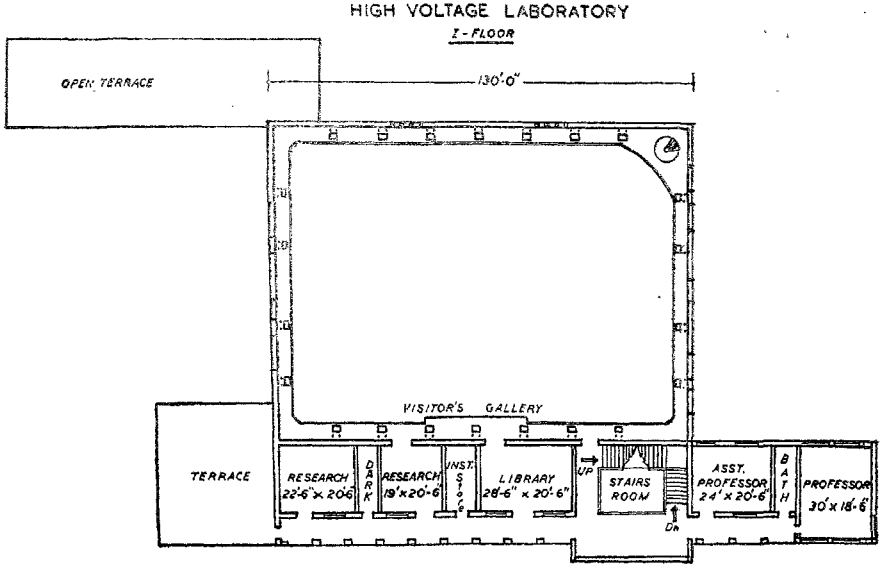
HIGH VOLTAGE LABORATORY
I - FLOOR
OPEN TERRACE
130'-0"
VISITOR'S GALLERY
TERRACE
RESEARCH 22'-6" x 20'-6"
DARK
RESEARCH 19'x20'-6"
INST. STORE
LIBRARY 28'-6" x 20'-6"
UP
STAIRS ROOM
Dn
ASST. PROFESSOR 24'x20'-6"
BATH
PROFESSOR 30'x18'-6"

FIG. 2a

Its visualizing element is a sealed off hot cathode ray tube whose screen may be photographed by a camera and simultaneously viewed by the Operator. Accelerating voltage of the tube is 25 kV; the writing speed is approximately 10,000 Okm/s.

A High Current Impulse Generator gives impulse currents up to 200 kA either positive or negative (Fig. 5). It consists of 48 capacitors each rated 50 kV D.C. 0·5 mfd. 28·8 kWs. Two Shunts rated 50,000 amps. and 150,000 amps. are used for measurements of surge currents with the cathode ray oscillograph.

For testing at power frequency three transformers each rated 1,000 kVA 2,300 to 350,000 V—50 cycles are provided which can be used either in 3 phase to produce 600 kV phase to phase or in cascade to produce 1,050,000 Volts to ground (Fig. 6). For this purpose the second and third transformers are mounted on insulating cylinders 5′ and 10′ high, excitation to the intermediate and top unit being provided after Dessauer by an exciting winding in the ground and intermediate transformers respectively. The high voltage winding of each transformer has been tapped for the measurement of high voltage (ratio 1 : 1,000).

A separate motor Generator set consisting of a 300 H.P. Synchronous Motor driving a 1,000 kVA Generator supplies a pure sine wave. They are housed in a separate room to prevent transmitting of vibration or noise to the main hall.

For H. V. Measurements of P.F. and Capacitance of Insulating materials and H. V. Equipment, a standard gas filled capacitor 0·0001 microfarads rated 300 kV is available. It will be used in conjunction with a Schering Bridge with an amplifier null detecter (Fig. 7).

A kenotron set provides ·025 Amp. at 250 kV and is placed in one corner of the main hall (Fig. 8). It consists of two identical rectifier units sealed under oil in insulating tank each rated for 125 kV. These are also provided with resistors rigidly mounted and immersed in oil for the measurement of high voltage.

The various equipments housed in the main hall have their own control tables, instruments and relays and can be operated independently.

A sphere gap with spheres of 2 meter diameter measures the High Voltage above 500 kV; under 500 kV electrostatic and crest voltmeters are used.

Pumps, storage water tank, nozzles and rack are available to conduct tests under artificial rain of any conductivity according to various specifications,

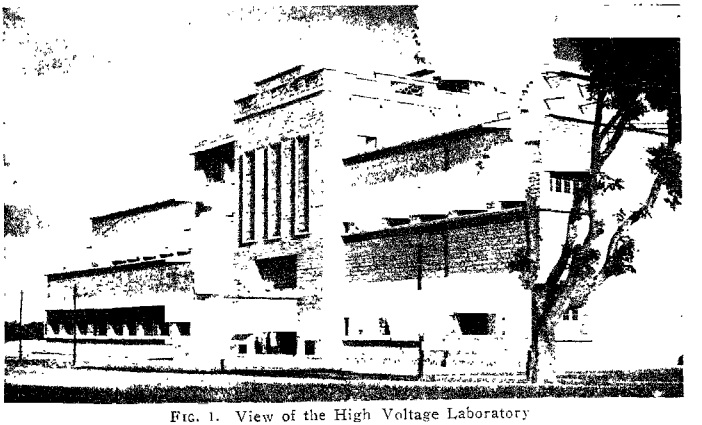

FIG. 1. View of the High Voltage Laboratory

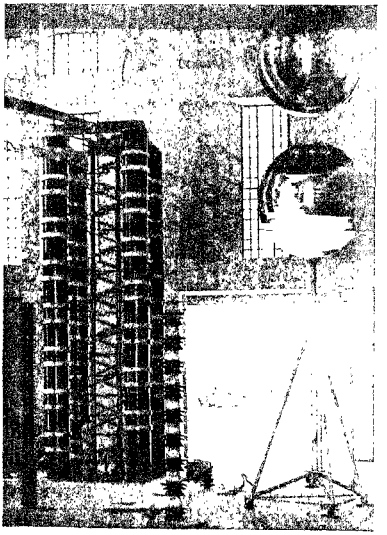

FIG. 3. 3 million Surge Generator with 2m Sphere Gap.

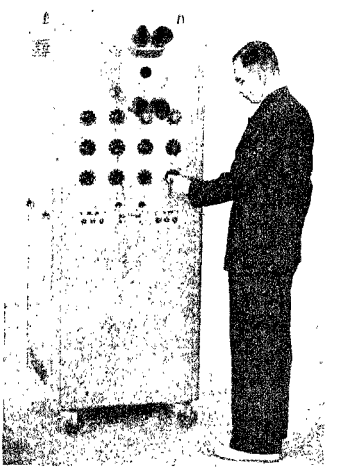

FIG. 4. High Speed Cathode Ray Oscillograph.

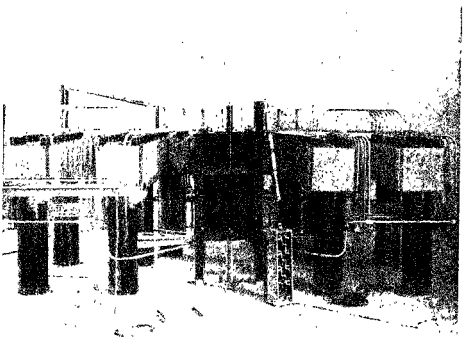

FIG. 5. High Current Impulse Generator

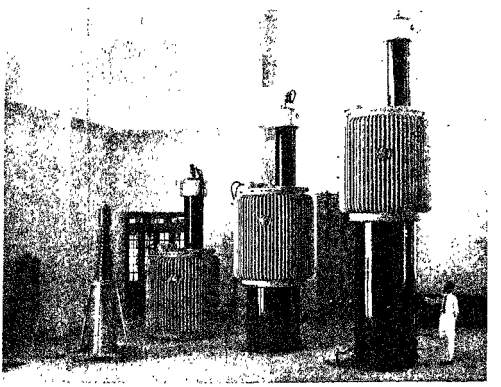

FIG. 6. Testing Transformers for million volt 1000 kVA in Cascade

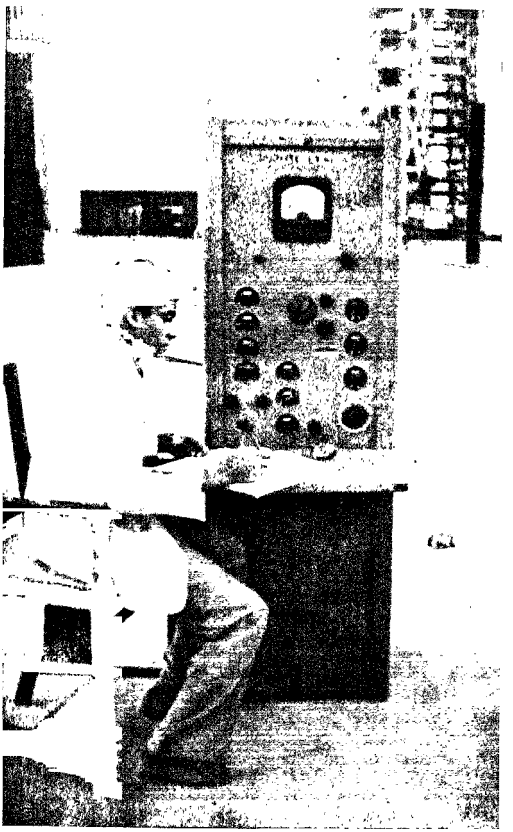

Fig. 7. Schering Bridge

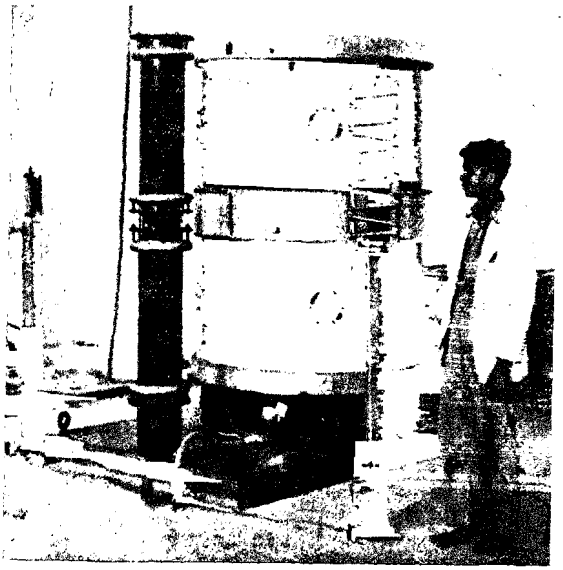

FIG. 8. 250 kV 25mA D.C. Testing Set

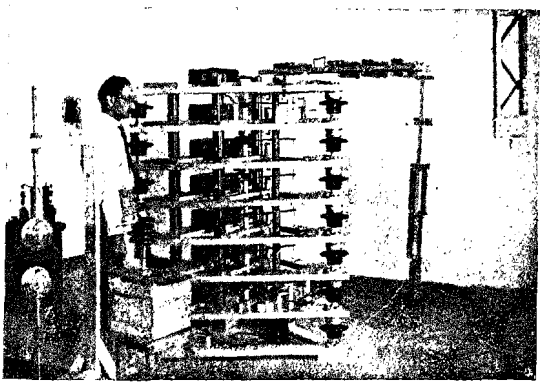

FIG. 9. Repeating Surge Generator 210 kV 50 Surges per sec.

An area for the erection of Transmission Line 1½ mile long belongs to the Laboratory and a flexible overhead line up to 380 kV will be constructed. Three big openings one of 20′ × 20′ and two of 10′ × 10′ normally covered by rolling shutters are used to take high voltage leads from the main hall to the transmission line.

One of the smaller halls houses 3 transformers 10 kVA each which can be connected to deliver 330 kV. It has a Schering Bridge with an air capacitor for 150 kV.

For testing insulating materials special conditioning ovens are provided and instruments are available for measuring the dielectric constant and power factor from 50 cps. to 10 Mcps. For testing high voltage equipment under conditions of heat and ice one of the rooms of the High Voltage Laboratory, dimensions 20′ × 20′ × 20′, is air conditioned. Any temperature between 20° F. and 140° F. (−6·5° C. and 60° C.) and rel. humidity between 60% and 100% can be adjusted and automatically controlled within narrow limits. High Voltages from the Main Hall can be led into this room through a special glass bushing.

For testing insulators under recurrent surge a Repeating Surge Generator upto 210 kV, is provided (Fig. 9). The voltage and current wave forms can be viewed and measured on a C.R.O.

One hall is permanently air-conditioned (20° C. and 60% rel. humidity) for calibration and standardizing work.

Photographic facilities, enlarger, micro-film reader, etc., are available next to the big hall so that films can immediately be developed, enlarged or viewed through a microfilm reader.

This Laboratory is the biggest of its kind in India and South East Asia. The main hall leaves plenty of space for large test samples and facilities for the observers.