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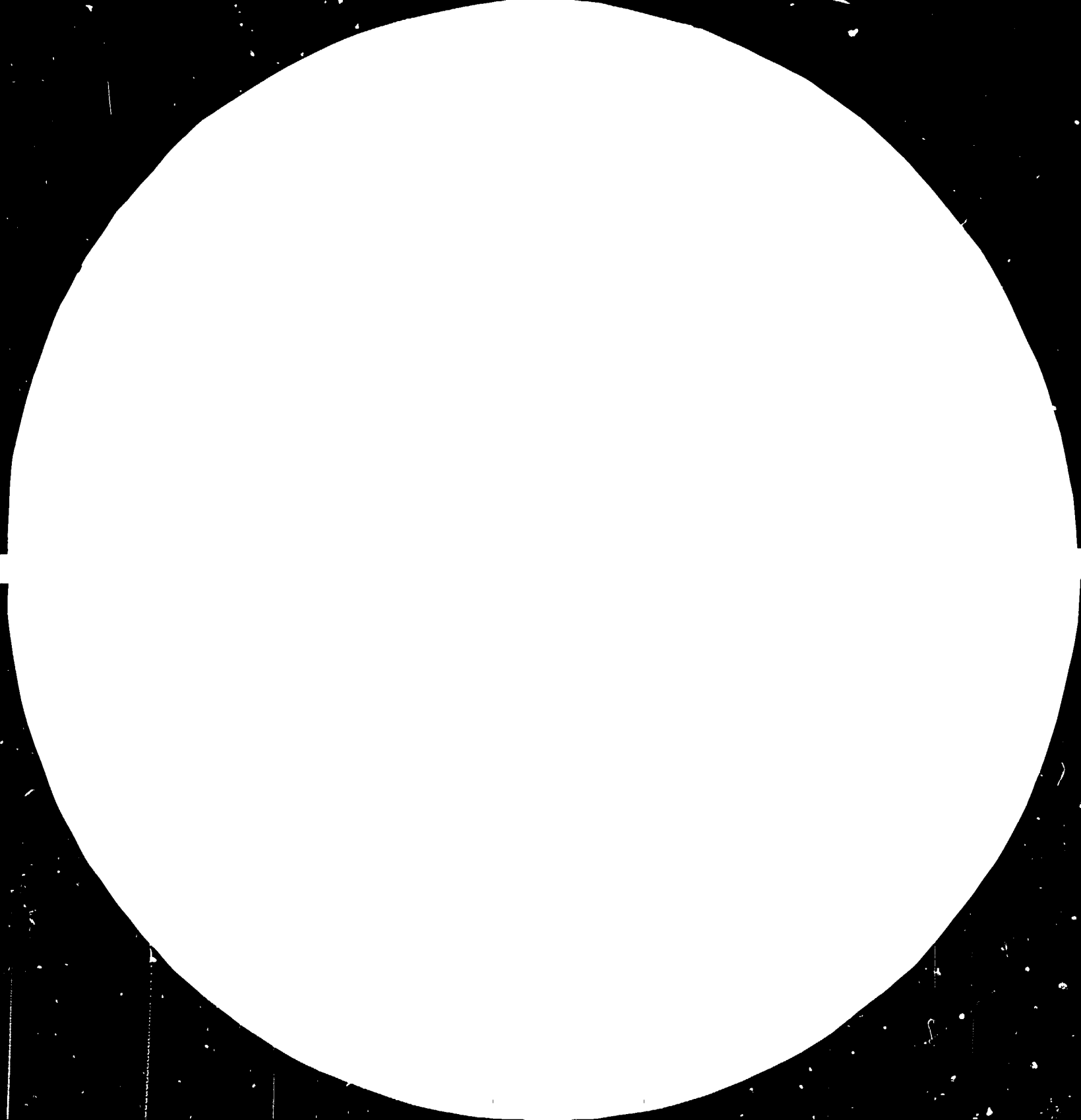
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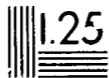
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MICROSCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS
MAGNIFICATION REFERENCE MATERIAL NO. 1963-A
APRIL 1963 U.S. GOVERNMENT PRINTING OFFICE

14409

October 1984

English

Vietnam.

NATIONAL NETWORK FOR STANDARDIZATION, METROLOGY

QUALITY TESTING AND CALIBRATION SERVICES

DP/VIE/81/006

VIET NAM

Final Report *

Prepared for the Government of the Socialist Republic of
Viet Nam

by

G. Muchaidze

UNIDO Expert on Electrical Testing - DP/VIE/81/006/11.05

United Nations Industrial Development Organization Vienna

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1. Abbreviations

- CI - Centre I in Hanoi
- C III - Centre III in Ho Chi Minh City
- EETL - Electrical and Electronical Testing
Laboratory at CI
- E T L - Electrical Testing Laboratory at
C III
- GDSMQ - General Department for Standardi-
sation, Metrology and Quality
Control
- CMEA - Council for Mutual Economic
Assistance
- GOST - State Standard of USSR
- ASTM - American Society for Testing and
Materials

2. Introduction

According to my job description, Ho Chi Minh City was expected to be my duty station with travel within the country. I should be a member of the international team of experts attached to the Metrology Centre I in Hanoi and Centre III in Ho Chi Minh City belonging to the General Department for Standardisation, Metrology and Quality Control (GDSMQ). I should work under the general coordination of the chief technical adviser and shall specifically be expected to :

1. Assist in installation and putting into operation of laboratory equipment and measuring instruments for testing electrical materials, components and appliances including preparation, whenever required, operational manuals or instructions as well as instruction on the maintenance and servicing of testing equipments ;
2. Prepare instructions and operational manuals on periodical checking and calibration of electrical testing equipment ;
3. Prepare and conduct short term courses combined with practical training for laboratory personnel engaged in electrical testing and measurements ;
4. Advise and assist in developing methodologies for conducting laboratory tests, result analysis and record keeping ;
5. Prepare a final report setting out the finding of my mission and recommendations to the Government on further action which might be taken.

The work plan is given below

Project DP/VIE/81/006

W O R K P L A N

For Electrical Testing Expert

Centre I, Hanoi (03.06.84 - 21.09.84 ; 22.10.84 -
26.10.84)

Centre III, Ho Chi Minh City (22.09.84 - 22.10.84)

BEETL, Centre I Hanoi . (03.08.84 - 21.09.84)

03.08 - 11.08

- Classification and analysis of electrical materials, components and appliances intended for testing in "Electric and Electronic Testing Laboratory" (Centre I).
- Classification and analysis of requirement laboratory equipments and measuring instruments for electrical testing in Centre I (acc. to the UNIDO Purchase Orders 15-3-BO 1498 , 15-3-BO 1524).
- Assistance in training of methods of measurement (frequency meter mod. r 3 - 54)
- Training in vibration testing of electronic appliances (transistor mod. KL 506, KL 507, KL 508)

13.08 - 18.08

- Assistance in installation and putting into operation of measuring instruments and testing components :
 - a) RCL meter, mod PM 6303
 - b) Digital surface Thermometer, mod. RLC - 80 p.
 - c) Digital stop watch, mod. CL - 0,15
- Repairing of measuring instruments :
 - a) Universal Thompson-Wheatstone Bridge. mod YTWK-1.
(2p)
 - b) Power meter, mod. K-506.

20.08 25.08

- Assistance in installation and putting into operation of following measuring instruments and testing component (combined with practical training) :
 - a) Electronic Galvanometer, mod. 2709,
 - b) Direct Reading Impedance Bridge. mod. DRZ - 2M.
 - c) Universal Thompson - Wheatstone Bridge, mod YTWK-2,
 - d) Power meter, mod. K-506,
 - e) Digital Capacitance Meter, mod. ICR - 745
 - f) Megohmmeter, mod SM - 5E.

27.08 01.09

- Training course on methodologies for conducting laboratory test and result analysis.
- Preparation of basic material for arrangement of the earthing connection and the safeguard.
- Preparation of basic material for definition of rules of safety under specified conditions of installation and use of testing equipment in C.I.
- Industrial visit (Transmission Station - Bala-Bong-Do, Hanoi ; Factory VINA-MIND, Hanoi)

03.09 08.09

- Assistance in preparation of specimen of insulating materials.
- Assistance in selection and installation of electrodes.
- Basic test methods of breakdown voltage, t_{gd} , R , R_1 , R_v , R_s .
- Assistance in installation and putting into operation of laboratory equipments (combined with practical training):

- a) Surface Temperature Indicator, mod. 2677,
- b) Sound Level Meter, mod. 3604,
- c) Wind Indicating System, mod. DC-551; 25A ; 23 S- 2,
- d) Distortion Meter, mod. LDM - 170,
- e) Universal Leakage Current Tester, mod. 3226,
- f) Battery Operated Insulation Tester, mod. D1 - 8.

10.09 15.09

- Practical guidance in periodical checking of laboratory test equipment.
- Assistance in installation and putting into operation of laboratory equipment (Combined with practical training) :
 - a) Function Power Meter, mod. PF - 810,
 - b) Power Factor Meter, mod. 3304,
 - c) Portable Protective Relay Test Set, mod. TPR - 22 CV,
 - d) Electric Water Bath with Regulator, mod. 107,
 - e) Constant Temperature Electric Drying Oven, mod. MIC - 126-C.

17.09 21.09

- Industrial visit (Plastic Factory; Automobile Battery Factory; Hai Phong; Transistor Factory; Hanoi.)
- Assistance in installation and putting into operation of testing equipment:
 - a) Magnet Wire Abrasion Tester, mod. 210,
 - b) 360° Turn Bending Flexibility Tester, mod. 224,
 - c) Mercury Bath Insulation Destruction, mod. 234.

- Preparation of basic recommendation for extension ETL activities in electric testing and quality control of insulating materials, electric components and appliances.

- Seminar : "Electric Testing of Insulating Materials. Electric Components and Appliances".

E T L, Centre III, Ho Chi Minh City

22.09 - 22.09.1984

1. Earthing system and safeguards in electric testing laboratory :
 - preparation of scheme, materials and connections
 - training in measurements of earthing system resistance
2. Laboratory training on method of measurements of volume and surface resistivity (ρ_v , ρ_s) with practical testing of insulating materials
3. Training in application of Insulation Polytester and Portable Frequency Meter
- 3a. Industrial visits and training in high voltage industrial laboratory

1.10 - 6.10.1984

4. Review and classification of electrical materials, components and appliances programmed for testing at Centre III, including classification and requirements of laboratory equipment.
5. Assistance in arrangement of laboratory earthing system
6. Training in application of electrical measuring instruments :
Insulation Tester, Decade Resistance Boxes, Slide Resistors, Portable Luxmeter, Pocket Thermometer

8.10 - 13.10.1984

7. Laboratory training sessions on testing methods and safety rules for high voltage testing :

- preparation of specimens of insulating materials
- selection and installation of electrodes
- conducting on seminar "Electrical Testing of Insulating Materials, Components and Appliances"
- preparation of basic material for definition of rules of safety under specified conditions of installation and use of high-voltage testing unit in C. III.

15.10 - 20.10.1984

8. Training in operation and use of Multimeters and RCL Meter
9. Installation and putting into operation of High Voltage Testing Unit. Practical training in conducting testing methods and verification of laboratory test instruments.
10. Preparation of Final Report.

22.10. - 26.10.1984

11. Final consultations in Hanoi, debriefing and departure.

Due to the request that I should take part in some activities related to the development of the Electrical and Electronical Testing Laboratory at Centre I the work plan had to be modified in some respects as compared to my job description. Simultaneously the stay at C. III was limited to one month and the programme was interchanged.

In what follows, I should account for basic results according to the work plan and state my recommendation on further action which might be taken for progress in methodological and technical base of the electrical and Electronical Testing Laboratory at C. I and the Electrical Testing Laboratory at C. III respectively.

3. Implementation of Project Activities in C. I

3.1. General

According to the technical data and the field of application the national electrical production intended for testing in EETL at C. I were classified into four groups :

- Electric Machines (M) ;
- Electric Appliances (A) ;
- Electric and Electronic Components (C) ;
- Electric Materials (M_t).

According to the Testing Program for Quality of Electric and Electronic Products at C. I the following products are intended to be tested :

GROUP M

- Rotating Electrical Machinery, power : 0,55 ...
50 kVA (acc. to TCVN 1897-77, 228 -78)

- Audio Frequency Amplifier and Receiver (acc. to TCVN 1982-77)
- Transformer for Wolding (acc. TCVN 2283-78)

Group A

- Electric Table and Ceiling Fans (acc. to TCN 1444-73, 1445-73)
- Electric Small Transformer (acc. to TCVN 1986-77)
- Tungsten Filament-Lamps (acc. to TCVN 1551-73, 2216-77)
- Relays and Contactor (acc. to TCN 271-73, 272-73)
- Electric Stove (acc. to 16 TCN 336-75)
- Electric Iron

Group C

- Semiconductor Devices (acc. to TCVN 2326-78)
- Resistors, Variable Resistors and Electrical Capacitors (acc. to TCVN 2556-78, 2557-78, 2559-78, 2561-78)
- Dry Cell (acc. to TCVN 2746-78, 2747-78)
- Single - Phase and Three-Phases Switches (acc. to TCVN 1831-75)
- Single - Phase and Three Phases Plug Connectors (acc. to TCVN 2048-77)

Group M_t

- PVC Covered Conductors (acc. to TCN 2103-77, 2104-77)
- Porcelain Isolators (acc. to TCVN 2215-77)
- Electric and Magnet Wires (acc. to TKN-80)

- Solid and Liquid Insulation Materials - Plastic, Varnishes, Transformer oil, etc. (acc. TCVN 3234-79, 3233-79)

In what follows are given main electrical, mechanical and other properties of the above mentioned industrial products - subject for testing in E E T L (C.I) according to the international and above mentioned national standards (taking into consideration the extended technical possibility in E E T L by already delivered UNDP testing equipments and instruments);

Electric Characteristics :

- Insulation Resistance (R_{ins}) Volume (ρ_v) and Surface Resistivity (ρ_s)
- Power ; Power Factors;
- Electrical Capacitance ;
- Dielectric Break - down Voltage, Dielectric Strength;
- Dielectric Constant (ϵ), Dielectric Dissipation Factor (D) ;
- Distortion, Signal - to - Noise Ratio ;
- Amplification Factor;
- Leakage Current; Permissible Current;
- Electric Impedance ;
- Destruction of Insulation ;
- Other Electrical Characteristics.

Mechanic Characteristic determined by :

- Vibration Test ;

- Over Speed Test ;
- Test of Momentary Excess Torque for Motor;
- Test of Speed Excess Torque for Motor ;
- Acoustic Test ;
- Test of Wind Volume ;
- Test of Wind speed and direction ;
- Test of Mechanical Endurance ;
- Measurement of Geometric Dimension ;
- Impact Test ;
- Turn - Bending Flexibility Test ;
- Abrasion Test ;
- Elongation Test .

Temperature Characteristics :

- Temperature Rise of Operating Part of Machine;
- Temperature Rise of Winding ;
- Deflection Temperature.

Climatic Characteristics (acc to TCVN 1612-75)

The existing testing equipments and instruments (corresponding list see below) were used for testing of the most important electrical products.

L I S T

of existing testing appliances and instruments
in EETL at C.I.

1. C 1204 - 500	- Digital AC Voltmeter;	(Gr. A)
2. C 1 - 65	- Oscillograph (one channel);	(Gr. A)
3. D 1 - 8*	- Battery Operated Insulation Tester ;	(Gr. B)
4. DC - 551*	- Wind Indicator;	(Gr. A)
5. DM	- Digital Voltmeter;	(Gr. A)
6. E O - 213	- Oscillograph (two channel);	(Gr. A)
7. H L C - 80 p*	- Digital Surface Thermometer;	(Gr. A)
8. K - 506	- A C Power Meter;	(Gr. A)
9. L A M	- Linear - Angular Measures;	(Gr. A)
10. L C R - 745*	- Digital Capacitance Meter;	(Gr. A)
11. L D M - 170*	- Distortion Meter ;	(Gr. A)
12. L P A 28/400/1-11	- Power Testing System ;	(Gr. B)
13. L T D C	- Life Tester for Dry Cell;	(Gr. B)
14. L T F	- Life Tester for Filament Lamps;	(Gr. B)
15. M I C - 126-0*	- Constant Temperature Electric Drying Oven;	(Gr. B)
16. N R 20/3	- Power Supply;	(Gr. B)
17. PF - 810*	- Power Factor Meter;	(Gr. A)
18. P K - 210	- Current Transformer;	(Gr. B)
19. R O 17 M	- Portable Luxmeter;	(Gr. A)
20. r 3 - 54	- Frequency Meter;	(Gr. A)
21. S M - 5 E*	- Megohmmeter	(Gr. A)

22. ST - 80	- Vibration Tester;	(Gr. B)
23. ST - 80/111	- Vibration Tester ;	(Gr. B)
24. T P R - 22 CV*	- Protective Relay Test Sets;	(Gr. B)
25. T R O E 60-A	- Decade Generator;	(Gr. B)
26. V P - 102	- Vibration Meter;	(Gr. B)
27. W I P 6	- High Voltage Tester;	(Gr. B)
28. Y T W K - 1	- Portable Double Bridge;	(Gr. A)
29. 25 - A*	- Anemometer;	(Gr. A)
30. 00014	- Sound Level Meter;	(Gr. A)
31. 23S - 2*	- Anemometer;	(Gr. A)
32. 107*	- Electric Water Bath;	(Gr. B)
33. 111 - T*	- Wind Indicating System;	(Gr. A)
34. 210*	- Magnet Wire Abrasion Tester;	(Gr. B)
35. 224*	- 360° Turn Bending and Flexibility Tester	(Gr. B)
36. 234*	- Mercury Bath Insulation Destruction Tester	(Gr. B)
37. 2677*	- Surface Temperature Indicator;	(Gr. A)
38. 2709*	- Electronic Galvanometer;	(Gr. A)
39. 3001 - 01	- Weathering Testing Machine;	(Gr. B)
40. 3007 - 01	- Weathering Testing Machine;	(Gr. B)
41. 3205	- Trasformer;	(Gr. B)
42. 3221*	- Insulation Resistance Meter;	(Gr. B)
43. 3226*	- Universal Leakage Current Tester;	(Gr. B)
44. 3281-00	- Portable Luxmeter;	(Gr. A)

- | | | |
|-----------------|---------------------------|---------|
| 45. 3304 - 03 * | | |
| 04 * | | |
| 07 * | | |
| 09 * | - Power Factor Meter with | (Gr. B) |
| 11 * | Custer Transformer | |
| 12 * | | |
| 46. 3604 * | - Sound Level Meter; | (Gr. B) |
| 47. 82012 | - High - Voltage Tester | (Gr. B) |

* Provided by UNDP testing equipments (Group B) and measuring instruments (Group A)

The large number and high quality of equipments supplied by UNDP increased the range of possible tests, which is shown in the following table. This was due to the work done by the expert during his short stay.

Group of Characteristics	Number of Testing Items			Total
	to 03.08.84	to 01.09.84	to 22.09.84	
Electric	6	19	24	49
Mechanic	8	15	4	27
Temperature	-	9	-	9
Climatic and Operation	18	-	2	20

The extended use of the existing equipment and the verification of the results so obtained was demonstrated to the staff.

3.2. Remarks from Experience Gained from Putting into Operation of Testing Instruments

- Battery Operated Insulation Tester, mod. D 1 - 8
is covering a wide insulation resistance range from 50 [M Ω] to 2000 [M Ω]. Also the proper volume resistance of the cable can be measured by its use.

The circuit voltage can be measured by contacting the tip of the measuring cord to the measuring piece circuit.

- Super Megohmmeter, mod. S M - 5 E

The indicator of this instrument is a special wide meter so that it is easy read the value in the range of higher insulation resistance (up to $20 \cdot 10^6$ [M Ω]).

The self calibration of the measuring voltage is possible without external instruments because of unique circuit and an accurate value is always measured.

During the practical training verification of the Super Megohmmeter was carried out by using existing instruments in the following sequence of operation:

Zero adjustment (0 \leftarrow reading \rightarrow ∞);

Checking up the scale (by using existing Reference Resistance Box);

Checking up the insulation resistance between the circuit and case (by $U \approx 3,5$ [kV] from the existing independent supply);

Checking up the voltage on the normally opened terminals by normally revolutions per minute
($\Delta U \leq 20\%$)

Error determination by 10 deg. inclination of measurement surface

- Universal Leakage Current Tester, mod. 3226, which is normally used for electric testing of insulation materials was used also for testing of low-voltage electric equipment (acc. to GOST 25072-81), rotating electrical machines (acc. to CMEA ST 1345-78, Publ. of IEC 34-1, 34-2, GOST 11828-75), three phase asynchronous electric motors (acc. to CMEA ST 168-75, IEC Publ. 34-1, 34-2, GOST 7217-79).
- Set of Instruments for Testing of Electric and Magnet Wires

The following equipment which are normally used independently for specific test was combined by the expert for testing of more important electric and mechanic properties of electric and magnet wires.

Electric Water Bath with Regulator, mod. 107 was used for preparing of electric test object (acc. to CMEA ST. 2779-78, 2121-80; GOST 2990-78, 6433.1-71).

Constant Temperature Electric Drying Oven, mod. MIC - 126 was used for drying of specimens and also was used for measurement the rate of the moisture content and the water absorbing capacity (acc. to CMEA ST 2121-80, GOST 6433.1-71, IEC Publ. 464-2-74, GOST 13526-79).

360° Turn Bending Flexibility Tester, mod. 224

The mechanic component of this equipment was broken, counter was out of order; the unit was repaired and checked service properties. This Tester was used for checking of mechanic properties of magnet wires (acc. to GOST 12182.1-71, 14340.3-69).

Mercury Bath Insulation Destruction, mod. 234

was used for checking of insulation's quality of magnet wire (acc. to CMEA Recommendation 488-66, 449-65).

Magnet Wire Abrasion Tester, mod. 210

was used in combination with mod. 234 for checking of mechanic properties of protective coating of magnet wire (acc. to GOST 6589-74).

Digital Stop-watch, mod. C 4 - 015 was used for measurement of time sections by preparing of the specimen and checking the duration and sequence in time of the testing operation.

- Set of Instruments for measurement of Frequency, Electric Resistance, Capacitance, Inductance, Impedance, Dissipation Factor (D) and Quality (Q) of Electric Materials, Components and Appliances.

- The Frequency meter, mod. r 3 - 54

was used only for frequency measurement. By expert's assistance it's function was extended in the field of a frequency ratio, period and interval measurement.

The Portabe Double Wheatstone Bridges (2p) mod.

Y T W K - 1 were broken. By expert's assistance they were repaired and by practical training of laboratory personnel was used for checking Direct Reading Impedance Bridge, mod. DRZ - 2 M.

The Direct Reading Impedance Bridge, mod. DRZ - 2M

was used for measurement the absolute value (from 10 [Ohm] to 10 [k Ohm] and phase angle (from 0° to $\pm 90^\circ$) of the impedance of electric and electronic components, produced in SRV.

During the practical training of laboratory personnel calibration of this instrument was realized by using existing instruments (Double Bridge, mod. YTWK-1, Digital L C R Meter mod. LCR - 745, Frequency Meter mod. r 3-54, Oscilator, mod. TROE-60 A, Galvanometer, mod. 2709). Readings of this arrangement was tried on Reference Resistance Box, mod Y T W K - 1 and capacitor and than on actual materials. The results were compared to LCR meter. LCR - 745 quickly identified the approximate value of the parameters which could than be measured by the external bridge meter for high accuracy.

The Digital L C R Meter, mod L C R - 745

was used for measurement of resistance, capacitance, dissipation factor, inductance, quality (at inductance measurement) of electric and electronic components and appliances.

Electric Galvanometer, mod. 2709 can detect and measure a minute voltage or current. It was primarily used for zero method measurement by electrical testing of insulation materials (like a bridge or

a potentiometer). This method using high-sensitivity Electronic Galvanometer, mod. 2709 requires the minimum of manual adjustment and it is easy to read.

- Set of Instruments for Power Measurement

Power Meter, mod. K - 506

This instrument was out of order. The failure was found (the ferrite-cored coil was broken) and removed by expert's assistance. After that the Power Meter was used for measurement of current, voltage and reactive power in single-phase and three-phase circuits by testing of electrical machines and appliances.

Power Factor Meter, mod. 3304 was used for measurement of power factor at commercial frequency in single-phase and three-phase machines by expert assistance in providing appropriate mechanical loading.

Function Power Meter, mod. P F - 810 is a passing type power/S R meter covering a wide frequency range of 1,8 [M H z] to 200 [M H z]. It was modified for testing of above mentioned electronic components by expert's assistance.

- Distortion Meter, mod. L D M - 170

Short - term course for testing of static and dynamic characteristics of amplifiers was prepared using existing instruments by expert's assistance (Oscillator, mod TROE-60, Frequency Meter, mod. r 3 - 54, Power Meter, mod. K-506; PF - 810, ICR Meter, mod. ICR - 745; Distortion Meter, mod. LDM-170) and prac-

tical training was provided. This instrument was practically used also for measurement of distortion of audio frequency decade generator's signal.

- Portable Protective Relay Test Set, mod. TPR - 22 CV, TPR - 22 VF was used for testing the various type of protective relays, such as single-current element, single-voltage element, two current element and single current / single voltage element relays. The testing of the phase characteristic was provided using mod. TPR - 22 CV and the current transformer.

The phase angle control was carried out also during practical training of laboratory personnel by using current and voltage adjusters.

- Set of Instruments for Electrical Measurement of Nonelectrical Quantity

The surface Temperature Indicator, mod. 2677 was used for measurement of surface temperature of motors and radiators. This measurement is capable now of measurement the surface temperature of relatively fast moving objects

Hand-Hold Digital Thermometer, mod. HLC - 80 p was used for measurement of the surface temperature of the components of electric machines and heating appliances.

- Sound Level Meter, mod 3604

This instrument is particularly useful for rapid surveys, for periodic checks on noisy environments and for production testing of manufactured products. The corresponding design was provided by which placement of sound reflecting surfaces should be made.

- Wind Indicating System, mod. DG - 551, 23 - S II was used for measurement wind speed and direction simultaneously, produced from ceiling and table fans. The range and accuracy of this instrument exceeded the requirement for testing Unit acc. to TCN 1444-73, TCN 1445-73, but the room should be rearranged in conformity with designm which was provided by expert's assistance for creating of corresponding condition of measurement.
- Vibration tester , mod. ST - 80 was installed and used for vibration-resistance test of the semiconductor devices (eg.transistor mod. KL 506, KL 507, KL 508), but testing method was incorrect. The training course on methodologies for conducting laboratory vibration test and result analysis was prepared by expert's assistance. During practical training course the laboratory staff was trained in correct installation and determination of vibration - resistance of heavy testing objects by using designed additional accessories. Concerning the localities there will be an improvement if special space is reserved for the vibration isolator.
- Power Testing System, mod. 28/400/1 - 11 is practically useful for testing the output power (up to 28 [kW]) and torque respectivity of rotating machines. However, the unit was not in operating condition, as I was told all connecting cables were missing. I was also told that most important cables had been already ordered. The suggestion of necessity of putting complete operational state of this system must be considered to be of a first priority.
- The E E T L is also in pocession of Cable Fault Burning and Surg. Unit, mod. 82012 covering the voltage range of 3 ... 70 [kV] . This unit was

installed but absence of corresponding earthing connection, safeguard, operating rods, earthing indicator and individual safety means made impossible putting it into operation. In what follows is given the list of above mentioned safety means and corresponding testing units :

High - Voltage Indicator, mod. Y B H - 90(USSR)
range 9 ... 110 [kV] , ignition threshold 9 [kV].

High - Voltage Indicator, mod. Y B H - 80 M(USSR)
range 2 ... 10 [kV], ignition threshold 550 [V]

Dielectric boots, rubbers, dielectric glove,
dielectric cover.

Earthing Indicator, Insulating Rod.

In same time the expert prepared the design for arrangement of testing units for testing of individual safety means and operating rods.

- Arrangement of the Earthing Connection and the safeguard

When using the high-voltage appliances (especially due to $U > 1000$ [kV]) it is essential to respect the necessity of arrangement the correct earthing system according to the requirements related to a permissible value of the earthing connections resistance.

The modification of the earthing connection for grounding of high- and low-voltage electrical installation simultaneously may be used in the E E T L at C. I. We suggest to use the external earthing system (corresponding design including the safeguard was carried out and given for assembling) for arrangement of economical earthing connection.

If the fault-to earth current increased in future due to increasing power supply and connection of more machinery, than the new permissible value of the earthing resistance should be established and new earthing system should be designed for sake of safety.

At the same time the expert prepared the basic material for definition of rules and norm of safety under specified condition of installation and use of testing instruments in both testing laboratory (at C.I and C, III).

If the corresponding rules and norm are approved by the respective Departments (eg. GDSMQ, Fire Department, Ministry of Health, relevant Committee of trade-unions, etc.) it is recommended to make references in other standards for electric testing methods to the above mentioned approval body. It is permissible to give referencies in branch standards too.

4. Proposals concerning E E T L at C. I.

The suggestion, which is being stated here must be considered to be of paramount importance for extension of efficiency function of E E T L .

- Concerning the installation of existing test units it would be an improvement if following special condition is created;

Arrangement of earthing connection, including safeguard as well as procurement of operating rods, individual safety means and corresponding equipment for their testing.

Location and arrangement of special space for installation of Wind Indicating System for measurement wind speed and direction simultaneously, produced from ceiling and table fans.

Location and arrangement of Special placement of sound reflecting surfaces and foundation for production sound testing of manufactured products by using existing Sound Level Meter.

Arrangement of machine foundation for installation of the engine test bed and of existing shaker unit for testing heavier object by using designed (by expert) spring hanger.

Construction of testing base for conducting of following tests of insulation materials, electric and electronic components and appliances, including measuring instruments and systems :

- Corrosion test;
- Full-scale, accelerated environmental and comprehensive test;
- Ageing test;
- Shelf - life test ;
- Tropical exposure test ;
- Salt mist test ;
- Pure - culture test ;
- Mould - growth test ;
- Spray Test ;
- Relaxion test ;
- Cracking test ;
- Withstand voltage test ;
- Break - down test.

Taking into consideration the unique (humid subtropical climate) and diverse environmental conditions (for corrosion, salt mist, ageing, pure culture, mould-growth

tests and etc.) in SRV we can expect that above-mentioned testing base may be constructed by international assistance.

- Concerning the requirement equipments and calibration apparatus it would be better if following means are procured:

80/110 [kV] High - Voltage Test Instrument (Siemens, mod. MO 6843-A1 for testing liquid and solid insulating materials.

Set of Instruments for Testing of the Amplifiers - Harmonic Analyser, Crystal - Controlled Oscillator, Precize Power Meter.

Sphere - gap ($U \approx 50$ [kV]) with inserted radiative radiator for calibration of kilovoltmeter.

High - Voltage Double Bridge for Determination of the Loss Tangent and the Dissipation Factor of a dielectric, mod. P - 525 (USSR)

Equipment for Testing of Operating Characteristics of semi conductors.

Reference HV capacitor, mod. C L P - 24, C L P - 30 (Hartman - Brown, GDR), M C T 100/75 (T U R, G D R).

High Current Stabilize Power Supply ($I \geq 100$ [A]) for Operating Protective Relay Test Set.

Above mentioned safety Means and corresponding Testing Units.

5. Implementation of Project Activities in C. III.

5.1. General

In conformity with the Testing Program for quality at C. III the following electronic products are intended to be tested :

Group A

- Electric Iron
- Electrical Transformers (acc. to TCVN 1986-77);
- Fluorescent and Filament Lamps (acc. to JYS C 7601-67) ;
- Electric Table and Ceiling Fans (acc. to TCN 1444-73, 1445-73)
- Accumulator (acc. to TCVN 164-64)
- Electric Stove (acc. to 16 TCN 336-75)

Group C

- Plug Connectors (acc. to TCVN 2048-77);
- Electric Switches (acc. to TCN 1831-75);
- Dry Cell (acc. to TCVN 2746-78, 2747-78);
- Ballast for Fluorescent Lamps (acc. to TCVN 2555-78)

Group M_t

- PVC Covered Conductors (acc. to TCVN 2103-77, 2104-77);
- Enameled PVR Wire;
- Electric wires and Cables (acc. to QTKN - 80);
- Porcelain and Glass Isolators(acc.to TCVN 2215-77);

- Transformer Oils;
- Insulating papers;
- Varnishes ;
- Plastic ;
- Mica, Micanite, Bakelite;

According to the national standards the following electrical, mechanical and temperature characteristics are subject to be tested in E T L at C. III (taking into consideration the technical possibility of existing testing instruments)

Electric characteristics :

- Insulation Resistance (Rins), Volume (ρ_v) and Surface Resistivity (ρ_s), Inner Resistance (R_i)
- Dielectric strength
- Withstand Voltage
- Leakage Current, Permissible Current
- Destruction of Insulation
- Power, Power Factor
- Dielectric Constant (ϵ)
- Dielectric Dissipation Factor (D)
- Other Electric Characteristics

Mechanical Characteristics :

- Wind Speed and Direction
- The Airs delivery
- The Dimensions

Temperature Characteristics :

- Temperature Rise of Operating Appliances
- Deflection Temperature.

The delivered UNDP testing instruments (i.e. Insulation Testers, mod. 2404, 3207, Multimeters, mod. PM 2521, A-43, passive electric components, mod. 2791, 2786, Luxmeter, mod 3281, Thermometer mod. 2541, 2542, RCL Meter, mod. PM 6303, Frequency Meter, mod. 2038 and High-Voltage Testing Unit, mod. M O 6 8 43-A1) increased the range of possible test.(see the table below).

Group of Characteristics	Number of Testing Items		
	to 22.09.84	to 22.10.84	Total
Electric	16	15	31
Temperature	2	-	2
Mechanic	3	-	3

As it is shown in table the extension of testing possibilities of E T L at C. III occurred only in the field of testing of electric characteristic of products.

5.2. Remarks from experience gained from putting into operation of testing instruments in E T L .

- Portable Frequency Meter, mod. 2038

This instrument is Precision Ponter Type Frequency Meter in which a frequency - to - DC current conversion is carried out by combining a differential type transducer with a DC current meter

or ammeter so as to directly read frequencies.

- Analogue Multimeter, mod. A 43

is normally used for ac/dc voltage and current measurement as well as for resistance and capacity measurements. By expert the two above mentioned instruments were combined with slide resistors, mod. 2790, ammeter, mod. 370 and oscilloscope, mod. 1D-17 for checking and elaboration a new system - electric motor - generator for frequency conversion (50 [Hz] - 60 [Hz]) of the supply means for testing of exported ceiling fans.

- Pocket Thermometers, mod. 2541, 2542.

They are suited for checking temperature of air conditions, ovens and refrigerators. They also contain a 0 to 999 second stop watch enables time interval of ceiling fans testing (as well as temperature sensor-test object time) to be measured. The test of single-phase and three-phase plug connector was realized using set existing instruments. (slide resistor as load, ammeter mod. 370, pocket thermometer mod. 2541).

- Insulation Tester, mod. 2404 was used for testing of the insulation resistance of electrical machines, ceiling fans and other electric devices. This instrument was also used for testing of the insulation resistance of the dielectric mat by arrangement of earthing system with safeguard in E T L.

- Insulation Polytester, mod. 3207 was used for checking of installed in E T L earthing system.

- R C L Meter, mod. PM 6303 is normally used for measurement of resistance, capacitances and inductances. The electric circuit for comparison and

- checking the accuracy of existing reference electric components (e.g. Decade resistance boxes, mod.2786) and instruments (insulation tester mod.2404, multimeter, mod. A - 43, RCL meter, mod. PM 6303, including Kelvin Bridge, mod. 4287 and multimeter, mod. PM 2521.) was designed and realized by expert's assistance.

- Automatic Multimeter PM 2521.

This microcomputer controlled digital multimeter is normally used for separately measurement of ac/dc voltage and current, time and counter, resistance and temperature, diode and trigger level measurement. This instrument was combined with existing measurement devices (frequency meter, mod. 2038, analogy multimeter, mod. A-43; Sympson ammeter, mod.10, capacitance box, RCL meter, mod.6303) for checking starting current and determination of optimal components of different electric appliances (e.g. table fan. mod. K.30 A, relay, electric swithes by addition current transformer and etc.).

- The 80/220 kV high-Voltage test Instrument consists of basic unit which is particularly suited for testing liquid insulating materials, especially oil, but the ancillary devices and accessories by which the basic unit was extended for testing of insulating raw materials, electric components and finished units, was designed and realized by expert's assistance. The training course on methodologies for conducting high-voltage test for liquid and solid materials, producing in S R V was prepared by expert. During practical training course the laboratory staff was trained in correct preparation of specimens and installation of electrodes on the solid insulating materials as well as in conducting HV testing procedure and calculation testing results acc. to

C M E A S T 3165-81, 3164-81, 3166-81, 2121-80, 2411-80 IEC Publ.212-71, GOST 6433.1-4-71, ASTM D. 1371, D 1163, D. 618, E 104, E 171, D 115, D 923, D. 117, D 257, D 143, D 150, D 1676, D 1398, etc.

The E T L at Centre III now is capable for providing of standard breakdown test of the transformer oils, mineral oil (in oil breaker), varnishes, mica products, VCP insulation, porcelain izolators, ceramics, etc.

- At the same time the external earthing connection with safeguard, for grounding of high- and low-voltage units was arranged acc. to expert's design. There were also provided corresponding electric tests in conformity with basic safety rules, prepared by expert.
- All existing instruments in E T L at C. III were classified by expert and established the extended field of testing using of elaborated set of measuring devices and testing units. By this way was determined the new group of electric products (e.g. accumulator, electric rotation machines, electric switches, transformers, amplifiers, etc.) some technical characteristics of which (especially insulation and service properties) the E T L is capable now to test.

It should be also separately noticed that the set of existing instruments and designed accessories was arranged for testing of following electric products:

- Electric switches - $I \approx 100[A]$ (in composition with current transformers mod. 2 A; mod. S M 15 A; ammeter and Voltmeter, mod. Sympson, 10 ; R C L meter; mod. P M 6303).
- Single and three phase plug connector - 220 V/6A, 380 V/50 A (in composition of current transformer, mod. 2 A, ammeter, mod. 370, pocket thermometer, mod. 2541, multimeter PM 2521).

- Exported Ceiling and desk fans (set for checking of starting current; testing of the supply system - meter - generator in composition with oscilloscope, mod 1D - 17; frequency meter, mod. 2038; slide resistor; mod 2790 ; multimeter, mod. A - 43; ammeter, mod. sympson 10; capacitance Box; R C L meter, mod. PM 6303 ; ammeter, mod 370). The practical training in conducting standard methods of test for above mentioned electric products, as well as for accumulator, motor, transformer, etc. was provided by expert assistance.

6. Proposals concerning E T L at C. III

- Respecting the extension of E T L testing capabilities by using the existing testing units I underline that the standardization of specifications for the electric products (especially transformer oil, mineral oil for oil breakers, mica products, porcelain isolators, ceramics, varnishes, plastic, etc.) as well as standardization of corresponding electric testing methods should be considered to be of paramount importance.

Cooperating activities of Electric Testing Laboratories (at C. I and C. III) and Quality Checking Laboratories of corresponding branches of industry in this field I considere as necessary condition for progress in the extension of efficiency function of both sides.

- Concerning the realization of testing method by using existing units (in C. III) and required equipments it would be an improvement if following works could be done:

Manufacture of ancillary devices and accessories for extension of H V testing unit designed by expert.

- Arrangement of necessary condition for preparing specimens and conducting standard method of electric testing ecc. to ST 2121-80, 2411-80, 3165-81, 3164-81, GOLT 6433.1-4-71, ASTM D 1676, D 1677, D 1371, D 1169, D 923, D 618, D 115, D 171.
- Arrangement of the set of equipments for testing of magnet wires, cords and cables (e.g. Electric Water Bath, Constant Temperature Electric Drying Oven, Mercury Bath Insulation Destruction, Magnet Wire Abrasion Tester, Turn Bending Flexibility Tester, Cable Fault Burning and Surge Unit, etc.).
- Arrangement of the set of Equipment for testing of electric motors and appliances (including Power meter K - 506; Power Factor Meter, mod. 3604, Power Testing System, mod. L P A 28/400/1-11 ; etc.).
- Installation of protective relays testing equipment.
- Arrangement of set of devices for testing of accumulators acc. to the list of required instruments, completed by expert.
- Arrangement of machine foundation for installation of the test object (e.g. motors) as well as of shaker unit.
- Procurement of operating rods, H V Indicator, mod Y B H - 90 (range 9 ... 110 [kV]; mod. Y B H - 80 M (range 2 ... 10 [kV]). Dielectric boot, rubbers, dielectric gloves, dielectric cover, earthing indicator, Insulating rod.
- Procurement of Sphere Gap for calibration of kilovoltmeter of existing H V Testing Unit.
- Procurement of High - Voltage Double Bridge for determination of the Loss Tangent and the Dissipation Factors of a dielectric (e.g. mod. P-525, USSR).

- Procurement of the Reference Lamp and Ballast for testing of electric lamps.

7. Training Course and Recommendation on Methodologies for Conducting Test Including Result Analysis and Report

- The technical national staff of C.I. and C.III was trained in methods for preparing of test cell and specimens of insulating materials, mica paper, plastics, enamel, lacquer, varnishes, insulation liquids, installation of electrodes according to IEC Publ. 212-71, C M E A S T 3165-81, 3164-81, 3166-81, 2121-80, 2411-80 ASTM D 1677, D 618, E 171, d 115, D 923, D 1160, GOST 1352.6-79, 6433.1-4-71, as well as in conducting methods of testing d.c. resistance or conductance, break - down voltage (dielectric strength), across characteristics and dielectric factor according to CMEAST 2411-80, 3165-81, 3164-81, 3166-81, GOST 6433.2-71, 6433.3-71, 6433.4-71 ASTM D 1676, D 1389, D 257, D 117, D 877, D 150, D 149, D 1169, D 1816. Bellow is given one of the examples of short-term training course providing with laboratory personnel in the field of Break-down voltage testing.

- Introduction

A brief review of three postulated mechanisms of breakdown, namely:

The discharge or corona mechanism; the thermal mechanism and the intrinsic mechanism as well as a discussion of the principal factors affecting test on practical dielectrics, were given to aid in interpreting the data. The discussion was concerned only to solid, semi-solid, and liquid materials.

- After review of above mentioned postulated mechanisms there was given information concerning the nature of electrical insulation materials. The nonhomogeneous character of solid commercial electrical insulating materials and the possibility of dielectric defect of various kind was noticed simultaneously. There was shown that dielectric breakdown often occurred in an area of the specimen other than that where the field intensity was greatest and sometimes in an area removed from the material directly between the electrodes.
- Concerning the influence of test and specimens condition there was given information about affect the test result by the electrode material and geometry, as well as by specimen thickness. Experiment showed that for solid and semi-solid material, the dielectric strength varies inversely as a fractional power a specimen thickness and there is a substantial amount of evidence that for relatively homogeneous solids, the dielectric strength varies approximately as the reciprocal of the square root of the thickness. Since the dielectric strength is so dependant upon thickness there was noticed necessity of stating the thickness of the test specimen by breakdown test.
- There was also given a review of general influence the test result by temperature of the specimen and its surrounding medium, as well as by the rate, the wave form and frequency of the applied voltage. Practically it was shown that the relative humidity influences the dielectric strength notwithstanding the materials absorbs little or more moisture.

Breakdown test procedure, results of calculation and report were made acc. to C M E A S T 3166-81.

In same logical sequence of operation the training course on methodologies for conducting test

of components (relay, magnet wire, capacitor, resistor, transistor) appliances (electric fan switches, ...) and machines (rotating electrical machines, transformer amplifier) was provided.

Concerning methodological guidance of standardization and practical electric testing activities in the electrotechnical branch of the national economy it would be an improvement if at C. I and C. III could be carried out advanced realization of work on standardization of raw and primary insulation materials, electric and electronic components, whose quality has a decisive effect on technical and economic characteristics, reliability and durability of important electrotechnical industrial products and consumer goods (e.g. rotating electric machines, transformer, three phase asynchrrus electric motors, electric fans, radio-receivers and etc.), producing in S R V.

In particular it was recommended to elaborate the adopted standard specification and standard method of test for following electric materials and components :

Transformer oils acc. to ASTM D 2283; testing method acc. to CMEA ST 3166-81, ASTM D 1816.

Electrical insulating oil for cable system acc. to ASTM D 1818, D 1819; testing method acc. to CMEA ST 3166-81.

Mineral oil for use in transformer and in oil circuit breaker acc. to ASTM D 1040, testing method acc. to SMEA ST 3166-81.

Power cable acc. to GOST 10695-80, 6106-80, testing method acc. to GOST 23286-78.

Wires and cords acc. to GOST 23286-78, GOST 2990-78
CMEA ST 2779-80

Varnishes acc. to ASTM D 115, D 618, D 2519, GOST
13526-79.

Mica products acc. to ASTM D 748; Testing acc. to
ASTM 1677

V G P insulation acc. to **A S T M** D 2219, D 2220

Ceramics acc. to **C M E A S T** 1648-79; 3568-82.

Enameled wires acc. to GOST 14340.1-74.

Porcelain isolators acc. to **S M E A S T** 2313-80
C M E A S T 2314-80

Communication cable acc. to GOST 10786-72

Electrotechnical products; methods of controlling
resistance to attack by special media acc. to
GOST 24683-81.

8. Seminar

The main subject of seminar was review and classification of general properties of insulating materials, including the standard methods and appliances for testing of insulation materials as well as electric and electronic components and appliances.

The last section of seminar covers the problem of earthing connection and safeguard.

1. In the first part of report there were given definitions of the main properties of insulating materials and they appeared in the following order :

- Volume resistivity ρ_v (volume resistance R_v);
- Surface resistivity ρ_s (surface resistance R_s);

- Insulating resistance - R_i ;
- Dielectric constant, (permittivity, capacitivity, or specific inductive capacity)
- Dielectric phase angle - θ ;
- Dielectric loss angle - δ ;
- Dielectric dissipation factor (loss tangent) - D ;
- Dielectric power factor ;
- Dielectric breakdown voltage;
- Dielectric strength ;
- Flashover;

2. In the light above mentioned we reviewed the testing methods and corresponding units for determination of the main properties of specimens.

The methods were presented in the following sequence :

- General Measurement Consideration;
- Electrode Systems ;
- Test Specimens; (Cleaning Solid Specimens: Liquid Specimens and Cells)
- Choice of Apparatus and Method for Measuring;
- Conditioning ;
- Surrounding Medium and Factors Affecting the Insulation Properties; (Temperature and Humidity Control)
- Test Circuit ;
- Procedure;
- References ;
- Calculation and Report.

In the following part were given the comments for preparing and cleaning of the test specimens, electrodes and test cell.

In the following part of seminar a brief review of three postulated mechanisms of breakdown (namely: the discharge or corona mechanism; the thermal mechanism, and intrinsic mechanism), as well as discussion of the principal factors (e.g. electrode geometry and area, specimen thickness, temperature, time, wave form, frequency, surrounding medium, relative humidity) affecting tests on practical dielectrics, components and appliances were given to aid in interpreting the data.

using

- 3.3. When the high-voltage appliances it is essential to respect the necessity of arrangement the correct earthing connection according to requirement related to permissible value of the earthing connection's resistance.

In the light of above mentioned in the last part of seminar, there were given materials for calculation and arrangement of earthing system including the safeguard, as well as the basic materials concerning the individual safety means and testing methods and units for determination of their insulation properties.

Three seminars were held during my stay; one at C. I, (on 18 September), one at C. III (on 13 October) and one at the factory "Tia Shang" (on 11 September), producing accumulator. The written documentation, containing the content of these seminars was left behind. The content of these seminars were modified acc. to the field of activities at C.I., C.III and factory "Tia Shang" respectively.

9. Industrial Visits

The expert visited the following industrial units :

- "VINAMID" (Hanoi) producing Desk Fan (225 mm) and Ceiling Fan (TQ1200)
- Transmission Station of Electric Energy "BALA-BONG-DO" (Hanoi). By expert assistance was provided practical training of laboratory personnel of EETL at Centre I in testing of the loss tangent and insulating resistance of the circuit breaker, mod. BBS - 110, BBS - 220 by using moving electric testing laboratory mod. ЭИТ - 35-02.
- Factory producing plastics (Hai Phong)
- Factory producing accumulator-"Tia Shang" (Hai Phong)
- Factory producing semiconductors (Hanoi)
- Electric Testing Centre (Ho Chi Minh City). The practical training of laboratory personnel (of ETL at C.III) in electric testing of transformer oil and porcelain insulators there was provided by expert assistance.

The expert prepared also recommendation for extension testing capability in "VINAMID" and "TIA SHANG" factories producing electric fans and accumulators respectively.

10. Acknowledgements

I was kindly received by Mr. Doan Fuong, the General Director of GDSMQ. I would like to express special word of thanks to Mr. Doan Fuong for his active interest and heartiness.

I was also kindly received by Mr. Van Tinh, Mr. Duyet and Mr. Van Chien in Hanoi. It was a pleasure for me to collaborate with Mr. Thang and his friendly team in EETL at C.I in Hanoi. The EETL at C.I will play a leading role as a support for improving quality control of electric products made in Viet Nam by extending technical possibilities.

My thanks to Mr. Duyet, Director of C.I, for his help and hospitality.

I was kindly received by the Director of C.III, Dr. Thien,

and his Deputy D.Quang in Ho Chi Minh City.

I would like to express my satisfaction with the achievements made during my stay by laboratory personnel at C.I and C.III.

Lastly I would like to express my appreciation for the role played by Mr. Cekiera, Chief Technical Adviser of the project, in extending my stay for one month, thus enabling me to fulfill the work specified in my job description. I would like also to thank the personnel of the UNDP office in Hanoi for their help and kind cooperation.

