

**REPORT ON ONE WEEK INTERNSHIP ON REPAIR & OVERHAUL
OF TRANSFORMERS & MOTORS IN
NLC INDIA LIMITED-NEYVELI**

Submitted in partial fulfilment of the requirements for the completion of
PROFESSIONAL TRAINING

By

MOHAN V (Reg. No. 41140056)



**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with grade “A++” by NAAC
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SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this report in the bonafide work of **MOHAN V** (Reg no.41140056) who carried out the internship entitled **REPAIR & OVERHAUL OF TRANSFORMERS & MOTORS** under my supervision from 15-05-2023 to 26-05-2023.

EXTERNAL GUIDE

Head of the Department
(DR.S.RADHIKA)

Submitted for Viva voce Examination held on _____

Name:

Signature:

Internal Examiner

External Examiner

DECLARATION

I **MOHAN V** here by declare that the Report entitled **REPAIR & OVERHAUL OF TRANSFORMERS & MOTORS** done by me in **NEYVELI NEW THERMAL POWER PLANT, NLCIL , NEYVELI 607807**.is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in ELECTRICAL AND ELECTRONICS ENGINEERING.

DATE :

PLACE:

A handwritten signature in black ink, appearing to read 'Mohan', is written over a horizontal line.

SIGNATURE OF THE CANDIDATES

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to the **Board of Management of SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr.N.M.NANDITHA, Ph.D. DEAN of School of Electricals and Electronics** and **Dr.V.SIVACHIDAMBARANATHAN,M.E., Ph.D. Head of the Department of Electricals and Electronics Engineering** for providing me with necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to my Project Guide **Dr.S.RADHIKA** for his valuable guidance, suggestions and constant encouragement which paved way for the successful completion of our project work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Electricals and Electronics Engineering who were helpful in many ways for the completion our project.

PREFACE

In the dynamic realm of electrical engineering, the heartbeat of power distribution lies within transformers. These silent giants play an indispensable role in ensuring the seamless flow of electricity, translating voltage levels, and maintaining the integrity of electrical grids. As I embark on my journey into the world of repair and overhaul of transformers, I find myself at the crossroads of curiosity and opportunity.

My internship in this specialized field represents a significant chapter in my educational and professional voyage. It is a unique opportunity to delve into the intricate workings of these vital electrical components, to learn the nuances of their repair and overhaul processes, and to contribute to the reliability and efficiency of power distribution systems.

Throughout this internship, I anticipate gaining a comprehensive understanding of transformer design, operation, maintenance, and the principles behind their repair and overhaul. I look forward to applying theoretical knowledge to real-world scenarios, honing practical skills, and working alongside seasoned experts who have dedicated their careers to ensuring the resilience of these essential devices.

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LIST OF SYMBOLS AND ABBEREVIATIONS

IR Insulation resistance ($k\Omega/M\Omega/G\Omega$)

DCR Direct Current Resistance

LV Low voltage

HV High voltage

DC Direct current

AC Alternating current

KVA Kilo volt ampere(power)

ABSTRACT

The internship focused on the repair and overhaul of transformers presents a unique opportunity to delve into the intricate world of electrical engineering. This experience is centered on gaining a comprehensive understanding of transformer design, operation, maintenance, and the principles behind their restoration and enhancement. Through this internship, the goal is to apply theoretical knowledge to practical scenarios, develop hands-on skills, and collaborate with seasoned professionals dedicated to ensuring the reliability and efficiency of power distribution systems.

Transformers are fundamental components in the electricity supply chain, silently powering our daily lives. However, their critical role often remains unacknowledged until issues arise. This internship aims to demystify transformers, enabling interns to troubleshoot and rectify issues, ultimately contributing to the longevity of these essential devices.

The abstract sets the stage for an immersive journey where interns will engage with real-world challenges, absorb insights from experienced mentors, and actively participate in the continual advancement of transformer technology. This internship promises to be an enriching experience, offering opportunities to deepen knowledge and expertise in the repair and overhaul of transformers while fostering a commitment to sustainable and dependable energy distribution.

CHAPTER -I

INTRODUCTION:

1.1ABOUT NLCIL

NLC India Limited, a "NAVRATNA "Government of India enterprise, under the administrative control of MOC has a checkered history of achievements since 1956. Demand for electrical power is increasing at a rapid pace in our country. In order to meet the rapid increase, installation of more thermal power station is the only choice. Neyveli has exclusively proven reserves of Lignite having low calorific value and is located near to the load center thus minimizing the capital cost of transportation lines and reduction in transportation losses. There are three open cast lignite mines of total capacity of 28.5 million tons per annum at Neyveli and one open cast lignite mine of capacity 2.1 million tons per annum at Barsingsar, Rajasthan. They meet nearly 30-40 percent of Tamil Nadu power requirement, Thermal power station - I power generation started from August - 1962, Thermal power station - II generation started from March 1986, Thermal power station - I Expansion generation started from June 2003. The first mine produces about 8.5 million tons of lignite per annum and the second produces about 10.7 million tons of lignite per annum, the mine-IA produces about 3 million tons of lignite per annum. The electrical mines base consists of service yard of LT and HT motors and cables and protection switchgears, substation for the mining of the lignite the raw material used for heating of water through boilers.

1.2. NEW SERVICE UNIT

The Neyveli New thermal power station comprises two lignite-fired, sub-critical units of 500MW capacity each. Each unit consists of a 1540 tonnes per hour (tph), pulverised lignite-fired, tower-type boiler, and a single reheat, multi-cylinder, and condensing type steam turbine with high pressure, intermediate pressure, and low-pressure sections. The plant also includes eight beater wheel mills each connected with three feeders, along with lignite chutes, fuel pipes, fuel burners, and wind boxes. The other components include an ash handling plant, electrostatic precipitators (ESP), flue gas desulphurising (FGD) system, selective catalytic reactor (SCR), denitrification equipment, apart from the plant water system, a gas-insulated switchyard (GIS), and a 275m-tall concrete-reinforced twin flue stack.

1.3.OBJECTIVES OF THE STUDY

To ensure the internal and external parts of the transformer and accessories are kept in good condition and “fit for purpose” and able to operate safely .

Overhauling of a transformer is normally undertaken either if it is faulty (internal) or at the end of 10 - 12 years of its service by way of periodic maintenance. It is advisable to review and analyze the periodical DGA values to check any abnormal variation and healthiness of the transformer.

CHAPTER -II

2.1. OIL FILTRATION MACHINE

Transformer is one of the most important and costly components of power system. Extreme reliability is demanded of electric power system, and even though the failure risk of a transformer is small, when failures occur, they lead to high repair costs, long downtime and possible safety risks. Moreover, transformers are too expensive to replace regularly and must be properly maintained to maximize their life expectancy. So for getting high performance and long functional life of the transformer, it is desired to perform various maintenance activities. Purification of transformer oil is one of these maintenance activities, since transformer's life mainly depends on its insulating oil i.e. transformer oil. To purify transformer oil, high vacuum transformer oil filtration machine is used. It consists of inlet pump, filters, heaters, ionic reaction column, degassing and dehydration chamber, discharge pump, vacuum pumps etc. In this paper, we will study about the transformer oil filtration machine and how it works to purify the contaminated transformer oil.



fig no.2.1 OIL FILTRATION MACHINE

Insulating Oil

Primarily, two kinds of basic insulation materials are widely used in the transformer, including the liquid insulation material such as insulating oil i.e. transformer oil and solid insulation material such as insulation paper. The widespread use of dielectric liquids for insulation and cooling is due to their greater electrical breakdown strength and thermal conductivity than gaseous insulators,

While their ability to conform to complex geometries and self-heal means that they are often of more practical use than solid insulators. Transformer oil is highly refined mineral oil that is stable at high temperatures and has excellent electrical insulating properties

. It is normally obtained by fractional distillation and subsequent treatment of crude petroleum. Hence why this oil is also known as mineral insulating oil. Transformer oil provides part of the electrical insulation between internal live parts in the transformer. It also helps cool the transformer i.e. it acts as a coolant.

Causes of contamination of transformer oil are electrical disturbances and thermal decomposition. Various contaminants like moisture, sludge, dissolved gases etc. Present in the transformer oil reduces the breakdown strength of transformer oil, promotes local heating, increases the electrical conductivity and decreases the electrical and mechanical strength of the insulation system. The contaminants also decelerates the transformer efficiency. The failure of liquid insulation can cause catastrophic damage not only to the power equipment, but also to the surrounding environment. Furthermore, failure often leads to major operational disruption and financial loss. Purification of the transformer oil by high vacuum transformer oil filtration machine removes all these contaminants from transformer oil. The dielectric strength of fresh, thoroughly purified (filtered, degassed, dehumidified) insulating oil is several times higher than that of aged, contaminated insulating oil. Better the insulation of the transformer, longer the life of the transformer and lesser the breakdown of the transformer which eventually results in good returns on investment of the transformer asset and uninterrupted power supply

Inlet pump pumps the contaminated oil from transformer to oil filtration machine. It is thoroughly tested for vacuum and is suitable for continuous trouble free operation. It is provided with an automatic protection against over-pressure build-up. Interlocking arrangement is provided in between the oil inlet pump and the heater so that heater cannot be energized unless inlet pump is on. Interlocking arrangement is provided in the oil filtration machine between the inlet pump and high level float switch (located into degassing and dehydration chamber) to avoid excess

The first step in this serial process is to raise the oil temperature to a desired level, generally upto 65 Degree Celsius. This aids to give the oil latent heat which later aids to dissociate the moisture and gases from oil in the degassing and dehydration chamber. Additionally the viscosity of the oil drops which aids in better filtration to some extent. Heaters are provided in protection tubes to avoid localized overheating, hot spot & breaking oil.

Non-hygroscopic throw away type cartridge filters of one micron rating is provided. This cartridge elements have large dust holding capacity. The replacement of cartridge elements is very easy and can be done without any special tools. Compound (pressure / vacuum) gauge is provided on filter vessel for inlet pressure indication in order to ascertain condition of cartridge elements. Aeration is provided on the filter vessel to aerate the vessel during draining. The cartridge type filter facilitates to achieve desired value of particle size in micron.

The third step in the oil filtration machine is dehydration and degasification of the transformer oil. In degassing and dehydration chamber, dissolved gases and moisture from the transformer oil is removed. It has mild steel welded construction. The chamber is able to withstand the vacuum to which it is subjected. Efficiently spread Raschig rings are placed in the degassing and dehydration chamber. Raschig rings are pieces of tubes which are approximately equal in length and diameter. Usually, Copper or Aluminum Raschig rings are used in high vacuum transformer oil filtration machine.

A Vacuum pumps are provided for evacuation of degassing and dehydration chamber. These pumps are of imported make.

A discharge pump is provided in high vacuum transformer oil filtration machine for sucking oil from the degassing and dehydration chamber held under vacuum. They are fully tested for pressure and vacuum leak rate. Interlocking arrangement are provided between low level float switch (located in degassing and dehydration chamber) and discharge pump to prevent dry running of discharge pump.

Two nitrile rubber hoses with flanged end connection on both sides are provided, one for oil inlet & one for oil outlet. They are capable of handling the transformer oil at 100 Degrees Celsius (maximum) and vacuum

After three to five passes in the high vacuum transformer oil filtration machine, the transformer oil gets purified. shows the transformer oil before and after filtration from high vacuum transformer oil filtration machine. The brown colored oil is unfiltered oil whereas pale yellow colored oil is filtered (or purified) oil. The dielectric properties of oil may vary depending upon the content of gas, moisture, suspended particles and contaminants. Even new oil absorbs gas and moisture while in storage. Therefore sometimes oil is to be treated before use. Degassing and dehumidification of oil is also necessary periodically, during use, because dielectric properties will be affected due to the absorption of gas and moisture in service at different weather conditions. This paper is related to the study of high vacuum transformer oil filtration machine and how its various components remove the contaminants like moisture, dissolved gases, sludge contents etc. from the transformer oil. Regular purification of transformer oil maintains its high quality, thus assures long and consistent results from the transformer.

2.2. DISMANTLING AND BOXING THE TRANSFORMER

To recycle the transformer, the lid has to be removed. The lid is made of steel and is either fixed with bolts or welded to the steel walls of transformer. To remove the lid, the welded part has to be cut out without letting any sparks go into the transformer which can set the oil inside to fire.

Alco Iron & Metal is willing and able to remove and recycle any substation transformers. When the transformer's components are properly recycled – aluminum, copper, core steel, and mineral oil – these pieces create like-new sustainable equipment.

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Mishandling poses considerable environmental risks and safety concerns. Our crew has the necessary knowledge and first-hand experience to get the job done safely and efficiently.

ASSEMBLING OF TRANSFORMER

Core and coil assembly is placed inside its tank, tank is filled with oil to stop exposure to air, a cover assembly added and bushing connections made. Once the cover is welded and leak checked, galvanized radiators are assembled to the tank, the unit is drained and the transformer is vacuum filled for final testing.

Final Assembly begins with the removal of the core and coil assembly from vapor phase. All internal assemblies are re-pressed to an engineering-specified pressure to ensure tightness now that excess moisture has been removed. Metal and fiber nuts are tightened or torqued as required and electrical clearances verified again.



fig no.2.2 Transformer

During this same time, the control box and any other customer-specified monitors and components are installed and wired. All external welded assemblies are mounted to ensure correct fit to the tank and removed before the finished transformer moves on for factory acceptance testing.

- Operation of power transformers
 - Standard and special transformer tests.
 - Site considerations.
 - Preliminary inspection upon receipt of transformer.
 - Plan for the prevention of contaminants.
 - Making connections that work.
 - Controlling sound level.
 - Make sure the transformer is grounded.
 - Final inspection and testing.

When your transformer arrives on site, various procedures should be carried out (installation, testing and various checkings). The successful operation of a transformer is dependent on proper installation as well as on good design and manufacture.

The instructions mentioned in the manufacturer manual or in Standards MUST be followed to ensure adequate safety to personnel and equipment.

This technical article will provide 10 general guidelines for installing and testing both and for placement into service:

When your transformer arrives on site, various procedures should be carried out (installation, testing and various checkings). The successful operation of a transformer is dependent on proper installation as well as on good design and manufacture.

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depending upon how and where the transformer will be used. The additional tests that can be conducted include the following:

When planning the installation, the location is selected, yet does not interfere with the normal movement of personnel, equipment, and material. The location should not expose the transformer to possible damage from cranes, trucks, or moving equipment.

When received, a transformer should be inspected for damage during shipment. Examination should be made before removing it from the railroad car or truck, and, if any damage is evident or any indication of rough handling is visible, a claim should be filed with the carrier at once and the manufacturer notified.

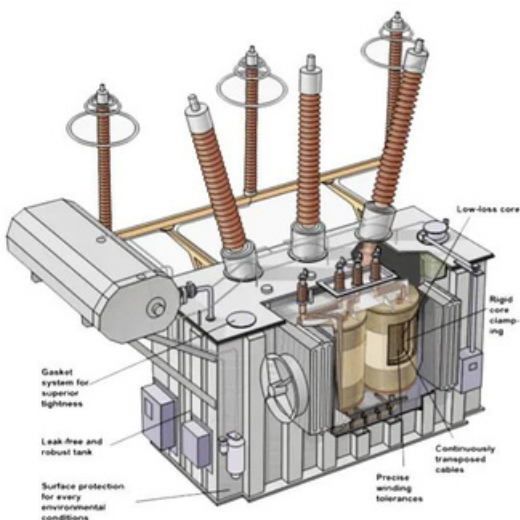


fig no 2.3 Parts of transformer



fig no 2.4 Coil of the transformer

2.3. TESTING OF TRANSFORMER

Power factor transformer testing is the process wherein the power loss of the insulation system is tested by measuring the angle the resulting current of power that occurs when AC voltage is applied.

The transformation ratio test is performed by applying a 3-phase 415 V supply to the high voltage winding, with keeping the low-voltage winding open circuited, the induced voltage is then measured at HV-winding terminals and LV-winding terminals of the transformer to determine the actual transformation ratio of the



fig no 2.5 **KIT FOR FINDING IR**



fig no 2.6 **KIT FOR FINDING DCR**

Insulation Resistance Test or Megger Test of Transformer: Insulation resistance is the ratio of applied voltage to the resulting current at a specified time after the voltage is applied. Direct voltage are used for measuring insulation resistance values. Insulation resistance test of transformer is essential type test

DC winding resistance testing is performed during transformer commissioning, after the occurrence of internal faults, and during periodic maintenance as recommended by the manufacturer [3]. Winding resistance tests are performed to assess the integrity of a transformer's windings, tap changer, and internal connections.

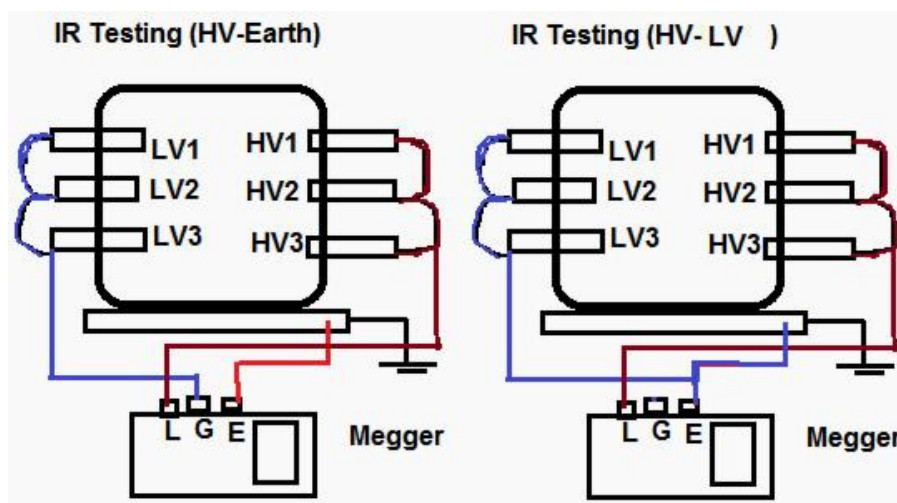


fig no 2.7 **Circuit connection with Megger**

Magnetic balance test is conducted only on three-phase transformers to check the imbalance in the magnetic circuit. Result of this test indicates uniform distribution of flux insulation. This test is carried out by applying 3 phase 400V AC to one winding, measured induced voltages on other two winding on same side.

The magnetic balance test is a most commonly used proactive test is performed only on three-phase transformers to detect the faults in the core and to verify the imbalance in the magnetic circuit also to identify inter-turn faults in the transformer at the early stage of manufacturing work.



fig no 2.7

Steps for Open Circuit Test to Measure Transformer Core Losses. Step 1: Obtain the value of Rated Voltage from parameters given in transformer's Name Plate as explained below. Step 2: Open circuit HT Side while apply voltage at LT Side through Variac until the Rated Voltage is achieved.

vector group is the International Electrotechnical Commission (IEC) method of categorizing the high voltage (HV) windings and low voltage (LV) winding configurations of three-phase transformers. The vector group designation indicates the windings configurations and the difference in phase angle between them.

This can be done by measuring the voltage across the transformer's terminals with a voltmeter. Another way to test for transformer failure is to measure the current flowing through the transformer while it is turned on. This can be done by measuring the amperage with an ammeter.

HOT AIR BLOWER

An air heat blower works by passing air across a heated element to elevate the temperature of the air. Hot air can be used for various applications ranging from heating a space, to drying coatings and parts, to de-flashing plastic components, to heating parts in a manufacturing process.

What is the purpose of air blowers in substation transformers?

Substation ventilation is generally required to dissipate the heat produced by transformers and other equipment, and to allow drying after particularly wet or humid periods.

What is discharge rod?

Substation Discharge Rods for Substation Earthing from PBwel

Home » Substation Earthing » Discharge Rods. The WDL Capacitor Discharge Rods are used for the removal of electrostatic charge from disconnected circuits, before undertaking maintenance work. Manufactured from 1.2-metre-long lightweight insulating tubing and fitted with a dischargeable hook



fig no 2.8 Hot air blower



fig no 2.9 Discharge rod

2.4. TEST SAMPLE RESULTS



fig no 2.10 Testing kit

1) IR VALUE TSTING ELTRA 11KV/433V TRANSFORMER

table no 2.1

	R15	R60
HV-E(5KV)	780M ohm	900M ohm
LV-E(560V)	670M ohm	650M ohm
HV-LV(560V)	1.04 G ohm	1.55G ohm

2) DCR TESTING

RANGE 1A 20 ohms

table no 2.2

DCR(HV ohm)	AB:4.084 ohm	BC:4.087 ohm	CA:4.078
DCR(LV ohm)	ab:5.50 m ohm an:2.75 m ohm	bc:5.48 m ohm bn :2.72 m ohm	ca:5.42 m ohm cn:2.71 m ohm
RATIO TEST	AB/an:44.08	BC/bn =44.08	CA/cn =44.08

3) PHASE MAGNETIC BALANCE

AB	BC	CA
403.6	349.8	56.93
217.6	406.5	189.1
53.06	351.7	403.7

an	bn	cn
9.19	7.96	1.28
4.92	9.27	4.26
1.20	8.02	9.21

table no 2.3

4) SINGLE PHASE MAGNETIC BALANCE

an	bn	cn
201.4	159.2	42.8
98.9	201.7	102.1
42.51	158.1	200.1

table no 2.4

I an -5.05A

I bn-1.37A

I cn-4.83A

5) VECTOR GROUP D Y 11

Bb - 390.1

Ac - 390.2

Bc -390.2

Cb-404.2

6) CORE HEALTH (remove interconnection)

I ab -0.24 A

I bc -0.24 A

I ca-0.38 A

7) TEST CHARGE

I ay -8.51 A

I by -5.09 A

Icy -8.72 A

ab - 405.5

bc - 407.6

ca -404.3

an -234.2

bn -235.1

cn -235.1

RELATED IMAGES



fig no 2.11 OIL FILLING



fig no 2.12
AUTO TRANSFORMER

CHAPTER -III

SUMMARY &CONCLUSION

3.1 CONCLUSION:

During one week training period, a lot of experience, knowledge and exposure that I have handy . All disclosures were awaken myself in a boost of self-confidence to face life more challenging now. Practical is a complement to the science or theory learned. This is clearly the concept of science and charity, where they have learned without practice will be lost and will not give anything - what effect. So if we do without the knowledge of course there will be problems in terms of grip and stance ever - changing During my industrial training, there are many changes from the point of learning environments and discussion among colleagues. It can directly increase the dedication and rational attitude toward myself. However, there are still some weaknesses that can be improved in the future. Therefore I conclude that the industrial training program has provided many benefits to students even if there are minor flaws that are somewhat disfiguring condition , so that this weakness can be rectified in the future. I can conclude that this industry is through training I received a lot of exposure in the computing world. I would like to thank also the NLCIL industry Learning and Development student mentors- students find their own experience with having Industrial Training like this.

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3.3 FEEDBACK

The internship training is very useful as well as it brought a good exposure to the industrial types of machines and huge production and lots of employees and employers who is kindly guiding us towards the peaceful training sessions and we thank the guides and mentors who guided us during the training sessions



NLC INDIA LIMITED

"NAVARATNA - A GOVERNMENT OF INDIA ENTERPRISE"

CERTIFICATE

This is to certify that

MOHAN V

Studying **BE** in **EEE** at

SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

has undergone Internship Training on

"REPAIR & OVERHAUL OF TRANSFORMERS & MOTORS"

during the period from **15-may-23** to **20-may-23** at New
service unit, NLC INDIA LIMITED, NEYVELI.

20.05.2023
NEYVELI

CHIEF MANAGER

**LEARNING AND
DEVELOPMENT CENTRE**

NLC INDIA LIMITED, NEYVELI

Chief Manager
Learning & Development Centre
NLC India Limited, Neyveli-3.

Training adding value to Life