

MULTAN ELECTRIC POWER COMPANY LTD.



BRIEF ON

**MEPCO TRANSFORMER
RECLAMATION WORKSHOP**

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TRAINING PROGRAM **REGARDING TRANSFORMATION LOSSES** **UNDER MEPCO MULTAN.**

Briefing regarding one day training program/seminars to realize the loss of authority in shape of increased transformation losses due to sub-standard repair of transformers through private electrician.

INTRODUCTION

1

A power system has different voltage levels to facilitate transmission of electrical power from generating stations to distant places. Sub-Stations of different voltage levels are designed to carry out smooth voltage transmission and regulation. Distribution transformers are integral part of this electrical network and are probably the expensive component in the system. Any minor or major damage to these transformers can result in heavy financial loss to the utility besides causing inconvenience to the consumers.

INTRODUCTION

2

The Transformer Reclamation Workshop specializes in repair and refurbishing of damaged distribution transformers, which are received from all over the MEPCO. The workshop is a nucleus of highly skilled engineers and technicians whose services are rendered to MEPCO.

INTRODUCTION

3

The workshop has so far repaired 75 No. distribution transformers of various ratings up to capacity of 200KVA per month saving million of rupees for MEPCO. It is to the credit of this workshop that at present most of distribution transformers running in the system have been repaired by this workshop instead of Reclaimed from Shalamar Lahore.

MEPCO TRANSFORMER RECLAMATION WORKSHOP

- On 1/11/2004 Transformer Reclamation Workshop MEPCO was established with 16 Nos. of employee attached from different offices with progress of 30 No. T/F per month.
- On 1/4/2005. 10 No. daily wagers were approved for TRW & progress fixed as 75 No. transformers per month.
- Presently our target is to reclame 200No.Transformers per month with total staff of 100 employee with 68 No. Daily wagers as per FESCO Reclamation Workshop.

OBJECTIVES:

- To **facilitate customers** with **reasonable** cost of **repair** along with quality assurance of repair.
- **Rapid repair** of the distribution transformers to avoid **loss** in **sale** of **power** and **un-interrupted** supply to consumers.
- **Dehydration** of the transformer oil **without delay** for up keeping of the power distribution system.
- To **reduce** excessive expenditure and running cost.

BRIEF HISTORY

1

Transformer Reclamation workshop was established at Qasim pur, 132KV Grid Station Multan for carrying out Reclamation of distribution transformers up to 200KVA under supervision of Manager (Tech: Services) M&T-I MEPCO Ltd, Multan.

BRIEF HISTORY

2

In the beginning, the transformers were repaired without complete dismantling and only those transformers were repaired which required minor repairs. Afterwards the workshop was equipped with a conventional type-drying oven and other equipments which enabled it to undertake repairs by opening transformers. At that stage the repair was mainly carried out by cannibalizing the damaged windings with the healthy windings.

BRIEF HISTORY

3

Now windings fabrication facilities were developed to manufacture windings up to 200KVA distribution transformers. This facility enabled to undertake major repairs of damaged windings with new insulated copper strips / enameled wires received from Regional Store Multan.



WORKING PROCEDURE

The repair activities of the workshop have been segregated into different sections. These sections / shops perform their duties independently and at the same time their activities are inter-connected and inter-dependent.

FITTING SECTION

In this shop the assembling and disassembling activities of distribution transformers are carried out. This section is the hub of main repair activities and work on various transformers are carried out simultaneously. Various checks are performed at different stages of repair to maintain the repair standards. All the silicon steel laminations are washed with petrol to remove carbons & sludge on it.



WINDING SECTION

This section has complete facilities of uncoiling and re-manufacturing of LT / HT windings up to 200KVA T/F. The damaged winding is uncoiled, enameled copper wire is used for windings according to design of different companies like, Siemens, Climax, PEL, NECOP, J&P, MML, Trans Pak etc.



DRYING OVEN

After the completion of windings, these are then put into coil drying oven where moisture is removed within 8 Hrs by applying temperature up to 80c and then those coils are used to assemble the transformer completely. The transformer is completely assembled / fitted in the fitting section. The active part is then put into vacuum drying oven for complete drying of transformer. The workshop is equipped with a vacuum drying oven, which takes 3 days for drying of a transformer at temperature of **90°C~ 120°C**.



OIL SECTION

All distribution transformers are filled with transformer oil for the purpose of insulation and cooling. The oil received with damaged transformer needs to be completely regenerated & dehydrated to achieve required quality level as per IEC standards. The process of oil treatment is started as soon as transformer is sent in the drying oven. The treated oil is filled in the transformer immediately after completion of drying process. At present only one test is possible in Lab.



TESTING SECTION

After the completion of repair and drying, complete electrical testing of transformer is performed in this section. This workshop is now equipped with almost complete testing up to 200KVA distribution transformers according to International Electrical Commission (IEC) recommendations.



MAJOR ACHIEVEMENTS

1

- Presently reclamation of 75~100 distribution transformers with Maximum capacity up to 200KVA per month.
- More than 2900 distribution transformers have been repaired / cannibalized at Transformer Workshop.
- The workshop plays a major role in saving millions of rupees for the MEPCO every year.
- Repair of most of the distribution transformers, presently in operation in field & only 2.5% Transformers are returned during warranty period.

MAJOR ACHIEVEMENTS 2

The performance of Transformer Workshop could be significantly increased mainly due to the interest of Chief Executive & Chief Engineer and better control by the engineers / managers of the workshop. The performance under Transformer Reclamation Workshop it self by looking at the comparative performance chart of the workshop as record number of transformers per annum have been repaired since then.

IMPROVEMENT OF SERVICE & REDUCTION OF LOSSES IN FESCO

A BIRD EYE VIEW

- In FESCO a beautiful attempt has been done to suppress Thara workshop & improve the quality of Transformer causing reduction of losses & improvement in service condition.
- FESCO has taken the following steps in this regard.
 - a. The production of Transformer Reclamation Workshop is up to 200 Transformers per month.
 - b. In field store healthy Reclaimed Transformers are every time available and in case of damaging of Transformer, healthy Transformer is issued immediately to replace the damaged one.

IMPROVEMENT OF SERVICE & REDUCTION OF LOSSES IN FESCO

- c.** The damaged Transformers are reclaimed in reclamation workshop with in minimum time.
- d.** In case of over loading of Transformers, the Transformer of high capacity or some additional Transformer are added in the circuit immediately.
- e.** There is no 2-phase Transformer existing in the system.

As a result of above mentioned steps taken by FESCO, the losses have been reduced and service conditions has been improved a lot. MEPCO is adopting the FESCO model in this respect.

EXTENSION OF TRANSFORMER RECLAMATION WORKSHOP MEPCO MULTAN

1

- The workshop has been able to cope with the increasing damage rate of distribution transformers. Keeping in view the importance of this workshop, the expansion plan for Transformer Workshop Multan is being carried out having two projects
 - To enhance the quantity of Reclamation of Transformers from 75 to 200 No. Transformers per month.
 - To install oil Regeneration plant at TRW MEPCO Multan during 2007-2008.

EXTENSION OF TRANSFORMER RECLAMATION WORKSHOP MEPCO MULTAN 2

- After the completion of these projects, it is expected that the workshop will be able not only to meet with the system demand but the quality of repair will also surely improve. The ultimate aim of Transformer Reclamation Workshop is to repair all the transformers including 2-phase & sick Transformers of MEPCO and availability of Transformer against damage be ensured on Minor/ Major fault of Transformer to reduce the interruption of Power supply.

Reasons For Damage of Distribution Transformers

- Unavoidable circumstances (Wind /Storm and Road Accident).
- Over loading.
- Decomposition of Oil (Required Dehydration) / Low Oil Level.
- Substandard private repair.
- Old age Transformer /Weak insulation
- Detoriated top cover gas kit.
- Connectors requiring replacement.

Reasons For Damage of Distribution Transformers

- Unbalancing of Transformers.
- Improper fuses.
- Mishandling & Improper Installation.
- Clogging of cooling pipes/ fins.
- Energization of Transformer and LT with out patrolling & rectification of fault.
- Damage of Transformer due to fault in LT Network

LOADING OF TRANSFORMERS 1

The load occasionally be checked during peak times. The load should be balanced over three phases and not exceed the rating and the result must be recorded in Transformer Loading Register in S/Division.

The high temperature indication **40°C** above ambient temperature should be reported & checked against the limit set out. The loading checks are important as higher than rating or large unbalanced loads cause reduction of service life.

LOADING OF TRANSFORMERS 2

The transformer loading should be checked using clip on meter. If the transformer temperature is high but the load is normal, the oil may have become contaminated and oil of Transformer may be got dehydrated from TRW Shop by the field formation.

In this connection, the sample of oil be got tested/ checked from TRW Shop and Recommendation/ Suggestion/ technical opinion be got for further process.

ROUTINE TESTING OF DISTRIBUTION TRANSFORMERS

1

- 1. Measurement of Winding Resistance**
- 2. Measurement of Insulation Resistance**
- 3. Turn Ratio Measurement**
- 4. Polarity & Phase Relation Test**
- 5. Load Losses (Copper losses), Short circuit test.**
- 6. No-load Losses (Iron losses), Open Circuit test.**
- 7. Separate Source Over-Voltage Withstand Test**
(34KV for 1min)
- 8. Dielectric strength of Transformer Oil**

ROUTINE TESTING OF DISTRIBUTION TRANSFORMERS

2

The following tests may also require to be conducted to ensure quality:

- 1. *Testing of bird-protection coating.***
- 2. *Induced Voltage withstand test.***
- 3. *Pressure test of Transformer tank.
(leakage test).***

SPECIFIED LOSSES OF TRANSFORMERS FOR WAPDA STANDARD

TRANSFORMER RATING	IRON LOSSES IN WATTS		COPPER LOSSES IN WATTS		TOTAL LOSSES IN WATTS	
	SPECIFIED	MAX.	SPECIFIED	MAX.	SPECIFIED	MAX.
10 KVA	65	75	320	368	385	443
15 KVA	85	98	435	500	520	598
25 KVA	123	141	640	736	763	877
50 KVA	175	201	1170	1346	1345	1547
100 KVA	310	357	2020	2323	2330	2680
200 KVA	495	569	3410	3922	3905	4491
400 KVA	925	1064	5600	6440	6525	7504
630 KVA	1350	1553	8150	9373	9500	10926

ADVANTAGES OF THARA **WORKSHOP**

- 1. Quick service for repair.**
- 2. Less repaired cost.**
- 3. Time saving in power failure.**
- 4. Less labour cost.**
- 5. Continuity of supply benefits in shape of billing.**

DISADVANTAGES OF THARA

WORKSHOP 1

1. Sub standard material used for repairing of Transformer which reduce life of Transformer as well as increase in tripping.
2. Loss due to theft of energy is less as compared to technical loss in Transformer in shape of Iron & Copper loss.

DISADVANTAGES OF THARA

WORKSHOP 2

EXAMPLE

Specified loss in 25 KVA T/F is 763 Watts. It means $763 \times 24 \times 30 = 549360$ watts hours per month. Or 550 KWH per month.

If tariff rate consider as Rs. 5/= per unit, the loss becomes as Rs. 2750 per month. This loss can cover the cost of Reclaimed 25 KVA Transformer per year.

DISADVANTAGES OF THARA WORKSHOP

3

3. If this Transformer is repaired from Thara workshop using:

- a. Sub standard material.***
- b. Poor workmanship.***
- c. Highly heated up oil can cause decomposition of Transformer oil.***

DISADVANTAGES OF THARA

WORKSHOP

4

4. Less insulated paper for winding & unserviceable parts be used. The losses i.e. Iron & Copper loss observed are 900~1000 watts against 763 Watts.

$$\text{Monthly loss KWH} = \frac{1000 \times 24 \times 30}{1000} = \mathbf{720}$$

$$\text{If Tariff rate is Rs. 5 per unit then} = 720 \times 5$$

$$= \text{Rs. } \mathbf{3600}$$

$$\text{Increase in financial loss} = 3600 - 2750$$

$$= \text{Rs } \mathbf{850} \text{ per month}$$

COMPARISON OF TRW & THARA WORKSHOP

1. **Material used in Reclamation of Transformers duly inspected by material inspection according to WAPDA standard & specification.**

2. **Quantity of winding for equal voltage on each phase checked with Transformer Turn Ratio set.**

3. **Iron & Copper losses are checked as per specification.**

1. **Material used for Reclamation having less cost but not according to standard & specification.**

2. **Having no such equipment so voltage fluctuation observed and three phase equipment may be damaged.**

3. **No checking equipment is available as equipment is very costly so the loss in shape of heat energy is much high. Which cause immediately damage of Transformer.**

COMPARISON OF TRW & THARA **WORKSHOP**

4. Oil of Transformer is dehydrated at 60C°.

5. Transformer is tested on 3 times, the voltage applied on it i.e. at 33KV with 1 minute with stand test.

6. Transformer is baked in oven for 72 Hrs at 90-120 C° with Vaccum of 1300 mm of Hg depending upon dimensions of oven.

7. Quality of work observed.

4. Oil is boiled openly and decomposed at 90C° and above Temp.

5. No provision of equipment as it is very costly.

6. Transformer winding and core heated in boiled oil only.

7. No quality of work observed as LS & SDO having no knowledge about it.

SOME TECHNICAL DATA

PROGRESSIVE TRANSFORMERS INSTALLED UP TO
01/2007 (MEPCO MULTAN)

CIRCLES	CAPACITY IN KVA							
	10	15	25	30	50	75	100	150
MULTAN	330	483	9993	26	4271	36	1688	75
D.G.KHAN	196	385	3083	0	2472	0	416	0
VEHARI	180	423	7610	0	1910	25	642	0
B.PUR	209	357	8498	2	3192	2	471	1
SAHIWAL	222	620	9495	0	2063	5	969	0
R.Y.KHAN	243	669	6787	0	3336	6	856	2
M.GARH	78	237	3419	138	2104	79	304	0
B.NAGAR	113	531	3080	0	2403	0	797	1
<i>TOTAL</i>	<i>1571</i>	<i>3705</i>	<i>51965</i>	<i>166</i>	<i>21751</i>	<i>153</i>	<i>6143</i>	<i>79</i>

PROGRESSIVE TRANSFORMERS INSTALLED UP TO 01/2007 (MEPCO MULTAN)

CIRCLES	CAPACITY IN KVA							Total	
	200	300	400	500	630	750	Others	ENDING 01/2007	
								Nos	MVAs
MULTAN	1225	1	213	1	160	0	1	18503	1090.2
D.G.KHAN	203	0	128	4	44	0	22	6908	401.0
VEHARI	257	2	122	5	57	3	10	11246	512.6
B.PUR	296	0	111	1	75	0	8	13223	588.5
SAHIWAL	445	0	113	0	64	0	0	13996	623.8
R.Y.KHAN	338	0	121	9	73	7	14	12461	625.5
M.GARH	126	0	47	2	48	3	6	6591	319.9
B.NAGAR	292	0	74	0	46	0	0	7353	403.0
TOTAL	3182	3	929	22	567	13	61	90281	4565

CAPACITY WISE PERCENTAGE OF TRANSFORMER INSTALLED IN MEPCO

MULTAN

Capacity of Transformer	Percentage
10 KVA	1.74 %
15 KVA	4.00 %
25 KVA	58.00 %
50 KVA	24.00 %
100 KVA	6.80 %
200 KVA	3.50 %
400 KVA	1.03 %
630 KVA	0.63 %
Others	0.30 %

STATEMENT SHOWING THE SICK TRANSFORMERS IN RESPECT OF MEPCO UP TO DATE

CIRCLE	CAPACITY OF TRANSFORMER											Total
	10 KVA	15 KVA	25 KVA	30 KVA	45 KVA	50 KVA	75 KVA	100 KVA	150 KVA	200 KVA	400 KVA	
Multan	1	1	25	0	0	113	0	117	0	88	0	345
D.G.K	0	0	3	0	0	2	0	6	0	5	1	17
Vehari	0	0	14	0	0	89	1	75	0	40	0	219
B/Pur	1	2	30	0	1	95	2	34	0	25	1	191
Sahiwal	0	0	12	0	0	92	2	85	0	27	0	218
R.Y.K	0	0	4	0	0	32	1	30	1	20	1	89
M/Garh	6	3	38	1	0	94	1	33	0	26	0	202
B/Nagar	0	1	7	0	0	54	0	19	0	5	0	86
TOTAL	8	7	133	1	1	571	7	399	1	236	3	1367

TRANSFORMERS

RUNNING ON 2-PHASE UP TO 01/07

S#	CIRCLE	Capacity of 2-Phase Transformer								Total
		10 KVA	15 KVA	25 KVA	50 KVA	75 KVA	100 KVA	200 KVA	400 KVA	
1	Multan	3	13	172	247	0	80	39	0	554
2	D.G.Khan	2	7	42	84	0	31	31	0	197
3	Vehari	0	5	31	65	0	17	2	1	121
4	B/Pur	3	6	89	177	0	31	9	0	315
5	Sahiwal	0	0	16	72	0	47	25	0	160
6	R.Y.Khan	2	0	20	84	1	42	21	0	170
7	M/Garh	11	24	177	299	0	37	4	0	552
8	B/Nagar	0	0	5	26	0	6	1	0	38
TOTAL		21	55	552	1054	1	291	132	1	2107

CURRENT OF TRANSFORMERS

(in Amps)

TRANSFORMER RATING	HT SIDE	LT SIDE
10 KVA	0.52	13.91
15 KVA	0.78	20.86
25 KVA	1.31	34.78
50 KVA	2.62	69.56
100 KVA	5.24	139.12
200 KVA	10.49	278.24
400 KVA	20.99	556.48
630 KVA	33.06	876.45

SELECTION OF FUSE RATINGS

FUSE RATING A	TRANSFORMER RATING KVA	CAPACITOR RATING KVAr	COLOUR
3 K	25 & 50	....	GREEN
6 K	75	....	BROWN
10 K	100 & 150	....	BLUE
15 K	200 & 250	....	ORANGE
20 K	300	300	YELLOW
40 K	....	600	GREY

MELTING CURRENTS FOR FUSE LINKS

RATED CONTINUOUS CURRENT	300 SECONDS MELTING CURRENT (AMPS)		10 SECONDS MELTING CURRENT (AMPS)		0.1 SECONDS MELTING CURRENT (AMPS)	
	MIN	MAX	MIN	MAX	MIN	MAX
A						
3	6.0	7.2	-	10.0	45.0	58.0
6	12.0	14.0	13.5	20.5	72.0	86.0
10	19.5	23.4	22.5	34.0	128.0	154.0
15	31.0	37.0	37.0	55.0	215.0	258.0

NO. OF TURNS OF WINDINGS

Sr. No	Capacity of T/Fs. In KVA	NO. OF TURNS OF EACH COIL	
		HT	LT
1	25	4958	108
2	50	3490	76
3	100	2480	54
4	200	1744	38

CAPACITY WISE RESISTANCE OF HT WINDING

Sr. No	Capacity of T/Fs. In KVA	HT Copper Winding Resistance in Ω
1	25	125 ~ 130 Ω
2	50	50~55 Ω
3	100	23~25 Ω
4	200	8~10 Ω

WEIGHT OF TRANSFORMER

MAKE	25KVA	50KVA	100 KVA	200 KVA
SIEMENS	303 Kg	438 Kg	612 Kg	1042Kg
PEL	297Kg	410Kg	663Kg	1114Kg

QUANTITY OF OIL USED IN TRANSFORMER

CAPACITY OF TRANSFORMER	QUANTITY OF OIL IN LITER
10 KVA	50~60
15 KVA	60~70
25 KVA	80~85
50 KVA	120~130
100 KVA	175~207
200 KVA	290~320

DISMANTLE COPPER (3-LEGS) OF TRANSFORMER

CAPACITY OF TRANSFORMER	WEIGHT IN Kg
10 KVA	15~25
15 KVA	18~30
25 KVA	20~38
50KVA	40~55
100KVA	55~85
200KVA	110~135

WEIGHT OF PAPER COVERED COPPER STRIP IN LT WINDING

CAPACITY OF TRANSFORMER	SIZE OF STRIP	WEIGHT IN Kg
10 KVA	0.8x5 mm	7~9
15 KVA	1.4x4.5 mm	9~12
25 KVA	3x4 mm	13~15
50KVA	4x5 mm	18~25
100KVA	5x8 mm	29~35
200KVA	5x13 mm	45~58

WEIGHT OF ENAMELLED WIRE **USE IN HT WINDING**

CAPACITY OF TRANSFORMER	SIZE OF WIRE	WEIGHT IN Kg
10 KVA	0.5 mm	14~17
15 KVA	0.5 mm	16~20
25 KVA	0.6 mm	22~26
50 KVA	0.8 mm	29~35
100 KVA	1.1 mm	49~55
200 KVA	1.5 mm	72~85

ESTIMATED PERCENTAGE COST OF TRANSFORMER

TANK	15%
CORE	30%
HT /LT COIL	25%
OIL	20%
Cost of LT / HT Bushing And Nuts Bolts	10%

THANKS