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**Sub: Proposed upgradation of Star Level of Distribution Transformers - Study of cost implication, cost benefit analysis, supply-chain issues and timeline for implementation along with pros & cons for suggested measures and any other important issues as per committee**

**Ref: AITMA submission on Sub-Committee (action point 5) meeting held on 13<sup>th</sup> January 2025**

Dear Mr. Sharma,

We refer to the sub-committee meeting held on 13<sup>th</sup> January 2025 to study the cost implication, cost benefit analysis, supply-chain issues and timeline for implementation along with pros & cons for suggested measures and any other important issues as per committee regarding proposed upgradation of star levels of Distribution Transformers.

As per the discussions during the meeting, associations were requested to provide their views on the cost implications of the proposed upgradation.

We have the following observations regarding the presentation made during the meeting:

a) The price comparison in the presentation was not based on the same material. For instance, the pricing at PSPDCL was considered without acknowledging that the current Level 2 pricing pertains to amorphous core transformers. This pricing cannot be matched by CRGO core transformers.

Consequently, to remain competitive, all transformers would need to be manufactured using amorphous cores, which are in limited supply and may not meet the large-scale demand.

b) The suggested cost increase of 4% in the presentation is under-estimated. The actual cost increase will be significantly higher, which will in turn, extend the payback period considerably.

In response, the All India Transformer Manufacturers Association (AITMA) has conducted an indicative estimation of the cost increase for a sample 63 kVA distribution transformer (as per design which can be vetted by any lab) when transitioning from the current Level 1 to new Level 3. We have also analysed the recovery period for this cost increase.

#### **AITMA's Observations and Recommendations:**

##### **1. Cost Implications:**

- Based on our estimation, the cost of a sample 63 kVA distribution transformer increases by approximately Rs. 54,320 (around 48%) when upgrading from Level 1 to Level 3. Detailed estimations are provided in Annexure I (Level 1) and Annexure II (Level 3).

- The cost increase follows a non-linear trajectory, with higher levels of transformers requiring disproportionately greater investments.

## 2. **Efficiency Calculations:**

- Unlike international practices where load losses are calculated at either half-load or full-load, India calculates losses at both levels. AITMA recommends prioritising full-load loss calculations to achieve higher operational efficiency.

## 3. **Cost Recovery Period:**

- The estimated reduction in energy consumption for a sample 63 kVA transformer is approx. 70 watts at half-load and 184 watts at full-load.
- Assuming a cost of electricity for DISCOMs at Rs. 3 per kWh, the annual savings at full-load amount to Rs. 4,835.52. However, after accounting for a 7% annual interest on financing (Rs. 3,780), the net annual savings reduce to Rs. 1,055.52.
- This translates to a recovery period exceeding 25 years, making the cost-benefit ratio unfavourable.

## 4. **Environmental Considerations:**

- Higher star-rated transformers require increased input materials, which results in higher carbon footprints. This contradicts the nation's mission to reduce carbon emissions.

AITMA submits above observations for consideration of the Sub-Committee and requests a detailed review of the proposed measures. We believe that aligning technical, economic, and environmental factors is essential for achieving a balanced and sustainable outcome.

We remain committed to supporting this critical initiative and look forward to contributing further to this important study.

With warm regards,

Sudeep Sarkar  
Director General  
All India Transformer Manufacturers Association (AITMA)

Attachments:

1. Annexure I – Cost Estimation for Level 1
2. Annexure II – Cost Estimation for Level 3

Capacity	<b>63</b>	KVA, Level-1	<b>Aluminium</b>	Wound				
Volt	HV :	<b>11000</b>	V <sub>L</sub>	<b>433</b>	V <sub>Ph</sub>	250.0	Frequency	<b>50</b>
Tapping:	<b>5</b>	%	to	<b>-5.0</b>	%	in step of	<b>0.0</b>	%
Core Frame Size :	CC Dia.	<b>110.0</b>	L.C.	<b>435.0</b>	W.H.			
Flux Density :		1.4986			L.T.Turn	<b>86</b>		
Core Density :		<b>0.00000742</b>			Shifiting	<b>10</b>		
Total Weight:		172.83	Kgs.		Core Used	<b>0.620</b>	<b>0.85</b>	W/Kg
No Load Loss :		133.94	Watt		Core Building Factor	<b>1.250</b>		
No Load Current at 100%Voltage		1.963			VA at 100% Voltage	<b>7.00</b>	<b>3.0</b>	2.520
No Load Current at 112.5%Voltage		3.217			VA at 112.5% Voltage	<b>14.00</b>	<b>6.0</b>	5.040

Level-1

**CORE COIL ASSEMBLY**

Capacity:	63	KVA	Aluminium	Wound			
Volt:	11000	433	249.99	Frequency	50		
Tapping:	5	%	-5.00	%	in step of	0	% 0.000
Tapping	5	2.5	0	-2.5	-5		
Tapping- Voltage:	11550	11275	11000	10725	10450		
Tapping- Current	3.15	3.23	3.31	3.39	3.48		
HV: Current Density :	0.699	0.716	0.734	0.752	0.772		
Ratio:	44.00	44.00	44.00	44.00	44.00		
CC Dia:	110.00	LC:	275	WH:	435		
Flux Density:	1.4986	Tesla		LT Turn:	86		
	<b>LV Wdg.</b>			<b>HV Wdg.</b>			
Rated Current I <sub>L</sub>	84.00			3.31			
Phase Current I <sub>p</sub>	84.00			1.91			
Conductor Area:	69.48	71.20		2.60			
Current Density:	1.209			0.734			
Inner Dia	120.00			177.0			
Outer Dia	155.0	0.10		265.0	1.46		
Axial Length	424	411	420	190	186.74		
Total Turn	86			1892.0			
Turn per layer	43.0			90.1			
Number of layer	2			21			
Conductor Size(Bare):	8.90	4.00	2	1.820			
Covering:	0.30	DPC		0.21	DPC		
Conductor Size(Covered):	9.20	4.30	2	2.03			
Conductor Arrange	1	2		Nil			
End Strip:	11	2		Nil			
Duck	0.00			0.00			
Transposition/Tapping	1			Nil			
Sec	1			2			
Stack Height:	416			386	24.3		
Conductor Length: (Meter)	37.43	0.300		2625.87			
Weight: Bare(Kgs)	21.07			55.36			
Weight: Insulated (Kgs)	21.49	7.16		58.12	19.37		
Total Weight: (kgs.)	21.79	7.26		58.62	19.54		
Total Winding Weight: (kgs.)	80.41						
Resistance at 75°C: (Ohm)	0.01861			34.86			
I <sup>2</sup> R Loss at 75°C: (Watt)	394.02			381.14			
Total I <sup>2</sup> R Loss at 75°C: (Watt)	775.16						
Calculated Stray Losses: (Watt)	39.42			0.0075	166.00	31.50	
Assumed Stray Losses: (Watt)	63						
Load Losses at 100% & 75°C: (Watt)	838	814.58					
Load Losses at 50% & 75°C: (Watt)	209.54	203.65					
No Load Losses (Watt)	133.94						
Total Losses at 50 % & 75°C: (Watt)	343.48	337.59					
Total Losses at 100 % & 75°C: (Watt)	972.11	948.53					
% of Reactance:	4.200	%	3.157				
% of Resistance at 75°C	1.330	%					
% of Impedance at 75°C	4.406	%					

Level-3

**Costing**

**Loss at 50 %**

Item	Weight	Rate	Amount
CRGO (0.62 W/Kg @ 1.5 T+BF: 25% Grd.: 0.85	172.8	300.0	51849.2
Aluminium HV-DPC	58.6	260.0	15242.2
LV	21.8	250.0	5446.7
T/F Oil	208.9	79.0	16506.1
M.S. for Core -clamp	35.9	70.0	2515.6
M.S. for Tank	116.9	78.0	9115.2
Radiator	40.0	58.0	2320.0
Insulation	6.2	150.0	931.9
Sundry	1.0	1750.0	1750.0
Labour	1.0	1750.0	1750.0
Miss.	1.0	1750.0	1750.0
<b>Total</b>			<b>109176.9</b>

63 KVA, Level-1

340 Watt

Capacity	63	KVA, Level-3	Aluminium	Wound	V <sub>Ph</sub>	250.0	Frequency	50
Volt	HV :	11000	V <sub>L</sub>	433	%	in step of	0.0	%
Tapping:	5	%	to	-5.0				
Core Frame Size :	CC Dia.	109.6	L.C.	W.H.				
		312.5		555.0				
Flux Density :		1.4989		L.T.Turn	86			
Core Density :	0.00000742			Shifiting	10			
Total Weight:	206.91		Kgs.	Core Used	0.540	0.80	W/Kg	
No Load Loss :	139.67		Watt	Core Building Factor	1.250			
No Load Current at 100%Voltage		2.281		VA at 100% Voltage	7.00	3.0	2.520	
No Load Current at 112.5%Voltage		3.783		VA at 112.5% Voltage	14.00	6.0	5.040	

Level-3

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**CORE COIL ASSEMBLY**

Capacity:	63	KVA	Aluminium	Wound
Volt:	11000	433	249.99	Frequency 50
Tapping:	5	%	-5.00	% in step of 0 % 0.000
Tapping	5	2.5	0	-2.5 -5
Tapping- Voltage:	11550	11275	11000	10725 10450
Tapping- Current	3.15	3.23	3.31	3.39 3.48
HV: Current Density :	0.395	0.405	0.415	0.426 0.437
Ratio:	44.00	44.00	44.00	44.00
CC Dia:	109.60	LC:	312.5	WH: 555
Flux Density:	1.4989	Tesla		LT Turn: 86
	<b>LV Wdg.</b>			<b>HV Wdg.</b>
Rated Current I <sub>L</sub>	84.00			3.31
Phase Current I <sub>p</sub>	84.00			1.91
Conductor Area:	114.63	116.28		4.60
Current Density:	0.733			0.415
Inner Dia	119.60			187.1
Outer Dia	165.1	0.00		302.5 0.94
Axial Length	541	525	535	251 245.61
Total Turn	86			1892.0
Turn per layer	43.0			90.1
Number of layer	2			21
Conductor Size(Bare):	11.40	3.40	3	2.420
Covering:	12.40	DPC		0.25 DPC
Conductor Size(Covered):	11.75	3.75	3	2.67
Conductor Arrange	1	3		Nil
End Strip:	14	2		Nil
Duck	0.00			0.00
Transposition/Tapping	1			Nil
Sec	1			2
Stack Height:	531			504 25.4
Conductor Length: (Meter)	38.74	0.300		2908.65
Weight: Bare(Kgs)	35.97			108.41
Weight: Insulated (Kgs)	37.77			119.25
Total Weight: (kgs.)	38.27			120.75
Total Winding Weight: (kgs.)	159.02			
Resistance at 75°C: (Ohm)	0.01168			21.84
I <sup>2</sup> R Loss at 75°C: (Watt)	247.18			238.79
Total I <sup>2</sup> R Loss at 75°C: (Watt)	485.97			
Calculated Stray Losses: (Watt)	30.78			0.0046 176.10 37.81
Assumed Stray Losses: (Watt)	63			
Load Losses at 100% & 75°C: (Watt)	549	516.75		
Load Losses at 50% & 75°C: (Watt)	137.24	129.19		
No Load Losses (Watt)	139.67			
Total Losses at 50 % & 75°C: (Watt)	276.91	268.85		
Total Losses at 100 % & 75°C: (Watt)	688.64	656.42		
% of Reactance:	4.220	%	4.843	
% of Resistance at 75°C	0.871	%		
% of Impedance at 75°C	4.309	%		

Level-3  
 Core 0.70 wt  
 per kg  
 at 1.7 Test

**Costing**

**Loss at 50 %**

		63	KVA, Level-3
		270	Watt
	<b>Item</b>	<b>Weight</b>	<b>Rate</b> <b>Amount</b>
	CRGO (0.54 W/Kg @ 1.5 T+BF: 25%	Grd.: 0.7	206.9 375.0 77592.2
	Aluminium	HV-DPC	120.8 280.0 33810.5
		LV	38.3 280.0 10715.3
	T/F Oil		268.6 76.0 20414.7
	M.S. for Core -clamp		40.4 70.0 2826.6
	M.S. for Tank		148.9 78.0 11610.4
	Radiator		0.0 58.0 0.0
	Insulation		8.5 150.0 1276.6
	Sundry		1.0 1750.0 1750.0
	Labour		1.0 1750.0 1750.0
	Miss.		1.0 1750.0 1750.0
	<b>Total</b>		<b>163496.4</b>