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Composite Insulated Cross Arms: A New Trend in Electric Power Transmission

K R SURI
General Manager (Retd), Power grid Corporation of India Ltd.
Consultant Sterlite power, New Delhi .Pin code 0091
kuldip.suri@sterlite.com

ABSTARCT – Growing urbanisation ,stringent rules & regulations , difficulty in obtaining ROW and awareness in public in general has forced engineers to develop more stringent solid ways to lay transmission lines in overall techno-economic and with efficient & reliable manner. Such demand has also been fulfilled by development of CICA (Composite Insulated Cross Arms).

Keywords— CICA --- Composite Insulated Cross Arms, ROW – Right Of Way, HVDC – High Voltage Direct Current

I. Introduction

With development in technological innovations in pace with fast growing society, need has emerged to come up to innovate new technologies to meet stringent rules and regulations, public awareness, growing ROW and meeting with highest standards of reliability in power systems for public at large. New technology has emerged in a very techno cum economic cum long life factor.

II. CICA DEFINITION

It is called as Composite Insulated Cross Arms. It replaces conventional porcelain, polymer long rod insulators and steel cum lattice type cross arms in use for the last so many years or we can say since inception of power transmission lines. Let us under anatomy of a power transmission line structure.

A normal conventional steel lattice type tower consists of members fabricated and erected to form a tower in complete. It mainly is divided in to 4 parts.

1. Tower body
2. Cross arms
3. Peak
4. Cage
5. Insulators

In a CICA type towers. Cross arms and insulators are replaced by CICA as seen below in figure 1.

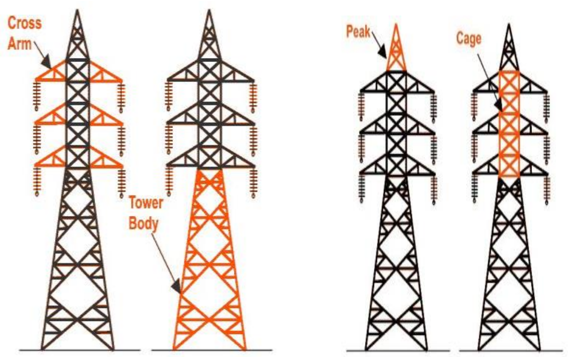


Figure 1.

K R Suri, “Composite insulated cross arms: A new trend in electric power transmission,” *International Journal of Scientific and Technical Advancements*, Volume 4, Issue 2, pp. 187-190, 2018.

III. HISTORY

It started a way back in 2008 in china as due to problem of growing population and fast pace of infra structure development. In India it was developed by Sintex Plastics, Pioneer in reinforced plastic industry. It was produced by them as per the standards of REC (Rural electrification Corporation, India) standards for use at large in Rural and Urban development in power distribution networks. Many other manufacturers also exit who are pioneer in this type of product.

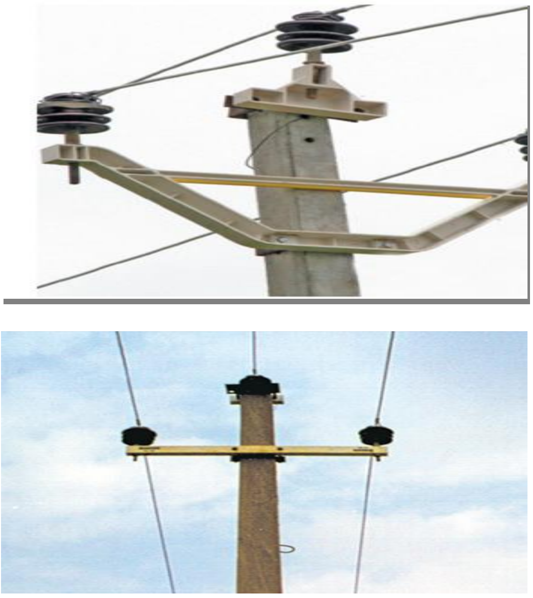


Figure 2.

IV. TECHNICAL SPECIFICATIONS

Technical Specifications are same as that of Long rod fibre glass polymer insulators. For example

1. *Nominal/Highest KV*
2. *Minimum dry/wet impulse voltage*
3. *Power Flow*
4. *Earth system*
5. *Configuration -- Unequal /Equal Triangle, Verti- -cal/Horizontal*
6. *KN Value --- Suspension & Tension*
7. *Creep Distance ----mm/kv*
8. *Max. Span*
9. *Sectional length*
10. *Conductor Type & Weight per meter*
11. *Pollution Type ---- Industrial/oceanic*
12. *Pollution level*
13. *Max /Min. Temp Around Year*
14. *Relative Humidity*
15. *Altitude/Elevation*
16. *Wind speed data*
17. *Safety factor*
18. *Profile parameters as per IEC 60815(S/P ratios etc.)*
19. *Receding water angle*
20. *Life expectancy*
21. *Colour Specific*

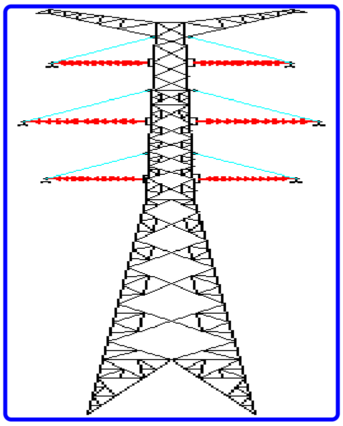


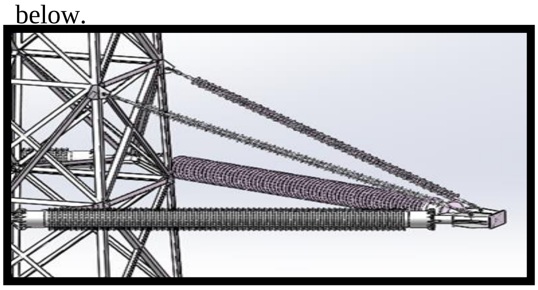
Figure 3.

V. MERRITS OF CICA OVER NORMAL POLYMER & PORCELAIN INSULATORS

- Reduces load on tower ie reduction in tonnage of steel
- Reduces ROW due to less cross arm dimensions
- Reduces overall height of tower, keeping ground clearances same as per standards
- No chances of Guana /Pollution flash overs
- No frequent replacement of insulators
- No swings due to high speed winds, hence no flash overs
- Tower appear to be slender

VI. TYPES OF FRAMES DEVELOPED

Development of frames depends upon type of configurations of tower and load on CICA.Few are exhibit below.



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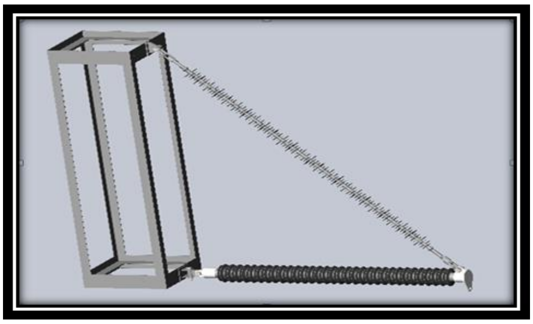
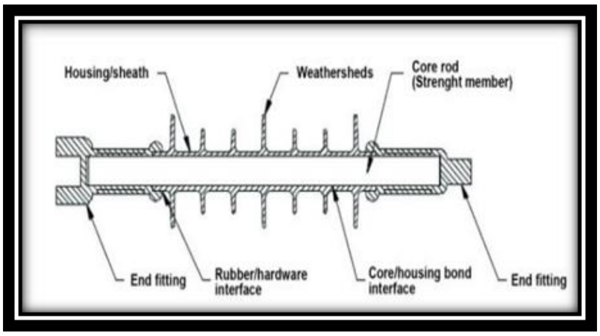


Figure 4.

VII. CONSTRUCTION OF INSULATOR

Main components of insulators are (Refer fig. below)

- Both ends fittings
- Weather shields/Petticoats for creep
- Fibre rod for strength
- Core housing & hardware interphase



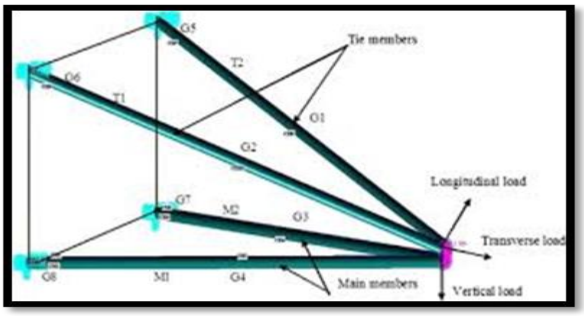
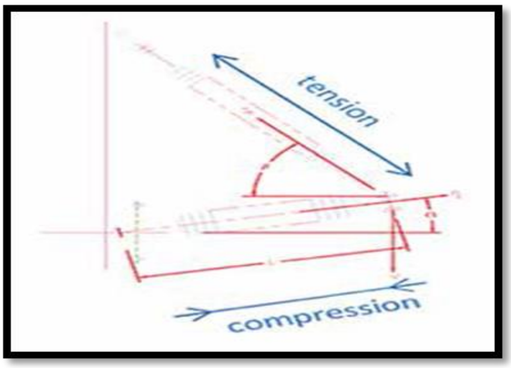


Figure 5.



VIII. DEVELOPMENT SO FAR

From 33kv to 8ookv (HVDC) CICA has been developed for single as well as double circuits for normal lattice type steel tower. Efforts have been made in China to develop complete tower of fibre glass and only of main tension members. It is under trial and has limitations of sustainability during

- Fire in nearby area
- During lightning strikes to pass on earth/fault currents
- Behaviour during heavy storms.
- Weakening at junctions of cross members.
-

IX. SPACE SAVINGS

Foot Dimensions		Overall Height	
KV	M. Sq.	CICA	Traditional
110	39	29	41
220	45	30	50
400	47	33	57
500	53	38	46
765	61	38	61
800	=	38	61

*These are tentative figures. However finally depends upon transmission construction/design/power flow parameters.

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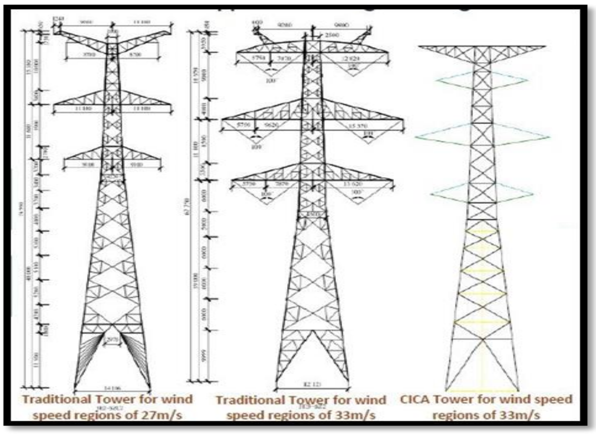

Cost Comparison of 765kV Tower in China

Shape & Structure	Angle-steel Tower	Composite Cross-arm Tower	Contrast
Wire Number	6×LGJ-400/50	6×LGJ-400/50	/
Circuits	Single circuit	Single circuit	/
Basic Wind Velocity (m/s)	31	31	/
Design Icing Thickness (mm)	5	5	/
Overall Tower Height (m)	74	64	-13.5%
Nominal Tower Height (m)	49	42	-14.3%
Width of Corridor (m)	35.2	25.7	-27%
Tower Weight (T)	32.9	23.1	-29.8%
Material Cost (ten thousand RMB)	29.6	27.3	-7.8%
Basic Cost (ten thousand RMB)	10.4	7.1	-31%
Total cost (ten thousand RMB)	**40**	**34.4**	**-14%**

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X. OVEALL BENEFIT

Power flow Vs CICA Vs HTLS Vs Traditional
Considering a 220kv S/c Line of traditional conductor (200mw)
Height savings = 50/30 = 1.6, Thus 0.6 is the height of tower saved.
Power Flow with HTLS = 2.5/1 – 2.5, thus increase in power flow 1.5 times.
Over all benefit ratio with combination of CICA, HTLS & Height = 1.5+0.6=2.1 times.
These are tentative values and depend upon various other parameters.

XI. LIMITATIONS

CICA has a limitation of using in suspension type towers. It can be at the maximum used up to 4 to 6 degrees deviations. Hence for B/C/D type locations, normal steel towers have to be used.
Deflections in arms is noticed in long run, hence require in large scale study on load pattern w.r.t. span, winds etc. particularly in area where intermittent high speed winds takes place.

XII. DEVELOPMENT WORLD WIDE

- China has developed such arms in big way up to 765 AC & 800kv (HVDC)
- Spain developed up to 132kv
- Italy also developed rotating type CICA on experimental basis.
- France developed CICA up to 90kv for normal as well as pivoted type towers
- Japan has done extensive studies to use in heavy ice loading transmission lines.
- Pacific Corp, USA modified/upgraded 2 lines due to Row & and increase (46kv to 138kv, 220kv to 345kv)
- Manitoba Hydro, Canada upgraded line from 115kv to 230kv
- COPEL, Brazil modified line from 138kv to 230kv.
- Puget Energy North America constructed new line of 230kv.
- Queensland Electricity Commission, Australia constructed new line of 275kv.

CONCLUSION/REMARKS **-** Development of any system for smooth and trouble free service to society has to continue and that is way world goes on.

XIII. REFERENCES

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