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TRANSMISSION SYSTEM DESIGN :SYNCHRONIZATION OF ELECTRICAL & CIVIL WORK

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ABSTRACT
Today the number of Projects per year has increased to meet the raised demand of the users. Synchronization between two Things or Branches is basic need for the project to complete without any major problem and in given space of time. As Electricity plays vital role in development of industries and running the project, consistent power supply is must. The paper describes meaning of Synchronization and its implementation at different phases of the substation & Transmission line projects & Case studies in transmission utility. The paper also includes different points of interfacing and co-ordination between Civil & Electrical Engineering in Substation and Transmission line through which project can be completed successfully.

Keywords-Transmission system design, interfacing, coordination between electrical and civil aspects

INTRODUCTION

Earlier there were only three basic needs of the human beings Air, Water & Food. But later on Shelter and clothing were added. After Industrial revolution in 19th century, Technology has raised the demand of the Humans. And to fulfill that demand various industries have established and many new projects were started, due to which nine new needs have added to the list and they are Power, Security, Adventure, Freedom, Exchange, Expansion, Acceptance, community & expression. Amongst this Power is the most demanding need of the humans. Power is utilized at each and every aspects of the life. Thus transmitting quality power supply is very essential for transmission utility.

Today the Number of projects per year has risen. So for any new project maintaining the quality and completing it within specified time limit are the key challenges for Engineers. This will lead us to make everything synchronized so as to achieve our target.

Synchronize briefly describe as make two or more things happen together, Synchronization is a time keeping which requires the coordination of events to operate a system in unison. In transmission utility synchronization between Civil & Electrical engineering is the key point. Any desynchronization will ultimately lead to delay in project and thus wasting our valuable time. Synchronization includes proper interfacing & coordination between these two branches of engineering.

COORDINATION AT DIFFERENT STAGES OF PROJECTS

Decision Making

At this level decision for necessity of the project, location & funding for the project etc. are taken. At this stage Electrical aspect are modality, location of the Incoming & Outgoing lines, availability of the required land, future extension etc. while Civil aspect are type of soil, cutting-filling area, type of foundation, High Flood Level etc.

Synchronization at this level will help the Project team to have clear vision for the project. It will also help Finance team to make the budget of the project.

Desynchronization at this level will lead to mismanagement of the project schedule; higher cost of the project then budgeted, and requires higher time for the completion of the project then actual.

Planing

In planning phase the layout of substation, route of transmission line, Bill of quantity for substation, Illumination, Earthing & Protection BOQ are being prepared. At this level maximum Interfacing is required. Arrangement for the location of control room, transformer bay, line bay, Cable Trench Route, Phase clearance and ground clearance for the equipments & Gantry tower etc. are decided and an Electrical layout of substation is prepared. At the same time preparation of each & every equipment foundation drawings keeping in view the phase and ground clearance, Control Room foundation & structural drawings, Rain water drain drawing, foundation layout etc. are being prepared for the same substation.

Proper Synchronization will lead to better understanding of the project; it also helps for better execution & thus saves project time and cost. Any desynchronization at this level will create havoc in Execution. Mismatching of the Electrical & civil drawings will ultimately delay the execution of the project and affects the cost and time very badly.

Execution

Execution of foundations, construction of control room building, Road, cable trench etc. work will fall under Civil engineering & Erection of equipment support structures on foundations, Erection of Equipments, providing panels in Control room & monitoring them, maintaining the functionality of the substation etc. will fall under the Electrical engineering side.

Proper co-ordination will lead to easy erection of equipment structures & equipments, Panels in control room. Proper Synchronization will ultimately solve the purpose of the project with proper time & cost management. Desynchronization will affect the project cost very seriously; it will also increase the project time. Problems in erection of equipments & panels will create the chaotic condition. And the project will fail in its purpose.

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CASE STUDIES

Case Detail: 1

In one of the substation the gantry foundations were wrongly orientated.

- **Corrective Measures**: Those foundations were dismantled and new foundations were casted.
- **Weak Point Analysis :** Substation layout & foundation layout must be checked jointly by electrical & civil engineers before execution to avoid such kind of error.

Case Detail :2

Error was found in casting of bolts of tandem isolators. Foundation bolts of 20 mm dia. were used initially, but the bolt required is of 25 mm dia. As per tandem Isolator equipment drawings.

Corrective Measures: New foundations were constructed afterward with 25 mm dia. Bolts and isolators were erected successfully on them.

Weak Point Analysis: Correct Foundation bolts details for particular equipment in substation shall be available with the civil engineer who is preparing the drawings. This is possible only with proper interfacing with Electrical Engineer who is approving the related equipment structure drawings.

Case Detail: 3

Earlier Earthings grid layouts were not sent to the site to the site. So Cable trenches & roads had to be broken for the earthing rods to pass through them.

Corrective Measures: Earthing grid layout is prepared and locations where earthing rod will cross the trenches & roads are marked and during execution suitable pipes are provided in roads &

trenches so that will pass through the pipe without breaking any structure, roads or trench.

Weak Point Analysis: Civil works starts before the earthing grid works in the substation and due to lack of interfacing, many problems & complications arose. Now earthing grid layout is prepared & made available to the site Engineer well before the civil execution work.

SYNCHRONIZATION THROUGH INTERFACING & CO-ORDINATION

On the basis of Project Case Studies. For success of any project it must have proper interface and coordination between Electrical & Civil Aspects in Substation Design at various stages as under:

1	Area of substation	Class of Substation,Nos. of bay required & future Exrension	Level of yard, HFL,contour map,coordinates and boundaries
2	Soil investigation	Control Room,Transfer and other heavy weight equipments location	Type of Soil,bearing capacity for design of control room,foundations etc.
3	Equipments & Structures	Layout	Loading on foundations
		Section	Plinth height
		Loading data of respective equipments	Foundation design of gantry & equipment structure
		Connection of gantry & beam,If base plan of gantry is rectangular	Foundation layout
		Earthing requirements	Necessary provision for construction & design
4	Control room Building	Nos.,Loading and Size of Panels	Architectural drawings, type of painting, flooring, size of doors and design of floor
		Type,nos. and loading of batteries	Acid resistance paints, Exhaust fan etc. in Battery room
		Arrangement of Panels and cutout details for cables of panels	Opening in floor for cable entry
		All type of cable entry in control room	Size of cable trench
		Cable laying required underground or overhead	accordingly cable trench/tray is to be designed
		Cable route diagram,Nos. of Cables	Decide size and internal connection between cable trenches
		Internal Building Electrical System	Arrangement for electrical system in building, concealed wiring
		Requirement of Earthing especially in case of GIS	To Provide the suitable arrangement
5	Gantry & Beam	Bay width / Bus Span	Dimension of Beam

	structure design	Height of Upper & Lower bus	Connection of beam with column at requires height
		Maintanance Requirement	Arrangement of Step bolt
		Earthing Requirements	Appropriate hole for earthing in diagonally placed in the structure drawing
		Loading Data of suspended Equipment (Pilot insulator,Wave trap)	Peak Height of Structure
6	Drainage system	Layout	Input data of drainage waste water and slope of drain towards outlet
7	Rain Water Drain	Layout	Route & slope of rain water and peripheral drain towards harvesting system and outlet
8	Equipment structure design	Ground Clearance,Phase to phase Clearance and phase to earth clearance	Dimension (Height,Width) of Structure
		Mounting arrangement of respective equipment	Top Plan of structure
		Type of Structure whether it is pipe or lattice	Necessary provision for construction and design
		Earthing Requirements	Cleat arrangement for Earthing strip
9	Cable Trench	Cable Route diagram	Entry of Cables in room Cable Trench layout and slope of cable trench Decide whether and how two sections of trench crosses,junction for hume pipe or other arrangement
		Details of control cables,Power cables and fiber optical cables	Arrangement of tray in the cable trench
		Loading data of heaviest equipment for transportation	Road Crossing Cable Trench design (big bang crossing/Hume pipe)
		Specify whether fire sealing arrangement to be provided and its location	Necessary slope to be provided in cable trench
		Specify whether fire sealing arrangement to be provided and its location	Necessary provision for construction and design
10	Transformer & Reactor	Location of marshalling box	Design of Plinth
		Quantity of oil in transformer and reactor	Design of oil sump
		Loading of transformer &	Height of fire protecting wall

		reactor on plinth	as per standards
		Requirement of Oil Sump	Height of Plinth,location of fire protection wall & design of rail cum road
11	Lightning mast	Location of lightning mast Height of ligting mast Requirement of platform or fixing arrangement of lighting fixtures Dimensions of spike Maintenance requirement Earthing Requirement	Design of ligtning mast structure,its foundation with foundation bolt Arrangement of ladder/Step Bolt Holes required for strip and cleat etc.
12	Water Supply	Location of Earthing pit,requirement of water in earth pit	Layout for water supply line for earthing
	Interface Between Civil & Electrical in transmission Line		
1	R.O.W.	Voltage Class	Tower design particular location (normal,narrow base,monopole)
		Nos. of Circuit	No. of Cross arm
		Type of Tower angle	Type of tower (suspension /tension)
		Details of conductor	Loading of tower
		sag tension calculations	Preparation of loading tree
2	Tower Structure Design	Details of earth wire	Peak height of tower
		Ground clearance	Height of bottom cross arm
		Other Electrical clearance	Design of crossarms
		Hardware data	Connection arrangement with tower
		Maintenance Requirement	Platform,Ladder and step bolt arrangement
		Provision of ACD & Other tower accessories	Provision of appropriate size of holes
		Length of insulator string	Distance between two cross arm
3	Extension	Earthing Requirement	Provision of appropriate size of holes at leg member of earthing
		Route profile of line	Height of extension required
		Loading data of normal/existing extension	Design proposed extension of tower
		Structural drawing of existing normal/extension	Arrangement of members Existing stub and leg member detail for connection

4	Foundation	Route map,check survey report,profile	Loading of tower (normal/broken wire condition) Soil data of Tower Location Stub details and drawing
5	Any Other Specific Requirement	Upgradation of loading capacity River Crossing Tower location	Special Tower Design Special Tower foundation Design

CONCLUSION

Coordination between Electrical & Civil Engineering aspects in transmission System design has been discussed in this paper. A systematic procedure has been presented for carrying out Installation & Commissioning of Transmission System in any Site Conditions. This can be conclude that Synchronism is must in any project irrespective of project type and its size. It will ultimately lead to save time and cost which are the crucial parts of the project. Errors in the project can be minimized with proper interfacing and coordination and thus problems can also be minimized. Thus post project cost can be minimized & post project maintenance is also reduced. be minimized. Any alteration or changes can be prevented if a project meet its requirement and fulfill its purpose. Thus post project cost can also be saved.

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