A STUDY ON DIFFERENT CONDUCTORS FOR OPTIMISATION OF POWER FLOW/LOADABILITY IN LONG AND MEDIUM TRANSMISSION LINE

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Abstract - *Transmission lines is the important factor of the power system. A transmission and distribution line has good contribution in the generating unit and consumers to obtain the continuity of electric supply. In the early days, simple copper wire or copper based bare conductors were used but nowadays, more cost effective solutions, such as aluminum and variations of aluminum alloy conductors are used extensively in the power system. The conductor of an overhead power line is considered as the most important component of the overhead line since its function is to transfer electric power, and its contribution towards the total cost of the line is significant. The conductor costs (material and installation costs) associated with the capital investment of a new overhead power line can contribute up to 40% of the total capital costs of the line. Furthermore, power losses in the lines account for the bulk of the transmission system losses, which in South Africa is about 1200 MW at peak load. These are critical economic factors which need careful analysis when selecting a conductor for a new overhead line, which will be in operation for an excess of 25 years. Choosing a larger conductor configuration will have higher up front capital costs, but this may lead to lower overall life cycle cost. Consequently, much attention has to be given to the careful selection of a conductor configuration to meet the present and predicted future load requirements.*

Keywords: *Aluminum, Overhead, Transmission Line, Conductor.*

1 INTRODUCTION

This paper represents a valuable guide to assist with the selection of conductor and tower configurations

for new overhead transmission lines. This addresses significance of incorporating planning and load forecast considerations, power quality constraints, voltage collapse studies, corona and audible noise, induction and transposition studies, line performance studies, and life cycle cost of maintenance for the different options, in the optimization algorithm the detection of those abnormal conditions where a conductor breaks and does not contact either another conductor or a grounded element.

A conductor is a physical medium to carry electrical energy from one place to other. It is an important component of overhead and underground electrical transmission and distribution systems. The choice of conductors depends on the cost and efficiency. An ideal conductor has following features.

- It has maximum electrical conductivity
- It has high tensile strength so that it can withstand mechanical stresses
- It has least specific gravity i.e. weight/unit volume
- It has least cost without sacrificing other factors

Choosing a larger conductor configuration will have higher up front capital costs, but this may lead to lower overall life cycle cost. Consequently, much attention has to be given to the careful selection of a conductor configuration to meet the present and predicted future load requirements. A process needs to be followed to optimally choose a conductor and tower configuration. This paper presents a procedure which has been formulated and tested to optimize the selection of the conductor and tower configuration from an overall system point of view.

The transmission line design engineering is confronted with choosing a conductor type form among this bewildering assortment. This choice must be based on basic conductor parameter.

TYPE OF CONDUCTOR:

There is no unique process by which all transmission and /or distribution lines are designed. It is clear, however, that all major cost components of lines design depend upon the conductor electrical and mechanical parameters. There are four major types of overhead conductor used for electrical transmission and distribution.

- AAC- All Aluminium Conductor
- AAAC- All Aluminium Alloy Conductor

- ACSR- Aluminium conductor Steel Reinforced
- ACAR- Aluminium Conductor Aluminium – Alloy Reinforced

The various combination and modification of these conductor types provide a wide variety of possible conductor designs.

1. AAC: All Aluminium Conductors

All Aluminum conductors sometimes referred to as ASC, Aluminum Stranded Conductor, is made up of one or more strands of 1350 Alloy Aluminum in the hard drawn H19 temper. 1350 Aluminum Alloy, previously known as EC grade or electrical conductor grade aluminum, has a minimum conductivity of 61.2% IACS. Because of its relatively poor strength-to-weight ratio, AAC has seen excellent corrosion resistance of aluminum has made AAC a conductor of choice in coastal areas.

2. AAAC : All Aluminium Alloy Conductor

These conductors are made from aluminum alloy 6201 which is a high strength Aluminium-Megnesium-silicon alloy. This alloy conductor offers good electrical conductivity (about 52.5% IACS) with better mechanical strength. Because of AAAC's lighter weight as compared to ACSR of equal strength and current capacity, AAAC may be used for distribution purpose. However, it is not usually preferred for transmission. Also AAAC conductor can be employed in coastal areas because of their excellent corrosion resistance.

3. ACSR : Aluminium Conductor, Steel Reinforced

ACSR consists of a solid or stranded steel core with one or more layers of high purity aluminium wires wrapped in spiral. The core wires may be Zinc coated (galvanized) steel or aluminium coated (aluminized) steel.

Galvanization or aluminization coatings are thin and are applied to protect the steel from corrosion. The central steel core provides additional mechanical strength and, hence, sag is significantly less than all other aluminum conductors. ACSR conductors are available in a wide range of steel content-from 6% to 40%. ACSR with higher steel content is selected where higher mechanical strength is required, such as river crossing.

4. ACAR – Aluminium Conductore Aluminium Alloy Reinforced:

ACAR combines 1350 and 6201 aluminium alloy stands to provide a transmission conductor with an excellent balance of electrical and mechanical properties. This conductors consists of one more layers of 1350-H19 Aluminium strands helically wrapped over one or more 6201-T81 aluminium alloy wires. The core may consist of one or more 6201 strands. The primary advantage of the ACAR conductor lies in the fact that all strands are interchangeable between mechanical and electrical characteristics, In effect; ACAR is a composite aluminium-aluminium alloy conductor which is designed for each application to optimize properties. Inverse ACAR conductors are also available with the harder 6201 aluminium alloy wires being on the outer surface of the conductor and the 1350 aluminium making up heart of the conductor.

2 TYPES OF CONDUCTOR IN TRANSMISSION LINE

Aluminium alloy conductors have higher tensile strength than the conductor of EC grade Aluminium or AAC, ACSR consists of a central core of steel strands surrounded by layers of Aluminium strands. ACAR has a central core of higher strength Aluminium Alloy surrounded by layer of Electrical-Conductor-Grade Aluminium.

Table 2.1

1	AAC	All Aluminium conductors
2	AAAC	All Aluminium Alloy conductors
3	ACSR	Aluminium conductors, Steel-Reinforced
4	ACAR	Aluminium conductor, Alloy-einforced

The alternate layers of a stranded conductor are spiraled in opposite direction to prevent unwinding and make the outer radius of one layer coincide with the inner radius of the next. Standing provides flexibility for a large cross-sectional area. The number of strands depend on the number of layers and on whether all the strands are of the same diameter. The total number of strands in concentrically stranded conductors, where the total annular space is filled with strands of uniform diameter is 7,19,37,91 or more.

STANDARD SIZES OF CONDUCTOR FOR LINES OF VARIOUS VOLTAGES

Table 2.2

No.	Voltage in volt	Size in milimeter
1	132 KV lines	'Panther' ACSR having 7-strands of steel of dia 3.00 mm and 30-Strands of Aluminium of dia 3.00 mm
2	220 KV lines	'Zebra' ACSR having 7-strand of steel of dia 3.18 mm and 54-Strands of Aluminium of dia 3.18 mm
3	400 KV lines	Twin 'Moose' ACSR having 7-Strands of steel of dia 3.53 mm and 54-Strands of Aluminium of dia 3.53 mm.

The composite conductors are subjected to following type tests:

(a) DC Resistance
(b) Ultimate Tensile Strength
(c) Surface condition Test
(d) Corona Test
e) Radio-Interference Voltage Test

Recently AAAC are being used in some SEBs to overcome menace of pilferage of ACSR and AAC conductors, particularly lower voltage lines. AAAC can not be re-cycled and it does not have any common use for other purposes, as that in case of pure Aluminium. AAAC is made out of heat treated Aluminium-Magnesium-Silicon Alloy designed as 64401 T 81 covered under IS:9997:1991 containing 0.6-0.9% Magnesium and 0.5-0.9% Silicon. Besides use of AAAC on lower voltage lines from the point of view of avoiding its pilferage, it is also better for use in coastal areas to avoid corrosion problem prevalent in Steel core of ACSR conductors.

It is clear that all the major cost components of a transmission lines depends upon conductor physical, mechanical and electrical parameters. Lists of these basic parameters are:

- Diameter of conductor
- Weight of per unit length
- Conductivity area
- Modulus of elasticity
- Rated breaking strength
- Coefficient of thermal expansion
- Cost of material
- Maximum unloaded design tension
- Resistance to vibration and or galloping
- Surface shape/drag coefficient
- Fatigue resistance

These basic parameter are not necessarily independent of one another. However, certain parameter can be varied independent over a range of design considerations.

3 LITERATURE SURVEY

Below are the literature review on fault parameters used in transmission line using different technique by some authors and their main observations:

HVDC Power Transmission System introduced by Author K.R Padiyar estimated the HVDC transmission technology is fast and its application are rapidly expanding in addition is also include the analysis and simulation of AC-DC system interaction which are of important in the planning .The unique component of HVDC system such as thyristor valves , converter ,control protection and harmonics filter by conventional protection schemes because of the low fault current due to the high impedance fault at fault point. These faults often occur when an overhead conductor breaks or touches a high impedance surface such as asphalt road, sand, cement or tree and pose a threat on human lives when neighboring objects become in contact with the line's bare and energized conductors.

Multi-Agents for Fault Detection and Reconfiguration of Power Distribution Systems: Author introduced system model for fault detection and reconfiguration based on graph theory and mathematical programming. The multi-agent models are simulated in Java Agent Development Framework and Matlab and are applied to a power system model designed in the commercial software, the Distributed Engineering Workstation, By K. Nareshkumar.

Most of the existing systems are reliable on various applications but not perfect for electrical applications. Electrical environment will have lots of disturbance in nature, Due to natural disasters like storms, cyclones or heavy rains transmission and distribution lines may lead to damage. The electrical wire may cut and fall on ground, this leads to very harmful for human beings and may become fatal. So, a rigid, reliable and robust communications like GSM technology instead of many communication techniques used earlier. This enhances speed of communication with distance independency. This technology saves human life from this electrical danger by providing the fault detection and automatically stops the electricity to the damaged line and also conveys the message to the electricity board to clear the fault. An Embedded based hardware design is developed and must acquire data from electrical sensing system. A powerful GSM networking is designed to send data from a network to other network. Any change in parameters of transmission is sensed to protect the entire transmission and distribution. By M. S. Sujatha.

A Transmission system comprises of terminal substation, intermediate substation, transmission line and other related control and auxiliaries. The task delegated to a transmission system are:
1 Transfer of electrical power at specific voltage and frequency.
2 Control over power transfer in term of magnitude direction. By Manoj Nair.

3 CONCLUSIONS

The condition monitoring of losses energy in transmission system and monitoring various type of effect occur in transmission system. The industrial setups and its operation accurately a challenge for maintenance engineers. The transmission line design engineering is confronted with choosing a conductor type form among this bewildering assortment. This choice must be based on basic conductor parameter. This is important for two principal reasons. Firstly, they provide an opportunity to understand the effects of the parameters of the line on bus voltages and the flow of power. Secondly, they help in developing an overall understanding of what is occurring on electric power system The proposed work is in full swing with developing the appropriate model and its validation and analysis. The literature survey has done with few excellent articles to be adopted for the work.

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