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USE OF G.P.S IN EHV TRANSMISSION LINE FAULT DETECTION AND TRANSMISSION LINE PROTECTION IN POWER SYSTEM

B.A. Jan B.E (Electrical Engg, M.Tech.(E&C Eng.)
Assistant Executive Engineer,
PDD J&K

ABSTRACT: **This paper presents a new technique of detection of faults on EHV electrical lines up to and above 800 KV up to now PLCC and SCADA were used for distance protection of EHV lines . now this paper presents GPS (Global Positioning System) for detection of faults and protection of EHV lines both ± 800 KV. Relay are located at each bus bar in a transmission network. These relay detect the fault and generate high transact signals and trace the time instant corresponding to different fault occurring at bus bar and it generates initial travelling wave. This paper will provide how to use global positioning systems for protection of faults on EHV lines and how to detect the faults. This paper will describe in details working of GPS system in this field and GPS signals accuracy and error . In power transmission accurate detection / location of faults not only save the time but also save resources . Self monitoring hardware can be configured for foundation sites with varing both condition i.e. geographical as well as environmental conditions mountains regions as well as in plains.**

I INTRODUCTION

In this fast age it is impossible to live without electricity as it is used in every field of life. Power system is known as Generators
Transmission system
Loads
Conductors
Capacitors and reactors
SCADA systems
Residential power systems
Commercial power systems
Industrial power systems

The majority of these systems rely upon three phase AC power electric power is the product of two quantities: current and voltage. These two quantities can vary with respect to time (AC power) or can be kept at constant levels (DC power).Alternating current generators can produce a variable number of phases of power. A higher number of phases leads to more efficient power system operation but also increases the infrastructure requirements of the system. Power systems deliver energy to loads that perform a function. These loads range from household appliances to industrial machinery. Most loads expect a certain voltage and, for alternating current devices, a certain frequency and number of phases. The appliances found in your home, for example, will typically be single-phase operating at 50 or 60 Hz with a voltage between 11 and 260 volts (depending on national standards). All devices in your home will also have a wattage, this specifies the amount of power the device consumes. At any one time, the net amount of power consumed by the loads on a power system must equal the net amount of power produced by the supplies less the power lost in transmission.

In these days high voltage transmission lines cover long distances i.e. hundreds of kilometers, particularly when the line passes through hilly terrains like Pirpanjal , Himalayan ranges. When a fault occurs on these transmission lines it is extremely difficult to patrol the line from tower to tower and identify the faulty spot. Accurate location of faults only only save the time but also saves different recourse for the power. Power system operator needs accurate information so that he can deploy men and machinery to the accurate spot immediately and rectify the fault thereby saving lot of time and resources. Soft ware system, communication system such as SCADA and PLCC hardware system can be designed. For fault location data from SCADA such as oscillographs, relays and sequence of events are used for fault location

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Now available latest technology i.e. GPS which can be used to locate a fault on long high voltage transmission lines self monitoring hardware can be configured for foundation sites for both conditions geographical / environmental. By inserting the information in a fault location (GPS) Geographical information system computer. Some power system operators have adopted this system.

II GLOBAL POSITIONING SYSTEM (GPS)

It is space based satellite navigation system that provides location and time information in all weather conditions any were on are near the earth where there is unobstructed line of sight to four or more GPS Satellites. Advances in technology and new demands on the existing system have now led to efforts to modernize the GPS system in addition to GPS other systems are in use or under development.

The design of GPS is based partly on similar ground based Radio Navigation systems the first Navigation satellite system transit was used by US 1960. GPS is owned and operated by United States as a national resource. The satellites carry very stable atomic clocks that are synchronized to each other and to ground clocks A GPS reviver monitors multiple satellites and solves equations to determine the exact position of the receiver and its deviation from true time. It is sometimes above is representative of a receiver start-up situation. Most receivers have a track algorithm, sometimes called a tracker, that combines sets of satellite measurements collected at different time-in effect, taking advantage of a the fact that successive receiver positions are usually close to each other. After a set of measurements are processed, the tracker predicts the receiver location corresponding to the next set of satellite measurements. When the new measurements are collected, the receiver uses a weighting scheme to combine the new measurements with the tracker prediction. In general a tracker can (a) improve receiver position and time accuracy, (b) reject bad measurements, and (c) estimate receiver speed and direction.

III ACCURACY

Most receiver lose accuracy in the interpretation of the signals and are only accurate to 100 nanoseconds.GPS time is theoretically accurate to about 14 nanoseconds.

IV TIMEKEEPING

Leap seconds

GPS navigation message includes the difference between GPS time and UTS. As of july 2012, GPS time is 16 seconds ahead of UTS because of the leap second added to UTS June. 30,2012 Receivers subtract this offset from GPS time to calculate UTS and specific timezone values. New GPS units may not show the correct UTS time until after receiving the UTS offset massage. The GPS- UTS offset field can accommodate 255 leap second (eight bits)

V ERROR SOURCES AND ANALYSIS

Magnitude of residual errors from these sources depends on geometric dilution of precision. Artificial errors may result from jamming devices and threaten ships and aircraft or from intentional signed degradation through selective availability, which limited accuracy to- 6-12 m, but has now been switched off

VI STRUCTURE

The space segment is composed of 24 to 32 satellites in medium earth orbit and also includes the payload adapters to the boosters required to launch them into orbit. The control segment is composed of a master control station (MCS), an alternate master control station, and a host of dedicated and shared ground antennas and monitor stations. The user segment is composed of hundreds of thousands of U.S. and allied military users of the secure GPS Precise Positioning Service and tens of millions of civil, commercial, and scientific user of the Standard Positioning Service (see GPS navigation devices)

VII CARRIER PHASE TRACKING (SURVEYING)

The period of the carrier frequency multiplied by the speed of light gives the wavelength, which is about 0.19 meters for the LI carrier. Accuracy within 1% of wavelength in detecting the leading edge reduces this component of pseudo range error to as little as 2 millimeters. This compares to 3 meters for the C/A code and 0.3 meters for the P code.

VIII APPLICATIONS

While originally a military project, GPS is considered a dual-use technology, meaning it has significant military and civilian applications

GPS has become a widely deployed and useful tool for commerce, scientific uses, tracking, and surveillance. GPS's accurate time facilities everyday activities such as banking mobile phone operations, and even the control of power grids by allowing well synchronized had-off switching.

- Astronomy: Both positional and clock synchronization data is used in astrometry and celestial mechanics calculations. It is also used in amateur astronomy using small telescopes to professional's observatories, for example, while finding extra solar planets.
- Clock synchronization: The accuracy of GPS time signals (±10ns) [71]is second only to the atomic clocks they are based on.
- Disaster relief/emergency services: depend upon GPS for location and timing capabilities.
- Meteorology-upper Airs: measure and calculate the atmospheric pressure, wind speed and direction up to 27 km from the earth's surface

- Fleet tracking: the use of GPS technology to identify, locate and maintain contact reports with one or more fleet vehicles in real time.

  Format:

  The GPS date is expressed as a week number and a seconds-into-week number. The week number is transmitted as a ten-bit field in the C/A and P(Y) navigation messages, and so it becomes zero. To determine the current Gregorian date, a GPS receiver must be provided with the approximate date (to within 3.584 days) to correctly translate the GPS date signal.

IX OTHER SYSTEMS:

Other satellite navigation systems in use or various states of development include:

- IRNSS – India's regional navigation system, planned to be operational by 2015, covering India and Northern Indian Ocean.
- COMPASS: People's Republic of China's global system, planned to be operational by 2020.
- Beidou – People's Republic of China's regional system currently limited to Asia and the West Pacific.
- Galileo – a global system being developed by the European Union and other partner countries, planned to be operational by 2014 (and fully deployed by 2019)
- QZSS – Japanese regional system covering Asia and Oceanic.

X TRAVELLING – WAVE BASED FAULT LOCATION IN ELECTRICAL DISTRIBUTION SYSTEMS WITH DIGITAL SIMULATIONS

Travelling Wave based fault-methods (TWF-LMs) have the advantages of less influence by saturation characteristic of current transformer, fault resistance, fault type and the operating mode of system, so they have been successfully applied into transmission networks. However, they can hardly be applied into EDSs because the feeders usually include many laterals.

To overcome the problems PSCAD/EDTDC, which is widely used in electromagnetic transient simulations and Matlab are used to study the TWFLMs. Meanwhile a novel fault location method based on characteristic frequencies of the recorded transient wave is proposed .

Travelling Wave based fault-methods. Generally, (TWF-LMs) can be grouped into the following main categories 1) methods based on wave-front identification (single ended algorithm, two ended algorithm and network based algorithm. 2) algorithms based on characteristic frequencies of the recorded travelling wave. In this power taken the fault location methods based on characteristic frequencies as an example . PSCAD/EMTDC and MATLAB are used to show the effectiveness of the methods. When the end of the transmission line is set as the starting point of the calculation distance x, the voltage can be represented in the time domain by

U= 2Uo+e-a3 cos(

U+ denotes the incident wave and u. represents the reflected wave. Assuming the impendence of the load equals Zx, the reflection coefficient at the end (x-)) for the voltage travelling wave is ;

As shown in figure 1, ref (10) proposed the principle of the characteristic frequencies if the measuring point is placed at bus A and the three phase short circuit fault occurs at middle of line DF, the travelling wave will propagate back and forth in the PATH A-B, A-B-C, A-B-D-D and A-B-D (f is the fault point).So the characteristic frequencies will exit in the recorded transient signal at bus A and can be calculated by

XI FREQUENCY DEPENDENT LINE MODEL

The traveling wave propagation must be calculated in frequency domain while the electromagnetic transient calculation is easy to carry out in time domain. To solve this problem one method is to utilize Fourier transform another method is to treat the characteristic impendence and propagation coefficient with approximation by rational function based on Bode diagram etc.

XII ANALYSIS OF THE CHARACTERISTIC FREQUENCIES

When the EDS operates normally and an impulse signal is injected at bus A, the characteristic frequencies of the recorded transient signal at bus A are called the inherent characteristic frequencies of the system.

When a fault occurs in the electrical distribution system, the frequencies of the recorded sinal at bus A will be different from the inherent characteristic frequencies. Take the fault at the middle of line DF swhown in figure 1 as an example, the recorded transient signal at bus A is shown in Figure 6.

The whole window of date which is analyzed by Fast Fourier transform (FFT) contained 1ms of pre fault and 1ms of post fault data, and the results corresponding to the fault at middle of line DF are shown in Figure 7. Then the characteristic frequencies of 10.74 KHz and 24.41 kHz can be founded. But in theory, the characteristic frequencies can be calculated as follows. 25.00Khz, 15.00 KHz, 37.50 KHz, 21.43 KHz and 11.54 KHz. So the big error exiwsts in the extraction of frequencies as same as the results mentioned .

A. A Novel Fault Location Method Based on Characteristic Frequencies :

fault location method based on characteristic frequencies can be proposed. Firstly FFT is used to extract the frequencies of the recorded signal. Secondly, the whole frequencies is divided to several sub frequency bands and each sub frequency bank contain one of the inherent characteristic frequencies . thirdly, the energy values of the sub frequency bends bcan be calculated and normalized. Fourthly the energy values corresponding to the typical fault positions can be obtained in advance. Finally, one a fault occurs, the following equation can used to identify the fault position.

B. Power system

The power system is noon as a grid and mainly consists of:-

- Generators
- Transmission system
- Loads
- Conductors
- Capacitors and reactors
- SCADA systems
- Residential power systems
- Commercial power systems
- Industrial power systems

The majority of these systems rely upon three phase AC power electric power is the product of two quantities: current and voltage. These two quantities can vary with respect to time (AC power) or can be kept at constant levels (DC power).Alternating current generators can produce a variable number of phases of power. A higher number of phases leads to more efficient power system operation but also increases the infrastructure requirements of the system. Power systems deliver energy to loads that perform a function. These loads range from household appliances to industrial machinery. Most loads expect a certain voltage and, for alternating current devices, a certain frequency and number of phases. The appliances found in your home, for example, will typically be single-phase operating at 50 or 60 Hz with a voltage between 11 and 260 volts (depending on national standards). All devices in your home will also have a wattage, this specifies the amount of power the device consumes. At any one time, the net amount of power consumed by the loads on a power system must equal the net amount of power produced by the supplies less the power lost in transmission.

C. Conductors

Conductors carry power from the generators to the load. In a grid conductors may be classified as belonging to the transmission system, which carries large amount of power at high voltages (typically more than 69 kV) from the generating centers to the load centers, or the distribution system, which feeds smaller amount of power at lower voltages from the load centers to nearby homes and industry. Choice of conductors is based upon considerations such as cost, transmission losses and other desirable characteristics of the metal like tensile strength. Large conductors are stranded for ease of handling small conductors used for building wiring are often solid, especially in light commercial or residential construction.

D. Capacitors and rectors

Mostly load in a typical AC power system is inductive; the current lags behind the voltage. Since the voltage and current are out-of-phase, this leads to the emergence of an "imaginary" form of power known as reactive power. Reactive power does no measurable work but is transmitted back and forth between the reactive power source and load every cycle. This reactive power can be provided by generators themselves, through the generator excitation.

Reactors consume reactive power and are used to regulate voltage on long transmission lines.
Capacitors and reactors are switched by circuit breakers, which results in moderately large steps in reactive power. A solution comes in the form of static VAR compensators and static synchronous compensators. Briefly, static VAR compensators work by switching in capacitors using thyristors as opposed to circuit breakers allowing capacitors to be switched-in and switched-out within a single cycle.

E. Protective devices

In higher powered applications, the protective relays that detect a fault and initiate a trip are separate from the circuit breaker. Early relays worked based upon electromagnetic principles similar to those mentioned in the previous paragraph, modern relays are application-specific computers that determine whether to trip based upon readings from the power system. Different relays will initiate trips depending upon different protection schemes. For example, an overcurrent relay might initiate a trip if the current on any phase exceeds a certain threshold whereas a set of differential relays might initiate a trip if the sum of currents between them indicates there may be current leaking to earth.
The first problem is resolved by the use of circuit breakers - devices that can be reset after they have broken current flow. In modern systems that use less than about 10 kW, miniature circuit breakers are typically used. These devices combine the mechanism that initiates the trip (by sensing excess current) as well as the mechanism that breaks the current flow in a single unit. Some miniature circuit breakers operate solely on the basis of electromagnetism. In these miniature circuit breakers, the current is run through a solenoid, and, in the event of excess current flow, the magnetic pull of the solenoid is sufficient to force open the circuit breaker's contacts (often indirectly through a tripping mechanism)

F. SCADA systems

Supervisory Control And Data Acquisition (SCADA) is used for tasks such as switching on generators, controlling generator output and switching in or out system elements for maintenance. The first supervisory control systems implemented consisted of a panel of lamps and switches at a central console near the controlled plant. The lamps provided feedback on the state of plant (the data acquisition function) and the switches allowed adjustments to the plant to be made (the supervisory control function). Today, SCADA systems are much more sophisticated and, due to advances in communication systems, the consoles controlling the plant no longer need to be near the plant itself. Instead it is now common for plant to be controlled from a with equipment similar to (if not identical to) a desktop computer.

G. Power systems in practice

Power systems vary widely both with respect to their design and how they operate. This section introduces some common power system types and briefly explains their operation.

H. Residential power systems

Residential dwellings almost always take supply from the low voltage distribution lines or cables that run past the dwelling. These operate at voltages of between 110 and 260 volts (phase-to-earth) depending upon national standards. A few decades ago small dwellings would be fed a single phase using a dedicated two-core service cable (one core for the active phase and one core Circuits would have both an active and neutral wire with both the lighting and power sockets being connected in parallel. Sockets would also be provided with a protective earth. This would be made available to appliances to connect to any metallic casing. If this casing were to become live, the theory is the connection to earth would cause an RCD or fuse to trip - thus preventing the future electrocution of an occupant handling the appliance. Earthing systems vary between regions, but in countries such as the United Kingdom and Australia both the protective earth and neutral line would be earthed together near the fuse box before the main isolating switch and the neutral earthed once again back at the distribution transformer.[35]

There have been a number of minor changes over the year to practice of residential wiring. Some of the most significant ways modern residential power systems tend to vary from older ones include:

- For convenience, miniature circuit breakers are now almost always used in the fuse box instead of fuses as these can easily be reset by occupants.
- For safety reasons, RCDs are now installed on appliance circuits and, increasingly, even on lighting circuits.
- Dwellings are typically connected to all three-phases of the distribution system with the phases being arbitrarily allocated to the house's single-phase circuits.
- Whereas air conditioners of the past might have been fed from a dedicated circuit attached to a single phase, centralised air conditioners that require three-phase power are now becoming common.
- Protective earths are now run with lighting circuits to allow for metallic lamp holders to be earthed.
- Increasingly residential power systems are incorporating microgenerators, most notably, photovoltaic cells.

I. Commercial power systems

Commercial power systems such as shopping centers or high-rise buildings are larger in scale than residential systems. Electrical designs for larger commercial systems are usually studied for load flow, short-circuit fault levels, and voltage drop for steady-state loads and during starting of large motors. The objectives of the studies are to assure proper equipment and conductor sizing, and to coordinate protective devices so that minimal disruption is cause when a fault is cleared. Large commercial installations will have an orderly system of sub-panels, separate from the main distribution board to allow for better system protection and more efficient electrical installation.

XIII CONCLUSION

Survey of transmission line protection is done through this article since the implementation of digital relaying protection of transmission line was being done now that technique is absolutely obsolete now but in the context of reformation in the power industry and operation of transmission line close to the stability limits new tools and alograthims are needed to maintain system reliability and security within an acceptability level a modern technique for protection of transmission line by using global positioning system (GPS). GPS plays an important role in electric power system, the inter connection of AC Grid through AC tie line increase the fault level , this fault level will decrease by using GPS as it will tell us the exact location where the fault occurs. Different traditional protection system such as time graded over correct protection and distance protection, this technique will provide a new concept by this way a lot of time will be saved and power operators will be able to provide smooth power supply to the consumers/electrical utilites.

References

[1] John W. Klooster, Icons of Invention: The Makers of the Modern World from Gutenberg to Gates, page 305

[2] Gene Wolf (2000-12-01). "Electricity Through the Ages". *Transmission & Distribution World*

[3] T.S Sidhu, H singh, and M.s. Sachdev, "Desighn ,implentaion an testing of an artificial neutral network based fault direction discrimination for protecting transmission lines,"IEEE Trans. On Power Delivery 2,pp.697-706,April 1995.

[4] Positional Protection of Transmission System Using Global Positioning System by Zhiqian Q.Bo, Geoff Weller, Tom an Miles A. Redfern Lomas.

[5] Hanif L, C. Yaman E.A machine learning and wavelet-based fault location method for hybrid transmission lines. IEEE transactions on Smart Grid 2014;51-59)

[6] Zhen W. Chen H, Dai p, and et al. simulation method and test technology of transmission line travelling wave. Electric Power Automation Equipmetn.2011;31(6):74-79.

[7] Tang Y. Chen H. Dai F, et al; Selction of Transmission Line Models for Travelling-wave protection Studies proceeding of the CSEE.1997;17(4):270-273.

[8] Pradhan AK,Routray A,Gudipali SM, Fault Direction Estimation in Radial Distribuiton system using Phase Change in sequence Current IEEE Transaction on Power Delivery , 2007;22(4):2065-2071.

[9] Wan Y, Robert K Equivalent Circuits for an SLG Fault Distance Evaluation by curve fitting in Comensated distribution Systems. IEEE Transactions on Power Delivery 2008;23(2);601-608.

[10] Salim RH, Resener M, Filomena AD, and et al. Extended Fault-Location Formulation for Power Distribution Systems IEEE Transactions on Power Delivery 2009:24(2)508-516.

[11] "A guide to the Global Positioning System (GPS)-GPS Time line " (htpp://support.radioshack.com/support_tutorilas/gps/gps_tmline.htm).Retrieved January 14,2010.