The Operation and maintenance of transmission network

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***Abstract*- This research focused on the operation, repairing and maintenance of transmission network, like every equipment in a substation it's important to maintain a transmission network. To learn about preventive maintenance of transmission system. To describe testing and parameter to detect and monitor abnormal condition of transmission system. To explain the operation in grid system and transmission line, understand the testing in the transmission system equipment and the maintenance in underground system. To learn cable termination, cable joints, jointing and connections are reviewed in this project and the operation, testing and maintenance of transmission network presented.**

Index terms- Power grid, transmission network, cable joint and cable termination

I. INTRODUCTION

Unlike developed countries rapidly increasing load demand is the challenge for developing countries like India. There is substantial shortage in energy, peak power demand and wide gap between demand and supply. In India, the gap between demand and supply of electricity is widening as the annual growth rate of electrical energy requirement is about 8%. The transmission system in the country is expanding very fast with 400kV, 765kV and +/- 500 kV HVDC transmission network to achieve the objective of formation of National Grid and to realize the vision of reliable, affordable and quality power for all by 2012 for which generation, transmission and distribution sectors have already been opened in stages since nineties for private participation through enactment of Electricity Act and regulations by the government. There is strong need for strengthening generation, transmission and distribution networks. The transmission system is the backbone of the power system. A well planned, properly designed and well-maintained transmission network can only provide reliable and quality power supply to customer.

II. PATROLLING OF TRANSMISSION LINE

All essential parameters which indicate the healthiness of the equipment in a substation shall be inspected by the shift engineer once in each shift and periodically by the officer in charge. Overhead lines shall be patrolled at periodicity decided by the transmission licensee and different patrolling schedules shall be implemented by the transmission licensee for normal terrain, vulnerable terrain and most vulnerable terrain. The important lines shall be inspected by senior engineers after patrolling by junior staff and maintenance works such as tree cutting, replacement of damaged insulators shall be carried out immediately after patrolling wherever required.

III. FAULT DETECTION IN TRANSMISSION NETWORK

In electric power supply services, power transmission lines are very important and very indispensable. For the purpose of protecting these lines, a new system was invented to discover the fault. Location using Composite fiber Optic Overhead Ground Wire (OPGW) system deals mainly with causes of fault situations such as lightning, dew, snow, fog, or gales. This new fault location system was developed to find out where electrical fault happened on overhead power transmission lines by detecting the current induced in the ground wire. The fault location method measures the current induced in the OPGW at many points along the line, these points are various sensors mounted on the tower and transmits the information to the central monitoring station through the optical fiber within the OPGW. So, the fault

information system is mainly given by sensing and data transmission.

IV. HOTLINE AND COLD LINE MAINTENANCE

Maintenance of transmission line in live condition is called hotline maintenance. During maintenance time all equipment are in live condition and supply will be on. Maintenance of transmission line during dead condition is called cold line maintenance. This is done after shutting down the supply and all equipment are out of service. Hot washing of insulators refers to cleaning the insulators in transmission lines when the lines are live. Transmission lines can afford very little downtime. Cleaning the hundreds of insulators must be carried out when the lines are live with voltage. Hot washing involves cleaning the insulator surfaces with de-mineralized water. The water is pressurized and sprayed in jets from special cleaning machines. These cleaning machines are stationed on the ground or in some cases fixed on helicopters which hover near the lines and clean the insulators. The hot washing is usually carried out from the bottom of the insulator. The whole insulator is not made wet at any given point of time. The bottom of the insulator is washed and then the washing proceeds to the middle sections and the then to the top of the insulator.

Fig 1. Hot line washing of insulators

V. JOINING PROCESS OF CABLE

Whenever a cable got faulty or newly laid cable is to be jointed for further extension, a specific process is being followed for cable jointing:

1. Make a pit according to specified standards
2. Both end of cables is stripped as per standard
3. Punch the cable with ferrule
4. Make a proper earthing connection
5. Heat insulated sleeves with blow lamp
6. After one or two hours again, cable is tested, and later pit is filled up

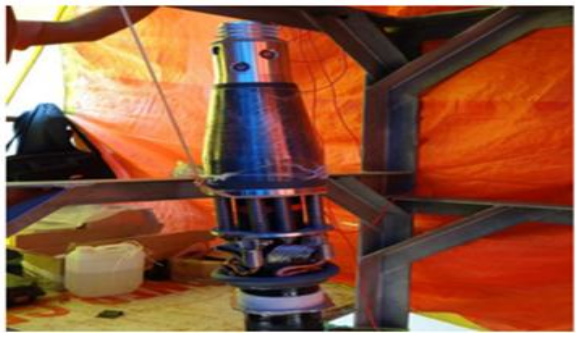

Fig2. Joining process of cables

The basic requirements of any cable joint and/or connection are that it must assume the mechanical and electrical strength of the cable(s) with which it is used. The workmanship and materials used should be of the highest quality, so that good electrical/mechanical contact and insulation (if required) will be ensured. The insulation materials must be equivalent in insulation properties to that of the insulated cable itself.

VI. MATERIALS and METHOD

In transmission substations it's mandatory to maintain the equipment properly and healthy. For that, maintenance is carried out periodically. This will improve the life of the equipment in the substation. For a systematic maintenance usually, the schedule prepares for all equipment. According to the schedule maintenance is conducted. In every substation maintenance and operation is carried out as per Standard Operation Procedures (SOP).

VII. CIRCUIT BREAKERS

Moulded case circuit breakers located in low voltage distribution panels are typically 125 to 250 volts direct current (Vdc); 120, 208, 240, 277 and 480 volts alternating current (Vac); or used for control, protection, and auxiliary power. These moulded case breakers should not be loaded more than 80% of the rated value unless the breaker is specified as a continuous type capable of being loaded to 100%.

Table 1. Maintenance Schedule of Moulded Case Circuit-breaker

1.	Moulded Case Breaker Maintenance or Test	Recommended Interval
2.	Exercising by hand	6 years
3.	Routine Maintenance Tests	6 years

VI. POWER CABLES

Periodic maintenance tests are needed during the life of the cable to determine whether or not there has been significant insulation deterioration due to operational or environmental conditions. The maintenance schedule for power cables only pertains to cables associated with critical equipment.

Table 2. Maintenance Schedule of Power Cables.

1.	Maintenance or Test for Power Cables	Recommended Interval
2.	Insulation test (DC ramp test)	5 years
3.	Insulating oil – dissolved gas analysis (DGA),	Annually
4.	physical, and chemical tests	

VII. CONTROL CIRCUITS, ANNUNCIATORS, ALARMS, BUSHINGS, COUPLING CAPACITORS

The maintenance schedule for control circuits only pertains to circuits of critical equipment. Control circuits (usually 125 Vdc, 250 Vdc, or 120 Vac) provide the path for all control functions for major equipment in the power plant. Reliability of these circuits is paramount.

The maintenance schedule for annunciator and alarms only pertains to circuits associated with critical equipment. Annunciators and alarms provide essential plant condition status information to O&M personnel.

Bushings are critical components of medium and high voltage circuit breakers and transformers. Bushing maintenance usually is conducted at the same time maintenance is performed on the circuit breaker or transformer, or at least during an outage on that equipment.

Coupling capacitor/voltage transformers (CCVTs) are instrument transformers that provide a path for communications, metering, control, and relaying equipment without allowing power system frequency energy to pass. This equipment normally is oil-filled and must be checked for oil leaks.

VIII. RESULTS AND DISCUSSION

Like all equipment in transmission system it is also important to maintain transmission cable. It plays an important part in the transmission of power from one place to other. So, it is necessary to check the condition of the cable like its mechanical strength, insulation resistance, present current capacity with respect to temperature, protection system, voltage capacity etc.

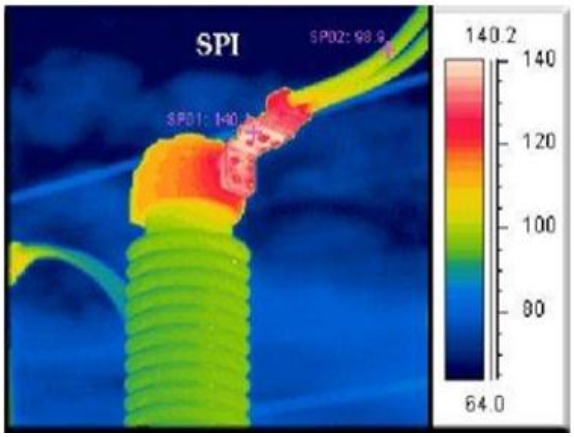

Fig 3. Thermo vision camera view

Why we are doing maintenance in transmission cable because as the time passes its property will change due to weather conditions, stresses inside the cable etc., this will decrease the life of the cable. It will lead to a huge economic as well as time loss. In order to avoid this kind of problem and for the better health of the cable we usually maintain the transmission cable.

Tests are conducted by injecting DC current through the breaker main contact and measuring the voltage drop and current while the breaker is operated. The breaker analyzer then calculates and plots resistance as a function of time. If contact movement is recorded simultaneously, can read the resistance at each contact position. This method is used for contact diagnosis, and in certain cases it is also used to measure times. With DRM measurement the arcing contact length can be reliably estimated. The only real alternative in finding the length of the arcing contact is dismantling the circuit breaker. In SF6 breakers the arcing contact is commonly made of Wolfram (tungsten). This contact is burned off and becomes shorter for each interruption of load current.

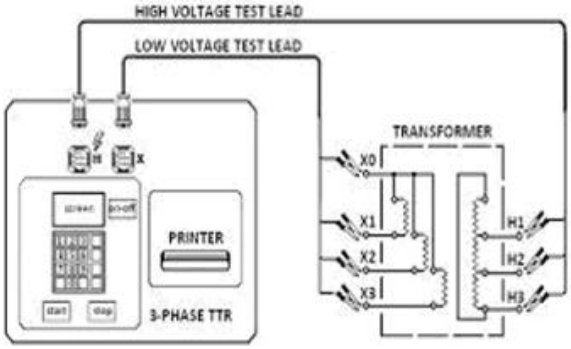

Fig 4. Transformer Turns ratio test

A reliable DRM interpretation requires high test current and a circuit breaker analyzer with good measurement resolution.

Load management: Controlling loads in a utility system to limit peak demand, reduce costs, improve load factor, or in some other way improve the stability and reliability of electrical power distribution. Grid reliability: Grid reliability means to maintain the power supply without any interruption. This is done by installing sophisticated switching and protection equipment (fuses, circuit breakers, transformers, etc.) in substations, and monitoring equipment (protection relays, phase monitoring units, thermal line sensors etc.) at strategic points on the grid. The monitoring units measure the rate and direction of power flow, its stability, the temperature of hot power lines, and other parameters critical to the normal functioning of the grid. Load Centre: A geographical area where energy is used. Most commonly refers to an area within a utility's service territory where energy demand is highest (i.e., cities, major industrial areas, etc.). Frequency the waveform of 230-volt, 50 Hz compared with 110 V, 60 Hz or that it is 50/60 cycles per second. Load dispatch as per schedule and operational planning, supply provided to utility. Feeder loading: Feeding load through feeder as per their capacity

IX. CONCLUSION

It is a device in the circuit breaker that prevents multiple closures of the breakers. Multiple breaker closures can damage the closing mechanism of the breaker. The anti-pump function is a very important feature of control circuits. Without the anti-pump function, if the user connected a maintained contact in the close circuit, and the circuit breaker were closed into a fault current, the protective relays would cause an immediate trip action, but the maintained contact in the close circuit would initiate closing (again) into the fault. This process is called pumping and would lead to ultimate catastrophic failure of some element in the system, perhaps the conductors leading to the fault, perhaps the circuit breaker, or elsewhere in the system. Therefore, anti-pump control is one of the fundamental requirements for every medium-voltage circuit breaker.

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