

Preventive Maintenance of Transmission and Distribution Systems

In global power scenario the hydro, thermal and nuclear power stations act as major energy conversion centers. The electric power produced by these power stations is wheeled to load centers at consumers end through transmission and distribution network. A healthy transmission and distribution system builds strong bridge between production centers and utilisation centers. Prof. Surendranath Sahu says that with the help of modern technology the maintenance personnel get sufficient clues and indications to predict future behavior of the equipment to undertake preventive action to alleviate forced shut down of the equipment and enhance system reliability.

In global power scenario the hydro, thermal and nuclear power stations act as major energy conservation centers. The electric power produced by these power stations is wheeled to load centers at consumers end through transmission and distribution network. A healthy transmission and distribution system builds strong bridge between production centers and utilization centers. A weaker transmission and distribution network fails to evacuate the power from generating stations efficiently and fails to cater the need of utilization centers for uninterrupted power supply at consumers' premises. Such a situation leads to under utilization of plant capacity, uneconomical higher generation cost, revenue loss, and above all consumer dissatisfaction. To bring an improvement in the power sector, reforms have been implemented in our country.

Under purview of the reforms, the generation, transmission, distribution and trading activities have been separated out with a view to handle each of these activities independently. In our country a new electricity act styled as 'the Electricity Act-2003' has come into force. Under the duties and responsibilities of generating, transmitting, distributing and trading agencies have been laid down with demarcation of boundaries. The act protects the consumers' interest and defaulting licensee is liable for payment of penalty/ compensation to affected person (s) and face legal action as deemed fit for non-compliance of specified standard of performance. To comply with provisions of the act for uninterrupted and quality power supply to consumers, the transmission and distribution systems and the associated sub stations / switch gear equipment have to be well maintained.

In various types of maintenance packages the preventive maintenance activities are given priority over other types of maintenance activities due to its multifold advantages.

Advantages of preventive maintenance

The preventive maintenance delivers the following benefits:

1. It reduces un-planned and forced outages of the system to a large extent.
2. It allows sufficient time for procurement of quality spares and replacements items in a planned manner. Thus avoids uneconomical, hasty, and distress purchase.
3. Long time major break down of the system is avoided.
4. During preventive maintenance residual life of system equipments can be estimated by non-destructive tests.
5. Diagnostic technique can be applied to fore-see system behavior and appropriate remedial action, wherever necessary can be initiated in time.
6. It facilitates to implement modern and up-to-date technology in relevant activity.
7. Allows adequate time to implement experts' advice and decision for improvement of the system
8. It enables the system trouble free, uninterrupted quality power supply to consumers.

Preventive maintenance activities

So far as preventive maintenance activities are concerned the transmission and distribution system is divided in to three major components such as (a) HT & EHT transmission line (b) Distribution net works and (c) Switchgear / Switchyard equipment Preventive maintenance prescribed for each of above components are discussed below:

(A) HT & EHT Transmission lines:

Long transmission lines are drawn across the country covering vast geographical territories. Usually whole or a portion of these lines pass through dense forests, high mountains, rivers, etc, These portion of lines and their supporting structures are not easily accessible during all the days of the years especially during monsoon. It is therefore essential to under take preventive maintenance activities as listed here under in pre-monsoon period.

- Cut and clean trees, bushes, creepers along corridors of transmission lines.
- Check transmission line conductors, jumpers for their soundness. If found broken, repair them by using repair sleeves, if more than ten percent strands are found broken replace the conductor
- Check for soundness of reactors and capacitors banks connected to transmission lines
- Check looseness of jumper connections, insulator tie points, etc.
- Check all insulators, if cracks are found, replace them.
- Check earth wire for its adequate mechanical strength.
- Maintain proper sag tension, earth clearance of line conductors.
- Check across arms and cross arm fixtures for their mechanical strength
- Paint supporting structures with anti corrosive paints.
- See that all clamps, nuts and bolt are intact and in good condition
- Check tower footings and protect the same from land sliding, soil erosion etc.
- Check conditions of vibration dampers, replace, them, if required
- Adjust arcing horn gaps to proper value.
- Check soundness of conductor spacers.
- Check earth resistance at every tower footing
- Clean bird nests, darts, chemicals deposited on insulators, cross arms and structures.

(B) Distribution Network:

Distribution network is the gateway for interaction between power supply agency and consumers, mostly of LT and medium voltage categories. A healthy distribution network caters quality and interruption free power supply to the consumers. Low voltage at consumers' premises and frequent interruptions power supply are mostly due to long and complicated distribution network systems which are existing with their years old style, shape and size without undergoing any appreciable renovation and modernization. The distribution networks thus require regular monitoring with regards to their maintenance. Preventive maintenance in this direction works as a life saving pill and relieves the supply agency from worries and sleep less nights to a large extent. The preventive maintenance package for distribution network consist the following activities.

- Determine load on each phase in regular interval and balance the load in three phases by shifting the load from the heavily loaded phase to lightly loaded phase.
- Check voltage regulation at consumer premises. If voltage dip is more than allowed value, necessary arrangements should be made to reduce voltage drop by installing additional distribution transformer (s).
- Wherever possible provide LT less service to small groups of consumers by installing 3 to 5 kva, 11/0.4 kv transformers mounted on HT (11 kv) line supports.
- The conventional overhead whether proof domestic / commercial service connection wires should be replaced by under ground cables having conductor material same as that of LT distribution line conductors wherever feasible.
- Check vertically of line supports and associated structures.
- Check tightness of stay wires and sound ness of stay insulators. Replace cracked, broken line insulators.
- Maintain ground, structure and building clearance of line conductors and other live parts.
- Clean bird nests, darts and chemicals from cross arms and insulators
- Clean creepers growing along stays and supports
- Check earth resistance.

- Check mechanical soundness of conductors, earth wires, C.I. Blocks, bolts, clamps, nuts, supports, cross arms etc.
- Paint all metallic parts with anti-corrosive paints.
- Check alignment and soundness of AB switches.
- Check proper functioning of horn gaps and lightning arresters.
- Check for adequate dielectric strength (BDV) of distribution transformers oil.
- Check HT and LT fuse carriers, replace them if found defective.

(C) Switchgear / Switchyard equipment:

Under this sub-title the equipment like bus bar, suspension / strain insulators, hardware fittings, lighting arresters, isolators, breakers, current transformers (CTs), potential transformers (PTs), power transformers, switch yard structures, marshalling boxes, compressors control panels, relays, contactors, wave traps, coupling capacitors, etc, are taken into account for following preventive maintenance activities.

- If the bus bars are made of flexible conductors the preventive maintenance activities recommended for transmission line conductors are also applicable for bus bars.
- The preventive maintenance activities suggested for transmission line insulators, hard wares are also applicable for suspension / strain insulators and hard wares used in switchyard
- Check bushings (insulators) of lighting arresters, CTs, PTs, circuit breakers, transformers, and insulators stakes of isolators, post insulators, if found cracked or broken, replace them.
- Check for quality and quantity of oil in oil circuit breakers, power transformers, CTs, PTs, and other oil filled apparatus, if required filter / change the oil.
- For gas circuit breakers check for quality and quantity of gas (SF6).
- Check and ascertain soundness of compressed air system i.e. all compressors are delivering required volume of compressed air at rated pressure and pipe line network is intact with out any leak.
- Adjust spring tension of motor operated circuit breakers and soundness of motor wherever provided.
- Measure insulation resistance (IR) between windings, between windings to earth, various live point to earth etc by meggers of suitable voltage rating and check for adequacy.
- Clean contact points of isolator blades, NO/NC contacts, breaker contacts, etc. by cleaning reagents.
- Check all mechanical and electrical indicators mounted on various apparatus for their proper functioning.
- Check proper functioning of Buchholtz relay, winding / oil temperature sensing relays of transformers and all other relays mounted on equipment itself and their marshalling boxes.
- Make the switchyard floor clean free from grass, mud, oil etc.

Conclusion

The modern technology has developed numerous methods, tests and sophisticated devices to diagnosis and monitor condition of the equipment. By the help of these tools the maintenance personnel get sufficient clues and indications to predict future behavior of the equipment to undertake preventive action to alleviate forced shut down of the equipment and enhance system reliability. Maintenance of history records of important and venerable equipment provides valuable information on future characteristics of the equipment to a large extent to launch appropriate corrective measures in time.

The maintenance personnel are required to take adequate steps to update their professional knowledge by attending short time courses, debates, and seminars on concerned subjects. Regular reading of periodicals and research publications provide maintenance people innovative thinking for implementation of it in practice to adhere the policy, that “the prevention is better than cure.”

Prof. Surendranath Sahu is Head of Dept., Electrical Engg
Synergy Institute of Engineering and Technology in Orissa. He was former Senior GM (Electrical)
Orissa Hydropower Corporation

Reference Book:

Electrical India October 2006
Vol. 46 No. 10