Asset Management

17

Jarlath Doyle

Contents

17.1 Introduction

Asset management can be described as "co-ordinated activity of an organization to realise value from assets" (ISO 2014). Managers of overhead transmission line assets must increasingly anticipate more and varied threats as well as opportunities, which will have a negative or positive impact on these assets (Electra 205, WGB2.13 2002). Utilities responsible for managing overhead transmission line (OHTL) must

Originally published by Cigré, 2014, under the ISBN 978-2-85873-284-5. Republished by Springer International Publishing Switzerland with kind permission

J. Doyle (✉)
Dublin, Ireland
e-mail: jarlath.doyle@esbi.ie

K.O. Papailiou (ed.), *Overhead Lines*, CIGRE Green Books,
DOI 10.1007/978-3-319-31747-2_17

consider the myriad of threat which could have an impact on their assets. These threats can take on many forms such as the threat of changing generation patterns, lack of skilled manpower, weather related outages and failures, right-of-way joint use and availability of suppliers and materials, to name but a few. Utilities need to ask themselves have they considered how these threats may be turned into opportunities. In a fast changing environment it is vital to systems in place for constant monitoring and assessment of these threats and opportunities (Cigré TB 353).

17.2 Asset Management Processes

In the past decisions on the management of existing overhead transmission lines were frequently based on the qualitative judgment of experienced individuals. This chapter is an attempt to quantify this analysis using risk management techniques. This guide will present methodologies for estimating costs and risks associated with various actions required for proper management of an overhead transmission line asset. The conclusions to support these management actions will be based on adequate inspections, analysis of a database of the conditions of the transmission line components, cost factors, safety, regulatory and environmental considerations. Management actions to be considered include risk reduction, risk acceptance and risk increase (Cigré TB 175). In recent years many standards organisations have published specific guidance on the management of physical plant or assets. A good example which is widely used in electricity utilities is “PASS 55”. PAS 55 is the British Standards Institution’s publicly available specification is explicitly focussed on the optimal management of physical assets. In addition to this ISO 55000 is the international standard developed from PAS 55 and provisioned for release in February 2014. These asset management standards describe the requirements for reactive and proactive monitoring of an asset (Figure 17.1).

17.3 Guideline for Overhead Line Asset Management

Electric power is an essential lifeline in mature, as well as, emerging economies. Overhead transmission lines (OHTL) play a significant role in the operation of a reliable power delivery system. Because of their complexity, extent and bold exposure to the elements OHTLs are vulnerable to degradation and possible failure from a wide variety of initiating events. The electric utility industry is in a transient condition brought on by privatization, deregulation and competition. It is becoming increasingly difficult to obtain the required permitting and/or funding to acquire new right-of-way and build new lines, therefore, utilities are seeking ways to get the most from their existing OHTL assets. This explains the interest in increasing the availability of OHTLs. In order to increase the availability of an OHTL, there must be a clear understanding of the negative and positive risk resulting from management decisions involving an OHTL. In the past many decisions concerning the management of an OHTL were made using qualitative data. In the future these

Figure 17.1 Typical 220 kV double circuit lattice steel tower.

decisions will need to be made using quantitative data to support these decisions. Information and databases may be required that were not previously available to support these decisions. Using this data, risk management techniques can be used to support management decisions (Cigré TB 175) (Figure 17.2).

17.3.1 Net Present Value (NPV) of Annul Expenditure

It is assumed that the goal of any management decision is to minimize the net present value (NPV) of the annual expenditures over a predetermined investment period. In order to get comparable results, future costs must be discounted to the present (SC22.13 2000; C1.1 & 309 2006). In general terms:

$$NPV = \sum_{i=0}^{i=n} \frac{C_i}{(1+r)^1} \tag{17.1}$$

Where:

- NPV is the net present value of the annual expenditures
- n is the period taken into consideration
- r is the discount rate
- C_i is the annual expenditures in year i, and where:

$$C_i = E_i + R_i \tag{17.2}$$

Figure 17.2 220 kV single circuit lattice steel tower.

- E_i is the deterministic costs, or planned expenditures, in year i, and
- R_i is the probabilistic costs associated with risk of failure in year i.

Sometimes the investment period (n) to be considered is low, i.e. the power plant at the end of the transmission line will shut down in 5 years. Sometimes the investment period is much longer, i.e. the lifetime of the asset. For an OHTL asset all relevant cost factors (deterministic and probabilistic) have to be taken into consideration during the investment period. According to the discounting principle, costs in the far future are less important than costs in the early years. The deterministic cost factors are called "Planned Expenditures" E_i. They consist of normal operations and maintenance costs, planned outages and investment costs accounted for in the year or at the time they are incurred. These costs are discussed in section 4.1. The probabilistic cost factor is called "Risk of Failure" R_i. In general terms risk is defined as:

$$risk = [chance] \times [consequence] \tag{17.3}$$

Chance is usually expressed as a probability of an event. In common usage, the event is undesirable and the consequences are adverse; however, risk may include potential for gain as well as exposure to loss. When the event is an OHTL failure, the chance is the probability of occurrence of the event initiating failure, and the consequences are the totality of resulting consequences from the failure. This risk of failure (R) can be stated in its simplest form as:

$$R = [probability\, of\, failure] \times [consequence] \tag{17.4}$$

Risk of failure during a time interval may be de fined in economic terms, such as net present value (NPV), and is a function of time since both the probability of failure and the consequences will vary as a function of time. Risk may also be defined in non-economic terms if strategic, policy or political issues are involved. From the above equation, it is obvious that risk can be controlled by either:

- Controlling the likelihood of occurrence of the failure initiating event, or
- Controlling the magnitude of the resulting consequences.

17.3.2 Annual Expenditure

There are costs during normal operation and there are costs connected to the risk of failures. Costs during normal operations are deterministic costs. They are costs of a known magnitude incurred at a known time. On the other hand, the costs connected to the risk of failure are probabilistic costs. Their magnitude must be estimated in most cases, and when they will be incurred is not known with certainty (Cigré TB 175).

Planned expenditures include costs of normal operations and costs of investments. These costs can be connected to different levels within the company: the company, as a whole, the system operation division (electricity commerce), and the OHTL division.

- Company level:
  - Costs of investments are frequently connected to the company and not to a division.
- System operation level:
  - There are energy and capacity losses. Depending on the conductors and the load. These losses may be substantial if the line operates close to its thermal limit.
  - Costs of planned outages.
- OHTL operation level:
  - Operation and maintenance are obvious cost elements of the OHTL operation. Regular inspections and patrols are necessary and the conditions of the components and elements must be checked. Painting, tree trimming and smaller interventions are performed regularly.
  - Costs for collecting information and maintaining a database for proper management of the OHTL asset.

17.3.2.1 Risk of Failure

As mentioned in section above the risk of failure of an OHTL is defined as the probability of failure times the totality of resulting consequences. The event causing failure may be predictable or unpredictable, and the consequences of the failure may be expressed qualitatively or quantitatively. The consequences of a predictable event may be different from the consequences of an unpredictable event.

17.3.2.2 Failure due to Predictable Events

The mechanical system of an OHTL consists of arrays of foundation, structure, conductor and insulator components that provide safe support for the power carrying conductors along an ever changing right-of-way. To be able to predict the probability of failure of an OHTL, it is first necessary to understand the present capabilities of the specific line configuration. In order to do this; the as-built line and terrain details can be entered into a three-dimensional analysis design computer program to create a model of the line and corridor. The present capabilities including residual electrical and mechanical strength, of all existing OHTL components can be determined using appropriate inspection/assessment technology as those outlined later in this chapter. The present value of each component's capability would be substituted for its new value in the analysis program. After that, loading conditions, such as different magnitudes of wind velocity at different angular directions, accreted ice or wind and ice, are applied to the model in increasing increments until the first component is loaded up to its capacity. That is the critical loading condition for that component. The probability of occurrence of that loading condition is an indication of the reliability level of that component. This process is continued until all loading events of interest have been applied and the weakest link identified. Probability of failure due to predictable events is equated to the reliability of the weak link components that cause failure of the OHTL. This is somewhat of a "reverse engineering" approach to the probabilistic method of design described in IEC standard 60826 (IE60826 2003). Once the weak link has been determined, the probability of cascading or a progressive line failure can also be determined. Progressive line damage after the initial failure of a component is line specific and not the same for all components. For instance, if the probability of occurrence of mechanical separation of a porcelain insulator is determined for a particular OHTL, it makes a difference whether the insulator is in a suspension string or dead-end string. In a suspension string, the event could lead to a dropped phase, which may not result in progressive line damage. On the other hand, a failure in a dead-end string would also drop the phase, however it would also release full line tension, which could be sufficient to set a line cascade in motion. Analytical techniques are available for determining the extent of progressive mechanical damage to an OHTL after the initial failure of a component, and devices and techniques are available for containing such a failure. The components of a line are subjected to many types of deterioration, such as: wear, fatigue, corrosion, deformation and elongation. Since they are made from different materials with different properties in different environments, it is likely that some of these components will deteriorate faster than others. If a database of past component capabilities exist then the future capabilities including residual electrical and mechanical strength can be extrapolated new weak links determined and the probability of survival and thus the probability of failure over a period of n-years can be calculated. The failures due to predictable events may be managed by proactive measures due to the predictability of the event.

17.3.2.3 Failure due to Unpredictable Events

The term "unpredictable event" is used to represent events that are managed by reactive measures, since their probability of occurrence cannot be economically reduced with proactive measures. Past service experience may indicate that certain events such as natural disasters, sabotage or human error will occur; however, the nature of the event precludes taking proactive corrective action before the event thus reducing the probability of failure of the event. Natural disasters such as hurricanes, cyclones or typhoons, tornadoes, massive ice storms, floods, earthquakes and earth slides fortunately occur infrequently. When they do, these disasters can cause total destruction of the above ground elements of OHTLs as well as have a destructive impact on and make serious changes to the very topography along the right-of-way. This makes post event access difficult and complicates restoration processes. This combination can make the total outage time for the OHTL very long. As previously mentioned, management decisions will always have to be made under conditions of risk and uncertainty. Intuition, judgment, and experience and information available from the database must be used to assign the probability of failure due to unpredictable events. Thus the assignment of probabilities in situations of uncertainty proceeds on a subjective basis, rather than an objective basis (Figure 17.3).

17.3.2.4 Consequences of a Failure

OHTLs may provide different functions, for example the function of an OHTL may be to:

- Transmit power between A and B continuously
- Transmit power between A and B if another line fails
- Increase stability margin (no continuous transportation of power required), etc.

Different functions lead to different consequences should the OHTL fail. The function of a particular line can change during time, for instance higher capacity is necessary because the load increases. Consequences resulting from an extended outage of an OHTL are site and function specific and can be considerable. Depending upon the extent and resulting consequences of the OHTL failure, monetary losses can occur to the OHTL asset owner, their customers and local or national governments. The total losses may be more than just the direct losses of the asset owner, especially if the owner is answerable to customers and government entities.

	Failure due to	
	predictable events	*unpredictable events*
The probability of *failure* is	relatively high	relatively low
An economic way to avoid *failure*	does exist	does not exist
Proactive action	can be taken economically	can not be taken economically
In case of proper action the OHTL	will survive the *event*	will not survive the *event*
Reactive action are	possible depending on economic evaluation	the only opportunities to reduce the *risk* economically

Figure 17.3 Summary table of predictable/unpredictable events.

The consequences arise generally at different levels within the company. Each case is different, however, in most cases, these costs can be connected either to the company as a whole, or to the system operations division (i.e. electricity commerce division), or to the transmission line division (Figure 17.4).

17.3.3 OHTL Asset Management Process

In order to present management with appropriate options that minimize the net present value of annual expenditures over an investment period, an information system and process must be in place. Figure 17.5 is an idealized process or model of the activities leading to management decisions for an OHTL asset. This process represents the technical activities leading to various management options and their associated risk. Management then decides which risk option is appropriate.

There is no starting point in this process, however, begin by examining the process after an OHTL failure (A). The box titled "OHTL Failures" could also be named "Anticipated or Expected Rate of OHTL Failures". As mentioned in failures will occur, however, management has made decisions to achieve an acceptable rate of failures due to certain events and consistent with Management goals. It would be unreasonable for management to anticipate no failures under all conditions. However, it might be reasonable for management to expect no failures due to corrosion of a tower, if tower painting is performed at least on a scheduled basis. Likewise, it would be reasonable for management to anticipate an OHTL failure if a tornado were to cross the OHTLs path.

Failures are not only a function of management decisions (B) but also outside failure events (C). The lack of failures under certain conditions may also tell management that there is a potential for gain, or reduction of costs, by taking advantage of this excess capacity of the OHTL.

Expenditures are connected mainly to	Annual Expenditures	
	Planned Expenditures	*Risk of Failure*
Company level	• Investments	• injury, death • serious damage in the built environment • bad publicity, loss of customers, even more difficulties finding new ROW • cascade *failures* with electrical system breakdown
Systems operation level	• energy and *capacity* losses	• additional energy and *capacity* losses • more expensive power generation • loss of profit due to non delivered energy • penalties due to non delivered energy • penalties by the regulator
OHTL operation level	• Operation and *maintenance* (including land owner compensation for the damages in vegetation) • Overhead costs for information collection and *maintenance* of a data base	• repair (including land owner compensation for the damages in vegetation)

Figure 17.4 Consequences of a failure summary table.

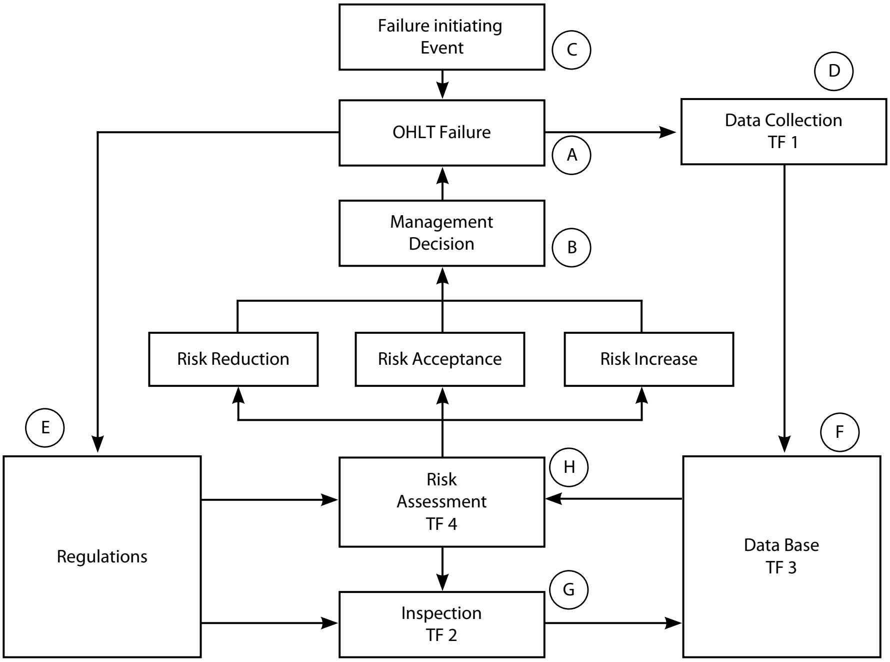

Figure 17.5 Model for OHTL Asset Management.

When an OHTL failure event occurs, data must be taken to determine the cause of the failure (D) as described in Cigré TB 175 Without this data collection, improvements to the management decision making process will be difficult if not impossible. Information on OHTL failures will also affect regulations, standards and company policy (E). Standards are written and regulations are normally formulated based on service experience and the anticipated failure rates of an OHTL by regulators and other governmental organizations as well as the public. If OHTL failures occur and adversely affect customers, regulations affecting the OHTL asset owner may follow (Cigré TB 175).

Ideally a useful database, as described in Cigré TB 175, will be established (F). This database will contain information on the OHTL, its components and its critical elements. Information for the database will be supplied by data collection after an OHTL failure (D) and from inspection of the OHTL right-of-way and its components and/or elements (G). Processing of the data in the database should reveal trends in the degradation of the OHTL components/elements in order to predict the remaining life of components/elements. Failure statistics due to predictable and unpredictable events must also be kept in the database in order to predict the probability of future events.

The OHTL must be patrolled and inspected (G) in order to update information on the degradation of the right-of-way and OHTL components/elements. This information is used to determine their present capabilities (H) including residual electrical or mechanical strength, and the remaining life of the component/element. This remaining residual strength must be compared to the historical data to determine if the strength is deteriorating, and to regulated requirements (E). The probability of failure must be estimated from historical data in the database (F). The consequence, or cost of the event, is calculated taking into account service experience (F) and environmental safety and availability requirements from regulators (E).

The risk must now be calculated for various management options. Risks may be expressed in net present value or in non-monetary terms. The cost and benefit of each management option is considered and accounted for in the net present value calculations. Various options and management initiatives are outlined in later in this chapter. These management options fall into three basic categories: risk reduction, risk acceptance and risk increase. Management must then select the best option consistent with company goals. Although the names might give the impression that one type of decision is better than the other, this is not true. All types are equally appropriate based on the risk assessment (H).

This process is continuous so that management decisions can be based on the latest risk assessment. It should be noted that the age of the assets should be considered along with the interval between risk assessments if the asset exhibits characteristics of accelerated reduction in capacity. The population and statistical distribution of the capacity also should be considered. However, it must realized that no matter what the management decision, failures will occur due to the nature of OHTLs and the environment they are subjected to. The discussion in this Section should not lead one into the “analyse-it-to-death syndrome”.

That syndrome leads to risk aversion by avoiding decision making and studying them forever looking for perfection. It should be noted that no decision is a management decision to accept the risk. While the analytical process seems formidable, there are many practical examples of how this process can lead to increasing the availability of OHTLs.

17.4 Data Collection for Overhead Line Asset Management

The purpose of this next section is to present guidelines on the data to be collected regarding defects and failures that effect the integrity of overhead transmission lines, in order to develop a strategy for the management of these assets (SC22.13 2000). This guidance is intended to assist transmission line asset owners (owners) and for the development of a uniform database leading to a maintenance management system conforming to good industry practice. Defects and failures occur in practice due to:

- Unforeseen external causes such as faults in an adjoining grid, extreme weather conditions, sabotage,
- Internal causes like wear, aging, deformation, poor construction or material,
- Operational aspects such as electrical overload, switching faults, improper functioning of protection and control.

Defects can lead to failures causing unforeseen unavailability of the line. Proper analysis of defects and failures can give a contribution to the development of strategies to maintain a sound condition of the overhead line. The availability, reliability and remaining life expectancy of overhead lines can then be improved with a known and controllable cost of ownership.

17.4.1 Consequences of Failures

Failures often involve the subsequent effects:

- Fluctuations in the voltage level leading to disturbances of operational processes of the customer;
- Reconfiguration of the system resulting in increased losses and/or higher generation costs;
- Disruption to planned maintenance programs;
- Restoration costs;
- Financial claims arising from unavailability of the transmission line.

17.4.2 Failure Analysis Data Collection

To be able to carry out a proper failure or defect analysis, there should be a database. This database should be unambiguous and contain, but not be limited to, pre-event, event, post-event and cost data. This can be expanded as follows:

17.4.2.1 Recording of Pre-Event Data

The following data is important for any transmission line database:

- Design criteria and applicable manufacturing and construction standards;
- As built/constructed data including all components, elements, their manufacturer, date of commissioning and location;
- All inspection and maintenance records including location, date, observation, deterioration, changes or modification to any component or element;
- Any refurbishment, uprating or upgrading;
- Climatic and pollution conditions along the line;
- Data from any previous event;
- Strategic emergency material and equipment inventory.

Data can be tagged with an accuracy level index. By doing this, generic data can be included which may not be precise for individual items but can be used for large scale assessment. It also allows data of different accuracy to still be included but used with care.

17.4.2.2 Recording of Event Data

Recording of data must be unambiguous (electrical/mechanical loading resulting in a defect or failure). For this purpose a failure recording form can be used. After each event this form should be filled in completely after which filing in a central database takes place. The form should contain a list of definitions, an explanation and the subsequent data, where applicable:

- Agency recording the event;
- Exact time of the beginning of the event;
- Distinction must be made between incidents involving manual tripping of the line, automatic tripping, automatic tripping with successful auto-reclose or automatic tripping with unsuccessful reclose (lockout);
- Climatic conditions such as wind, precipitation and ice accretion should be described as well as pollution influencing the line;
- Nominal voltage;
- Load current immediately prior to the event and an estimate of the fault current;
- Name and code of the circuit involved; arm, suspension, insulator, conductor, earth wire, damper, spacer etc.;
- Failure during operation, switching in, switching off or during works;
- Switching off by hand or by protection equipment;
- Switching off due to electrical phenomenon, secondary installation, inadequate functioning of protection, error in operating or switching, cause outside control area;
- Cause for electrical phenomenon or defect:
  – unforeseen external causes like fault in adjoining grid, fault at a user, extreme weather conditions, fire, sabotage, birds, crane, etc. (if weather related, estimate or measure values of wind and/or ice at the failure site and recorded values from nearby weather stations);
  – internal causes as wear, aging, deformation, poor construction, material, assembly, manufacturing and adjustment;
  – operational aspects such as overload, switching or testing errors, poor or insufficient maintenance and improper operation of protection and control;
  – works in or under the line by or on behalf of the owner;

- Any required continued investigation activities involving the failed component or element, or of additional like components or elements, measurements, outside expert opinions, accident reports, formulation of a repair or replacement plan and cost analysis;
- Exact time to start the repair work;
- Exact time to complete the repair work;
- Exact time of recommissioning the line.

17.4.2.3 Recording post-event data

As mentioned before every failure or defect causing switching off the line should be analysed. This analysis is meant to find the cause and detect possible deficiencies, wear, etc. of the type of component or element involved in order to take action at other points of installation. The results of an investigation and the measures taken should be recorded unambiguous in a database. At least the subsequent aspects should be mentioned:

- Agency reporting;
- Time of the failure;
- Name and code of the circuit involved;
- Failed component;
- Failed element;
- Manufacturer and type; number of years in operation;
- Voltage level;
- Comparison of the condition at the time of failure with the original design criteria (i.e. pollution, mechanical loading or electrical loading);
- Material;
- Description of the extent of the damage, including photographs;
- Description of the manifestation of the damage, including photographs;
- Identification of the cause of the damage;
- Measures to be taken and action plan.

17.4.2.4 Cost of Defects and Failures

The cost per event should at least comprise:

- Loss of income due to undelivered energy;
- Cost of increased network losses;
- Cost of switching operations;
- Customer claims or penalties;
- Cost of investigation;
- Cost of called in experts;
- Total cost of restoration including manpower, equipment, materials and outside contracts.

17.5 Database Management for Overhead Line Asset Management

The primary aim of a Database System for proper management of existing overhead transmission lines is to store and extract the data "as-built" of the line assets and their historical data. A very efficient tool to rank the various possible actions on existing and ageing overhead transmission lines and to select the most appropriate management action is a database on line assets. Experiences in the past, have learnt that poorly designed databases have failed. In this context, recommendations how to start a simple database and how to extend this database in different steps with increasing detailing may be useful. It is assumed that management decisions must be based on statistics processed from the collected quantitative basic data. This section is intended for the use of overhead transmission line asset owners in order to improve their database system, in such a way that it can provide statistics supporting management decision process on assets.

17.5.1 The Different Kinds of Data

As mentioned here above it is assumed that the Database System includes the data "as built" of the overhead transmission line assets as well as their historical data (SC22.13 2000).

17.5.1.1 Asset Data as Built

This Guide suggests to collect the asset data as built on three successive levels:

- lines and circuits;
- line components;
- elements of components;

The data stored on the three levels allow to analyze and compare successively:

- the performance of lines;
- the condition of components;
- the condition of elements.

17.5.1.2 Historical Data

Three different kinds of historical data on overhead transmission lines can be distinguished:

- The real historical actions such as:
  - Replacement or heightening of a support or a part of a line (for instance due to the construction of a railway), stringing of a second circuit, etc;
  - Maintenance or painting, life extension, refurbishment, uprating, upgrading, etc.
- Historical events such as failures, forced outages, etc;
- Historical observations and measurements on defects of assets registered in periodic inspection reports.

Finally a database can include costs and duration of actions, as well as costs of the replacement of line segments, components and elements.

17.5.2 Storing and Extracting Data

In the past information on overhead transmission lines was neither systematically kept nor even directly accessible. Nevertheless this information is required in an appropriate form or structure to support any management decision on overhead transmission lines. It is important to know where to find the information required. It has to be recorded on a consistent and comparable basis such as books in a bookcase or in a library in such a way that it can be found easily. Today, the use of a database system is the most convenient tool to store, to consult, to revise and to extract data.

This document gives guidelines as to which kind of data are at least required and how they can be stored efficiently. Generally, historical data are available in various reports and they must be extracted from the report. It is recommended to provide in the future special data collection checklists so that the inspection results can be stored in the database immediately after the inspection. The date (or the year) of each recorded data is important in view of management decisions.

The database represents the line as built in the present situation provided that the modifications and adjustments since the construction of the line have been introduced. Each historical data has to be linked with the appropriate asset in the network. So every action, every observation, every event can be located in the network. In this way, it becomes possible to follow the history of each asset in function of time and to estimate its degradation rate. Moreover the historical data of different assets can now be compared. This database allows to establish statistics on line performance, component and element condition. In the past, management decisions were frequently based on qualitative judgement of overhead line experts. Nowadays decisions can be supported by the quantitative data of statistics. Statistics can be processed from basic data only if the asset owner decided to list the present line assets on one side and the historical reports – at least for the last years – on the other side. In order to store and to retrieve both data, they must be related to one another in a simple framework.

17.5.3 Storing Reports

If an appropriate database system does not exist, a lot of historical and vital information may probably be lacking or has not been recorded at all. It could cost a considerable amount of money later to reacquire those data. Unfortunately, for various reasons, it would be impossible to include in the database all information available in the reports on historical actions, observations and events on line assets. So, this Guide recommends at least to refer in the database to the code number or the serial number of any historical report, so that the report remains traceable. In this way interesting data, for which any provision has been foreseen in the database, are not destroyed but can be indirectly consulted. Nevertheless, it would not be possible to use these data for the above mentioned statistics. The costs relating to the different historical actions, observations and events have also been recorded so that they can be extracted from the database when a new budget has to be established.

17.5.4 The Link with other Databases

If other databases containing information on overhead transmission line assets are available, they should be linked with this database. This can be achieved by using the same code or reference number for the same item. Databases with different specific purposes sometimes use common data with the same characteristics, so that integration of the data structure may be useful. In the future, databases with different purposes can be integrated in one unique and integrated system dealing also with finances, purchasing, storing, human resources, planning, etc.

17.5.5 The Quality of the Data

The quality of the data cannot be improved by recording in a database. Its quality depends mainly on the crew collecting inspection information and on the inspection technique. Both have to be recorded with the corresponding date to estimate its quality and reliability. Later on it might be found that one crew had a bias in one direction which caused a distortion in the input data. Without knowing which crew collected the data, it may be impossible to correct this misinformation. It is important to know who is responsible for inputting of the data. Who is in charge of updating? Can the stored data be guaranteed? Data must be validated and dated. A second factor determining the quality of a data is the inspection technique. The longer the distance is between the inspected item and the sensor, the less reliable the data may be.

17.5.6 Conditions for Success

In the past many databases on overhead transmission lines have failed. The reasons are known: a lack of reliable data for an extensive database; a lack of motivated manpower to collect, to store and to maintain the data; not so user-friendly input and output, and especially a lack of a clear accepted scope or a lack of integration with other databases. In general, it is relatively easy to store the data of a new line. Nevertheless, updating of a database is a challenge and can be a considerable cost. If it is updated, the database must be easy to use for the design of new lines just as for modifications of lines. A user-friendly access supposes a recording of data in the database in the same order as in the documentation. It is necessary to have a clear and concise method to store the relevant asset data relating to each other and to keep a history of the actions, observations and events of the overhead transmission line assets by filtering or selecting data and referring to historical reports.

17.6 Summary

Good asset management practice will ensure the utility or owner will follow a systematic process of maintaining, operating and refurbishing it overhead line assets. As outlined in this chapter it is vital that owners keep accurate and update database on the performance and failure that occur over time. On this basis it is possible to make comparisons and exchange information. This facilitates for instance to use the experience obtained from the investigation on events due to internal causes to prevent problems on the same type of component or element. Those owners that follow these guidelines will have a procedure in place to enable them to continually improve the quality of their maintenance management system. Furthermore, this will lead to an improvement of their transmission line availability and reliability, and give the owner a better insight as to the remaining life expectancy and future operating costs of their transmission assets. Further information on the methodologies and strategies in the asset management of overhead transmission lines can be garnered from the Cigré B2 committee and e-cigré website.

References

2409, I: Paints and varnishes – Cross-cut test (2013)

55000, I: Asset management – Overview, principles and terminology (2014)

B2-08, C. W.: Cigré *TB 230;* Assessment of existing overhead line supports, Cigré (2003)

B2-WG13, C. W.: Existing Overhead Transmission Lines: How to Detect and Manage threats and opportunities in a changing industry. Electra (2002)

C1.1, C. W., & 309, T. B.: Asset Management of Transmission Systems and Associated CIGRÉ Activities. Cigré (2006)

IE60826.: Design Criteria of Overhead Transmission Lines, 3rd ed., IEC, 2003. International Electrotechnical Commission (2003)

ISO, B.: 55000 Asset Management – Overview, Principles and Terminology (2014)

SC22, C. W.: Cigré TB 141; Refurbishment and Upgrading of Foundations, Cigré (1999)

SC22.13, C. W.:. Cigré TB 175; Management of Existing Overhead Transmission Lines 2000, Cigré (2000)

Jarlath Doyle holds BE and MBA degrees and has worked in the area of transmission and distribution overhead lines since joining ESBI in 1999. He has gained many years' experience in the planning, design, construction and maintenance of transmission and distribution equipment and is currently working for ESB Network as a project director on major 400 kV projects. Mr Doyle is an active member of several Cigré Working Groups within Study Committee B2 and Convener of Technical Advisory Group B2.07 "Asset Management, Reliability & Availability.