PATH TOWARDS PAS-55 IN THE PORTUGUESE DSO: A WORKING EXAMPLE IN THE PROTECTION AND CONTROL SYSTEMS

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ABSTRACT

Traditionally, Distribution System Operators (DSOs) asset management practices are based on the operational performance of assets. However, in order to establish a better asset management practice, it is necessary to deploy developments in cooperate governance. British Standards Institution (BSI) PAS 55 is a publicly available guideline which specifies good practices in physical asset management and it could be an ideal tool and model available for asset cooperate governance of Distribution Network Operators. The 28-point requirements checklist in the BSI PAS 55 specification was applied to the management system of Protection and Control assets in EDP Distribuição (Portuguese DSO). A "gap analysis" assessment of the current asset management practices is employed and a report with the roadmap is produced to ensure that the engineering of Protection and Control Systems can help the Portuguese DSO to undergo the certification assessment process. A working example with the implementation of the BSI PAS 55 specifications to the asset of Ripple Control System is given along with the risk-based decision making process for that particular asset.

INTRODUCTION

Following the worldwide tendency, in the last few years the energy sector in Portugal was unprecedentedly privatized and deregulated, in parallel with other market-orientated reforms. Given this environment and in order to maximise organisational performance and business goals, rationality and transparency are key to build trust with shareholders and attract their interests to invest. Asset management is essential to the performance and growth of electrical utilities. An effective asset management takes into account capital and operating costs, costs and benefits, customers seeking for the best value and the environment. It also ensures that risks are managed and levels of investment are appropriately targeted [1].

BSI PAS 55 is a publicly available guideline which specifies good practices in physical asset management, and it could be an ideal tool and model available for asset cooperate governance of Distribution Network Operators (DSOs). Thus, asset governance may be a way to operate ownership and manage assets in a competitive and deregulated market. It could also be an innovative solution to meet the regulatory and competitive challenges faced by DSOs [2].

The 28-point requirements checklist in the BSI PAS 55 specification was applied to the management system for Protection and Control assets in the Portuguese DSO [3].

A "gap analysis" assessment of the current asset management practices is employed, which reviews the actual asset management system and specifies gaps against the 28-point requirements of the BSI PAS 55. A report with roadmap is produced to ensure that engineering of Protection and Control Systems can help the Portuguese DSO to undergo the certification assessment process. A working example with the implementation of the BSI PAS 55 specifications to the asset of "Centralized System by Musical Frequencies" is given, along with the risk-based decision making process for that particular asset. In sum, this paper investigates how engineering of EDP Distribuição can meet the governance perspectives of asset management and thus maximise optimal asset and organizational performance [2,3].

THE NEED OF ASSET MANAGEMENT & BSI PAS 55

When seeking to ensure the sustainability of a company, correct operation of its equipment is critical. Distribution Network Operators (DSOs) manage intensively a huge number of assets on the daily basis. With the actual financial constraints that DSO may face, investment in assets will be reduced. Thus, in order to reduce the risk for company assets to fail, a detailed introduction of risk assessment methodology is needed to delay assets replacement and thus improve the associated asset payback.
Managing assets with a holistic view enables companies to identify more easily which areas to reduce maintain or

invest, in order to obtain an optimal mix of activities and investments in the company. Asset management can integrate a wide variety of perspectives including engineering, financial management, risk management, logistics, client relationship, environmental management, legislation, and life cycle of the assets (acquire/create, utilize, maintain and renew/dispose) [4,5]. In addition to this, asset management provides a better platform for different units to collaborate. This diversity and sharing of information about the same asset may help to reduce financial burdens on asset managements.

Collaborating with the Institute of Asset Management [5], BSI PAS 55 was designed to specify good practices in physical asset management, and it could be an ideal tool and model available for asset cooperate governance of the Distribution Network Operators (DSOs). The PAS 55 specifies guidelines and best practices for physical asset management in a company and it incorporates a functional structure that allows continuous improvement of the asset management system. Although PAS 55 is not yet an International Standard (ISO), it has a structure similar to that of an ISO standard and can be easily integrated with the international standards of ISO 9001, ISO 14001 and British Standard OHSAS 18001[2].

PAS 55 advocates the analysis of asset life cycle in order to optimize all expenditures associated with asset (such as creation/acquisition, utilization, maintenance and renewal/disposal), rather than only singular phases of the process. PAS 55 is divided into four phases: "plan-do-check-act". (i) In the "Plan" phase, a strategy, objectives and plans to the project are defined, aligned with the policy and company strategic plan. (ii) In the "Do" phase, the plans are implemented in the field, following the specifications and requirements. (iii) In the "Check" phase, errors or anomalies are detected through monitoring the work process and measurement magnitude previously specified. (iv) Lastly, in the "Act" phase, errors and problems detected in the previous phase are corrected.

With this four-phase cycle it is possible to check all processes in a continuous way. Thus, it ensures the introduction of improvements along with the process through a continuous analysis. Although it is possible to define various types of assets, like human, physical assets, information, financial asset and even intangible assets, PAS 55 focuses only on physical assets.

A WORKING EXAMPLE IN THE PROTECTION AND CONTROL SYSTEMS

In order to seek a PAS 55 certification in EDP Distribuição, i.e. the Portuguese Distribution System Operator, the engineering of Protection and Control Systems firstly aims to identify challenges when applying the specification. The main objectives are to identify: (i) the methodology to apply PAS 55 requirements in the Protection and Control Systems; and (ii) the potential benefits to implement the specifications, in terms of risk asset management, harmonization and adoption of new procedures, and consistency and repeatability in the whole company.

Protection and Control Systems Assets in EDP Distribuição

Normally, the Portuguese DSO classifies physical assets of Protection and Control Systems into two main groups: (i) Protective System; (ii) Automation, Control and Monitoring System.

The Protective System assets are responsible to detect equipment failures and reduce their impact. This group incorporates protective electromagnetic, electrostatic and digital relays. Automation, Control and Monitoring System assets are mainly responsible for the operation of primary substations. This electrical equipment can be controlled either locally or remotely. In this group, the Ripple Control System assets are also included. It is responsible of controlling and sending signals through the electric network to, for instance, switch on or off the public lights or change the tariff periods at the consumer reading meters. The assets of this group could also be routers, switches and modems.

Methodological Approaches

Firstly, there was an analysis of all the physical assets at the operational area responsibility and secondly follow a performance analysis on the Portuguese DSO activities and process. This is called "Gap Analysis" and it is used to determine 'the space between where we are and where we want to be'. It also serves as a means to bridge that gap [6].

Gap Analysis

The analysis was then conducted to determine the difference between the actual state and the desired future state. Two complementary "gap analysis" methods were used (i) the "Initial Gap Analysis" and, (ii) the "Detailed Gap Analysis", both with different levels of details, range and anticipated outcomes.

(i) Initial Gap Analysis

With the "Initial Gap Analysis" it is possible to define a roadmap incorporating the requirements needed by the certification. The aim of this analysis was to tag each of the specified requirements with application on the EDP Distribuição and to understand better whether the requirements are already fulfilled by the current practices in the engineering of EDP Distribuição. With Initial Gap

Analysis it was possible to understand the current state of the DSO in terms of the specified requirements; and identify areas where improvements or new methodologies can be introduced in the process. It was also possible to estimate the amount of future work in order to archive the PAS 55 certification.

(ii) Detailed Gap Analysis

The objective of the "Detailed Gap Analysis" is to bring up solutions or methods and to determine which of the PAS 55 requirements are not yet satisfied by the current practices at EDP Distribuição. In this work, the solution theme of Risk Management Analysis and Documentation was selected from the "Initial Gap Analysis", which allows fulfilling the mandatory requirements to achieve the certification.

OUTCOMES OF THE INITIAL AND DETAILED GAP ANALYSIS

The results of the "Initial Gap Analysis" are summarised in Fig. 1. The figure shows the percentage of the PAS 55 requirements that are applicable to engineering of Protection and Control Systems. Figure 1 also presents the requirements already fulfilled. The requirements not yet satisfied were categorised in themes (i.e. Documentation, Improvements on Today's Practices and Risk Management).

It is possible to see from Fig.1 that more than half of the specified requirements are applicable to engineering of Protection and Control Systems, whereas 28% of the requirements are already fulfilled. The rest of the unfulfilled requirements are related with documentation, today's practices and risk management of the assets.

In the "Detailed Gap Analysis" two themes, "Risk Management" and "Documentation", were selected which needs further examination and advancing the procedures in order to achieve the fulfilled requirements.

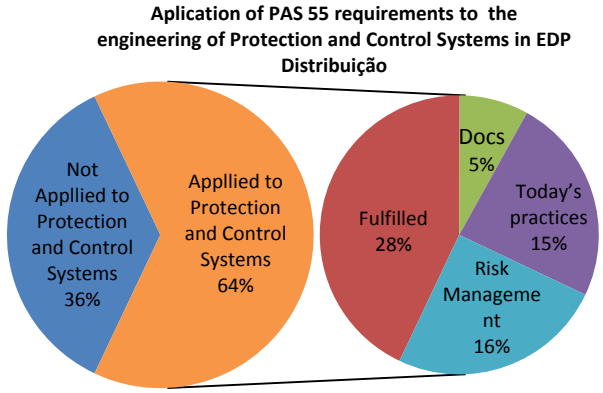

Fig. 1 - "Initial Gap Analysis" results

Risk Management Analysis

From PAS 55 a methodology was identified to set the Risk Management Analysis of the assets. The methodology is composed by the following steps: (1) Identifying potential risks associated with the assets and making an estimate on the basis of existing or proposed risk controls; (2) Determining whether these risks are tolerable; (3) Determining whether further analysis is required to establish whether the risks are tolerable, or not, and (4) Devising risk controls where they are found to be necessary or desirable.

In this example, the Risk Management Analysis was applied to the Ripple Control System group of assets, i.e. specifically to the "Centralized System by Musical Frequencies". From the Risk Management analysis the Failure Tree and Risk Matrix are identified, as showed in Fig. 2.

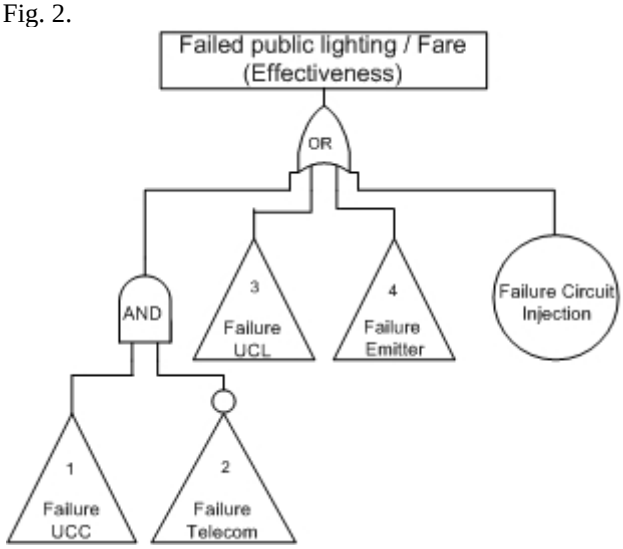

Fig. 2 - Failure Tree of "Centralized System by Musical Frequencies"

The Failure Tree is used with the main objective to identify critical risks of the assets in the "Centralized Control System by Musical Frequencies". In order to define the critical risks of the assets, it is necessary to determine the weight of each asset that contributes to failure of the whole system. The influence of each asset will be used to calculate the risk level of the system performance. This failure tree is also used to auxiliary outwit breakdowns of the system. After assessing the Failure Tree, it is followed by the Risk Matrix demonstrated in Fig. 3. This figure shows also a simple categorization of the assets Risk Analysis.

Impacts						Average Efficacy				
Business Values	Sustainability		Reputation	Quality of service	Results	Efficacy values checked (Last Year)				
Indicators	Safety of People	Environment	Impact on Media and Population	Average Availability	Results (k€)	Very Low (92% ≥ X)	Low (93%≥X>92%	Mean (94%≥X>93%	High (95%≥X>94%	Very H (X≥95
						5	4	3	2	1
5 very Critical	May cause death or permanent disability	Significant damage to the environment over 5 years	International or National	97% ≥ Value	R ≥ 4500	I5	I2	I4	M5	M1
4 critical	May require hospitalization	It can cause significant damage until 5 years	Nacional or Regional	98% ≥ Value > 97%	4500 ≥ R > 2000	I3	I5	M6	M2	A1

Fig. 3 - Simple Risk Matrix Advanced for EDP Distribuição

For each asset, a more detailed analysis was performed to analyse its current condition and the consequences of failing. This detailed analysis took into account the local asset deployment, number of customers affected by its mal-operation or failure, and redundancy in supplying costumers in case of failure. The analysis of asset condition or failure probability took into count the age, failures recorded, availability, and time period since the last maintenance or inspection.

Fig. 4 - Summary Table of Detailed Risk Matrix advanced

The development of new solutions will be based on the risk matrix, adapted to the type of analysed asset.

Documentation System

Documentation of procedures within an organization can improve the effectiveness, efficiency and uniformity, as well as increase consistency in the procedures used. The definition of procedures to include in the document was carried out through advice of the team staff, mainly the ones that deploy the assets on the ground. The document devised is divided in three main areas, Communal Procedures, Management of Shared Information and Additional Information. The Communal Procedures include equal practices for every area of Protection and Control Systems, like registration failure, control of spare parts, planning activity or periodical meetings. Management of Shared Information include its structure and the information responsibility in each area. The section of Additional Information has particular information like tutorials, technical information or links to documents often used by workers from different areas.

FINAL REMARKS

This paper investigated how engineering of EDP Distribuição can meet the governance perspectives of asset management by adopting the asset specification PAS 55. The 28-requirement from this specification was performed in the boundary of the Portuguese DSO. Some of the requirements were already fulfilled and others were not. A Failure Tree was produced and a Risk Analysis for all the assets and procedures was practised. This working example identifies the potential benefits on implementing the PAS 55 specification, in terms of risk asset management. It demonstrated how this PAS 55 specification can be implemented in the rest of the company, with clear benefits of transversal harmonization of procedure between units and cost saving in the asset risk management.

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