Managing Risk In Transmission System With Implemented Service Oriented Arhitecture

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Abstract –**The purpose of the paper is to analyze power system disruptions, high voltage (HV) equipment condition and to provide a methodology for their interception and risk reduction. Risk management in energy companies refers to the analysis, identification and quantification of risk events. Web services and Service Oriented Architecture (SOA) are used for system planning and analysing. Risk planning and identification phase includes database design for defined risks, reasons for their occurrence and consequences of the emergence and proposing responses to address the risks in the energy sector.**

Keywords – **Risk management, risk assessment, transmission power system, web services, SOA**

I. INTRODUCTION

The introduction of ICT and risk management is a particular challenge in the process of energy development. Power system is a complex technological system, composed of a number of components that are subject to uncertainties and disruptions during their lifetime.

Risk Management and assessment, in energy companies, are increasingly used to provide conditions for safe and reliable operation, improve the quality of delivery of electrical energy, to reduce the number of outages and cost of failure removing, to invest in new equipment and to protect the environment (Brown and Humphrey, 2005) and to ensure greater reliability of the energy system (Bilinton, 2001; Schilling 2009). (Sand, 2007).

According to Sand and Hughes (2005), and Hamond [2007] most of the risks in power system, are immeasurable, and the effects on the performance of the company overlap and are difficult to distinguish. Therefore in its research in 2009, Hughes suggested: if the effects of risks overlap, for example effects of construction on safety and security, environment and finance, then more identified risks can be merged into one type of risk - economic risk [8,9].

The starting point in the most of the purposed risk analysis for power system is the perception and identification of risk and its acceptance. The perception of risk means to identify risk category based on its characteristics and the frequency of its occurrence. Aspects that influence the perception of risk (Starr, 1996; Slovic, 1998): uncertainty, voluntary, familiarity with the problem / process, effects on humans and the environment, vulnerabilities, media attention and so on.

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II. USING SOA FOR RISK PLANNING AND ANALYSING

Service Oriented Architecture (SOA), form of distributed system architecture, is a complex software application or set of interrelated and interdependent blocks - services. Service combination creates new applications, offers global network of web services, which will allow construction of a flexible and uniform information system. Application of SOA leads to a reduction in the number of interfaces required to implement the demand functions, simplified interoperability and deployment of institutions that use the services of the information system. The application is used not only within the company but also from the outside users, which need some of the company service [13].

SOA is mostly built using standard web services that are available in industry and commerce. These standards provide greater interoperability and proper care of the "closed" software, specific manufacturers.

For the purpose of risk assessment basic three components SOA model with: service provider, service broker and service consumer is used. Service provider, person or company, provides appropriate agent to implement a service. The agent is nothing but a piece of software or hardware that sends and receives messages, and service is a resource of abstract set of functionalities that are provided with web service requests.

Service requester is a person or company that wants to use the services offered by the web provider. For successful communication:

- service requester also has to use an agent, who usually sends the initial message to the service provider and
- the format of the message and the principle of exchanging information through appropriate specification has to be defined.

To exchange messages between services, WSDL-Web Service Description Language, XML (Extensible Markup Language) and SOAP (Simple Object Access Protocol) are used.

A. Model-View-Controller

For the paper purpose, a model of information system is developed, consisting of user interface, web service and

database. The database consists of the basic parameters of high voltage equipment: Substation on 110, 220 and 400 kV-level, buses, transmission lines and measuring equipment, relay protection and others.

The application is created in Xcode 4.1 using the Model-View-Controller-MVC. MVC is used, if necessary in the future, to add additional modules without disturbing the rest of the code. Model-view-controller (Figure 1) is a software architecture that consists of three parts: model, view and controller.

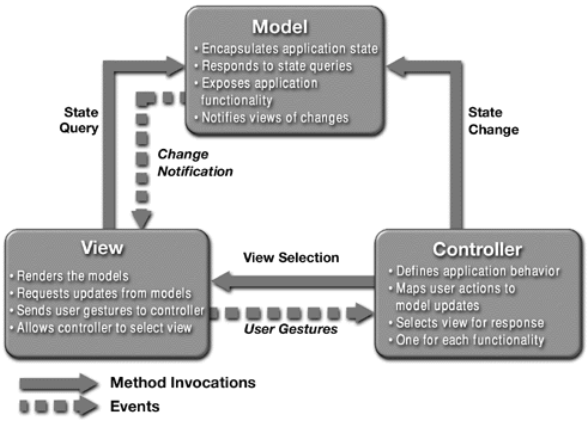

Figure 1. Model-view-controller

Model is the skeleton of the application and may consist of a building or structure of buildings. Its task is to encapsulate data that visually are displayed and edited on View. View acts as a filter with emphasis on application specific, and suppression of other attributes in the model. Since it is attached to the model, in whole or refers to a part of it, View can update the model by sending appropriate messages. Questions and messages sent have to be in the terminology of the model, and View needs to know the semantics of attributes that represent the model. Controller defines the logic of the first two parts of the application. In this way the separation of responsibilities can develop an application that would be easy to design, implement and maintain. MVC pattern means that Interface Builder does not require code to be written or generated as we focus exclusively on the layout of the application.

B. Data base

The application is developed in NetBeans IDE 7.3- open source, which provides reliable and flexible application architecture. Derby - open source generator databases (Java DB) is fully implemented and created in Java environment and ensures data integrity and transmission security. To develop database first entities are identified, its attributes and relationships between entities (Fig.2). Entity is an object or process that we want to store information for. In our case entity is one of the basic elements of the transmission system - substations of 110, 220 and 400kV-level, transmission overhead and cable lines, high voltage equipment: switches, disconnectors, instrument transformers, surge arresters, insulators and other accessories and possible errors that occur in equipment. A relationship captures how entities are related to one another. Entity or relationship has its own attributes - unique characters refer to the appropriate entity.

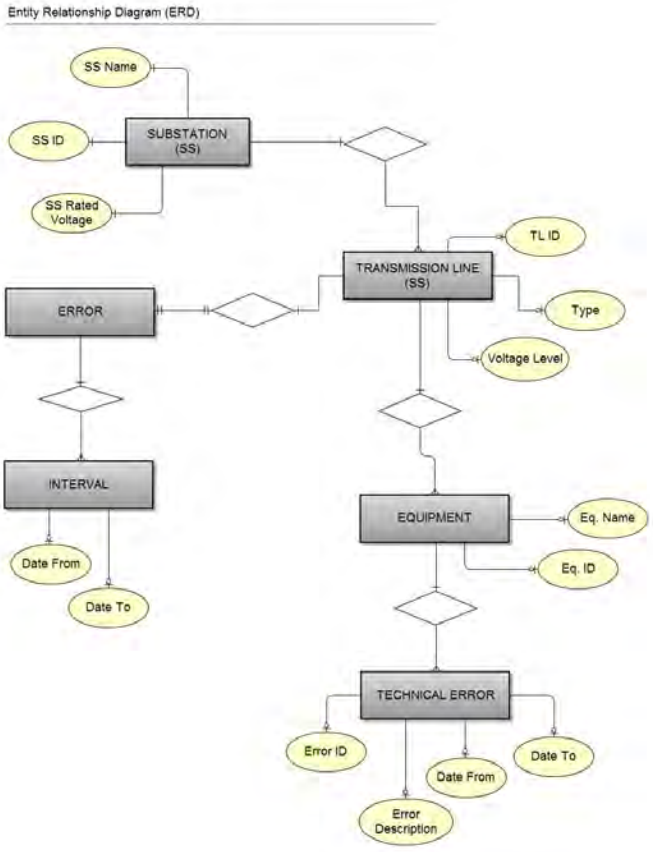

Figure 2. Entity–relationship model (ER model)

C. Users

Possible scenarios of service users of the transmission system operator will depend on their requirements and granted privileges. Two kind of service users are defined in the application-administrator and outside users. Basic scenarios are identified according to the process planning, investment and development of the power system. Possible scenarios related to administrators and other users are: providing information from multiple departments within the company or sources of information related to the external environment; calling other scripts or iterative reference to one or more scenarios, coordinating the work of the department or supporting specific requirements of a particular institution.

III. Risk and Risk Management

What is risk and what are the effects of the risk in power system?

Usually risk can be defined as uncertain event or condition of the system, which if occur, may affect the project parameters - cost, time and quality (Kaplan, 1997). The term "event" can also be found in the literature of ISO Guide 73,

where the term is used to describe a particular cause of error, unintended damage or desired state of system, project or company. For system failures or uncertain events, in the terminology of the standard ISO / IEC 27005, is used the term "threat". According to the standard, the threat is not necessarily a reason to risk but only a definition or determination of the topology of possible risks [4,5].

In the field of information systems term threat is replaced with vulnerability or vulnerability of the system. Vulnerability is a characteristic of information systems that are subject to certain threats or vulnerability can be seen as a lack or failure of the system in terms of safety and security, because of the influence of a threat or attack on the system.

Risk causes in a project or system are known or unknown. Usually known risks can be identified and analyzed and then risk response and future directions are planned, for removing or reducing the consequences. The process of eliminating or preventing unknown risks is a little bit more complicated and only instruction for risk mitigation can be done [1].

How often risk events occur? The risk may occur only once or may have multiple events depending on project or system environment condition, lack of knowledge of the system, lack of experience in the field of risk management, the application of new technology in the process, identity theft, disorganization, accident, adverse weather conditions or natural disasters, etc..

What are the consequences?

Even though we treat the risk like an unwanted event, failure, hazard or vulnerability not always the effect is negative. Risk consequences can lead to a positive outcome or chance with little inventiveness and diversion [6,7].

Risk nature may be material or immaterial and can cause changes in the function of the component (power line, power transformer, bus, switch..) or system or the effects are impact on the management, the customers, the cost of repairing the failure equipment, the fact of the importance of the entity for the proper functioning of the process and so on [3].

IV. Risk ranking

Risk management process is performed on data from Derby database. SOA application has defined service for analizing and statistical evaluation of the historical data form the Transmission operator. This data contain information for planned and unplanned events in HV facilitates for two periods: 2004-2007 and 2010-2012. There is no available data for the period 2008- 2009 [11].

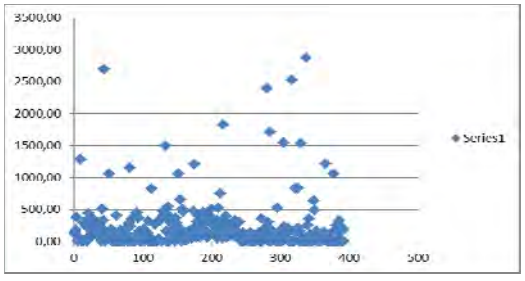

Figure 3. Failure data for the HV equipment

The number of register events in mention years, are concerning HV power transformers, current and voltage transformers, HV bus bars, power lines etc. Almost 400 events are analyzed and evaluated (fig.3 and 4). Most of them are with duration from 200-1000 minutes, and around 100 events have duration less than 20 minutes, but are ranked like events that have severity more than 5 times in year with minor effect.

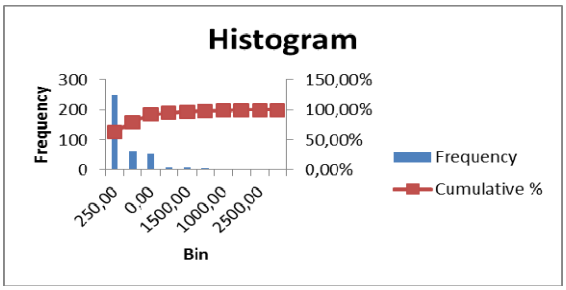

Figure 4. Cumulative frequency for the failure data

TABLE I
RISK SCORE FOR SPECIFIC EQUIPMENT FAILURE

Equipment	Number of Outage	Risk score (0-3)
Transformers 400/110	40	1
Transformers 220/110	18	0
Transformers 110/x	70	2
Circuit Breakers	80	2
Disconnections	12	1
Power lines	120	1
Current and voltage TR	48	1
Surge arrester	15	1
Protection system	70	1
Control system	20	1

Risk ranking (Tabela 1) is performed on severity, occurrence and detection of failure events. Failures are classified in few groups, depending of the consequence and form risk matrix (fig.5). First group are not critical events, with high severity and short failure, the second group are events that cause interruption of the normal component functioning but are still not critical events for the system and the last group are events that have high impact on the system functioning and human safety but have small severity and occurrence [2].

During the development of Risk management for the HV facility, the most critical is the interest of the stakeholder to assess and mitigate the risk. Stakeholders are all subjects (not only investors) that could be affected by the project and also

interested groups and associations. So, the technical risk assessment should be oriented towards the mission of the project, stakeholders and project parameters. Exploitation of the plant is already included in the project parameters time, costs and quality.

V. CONCLUSION

In small countries like Macedonia, Risk management is not risk treatment oriented. Short lasting failures are not taken for serious. If failure occurs in system or component, maintain action is performed, maybe new equipment is installed but the costs are covered by insurance company. That is way this kind of failures are not so important for system planning. Usually, system planning and analyzing are based only on N-1 criteria, maintaining voltage and frequency level and long power supply interruptions. Risk matrix is very helpful tool in planning the new HV facility and also concurrent projects in a power system.

The aim of this paper is to identify relevant sources of risk and to pinpoint undesired events that might origin from these sources. Input to this can be:

- Expert knowledge,
- Results from inspections,
- Data from databases,
- Results from previous analyses.

Experience shows that only limited information can be found in statistical databases related to the analysis of intangible risks (due to the fact that the information simply does not exist), and previous analyses are also few in numbers. Expert judgment and results from inspections will hence often be the best available sources for identifying undesired events.

That is the reason why the project companies should start immediately with a standardized database convenient for risk mitigation and risk response planning. Furthermore, such documentation as it is Risk register should be encouraged by the legal policies and public associations dealing with the business in power engineering environment.

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