

EFFECTS OF ENVIRONMENTAL CONDITIONS TO ONLINE PROCESS AND RISK MONITORING OF POWER SYSTEMS

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Risk based analysis methodology, for a power system that uses the event tree and fault tree models development, processing and quantification approach, is widely spread in the industrial research.

The developed model, for a power system, includes events associated to the specific components. The actual risk evaluation studies suppose some steps that are almost knew by PSA specialists.

This paper will presents the specific method and technique to specify the effects of environmental conditions to the operation and availability of power systems and also the influence of abnormal environmental conditions to the risk level of an power system based on combination of a specific PSA model with a fault events transmission and processing equipment that permits the rapid collection/acquisition and processing of data and information by using advanced hardware.

Associated to such models and equipment is a specific software that manages and processes the information, acting as an interface between models, data, information and hardware. The abnormal environmental conditions are monitored online by means of the data acquisition equipment.

The technique is adequate for application in multiple industrial systems. The method could be used for reliability, safety and availability determination, for a specific system, power plant or installation, and also the method and technique could be used for process monitoring and evaluation.

Keywords: risk, environment, online, probabilistic, monitor.

1. Introduction

The evaluation of operational risk to the industrial objectives is a common task that uses the probabilistic analysis technique and methodology.

Data acquisition process is a continuous and consuming time process. A risk monitor for an installation or system is a good tool but the important lacks of such a device are data acquisition and model updating.

To make a risk monitor is necessary to use event trees and fault trees methodology (PSA technique). To process such models specific computer codes to process the system models are necessary.

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In such models the effects of environmental conditions could also be incorporated either as initiated events or by the effect of environmental parameters to the SSCs operation.

2. The Method Of Analysis

For some installation specialists like operators, shift chiefs or operation managers is important to take rapid decisions in case of a component failure. The evaluation of risk associated to environmental conditions effects is very important in such case to help decision taking.

2.1 Resources that could be reduced or optimization using the new technique for data acquisition

The resources that could be reduced by using the new technique for data acquisition are:

- *Time for data acquisition, processing, transfer and implementation;*
- *Time to take decision;*
- *Cost of the overall activities.*

Specific overall model's optimizations could also be done.

2.2 Situations recommended for such technique implementation

There are installations or industrial systems with undesired consequences in case of accident (or initiating events). In stress conditions, the time to take correct decisions is difficult to be low. By taking automatically the data this situation changes. Also by a such technique of data acquisition the configuration of the system could be changed as desired, depending of the operational state of the system or of the environmental parameters, and specific data for system's components could be used.

2.3 Solutions that were implemented in order to solve the above negative aspects

To reach such technique and to make it functional the following new modifications were implemented:

- *Installation updating to permit monitoring of component's states (the major modification is the installation of sensors for monitoring of the component's states or the system's process or failure parameters);*
- *Specific data transmission, acquisition and processing in order to permit data use in installation modeling;*

- Updated fault tree and event tree models to permit reconfiguration of them in case of system reconfiguration (in case of components failure);
- System reconfiguration presentation by use of interactive system schematic;
- Specific software to link all the technique pieces.

2.4 Installation modification

The installation or the system will be modified to permit the montage of the sensors. So there is different type of sensors, depending of the installation's components (see figure 1 below).

- For valves with the failure modes – fail open, fail closed - the sensors are contact switches;
- For pressure relief valves the sensors could be pressure sensors and especially differential pressure sensors (to compare the pressure inside the circuit and outside the circuit);
- For pumps the sensors could be pressure sensors;
- For electrical motors the sensors could be electrical sensors.
- etc.

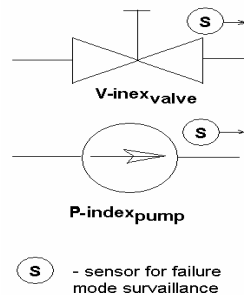


Figure 1 – Installation modification to permit automatic data acquisition

2.5 Specific data transmission, acquisition and processing in order to permit data use in installation modeling

Data from sensors is processed and transmitted to the system models to be included for processing of these models. By such sensors could also be monitored the environmental parameters as temperatures, pressures, humidity.

Anyhow data exist for model processing, from specific or generic databases, but by new data acquisition the old data will be updated and will be more specific to the analyzed installation or system.

Figure 2 below shows the method's steps.

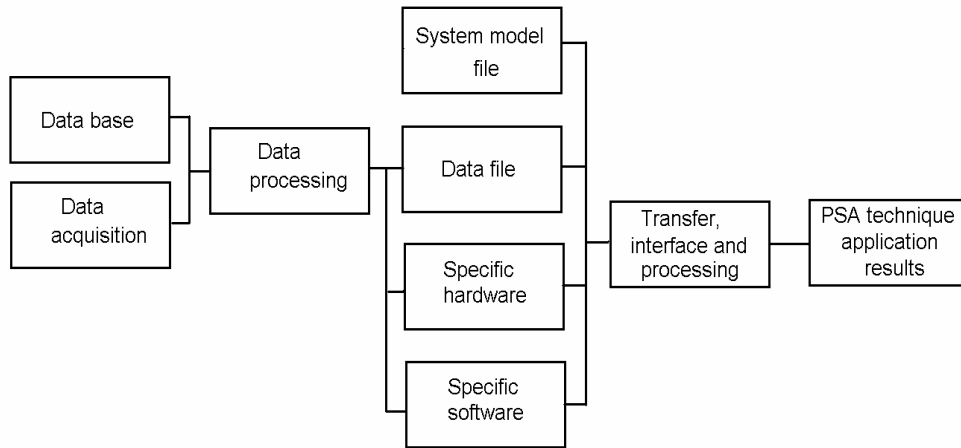


Figure 2 – The steps of the analyzing method

2.6 Fault tree changing to permit automatic data interfacing

Fault tree changing will be done so to permit data to modify or interact with the fault tree.

Switch events are the best solution that could be included in the fault tree. Such options that include switch events automatic transfer is useful for dynamic fault tree structure. Figure 3 below indicates how a switch gate will manage the input events.

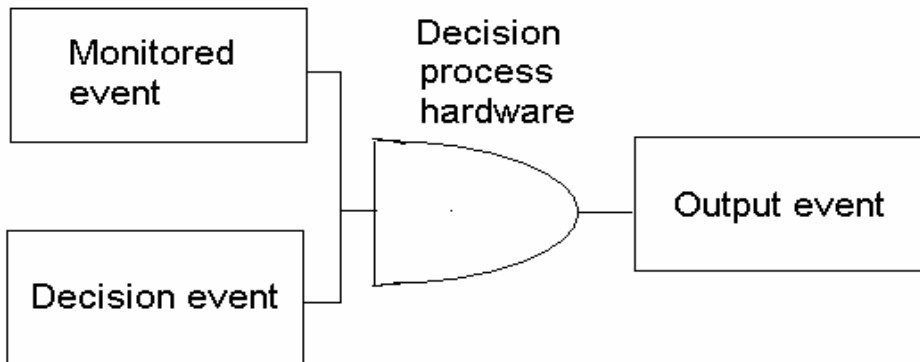


Figure 3 – Modification of the fault tree logic to permit online risk monitoring

2.7 Indication of system reconfiguration

The possibility to present the new system configuration (*or the reconfiguration of the system*) consists of an interactive image or schematic of the system where the component state could be modified directly after some system's components failures.

2.8 Appropriate software that permits the link of all technique's pieces

The appropriate software has to be capable to link all the technique pieces.

The characteristics for such software permit:

- *Developing, editing, modifying and processing of systems models;*
- *Data acquisition and processing;*
- *Results processing;*
- *System schematic interaction with data from components.*

2.9 Appropriate hardware that permits the link of all technique's pieces

The appropriate hardware that permits the link of all technique's pieces consists of:

- *Computer;*
- *Data acquisition card;*
- *Support equipment;*
- *Sensors.*

Figure 4 below shows also the components of the data acquisition and processing system.

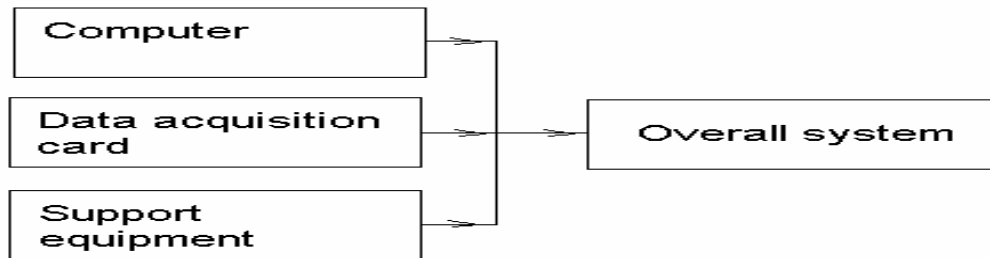


Figure 4 – Specific hardware components used for method applying

2.10 Advantages of this method

This technique has the following important advantages:

- *Data collection by an automatic process eliminating the human errors;*

- *Rapid risk evaluation that permits use of results to taking decision.*
- *Automatic process by passing the control/decision to the data processing hardware/software.*

3.0 CONCLUSIONS

PSA studies to be credible must have specific system's models and more specific reliability data and parameters.

The original data acquisition, transfer and processing method eliminate the subjective situation when some data are not included in database or in the data selection process for the analyzed case.

The paper presents an experimental and analytical (probabilistic) method that permits evaluation and modeling of ISSCs and solves many problems of data acquisition uncertainties by adopting appropriate analyzing techniques.

The method is stated for special applications and is based on specific PSA analysis steps, information, algorithms, criteria and relations, in correspondence with the fault tree/event tree modeling and similar techniques, in order to obtain appropriate results for ISSC model analysis.

As special application the method permits also monitoring and integration for analysis of the environmental parameters.

The risk monitor become a technique (in fact an equipment) than a study or method of analysis and is specific to an certain installation or system.

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