Safety Issues of Power Grid Construction Simulation Research Based on Qsim Algorithm*

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ABSTRACT: Power grid security is of great significance for social stability. In this paper, the relationship of safety issues of power grid construction is analyzed. According to the association between safety issues of power grid construction, constraints and inference rules of qualitative simulation are set, and safety issues of power grid construction are analyzed by QSIM algorithm for qualitative simulation. The actual results are consistent with the actuality, so this study is significant to control and management of the power grid safety.

1. INTRODUCTION

Rigid electricity demand makes the study of security issues of power grid extremely important. And Safety Issues of Power Grid Construction is a most important part security issues of power grid. So how a power company manages and controls safety issues in the process of power grid construction by controlling its own internal is the focus of this study. Meanwhile, with the "Three Intensive Management and Five Systems"(or called 3IM5S) ideological system proposed, it raises new demands for management and control of security issues of power grid construction. 3IM5S emphasizes intensification and flat through the power grid company management, at the same time, it also stresses the "BIG" of the thinking during the power grid company operating.

Based on the ideological background, controls and management of security issues should adapt to this new rhythm, with the "Big Security" thinking establishing. In this paper, to identify key points of security controls, the study will be on the basis of QSIM algorithm to simulate power grid security issues for the mutual impacts on risk points in the overall system.

QSIM algorithm is one of algorithms with the highest recognition in the qualitative simulation process. Since 1986 Benjamin Kuipers has proposed this algorithm, many researchers have done a lot researches in this direction. For example, Thomas Hinrichs, etc. applies QSIM algorithm on the study of the use of allocation of military system resources. To study the social
public opinion system, Yijun Liu, etc. uses QSIM algorithm on the 2003 SARS event simulation study; Chuanliang Jia, etc. discusses on internal synergies of early warning systems, and uses QSIM algorithm for simulating early warning systems in general.

Security issues of power grid construction get the attention of many scholars: Jiang Yin notes that major problems of safety management during the expansion of the power grid construction; Zhijun Xu explains how to keep a successful safety supervision in the process of construction, which is based on the practice of safety supervision of power grid construction; Weiqiang Chen takes an actual safety management of a power supply bureau for instance, exploring the security management issues of power grid construction of power enterprises.

To sum up, many scholars give high attention to security issues of power grid, but most of them are stuck in the aspects of subjectively qualitative description. Under the 3IM5S ideological background, systematic idea of "Big Security" becomes a new trend in security and control of power grid. In this paper, QSIM simulation method will be applied to the study of safety issues of power grid construction, and it’s significant to systematically and coordinated manage and control safety issues on power grid construction.

2. INTERNAL ASSOCIATION ANALYSIS ON THE SECURITY ISSUE OF POWER GRID CONSTRUCTION

According to the researches, the main security issues that the power company faces in the process of power grid construction are shown in the Figure 1. We analyze the above security issues and build a comprehensive model of internal causal relationship of safety issues of power grid construction, combining the actual situation of the power grid operation.

![Figure 1. Internal Relationship of Safety Issues of Power Grid Construction.](image)

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In Figure 1, sign "+" indicates that increases on the variable in the tail of the arrow will lead to increases on the variable in the head of the arrow and this is a positive correlation between the two. Sign "-" indicates that increases on the variable in the tail of the arrow will lead to diminishes on the variable in the head of the arrow. For example, if the power company carries out strict bidding for projects before the project starts, it will reduce supplies risks.

In Figure 1, most of safety issues of the power grid construction are difficult to quantitatively describe. So in order to facilitate the further study on the interaction relationship between security issues of the power grids construction, we select QSIM algorithm to qualitatively simulate the simulation system in this paper. Within this system, the object is to find out how changes of one of the link state will impact on other parts as well as the level of risk of power grid construction itself.

In order to facilitate the simulation analysis later, parametric variables in Figure 1 will be represented by letters: $X_1$ denotes power grid planning; $X_2$ represents power grid construction tender management; $X_3$ means the demolition hazards of power grid project; $X_4$ represents construction material supply risks; $X_5$ denotes project contracting and out-contracting risks; $X_6$ indicates poor management of construction funds; $X_7$ represents schedule delays; $X_8$ means regulators system; $X_9$ represents risks of social public opinion; $X_{10}$ denotes risks of project construction; $X_{11}$ represents the level of risk of power grid construction. Interaction (promote or restraint) of parametric variables above is reflected on the Figure 1. In order to find out which parametric variable is the focus of the control of safety in power grid construction, we will use QSIM algorithm to simulation analysis next.

3. QSIM QUALITATIVE SIMULATION ALGORITHM

QSIM (Qualitative SIMulation) was put forward in 1986 by Benjamin Kuipers. This algorithm is derived through rigorously calculus reasoning.

3.1 Define the State of Parametric Variables

In QSIM, the definition of a parametric variable state at a certain point in time includes its landmark value and the change direction of the parametric variable:

$$QS(X_j, t) = (qval(X_j, t), qdir(X_j, t))$$  \hspace{1cm} (1)$$

In formula (1), $QS(X_j, t)$ represents that state of parametric variable $X_j$ when the time is $t$. 
moment, consisting of the landmark value $qval(X_j, t) \in \{-2, -1, 0, 1, 2\}$ and the change direction $qdir(X_j, t) \in \{dec, std, inc\}$, in this article.

3.2 Define Parametric State Transitions

Conversion process of parametric variables can be divided into P transition and I transition according to Benjamin Kuipers’ description of the state transition in his article Qualitative SIMmulation in 1986. Definition of General Function State Transitions Table is as follows:

<table>
<thead>
<tr>
<th>$P$ Transitions: $QS(f, t_i) \rightarrow QS(f, t_i, t_{i+1})$</th>
<th>$I$ Transitions: $QS(f, t_{i-1}, t_i) \rightarrow QS(f, t_i)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_1$ $&lt; l_j, std &gt; \rightarrow &lt; l_j, std &gt;$</td>
<td>$I_1$ $&lt; l_j, std &gt; \rightarrow &lt; l_j, std &gt;$</td>
</tr>
<tr>
<td>$P_2$ $&lt; l_j, std &gt; \rightarrow &lt; (l_j, l_{j+1}), inc &gt;$</td>
<td>$I_2$ $&lt; (l_j, l_{j+1}), inc &gt; \rightarrow &lt; l_{j+1}, std &gt;$</td>
</tr>
<tr>
<td>$P_3$ $&lt; l_j, std &gt; \rightarrow &lt; (l_{j-1}, l_j), dec &gt;$</td>
<td>$I_3$ $&lt; (l_j, l_{j+1}), inc &gt; \rightarrow &lt; l_{j+1}, inc &gt;$</td>
</tr>
<tr>
<td>$P_4$ $&lt; l_j, inc &gt; \rightarrow &lt; (l_j, l_{j+1}), inc &gt;$</td>
<td>$I_4$ $&lt; (l_j, l_{j+1}), inc &gt; \rightarrow &lt; (l_j, l_{j+1}), inc &gt;$</td>
</tr>
<tr>
<td>$P_5$ $&lt; (l_j, l_{j+1}), inc &gt; \rightarrow &lt; (l_j, l_{j+1}), inc &gt;$</td>
<td>$I_5$ $&lt; (l_j, l_{j+1}), dec &gt; \rightarrow &lt; l_j, std &gt;$</td>
</tr>
<tr>
<td>$P_6$ $&lt; l_j, dec &gt; \rightarrow &lt; (l_{j-1}, l_{j}), dec &gt;$</td>
<td>$I_6$ $&lt; (l_j, l_{j+1}), dec &gt; \rightarrow &lt; l_j, dec &gt;$</td>
</tr>
<tr>
<td>$P_7$ $&lt; (l_j, l_{j+1}), dec &gt; \rightarrow &lt; (l_j, l_{j+1}), dec &gt;$</td>
<td>$I_7$ $&lt; (l_j, l_{j+1}), dec &gt; \rightarrow &lt; (l_j, l_{j+1}), dec &gt;$</td>
</tr>
<tr>
<td>$P_8$ $&lt; (l_j, l_{j+1}), inc &gt; \rightarrow &lt; l_j, std &gt;$</td>
<td>$I_8$ $&lt; (l_j, l_{j+1}), inc &gt; \rightarrow &lt; l_j, std &gt;$</td>
</tr>
<tr>
<td>$P_9$ $&lt; (l_j, l_{j+1}), dec &gt; \rightarrow &lt; l_j, std &gt;$</td>
<td>$I_9$ $&lt; (l_j, l_{j+1}), dec &gt; \rightarrow &lt; l_j, std &gt;$</td>
</tr>
</tbody>
</table>

3.3 Define The Constraint Relationships

Benjamin Kuipers defines the constraint relationships of parametric variables, which includes ADD, MINUS, MULT, DERIV, $M^+$, $M^-$. The main object in this paper is security issues of power grid construction and the relationships between parametric variables which can be seen from Figure 1 mainly are single increase and single reduction. The constraint relationships between parametric variables can be defined according to Figure 1 as follows:

\[\text{Kuipers B. Qualitative Simulation [J]. Artificial Intelligence, 1986, 29(86): 300}\]
Table 2. Power Grid Construction Safety System Constraint Relationships between the Variables.

<table>
<thead>
<tr>
<th>variable</th>
<th>$X_1$</th>
<th>$X_2$</th>
<th>$X_3$</th>
<th>$X_4$</th>
<th>$X_5$</th>
<th>$X_6$</th>
<th>$X_7$</th>
<th>$X_8$</th>
<th>$X_9$</th>
<th>$X_{10}$</th>
<th>$X_{11}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_1$</td>
<td>0</td>
<td>-</td>
<td>+</td>
<td></td>
<td>-</td>
<td>-</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_2$</td>
<td>0</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_3$</td>
<td>0</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_4$</td>
<td>0</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$X_5$</td>
<td>0</td>
<td></td>
<td>0</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_6$</td>
<td>0</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_7$</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_8$</td>
<td></td>
<td>-</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_9$</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{10}$</td>
<td></td>
<td></td>
<td>+</td>
<td>0</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$X_{11}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

In Table 2, sign \{-, 0, +\} represents that a change of the variable in the vertical axis causes the changes of the variable in the horizontal axis. Sign \(-\) indicates monotonically decreasing relationship, sign \(+\) represents a monotonically increasing relationship, and zero or blank denotes that their relationship is not strong and can be ignored.

4. THE ACTUAL SIMULATION

Parametric variables in complex systems on the power grid construction safety issues are generally analyzed, combining the actual situation of power grid. According simulation steps of QSIM algorithm, the actual simulation is following:

Exhaustive simulation process is as follows:

1. The initial states of each parametric variable will be given.

   \[ t = t_0; \]

   \[ QS(X_1, t_0) = \text{inc}, \quad QS(X_2, t_0) = \text{inc}, \quad QS(X_3, t_0) = \text{dec}, \quad QS(X_4, t_0) = \text{inc}, \quad QS(X_5, t_0) = \text{dec}, \quad QS(X_6, t_0) = \text{std}, \quad QS(X_7, t_0) = \text{std}, \quad QS(X_8, t_0) = \text{inc}, \quad QS(X_9, t_0) = \text{std}, \quad QS(X_{10}, t_0) = \text{std}, \quad QS(X_{11}, t_0) = \text{inc} \]

2. According to General Conversion Tables, possible transference of parametric variables will be obtained.
From \( t = t_0 \) to \( t \epsilon(t_0, t_1) \), using P transit is to transfer time point into time interval.

For \( X_1 \): \( QS(X_1, t_0) \rightarrow QS(X_1, t_0, t_1) \)

\( P_1 < 1, \text{std} \rightarrow< 1, \text{std} > \cdot P_2 < 1, \text{std} \rightarrow< (1,2), \text{inc} > \cdot P_3 < 1, \text{std} \rightarrow< (0,1), \text{dec} > \)

For \( X_2 \): \( QS(X_2, t_0) \rightarrow QS(X_2, t_0, t_1) \)

\( P_4 < 0, \text{inc} \rightarrow< (0,1), \text{inc} > \)

For \( X_3 \): \( QS(X_3, t_0) \rightarrow QS(X_3, t_0, t_1) \)

\( P_4 < 0, \text{inc} \rightarrow< (0,1), \text{inc} > \)

For \( X_4 \): \( QS(X_4, t_0) \rightarrow QS(X_4, t_0, t_1) \)

\( P_1 < 0, \text{std} \rightarrow< 0, \text{std} > \cdot P_2 < 0, \text{std} \rightarrow< (0,1), \text{inc} > \cdot P_3 < 0, \text{std} \rightarrow< (-1,0), \text{dec} > \)

For \( X_5 \): \( QS(X_5, t_0) \rightarrow QS(X_5, t_0, t_1) \)

\( P_1 < 0, \text{std} \rightarrow< 0, \text{std} > \cdot P_2 < 0, \text{std} \rightarrow< (0,1), \text{inc} > \cdot P_3 < 0, \text{std} \rightarrow< (-1,0), \text{dec} > \)

For \( X_6 \): \( QS(X_6, t_0) \rightarrow QS(X_6, t_0, t_1) \)

\( P_1 < -1, \text{std} \rightarrow< -1, \text{std} > \cdot P_2 < -1, \text{std} \rightarrow< (-1,0), \text{inc} > \)

\( P_3 < -1, \text{std} \rightarrow< (-2, -1), \text{dec} > \)

For \( X_7 \): \( QS(X_7, t_0) \rightarrow QS(X_7, t_0, t_1) \)

\( P_1 < 0, \text{std} \rightarrow< 0, \text{std} > \cdot P_2 < 0, \text{std} \rightarrow< (0,1), \text{inc} > \cdot P_3 < 0, \text{std} \rightarrow< (-1,0), \text{dec} > \)

For \( X_8 \): \( QS(X_8, t_0) \rightarrow QS(X_8, t_0, t_1) \)

\( P_4 < 0, \text{inc} \rightarrow< (0,1), \text{inc} > \)

For \( X_9 \): \( QS(X_9, t_0) \rightarrow QS(X_9, t_0, t_1) \)

\( P_4 < 0, \text{inc} \rightarrow< (0,1), \text{inc} > \)
For $X_{10}$: $Q(S_{10}, t_0) \rightarrow Q(S_{10}, t_0, t_1)$

$P_1 < 0, std \rightarrow (0,1), inc, P_2 < 0, std \rightarrow (-1,0), dec$

For $X_{11}$: $Q(S_{11}, t_0) \rightarrow Q(S_{11}, t_0, t_1)$

$P_1 < 0, std \rightarrow (0,1), inc, P_2 < 0, std \rightarrow (-1,0), dec$

The above is all successor states of all parametric variables in the $P$ conversion situation. After completing all possible $P$ conversions, let's go to the third step for the filtration.

3. Filtering: this includes constraint consistency filtering and matching consistency filtering.

By verifying whether the relationship between variables after conversion is consistent, the states will be filtered for constraint consistency. Then the matching consistency filtering will be the next.

After filtration above, the variables at the time $t = (t_0, t_1)$ are as follows:

For $X_1$: $Q(S_{11}, t_0) \rightarrow Q(S_{11}, t_0, t_1)$; For $X_2$: $Q(S_{12}, t_0) \rightarrow Q(S_{12}, t_0, t_1)$

For $X_3$: $Q(S_{13}, t_0) \rightarrow Q(S_{13}, t_0, t_1)$; For $X_4$: $Q(S_{14}, t_0) \rightarrow Q(S_{14}, t_0, t_1)$

For $X_5$: $Q(S_{15}, t_0) \rightarrow Q(S_{15}, t_0, t_1)$; For $X_6$: $Q(S_{16}, t_0) \rightarrow Q(S_{16}, t_0, t_1)$

For $X_7$: $Q(S_{17}, t_0) \rightarrow Q(S_{17}, t_0, t_1)$; For $X_8$: $Q(S_{18}, t_0) \rightarrow Q(S_{18}, t_0, t_1)$

For $X_9$: $Q(S_{19}, t_0) \rightarrow Q(S_{19}, t_0, t_1)$; For $X_{10}$: $Q(S_{110}, t_0) \rightarrow Q(S_{110}, t_0, t_1)$

For $X_{11}$: $Q(S_{111}, t_0) \rightarrow Q(S_{111}, t_0, t_1)$; For $X_{12}$: $Q(S_{112}, t_0) \rightarrow Q(S_{112}, t_0, t_1)$

4. I transition is used from $te(t_0, t_1)$ to $t = t_1$, detail is alike step 2, just here is according to I transition table, so omitting.

Similarly, by following constraint filtering rules and pairing consistency rules, possible successor states of each parametric variable above in I transition should be filtered to obtain the simulation results of the following two:

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2The detail of $P_1$ was shown in step 1
In Table 3, the biggest difference between the two simulation results is that variable $X_{11}$ in result 1 is controlled well. The result 2 illustrates that $X_{11}$ is not well controlled. Ostensibly, differences in $X_1$ simulation results directly lead to differences in final $X_{11}$ simulation results when the reason is investigated from the simulation results, but it is not true. This is the result of interaction of each of parametric variables in the process of power grid construction in internal complex systems. Because there is no direct relationship between $X_1$ and $X_{11}$ that illustrates in Figure 1: First, this indicates that the power grid planning plays an importantly significant role in the management and control of grid construction safety as a strategic decision-making in power grid construction; Second, the two are seemed to have no direct relationship, but it illustrates that we should conduct our analysis in the perspective of a systematic thoughts on security issues instead of viewing in isolation during the management and control of security risk, because the variables that show no relationship may have an important impact on the results; Finally, power grid planning is not a part of the power grid construction business links,

<table>
<thead>
<tr>
<th>Result</th>
<th>$t = t_0$</th>
<th>$t = (t_0, t_1)$</th>
<th>$t = t_1$</th>
<th>$t = t_0$</th>
<th>$t = (t_0, t_1)$</th>
<th>$t = t_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_1$</td>
<td>$&lt; 1, \text{std} &gt;$</td>
<td>$&lt; (1,2), \text{inc} &gt;$</td>
<td>$&lt; 2, \text{std} &gt;$</td>
<td>$X_1$</td>
<td>$&lt; 1, \text{std} &gt;$</td>
<td>$&lt; (0,1), \text{dec} &gt;$</td>
</tr>
<tr>
<td>$X_2$</td>
<td>$&lt; 0, \text{inc} &gt;$</td>
<td>$&lt; (0,1), \text{inc} &gt;$</td>
<td>$&lt; 1, \text{inc} &gt;$</td>
<td>$X_2$</td>
<td>$&lt; 0, \text{inc} &gt;$</td>
<td>$&lt; (0,1), \text{inc} &gt;$</td>
</tr>
<tr>
<td>$X_3$</td>
<td>$&lt; 0, \text{inc} &gt;$</td>
<td>$&lt; (0,1), \text{inc} &gt;$</td>
<td>$&lt; 1, \text{inc} &gt;$</td>
<td>$X_3$</td>
<td>$&lt; 0, \text{inc} &gt;$</td>
<td>$&lt; (0,1), \text{inc} &gt;$</td>
</tr>
<tr>
<td>$X_4$</td>
<td>$&lt; 0, \text{std} &gt;$</td>
<td>$&lt; (-1,0), \text{dec} &gt;$</td>
<td>$&lt; -1, \text{dec} &gt;$</td>
<td>$X_4$</td>
<td>$&lt; 0, \text{std} &gt;$</td>
<td>$&lt; (-1,0), \text{dec} &gt;$</td>
</tr>
<tr>
<td>$X_5$</td>
<td>$&lt; 0, \text{std} &gt;$</td>
<td>$&lt; (-1,0), \text{dec} &gt;$</td>
<td>$&lt; -1, \text{dec} &gt;$</td>
<td>$X_5$</td>
<td>$&lt; 0, \text{std} &gt;$</td>
<td>$&lt; (-1,0), \text{dec} &gt;$</td>
</tr>
<tr>
<td>$X_6$</td>
<td>$&lt; -1, \text{std} &gt;$</td>
<td>$&lt; (-2,-1), \text{dec} &gt;$</td>
<td>$&lt; -2, \text{std} &gt;$</td>
<td>$X_6$</td>
<td>$&lt; -1, \text{std} &gt;$</td>
<td>$&lt; (-2,-1), \text{dec} &gt;$</td>
</tr>
<tr>
<td>$X_7$</td>
<td>$&lt; 0, \text{std} &gt;$</td>
<td>$&lt; (-1,0), \text{dec} &gt;$</td>
<td>$&lt; -1, \text{dec} &gt;$</td>
<td>$X_7$</td>
<td>$&lt; 0, \text{std} &gt;$</td>
<td>$&lt; (-1,0), \text{dec} &gt;$</td>
</tr>
<tr>
<td>$X_8$</td>
<td>$&lt; 0, \text{inc} &gt;$</td>
<td>$&lt; (0,1), \text{inc} &gt;$</td>
<td>$&lt; 1, \text{inc} &gt;$</td>
<td>$X_8$</td>
<td>$&lt; 0, \text{inc} &gt;$</td>
<td>$&lt; (0,1), \text{inc} &gt;$</td>
</tr>
<tr>
<td>$X_9$</td>
<td>$&lt; 0, \text{inc} &gt;$</td>
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<td>$&lt; 1, \text{inc} &gt;$</td>
<td>$X_9$</td>
<td>$&lt; 0, \text{inc} &gt;$</td>
<td>$&lt; (0,1), \text{inc} &gt;$</td>
</tr>
<tr>
<td>$X_{10}$</td>
<td>$&lt; 0, \text{std} &gt;$</td>
<td>$&lt; (-1,0), \text{dec} &gt;$</td>
<td>$&lt; -1, \text{dec} &gt;$</td>
<td>$X_{10}$</td>
<td>$&lt; 0, \text{std} &gt;$</td>
<td>$&lt; (-1,0), \text{dec} &gt;$</td>
</tr>
<tr>
<td>$X_{11}$</td>
<td>$&lt; 0, \text{std} &gt;$</td>
<td>$&lt; (-1,0), \text{dec} &gt;$</td>
<td>$&lt; -1, \text{dec} &gt;$</td>
<td>$X_{11}$</td>
<td>$&lt; 0, \text{std} &gt;$</td>
<td>$&lt; (0,1), \text{inc} &gt;$</td>
</tr>
</tbody>
</table>
but it not only brings an important impact on safety risk assessment, but also shows that we should focus on both the horizontal associated analysis of risk and vertical association analysis of mutual influence between risks of the power grid business.

5. SUMMARY

In this paper, safety issues of power grid construction are qualitative studied by QSIM algorithm to solve issues about associated simulation of power grid construction safety in case of insufficient quantitative data. From the analysis results, we can figure out the importance of treating the problem systemically in the process of security issues analysis. Further considering, the description of the associated relationship of the risks in this paper merely stays on the qualitative stage, and it should be joined the quantitative description in the relationship in the subsequent studies. In addition, variables that influence each other should be added some efficiency parameters, such as time, so that simulation results will be more accurate.

REFERENCE


