DOI: 10.53469/jtpes.2023.03(09).07

# Analysis of Common Problems and Improvement Measures of Pressure Pipeline Inspection

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**Abstract:** ***The recent pressure pipeline reform and China's opening to the outside world have become catalysts for further economic and social development. The oil fields in the northeast and the pure water projects in the southwest have benefited the residents, however, due to the working pressure problems in the pipeline transportation, which are caused by the corrosion of the pipeline materials and the various problems arising from the operation of the pipeline, resulting in long-term safety problems. Therefore, the importance of checking pipeline pressure cannot be missed. In order to ensure the safety of China's natural gas pipelines under pressure, we need to concentrate on analyzing various existing problems and quickly find solutions.***

**Keywords:** pressure pipeline; Inspection problem; discuss.

In order to extend the life of the pressure pipeline, the operator should pay attention to the problems in the work, and carry out regular inspection and maintenance. During testing, the operator should focus on checking and diagnosing the quality of the pressure hose in the pressure line and the presence of faults. However, during the operation of pressure in linear pressure pipelines, many uncertainties and the possibility of quality problems increase the complexity of the verification process. In addition, field inspectors rarely notice problems in the work and are not aware of many inspection problems, which makes it difficult to obtain high quality and expected high quality results. Operators are encouraged to describe standards for regular inspection of specific equipment and to provide solutions to common problems. With the development of 4G and 5G mobile communication technology, using mobile phone to pay for goods and services has become a very popular application. The traditional forms of payment cannot be applied in e-commerce environment. This paper employs model checking method to verify the security and reliability of the Environment Information Systems. A PROMELA model for the System is present. As an important part of the modeling methodology, the Environment Information System is translated into a simpler model that nevertheless preserves all the essential behavior to be verified. It also proposes initial results on the actual verification of the Environment Information System using SPIN. The result of this work is a complete procedure for the modeling and verification of the Environment Information System.

## 1. ANALYSIS OF PRESSURE PIPELINE

In recent years with the rapid development of 4G and 5G mobile communication technology, making the 4G/5G era has quietly penetrated into people's lives and work in various fields. In the traditional business activities, the payment process is mainly classified in paper forms, such as bill payments and cash payments. The traditional forms of payment cannot be applied to the e-commerce environment. The reasons are as following: the traditional payment cannot be binding and monitor between the participants of the transaction. Quality of the goods, transaction integrity, and requirements of return and replacement cannot be reliable guarantee. The Financial Institutions focuses these days to move all payment forms (i.e. transfers, deals, purchases, and bill payments) to electronic form instead of paper form. Recently the mobile has become an essential tool for commerce and financial services. With the help of new communication and information technologies, these services have experienced tremendous growth.

It is convenient for people to use Environment Information System s in transactions. Mobile phone payment application mode is not a single technology, which requires more extensive and powerful system to do the support. In addition, it also need to telecom operators, commercial banks and card associations, third-party service providers to jointly build a Environment Information System. Mentioned above, the mobile phone payment system, in the final analysis, are based on the mobile phone payment platform. Because the Mobile Payments are related to both capital flows and goods flows, higher security and reliability is required for the transaction process. In mobile payments, participants may use communication protocols for which there are no transactional variants and the

programs may be deployed in very heterogeneous application environments. For these reasons, Environment Information System s cannot rely on traditional transaction mechanisms [1]. The research on mobile payment agreements has been the focus of financial payment system in recent years. But there are not many related works to verify the logic and design of business processes during the mobile payment to ensure the safety and reliability of the systems. This paper discusses how to employ SPIN [5, 6, 7], one of the most powerful and well-known model checking tools, in order to specify and analyze the correctness of protocols for Environment Information Systems. Different from Europe and other developed countries, in the area of cross-border e-commerce, there are many trade rules are not made, Henan Provinces should grasp this opportunity to attract more cross-border e-commerce giants, and make sure the local e-commerce enterprises can grow in good atmosphere. At the same time, we should use the "The Belt and Road" strategy as an opportunity to strengthen exchanges with countries along, and enhancing the influence in the e-commerce trade, lay down the material basis and guarantee for the formulation of new rules for cross-border e-commerce business in the new era, strengthen the power of right to speak when making the rules and regulations of cross- board e-commerce with BRICS countries.

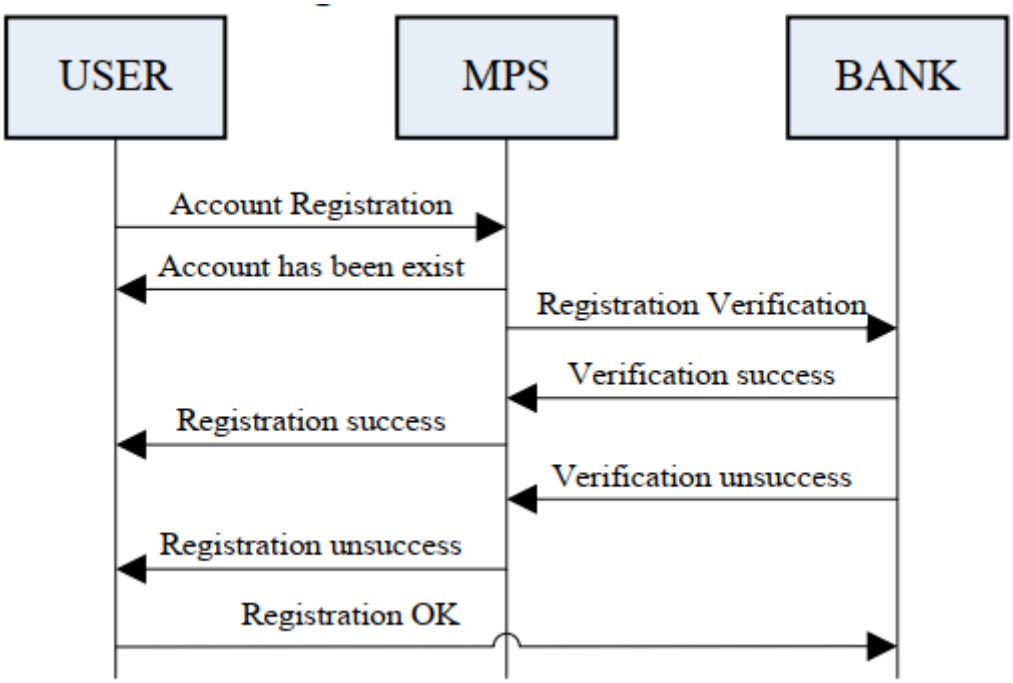


**Figure 1:** Account Registration in Environment Information System s

### 1.1 Characteristics of pressure pipeline

First, the pressure line is an integrated system. The internal components of the system are interdependent and interact with each other, and even small changes and instabilities can affect the overall performance of the pressure line. And it's easy to see why pressure lines are an important part of the system. Second, pressure hoses are usually used in large transportation pipelines, so they are usually longer in length and have more difficult pulling conditions than traditional pipe pressure vessels. Third, there are many kinds of accessories and materials, which constitute the complexity and advanced technical requirements of the pressure pipeline process. It also enables multiple bearings filtered in the pipeline pressure to drive the medium to its longer length and other characteristics under a certain pressure, and there is no place where it can be easily filtered. Finally, pressure piping includes not only multiple types of materials, but also various types of piping with a large number of pipes, managing various projects and validation processes with more complex processes and conditions.

### 1.2 The importance of regular maintenance and inspection of pressure pipelines

Heavy rain often carries dangerous corrosive liquids under normal conditions, and the pressure line is kept at a certain pressure and temperature during transportation, which can be hazardous. For example, in the case of relatively dry pipelines, which are usually under high pressure, the oil and gas in the pipelines may be exposed to a large amount of gas in a short time due to high temperature, leading to an explosion, which will lead to a large

amount of leakage, thus causing a larger explosion. Without regular inspection and maintenance, these conditions are not only time-consuming, but also a source of pollution to the natural environment, a constant threat to human lives and a loss of national resources. So recognize that periodically importance of maintaining and inspecting pressure lines and using scientific and effective management methods to improve monitoring and maintenance and keep them safe. High-tech equipment must be developed to avoid risks and play a skilled role. Pressure pipelines should play a positive role in promoting national development and safeguarding national and people's security [1].

## 2. PROBLEMS EXISTING IN PRESSURE PIPELINE INSPECTION

As theoretic background, we introduce some frameworks of the Environment Information System s. Mobile payment is a payment mode through the mobile device (which can be SD cards, foil cards Or SIM card, etc.), in which the bank card information is stored in, and use of mobile phones or radio frequency wireless communication technology to achieve the remote technical paid. There are many types of the mobile payment products, such as GPRS /Client payment mode, STK/SMS payment mode. However, as the promotion of economic development in the BRICS countries and consumption level of the people, the problem will become more severe, Low innovation capability, no major industry chain, which will restrict future Henan Provinces in the further development of cross-border e-commerce.

In this paper, we focus on GPRS /Client payment mode, which are widely used in the Environment Information Systems. The saturation of traditional manufacturing industry market, weakening of investment, capital return and trade protectionism, these negative factors have prompted the industry to upgrade. Benefit from a new round of technological revolution, smart terminal manufacturing has become the core of new industries. However, only one is not enough to support the overall development of the industry. Cross-border e-commerce needs further improving. cooperation with scientific research institutions and improve the technical conversion. Traditional industries such as manufacturing need to be led its online operations. International brand reflects the product's market value and influence (Hu Chen and Xingwei Xie,2015), Henan Provinces lack such big international brands. Meanwhile, the lack of financial support and experience in cross-border trade, which make small enterprises facing difficulties in international cooperation, such as high transaction costs. Therefore, through the development of large data to expand overseas brands, integrate similar advantages in the profit areas, improve the influence and competitiveness of the products within the BRICS countries, and create a lot of first-class enterprises. Using the power of these enterprises to drive development of the small enterprises in Henan, which can form an industry alliance (Jinlong Li,2015). By doing so, we can form a virtuous cycle, achieve the purpose of collaborative innovation.

One whole Environment Information System is composed by a number of transactions. Figure 1 shows the Account Registration transaction of one Environment Information System. This transaction generally involves three participants: Users (USER), MPS (Environment Information System) and the bank (BANK). The general process is as follows:

(1)USER sends a request to register an account to MPS;

(2)MPS determine whether the user has an existing account;

(3)If the USER already has an existing account then returns it to USER;

(4)If the USER has not an existing account; then MPS sends the Verification request to BANK;

(5)If Verification success, BANK sends the message to MPS, and MPS send Registration success message to USER.

(6)USER sends the transaction successful message to BANK (transaction successful);

(7)If Verification is unsuccessful, BANK sends the message to MPS, and MPS send Registration unsuccessful message to USER (transaction failed).

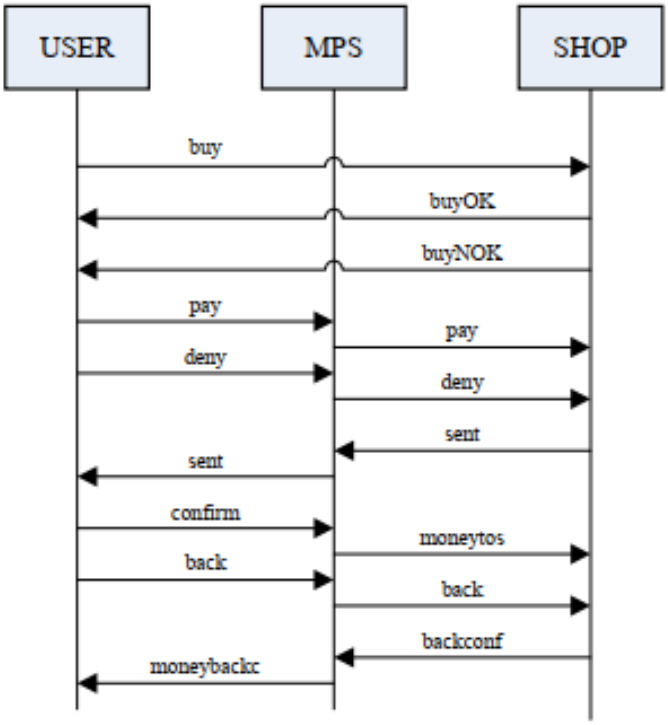


**Figure 2:** Massage flow in core transaction of Environment Information System

### 2.1 Turnover of special equipment safety management personnel

Now, there are concerns about the special equipment of some companies. If these companies have enough money, they will hire more staff to improve productivity. If these companies have little money, it can be expensive to find staff. Large companies must adapt to personnel management, and when a business stops production for inspection, production facilities are closed for further research and maintenance. As a result, it is not possible to notify professional safety management organizations of rapid replacement of pipeline components. Import and export trade in Henan province are mainly concentrated in agriculture, wholesale and retail trade and manufacturing, which has a low added value[12]. Beside smartphone, Henan province exported commodities at the lower end of the chain, mainly concentrated in the resource-based, low technology content and low added value of the product. There is a large gap with the developed area in the export industrial structure, the technological content of products, innovative aspects compared and Exports of large complete sets of equipment and high technology products is far below the national average. Now, the short boards of innovation is not obvious when carry out the cross-board e-commerce with the BRICS.

### 2.2 Design and material selection

"Rules for Technical Supervision of Pipelines - Industrial Pipelines", "Regular Inspection of Insulation of Designed Pipelines" and "Rules for Public Pipelines - Regular inspection of Public Pipelines" recommend that special equipment be used to inspect pressure pipelines when they are in use. Regular maintenance and regular self-inspection should be carried out at least once a month, and the inspection situation should be recorded to timely solve abnormal situations. However, some companies do not provide complete source data on the pressure hoses used for storage, and some companies do not have a record of the operation of the pressure hoses. Pressure fittings (e.g. valves, piping structures, etc.) were selected randomly, improperly constructed, and incorrectly made of materials.

### 2.3 Inspection of safety accessories

Safety devices, such as relief valves and pressure switches, are regulated by law and the tests have been approved to identify and protect pressure lines for the first time. However, the problem is that many companies are not suited to properly test pipelines for pressure and safety and do not evaluate safety products on an irregular basis. They

are not aware of the role of maintenance of protective devices in the pressure pipe, and do not filter out damaged products. They can choose the safety tool of the pressure passage at will, and can replace the quality safety joint regardless of the pressure in the hose [2].

## 3. STRENGTHEN THE COUNTERMEASURES OF IN-SERVICE PRESSURE PIPELINE INSPECTION

Constructing a model for a protocol in PROMELA requires a previous abstraction process of the original source code. Usually, this process eliminates details that are not necessary for debugging purposes. Therefore, models will be as small as possible making sure that they represent the exact details needed for the properties to be analyzed. Judging from the perspective of policy, capital entry and market growth rate, at present, cross-border e- commerce of Henan Province are in the golden period of development, but it is different from the domestic e- commerce, the long supply chain, logistics and the payment have to adjust to the cross-border e-commerce. At the same time, the BRICS have the demand for e- commerce, it will provide a chance for Henan Province cross-border e-commerce. At with the help of policy, it will go through a period of rapid development

Extended Finite State Machine (EFSM) has been the underlying model as formal description for the communications protocol. EFSM model is extended with the finite state machine (FSM) model. Compared with FSM, there are environmental variables and the migration of pre-conditions in EFSM. So EFSM model has a stronger ability to describe the dynamic behavior of the system. For these reasons, we use EFSM to model the process, which is formula in the area of model checking, and also can be described in PROMELA easily. Development of e-commerce has led to the development of the logistics industry. The requirement of cross-board e-commerce is more comprehensive for logistics enterprises, which bring a big challenge for these companies. When developing cross-border e- commerce with the BRICS countries. More types of goods also contributed to the growth of logistics services. That contribute to the formation of a new pattern of coordination and distribution, promoting cross-border e- commerce in bargaining power and achieve scale economic.

In this section we describe the core transaction of the Environment Information System s. Formal modeling is the first and crucial step in model checking. In the formal modeling process, we should ignore the participants which are independent of the desired characteristics of the system. In order to get an accurate model of the Environment Information System, here we only pay attention to the three objects in the core transaction, the users (USER), the shops (SHOP) and the Environment Information System (MPS). We use the notation “A B Message” to indicate that A sends the message to B. The basic protocol consists of the following messages:

(1)USER SHOP Buy

(2)SHOP USER BuyOK or BuyNOK

(3)USER MPS Pay or Deny

(4)MPS SHOP Pay or Deny

(5)SHOP MPS Sent

(6)MPS USER Sent

(7)USER MPS Confirm or Back

(8)MPS SHOP Moneytos

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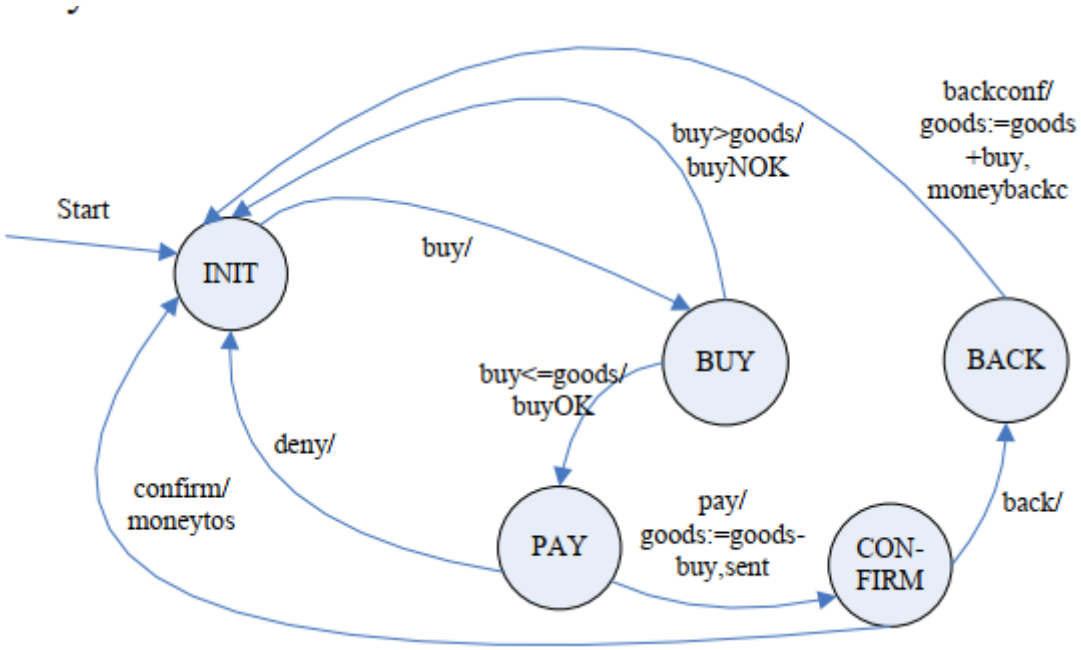


**Figure 3:** EFSM of the Environment Information Systems

### 3.1 Strengthen the relative fixity of safety management personnel and pressure pipeline data

The safety manager must adopt a long-term safety management system to ensure continuous safety management and needs to properly maintain and store pipeline data for manager approval, exchange and transmission of basic data (such as pipeline pressure Settings).

### 3.2 Strengthen the inspection of pressure pipelines

The inspection of pressure pipe must be based on the specific situation of pressure pipe, take different measures to ensure the safety of high pressure pipe. The characteristic of the pressure channels in the equipment is that each channel is very short distance apart, so in some channels, the mean is mixed, and the center direction is flowing in both directions. More modern pipes and pressures are often used, so it is very common to replace pipe parts. When inspecting a pipe, carefully check the initial data of the pipe. For newly replaced piping assemblies, if the wall thickness, material and standard are consistent with the original design, this should be described in detail. During the inspection process, it is necessary to study pipe detection, vibration, corrosion and corrosion, and valve joint Anti-corrosion conditions can prevent the corrosion and thinning of the material, and in the low pressure pipeline of the material, the temperature drop and vibration conditions are sensitive to fatigue [3].

### 3.3 Solve the problems of pressure pipeline itself

In order to effectively solve the problems in pipeline inspection and ensure the safety of the pipeline, firstly, the quality of the pipeline itself must be checked. The pressure pipeline effectively improves the quality and safety of the pipeline. By checking the running condition of the pipeline, we can ensure its normal operation. When selecting pressure pipe materials, design and inspection testing must first be conducted in the materials market, which will contribute to the stability of the pipeline. It is also necessary to enhance communication among multiple departments, manage large markets, create market standards, improve market compatibility and facilitate the selection of pressure channels. Local geographic and climatic conditions can effectively create more scientific and relevant standards, such as thickness standards for deep materials. On the other hand, it is necessary to strengthen the personnel responsibility system in the inspection process, requiring personal responsibility and increasing the importance of managers.

### 3.4 Overhead pressure pipeline of the pipe gallery outside the device

External pipe passage of the device External pipe is characterized by a large distance between the pipe and a

particular part of the pipe. The inspection focuses on whether individual pressure lines are identified when moving mounting brackets and sliding brackets, if corrosion resistant. If the layer and insulation layer are damaged, timely maintenance is needed. Conveying pipelines with inflammable, explosive and toxic levels above. Due to the particularity of this stress management, most companies take it seriously. Be interested. The installation inspection should check the presence of wires by checking the flange, grounding resistance, and transfer resistance between pipe sealing surfaces, and ensure that the side and surface of pipe seals are clean, and risk assessment should be carried out if necessary.

### 3.5 Strengthen the inspection of buried pressure pipelines

Some pressure pipes are located underground and cannot be inspected regularly. The only assessment that can be made is to check the corrosion of the outer layer of the pressure pipe. However, the correct drilling site must be selected to assess the condition of the buried pressure pipe and to assess the working conditions. For long life underground lines, the "man space" method can be used, which is easier to use and can more accurately detect the loss of the right etch layer for more accurate information.

### 3.6 Strengthen the inspection of pressure pipelines under special conditions

For certain pressure pipelines under long-term operating conditions, high temperature conditions, severe corrosion conditions, pressure, temperature changes and vibration conditions, the key points of inspection are: corrosion of hydrogen materials, use high temperature pressure pipelines to prevent corrosion of materials. powerful

## 4. DESCRIPTION OF THE MODEL AND PROPERTIES

In the last section, the core transaction of Environment Information System modeling in PROMELA has been completed. In the modeling process, we have done lots of abstraction to prevent the state explosion. The main purpose of this paper is to verify the process of mobile payment transactions for any errors, so the model does not reflect the identity, password authentication and other security aspects of the process, these parts will also be the focus of our future research. Although it has been abstracted, this model still can describe the actual process of the mobile payment transactions. The more details we will introduce are as following.

In the model, there are three main variables represent the different meanings. The variable i means the number of users. The variable buy means the number of goods bought by each user. And the variable goods means the inventory of shop. The three variables given different initial values, there will be several different situations, which represent the different actual payment business.

There are two major types of cases of the variable i. When it is i<=1 in the loop, there is only one user process running. When i <= any number larger than 1, there will several concurrent user processes running together. If there are concurrent processes running, the SHOP process will control each user to turn correct state. Specific control process can be seen in the fragment of SHOP process, and the detail of the next states is shown in Figure 4.

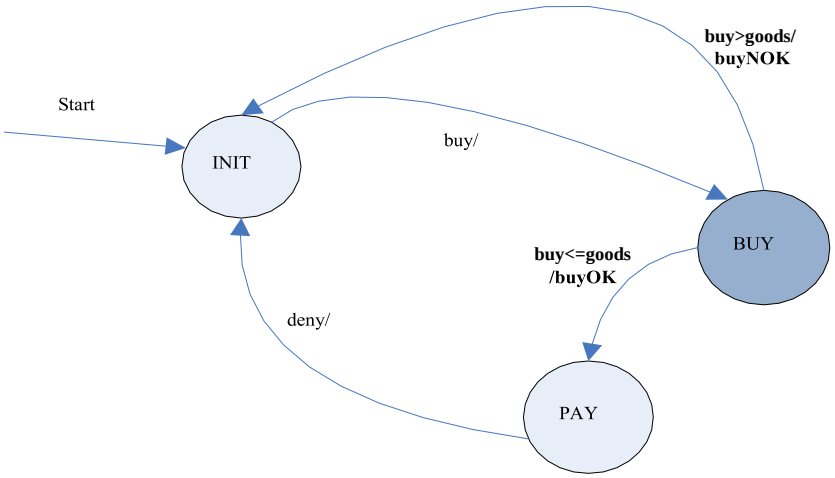

**Figure 4:** Different situations of the state BUY

In Figure 4, we will see that the other two variables buy and goods are compared in the process. Also it represents two different situations. If it is the situation of "buy<=goods", it means the user can buy the goods, as there are enough inventories of the shop. If it is the situation of "buy>goods", it means there are not enough inventories. The process will turn back to the state INIT. So, if these two variables are defined by the initial values to meet the condition "buy>goods", there will be some of the states that could never been reached. We will discuss these cases in more detail with experiments in next section.

As explained in Section 2, SPIN supports two kinds of analysis for the modeled protocols. The first one consists of checking deadlocks and other safety properties by generating the execution paths in the model. The second kind of analysis consists of checking temporal properties specified with temporal logic. Here we describe correctness criteria we are interested in, and show how they can be defined in SPIN. In order to formalize both desired and undesired properties of the Environment Information System s, we use LTL (linear temporal logic notation), which has been explained in Section 2. LTL allows expressing temporal properties we expect the system behavior will conform to during the system lifetime. Such properties can be seen as a part of requirement specification. Expression of properties in the formal LTL notation gives both an unambiguous presentation of expected system behavior and possibility to verify whether the system model conforms to the requirements. LTL formulae can express both safety and aliveness properties, and are effectively supported in SPIN.

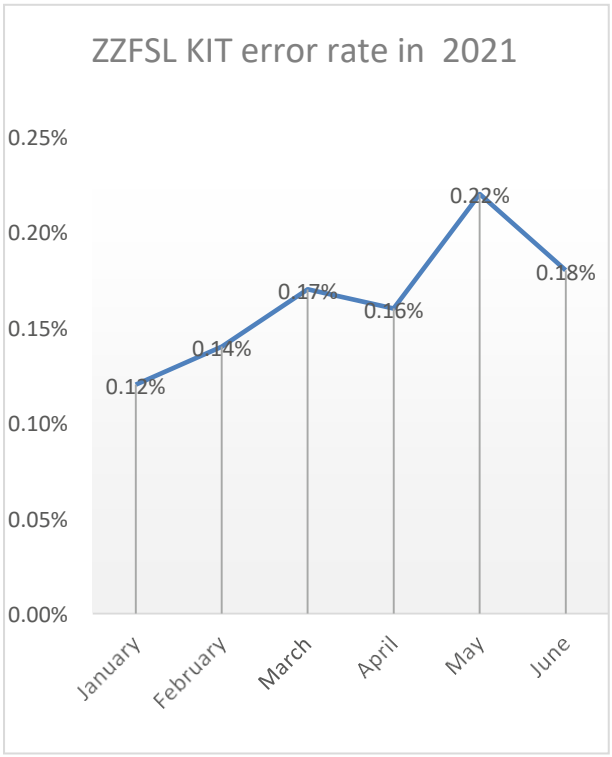


**Figure 5:** ZZFSL in the first half of the KIT error rate

Examples of typical requirements to the internet payment behavior can be formulated in plain English as following. For users, the users need the support of the payment is guaranteed:

(1)Before receiving confirmation, MPS will not pay the money to the shop;

(2)IF users are not satisfied with the goods, after the required return, the MPS will refund money to users;
For the shop, the business requires the support of the Environment Information System guaranteed: After confirmation of receipt in user, the MPS will pay the money to the shop. That requires the support of the system:

(3)When transaction succeeds, the users receive the goods, the shop get money from the MPS.

(4) When transaction fails, the goods are returned to the shop, and the money is back to the users from the MPS.

## 5. CONCLUSION

Since there may be hidden dangers in all aspects of the normal operation of the discharge pipeline, the inspection of the discharge pipeline is very important as it is the basis to ensure the normal operation of the pipeline. In addition, the pipeline inspection program is unable to ensure the proper operation of the pipeline, so as to continuously explore and improve the problem, improve the laws and regulations and management inspection systems related to strengthening and strengthening the safety management and personnel verification technology training.

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