Based on IPC-610H industrial control computer low voltage self-starting control system of motor group

Hongyu Zhao[1], Yan Li[2], Tao Xu[3], Weichong Zhang[3*], Yunning Zhao[4]

[1]*Engineering Training Center, Beihua University, Xinshan Str. 1, Jilin, China*

[2]*Department of electronics, Jilin Industry and Trade School, Changyi Str. 1, Jilin, China*

[3]*Department of computer science and Technology, Beihua University, Xinshan Str. 1 Jilin, China*

[4]*Department of Management and Economics, China University of Geosciences, Lumolu Str. 388, Wuhan, China*

Received 1 October 2014, www.cmnt.lv

Abstract

This paper proposed taking IPC-610H as the controlling core, a monitoring picture is established via configuration software, implemented with a remote or local monitoring and control, a low voltage self-starting system of motor group are achieved with accurate determination and rapid response.

Keywords: flashover voltage loss, automatic starting of motor group, industrial control computer

1 Introduction

Flashover voltage loss of power network, generally speaking, doing to lightning, short circuit and other reasons made a brief loss of power or voltage fluctuations in a short time. Generally within a few hundred milliseconds, which will lead to the suction insufficient by the electric ac contactor and release enough work motor to stop running. When the network voltage returns to normal, before flashover the running state of the motor cannot be automatically restored to the normal running state before flashover. For chemical industries, if the flashover voltage loss cannot restore in time and resulted to the manufacture stopped, large loss, fault and damage of the production facilities, and even accidents may happen [1]. After the flashover, the automatic starting device of motor groups shall be the evitable choice to deal with the stop of the manufacture process doing to the flashover voltage loss [2].

2 System project design

In order to deal with the motor self-starting after the power network flashover, the system adopts the way of industrial control computer. In the plan that the motor group self-starting is realized by the industrial control computer, the wave shaped record of the network current and voltage and the historical data storage can be achieved to help the field personnel and engineers to analyze the running status of the power network. The running status of the motor in the process of power network flashover can be recorded, and the starting in batches of the motor can also be achieved based on the running status of the motor at the moment of the power network flashover after the power network gets back to the normal condition, moreover, the system can quickly restore the reliable operation of the production equipment under the premise of safety to meet the power network.

3 System hardware

For the system hardware design, the modularization of the hardware configuration of the system shall be strived to be achieved on the basis of the reliable and accurate operation of the system resulting in a simple and clear whole hardware system. Which is convenient to be used and maintained, and the failure rate of the system operation is reduced; the low voltage self-starting system of the motor group (as shown in Figure 1) controlled by the industrial control computer works via Yanhua IPC-610H industrial control computer and adopts computer interface technology, rapid detection technology and network communication technology. Moreover, taking the 32-bit industrial control computer as the core of the detection and control [3], the system detects and stores the running status and power network parameters of each motor in the working field and realizes the display on the LCD via the configuration software running on the industrial control computer.

Through the current transformer and power network bus, the low power network current and voltage are sent to the isolated conversion module. From which the standard power signal is transmitted to the AI analog acquisition boards of the computer interface to finish the detection of voltage and current on the spot. The related settings in the configuration software shall be done to realize the rapid

* ***Corresponding author's*** e-mail: zwc_mail@163.com

acquisition and display of the parameters data. Through the signal collection of the secondary passive nodes of the electric main circuit contactor, the settings shall be done in the configuration software to realize the one to one correspondence of the display status and switch acquisition point, and to make sure the input correct; through the internal procedure control of the configuration software, the corresponding intermediate relay is controlled based on the control of the computer interface DO digital output board according to the input signal status, and control signal is output on the relay to control the motor starting and running.

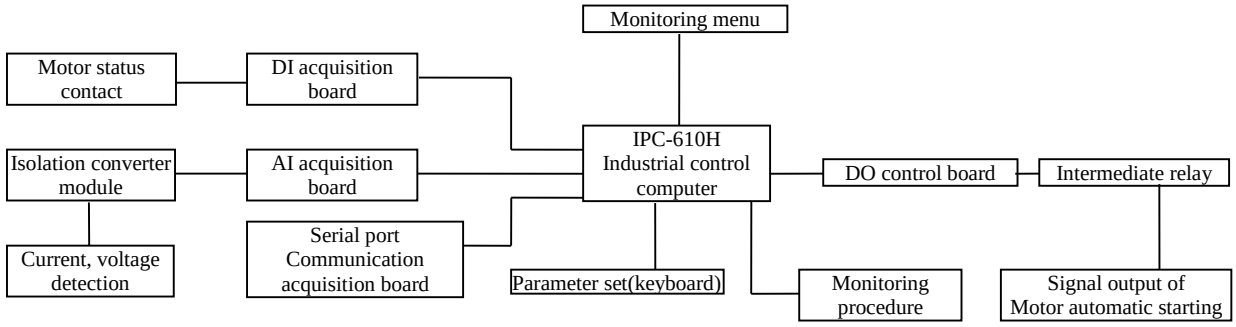

FIGURE 1 Low voltage self starting system of motor group structure chart

When the flashover in certain power section or voltage loss in a short time appears, the computer shall store the working motor status in the circuit at the moment of flashover and times of the flashover voltage loss. If the time of the actual flashover voltage loss is within the set flashover time limitation, the computer shall start the self-starting procedure of the motor group after the power voltage gets to the normal condition. And conduct the motor group automatic starting operation based on the locale technological requirements in the set starting delay time and sequence, and then finish the self-starting process of the whole motor group in a reasonable time interval; if the actual flashover voltage loss time exceeds the set flashover time, it shall be the power down fault of the power network, then the self-starting procedure of the motor group shall not be executed and the alarming shall ring. During the whole process of the flashover voltage loss or power network power down, data storage in time sequence shall be done on all running parameters by the configuration to offer reliable data basis for the analysis on the whole events by the managers.

4 System designed and implementation of computer software

The system adopts KIGNVIEW control software, which features with strong adaptability, good openness, easy expansion, economy, short develop cycle and other advantages [4], can conduct real time detection on and record of the power network current and voltage (as shown in Figure 2-3) and the historical data storage, check and print, can record the motor running status in the power network flashover process (as shown in Figure 4) and also can conduct the starting in batches according to certain technological requirements after the power network gets back to the normal condition [5].

FIGURE 2 Monitoring menu of the power network status

The processes of self-starting and starting in batches shall be controlled based on the bus bar voltage and current, the processes are featured with characteristics as shown in below.

4.1 SELF-STARING IS RAPID

The timing starts when the flashover incident happens. When the automatic starting process is within the set time limitation range and the power network gets back to the normal condition, the motor group self-starting procedure is conducted immediately when the set time of the

flashover voltage loss achieves. The detection cycle on the power network parameters in the running process of the monitoring software shall be 10ms, and the detection cycle on the motor running status shall be 1s, the motor group self-starting procedure may be conducted at the moment the power network is fluctuant. And the flashover voltage loss status can be captured accurately, a quick response may be made to realize the advantage of rapid starting

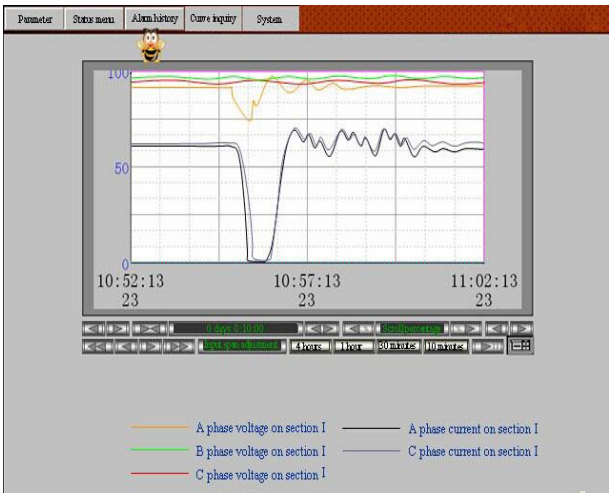

FIGURE 3 Historical curve of power network parameters

4.2 ACCURATE DETERMINATION ON THE INCIDENTS

The flashover voltage loss, the voltage fluctuation and power down incidents in the power network can be identified and judged accurately to respectively conduct the safe and reliable response, and no faults in determination and operation which shall result in huge loss shall exists.

4.3 THE RESTART CURRENT IS LOW

Taking the voltage and current signal collected from the power network as the basis of the restart, the motor group shall be re-started in batches after the voltage gets back to the normal condition. Which reduces the impact conducted by multiple motors started in the same batches, ensure that the total current of the power network motor in the starting process shall not too large and therefore each motor can be started in a steady and reliable condition.

4.4 QUICK RESPONSE

The automatic start is accurate and reliable, and the Lights Out can be realized.

4.5 HUMAN-COMPUTER INTERFACE IS FRIENDLY

The flashover incidents and the starting condition of each motor in the control can be recorded automatically in tabular form to offer checks for the users. And the data check shall not affect the self-starting function. The system also bears the data transmission interface which can realize data sharing.

FIGURE 4 Monitoring menu of the motor running status

4.6 GOOD EXPANSIBILITY

Function expansion can be done according to the needs.

To enhance the usability of the application program, the command language shall be written to expand the function of the application program [6].

Command language of the application program:

```
Startup: \\ site \working manner=0;
In operation: each 1000ms
if (\\ site \ startup voltage setting <= \\ site \ A phase voltage on Section I
& & \\site \ startup voltage setting <=\\site \ B phase voltage on Section I
& & \\site \ startup voltage setting <= \\site \ C phase voltage on section
I & & \\ site \ startup voltage setting <= \\site \ A phase voltage on Section
II & & \\site \ startup voltage setting < = \\site \ B phase voltage on section
II & & \\ site \ startup voltage setting <= \\site \ C-phase voltage on
Section II)
\\site\startup allowance =1;
else\\site startup allowance =0;
if (\\site\alarming close==1)
\\site\alarming ring=0;
if (\\site\quantity>=5 &&\\site\ quantity<30)
{\\site\quantity=\\site\quantity+1; }
if(\\site\quantity>=30)
{
\\site\quantity=0;
}
Stop:
Command language is changed by data:
\\site\$second:
\\site\change=\\site\change+1;
if(\\site\change>=5)
\\site\working manner=1;
\\site\$ millisecond：
float x1;
if (\\ site \ working manner == 1)
 {
if (\\site \ Power down time setting> \\site \ abnormal time & &\\site \
abnormal time> = \ \ site \ flashover time setting)
 {
\\site \ delaying start time =\\site \ delaying startup time + 0.001;
\\Site \ flashover voltage loss fault = 1;
 }
else {\\ site \ flashover voltage loss fault = 0;
```

```
    \\Site \ delayed start time = 0;
      }
     // flashover voltage loss determine
if (\\site \ power-down time setting <=\\site \ abnormal time)
 {
\\site \ voltage loss power down accident = 1;
 }
else\\site \ voltage loss power down accident = 0;
// voltage loss power down determination
if (\\site \ delaying startup time <= \\site \ Power-down time setting -
\\site \ flashover time set & & \\site \ group 2 == 1 & &\\site \ flashover
voltage fault == 1)
 {\\site \ group 1 = 1;
// motor set startup
\\Site \ delaying startup time 1 = \\site \ delaying start time 1 +1000;
 if (\\site \ delaying start time 1 <= 3000)
 {
P3401AC=1; P3401BC=1;
P3402AC=1; P3402BC=1;
P3407AC=1; P3407BC=1;
A3401AC=1;
A3401BC=1;A3401CC=1;A3401DC=1;A3401EC=1;A3401FC=1;
P3501AC=1; P3501BC=1;
P3502AC=1; P3502BC=1;
C3501AC=1; C3501BC=1;
C3502AC=1; C3502BC=1;
V3506AC=1; V3506BC=1;
P3608AC=1; P3608BC=1;
P3601AC=1; P3601BC=1;
P3602AC=1; P3602BC=1;
P3603AC=1; P3603BC=1;
P3604AC=1; P3604BC=1;
P3410AC=1; P3410BC=1;
A3601AC=1; A3601BC=1;
A3602AC=1; A3602BC=1;
 }
if (5000> = \\site \ delaying start time 1 & & \\site \ delaying start time
1> 3000)
P3401AC=0; P3401BC=0;
P3402AC=0; P3402BC=0;
P3407AC=0; P3407BC=0;
A3401AC=0;
A3401BC=0;A3401CC=0;A3401DC=0;A3401EC=0;A3401FC=0;
P3501AC=0; P3501BC=0;
P3502AC=0; P3502BC=0;
C3501AC=0; C3501BC=0;
C3502AC=0; C3502BC=0;
V3506AC=0; V3506BC=0;
P3608AC=0; P3608BC=0;
P3601AC=0; P3601BC=0;
P3602AC=0; P3602BC=0;
P3603AC=0; P3603BC=0;
P3604AC=0; P3604BC=0;
P3410AC=0; P3410BC=0;
A3601AC=0; A3601BC=0;
A3602AC=0; A3602BC=0;
}
if (8000> = \\site \ delaying start time 1 & & \\site \ delaying start time
1> 5000)
{
P3406C=1;
P3408AC=1;P3408BC=1;
P3409C=1;
C3501AC=1; C3501BC=1;
V3404AC=1;V3404BC=1;
V3513C=1;
P3503AC=1; P3503BC=1;
P3504AC=1;P3504BC=1;
P3505AC=1;P3505BC=1;
E3508C=1;
FI3602C=1;
P3606C=1;
}
if (\\site \ delaying start time>8000)
{
P3406C=1;
P3408AC=1; P3408BC=1;
P3409C=1;
C3501AC=1; C3501BC=1;
V3404AC=1; V3404BC=1;
V3513C=1;
P3503AC=1; P3503BC=1;
P3504AC=1; P3504BC=1;
P3505AC=1; P3505BC=1;
E3508C=1;
FI3602C=1;
P3606C=1;
\\Site \ delaying startup time 1 = 0;
\\ Site \ delaying start time = 0;
\\ Site \ group 1 = 0;
\\ Site \ group 2 = 0;
}
}
/ / operation after the flashover voltage loss
if (\\site \ voltage loss power down fault== 1 & & \\ site \ alarming close
== 0)
{
x1 = x1 +100;
if (x1 <= 1000)
\\Site \ alarming rings = 1;
else
{\\Site \ group 2 = 0;
\\Site \ alarming rings = 0; }
}
}
```

Command language of events:

(\\site \ A phase voltage on Section I <=\\ site \ flashover voltage setting & &\\ site \ B phase voltage on Section I <=\\
site \ flashover voltage setting & &\\ site \ C phase voltage on section I <= \\ site \ flashover voltage settings) & & (\\ site \ A phase voltage on section II <= \\ site \ flashover voltage setting & &\\ site \ B phase voltage on Section II <=\\
site \ flashover voltage setting & &\\ site \ C phase voltage on section II <= \\
site \ flashover voltage setting) flashover occurred

Occuring:

\\site \ abnormal time = 0;
Existing: 1000ms
\\site \abnormal time = \\site \ abnormal time +1;
Disappearing:
\\site \ number = 5;
\\site \ group 2 = 1;
((0.05 <= Abs (A-phase voltage on section220-I) / 220 & & Abs (A phase voltage on section 220-I) / 220> = 0.15) & & (0.05 <= Abs (B-phase voltage on Section 220-I) / 220 & & Abs (B phase voltage on Section 220-I) / 220> = 0.15) & & (0.05 <= Abs (C-phase voltage on section 220-I) / 220 & & Abs (C-phase voltage on section 220-I) / 220> = 0.15)) & & ((0.05 <= Abs (A-phase voltage on 220-II section) / 220 & & Abs (A phase voltage on section220-II) / 220> = 0.15) & & (0.05 <= Abs (B-phase voltage on section 220-II) / 220 & & Abs (B phase voltage on section 220-II) / 220> = 0.15) & & (0.05 <= Abs (C-phase voltage on section220-II) / 220 & & Abs (C-phase voltage on 220-II section) / 220> = 0.15)) voltage fluctuation

Occuring:

\\Site \ voltage fluctuation fault = 1;
Existing: 3000ms
Disappearing:
\\Site \ voltage fluctuations fault = 0

5 Conclusion

Automatic starting hardware and software of the motor group controlled by industrial control computer is reliable with a strong capability of anti-jamming. By utilizing it, the determination and treatment on the flashover voltage loss and power down faults of the power network in the sulfur recovery device of the oil refinery, the group automatic starting operation with high speed and reliability on the motor group is finished after the flashover voltage loss and also resolves the problem that the automatic starting cannot be done when power down happens in the network voltage loss. After operated in the sulfur recovery device of Oil Refinery of Jilin Petrochemical Company, Ltd., PetroChina, the system runs well and reduce the economic loss caused by flashover faults.

References

[1] Ying L, Haiyan J, Qiang W 2004 Self-starting *Ningxia Petrochemical Industry* **3**(1) 36-8
[2] Shiming W 2010 *Electrical Applications* **6**(1) 44-7
[3] Kefei C 2010 *Embedded System Design Press Mechanical Industry*
[4] Chuanqing L 2007 *Heilongjiang Science And Technology Information* **14**(1) 50-1
[5] Xiuduan L 2003 Application Technology of Motor Restart *Electrotechnic* **22**(7) 51-2
[6] Chunyu Z, Guan-Rong S 2008 Design on the Anti-jamming of the Motor Group Self-starting Cabinet Controlled by Microcomputer *Refinery Technology and Engineering* **38**(3) 48-51

Authors

Zhao Hongyu July 14, 1965, Yichuncity, leilongjiang, China.

Current position, grades: intermediate technician in Engineering Training Center of Beihua University in Jilin City.
University studies: electrical automation of Beijing Iron and Steel Institute.
Scientific interest: electric automation, electronic and mechanical engineering.
Publications: 6 papers.

Li Yan, November 10, 1973, Jilin city, Jilin, China.

Current position, grades: Secondary school teacher at electronics Department of Industry and Trade Schools in Jilin City.
University studies: electrical automation of Beihua University.
Scientific interest: electric and electronic aspects.
Publications: 4 national papers.

Xu Tao, December 13, 1973, Jilin city, Jilin, China.

Current position, grades: intermediate engineer in Engineering Training Center of Beihua University in Jilin City.
University studies: Jilin University of Automation and Control professionals.
Scientific interest: electric and electronic aspects.

Zhang Weichong, March 18, 1989, Heze city. Shandong, China.

Current position, grades: a graduate student.
University studies: Qingdao Agricultural University of Communication Engineering professionals of Beihua University in Jilin City.
Scientific interest: communications and embedded development.

Zhao Yunning, May 23, 1993, Jilin city, Jilin, China.

Current position, grades: an undergraduate student of Department of Management and Economics of University of Geosciences in Wuhan City.
University studies: project management.
Scientific interest: electric automation and project management.
Publications: 1 paper.