

The Incorrect Action Analysis Of Two-Stage Backup Automatic Switch

Yang Yongbo

State Grid Henan Electric Power Company
Zhengzhou Henan, China

Wang Yujiang, Su Di

State Grid Henan Electric Power Company
Zhengzhou Henan, China

Abstract—According to a 110 kV within the bridge connection of two-stage backup automatic switch in substation misoperation, line reclosing match problem and the cooperation of the two-stage backup automatic switch device are analyzed in this paper. In view of the action logic analysis, this paper discusses two kind of timer logic in different protection equipment, and puts forward the improvement scheme of different principle. This research provides a reliable basis on the regional power grid for the related relay protection setting work, and guarantees normal operation of power grid.

Keywords—Backup Automatic Switch; Auto-Reclosure; Logical; Timer

I. INTRODUCTION

Users are increasingly demanding to the power supply reliability of the power system. In order to meet the demand, power grid below 110 kV is made redundant design, setting a standby power supply.

When the main power supply loses due to abnormal factors, requirements for the switch device can run automatically and quickly add the standby power, to ensure the power supply reliability. Case since the switch device is mainly applied in medium and low voltage power distribution system under 110 kV, the application for the switch device, should prevent the standby power supply or standby equipment into the fault components, causing the failure. For since the switch device action time so that the load of a power outage time is as short as possible for the principle.

II. EVENT PROCESS

A. Operation Mode

Within certain 110 kV substation as bridge connection, the normal operation of 110 kV system:

Line 1 through 110 kV bus I with 1 # main transformer operation, and lines 2 through 110 kV bus II with 2 # main transformer, and the bridge circuit breaker 3 CB standby.

10 kV system:

1 # main transformer by 4 CB with 10 kV bus I, 2 # main transformer by 5 CB with 10 kV bus II, bus coupler circuit breaker 6 CB set aside.

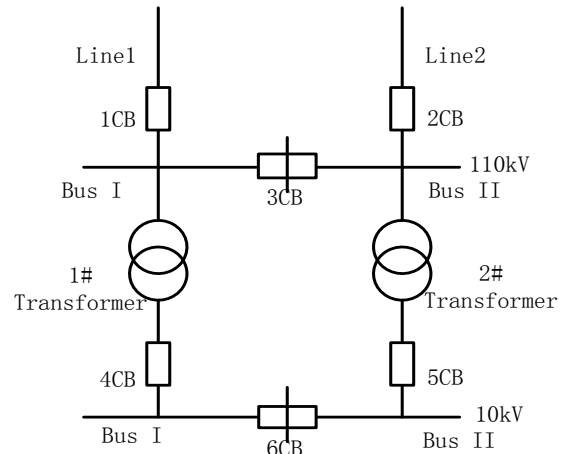


Figure .1 A System Diagram of a Substation

Related the protection equipment configuration:

Both line configuration distance protection, zero sequence protection, and reclosing device.

3 CB bridge switch configuration, charging protection and prepare the cast for cast by Guodian Nanjing automation Co., LTD. PSP 643 U segmented protection device.

6 Cb as 10 kV bus coupler, configuration and prepare the charging protection, since the vote by Jiangsu JinZhi science with the function of prepared from the cast of IPACS - 5763 - d segmented protection device.

B. The Event Log

A 110 kV substation line 1 B phase permanent ground fault occurs, line protection distance II period of action and exports, removal of the fault. After reclosing time, the line 1 overlap permanent fault point, from the acceleration period of action. The two levels backup automatic switch of substation for exports and movement, the circuit breaker action sequence 4 CB and 1 CB to jump, then close 3 CB and 6 CB, making two levels for the cast missing, for 1 # main transformer no-load closing.

C. Hazard Analysis

Permanent ground fault occurs, while line 1 to 10 kV substation bus even prepared from the cast and 110 kV bridge for since the start at the same time, apparently, for since the vote the 110 kV bridge first issued a jump instruction, namely the jump drive circuit switch 1 CB. At this point, 10 kV bus coupler for the switch device action at the same time, opening 4 CB which is No. 1 main transformer low voltage side switches. Then the switch device continue to make the action logic, closed 3 CB, and

then 6 CB. At this point no. 1 main transformer low voltage side switch is already break-brake position, and the No. 1 main transformer closing with no-load.

Transformer drop, when the power supply side switch of the phase to pull, timeliness, breaker if the neutral point ungrounded, transformer power supply voltage up to neutral point to earth phase voltage, will cause the damage of transformer insulation.

110 kV substation in normal operation mode, main transformer neutral point are disconnected position, 10 kV bus prepared since before the 110 kV bridge for the activity may cause damage to transformer, threat of power grid and equipment safety.

Therefore, it is necessary to analyze the misoperation reason, to avoid similar events again.

III. EVENT ANALYSIS

A. Mode of Backup Automatic Switch Device

Prepared from the cast ways mainly include: buscouple prepared or bridge from the cast, prepared from the cast into line, transformer for the cast and the special circumstances for the cast, as with small power supply, balanced load for the shot. The substation adopts the way of prepared from the cast for the cast or bridge [1].

The action logic of bus coupler or bridge for the cast as:

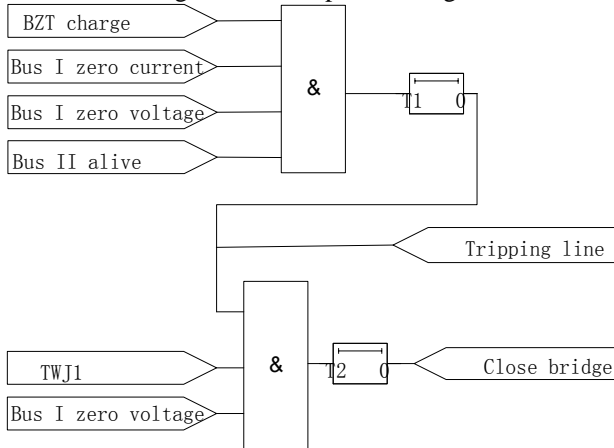


Figure. 2 Bus-Coupler for the Action Logic Diagram

When meet since cast all action condition, after a delay, for export tripping command is issued by the switch device.

When Bus I without voltage, line I no flow section, and meet the bus II with power, jumped 1 CB after delay. Confirmed after 1 CB jumped, by delay closed bus coupler circuit breaker or bridge. Similarly bus bar II loss, the bus I ready for action.

B. Cooperation with Reclosing

“The 3 kV ~ 110 kV power system relay protection setting rules”, for the cast with reclosing, mainly considering setting time delay [2]. For since the switching action time should be greater than the corresponding circuit power supply side action time and backup protection circuit reclosing time combined.

By case since the action time:

$$t \geq t_{TZ} + t_{HJS} + t_{CHZ} + t_0 \quad (1)$$

Among them:

t_{TZ} for the line power supply side protection time;

t_{HJS} as major acceleration after closing protection action time;

t_{CHZ} as buscoupler closing time.

t_0 as the time margin.

C. Complexes with Two-Stage Backup Automatic Switch

Bridge connection within 110 kV substation, often configuration 110 kV and 10 kV two-stage case. Even though the procedures for setting no time with the requirements of the two levels of the shots, but their action may cause power grid security [3].

Generally the status of 110 kV substation in the power grid for the electricity side, if one of the power supply into line failure, firstly by the circuit power supply side has a protection circuit full-length line protection device, jump line on side switch, then the action of lateral line reclosing after the success of the coincidence, the two level for investment start together, but should not be action. If reclosing on permanent fault, again by the accelerating period of protection failure, 110 kV and 10 kV bus decompression to meet start condition of backup automatic switch, two-stage spare switch device start at the same time. Considering the reliability of system operation mode, first by 110 kV bridge prepared for export, into the line 1 circuit breaker, and then close the bridge circuit breaker, by line 2 with two main transformer load. 10 kV bus coupler from cast is also start together, but not action. Two stage for cast with the action sequence diagram as shown below:

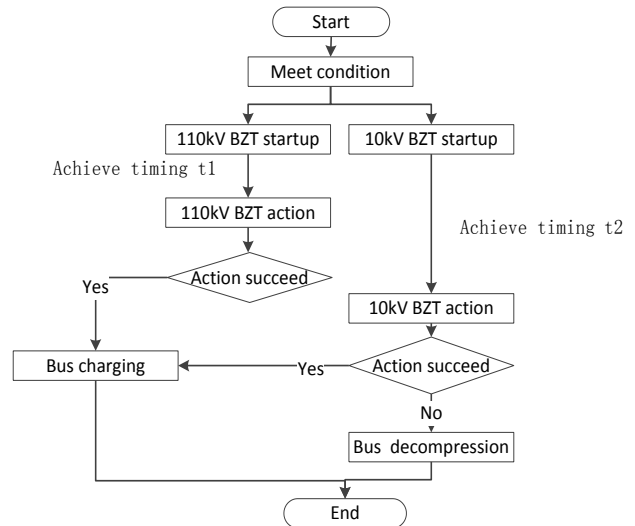


Figure. 3 Action Logic of Two-Stage Backup Automatic Switch

Due to various reasons, such as the case since the switch device, two stage for cast with the setting is usually accomplished by time difference. Concrete plans on action time since the switch device, the 10 kV bus coupler for tripping time setting is longer than 110 kV bridge since the vote for the sum of tripping and closing time can achieve the above logic.

So 10 kV bus coupler for cast trip time is:

$$t_{10} = t_{110TZ} + t_{110HZ} + \Delta t \quad (2)$$

Among them:

t_{10} for 10 kV bus coupler for tripping time,

t_{110TZ} for 110 kV bridge from tripping time,

t_{110HZ} for 110 kV bridge from closing time,

Δt as the margin of time, including the actual switching time, data transmission and processing delay and other factors.

Based on the analysis of 110 kV bridge from cast and 10kV segmented from the trip time, closing time should be whole set:

110 kV bridge for setting trip time is 4.0 s, closing time is 1.0 s;

10 kV bus coupler since the pitch setting trip time is 6.0 s, closing time is 1.0 s.

Advantages of this design is the 110 kV bus bar, the decompression by 110 kV for since the first action, 10 kV for the cast as a failure of the 110 kV bridge for move the backup device. Therefore, for the investment operation mode is more reasonable, greatly improving the success rate of the prepared from the cast of the action to further ensure the power supply reliability.

D. Incorrect Action Analysis

In order to further analysis of two stage for since couldn't cooperate with the cause of action correctly, respectively analyzing the PSP 643U device and IPACS - 5763 - d block protection device for the action logic. Logic in part time delay, two for the design of the automatic switch device is different [4-6].

PSP 643 u device adopts through to delay timer. Principle of timer input from 0 to 1 and rising, timer timing starts. Time period if the input to 0, timing to stop. And then the change from 0 to 1, produce new rising edge, the timer will be reset and time to start over from the default values. Time arrival, and keep output into 1.

IPACS - 5763 - d device adopts keep delay timer. The timer start, terminate the same logic. During different timing if input into 0, timer stop timing; And then the change from 0 to 1, produce new rising edge, the timer will start again, continue to timing from memory retention value. To achieve timing signals after time t .

Two timer sequence diagram is as shown in the figure below:

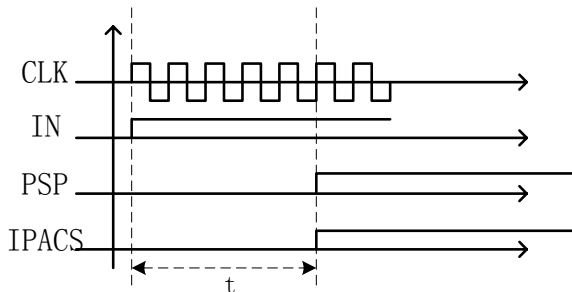


Figure. 4 At Constant Input Two Timer Output Sequence Diagram

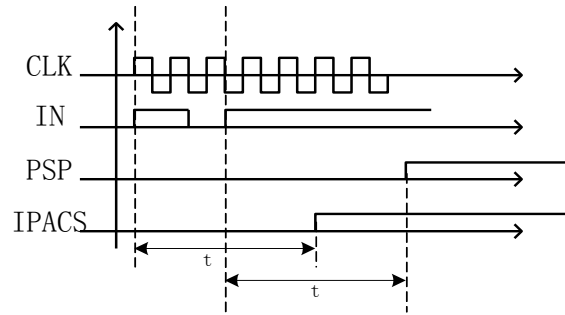


Figure. 5 Input Reset When Two Timer Output Sequence Diagram

When there is a failure in the substation power supply line, line 1 distance protection act and open the circuit breaker. The two level in substation, prepare the switch device shall meet the action start conditions. But after reclosing action into lines, bus voltage, current short-term recovery.

At this time bus line voltage is greater than the pressure setting value, current greater than no flow fixed value. Switch is protected with 3 CB bridge ranks since the PSP 643 u timing logic device reset immediately, but 10 kV bus coupler 6 CB configuration Jinzhi technology IPACS - 5763 - d segmented protection device, its timing logic not reset.

Line reclosing action, make the line after reclosing permanent fault, distance to accelerate action again to open the circuit breaker of power supply lines. At this point, to meet the 110 kV bus coupler for the action start conditions, PSP 643 u device timing starts again. But 10 kV bus coupler IPACS - 5763 - d segmented protection because there is no reset timer and on the basis of the last time to time.

At this moment, time in the timers of the two-stage backup automatic switch is:

$$t_{6CB} = t_{3CB} + t_{CHZ} + t_{CB} + t \quad (3)$$

Among them,

t_{3CB} for 3 CB switch device in reclosing time after time;

t_{6CB} for 6 CB since the switch device in reclosing time after time;

t_{CHZ} for the line reclosing setting time;

t_{CB} for circuit breaker action;

t for the system transmission delay and protection action.

According to the regional power grid relay protection setting principle, set up 3 CB since cast trip time between the fixed value and 6 CB has 2 s with the time. Reclosing setting time is 1.0 s.

From line 1 trip timing starts for the first time, about 6.0 s, 110kV switch device issue a jump line circuit breaker 1 CB commands. At this time due to the 3 CB closing command not issued, 110 kV bus I without voltage, to meet the conditions of 10 kV switch device, and to reach the time for action, order to open bus couple circuit breaker of 10kV. Subsequent movement conditions are met, the actual action order for 3 CB, 6 CB. Protection of incident wave record 110 kV for since the time switch device for 5950 ms, in conformity with the logic analysis.

IV. IMPROVEMENT

For substation in the region for the devices from different manufacturers, timer delay logic inconsistency, cast misoperation may cause for the problem, put forward the following suggestions.

A. Unified Delay Logic

For the operation of the transformer substation for the switch device, the timer delay logic inconsistency, asked equipment manufacturers to cooperate to adjust the timer delay logic. Thus, for the region since the switch device timer delay logic, which avoids the timer delay logic prepared from caused by misoperation. For regional new substation equipment since the switch device design, choose the same manufacturer, the same delay logic for the switch device to radically eliminate hidden dangers.

B. Time Setting

This article analyzes the two levels of the setting time of this problem, obviously, when 10 kV prepared from the cast prolonged action, is greater than 110 kV for the switch device setting time, reclosing time, the action time of the circuit breaker, transmission delay and the sum of 110 kV spare the time for closing, cast, in turn, can achieve two levels for the same gesture.

For example 110 kV bridge for setting trip time is 4.0 s, closing time is 1.0 s;

10 kV bus coupler since the pitch setting trip time is 7.0 s, closing time is 1.0 s.

Obviously this solution increased the system outage time, reduces the power supply reliability of the power grid, violating the case since the purpose of the switch device design. In the factory did not change and unity for the region since the switch device timer delay logic, this solution can be used to avoid misoperation, but this method does not as a long-term solution.

C. Add Blocking Signal

Two level for now since the time limit for automatic device depend entirely on the device with reasonable steps of setting, can add drops to the 10 kV for since latching logic conditions, so as to realize two levels of substation for the right match.

Such as the 110 kV for the switch device, while action condition to 10 kV for the switch device, blocking signal, when the 110 kV for automatic switch device failure, only to allow 10 kV for the switch device to launch command.

Considering the 10 kV a bus bar loss of electricity and meet for the move condition, should not meet 110 kV for the switch device meet the conditions, 10 kV for shielding blocking signal since shots, ensure the reliable action of the 10 kV for the switch device.

V. CONCLUSION

The 3 kV ~ 110 kV power system relay protection setting rules for preparation of the cast with reclosing mode of regulation, is aimed at using type delay timer for automatic switch device and reclosing. For use on type delay timer for the switch device, puts forward different setting scheme: spare the time for action should be greater than the corresponding circuit power supply side action time of the backup protection, need is greater than the

spare the time for action, otherwise it will cause for the setting time is too long.

In this paper two prepared from the cast including line reclosing to cooperate, for the reason caused by error action of switch device is two level for the switch device timer delay caused by different logic. Aiming at the situation, in this paper, from the initial planning and design, improve the existing protection setting, forward device improvement three aspects put forward the improvement project of three.

The analysis of the proposed scheme is evaluated, the new substation should be unified timing logic for the switch device; Modification of existing device can increase type keep delay timer setting time, in order to realize the two level for the switch device.

This article through to misoperation in-depth analysis of the switch device, to prepare the switch device setting of regional power provides a reference basis, provides the guarantee for the power supply reliability of power system.

REFERENCE

- [1] Zhang Bao-hui, Yin Xiang-gen. Power system protection [M]. China Electric Power Press, 2005.
- [2] GB / T 584-2007, 3 ~ 110kV power grid protection devices running the tuning procedure [S].
- [3] Song Guo-tang, Yu Haipeng, Zhao Wenjing, Wang Li. BZT Device applications Malfunction Problem Analysis and Countermeasures [J] Electric Power Automation Equipment, 2010,07.
- [4] Guodian Nanjing Automation Co., Ltd. PSP643 digital standby power source and control devices Technical Manual [EB / OL].
- [5] Li Hai-xing, Wang Zheng-tao, Wanf Rui, Cao Li-lu. IEC61850 standards-based network equipment from the cast features [J]. Power System Protection and Control, 2009.14.
- [6] Wang De-quan. 110kV automatic switching and protection devices with the analysis and discussion of issues [J]. Jiangsu Electrical Engineering, 2010.04.