System Development and Application for Preventing the Explosion of Aluminum Reduction Cell Bypass Shunts

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Abstract

As a major safety accident, the explosion of the cell bypass shunts will cause a series of shutdowns and power outages if it happens, which will also bring huge economic losses to the smelter. At the present time, manual inspection is made to prevent these explosion accidents. Smelters lack a comprehensive and effective digital monitoring and early warning system. In view of this situation, a system to prevent the explosion of the cell bypass shunts has been developed by Zhengzhou Non-ferrous Metals Research Institute Co, Ltd of CHALCO. Three functional modules are covered in the system, such as data acquisition, research and judgment software, and communication linkage protection. In the data acquisition module, a PLC collects the status of hidden danger points and uploads the data. The research and judgment software carries out feature analysis of the uploaded data, which tries to find out the explosion potential in time, and issues the corresponding level of warning signal through the Internet of Things. For the highest hazard level, the system linkage protection function of the power supply start-up reduces the input power to ensure production safety. By taking advantage of information technology, this system provides the digital and intelligent protection of cell safety. As the result, it is very important for potline safety, and it avoids economic loss for the smelters.

Keywords: Aluminum reduction cell, Cell bypass shunts, Cell safety.

1. Introduction

As a major safety accident, the explosion of the cell bypass shunts will cause a series of shutdowns and power outages if it happens, which will also bring huge economic losses to the smelter. All electrolysis companies attach great importance to this and formulate various investigation measures and emergency plans to prevent them. However, at present, the accident has not been effectively curbed. On the one hand, due to the complex factors that caused the explosion of the cell bypass shunts, the hidden danger points are scattered and the incident is sudden, it is difficult to achieve a comprehensive, continuous and thorough investigation by manual inspection alone. On the other hand, the site lacks a set of digital and intelligent safety detection and protection system.

In response to this situation, Zhengzhou Nonferrous Metals Research Institute Co., Ltd. of CHALCO has developed a system to prevent the explosion of the cell bypass shunts, using information technology to prevent it, and eliminate unsafe hidden dangers, ensuring the safety of electrolytic production and avoiding major economic losses.

2. Accident Analysis and Identification

By classifying the causes of historical explosions of the cell bypass shunts, it is found that the causes mainly include: serious bias current in cell preheat, cell tap-out, abnormal contactor, high anode-to-cathode distance (ACD) in operation process, high anode effect voltage and non-technical reasons (non-technical reasons refer to natural disasters such as earthquake and flood, which are not discussed in this paper). Further analysis shows that before each accident, the data related to the electrolytic cell has its own characteristics. Therefore, through the collection, analysis and mining of the data related to aluminum electrolysis, the accident characteristics can be extracted to form a recognition algorithm to predict the explosion risk at the cell bypass shunts in advance.

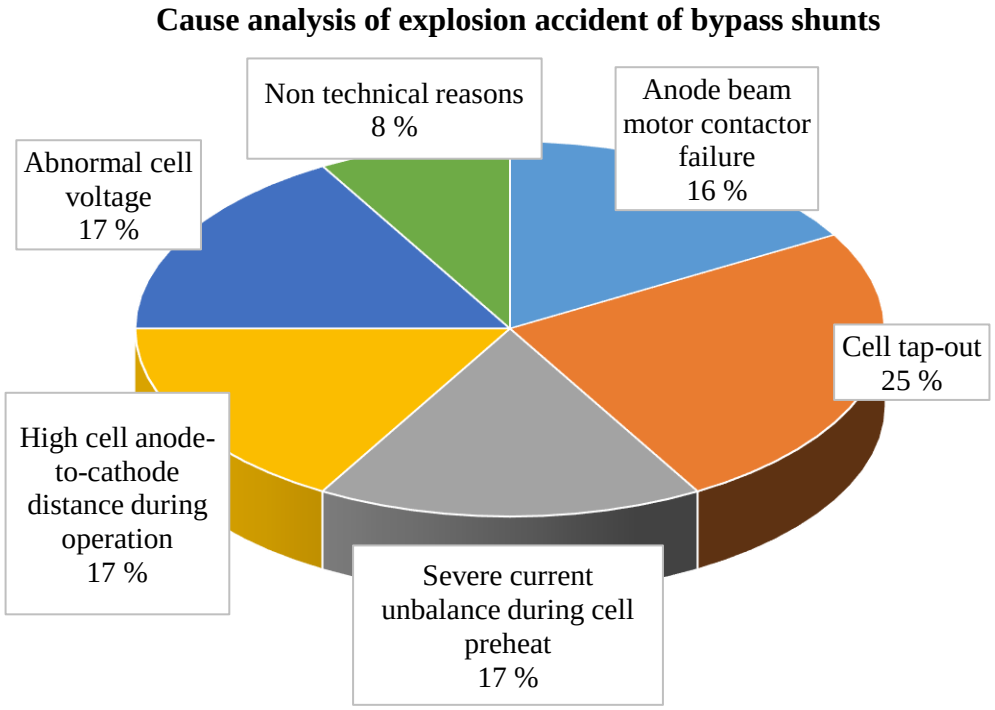

Figure 1. Classification of explosion causes of the cell bypass shunts.

2.1. Identification Technology of Severe Current Unbalance during Cell Preheat

During the start-up stage of cell preheat, if the temperature distribution is uneven or the anode is abnormal, a large current will concentrate on one anode or its flexible connection, forming a serious problem. Excessive current will melt the electrical transition joints, which will lead to a vicious cycle of current overload, resulting in the burnout of the electrical transition joints one after another and the explosion of the short-circuit shunt. Through the study of historical data, it was found that when serious unbalance of the current occurs during preheat, the resistance balance of the whole electrolytic cell is destroyed and the cell voltage variation is abnormal. Therefore, the serious current unbalance during the cell preheat can be identified in advance according to the variation relationship and characteristics of voltage and current during the preheat.

6. References

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