Analysis and Research on New Drilling Parameter Acquisition System of Coalbed Methane

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Abstract

In view of the complex structure, over-capacity, and high cost of traditional integrated logging tools in CBM drilling applications, A new type of drill ginseng collection system suitable for CBM drilling was designed and analyzed. The system can monitor and analyze the drilling engineering parameters, gas-logging data and MWD data during the CBM drilling process; The real-time friction/torque warning subsystem is developed to realize the real-time warning of downhole friction/torque, and then to judge whether the downhole collapse or sticking occurs. It effectively improves the accuracy and reliability of judging the collapse and sticking of CBM drilling, and reduces the occurrence of derivative accidents. It effectively reduce development costs while meeting the actual conditions of current CBM drilling sites.

Keywords

Coalbed methane, Data acquisition, Monitoring and early warning.

1. Introduction

Without the specialized CBM drilling monitoring equipment with mature technology and pertinence abroad. At present, the commonly used CBM drilling monitoring equipment in China is still a traditional comprehensive logging instrument. In the drilling process of coalbed methane, the traditional comprehensive logging instrument has a complicated structure, high service cost, and some of its functions are redundant. Therefore, the application of the traditional comprehensive logging tool for CBM drilling construction has great limitations.

In response to the above problems, the designed new coalbed methane acquisition system can be compatible with a variety of CBM drilling equipment by simplifying and optimizing the sensor matching and data acquisition system of the traditional integrated logging instrument to realize the rapid installation and linkage of field equipment. The system can effectively reduce the service cost of drilling monitoring equipment in the CBM drilling project while meeting the actual needs, and provides a guarantee for safe construction and rapid drilling.

2. Ystem suitability analysis

Compared with foreign CBM special drilling monitoring equipment, the domestic research and development of similar equipment started late, and it is mainly transplanted to the traditional comprehensive logging instrument.

In the process of CBM drilling, the drilling monitoring equipment is mainly used for rapid discovery and quasi-target reservoirs, effectively avoiding drilling engineering accidents[1]. Traditional integrated logging tools, such as the evaluation of oil and gas in the formation and the discovery and interpretation of oil and gas layers[2]. This function is not applied in CBM well drilling, this means

performance redundancy. At the same time, according to the low mechanical strength of the coal seam, the development of natural fractures, poor homogenization, etc., the under-balanced horizontal well drilling technology used in China[3][4], In the drilling process, special downhole measuring instruments are usually equipped, and the comprehensive logging instrument cannot realize the multi-source information fusion of the downhole instrument and the ground.

The designed new coalbed methane drilling system can be applied to different CBM drilling equipment, it can be quickly installed and linked on the drilling site, and can be combined with directional and mud logging. At the same time, it can carry out integrated monitoring of underground and surface multi-source data on the drilling site. These functions provide data basis for fast discovery, calibration of target layer and correction and adjustment of well trajectory[5]. The real-time frictional/torque warning can also be carried out through the inversion of the corresponding monitoring data, so as to realize the warning of collapse and sticking.

The system can meet the actual needs of CBM drilling technology and low-cost development, and can adapt to the characteristics of short CBM drilling cycle, small well site size and scattered distribution, and make up for the sensor of traditional comprehensive logging instrument in CBM drilling process. The configuration and acquisition system configuration structure is complicated, the installation is cumbersome, and it is difficult to integrate with the special measuring instrument for coalbed methane.

3. System composition

The new drilling system for coalbed methane can be divided into hardware systems and supporting software systems. It can realize the collection, transmission, monitoring, management and processing of multi-source data from underground and ground. The overall design scheme is shown in Figure 3-1.

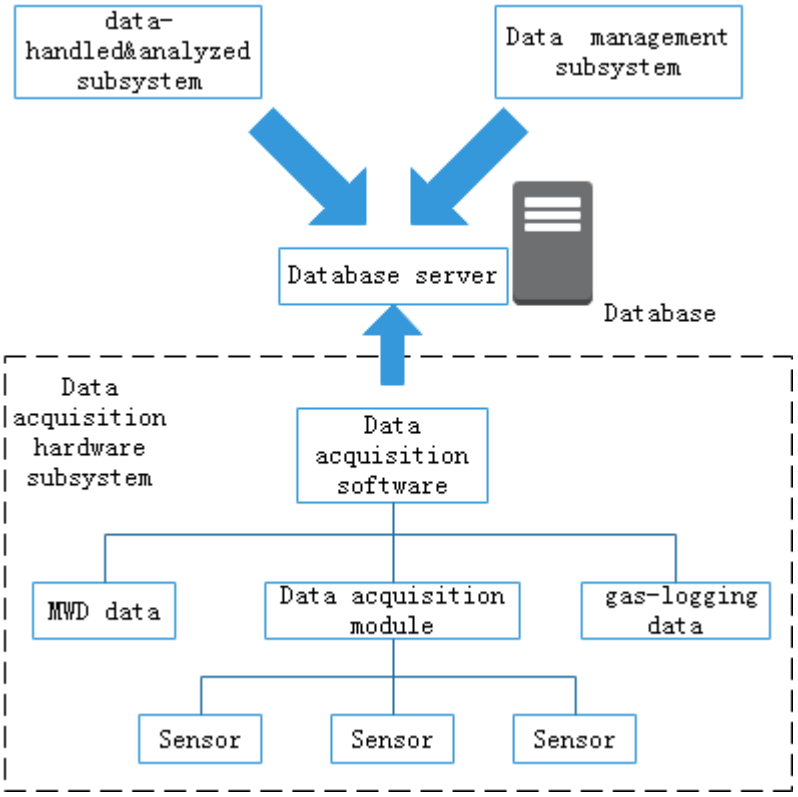

Figure 3-1 Overall design of the system

The supporting hardware and the self-developed supporting software consisting of data management subsystem, real-time monitoring subsystem and real-time early warning subsystem are used to integrate software and hardware, thus forming a complete new industrial system for drilling and

collecting. The system can comprehensively monitor coalbed methane drilling engineering parameters, gas-logging data and MWD data; the friction/torque real-time warning subsystem provides the ability to collide and track real-time dynamic warnings. The system data architecture is shown in Figure 3-2.

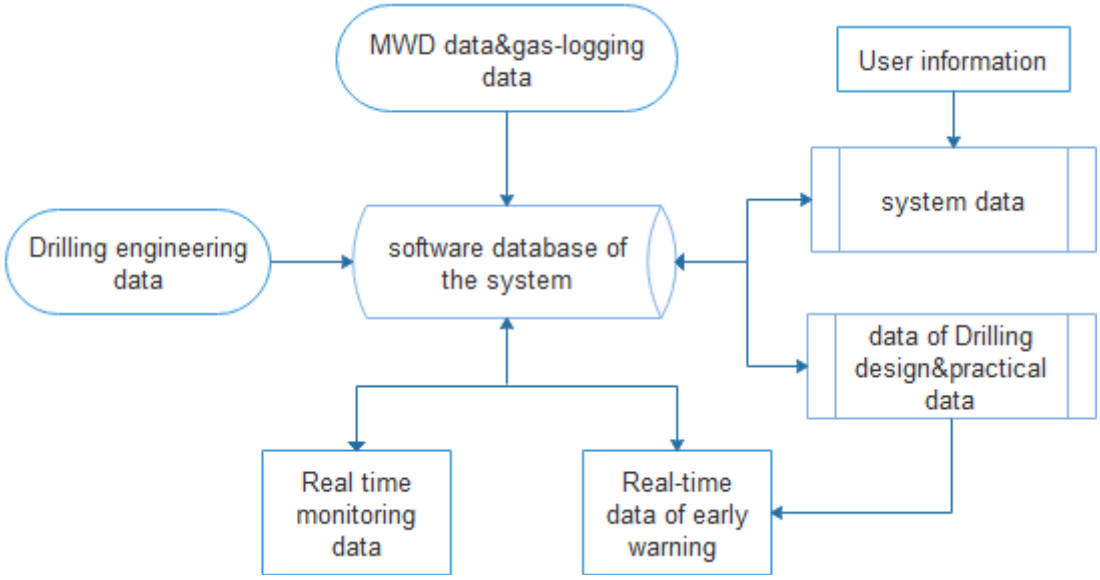

Figure 3-2 The system data architecture

3.1 Hardware system

The hardware design is mainly divided into data acquisition part and data transmission part. The system workflow is: The on-site sensor will be converted into a standard signal and transmitted to the data acquisition module. After signal processing, it will be transmitted to the Ethernet switch through the serial device networking server, at the same time, the gas-logging data and the MWD data are intercepted, and finally the collected and intercepted data is processed and stored. On the well site, each client establishes a local area network through Ethernet, and uses the standard WITS interface for wired transmission to realize real-time data acquisition and multi-screen monitoring on site.

3.1.1 Data acquisition part

The data acquisition part mainly simplifies, optimizes and re-integrates the complex sensor matching and data acquisition system of the traditional integrated logging tool, Thereby forming a set of hardware design of a new coalbed methane drilling system. This system can be matched with related CBM drilling equipment. In turn, real-time real-time monitoring parameters of drilling engineering (including winch, suspension weight, vertical pressure, casing pressure, pumping, turntable torque, drilling fluid inlet and outlet flow, etc., which can increase or decrease the monitoring parameters according to the actual situation of the drilling construction site) collection, At the same time, MWD data (including vertical depth, well angle and azimuth angle) and gas-logging data (all hydrocarbons, methane, etc.) are intercepted and processed by the host computer and stored in the database for post-processing and analysis. The design of the acquisition scheme is shown in Figure 3-3.

For different sensor output modes, the corresponding signal acquisition module is required. All the collected signals are processed by each module, and then transmitted to ADAM-4570 through KSD2-GW-MOD.485 communication module. Then the data is transferred to the upper computer through the switch, and stored in the database after processing to complete the whole data acquisition process.

The collection of on-site drilling engineering parameters uses the above-mentioned drill data system supporting instrument data acquisition system, while the gas-logging and MWD data is based on WITS-based data acquisition system: the gas-logging and MWD data are packaged according to the standard data format of the Well Field Information Transmission Specification (WITS), and the data is transmitted by the Windows Sockets programming interface and the TCP/IP protocol[6].The

database system is combined with the established system. Software system database, compile and develop gas-logging and MWD real-time data acquisition software, and realize data unified interface to facilitate post-software integration work.

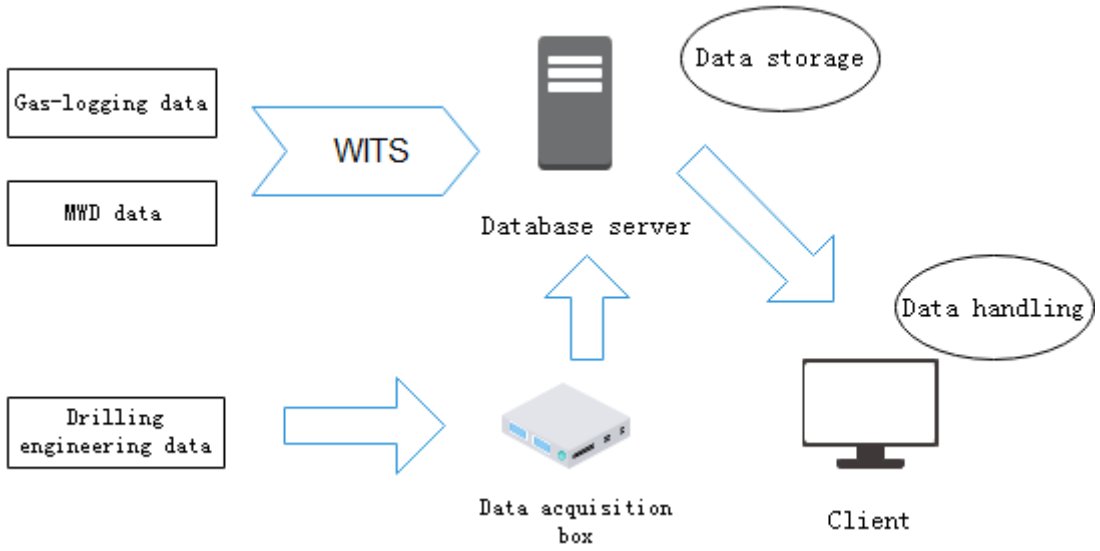

Figure 3-3 Design of data acquisition scheme

3.1.2 Data transmission part

According to the overall functional requirements of the drill system, the data transmission system can be roughly divided into two parts: the underlying data acquisition transmission network and the upper layer data processing transmission network.

The underlying data acquisition and transmission network is composed of various sensor interconnections at the drilling site. Drilling site sensors are more scattered in the well area and are more numerous. The basic sensor network must meet the requirements of real-time, stable and reliable system signal acquisition, and it needs to meet the requirements of less field wiring and simple wiring. The RS-485 standard is generally used as a communication platform that is relatively economical, has relatively high noise suppression, relatively high transmission rate, and long transmission distance. Therefore, the sensor uses RS485 bus to achieve interconnection. The field sensors are mainly concentrated in the two areas of the drilling platform and the mud irrigation area. The sensor lines are finally collected in the collection box.

The upper layer data processing is mainly composed of the monitoring PCs of the drill room and the duty room. Inter-PC interconnection uses Ethernet to form a LAN[7]. The structure of the upper layer data processing network of the new Drilling System is shown in Figure 3-4. The monitoring PCs of the drill room and the duty room are connected by wires through the switch, and each signal is transmitted through Ethernet; the CDMA / GPRS wireless router is also connected to the switch, through which wireless access to the Internet enables the remote base station to receive well drilling data in real time. The remote client can know the drilling status in real time[8]. The RS485 bus network and Ethernet are two different heterogeneous networks. The serial device networking server enables the interconnection of information between the two, making the well network connection an organic whole[9].

3.2 Supporting software

According to the overall design and hardware architecture of the new coalbed methane acquisition system, the software system is mainly composed of real-time data acquisition and processing system, data management system and real-time monitoring and early warning system. The overall architecture design of the system is shown in Figure 3-5.

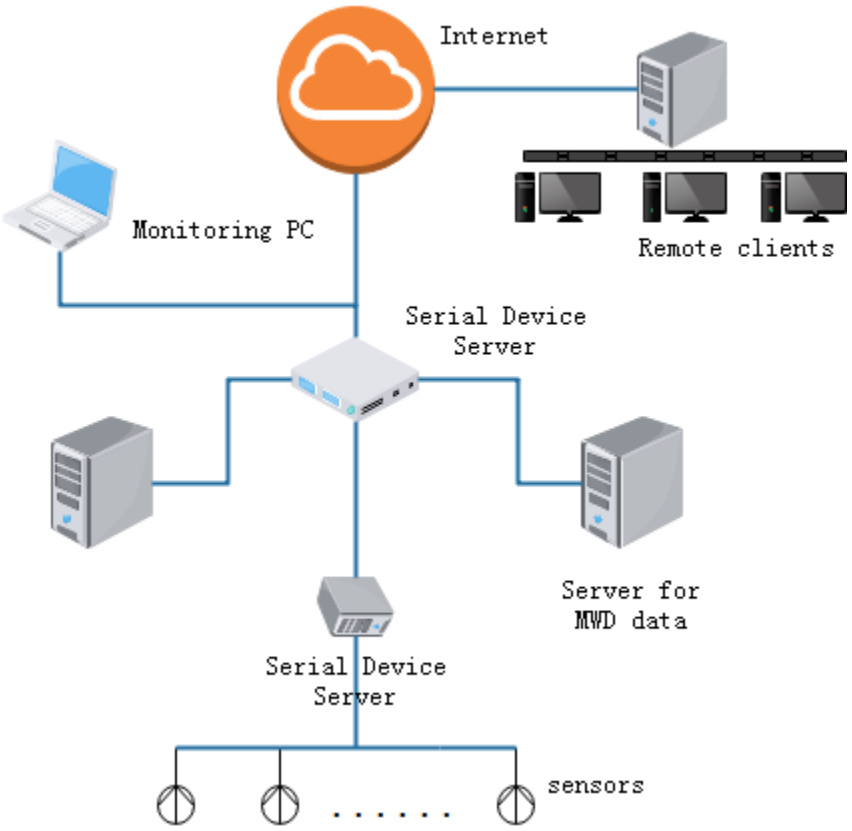

Figure 3-4 Upper data processing network of the system

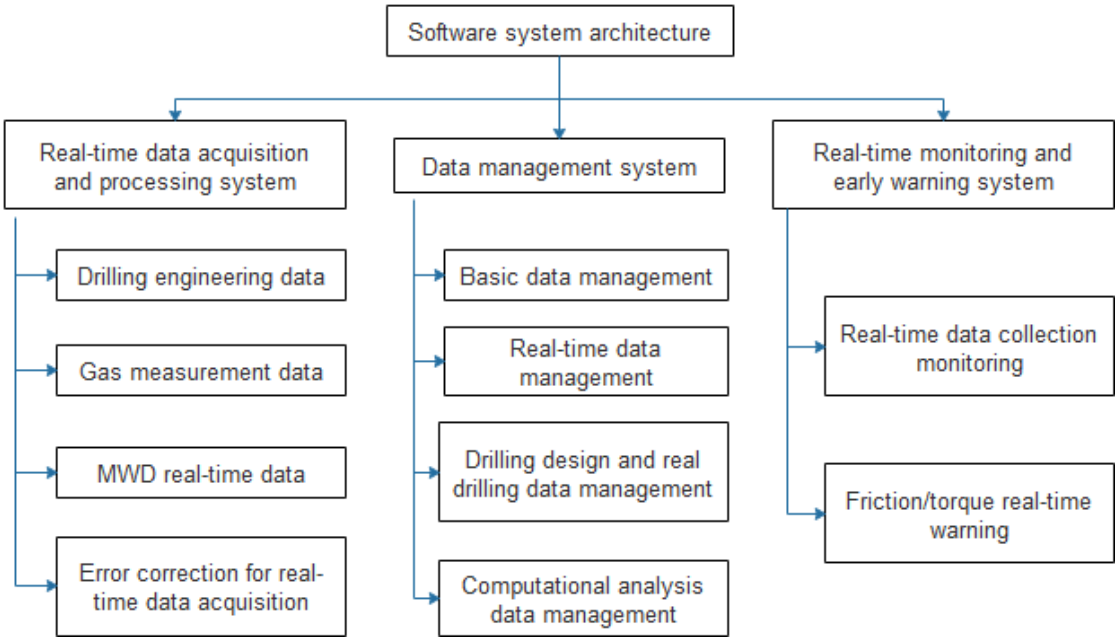

Figure 3-5 Software system architecture

Among them, the real-time data acquisition and processing system mainly completes the real-time collection of drilling engineering data, gas-logging data and MWD data, and stores the real-time collected and processed data into the system database. If the accuracy of the data collected by the drilling engineering is low, the error correction of the data collected in real time can be performed, and the data collected and processed in real time is stored in the system database; the data management system mainly realizes the interactive management of basic data, real-time data, drilling

design and actual drilling data and calculation and analysis data; real-time monitoring and early warning system mainly realizes integrated monitoring of drilling engineering data, gas-logging data and MWD data, and underground mine Real-time warning of resistance/torque.

3.2.1 Data management system

The data management subsystem of the new CBM software system of CBM mainly completes the real-time measurement data of the Drilling Instrument and the management of the basic data, and provides complete and accurate data support for the operation of the system.

The basic data management includes well basic data management, well structure data management, drilling tool assembly component data management, drilling tool combination data management, drilling fluid performance data management and other modules, which can be used to manually export, add, modify, and delete data. And other functions.

The system real-time data tube module can perform real-time management including drilling engineering parameters, gas-logging data and MWD data, and can display various data in real time.

The data management software can edit and process the CBM new drilling parameter measurement data and the drilling basic data. The user can query the relevant data in the database through keywords; it can display various data in real time; it can be entered according to user needs. Related data, you can also export arbitrary data to a text file, and perform functions such as remote backup.

3.2.2 Real-time monitoring system

Develop a new real-time monitoring subsystem for coalbed methane based on the supporting data acquisition system. The system realizes integrated monitoring of drilling engineering data, MWD data and gas-logging data in real time, and presents the data to the user in real-time curve or digital display. Provides a real-time reference for the CBM drilling process for technicians to analyze the drilling conditions.

3.2.3 Early warning system

Based on the real-time early warning model of downhole friction/torque established by using ground monitoring parameters, the real-time dynamic early warning subsystem of the new drilling and ginseng system supporting friction/torque is developed. The system can provide early warning of collapse and stuck drilling abnormalities in the drilling formation, so that the construction personnel can take corresponding measures in time to effectively avoid the occurrence of derivative accidents.

According to the parameters such as the large hook load and torque collected by the new coalbed methane drilling instrument, the friction and torque model can be used to invert the downhole friction/torque to judge the complex situation. When the friction/torque of the reverse performance is high, it indicates that there may be a collapse or stuck drill accident in the lower section. The running process is shown in Figure 3-6.

Combined with the running process of the friction/torque real-time warning system, the design of the friction-torque/torque real-time dynamic early warning system is carried out. The front-end real-time monitoring system completed the on-site real-time collection of drilling engineering data, gas-logging data and MWD data integration monitoring. The friction/torque real-time warning system completes the information interaction with the real-time monitoring system, extracts the relevant real-time data required for the friction/torque dynamic analysis, and extracts the corresponding static data required for the friction/torque dynamic analysis from the system database; based on the friction/torque dynamic analysis model, the downhole friction/torque under different working conditions is calculated to realize the real-time dynamic warning of the downhole friction/torque under different working conditions. Through the friction/torque real-time early warning system, the purpose of using the drill-drilling instrument to perform real-time early warning of collapse and stuck drilling in the CBM drilling process is realized.

The early warning system can provide early warning of collapse and stuck drilling abnormalities in the drilling formation, so that the construction personnel can take corresponding measures in time to effectively avoid the occurrence of derivative accidents.

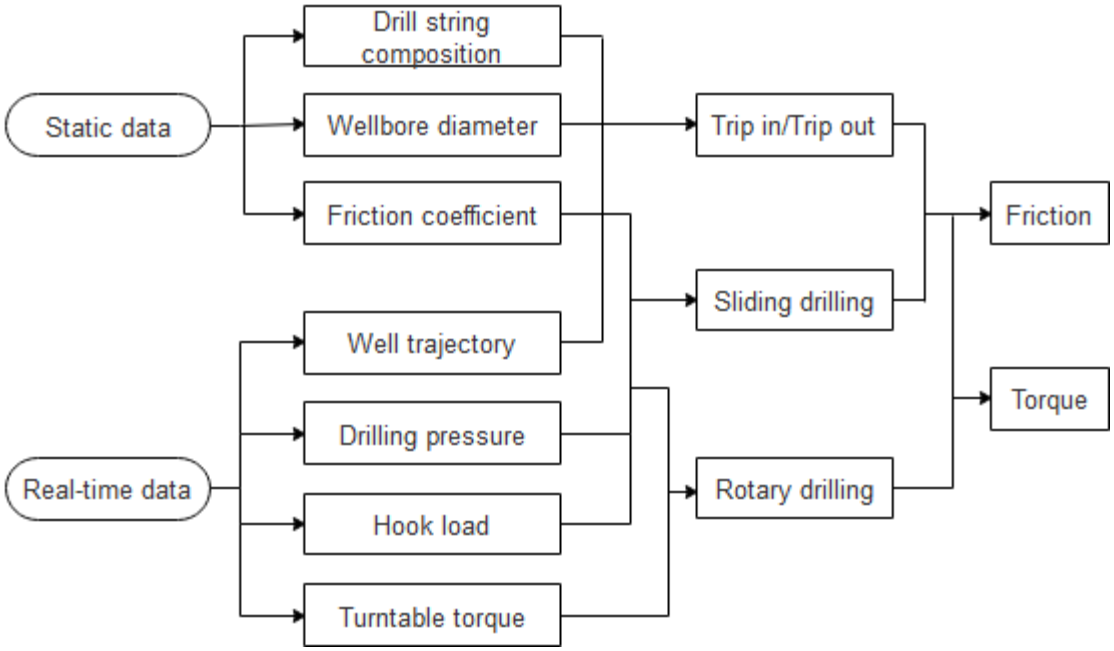

Figure 3-6 Running process of friction/torque real-time warning system

4. Result

Aiming at the limitations of the traditional comprehensive logging instrument in the monitoring application of coalbed methane drilling, a new coalbed methane acquisition system was designed. The system has simple structure and comprehensive data collection. It can display real-time monitoring data such as drilling engineering parameters, gas-logging data and MWD data intuitively and accurately. It has the function of integrated recording, which can meet the on-site requirements of CBM drilling; at the same time, the system can also provide real-time warning of the downhole friction/torque, effectively reducing the occurrence of downhole derivative accidents during the drilling process. It is beneficial to reduce the cost of CBM drilling and achieve safe and rapid drilling.

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