

Research and Application of Intelligent Fully Compatible integrated verification system

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Abstract. At present, the State Grid verification pipeline can only work for a single metering equipment, and exists some outstanding problems, including utilization rate, clear line time, the project investment cost and occupation area and so on. This paper introduces fully compatible integration verification system which has multi material, multi batches and multi task features. It supports the single-phase electric energy meter, three-phase direct access type electric energy meter, three phase by transformer access type electric energy meter, I type collector, I type concentrator, II type concentrator, III type data acquisition terminals of special transformer online verification at the same time. The application of fully compatible integration verification system reduce the project investment cost, floor space and manpower cost effectively. It improves the verification efficiency greatly and has obvious economic benefit and social benefit.

Introduction

In order to ensure the accuracy of measurement, all new arrival metering equipment must be tested, including full performance testing and sample testing in accordance with the relevant national regulations. According to the provincial center of measurement work requirements, the Sichuan Electric Power Corporation Metering Center has established single-phase electric energy meter verification line and three-phase electrical energy meter verification line. The application of automatic verification line has improved the verification efficiency of large batch arrival batch electric energy meter greatly, and ensured the accuracy of verification.

In the actual situation, the traditional verification testing pipeline construction mode also exists many problems. Firstly, the verification quantity of all kinds of measuring equipment are big different. Because of the traditional verification system is not compatible with a variety of meter device, they can't realize the complementary of production capacity. Secondly, the traditional verification testing pipeline system cannot share the common infrastructure equipment, including feeding robot, transmission unit, indoor temperature control system and so on, which increased the project investment cost, manpower cost and covering area; Finally, the traditional verification testing pipeline system spend a lot of time clearing pipeline between different batches, which makes the verification system cannot give full play to its advantage of large batch verification.

Aiming at the above problems, this paper discussed the tray technology、robot baiting unit、verification unit and material scheduling system, developed new verification system for multi batch、multi batch and multi task, which overcome the differences size of metering equipment, verification item and other key problem. The application of the system greatly improves the metering equipment verification efficiency, saves the project investment cost, manpower cost and covering area and have yielded remarkable social and economic benefits.

THE WHOLE OF SYSTEM

The system is composed of management layer, transport layer, execution layer composition. The management system platform is responsible for the management and control of the whole test system. The transport layer is composed of conveying unit, which is responsible for conveying and positioning measurement equipment in the verification process. The execution layer is composed of intelligent storage feeder, upper and lower material sorting, pressure test, visual inspection, power

test, communication test and multifunction test module, automatic seal, automatic labeling, connecting and disconnecting unit form, perform detection system platform instruction, which is responsible for all kinds of function testing.

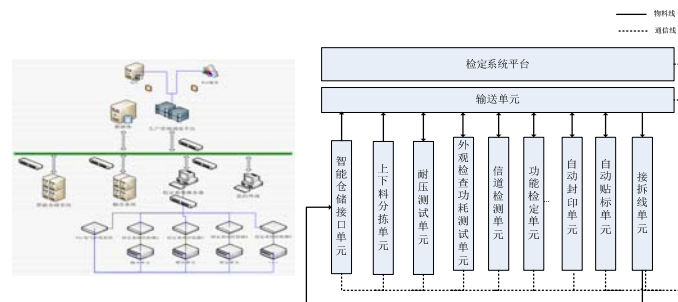


Figure 1. System architecture

Fully compatible integration verification system consists of two A class verification bin and seven B class verification bin. A class verification bin is mainly responsible for the acquisition of I type, concentrator of II type and single-phase electric energy meter for a total of 120 meters; B class verification bin is mainly responsible for concentrator of I type, III type data acquisition terminals of special transformer, three-phase direct access type electric energy meter and three-phase by transformer access type electric energy meter for a total of 168 meters.

MODULE DESIGN

TRAY DESIGN

The traditional verification system is designed for verification of a single device, so the size of the tray fixed. For full compatibility verification requirements, the tray must adapt different measurement and acquisition equipment.

In accordance with The State Grid relevant national regulations ,including "single phase intelligent electric energy meter type specification", "three-phase intelligent electric energy meter type specification" and "power user electric energy data acquire system type specification", The size of equipment you see will be as follow^[1,6]:

Table 1. Size of metering device

Device	Length(mm)	Width(mm)
collector type I	160	112
concentrator type I	290	180
concentrator type II	160	112
the acquisition terminal of special transformer type III	290	180
single phase electric energy meter	160	112
three-phase direct access type electric energy meter	290	170
three-phase by transformer access type electric energy meter	290	170

It can be find that the size difference of all kinds of measurement equipment is large. Comparison and analysis of various types of equipment by the length and width, we can found the size is mainly concentrated in the 160mm * 112mm, 290mm * 170mm. For the cost and maximize the benefit consideration, the system adopts two kinds of tray, namely the A tray and B tray. The lifting, positioning, expanding device push clamping fingers on the tray to make the initial position of clamping fingers changing which makes the tray can be compatible with a light change in size.

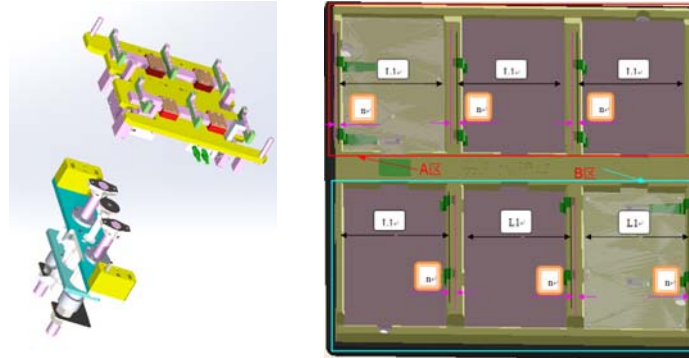


Figure 2. Tray structure

ROBOT CLAW DESIGN

In the electric power metering devices automatic verification system field, the loading and unloading operation is accomplished by the robot. The robot is mainly composed of base, connecting rod, mechanical arm and mechanical hand grasp component. It has the advantages of low noise, high reliability.



Figure 3. Sucker claw

For fully compatibility integration verification system, due to the size of single-phase electric energy meter, three-phase direct access type electric energy meter, three phase by transformer access type electric energy meter, I type concentrator, I type collector, II type concentrator, III type data acquisition terminals of special transformer measurement equipment are not identical and different, the traditional mechanical hand can't achieved grasping for different size. In order to solve the above problem, the system replaced the mechanical hand grasp with the sucker. Compared with the traditional mechanical hand grasp, the sucker can adapt to various measuring equipment size, and grab the implementation of metering equipment non-differentially.

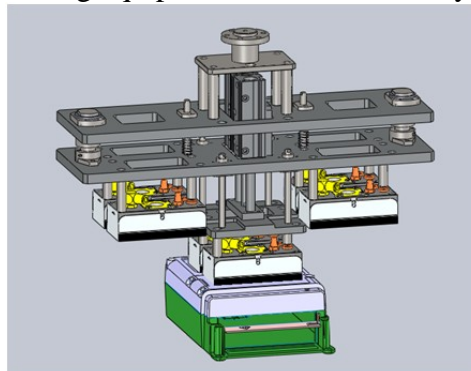


Figure 4. one meter catch mode

When loading and unloading operation, the robot controller control the robot operation mode based on the tray RFID information. If the measurement equipment is A class, all three suckers of robot grab metering equipment simultaneously, namely "three meter catch" mode; if the measurement equipment is B class, the middle sucker of robot grab the metering equipment, the others suckers are restored to the initial state, namely "one meter catch" mode.

DESIGN VERIFICATION BIN

According to the different sizes of measurement equipment, fully compatible integration verification system verification bin is divided into A, B two kinds. A class verification bin is mainly responsible for the acquisition of I type, concentrator of II type and single-phase electric energy meter; B class verification bin is mainly responsible for concentrator of I type, III type data acquisition terminals of special transformer, three-phase direct access type electric energy meter and three-phase by transformer access type electric energy meter. In order to solve the carrier module connection problems, the class B bin is designed on both sides respectively, one side is responsible for the acquisition terminal of special transformer type III, concentrator of type I; the other side is responsible for three-phase electric energy meter. The verification system recognized the meter information through tray RFID, and utilize the inner rotating structure to control the B class device connecting direction. By using rotational structure, it can make the bin width only as a tray width, which save the bin area.

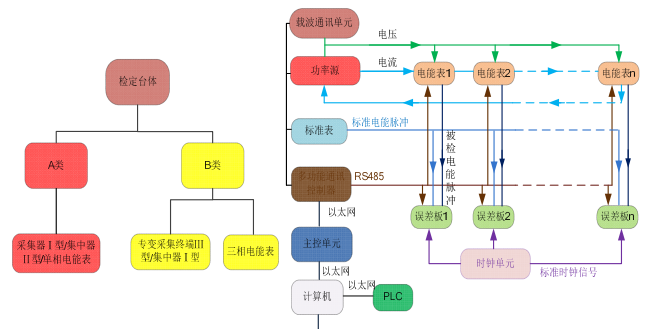


Figure 5. Verification bin structure

The main control unit: the main control unit adopts the industrial control machine (Advantech AMIB212). Main control unit connect to the control center by Ethernet. The control center is responsible for sending meter information and verification scheme to the main control unit, and the main control unit start the verification. After the completion of the verification, the result will be sent to the control center.

Multifunctional communication controller: multifunctional communication controller exchange instruction and data with the main control unit, power source, the standard meter, carrier communication unit via the Ethernet controller; and communicate with the aimed meter and error board one by one by the 485.

Power source: the main control unit control the output of power source, including voltage, current, phase, frequency, power and so on. The amplitude, phase and frequency of voltage and current can be set freely, and can be adjusted in the output state.

The error calculation unit: The error calculation unit ,namely as error board, receive the standard meter electric energy pulse, the aimed meter electric energy meter pulse and clock pulse simultaneously, and calculated the electric energy meter error the error of time of day, time switching error, demand cycle error and so on.

Carrier communication unit: this module switch different carrier channel, including Neusoft, XiaoCheng and DingXin according the instruction of the main control unit. At the same time, Carrier communication unit send the carrier signal of the main control unit to the aimed meter.

The clock unit: it provide standard clock signal to calculate the timing error.

SYSTEM APPLICATION RESULT ANALYSIS

Performance analysis

Table 2. Comparison of verification ability

Pipeline		meter place/per bin	bin	total	experiment time/hour	clean line time/hour
Single-phase electric energy meter verifi- cation Pipeline		17	72	1224	1.3	3
Fully Compati- ble integrated verification sys- tem	A	2	60	120	\	0
	B	7	24	168	\	0

Take Sichuan Electric Power Corporation Metering Center 2014's single-phase electric energy meter for example. Influenced by the capital attribute, the Sichuan Province Electric Power Company metering center verification plan involve the power companies, holding, the escrow company for a total of 83. Verification batches are four hundred approximately, and 249 batch's amount is less than 2000. The average clear line time is three hours, the total clear time is 747 hours. Since full compatibility verification pipeline adopts new scheduling system which has multi material, multi batches and multi task features, the clear line time is shortened to 15 minutes. When using the full compatibility verification system to replace the single-phase electric energy meter pipeline for small quantities of electrical energy meter verification, the amount of the single-phase electric energy meter verification pipeline can be improved about 680000.

Analysis of economic benefits

Before the application of the system, it needs construction four automatic verification assembly lines separately to accomplish the same function. The electric energy meter pipeline costs approximately 110 thousand/meter, the collector pipeline costs approximately 20 thousand/meter, the concentrator pipeline costs about 100 thousand/meter, the acquisition terminal of special transformer pipeline construction costs about 110 thousand/meter. The four automatic verification assembly line investment cost about 51.36million. The fully compatible integration verification system cost about 17 million, the investment cost of pipeline could save 34.36 million.

Each pipeline needs 5 operators, four pipeline need 20 person. The average human cost of one people is 50000 yuan, manpower cost 1000000 yuan annually. After the application of the system, and it only need 5 people, the annual manpower cost 250000 yuan. The human cost is reduced by 750000 yuan /year.

Before the application of the system, it needs floor space 1088m², including 320 m² for electric energy meter pipeline, 295 m² for collector, 245 m² for concentrator pipeline and 228 m² for the acquisition terminal of special transformer pipeline, the annual average floor space cost is 400 yuan /m², annual cost of floor space is 435200 yuan. Fully compatible integrated system floor space is 285 m², the annual cost is 114000 yuan. the cost of floor space saved 321200 yuan / year.

Summary

This paper studies fully compatible integration verification system which has multi material, multi batches and multi task features .This system has been implemented at verification. The system supports the single-phase electric energy meter, three-phase direct access type electric energy meter, three phase by transformer access type electric energy meter, I type collector, I type concentrator, II type concentrator, III type data acquisition terminals of special transformer online verification at the same time. The application of fully compatible integration verification system reduce the project investment cost, floor space and manpower cost effectively. It improves the verification efficiency greatly and has obvious economic benefit and social benefit. Deadline

The above material should be with the editor before the deadline for submission. Any material received too late will not be published. Send the material by airmail or by courier well packed and in time. Be sure that all pages are included in the parcel.

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