TELKOMNIKA, Vol. 11, No. 4, April 2013, pp. 2018~2023
ISSN: 2302-4046

The Application of NTAUTO in the 1000MW Ultra-Supercritical Units

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Abstract

NTAUTO is an auto-configuration software, which is developed by department of technology of Beijing GuoDianZhiShen Control Technology Co., Ltd.,. The configuration software has been applied in the configuration of 1000MW ultra-supercritical units. The automated configuration technology is the advanced technology of Beijing GuoDianZhiShen Control Technology Co., Ltd through years of accumulated technology in thermal power control field. It makes full use of computer control and CRT to provide a configuration solution of I/O database, SAMA control sheet, and the man-machine interface.

Keywords*: 1000MW, ultra-supercritical units, DCS, automated configuration*

1. Introduction

Distributed Control System for short DCS industrial automation CONTROL field is widely used in CONTROL system. The CONTROL technology, COMPUTER technology, COMMUNICATION technology, and image display technology (CRT) 4C technology are its salient features. Domestic industrial automation control, before take the form of a foreign import system, after years of development, the domestic DCS system gradually to catch up with and surpass the import system, and it has been widely used in China's thermal power unit automation control system.

GuoDian ZhiShen Control Technology Co., Ltd can provide with independent intellectual property rights automation control system products and engineering design, service and even the whole solution of one of the main suppliers. With more than 30 years in thermal power industry automation product development design and engineering application service primarily history, its independent intellectual property rights automation control system (EDPF-NT+) in industrial field (in thermal power industry primarily) application performance more than 500 sets [1]. In the thermal power in the field of industrial automation control, thermal power unit DCS design has been formed a set of standardized system. The research has developed a set of efficient automation configuration technology, "NTAUTO".

2. EDPF-NT+DCS Standard Design

EDPF-NT+DCS efficient automation configuration technology is by using the computer technology to make EDPF-NT+DCS standardization for programming, routing designed to convert to computer which can recognize cooperation technology. DCS design standardization is the automation configuration foundation and basis.

Industrial enterprise's production can't be separated from all kinds of standards. In compliance with all kinds of external standard case, a certain scale of enterprises should have their own enterprise standard, with these standards engineering design, implementation, and commissioning. GuoDian ZhiShen Control Technology Co., Ltd in reference to a large number of domestic and foreign standard lemmas, formulate a set of our own enterprise standardization system, which includes a total of 20 kinds of standard documents, covering the project management, project design and implementation, the commissioning and so on[2]. Standard into engineering design provides a basis for implementation. It can shorten the design cycle, implementation period, and increase the generality.

Received January 9, 2013; Revised February 21, 2013; Accepted March 3, 2013

At present, the DCS configuration standards in GuoDian ZhiShen Control Technology Co., Ltd. are: "EDPF-NT+ automation configuration technology standard", "EDPF-NT PLUS system control page distribution and intermediate roll call configuration standards", "the I/O database distribution standard", "EDPF-NT PLUS typical chart standard", "EDPF-NT PLUS system DAS screen design standard", "BSCS function design standard", "coal-fired power plant FSSS design standards", "MCS function design standard", "ECS function design standard", "MEH function design standard", "ETS function design standard", "DEH function design standard", etc. These standardized documents for enterprise a lot of project implementation and practice to lay a solid technical foundation, the configuration process of each process provides a technical document instruction, for the automation configuration technology provides the strong basis. Flow chart as Figure 1.

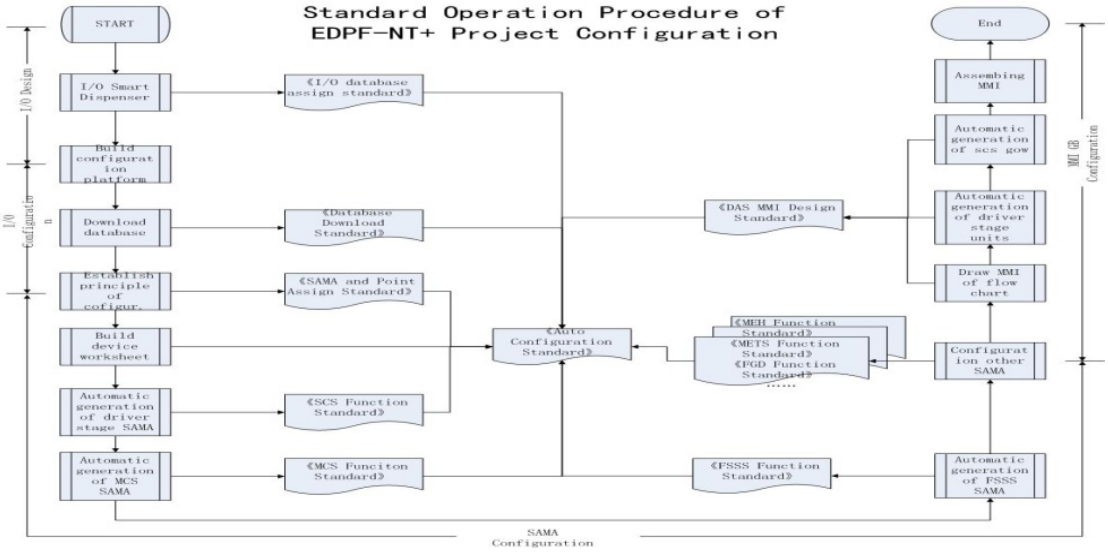

Figure 1. Configuration Process of EDPF-NT+ Project

3. EDPF-NT+ Efficient Automation Configuration Technology

The project configuration process, the standardization of design files in all links provide the technical documents guiding, automation configuration technology standardization documents according to influence of the configuration each link. From the I/O database automation configuration, SAMA control logic automation configuration, MMI man-machine interface automation configuration expounds three aspects.

3.1. I/O Database Automation Configuration Technology

3.1.1. Three Layers of the I/O Data Clustering Model

For 1000MW level of DCS control system, its I/O points reaches more than 15000 points, if one logarithmic stronghold distribution, it is sure to make a huge project. Fortunately, seemingly isolated I/O point is actually organic contact; through data mining can be found after a lot of I/O point is a device or a function of the subordinate point. For example form 1, 6 I/O point can clustering [3] for one.

Table 1. Clustering I/O of 1000MW Unites

Cluster	KKS	I/O Description
D0LCA60AA001 (Low Pressure Heater 9 Outlet Valve)	D0LCA60AA001XB11	Low Pressure Heater 9 Outlet Valve Open Command
	D0LCA60AA001XB12	Low Pressure Heater 9 Outlet Valve Close Command
	D0LCA60AA001XB01	Low Pressure Heater 9 Outlet Valve Full ON
	D0LCA60AA001XB02	Low Pressure Heater 9 Outlet Valve Full OFF
	D0LCA60AA001XG01	Low Pressure Heater 9 Outlet Valve Remote Control
	D0LCA60AA001XG03	Low Pressure Heater 9 Outlet Valve Fault

For thermal power control object, according to the process can put the whole control system into several subsystems. For example, a 1000MW ultra-supercritical unit control system of the subsystem can be divided into such as Table 2.

Table 2. Sub System of 1000MW Unites

Main Function	Subsystem
FSSS	SOE,MFT,BATH oil system , Seal Air system, Milling system, Flame Check system, SCAF, Fuel system, Tiny-oil Ignition system
Boiler MCS	CCS control, Feed water control, Start Feed Water control, Burn Master control, Primary Air control, Air Supply control, Superheated Steam Temp control, Induced-draft control, Reheat Steam Temp control, Fuel control, Auxiliary Wind control, Fuel Wind control, Drain control, Air Bleed control, OFA control etc
Boiler Control	Wind & Smoke system, Boiler Circuit system Start Feed Water system, Drain & Air Bleed system Steam Air heater system, Superheated Steam system, Reheat Steam system, soot Blowing system, Denitration system、APS,
Turbine Control	Feed Pump system, Water Induction Prevent system, Heater Drain Flash Tank system, Turbine system, HP,LP, sewage Disposal, Shaft Seal, Deaerator, High Pressure Heater & Steam Extraction system, Low Pressure Heater & Steam Extraction system, Four period of extraction, Condensate Pump, Vacuum pump ,Condensing Water system, Condensing Water Pump, Open circulating water system, Closed circulating water system, AUX STEAM Auxiliary steam, Generator hydrogen, Sealing oil system, GST, Water circulating pump, Lubricating oil system, Jacking oil system, EH oil system, MEH,METS,DEH,ETS
ECS	Power generation transformer system, Excitation system, Generator, Station using transformer system, Auxiliary power system, DC system, Diesel engine system
Public System	Air compressor system, Starting transformer system, Station using 6Kv,Public transformer system

Low Pressure Heater 9 Outlet Valve of Table 1 can be included in Low Pressure Heater & Steam Extraction system of Table 2, the I/O database in the bottom, equipment clustering in the middle, sub system in the top constitute the three layers data clustering model of "NTAUTO" automation configuration technology as Figure 2.

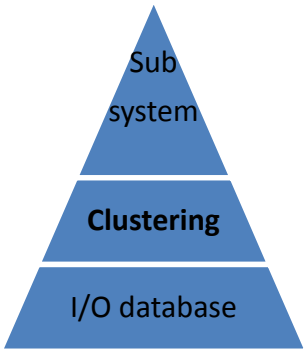

Figure 2. Three Layers Data Clustering Model

Figure 3. Sub System to DPU

3.1.2. Database Automation Configuration Technology

According to the three layer data clustering model, in dealing with the database to the I/O data point clustering for equipment list (Table 3), the equipment again clustering for subsystems, subsystem according to the process of thermal power unit gathered in this complex control of the production process.

When the database has been categorized clustering for equipment, subsystems, based on database, the software configuration personnel needs not to concern too much detail, only needs to delimit subsystem according to the actual requirements of controller (Figure 3). Distribution good controller, point to channel distribution [4] automatic according to company standard file the I/O database distribution standard "rules of channel assignment and fill in the terminal connection.

Company standard also gives several typical subsystems in the division and the distribution of the DPU, configuration personnel may, according to the actual unit selection of

"intelligent matching subsystem". The system will be allocated to the DPU, then each subsystem of the automatic measures point distribution card pieces, channel, and fills in the terminal number. Thus, it can greatly improve the work efficiency.

Table 3. Devices Table Clustered by I/O

	KKS	Device	START CMD	STOP CMD	START	STOP	ROMOTE	FAULT
1	HFW10AN001	Seal Fan A	YB01	YB02	XB01	XB02	XB04	XB03
2	HFW01AA001	Seal Fan A Inlet valve	YB01	YB02	XB01	XB02	XB04	XB03
3	HFW01AA003	Seal Fan A Outlet value	YB01	YB02	XB01	XB02	XB04	XB03
4	HHQ01AN001	SCAF A	YB01	YB02	XB01	XB02	XB04	XB03
5	HHQ02AN001	SCAF B	YB01	YB02	XB01	XB02	XB04	XB03
6	HJF80AA191	Oil return fast valve	YB01	YB02	XB01	XB02	XB04	XB03
7	HFC10AJ001	Coal mill A	YB01	YB02	XB01	XB02	XB04	XB03
		……						

3.2. SAMA Control Logic Automation Configuration Technology

3.2.1. Managed Code Technology

EDPF-NT+ has developed full graphic interface configuration environment based on Microsoft Visio platform. The configuration personnel are to provide similar Office development environment, friendly interface that can be easy to get started. VSTO (Visual Studio Tools for Office) is the NET platform of Office development technology. Compared with traditional VBA (Visual Basic Application) development, VSTO provides a more powerful development platform and language for senior developers. It partially solves the traditional office development in many problems as updating difficultly, expandability, maintaining difficultly, and low safety, etc. Developer can use familiar technology to construct flexible, strong, cross-platform enterprise-class solutions [5]. Logic structure is as shown in Figure 4.

Figure 4. Structure of VSTO

Table 4. Drive Control Model of EDPF-NT+

	Algorithm Name	Function
1	BREAKERII	Electric switch control
2	MOTORII	Electric motor control
3	MOV	Motor-operated valve control
4	MOVSPII	In stopping valve control
5	SCSOV	One coil electromagnetic valve control
6	STEPVALVE	Inching valve control
…	……..	……

3.2.2. Control Logic Automatic Configuration Technology

For the DCS system, control logic from the control function specification, such as standardized document has the BSCS function design standard, "the coal-fired power plant FSSS design standards", "the MCS function design standard", "the ECS function design standard", etc., which stipulated the control logic of the general form. In order to get convenient and quick configuration, according to the long-term thermal power unit control system debugging experience, Guodian Zhishen Control company cures and package some typical logic to drive field equipment, the EDPF-NT+ typical chart standard "carry on the rules and instructions. Table 4 is EDPF-NT+ typical equipment driver stage.

There is a corresponding typical equipment driver stage and the corresponding. According to the control function specification perfect other control logic and the form of data form record, then use VSTO programming processing data form, automatic generation of SAMA file. Figure 5 for automatic processing equipment form generation driver stage control SAMA system interface.

3.3. MMI Man-Machine Interface Automation Configuration Technology

3.3.1. Analytical and Batch Processing Technology

Extensible markup language is used to mark the electronic file with structural markup language, which can be used to mark data, define data types. It is a kind of allowing users to own markup language for definition of the source language [6]. XML simple make it easy to in any application, speaking, reading and writing data, this makes XML soon become the only public data exchange language, although different application software also support other data exchange format, but soon they will support XML, that means program can more easily with Windows and Mac OS, Linux and other platform produce information combination, and then can easily loading XML data to the program and analysis, and the output in XML format.

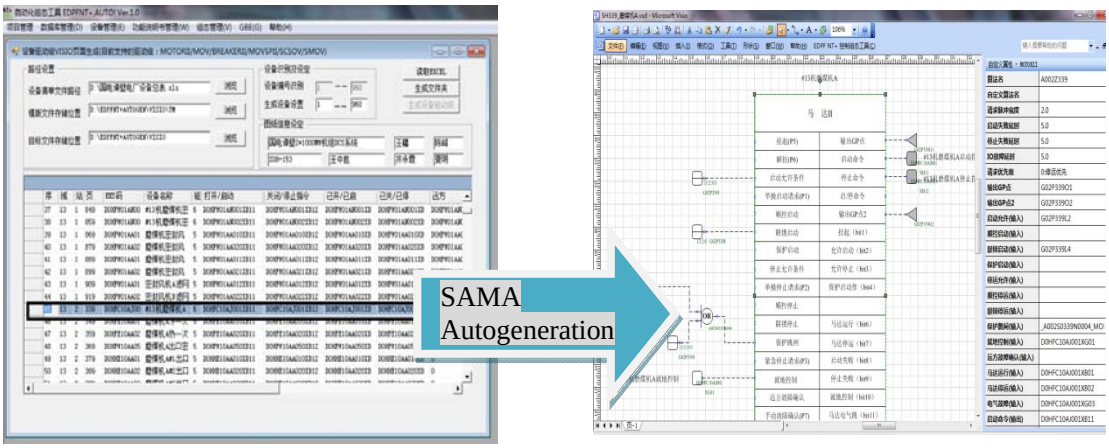

Figure 5. Creating Drive Control Model SAMA of NTAUTO VISIO

EDPF-NT+MMI of man-machine interface supports XML pure text editing technology, editing tool GB (Graph Build) supports batch derivation function. All the system master drawing (GOC), system window diagram (GOW) all can be derived XML format GOX file. For example to explain, when a GOC file derived for GOX documents, XML format picture MMI DAS point data representation, as shown in Figure 6.

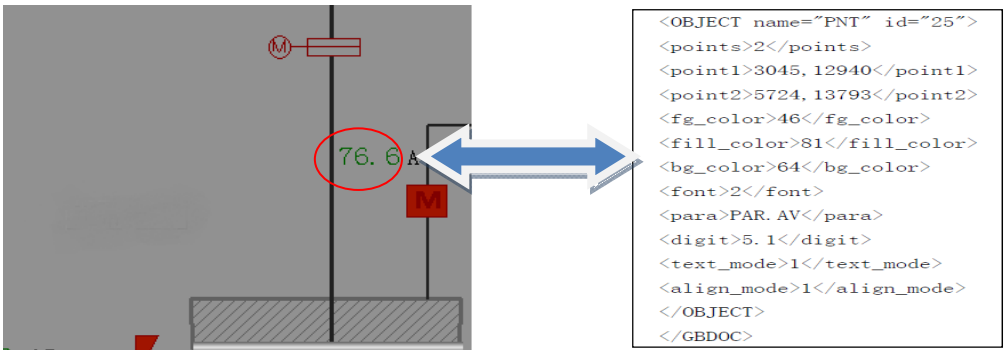

Figure 6. DAS Point in XML Mode

3.3.2. MMI Man-machine Interface Automation Configuration Technology

XML format GOX file is very convenient program, speaking, reading and writing process, all the system flow diagram and main window diagram into GOX file after all of the measuring point, equipment map symbol, piping, operating area into XML format data text files. It can automatically generate SAMA file data form here, also play an important role. Standard configuration form also can be done quickly standard man-machine operation process of MMI interface configuration work.

Take 1000MW ultra-supercritical unit for an example, its I/O points scale is to achieve more than 15000 points, controlled equipment more than 1200. The system process homepage faces up to more than 50 pages, window diagram of more than 2000. Such a large-scale configuration work pure artificial execution require considerable manpower and time, and according to the configuration of personnel and bad are intermingled level easy error and error is difficult to punch. "NTAUTO" technology, complex huge configuration workload converses into a computer program can identify equipment form and conditions, such as form the standard configuration form [7]. In accordance with the standard picture normal realization programming processing, it is completed the MMI configuration of the work efficiently. Automation configuration technology for the treatment of a 1000MW coal mill a picture and conditions MMI window diagram.

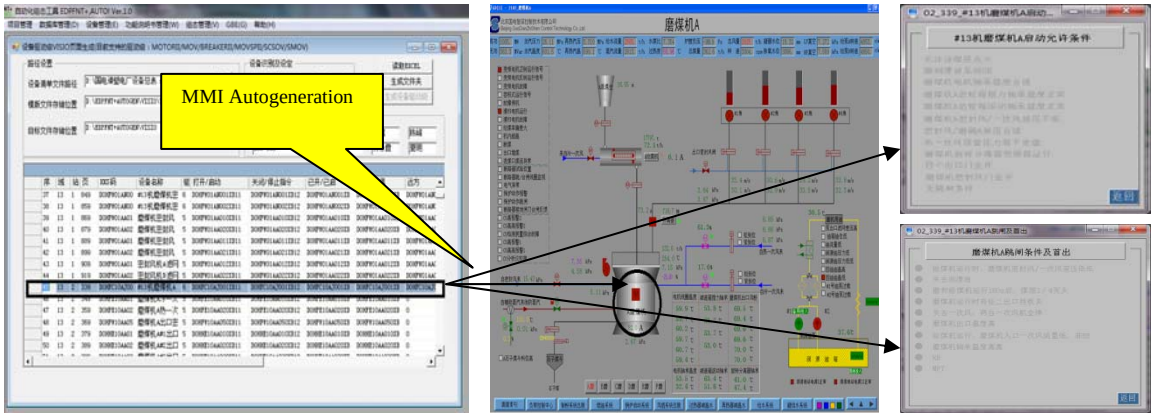

Figure 7. NTAUTO MMI Configuration

4. Conclusions

Since 2008, the EDPF-NT+DCS efficient automation configuration technology has been widely used in domestic 300MW-1000MW unit of the DCS control group state, Guodian suggestion wall, Guohua Xuzhou 1000MW unit such as smoothly through the 168 assessments that complete commercial production, Guodian HanChuan 1000MW unit smoothly through the FAT marks the technology. They have been successfully applied to the domestic 1000MW unit.

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