

THE UNICOS-CPC

VACUUM CONTROLS PACKAGE

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Abstract

The vacuum control of the Large Hadron Collider and its injectors is based on PLC and SCADA off-the-shelf components. Since late '90s, CERN's vacuum group has developed a dedicated control framework to drive, monitor and log the more than 10 000 vacuum instruments. Also, in 1998, CERN's industrial controls group developed the UNICOS framework (UNified Industrial Control System), becoming a de facto standard of industrial control systems and gradually deployed in different domains at CERN (e.g. Cryogenics, HVAC...). After an initial prototype applying the UNICOS-CPC (Continuous Process Control) framework to the controls of some vacuum installations, both teams have been working on the development of vacuum-specific objects and their integration, together with new features, into the UNICOS framework. Such convergence will allow this generic framework to better fit the vacuum systems, while offering the advantages of using a widespread and well-supported framework. This paper reports on the experience acquired in the development and deployment of vacuum specific objects in running installations, as a prototype for the vacuum controls convergence with UNICOS.



CALEPCS20 Barcelona · Spain, October 8-13 Palau de Congressos de Catalunya www.icalepcs2017.org

> October 12, 2017 Paper ID: THPHA016

				Vacuum CPC Objects			
List of Vacuum objects developed:			<u>Why do vacuum apps require specific objects?:</u> UNICOS-CPC only package		Widget's contextual menu: IRAININGLAB. VPIAA.003.A- (dick to copy) Voltage: 6900.00 V Current: 8.90 e-5 A Pressure: 1,10 e-8 mbar		
Symbol	Name VP_TP VG_PT	Description Turbomolecular Pump Passive Gauges (TPG300)	Type Field Object Field Object	VPT1 0.36 Amps 6 Objects	1 Object	Disable Help Show in TrendHistory Show in StateHistory Create Work Order Link to Position/Asset in inforDB Link to Functional Position in vacDB Select	
VRGP	VR_GT VP_I	TPG300 Controller Ion Pump (Profibus interface)	Field Object Field Object	<u>Gauge controller faceplate:</u>	<u>Pi</u>	Umping group process panels:	
	VV_S OnOff, widget VP_P	Sector Valve (Profibus interface) Primary pump widget (OnOff field object)	Field Object Widget panel	1 - VRGT.TRAININGLAB.R01.Y2X2Z TPG300 Gauge control VRGT.TRAININGLAB.R01.Y2X2Z Status Trends Alarm Event Comments Gauges Object Status	ller	4 Accelerating VPT Nominal Speed & Wait 2s 5 Nominal	
VRPI	VR_PI VR_AH	Ion Pump controller (Profibus interface) Hardware Alarm (generated by field controller)	Field Object Field Object	Comm StatusBusyRelay 1Valid and ON(ok)Relay 2Valid and ON(ok)Relay 3Valid and ON(ok)Relay 4Valid and ON(ok)Relay 4Valid and OFF(bad)Gauge 1Valid and OFF(bad)	160 ms I/O Error I/O Simulated	I - TRAININGLAB.VPGX.202.A Pumping Group Process Image: Comments Image: Comments <t< th=""></t<>	
Start WR open Accelerating	VP_G	Pumping Group	Process Object	Gauge 3 Valid and OPProad) OK OK Valid Valide Firmware 17408 Relay 2 Relay 3 Relays Relay 1 Relay 2 Relay 3 Source B2: TRAININGLAB //GPAA.006 A B1: TRAININGLAB.//GRAA.003.A A1: TRAININGLAB.//GPAA.006 A High 4.0 e-5 mbar 2.0 e-5 mbar 2.0 e-5 Low 4.0 e-5 mbar 4.0 e-4 mbar 4.0 e-5 TOff 0.0 s 0.0 s 0.0 s 0.0 s	Relay 4 004.A Invalid 5 mbar 4.0 e-5 mbar 5 mbar 4.0 e-5 mbar 0.0 s 0.0 s	State Manual State Manual State State Manual State State Manual State State State State State State Manual State	
				Refre	sh Select	Active Option PUMPING Stepper	

SCADA Features

Implementation of automatic synoptic:

WinCC-OA allows to write extension shared libraries, in C++, within functions that can be called from WinCC-OA CTRL language. First, the extension library function initializes geograph-ical information for machine by reading and parsing XML configuration files. Resulting geographical information is stored in memory of shared library for fast access during synoptic building. Then WinCC-OA panel calls extension library function to prepare synoptic, supplying geography range for synoptic and which natures of device shall be shown in the synoptic.



Automatic synoptic panel with different widget types:



Profile panel in pressure raised detection mode:



tate history	<u>pane</u> Proc	<u>91:</u> ess	Turboı P	Turbomolecular Pump			Intermediate Valve		
						- I			
🍄 State_History: State_Hist	ory						_ 🗆 🗵		
Module Panel Scale Help									
From-		o ———							
03-10-2017 10:56:25 🚍	Now	3-10-2017 1	1:02:19 🛨	low S	how Pr	int Save	9		
25-09-2017 15:06:04	Init		No rotatio	n	Undefin	ed			
03-10-2017 10:53:42			No rotatio	n	Undefin	ed			
03-10-2017 10:53:42					Off/Closed				
03-10-2017 10:54:45			No rotation						
03-10-2017 10:54:45			No rotatio	n					
03-10-2017 10:56:18	Acceleratin	a							
03-10-2017 10:56:24	Accelerating		No rotation		Off/Closed				
03-10-2017 10:56:28					Off/Closed				
03-10-2017 10:56:28					Undefined				
03-10-2017 10:56:28					On/Open				
03-10-2017 10:56:38			No rotation						
03-10-2017 10:56:41			No rotation						
03-10-2017 10:56:41	A		Accelerating						
03-10-2017 10:59:39			Nominal s	peed					
03-10-2017 10:59:39		Nominal speed							
03-10-2017 11:00:10	Accelerating	9							
03-10-2017 11:00:10	Nominal sp	eed							
03-10-2017 11:01:47			Nominal speed		On/Open				
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03-10-2017 11:01:47	Nominal sp	eed							
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03-10-2017 11:01:47					Undefined				
03-10-2017 11:01:47					Off/Closed				
03-10-2017 11:02:27			Decelerat	ing			_		
StsReg01 AulhMMoS	t AlSt	AulhFoMoSt	AlUnAck	TStopISt	StartISt	FuStopISt	AuMRW		
IOSimuW	IOErrorW		FoMoSt	MMoSt	AuMoSt	OffSt	OnSt		
SteReen OutSBOVS	t OutOffOVSt	AIBW	SoftLDSt	EnRstartSt			CStopOSt		
TSasFSRS	t MAIBRSt	AuCStopRSt	AuDepOSt	.uAuDepRSt	MOnRSt	AuOnRSt	RunOSt		
ObjectSt 1=Nominal									

The state history panel is an advanced tool for post mortem analysis. User has a fast look of meaningful device events and their chronology without any minor events reported.

Conclusion

The first set of vacuum objects has been developed jointly by the vacuum control team and the Industrial Controls and Safety group. The widgets have been developed according to UNICOS standard and vacuum control user requirements. SCADA features – i.e. automatic synoptic, state history panel and pressure profile panel – have been redesigned from vacuum framework in a more portable version and compatible with UNICOS-CPC objects. All the features are scalable. They have not only been refactored but upgraded with new functionalities. The goal is to provide a smooth migration to UNICOS and limit the impacts for users. The only change for users is relative to standardization of widget's animation and panel layout. The new SCADA panels remain user friendly with same look as vacuum framework panels. The first version of the UNICOS vacuum control package has been tested, it will be released soon after a review with vacuum control users. In order to migrate large vacuum system to UNICOS framework, the vacuum control package needs to be complemented with additional CPC device types (ion gauge, fast valve, bake-out cabinet, mobile pumping group...) and SCADA features (device list, vacuum trending, replay...).



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ICALEPCS17, October, 2017

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