

The control system for TRIUMF's upgraded secondary beam line M20 was implemented by using a PLC and one of many EPICS IOCs running on a multi-core Dell server. Running the IOC on a powerful machine rather than on a small dedicated computer has a number of advantages such as fast code execution and the availability of a large amount of memory. A large EPICS database can be loaded into the IOC and used for visualization of the interlocks implemented in the PLC. The information about interlock status registers, text messages, and the names of control and interlock panels are entered into a relational database by using a web browser. Top-level EPICS schematics are generated from the relational database. For visualization the embedded windows available in the Extensible Display Manager (EDM) are the EPICS clients, which retrieve interlock status information from the EPICS database. A set of interlock panels is the library, which can be used to show any chains of interlocks. If necessary, a new interlock panel can be created by using the visualization tools provided with EDM. This solution, in use

Visualization of Interlocks with EPICS Database and EDM Embedded Windows

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Motivations

15 years ago we lived in MEGA time: MHz CPUs, Mb Memory, Megabit Ethernet. Now we live in GIGA time: GHz CPUs, Gb Memory, Gigabit Ethernet. We can develop much simpler solutions (not 1000 times simpler, though \mathbf{C})

The new control systems at TRIUMF are implemented by using the Experimental Physics and Industrial Control System toolkit (EPICS). The M20 Control System contains Programmable Logic Controllers (PLCs) + EPICS. EPICS support is realized as an application running on a Linux server (PLCIOC). This application communicates with the PLC on one hand and with the EPICS clients on the other:

A Multi-core Dell PowerEdge R610 is used



• Memory usage by ~100 devices is 1.5% (of

• CPU usage is 12% for one core (out of 8).



 Transfer of data between EPICS clients, All interlocks are implemented in a PLC. The PLCIOC, and PLC is provided by a Gigabit

EPICS screens (device control + interlock panels)

are used only for visualization of the interlocks.

Rules for construction of Interlock Panel names

The Interlock Specification provides logical equations for

interlocks. Enumeration of bits starts with zero:

network.

(Bit_0 and Bit_1) and (Bit_2 or Bit_3 or Bit_4) and Bit_5 and The visualization scheme is universal: M20 optical Rather complicated hierarchical interlocks Bit_6 and ... (some more bits)

can be handled in a simple way:

force O

force 1

force 2

force 3

force 4

force 5

S2:CG1 <

S2:CP1 on

S2:CG1C <

S2:RV1 closed

S2:VV1 closed

S2:CP1 temperature < 25.002169

6.016393



and vacuum devices are handled in similar manner:



Such equations correspond to the ladder logic of the PLC code. The name of the interlock panel is constructed by applying the following simple rules: • Dash sign represents "and" for groups before and after the sign (corresponds to vertical lines on interlock panels). • If several bits are used in "and' statements they are combined into the range of bits by using colon sign, for example, 0:1.

• The word "or" is used every time to avoid confusion.

The interlock panel name is:0:1-2or3or4-5:15.edl

	./0:1-2or3or4-5:15c.edl (on sbd1)								
\$(D):TEXT0			\$(D):RDTF	Fro in Eff					
\$(D):TEXT1			\$(D):RDTF	Fro in Eff					
\$(D):TEXT2			\$(D):RDTF	Fro in Eff					
T	\$(D):TEXT3		\$(D):RDTF	Fro in Eff					
	T	\$(D):TEXT4	\$(D):RDTF	Fre in Eff					

S2:MAG1 U 17.397 185 17.396 A 7.855 Y	complete scheme for in	nterlock visual	ization was crea	ated. It was	s used for 3	years o	M20.087 M20.0110L		\$(D):TEXT5	\$(D):RDTF Frein Eff	3M1:CG1_5mTom 0.000 T < 0.005 < 800.000 T +0074
the TRIUMF M20 Secondary Beam Line and proved to be easily maintainable and										\$(D):RDTF Frein Fil	pics/projects/sb/edi/m20_tpt_ion_gauges.edi ion.sbc _ C_X
szwsurra width: 45.000 45.000 positain: 0.000			ine and proved		ing mean can a		M20.088 M20.011DR		\$(D):TEXT7	\$(D):RDTF From Eff	Set
	tensible. It can be re	commended [·]	for developmen	nt of anv i	new control	svstem	Reset Reset Water Elevy Temperature Water Elevy	Tamorahra	\$(D):TEXT8	\$(D):RDTF From Eff	1G1_07mT 0.000002 Tx 0.000700x 0.020000 T #8#
0 84.463 200 84.441 A 1.699 V	0 84.463 200 84.441 A 1.599 V	at TO Taxaat	in the second se	Doublet Filmp	s/projects/sb/ed/m20_menu.edi (on sbd1)	CD Channele be		usr1/local/epics/prok	\$(D):TEXT9	\$(D):RDTF Frein Eff	JG1_07mT 0.000002 Tx 0.000700k 0.020000 T (140)
0 34,575 200 34,578 A 1,052 VV	hich uses the EPICS to	olkit.						M20 Sec	\$(D):TEXT10	\$(D):RDTF Frein Eff	_07mT 0.00002 Tx 0.000700x 0.020000 T (1x0) Cunditioning H97
								M20:GV3	\$(D):TEXT11	\$(D):RDTF	
								- 0 X	\$(D):TEXT12	\$(D):RDTf Frein Ell	picsprojectsjøbledim: _ E X
								Infertal I	\$(D):TEXT13	\$(D):RDTF Frein Eff	uges Forces and Bypasses Save/Restore/Scale for: m20
								INCVAL J	\$(D):TEXT14	\$(D):RDTF Fre In Eff	(20:K1:IG1
									\$(D):TEXT15	\$(D):RDTF Frein Eff	Save with Timestamp + Standard name
								M20:BV3	M20:S2:WV1 M20168 M201K1:WV1		Type ture file rank (mox 23 characters) 1151013_1148_W1594_LF snap
											M20:S1:IG1 Save with Timestamp + Chosen name
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									site: http://hlaweb.triumf.ca		
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