UPGRADING AND ADAPTING TO CS-STUDIO PHOEBUS AT FACILITY FOR RARE ISOTOPE BEAMS

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Abstract

The Facility for Rare Isotope Beams (FRIB) has been an early adopter of the CS-Studio ecosystem for its needs for a feature-rich and user-friendly interface with EPICS and the underlying accelerator controls infrastructure. For more than a decade, FRIB has developed thousands of operator displays spanning many areas of accelerator operations and engineering using the CS-Studio display tool "BOY". CS-Studio has provided many useful control system tools like an alarm system (called "BEAST"), scan system, channels aggregator, display manager and more to support controls operations of the FRIB accelerator. In recent years, there has been a major redesign of the CS-Studio software architecture resulting in the new and upgraded CS-Studio Phoebus. Phoebus replaces the Eclipse RCPand SWT-based Java framework with modern Java standards like JavaFX, SPI, Adapters and more. This paper details the efforts that have been made at FRIB to adapt and migrate to the upgraded CS-Studio Phoebus for FRIB's operations and engineering needs.

ALARM SYSTEM

FRIB deploys over 20 instances of the CS-Studio alarm system [1] to monitor thousands of EPICS [2] Process Variables (PVs) throughout the FRIB accelerator system [3]. Alarm systems are provided a configured list of PVs to monitor and report when the PV values are out of their normal value range or get disconnected. Operators in the FRIB control room use the alarm system to determine which PVs are not in an okay state and need attention. Some engineering groups have their own specialized alarm servers that notify them through emails and phone texts when their concerned PVs are not in the state that they should be.

The alarm system of CS-Studio changed its implementation from Apache ActiveMQ and a relational database to Apache Kafka for Phoebus [4]. At FRIB, we run a 3-node Kafka cluster to provide a fault-tolerant and load-balanced backend for the new Phoebus alarm system. Scripts provided with the Phoebus alarm server take care of correctly creating and configuring the Kafka topics for the alarm system. The alarm tree configuration, consisting of a list of PVs and their related alarm settings for legacy alarms, are automatically compatible with the new Phoebus alarm system, reducing setup efforts to a minimum.

Adopting the New Alarm System

The new Phoebus alarm system's client user interface has a very similar look and feel to the legacy alarm client. We observed a much faster performance with the importing time of the alarm tree configuration to the new Phoebus alarm server in comparison to the legacy BEAST alarm server. There are a few differences to the email/text notification behaviour of the new alarm system which were added to address the issue of duplicate alarm notifications that existed in the legacy alarm system. There are two additional alarm features available with the new Phoebus alarm system for logging the history of alarm states for all PVs and the history of alarm configuration updates. Both of these features have been determined to be effective diagnostic tools for alarm users and system maintainers.

Additional features that were requested by FRIB users to be added to the Phoebus alarm system have also been implemented. These features included a mode to disable email notifications for alarms temporarily. It's a feature used extensively by FRIB Operations to disable alarm email notifications when operators are present in the FRIB control room to live-monitor and address alarms in person. Alarm email notifications are later re-enabled so that alarms can be monitored remotely and catered to during offline operation hours. In Fig. 1, the yellow mail icon in the alarm table's toolbar is used to disable and re-enable email notifications for alarm system.

		<u>~]!</u>
Alarm Time	Alarm Value	PV Severity
2023-09-06 12:37:29.289		UNDEFINED

Figure 1: Mode to disable/re-enable email notifications.

The Phoebus alarm system provides an authorization mechanism to allow only selected and authorized users to be able to interact with their alarm server, change its running alarm configuration, or edit the alarm PV tree. As per FRIB's requirement for running many alarm servers within the same network, the alarm system's authorization mechanism has been extended to have authorization rules set on a per-alarm-server instance basis. This allows authorized users of an alarm server to be able to interact only with their relevant alarm server and not with alarm servers belonging to other groups or parties. This feature helps to avoid accidental updates an unauthorized user might cause to an alarm server owned and maintained by somebody else. Figure 2 shows the various alarm views supported by the Phoebus alarm system.

^{*} Work supported by the U.S. Dept. of Energy Office of Science under cooperative Agreement DE-SC0023633

								CS-Studio				
File Applications Window Help	2											
(b) = (b) = (c)												
ALANM_OPS Alarm Table X								ALAAM_OPS Alerm Tree X		ALARM_OPS Annunciator ×		
tive Alams: T92 ALAM_OPS								ALAM_OPS *	LEE	ALAAM_OPS *		4 Test Clear Message
PV a		Alarm Severit	y Alarm Status	Alarm Time	Alarm Value	PV Severity		+ 1 o com		Time Received * Severity	Description	
	BDS BTS Magnets - D5467 Temperature Not OK BDS BTS Magnets - D5486 Temperature Not OK	UNDEFINED	Disconnected	2023-09-26 07:26:28.056		RAJOR	STATE ALARM STATE ALARM	A 1-Front, End A Antemis			MAJOR Narm: LS2 CD03 Cryo - 2K Helium Header Level	
	EDS ETS Magnets - D5496 Temperature Not OK PPS Warning Alarm - Tunnel ACS, See HMI for details.	UNDEFINED MINOR	Disconnected STATE ALARM	2023-09-26 07:26:28.056 2023-09-25 15:18-45:280		MAJOR	STATE ALARM NO ALARM	 1 649 803 		2023-09-25 09:07:04.854 A MAJOR 2023-09-25 09:04-44.733 OK	MAJOR Marm: LS2 CD03 Cryo - 4K Helium Header Level Annunciator started	
FE ISACLIG DOSTRAP RD	PPS Blaning Alarm - Tunnel ACS: See HM for details. Attemis the um - Injection Ion Gauge Pressure	MACK	HIME ALARM	2023-09-25 15 18-45 280 2023-09-25 17:03:54 229	3 21554160	OK CK	NO ALARM NO ALARM	 <i>≝</i> ⊂ 9031 		2023-09-25-09/04:44.733	Annunciator started	
FE ISRCE IS DOMESNE RD	Artemis Vacuum - Extraction Ion Gauge Pressure	MADR	HIM ALARM	2023-09-25 16:01:49 229	3.02735429		NO ALARM	★ £ 45CS2				
	Attemis RF - Microwave Amplifier Reflected Power	MINOR	HIGH, ALARM	2023-09-25 15:53:04.827			NO ALARM	+ 6-ULENT + FV-LENT				
FE_ISRC2.CCG_N0001/VP_RD	HP ECR - Magnet Vacuum Vessel CCG Pressure	MINOR.	HIGH, ALARM			OK.	NO, ALARM	• Calutt				
F5_F151-CC0_D0993-VP_RD	PS F151 Vacuum - PS1 Cold Cathode Pressure	MINOR.	UNK, ALARM	2023-09-25 12:38 13:855		HINOR.	LINCALARM	• (22-870_MEBT)				
F5_F151-CC6_D1015-VP_RD	PS F1S1 Vacuum - Target Magnet Chamber CCG Pressure	MINOR.	UNK, ALAAM	2023-09-22 09:23:12.210		HINOR.	UNK, ALAM	• (D) 3458				
F5_F151_CC6_D1038 VP_RD F5_F151_CC6_D1061_VP_RD	PS P151 Vacuum - P52 Cold Cathode Pressure PS P151 Vacuum - P53 Cold Cathode Pressure	MINOR MINOR	UNK, ALAAM UNK, ALAAM	2023-09-25 12:38:20:123 2023-09-25 12:38:21:123	0.0	MINOR MINOR	LINK, ALARM LINK, ALARM	0451				
P5_F151_CC6_D1061_VP_RD	PS P1S1 Vacuum - P53 Cold Cathode Pressure P5 P1S1 Vacuum - P54 Cold Cathode Pressure	MINOR MINOR	LINK ALAM	2023-09-25-12-38-21-123 2023-09-25-12-38-21-472		MINOR	LINK ALARM	• (0) 5 (52 • (0) 6 (52				
PS F151-CCG 01136-VP RD	PS F151 Vacuum - P54 Cold Calholie Pressure	MINOR	UNK ALAM	2023-09-25 12:30:21.872		HINOR.	LINK ALARM	• (2) 7-153				
P5 F151 CCG 01175 VP RD	PS P151 Vacuum - P56 Cold Cathode Pressure	MINOR	LINK ALAM	2023-09-12 10:51 33 168	0.0	MINOR.	LINK ALAMM	• @ 0-405				
F5_F151-PG_D0992-VP_RD	FS F151 Vacuum - Target Chamber Pirani Gauge Pressure	NAJOR.	HH, ALAM	2023-09-25 05:44:50.714		нара	HHUALAMM	• @+is				
75_F151-PG_D1163-VP_RD	PS P151 Vacuum - Wedge Magnet Chamber Pirani Gauge .		HHL,ALAM	2023-09-22 09:30:14:522		најол	HIN_ALAAM					
F5_F151-PG_D0179-VP_RD	FS F151 Vacuum - Wedge Chamber Brani Gauge Pressure		HH,ALAM		830.0	најол	HH_ALAIM					
P5_F151_R8_N0001_FLT_R5T5	PS F1S1 Vacuum - Target Roughing Station Fault	UNDEFINED	Disconnected	2023-09-26 07:22:31.960		OK.	NO_ALARM					
PS_F151_RB_N0003_FLT_RSTS PS_F151_SLV_01183:T_R0_1	PS F151 Vacuum - Wedge Roughing Station Fault Wedge Assembly - D1183 Silt Temperature	UNDEFINED	Disconnected Disconnected	2023-09-26 07:22:31.960 2023-09-26 07:22:31.962		ok ok	NO_ALARM NO ALARM					
PS (151-50) 011031 (00 1	Wedge Assembly - D1183 Sit Temperature Rindra Assembly - D1183 Sit Temperature	UNDEFINED	Disconnected	2023-09-26 07:22:31.962		05	NO AL ARM					
F5_F151_TMP_009931_R0	PS F1S1 Vecuum - PS1 TMP Current Draw	MAJOR.	LOLO ALARM	2023-09-22 10:13:16:264		MAIOR	LOLO ALARM					
FS_F1S1:TNP_001001_RD	PS F251 Vacuum - PS2 TMP Current Draw	MAJOR.	LOLO_ALARM	2023-09-22 10:10:11 992	0	MAJOR	LOLO_ALARM					
F5_F151:TNP_010611_RD	PS F1S1 Vacuum - PS3 TMP Current Draw	NAJOR.	LOLO, ALAAM	2023-09-22 10:13:18:370	0	RAJOR	LOLO_ALARM					
F5_F151-7NP_011071_R0	PS F1S1 Vecuum - PS4 TMP Current Draw	NAJOR.	LOLO_ALARM	2023-09-22 10:14:50:373	0	RAJOR	LOLO_ALARM					
F5_F151:7NP_011361_RD	PS F1S1 Vacuum - PS5 TMP Current Draw	MAJOR.	LOLO_ALARM	2023-09-22 10:12:56.400	0	MAJOR	LOLO_ALARM					
F5_F151_TNP_011751_R0 F5_F151_WED_01104:T_R0_1	PS F151 Vacuum - PS6 TMP Current Draw Wedge Assembly - Wedge Temperature	MAJOR. UNDEFINED	LOLO_ALARM Disconnected	2023-09-22 10:21:18 767 2023-09-26 07:22:31 960	0	MAJOR OK	LOLO_ALARM NO_ALARM					
FS F1S1 WED D1104 T FD 2	Wedge Assembly - Wedge Temperature Wedge Assembly - Wedge Temperature	UNDEFINED	Disconnected	2023-09-26 07:22:31.960		OK .	NO AL REM					
PS_F1S1_WED_D1104_T_RD_5	Wedge Assembly - Wedge Hotar Temperature	UNDEFINED	Disconnected	2023-09-26 07:22:31.962		OK	NO ALARM					
F5 F152 CCG 01267 VP RD	PS F152 Vacuum - PS1 CCG Pressure	MAIOR	LOLO ALARM	2023-09-25 13:09:05:059		MAIOR	LOLO ALARM					
F5_F152.CCG_01325.VP_RD	PS F152 Vacuum - PS2 CCG Pressure	MAJOR.	LOLO, ALARM	2023-09-25 09:53:42.150	0.0	MAJOR	LOLO_ALARM					
F5_F152_P6_01325-VP_RD	PS F152 Vacuum - PS2 Pirani Gauge Pressure	MINOR.	HIGH, ALARM	2023-09-25 18:31:53.697	0.005	MINOR.	HIGH, ALAAM					
FS_SCDLTC_N070LT_RD	PS SCD1 - Magnet Temperature High	UNDEFINED	Disconnected	2023-09-26 07:22:31.962		OK	NO_ALARM					
F5_5CD1.TC_M0702.T_RD F5_5CD1.TC_M0703.T_RD	PS SCD1 - Magnet Temperature High PS SCD1 - Magnet Temperature High	UNDEFINED	Disconnected	2023-09-26 07:22:31 960 2023-09-26 07:22:31 959		OK OK	NO,ALRM NO,ALRM					
P5_SC00.TC_M0703.T_RD P5_SC00.TC_M0704.T_RD	PS SCD1 - Magnet Temperature High PS SCD1 - Magnet Temperature High	UNDEFINED	Disconnected	2023-09-26 07:22 31 959 2023-09-26 07:22 31 960		CK CK	NO ALARM NO ALARM					
F5_SC01TC_N0705/T_RD	PS SCD1 - Magnet Temperature High	UNDEFINED	Disconnected	2023-09-26 07:22:31.962		CK	NO ALARM					
FS SC02 TC MOTO T RD	PS SC02 - Magnet Temperature High	UNDEFINED	Disconnected	2023-09-26 07-22 31 959		OK .	ND AL 88M	ALARM OPS Alarm Area Panel X				
FS SCO2 TC NOTO2 T RD	PS SCD2 - Magnet Temperature High	UNDEFINED	Disconnected	2023-09-26 07:22 31.959		OK	NO ALARM	ALANN, OP'S Alam Area Panel X				
knowledged Alarms: 106												
PV A	Description	Alarm Severit	y Alarm Status	Alarm Time	Alarm Value	PV Secondary	PV Status					
BDS. 885 DCCT. D55781. RD	BDS BBS - DCCT DSS38 Communication Lett	INVALID_ACK	THEOUT ALARM	2023-09-29 15-05-33-258		INVALID	CONDUCTOR					
	MEBT 8TS Vacuum - Beamline Pressure Interlock	MAJOR, ACK	STATE ALAAM	2023-09-15 08:23:43.334			STATE ALAAM	0.0km	1.600		2.8F0 MERT	
	Artemis PS - Puller Position Out of Calibration	MAJOR_ACK	STATE, ALAAM		Uncalibrated		STATE, ALAAM	0 Gildean			24870_96561	
FE_ISRC1 HVP_D0679/UK_ASTS		MAJOR_ACK	STATE_ALAAM	2023-09-25 15:24:54.483		MAJOR.	STATE ALAAM					
	Artemis PS - 100kV HV PS Interlock	INVALID_ACK	UNK, ALAMM LOLO ALAMM	2023-09-25 15:24:54.483		INVALID	UNK ALAMM					
PE_ISRC1.PHT_D0600.P_RD_1 PE_ISRC1.TMP_D0684-FLT_RSTS	Artemis Water Skid - Betarn Pressure Artemis Varsam - Meldie TMP Fault	MAJOR_ACK	STATE ALARM	2023-09-21 10:01:01.630	4.90661421	MALOR	LOLO ALAMM STATE & AMM					
	Artemis Vacuum - Middle TMP Fault Artemis Vacuum - Middle TMP Pream	MAJOR, ACK	STATE ALARM	2023-09-25 11:54:36.912 2023-09-25 15:26:56.723		MAJOR	STATE, ALARM					_
15,08527WP,008528A,8915	THE ELR PS - REFER FILE PS INSTRUCT	WWALSI, ALA	LINE, ALAPPE	2022-09-05 99:52 29.218	PERFORM.	INVALUE	UNA, ALARM					
10_ISRC2 HVP_D0677 LK #STS	HP ECR PS - 100kV MV PS Interlock	INVALID, ACK	LINK_ALARM	2023-09-01-00 52:59.378	Interlock	INVALID	UNK ALASM					
TE_ISRC2.PLN0002.P_R0	HP ECR - Helium Pressure	MALOR_ACK	LOLO, ALAAM	2023-09-25 15:27:03:946	0.59060812		LOLO ALARM					
	HP SCR.RF - Microwave Amplifier Interfeck	MAJOR, ACK	STATE ALARM			MAJOR	STATE ALAAM	5.65				
	HP ECR Vecuum - Hyection TMP Fault	MAJOR, ACK	STATE_ALARM	2023-09-25 15-22-29.347		MAJOR	SPATE_ALAAM					
	HP ECR Vacuum - Extraction TMP Fault L. LEET AF - MHB 40 MHz Interlock	MAJOR, ACK INVALID ACK	STATE ALARM	2023-09-25 15:22:29.347 2023-09-06 12 37:00.681		MAJOR	STATE ALARM					
	L LEET RF - MHB 80 MHz Interlack	INVALID_ACK	UDF_ALARM	2023-09-06 12 37:00.681	NOK	INVILO	UDF ALARM					
	LIJET OF 1948 120 NH2 Internet	INVILID NCK	UDF ALARM	2023-09-06 12 37:00-681		INVILID	LIDE ALARM					
PE MERTIRIC DIDIG ILK LTCH A	MERT Rf - First Buncher Interlock	INVALID ACK	UDF ALARM	2023-09-06 12 37:00.689	NOK	INVALID	UDF ALARM					
HE MERTINIC DIDAGUE RSTS T.	NEST RF - First Buncher Tuner Fault	INVALID, ACK	UDF, ALARM	2023-09-06 12:37:00.689	NOK	INVALID	UDF_ALAXM					
PE MERTARC DISTRIK LTCH A.	MERT IV - Second Buncher Interlock	INVALID_ACK	UDF, ALARM	2023-08-06 12:37:00.689		INVALID	UDP_ALARM					
PE_MERTARC_DILGTILK_RSTS_T	NEST RF - Second Buncher Tuner Fault	INVALID_ACK	UDF_ALARM		NOK	INVILO	UDF_ALARM					
	RFQ Vacuum - Douplet Pressure Intertock	MAJOR_ACK	STATE ALAMM	2023-09-06 12:37:00.557	0	MAJOR	STATE_RLARM	612				
TE AFO AFC DURS LADK ACHD TE AFO AFC DURS LADK ACHD	APD Ampimer - LUAR Enable Bad	MAJOR_ACK MAJOR_ACK	STATE_ALAAM STATE_ALAAM	2023-09-06 12 37:00 557 2023-09-06 10 51 36:145	N. N. N.	NUOR	STATE ALASM STATE ALASM					
	HFQ LLHF - Interlock HFQ Vacuum - Foreitne Pressure Tarbo 75	MAJOR, ACK MAJOR, ACK	STATE ALARM	2023-09-06 10:51:36:145 2023-09-06 12:37:00:552	ALC: NO.	MAIOR	STATE ALAM					
FE REGREG NOSIO VE RO	RFG Vacuum - Foreine Pressure Turbe 15 RFG Vacuum - Foreine Pressure Turbe 15	MAJOR, ACK	HERE ALARM		1.504	MAJOR	THE ALADM					
	NFQ Vacuum - Turbopump 15 Not OK	MAJOR, ACK	STATE ALAAM	2023-09-06 12:37:00:558		MAJOR	STATE ALAAM					
TE NFOAFE WOODLF, RD	RFQ Amplifier - Screen LCW Flow Law	MAJOR, ACK	LOLO ALARM	2023-09-06 12:37:00.557	0.03477627	MAJOR	LOLO_ALAAM					
HE AFOAFE NODE2 F. RD	RFQ Amplifier - Anode LOW Flow Low	MAJOR, ACK	LOLO, ALASM	2023-09-06 12:37:00:557	0.00873470		LOLO, ALAAM					
HE, REQARE, NODO3.F, ND	RFQ Amplifier - 200KW LD. Flow Low	MAJOR, ACK	LOLD, RLARM	2023-09-06 12 37/05 557			LOLO ALAAM					
HE,REGARE,N0004F,RD	RFQ Angelfur - SKIII Match L.D. Flow Low	MAJOR_ACK	LOLO, ALARM	2023 09 06 12 37 00 557	0.00305223		LOLD ALAMM					
HE_SCSERPG_00107.VP_RD	SCS1 Vacuum - Roughing Pressure	MAJOR, ACK	HHLALARM	2023-09-25 15 28:00.273		MAJOR	HIN ALARM	105				
PE_SCS1.8PG_00739379_RD	SCS1 Valuum - Roughing Pressure	MAJOR, ACK	HH AAM	2023-09-25 11-59-41-050		MAJOR MAJOR						
HE_5CS2/RPG_00752/VP_RD	SCS2 Vacuum - Roughing Pressure PS-F153 Vacuum - Taront Chamter CCD Pressure	MAJOR, ACK	UNK ALARM	2023-09-25 11:59-40-500		MADE	HIR ALARM					
P5 /151 CCG 00992 VP AD	PS F151 Vacuum - Target Chamber CCG Pressure PS F151 Vacuum - Beam During Chamber CCG Pressure	MADR, ACK MADR, ACK	LINK ALARM			MACK MACK	LINK ALAMM					
P5 /151 CC6 01163 VP 80	FS F1S1 Vacuum - Beam pump Chamber CCG Pressure FS F1S1 Vacuum - Biodge Magnet Chamber CCG Pressure	MADE ACK	UNK ALARDE	2023-09-25 12 38 17 797		MINOR	UNK ALARM					

Figure 2: Phoebus showing alarm table (left), alarm tree (top center), annunciator (top right) and area panel (bottom right).

OPERATOR INTERFACE DISPLAYS

There are thousands of operator interface displays spanning across the FRIB beamline that have been developed by FRIB users over a decade with the CS-Studio BOY tool. As it is not feasible to re-develop all of these displays for Phoebus, we have utilized the auto-conversion tool provided with Phoebus to convert displays from the old ".opi" format to the new Phoebus-compatible ".bob" format. This tool has helped us convert the bulk of our displays leaving most of our effort focussed towards the testing of converted displays and addressing parts that didn't convert with the conversion tool.

We have observed some significant advantages with the auto-conversion tool. First, it was able to convert old BOY widgets to new Display Builder widgets in most cases without needing any modifications from users. It reported through warnings when it came across a missing widget, missing widget property, or a missing application programming interface (API) for scripts during conversion which helped us to add the missing entity to the Phoebus Display Builder to ease the transition from BOY. The auto-conversion tool was also able to correct widget types when they were used in a wrong context in the old BOY display; for example, "Text Update" widgets without configured PVs were automatically replaced with static "Label" widgets accompanied by warnings about these replacements. The automatic patching of script imports was helpful to skip updating every widget script. Most of the manual work was restricted to fixing scripts that had a different API in Display Builder and to fixing any plot widgets that did not belong to the default converted plot widget type. The autoconversion tool has since been expanded to address any missing mappings between a BOY widget and a new Display Builder widget that were reported by our users.

At FRIB, users developed some scripts for bulk-fixing the common issues they came across with the newly converted files. Some of the simpler fixes like updating the associated linked files within a display with newly converted ".bob" files was achieved with the help of a script. LED widgets in BOY allowed a script or rule comprising of state of multiple PVs to decide the LED status while LED widget in Display Builder restricts the LED status to depend only through the configured PV property. In order to easily transition hundreds of our LED widgets, users ran scripts to update their LED widget to utilize the PV formula to implement the logic from their old LED widget.

In the legacy CS-Studio, perspectives are used to create layouts consisting of various windows and tabs to help organize the workflow of a user. There is some user effort required in re-creating the old CS-Studio's perspectives with the new Phoebus equivalent "Layouts" to achieve the same workflow. Figures 3 and 4 show the operator displays for the FRIB LINAC overview run with Phoebus.

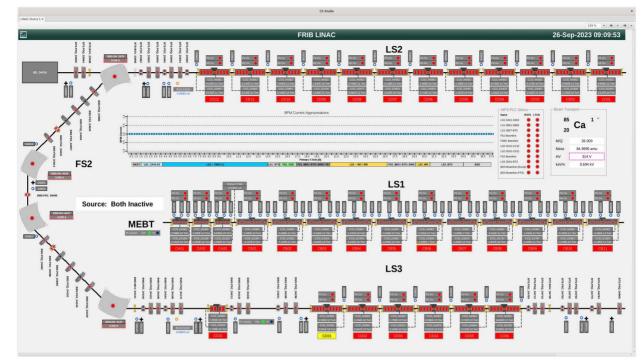


Figure 3: FRIB LINAC West in Phoebus Display Runtime.

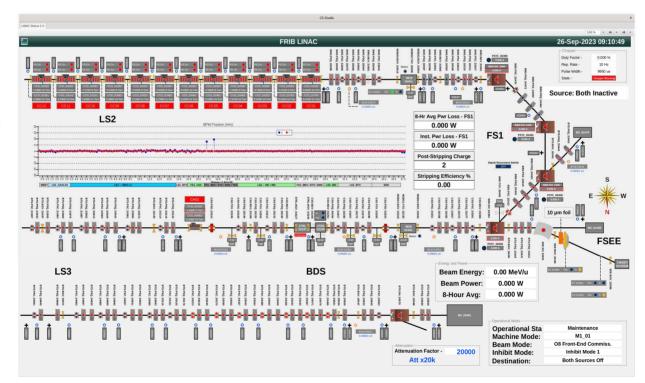


Figure 4: FRIB LINAC East in Phoebus Display Runtime.

SAVE-AND-RESTORE

Phoebus Save-and-Restore is a tool to take snapshots of a pre-configured list of PVs at a specific time and write values of a snapshot back to PVs at a later time. The old Save-and-Restore tool has Git Repository or a relational database engine for its backend where it stores the beamline savesets and their snapshots. The backend for Phoebus Save-and-Restore has been designed with Elastic Search for the storage for beamline savesets and snapshots. The transition to the Phoebus Save-and-Restore required a method to migrate savesets and snapshots from Git to the new Elastic Search backend. At FRIB, we used the Git migration tool provided with the Phoebus Save-and-Restore service to migrate hundreds of beamline savesets and snapshots to Phoebus. Figure 5 shows the migrated git repository to a new directory in the Phoebus Save-and-Restore tree.

Save And Restore ×
Filter 🔹
Root folder (http://phoebus-sar.ftc:8080)
Migration 2023-09-14 10:28:42
🔻 🗁 rf
FE
► 🗁 FRIB_all
▶ 🗁 FS1
▶ 🗁 FS2
▶ 🗁 gts-clock
▶ 🗁 LS1
▶ 🗁 LS2
LS3
Segments
SingleCavity
Amplifier
▶ 📄 D0987_F1
D0987_F2
D0987_F3
E_CSET
► 📄 FE_all
FE_interlock
SOL
🕨 🔚 test
► 🗁 RF
🕨 🗁 test

Figure 5: Migrated Save-and-Restore.

OTHER TOOLS

Phoebus provides many other controls system tools that share a similar user interface and functionality as the old CS-Studio but have been improved for user experience and system maintainability. For instance, the Probe tool has been extended to display PV values in formats other than the default and a new GUI version of Probe called "Probe Display" is available with Phoebus. A new tool "3D Viewer" has been added to allow users to configure 3 dimensional structures using spheres, cylinders and boxes which can be rotated, zoomed and moved when rendered on screen.

SUMMARY

FRIB is in the process of transitioning to the new and upgraded CS-Studio Phoebus. We are utilizing a combination of the Phoebus auto-conversion tool, user scripts and manual testing to migrate our large number of displays to Phoebus Display Builder. We have deployed multiple instances of the Phoebus alarm server across the FRIB beamline that has been robustly providing alarm monitoring to the FRIB Operations and various engineering groups. In the coming months, we plan to transition all of our displays for all FRIB beamlines to Phoebus and to decommission the old CS-Studio and its services entirely.

ACKNOWLEDGEMENT

We thank the CS-Studio collaboration for their contributions towards the development, maintenance, and education of CS-Studio Phoebus. We also thank the FRIB operators and engineers who have contributed towards the conversion efforts, provided feedback, and led the acceptance of the new CS-Studio.

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