Control System Using EPICS Tools at TARLA Linac

O.F.ELCIM [a*], A. AKSOY [a]

a.) Ankara University Institute of Accelerator Technologies, Ankara, Turkey,

ABSTRACT

The first accelerator based research facility of Turkey-TARLA is under commissioning at Institute of Accelerator Technologies of Ankara University. It is designed to generate free electron laser and Bremsstrahlung radiation using up to 40 MeV continuous wave (CW) electron beam. The control system of TARLA is based on EPICS and are being tested offline. TARLA also has industrial control systems such as PLC based cryoplant and water cooling system. Its control system is under development, it benefits from the latest version of EPICS framework, i.e. V7.

In other words, TARLA control system uses existing demonstrated tools of EPICSV3 as well as pvAccess which comes with EPICSv4 for transferring the large data through control network. Archive (CSS BEAUTY) and alarm (CSS BEAST) system have been set up to detect stability and prevent failures. Operator interfaces have been designed using CSS BOY. Currently, CCDs, PSS (Personel Safety System), MPS (Machine Protection System), Superconductive Cavities, RF Amplifiers, microTCA based LLRF system are being integrated into distributed control system. In this proceeding we summarize the current status and future plans of TARLA control system.

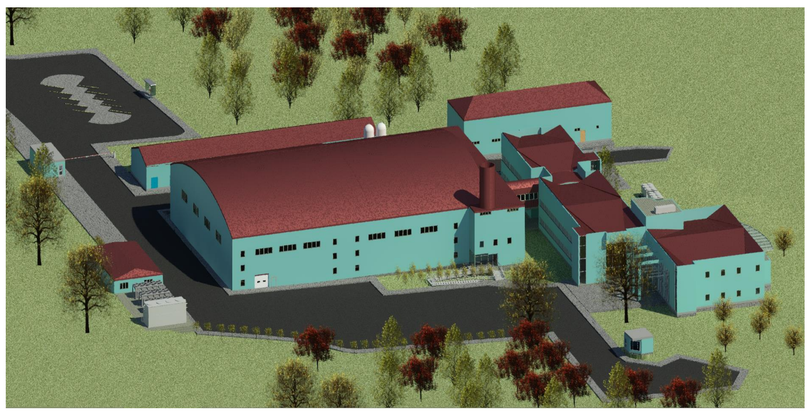

Figure 1. General View of TARLA Facility.

E-GUN CONTROL

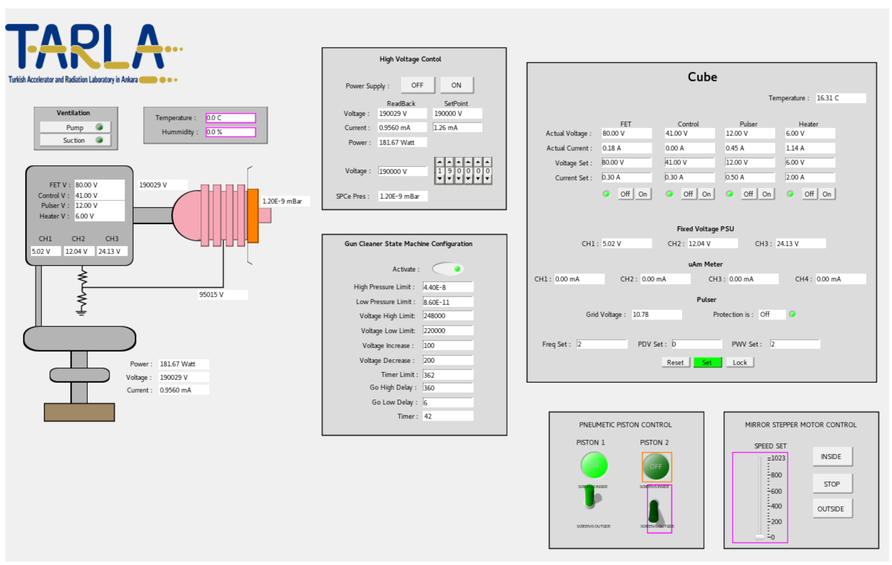

Figure 2. TARLA Gun Cleaner State Machine Configuration and Gun GUI.

Control system for TARLA e-gun is capable of controlling the electron beam in DC/CW or macropulsed mode at the moment. In terms of control system devices e-gun test stand consists of 5 power supply unit (4 remote controllable), a vacuum pump controller, a master oscillator, a pulse gating unit, pulser interlock unit, a 4 channel microampermeter, a stepper motor controller, a high voltage power supply and a relay controller for 2 pneumatic view-screens. All of the devices are RS232 or TCP/IP controlled and device communication is held via streamdevice and asyn combination.

Gun controller also has a state machine algorithm for gun cleaner created via SNL (see Fig. 2). The *State Notation Language* (SNL), is a domain specific programming language that smoothly integrates with and depends and builds on EPICS base[5].

SUBSYSTEMS CONTROL

Current direction of TARLA control system development is weighted toward independent subsystems with zero or very limited connectivity between them. Main interface to them and majority of the devices is serial communication and majority of the control loops are implemented on the lower levels, i.e. in PLCs. The following TARLA subsystems are built around Siemens Step 7 PLC:

- Cryoplant (see Fig. 4)
- Water Cooling System (see Fig. 5)
- Personal Protection System
- SRF controller
- Electrical infrastructure

There are few exceptions like LLRF that will come with its own local control system and gateway to EPICS (see Fig. 3).

Such design will ease the workload on the control system developers while on the other side it will make the whole machine more rigid and hard to modify while putting additional stress on development of the subsystem control logic.

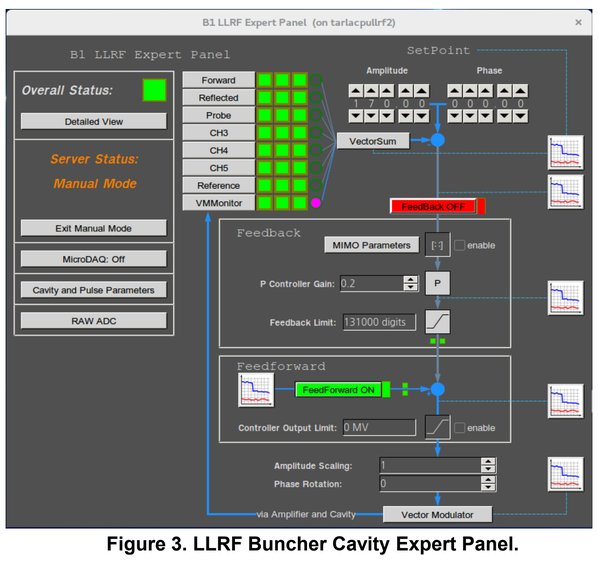

Figure 3. LLRF Buncher Cavity Expert Panel.

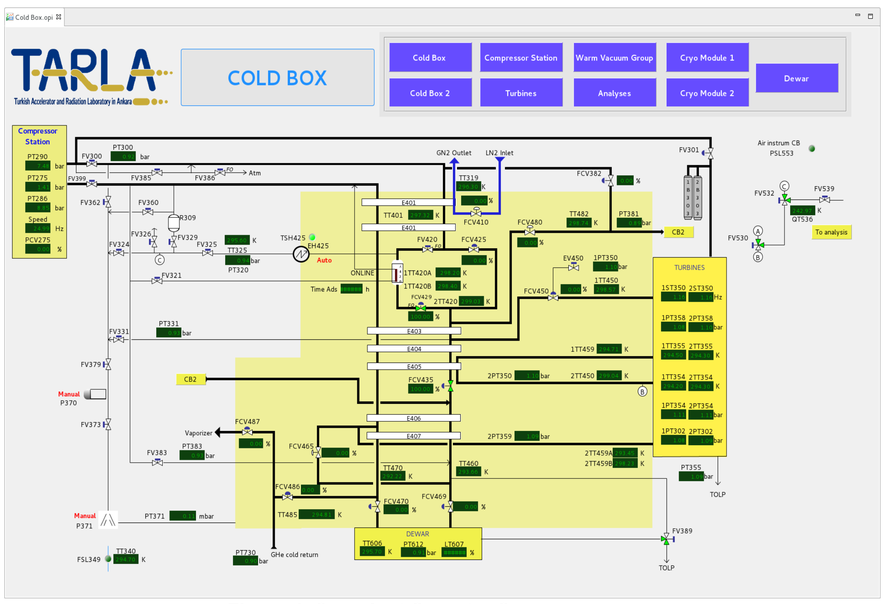

Figure 4. Cryoplant Operator Screen.

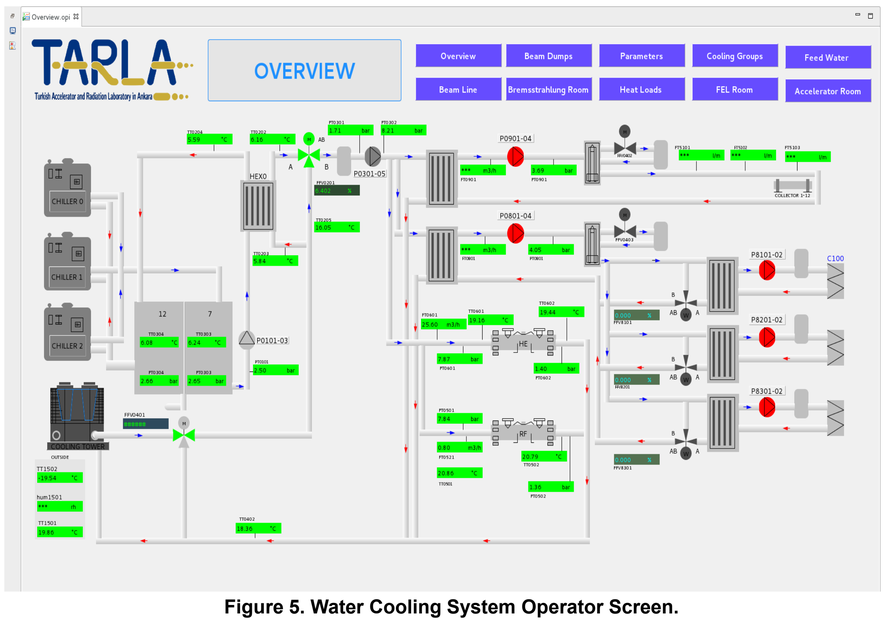

Figure 5. Water Cooling System Operator Screen.

EPICSv3 vs EPICSv4

EPICS is a set of Open Source software tools, libraries, and applications developed collaboratively and used worldwide to create distributed soft real-time control systems for scientific instruments such as a particle accelerators, telescopes and other large scientific experiments [1].

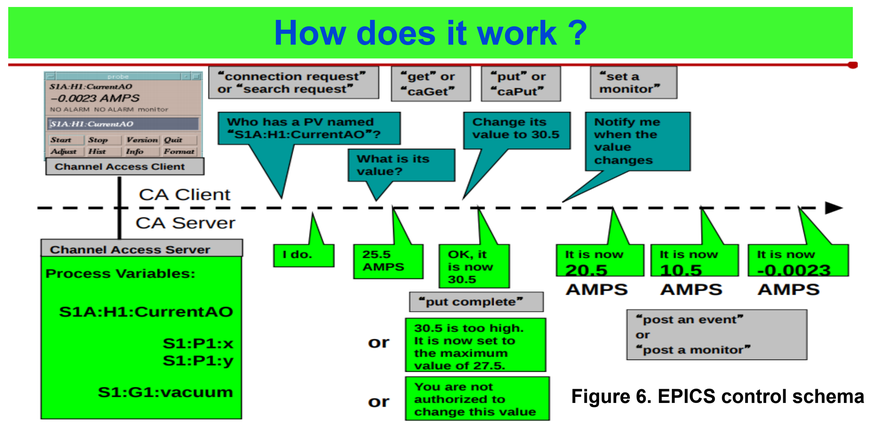

Figure 6. EPICS control schema [2].

EPICS Base (v3.14, v3.15 and others in use) includes a communications protocol named "Channel Access". Version 4 adds a new protocol called "pvAccess". Interoperability between the two protocols, their APIs, and record processing, is provided in EPICS Version 4, in 2 ways [3]:

- The pvAccess client system includes Channel Access as a protocol "provider". The other protocol provider is pvAccess. That way, a single client library and API gives communications on both protocols
- A new IOC module, pvaSrv, interfaces pvAccess protocol wire I/O, to an IOC's regular CA and database processing.

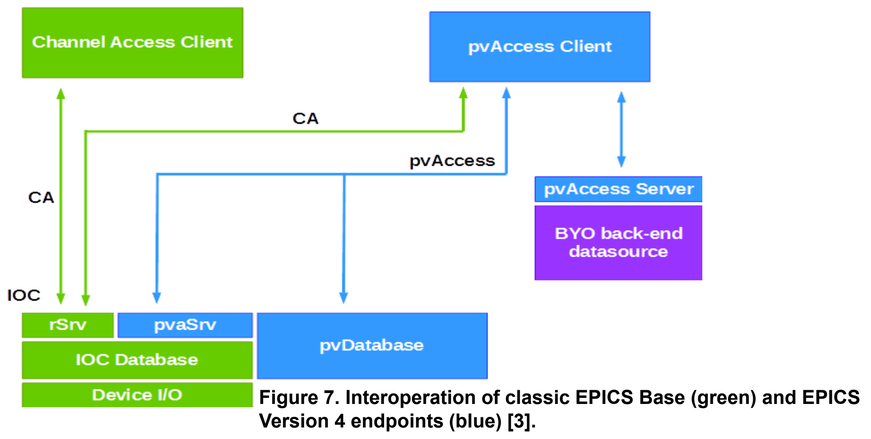

Figure 7. Interoperation of classic EPICS Base (green) and EPICS Version 4 endpoints (blue) [3].

Table 1. Control System Framework Comparison [4].

Framework	Pros	Cons
EPICS v3	• big pool of already available device support and additional modules • IOC logic (records, state machine logic, access security ...) • mature central services (archiver, alarm, GUI) • huge community • fastest development between all options	• theoretical performance celling may be lower
EPICS v7	• all pros from v3 • flexibility of pvAccess where needed	• central services must support both CA and PVA (either via plugins, additional apps …)
EPICS V4 without v3 IOC (TARLA 2017)	• design freedom	• huge time and effort investment • end result will not be what community version of EPICS V4/7 will look in next decades • newly developed software will have to be prudently tested and debugged before it will be production ready • no support from the community

CONCLUSION

Device integrations to the EPICS-based control system and infrastructure improvements of the control system continue parallel to the installation of the line. The integration of the injector line control and diagnostic devices of the linac will be completed in the first quarter of 2019.

TARLA team as well as control system group wishes to be an example of the state-of-the-art system, fully featured and debugged by the first laser beam generation with the latest and most modern hardware and software solutions.

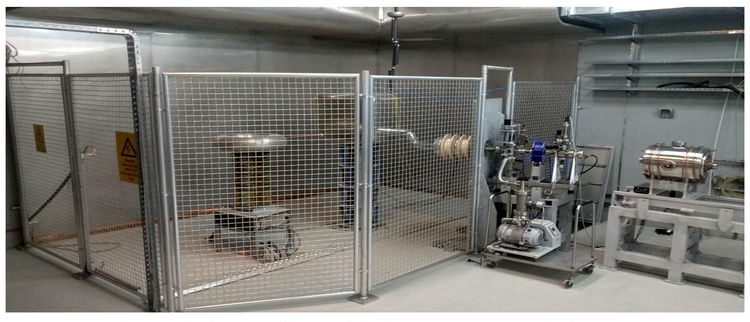

Figure 8. Current State of TARLA HV Area and E-GUN.

ACKNOWLEDGMENT

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REFERENCES

1. http://www.aps.anl.gov/epics/
2. https://portal.slac.stanford.edu/sites/conf_public/AWLC17/Documents/program2.htm
3. http://epics-pvdata.sourceforge.net/index.html
4. TARLA Control System CDR, 2017
5. https://www-csr.bessy.de/control/SoftDist/sequencer/

Ankara University
Institute of Accelerator Technologies, 06830 Gölbaşı Ankara Turkey
www.tarla.org.tr – http://hte.ankara.edu.tr

***Omer Faruk Elcim**
e-mail: omer.faruk.elcim@tarla.org.tr
Phone: +90 312485 37 45