

Muhammad Gul  
University of Ghent, Belgium  
On the behalf of CMS RPC Community

## Introduction

- GIF++ (Gamma Irradiation Facility) is the new CERN irradiation facility located in the North Area of the CERN SPS;
- 13.9 TBq  $^{137}\text{Cs}$  source (662 keV gammas).
  - Gamma flux =  $58.7 \times 10^6 \text{ s}^{-1} \text{ cm}^{-2}$  at a distance of 1.5 m from the source.
  - A filter system attenuate the photon rate of several order of magnitude  $\sim (10^4 - 10^5)$  [1a].
  - Muon beam of 100 GeV and  $10^4$  muons/spill [1b].

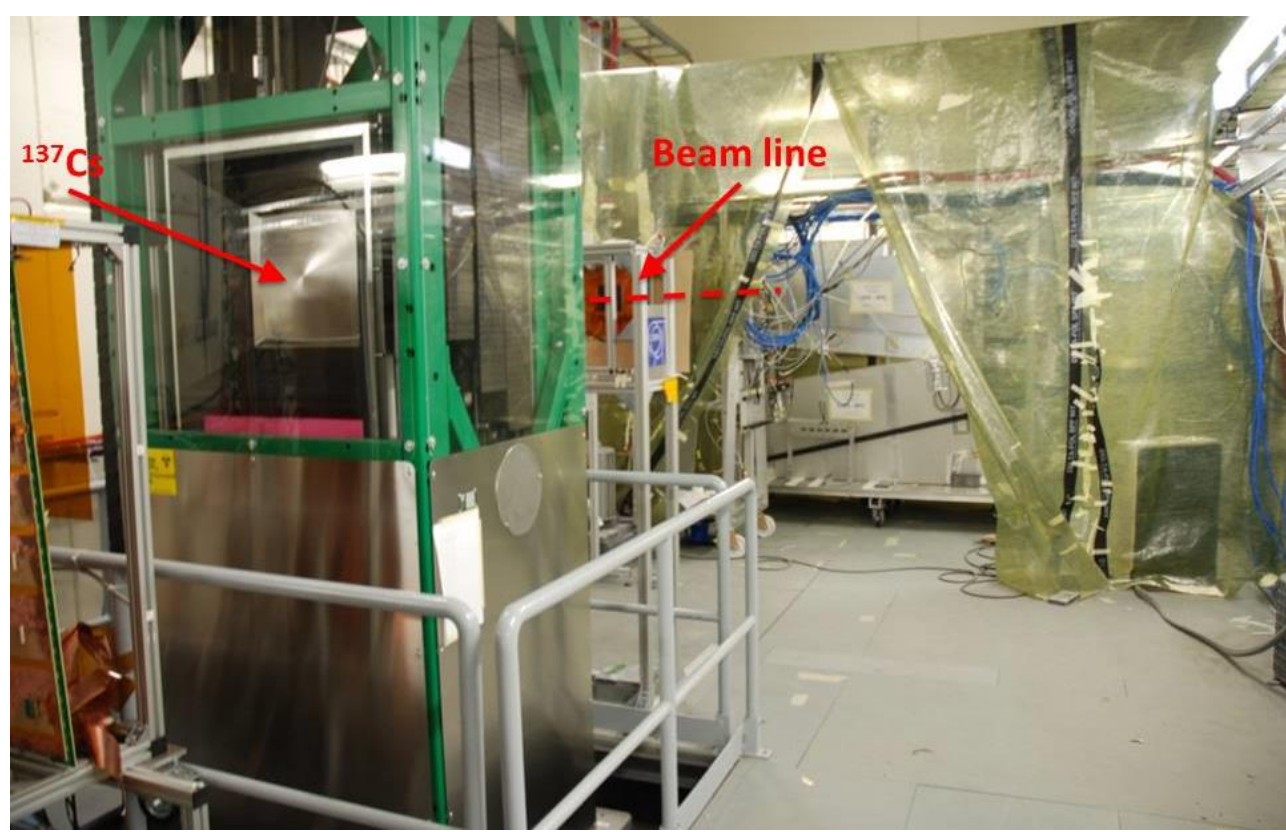


Fig 1a: Source inside the bunker with beam line.

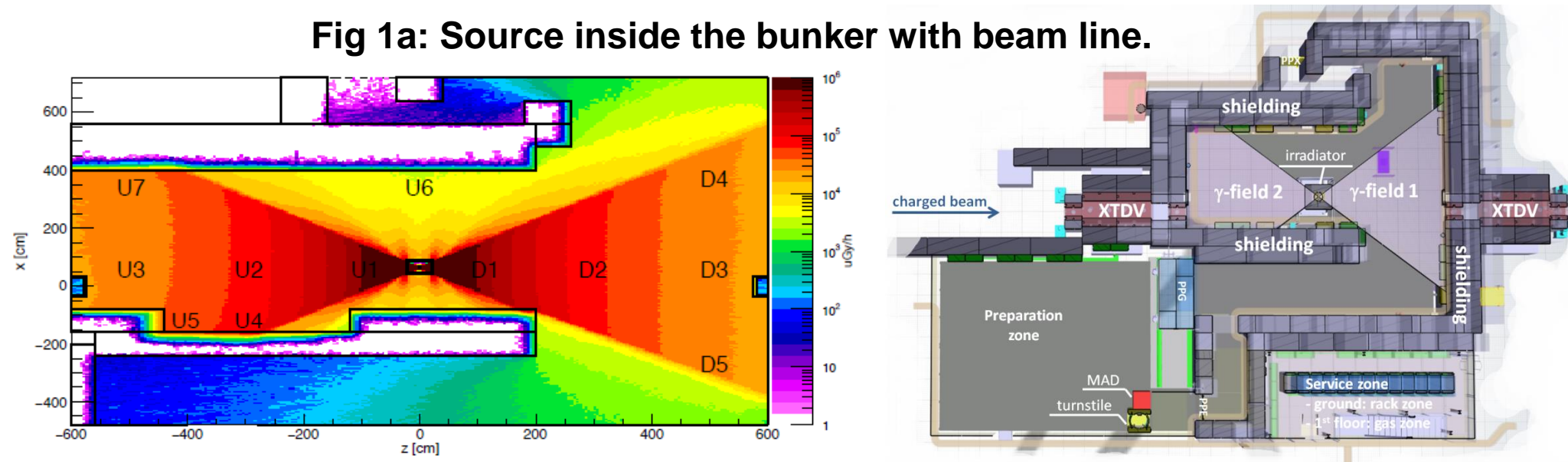


Fig 1b: Simulation study by D. Pfeiffer et. al. Fig 1c: The whole setup of GIF++.

## Purpose

- To test Large-Area Muon Detectors for the HL-LHC program. It includes the study of:
- Detector performance in presence of gamma background.
  - Ageing studies.

## Detectors under test

Since April 2015, the CMS RPC collaboration installed in the GIF++ several spare chambers to study the stability of detector performance for 10 years of HL-LHC. New improved RPC were also tested during the test beam in 2015.

## WinCC-OA (PVSS)

Large experiments at CERN use WinCC-OA [2] as a tool to develop a control system. It has capabilities to describe a device in the form of a data point and its elements which can be used for reading and writing to corresponding device. The devices can be accessed via OPC, ProfiBus and Drivers -makes a bridge between WinCC-OA and device. Alarm can be generated and handled for different purposes. Data coming from the real devices archives in the data base. The archived data can be plotted in the form of histogram called trending. WinCC-OA gives a User Interface (UI) facility. Access to the system can be controlled using Access Control system [3].

## Overview of DCS

The CMS RPC DCS system in GIF++ uses most of the functionalities of WinCC-OA+JCOP software. OPC server communicates between DCS and main frame which controls HV, LV and ADC boards. The source information and attenuator values are provided centrally and accessed via DIP protocol [4].

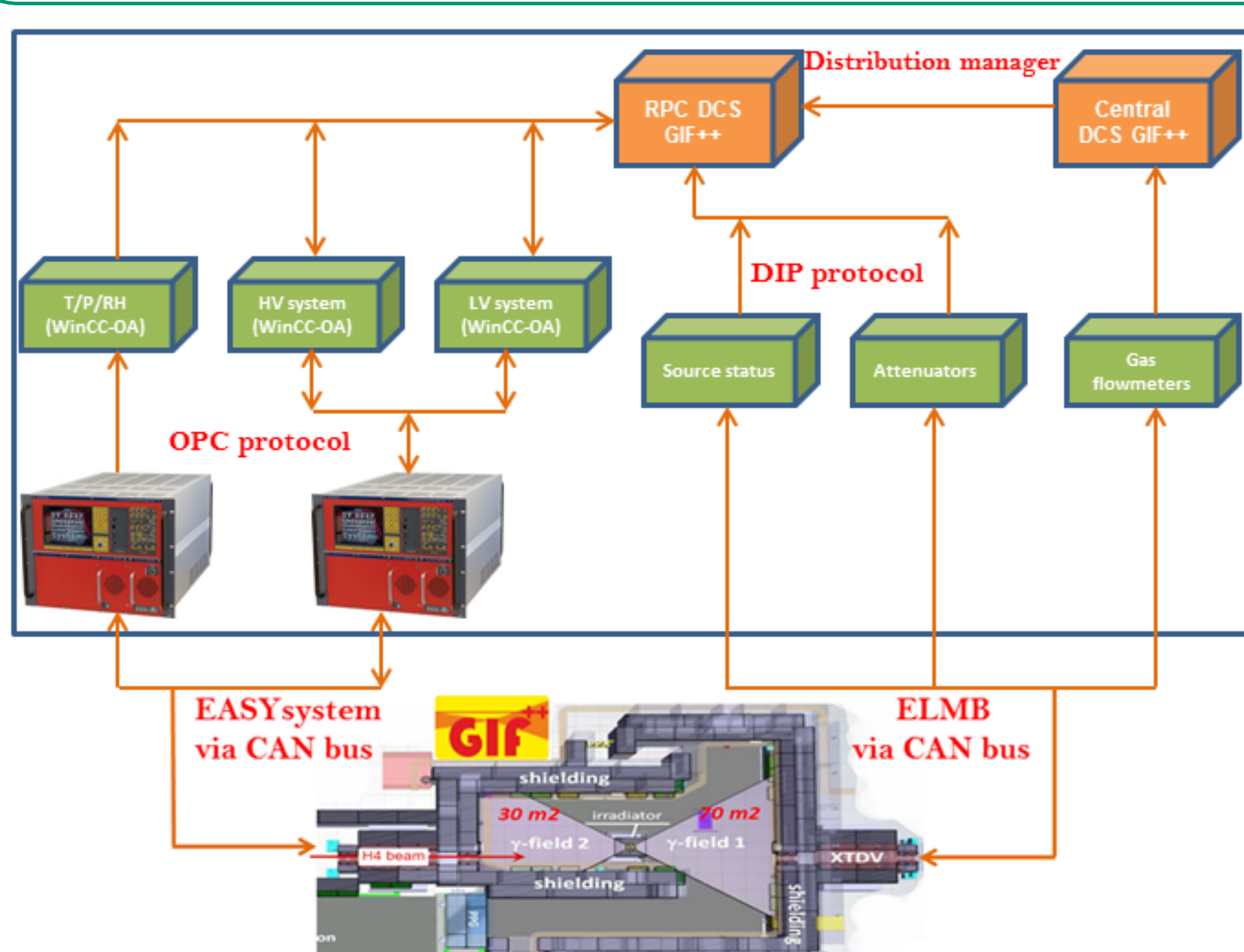


Fig 2: Schematic diagram of CMS RPC DCS.

## DCS Hardware at GIF++

- CAEN main frame with High Voltage and Low Voltage modules.
- Easy Crate with ADC module; reading sensors from different sources (current, gas parameters and environmental parameters (P, T, RH)).
- DCS applies T-P corrected voltage because of the RPC dependency on the environmental temperature and pressure [5].
- The source status and attenuator values are reading from DIP protocol.



Fig 3: RPC DCS hardware in GIF++.

## FSM view

The FSM (Finite State Machine) hierarchy is based on the naming convention of trolley where the detectors are installed. Each trolley has 6 sections and each section accommodates one detector. Currently 3 CMS RPCs trolleys are in GIF++. Trolley 1 (RPC Consolidation) is equipped with spare RPCs, trolley 2 with small Glass RPCs and trolley 3 with prototypes of improved RPC.

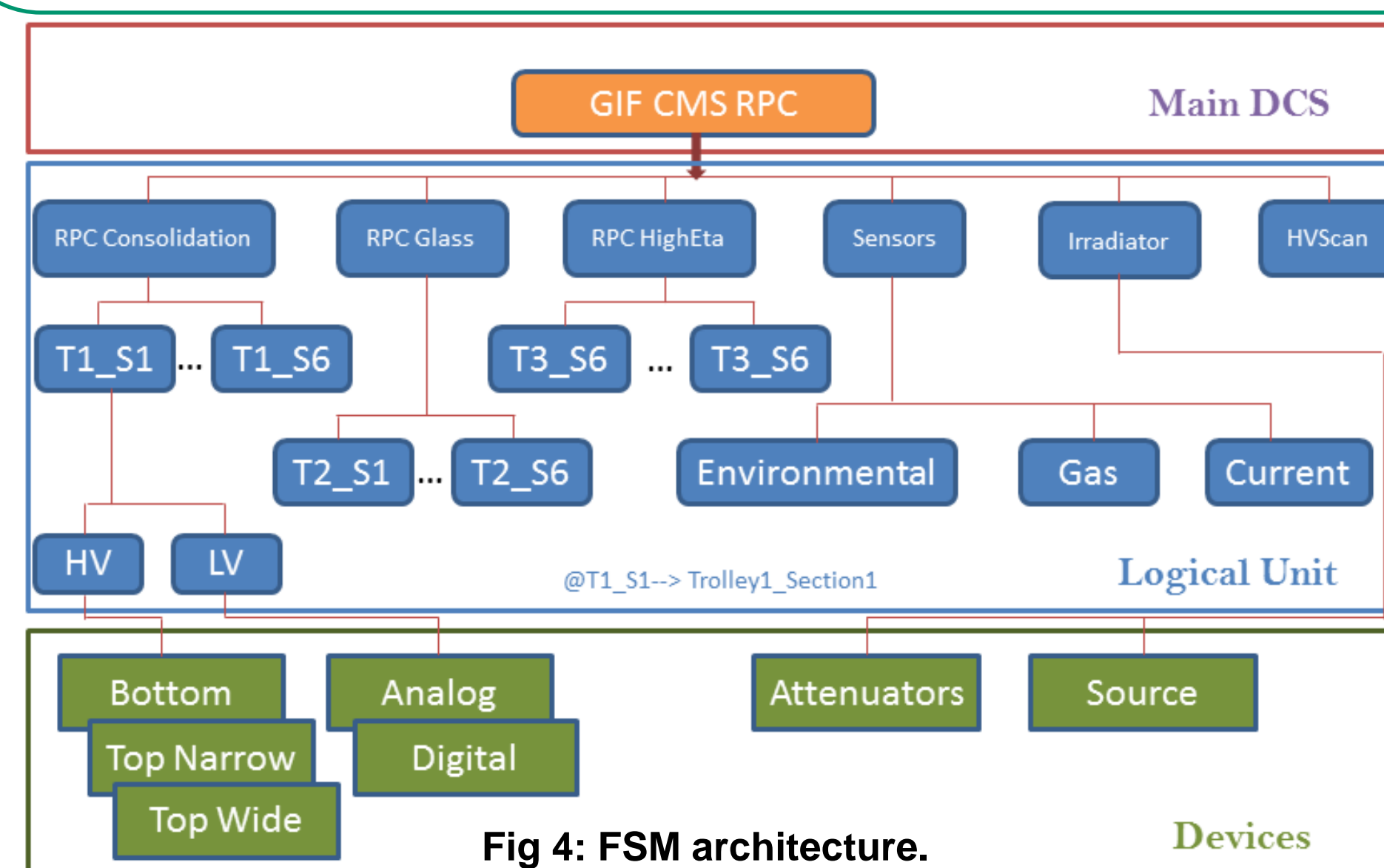


Fig 4: FSM architecture.

## Detector Operation

- WinCC-OA uses User Interface (UI) panel for detector operation.
- For detectors R&D study, High Voltage Scan and longevity study are required.
- The users can control and plots all parameters such as voltage and current.

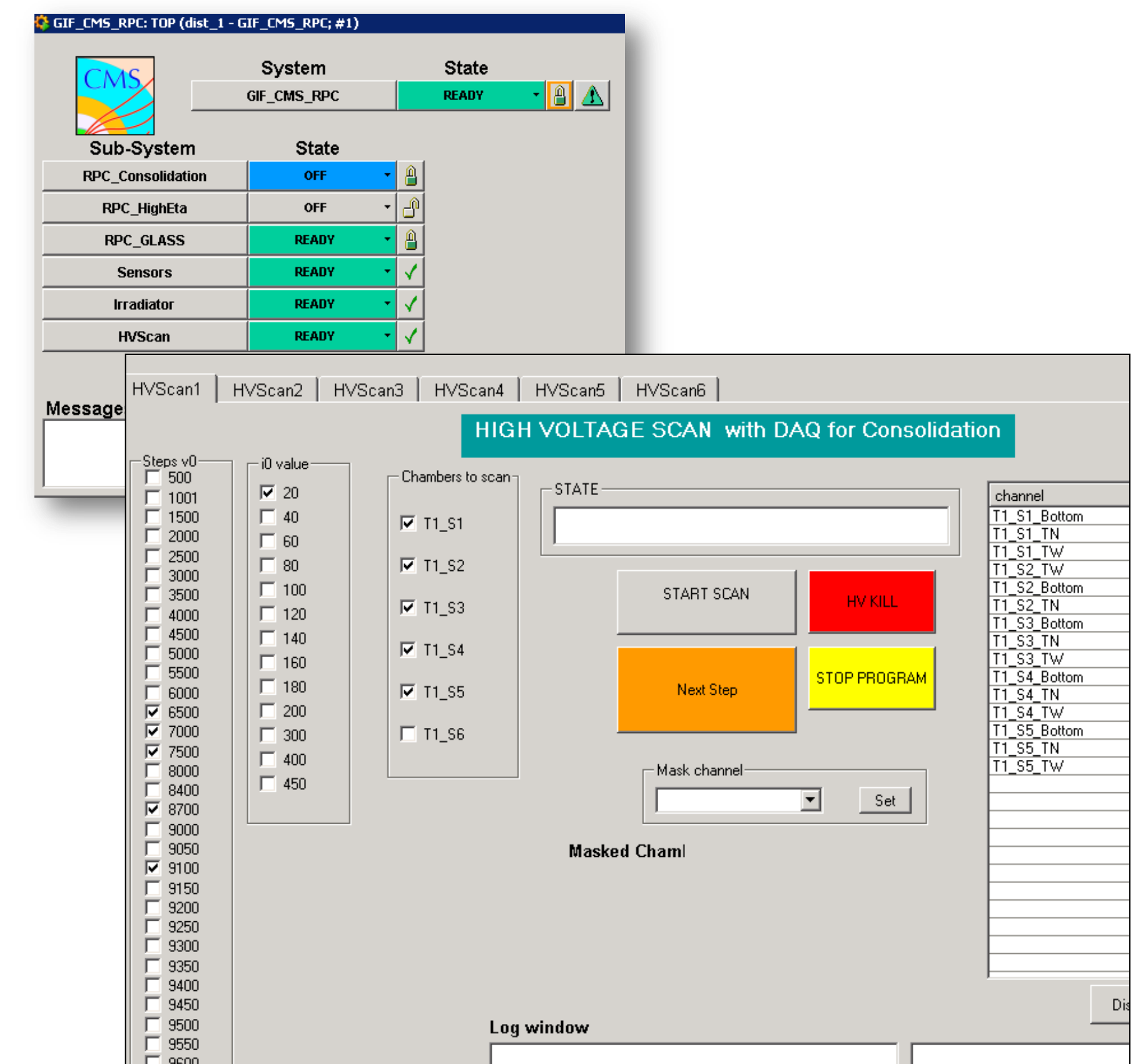


Fig 5: User Interface panels.

## Data archiving and Trending

- DCS archives data points in a dynamic data base.
- The archiving is value or time dependent or both value and time dependent.
- Using internal database for archiving data points in GIF++ [6].
- The archived data is extracted within the domain of the project.
- All the archived values are synchronized w.r.t time.
- WinCC-OA has trending feature that gives the opportunity to plot different data points on single page for comparison.

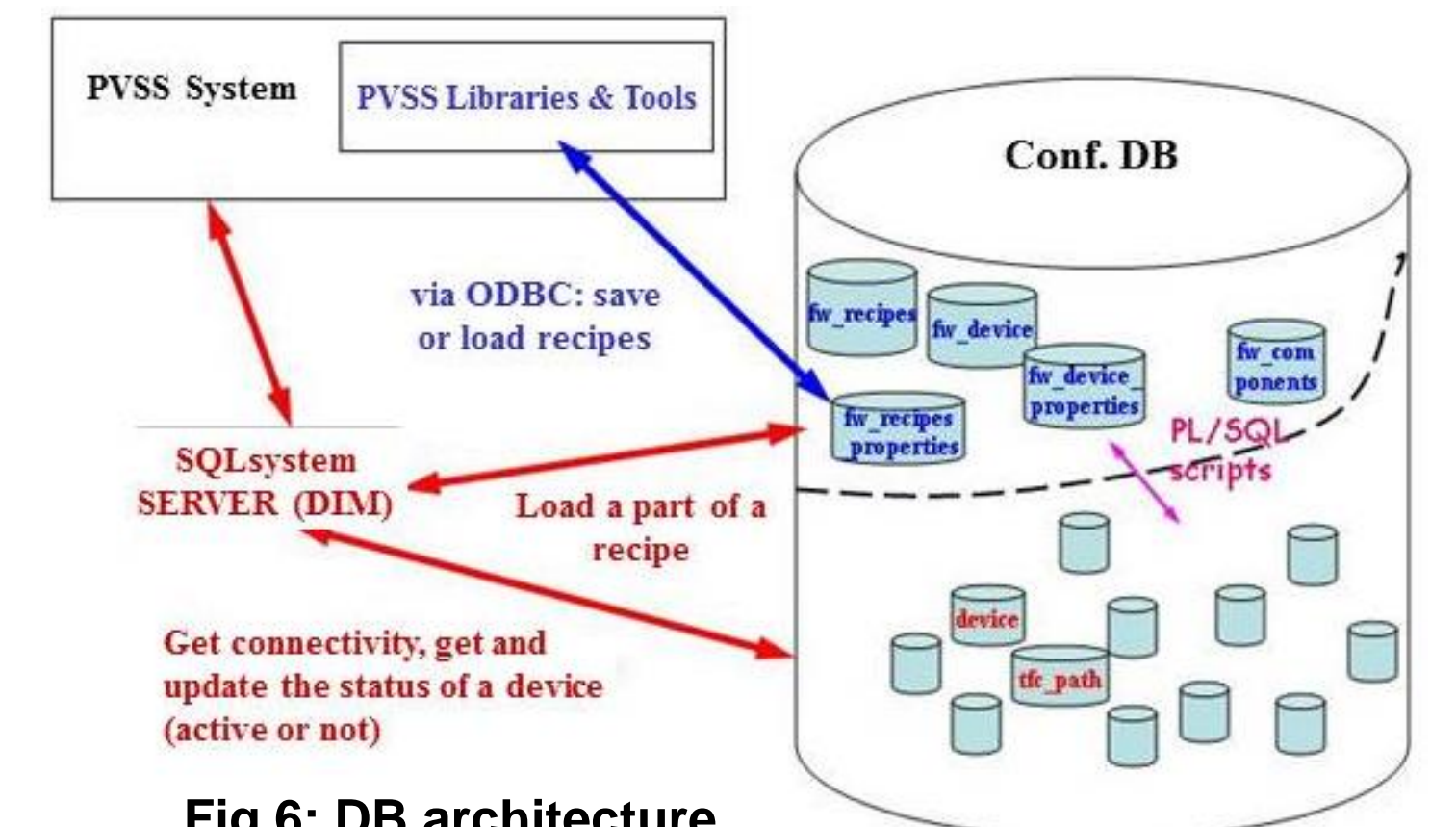


Fig 6: DB architecture.

## Results and Discussion

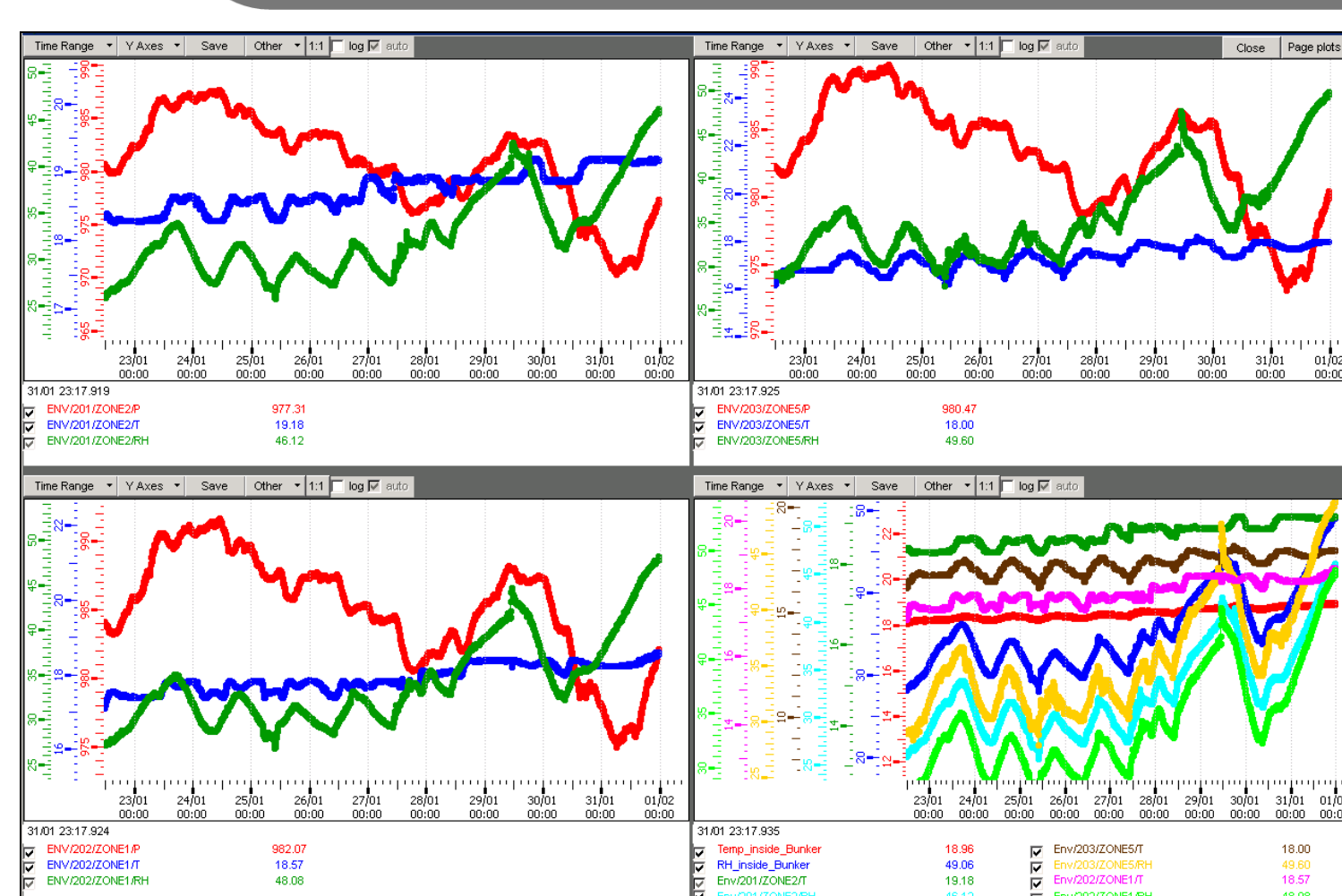


Fig 7b: Environmental T, P and RH.

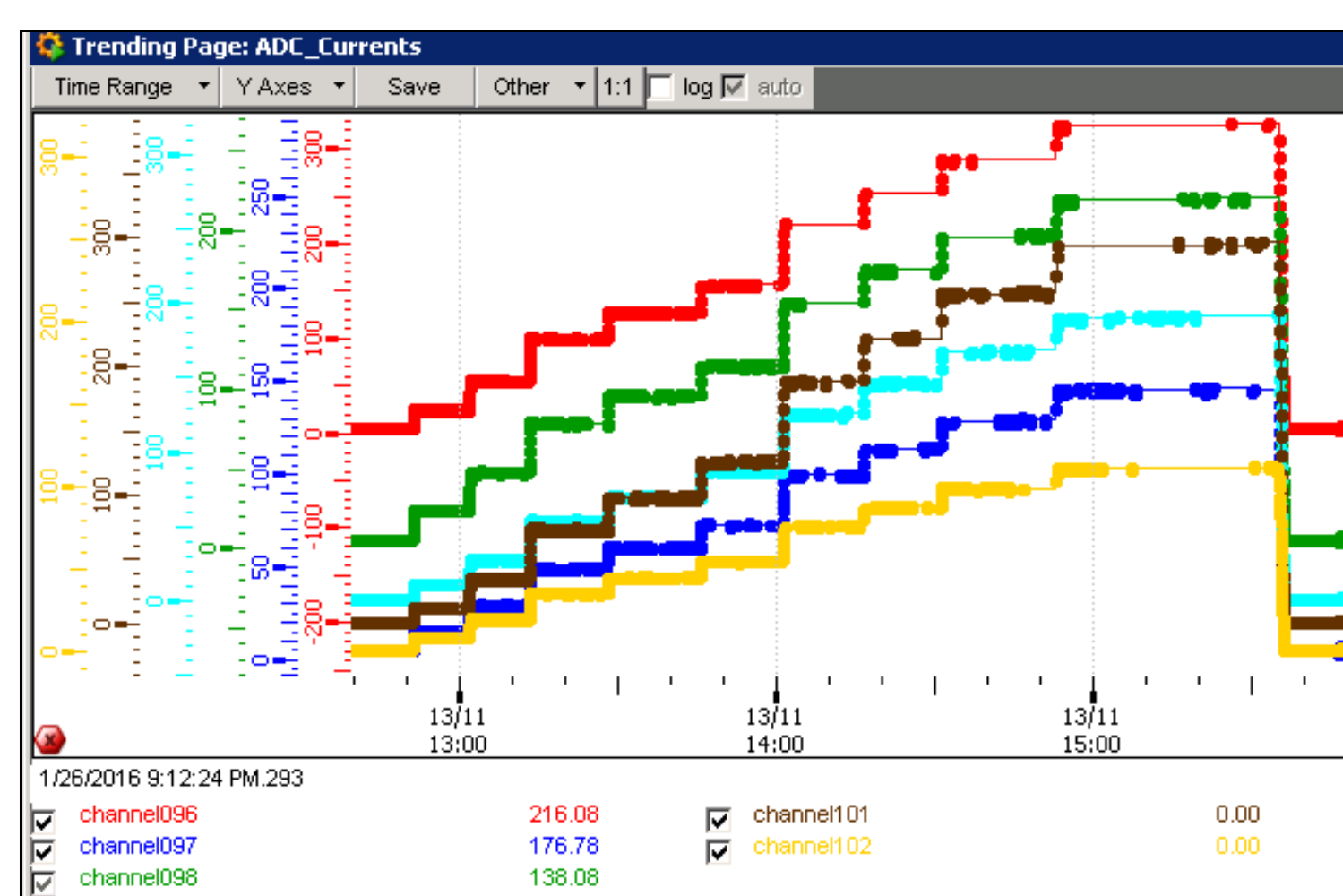


Fig 7c: Current via ADC channels.

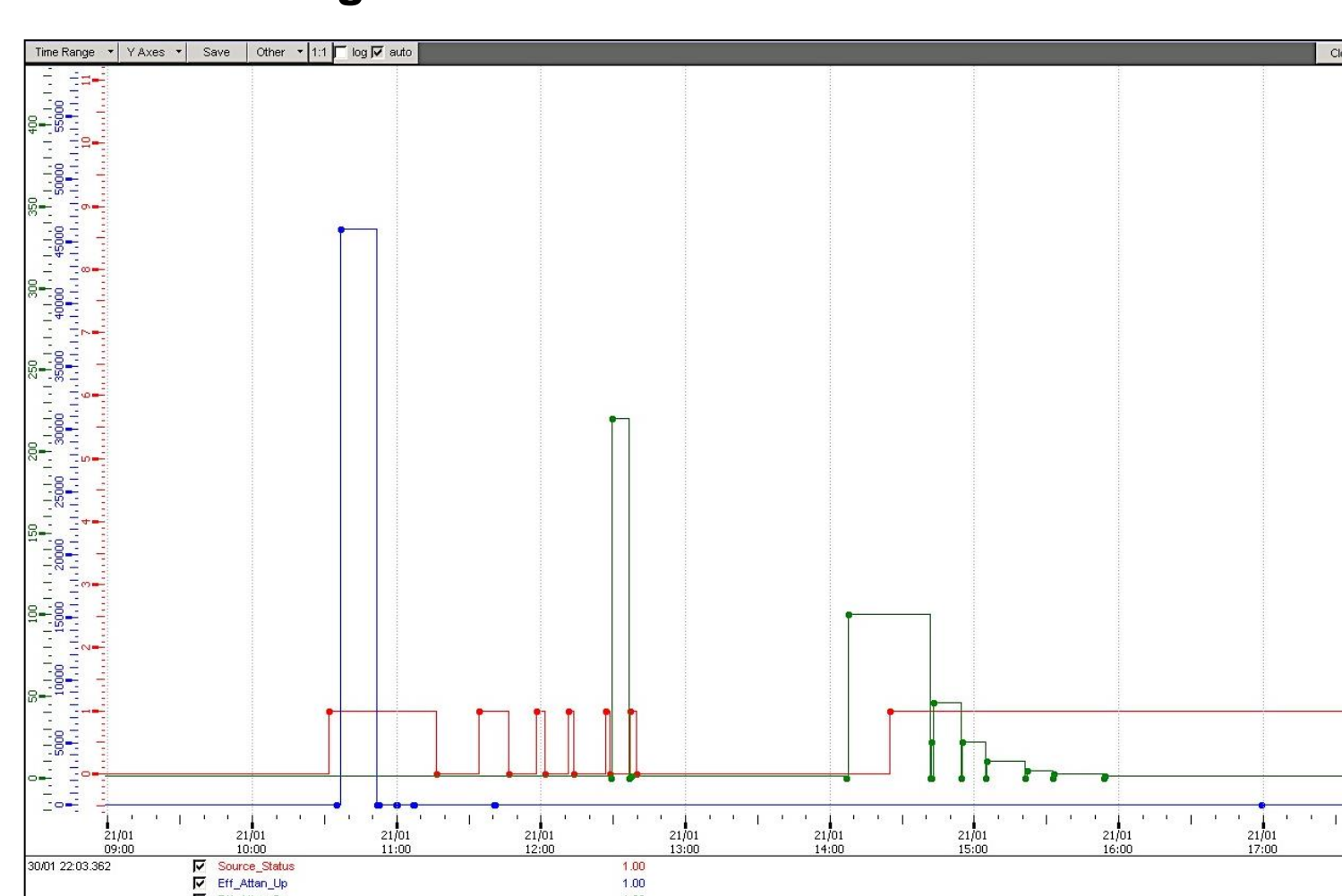


Fig 7d: Source status and attenuator values.

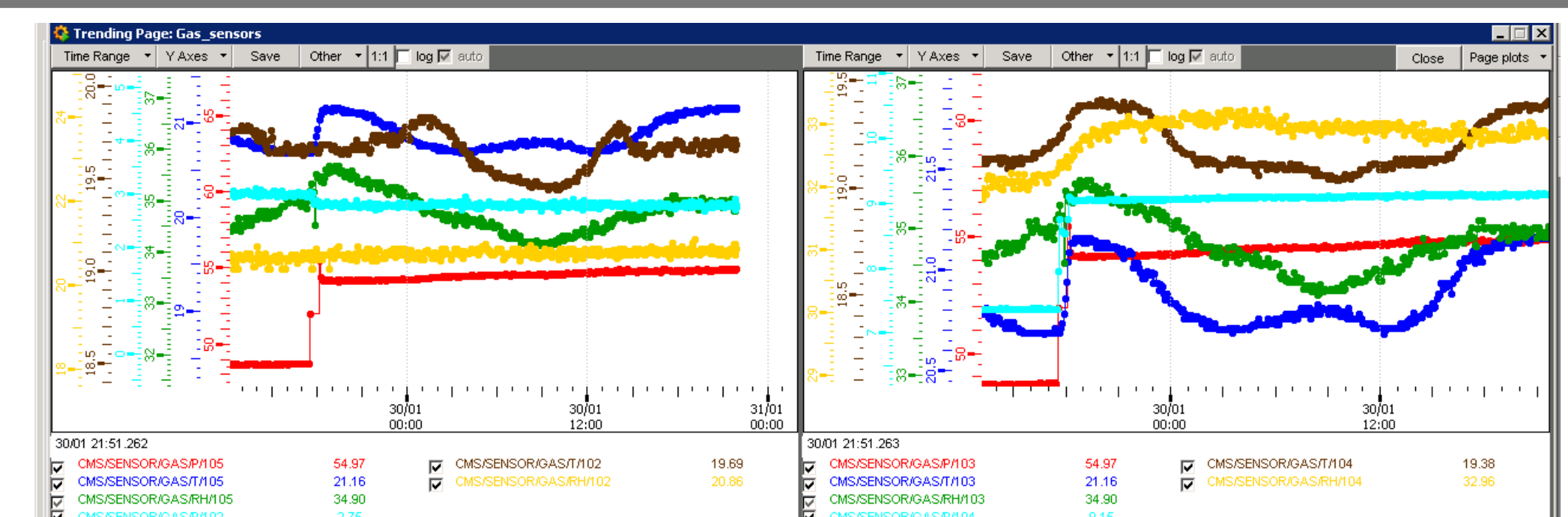


Fig 7a: Gas T, P and RH.

The DCS is developed using WinCC-OA software, which is further equipped by installing JCOP framework. HV and LV power supplies are communicating through OPC protocol. T/P/RH sensors are also readable through OPC protocol -published centrally. The project has designed for R&D study that uses HV Scan and longevity test often. HV Scan panels are applying for each independent detector with P/T corrections. The longevity test is running in a backup script. All useful parameters are archiving in the internal DB of the project. The data is taking from the DB in the txt format for offline analysis with all the variables synchronized.

## Conclusion

- The DCS project successfully tested and applied in the GIF++.
- Detectors are controlling and operating for HV Scanning and longevity study with the application of T/P corrections.
- Data is archiving and using for history plots and offline analysis.
- Alarms create if there is problem like issue in gas system, communication and power cut.

## References

- [1a]: <https://cds.cern.ch/record/2109705/files/ATL-MUON-PROC-2015-021.pdf>
- [1b]: R. Guida, GIF++: The new CERN Irradiation Facility to Test Large-Area Detectors for the HL-LHC Program.
- [2]: PVSS Introduction for Newcomers
- [3]: Engineering Dept., WinCC Open Architecture (OA) Service
- [4]: Engineering Dept., DIP and DIM
- [5]: B. Bilki et. al., Environmental Dependence of the Performance of Resistive Plate Chambers
- [6]: SIMATIC WinCC Open Architecture