DESIGN CONSIDERATIONS FOR DEVELOPMENT OF DISTRIBUTED DATA ACQUISITION AND CONTROL SYSTEM (DDACS) FOR RADIO-ACTIVE ION BEAM (RIB) FACILITY

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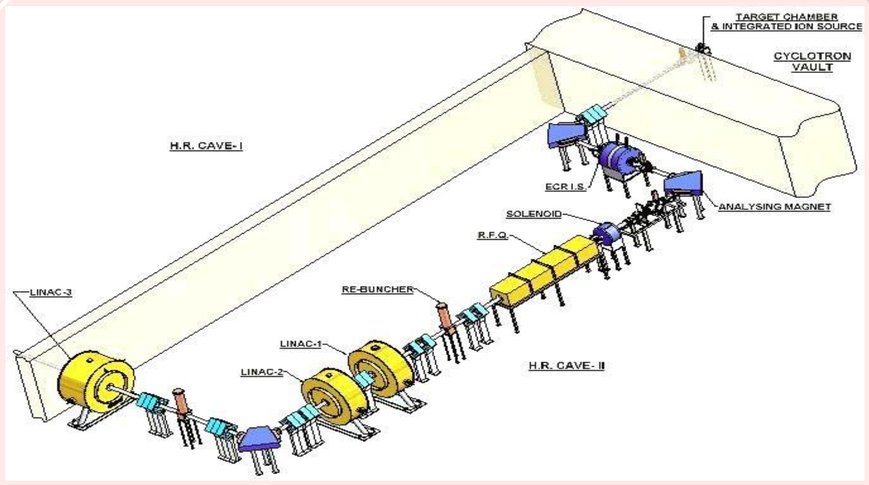
RIB Facility – An Overview



Layout of RIB Facility

Radioactive Ion Beam (RIB) Facility is being developed at VECC . The low energy RIB is accelerated from 1.75 KeV/u to about 100 KeV/u in a RFQ LINAC. Three IH LINAC modules raise the energy up to around 415 keV/u. Subsequent LINAC modules are to be used to achieve the final beam energy of 1 to 5 MeV/u.

- ❑ The RIB beam line is equipped with state of the art systems to produce and accelerate Radio-active Ion Beam. The major systems are broadly listed below:
  - Linear Accelerators (LINACs) , RF Quadrupole (RFQ), Rebunchers
  - Faraday Cup, Vacuum Pump, Gate Valve systems etc.,

and theses beam line systems are powered with :
- Klystron High Power Amplifier (KHPA)
- High power RF Transmitters, High voltage sources, High current power sources

- ❑ **"Distributed Data Acquisition and Control System (DDACS)"** was developed for monitoring, supervision and control of all the important parameters associated with the various sub-systems of RIB.

Need for DDACS System

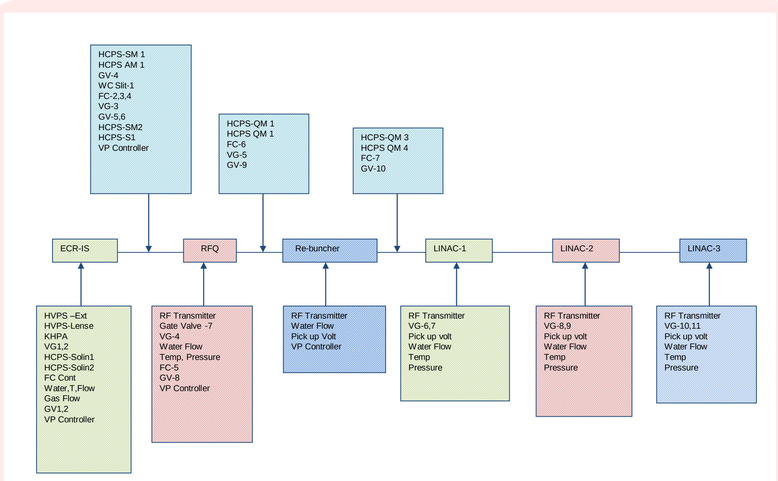
The RIB facility integrates many Electronics Sub-systems procured from different international sources. Each system has its own interface for remote controlling the system parameters.

- ❑ DDACS system is aimed to develop all necessary systems, sub-systems and interface circuits to monitor and control the RIB systems.
- ❑ The software developed for DDACS system helps an easy way of controlling the parameters at sub-system level and system level with necessary Graphical User Interface (GUI).
- ❑ An Embedded Controller planned at the Control Room (CR) shall control all the RIB systems and associated equipments

DDACS System Design Approach

- ❑ The design is planned to support Distributed Data Acquisition, considering the physical locations and number of associated RIB systems
- ❑ Entire RIB beam line systems are divided in to eight sections depending on the process flow and the equipments connected to it.
- ❑ There are eight such Data Acquisition and Interface modules called "Equipment Interface Module (EIM)" which covers Data Acquisition from all the RIB Systems
- ❑ Each EIM modules independently collects the data, monitors and control their respective RIB systems
- ❑ There are two RIB Controllers, one positioned near RIB beam line and other in the Control Room. Control and monitoring the status of the RIB systems are possible from both the RIB Controllers depending on the operational requirements.
- ❑ The EIM modules and the RIB Controllers are connected through Fibre Optic Interfaces for EMI free operation
- ❑ The DDACS system is planned with three layer architecture, i) Equipment Interface Layer ii) Supervisory Control Layer iii) Operator Interface layer

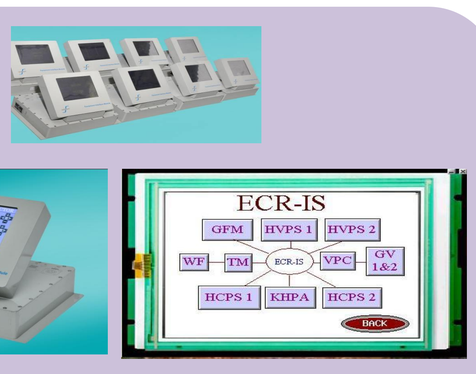
Development of DDACS System



RIB System and Control Parameters

- ❑ RIB beam line systems are broadly divided and classified in to eight sectors covering the following sub-systems.
  - Electron Cyclotron Resonance Ion source (ECRIS), ECRIS -to- RFQ Beam Line,
  - Radio Frequency Quadrupole (RFQ), RFQ-to-Rebuncher Beam Line, Rebuncher,
  - Rebuncher-to-LINAC-1 Beam Line, LINAC-1, LINAC-2 and LINAC-3

- ❑ The DDACS System developed to monitor and control the RIB systems are broadly classified as:
  - Equipment Interface Modules (EIM) - 8 Modules distributed in the RIB beam line
  - RIB Controllers (RIB room and Control Room)
  - RIB System Simulator
  - Remote Interface Module (RIM) for RF Transmitter
  - Faraday Cup Controller, Slit Controller, Vacuum Pump Controllers



EIM Modules


RIB Controllers

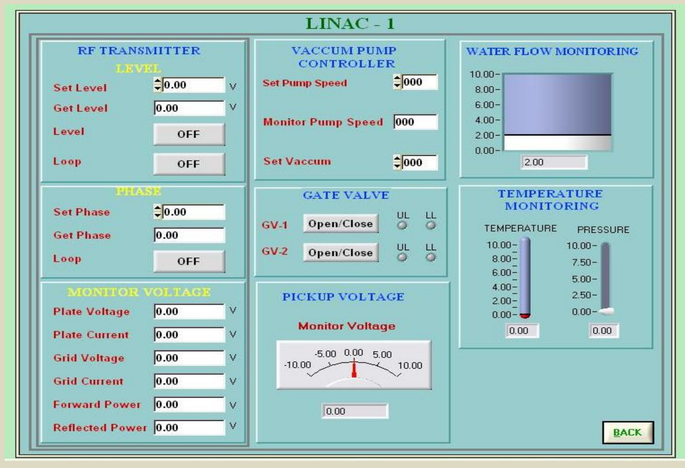

RIB System Simulator


Faraday Cup Controller,
Remote Interface Module (RIM),
Slit, Vacuum Pump Controllers

System Qualification Aspects

- ❑ The DDACS system is designed and developed considering the end application and operating environment. The following three aspects were addressed during the system design and implementation phase.
  - Functional specifications and operational requirements
  - Environmental specifications
  - Electromagnetic Compatibility(EMC) requirements
- ❑ As the DDACS System can be a potential victim of Electromagnetic Interference (EMI) generated from the RIB systems, the following EMC tests were carried out as per IEC Standards and the system was qualified.
  - Radiated Susceptibility (RS) test – IEC 61000-4-3
  - Power Frequency Magnetic Field test IEC 61000-4-8
  - Conducted RF Immunity test –IEC 61000-4-6

System Evaluation and Integrated Testing



A typical GUI for LINAC-1 Sub-system

- ❑ Functional performance of the modules have been checked using the RIB System simulator
- ❑ EMI/EMC qualification tests as per IEC 61000 standards on the modules to qualify them to be used in an accelerator environment.
- ❑ DDACS was installed and integrated to the RIB system and testing was carried out at EIM module level and from RIB Controllers.

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