

VACUUM CONTROL SYSTEMS UPGRADE AND ANALYSIS FEATURES AT DESY

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Abstract

The vacuum control systems of the particle accelerators at DESY are being progressively upgraded using the DESY PETRA style system described at PCaPAC96. It is based on a network of PC and Novell File Server Systems. To date, the DESY particle accelerators HERA-e, DORIS and LINAC 3 have been successfully transferred to the upgraded system. The new vacuum systems support analysis of status and dynamic processes. Investigation of individual pressure measurements and pressure profiles of a whole machine are possible. Short and long range archives of the recent and distant past are included. The long range archive is a separate system which performs data logging for many other device controls as well. Special emphasis is put onto the data visualisation. Time accelerated views of pressure profiles help to watch the development of vacuum quality or locate a developing leak. Experience gained on the DESY Vacuum Control Systems Upgrade and the Vacuum Analysis Features will be described.

1 INTRODUCTION

The preacceleration of protons and electrons for the Hadron Electron Ring Accelerator HERA is done by the machine PETRA[4]. The PETRA Control System is based entirely PC hard- and software since the spring of 1996. The specific solution of the PETRA Vacuum Control system VCS is shown in figure 1.

Characteristics of this PC based Control System are

- All PCs are connected by an ethernet LAN¹ with a fileserver running Novell Network 4.11
- Console PCs running client applications are the graphical user interfaces
- Device Server PCs running server applications are the interface to the inhouse field bus SEDAC² [1][2] which is the long distance connection to hardware device controllers
- MS Visual Basic 3.0 is used for development of Client and Server applications under MS Windows 3.11
- The communication of Client and Server applications is realized by inhouse-developed custom controls (VBX³) which also support the Novell IPX protocol[3]
- Standard Novell file access to the file server
- Data and program code are hosted on the file server

¹ Local Area Network

² Serial Data Acquisition and Control system

³ VBX is the extension of Custom Control Files

- A LAN clock is realized by an IPX broadcast sent by the Cycle PC once per second
- Applications on the Device Server PC are triggered by the LAN clock to perform the read-out of the device status, to process the data and to send them into the LAN
- The client applications on the console PCs listen to LAN and display the current device status
- The server applications on the Device Server listen for device operating commands coming from the console PCs.

These principles of the PETRA Vacuum Control System VCS were adapted for the upgrade of the VCS to the other accelerators at DESY.

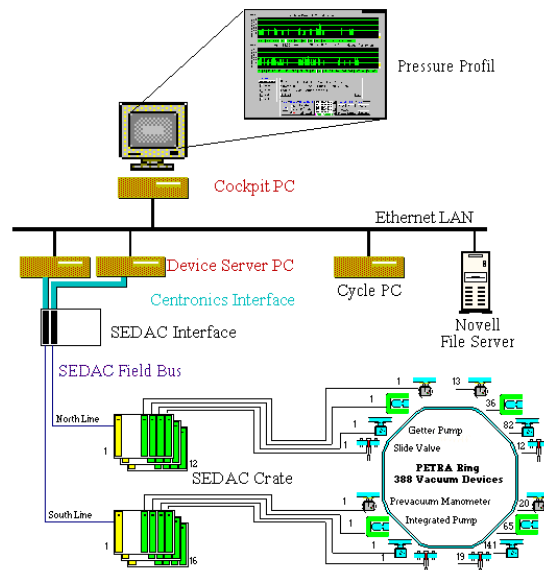


Figure 1: PETRA Vacuum Control System

2 THE VACUUM CONTROL SYSTEMS UPGRADE OF HERA-e, DORIS AND LINAC3

A direct transfer of the PC software of the PETRA VCS to the other machines was not possible due to the differences in the device controllers (hardware generations) and additional devices not present in the PETRA VCS.

A redesign of the Device Server applications was needed to take into account the new operation modes available with microprocessor based vacuum controllers.

The new and additional information about the vacuum devices had to be integrated into the client applications on the console PC.

Additionally there was the desire to maintain as much as possible the proven graphical interface as it is at PETRA for the vacuum operators.

2.1 DORIS

Applications for the separate operation of the microprocessor based controllers were developed. Console and Device server applications for Titanium-Sublimation pumps not used at PETRA were written.

The DORIS VCS was redesigned in this way in 1997.

2.2 HERA-e

The HERA-e VCS has a much greater number of getter pumps as PETRA (about 800, PETRA: 200). So major changes of the Console and Device Server applications were necessary because of the limited packetlength of the IPX communication interface.

The operation programs for the microprocessor based device controller and for the Titanium Sublimation Pumps could be transferred from the DORIS VCS.

Applications were developed for the following devices not used at PETRA and DORIS

- Turbo Pump Stations
- High Voltage operation

2.1 LINAC3

At LINAC3, differences in the power supplies of the getter pumps led to changes in the software of the Device Server applications.

In some vacuum sections of the LINAC3 accelerator there is a lack of pressure information by getter pumps; in these machine sections Pirani and Penning pressure meter are installed. Major changes in the Console and Device server applications were done to show the pressure values of these different devices in one display.

These modifications in the software for the VCS of PETRA does not effect the reliability of the new VCS of HERA-e, DORIS and LINAC3.

In contrary the better performance in terms of a higher time resolution of status information (HERA-e: 1 second, 40 seconds before) and the analysis features bring more clarity into vacuum system operations.

3 ANALYSIS OF PRESSURE STATUS

3.1 Pressure Display

In the operation mode of the accelerators the getter pumps supply the main pressure information of the vacuum chamber.

A single pressure value is visualized by a vertical green bar on the screen at the console. The scale runs from about 1E-12 to 1E-05 mbar.

A pressure profile of all the single pressure values taken around the accelerator ring is collected within less than one second. The display is visually prepared in the comb representation[5]. So even for the HERA-e accelerator there is a clear overview of the nearly 800 pressure values.

The position and length of the pressure bars on the screen correspond to the position and pressure values in the machine.

3.3 Marker

For the visualization of changes of pressure in time the Marker function is used.

A reference machine profile can be fixed at one instant by setting the Markers: At the top of each pressure bar a small red horizontal bar is painted. These Marker signs are permanent until the Marker is set or cleared.

If the pressure values of the profile change in time the amount of the change with respect to the reference profile is directly visible in the different positions of the Marker and the endpoints of the pressure bars.

3.4 Range Check

To focus the attention to a pressure value which has exceeded a previously defined limit there is the Range Check function: The color of the corresponding pressure bar is changed to red as long as the limit value is exceeded.

4 ANALYSIS OF PRESSURE DYNAMICS

4.1 Five Minute Archive: History

Per mouse click a history of every single pressure measurement in the accelerator of the last five minutes is provided.

At an update rate of once per second a time profile of the selected pressure measurement can be watched on the screen.

The data for these histories are held in the memory of the Device Server PCs: About 250KB for HERA-e. At the request of a console PC the Device Server sends the data for the selected pump via IPX telegram over the LAN: 600 bytes per second.

4.2 One Hour Archive: Playback

The pressure profiles of the whole machine for every second of the last hour are held in the memory of the console PC. Thus the data for 3600 profile pictures are available for a playback: Showing picture-for-picture at ten per second supplies a time accelerated vacuum movie that starts in the present and goes to the past.

- A one hour vacuum history of a whole machine pressure profile shrinks to a six minute playback show.
- A developing leak propagating as a pressure wave through the vacuum tube can be studied again and again. The option to go step-by-step, picture-for-picture through the show enables one to locate a leak.
- The process of the developing vacuum quality in the last hour becomes dramatic in this time-accelerated view.

4.3.1 One Month Archive: World Wide Web

There is a separate long range archive system. It is independent from the Vacuum Control System and performs the data logging for all the different Device Control Systems running on PCs.

There are following archived vacuum parameters:

- Average pressure of the whole machine
- All the single pressure measurements
- Status information of the gate valves

At present the hard disc capacity for the HERA-e vacuum data is sufficient for

- 31 days with a time resolution of 20 minutes
- 7 days with a time resolution of 2 minutes

At this time the archived data are presented in the World Wide Web in terms of numbers.

4.3.2 One Month Archive: Playback Archive

The Playback Archive is the Playback with an interface to the Long Range Archive.

So the pressure data can be presented in the accustomed comb representation.

For any selected time range out of the 31 days the Playback Archive allows viewing a vacuum movie. The time steps are variable. An eight hour vacuum shift could shrink to an eight minute playback show.

5 CONCLUSION

The PC concept of the PETRA Vacuum Control System was transferred very successfully to the accelerators HERA-e, DORIS and LINAC3.

The systems are reliable, have a high performance in terms of the time resolution of presenting the vacuum device status and the described analysis features help to

bring clarity into vacuum system operations.

6 REFERENCES

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