

# PARTIAL PRESSURE ALARM SYSTEM FOR THE USE ON BEAM LINES WITHOUT ANY PHYSICAL LIMITATION TO THE STORAGE RING VACUUM SYSTEM

D. Schmied, E. Burtin, I. Parat, ESRF, Grenoble, France

## Abstract

The ESRF operates eight of its forty beamlines without any physical separation of the Storage Ring (SR) vacuum and the experimental chambers. Protection of the SR vacuum against possible contamination is required.

Partial pressure variations due to radiation-induced photodesorption should clearly be distinguished from pressure variations due to leaks or contamination.

This involves further developments of the existing Residual Gas Analyser (RGA) system [1] in order to gain the necessary flexibility.

## 1 GENERAL DESCRIPTION

Beam lines without any physical separation to the SR vacuum system have a specific vacuum layout and also additional interlock features. Triggered by total pressure signals, the interlock system protects the SR vacuum against accidental venting due to material failures or human error [2,3].

Residual gas analysers are installed between the Front End and beam lines limiting gate valves. In order to continuously protect the SR vacuum it is necessary to include the partial pressure measurement in an alarm system. This signal, connected to the standard Front End / beam line interlock system, will close shutters and gate valves to isolate the vacuum sections.

## 2 CONCEPT

### 2.1 General Concept

Based on the installed Quadrupole Mass Analysers (QMA) this microprocessor-controlled unit can work independently from an external computer in order to set the RGA into a predefined operation mode and activates its alarm outputs [3].

This system is connected to the computer system to enable remote operation and data analysis (see Fig. 1).

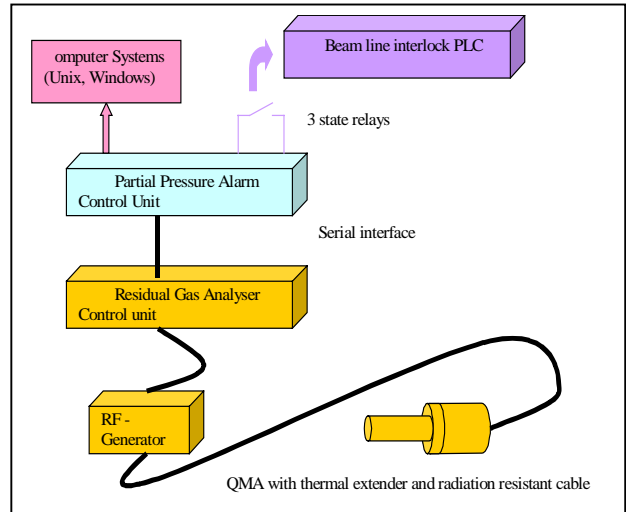


Figure 1: Partial pressure alarm layout.

### 2.2 Main features of the alarm system

#### 2.2.1 Hardware compatibility

The partial pressure control unit, designed as a hook-up unit, connected to the existing RGA system, can operate the dedicated analyser alone. A serial interface allows the initialisation, operation and monitoring of the RGA as well as the partial pressure alarm unit (PPAS).

#### 2.2.2 Operation modes

A local operation or remote command sets the partial pressure alarm unit into its operation modes.

The Bypass mode inhibits the alarm unit and enables the standard operation of the RGA.

In the Control mode, the RGA is set in a predefined operation mode for a continuous residual gas survey.

In order to guarantee the correct functionality of the complete system the alarm unit performs frequent self-checks and diagnostics such as: filament status, power supplies' status, RF-tuning, mass alignment, resolution and total pressure check.

Should a failure be detected, then the partial pressure alarm unit provides a complete error handling which includes also the relay assignments.

In Control mode the alarm unit initialises and loads the operation parameters for the scanning mode. These parameters are either stored in the control unit or can be downloaded via the serial interface. The scanning mode itself is a multirange self controlling BarChart mode (see Fig. 2)

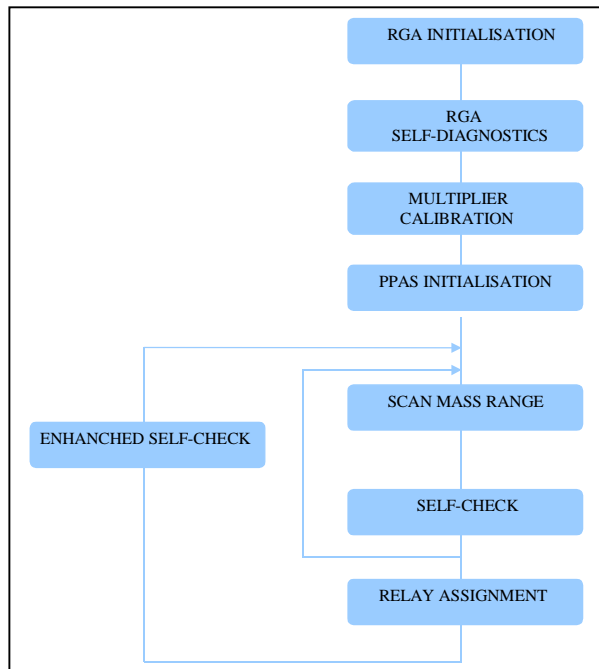


Figure 2: Control mode logic

### 2.2.3 Alarm definitions

The partial pressure alarm algorithm consists of Boolean and arithmetic operators in order to define the different alarms.

An alarm, which means the status change of a relay from "good" to "bad" is declared in two steps:

- a) Alarm conditions are defined using arithmetic operators, absolute or relative comparisons and pressure normalisation via an external total pressure signal. A hysteresis of half of the limit is used to release the active condition.
- b) Relays are assigned by linking the different alarm conditions with Boolean operators together. Error flags which indicate a device failure can also be assigned. The repetition is used as a filter which defines how often the combination has to be repeated before contact closure ( see Fig. 3).

The relays are not operated when either no condition is defined or the unit is set in the Bypass mode.

In case of an alarm the complete mass spectrum, alarm condition and relay status' are stored in the controller.

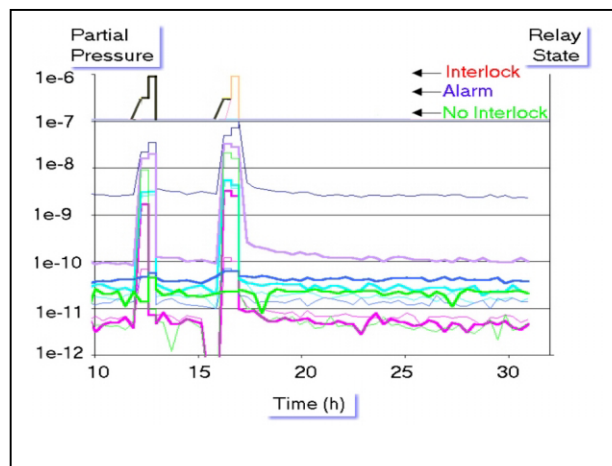
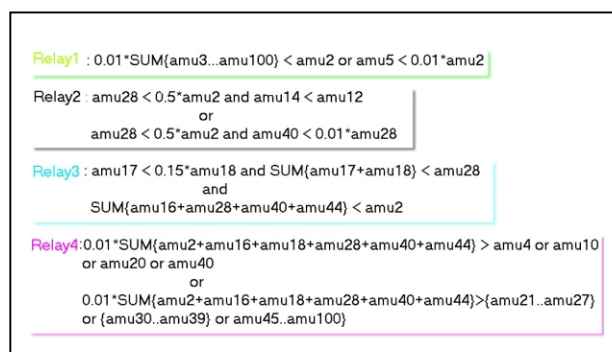


Figure 3: Example of an alarm relay assignment.

## 3 OPERATION

After acceptance tests of the prototype the in-situ commissioning phase is in progress.

The partial pressure alarm system is installed on several windowless beam lines.

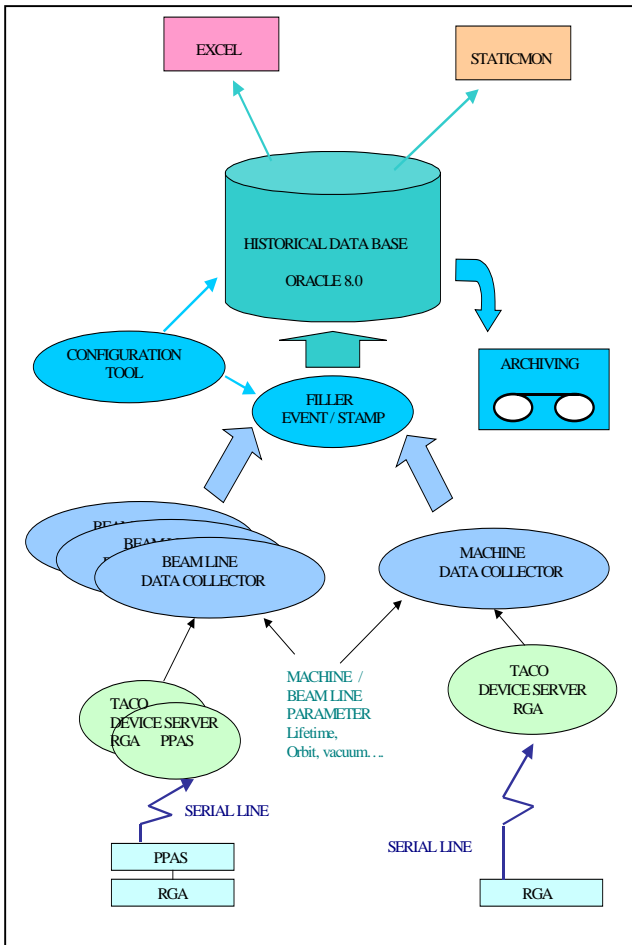
The RGA is hooked up with its partial pressure alarm system on the first beam line module.

The complete system has been integrated in the general control structure (see Fig. 4).

Device dedicated software has been developed to configure the alarm system and also to control and operate the RGA.

Continuous data acquisition of the mass spectra independent of the operation mode is performed and stored on the history database.

Tools are available in order to retrieve the stored data and compare them with other machine and beam line parameters (pressure, beam intensity, Front-End status...).



[2] D.Schmied, "Vacuum control and operation of the ESRF Accelerator System", EVC6, Villeurbanne, 7-10.12.1999  
 [3] D. Schmied, "Vacuum controls and operation", CAS Vacuum Technology, Denmark, 27.5.-3.6.1999  
 [4] Dipl. Phys. Ulrich Misse Gasanalyse-systeme, Deichselbach 62, 58285 Gevelsberg, Germany

Figure 4: General control structure

#### 4 CONCLUSION

The in-situ commissioning phase comes to its end. The alarm control unit has proved to be fully compatible with the installed RGA system. A correct functionality and a stable operation have been confirmed. The dedicated control software for the alarm control unit and RGA is working. With the gained experience we are confident that the PPAS can be integrated into the beam line interlock system.

#### ACKNOWLEDGEMENTS

Thanks to J-M. Lefebvre and R. Kersevan for the decisive support of this project. Many thanks to P. Guerin, J-M. Chaise, O. Martin and J-L. Pons for the software developments as well as to beam lines ID1, 21, 27 and 32 for their nice collaboration.

#### REFERENCES

[1] SPECTRA INTERNATIONAL, Cowley Way, Weston Road, Crewe, Cheshire Cw1GAG, England