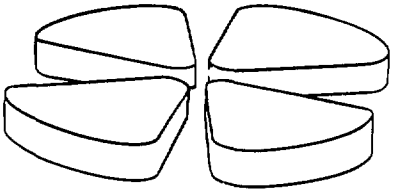
# GANIL



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# A NEW RADIATION SAFETY CONTROL SYSTEM FOR GANIL

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Abstract : A second generation radiation safety control system has been carried out to supersede the initial system which was not flexible enough to support new ion beams and new experimental conditions required by the accelerator operation.

The main reasons which determined us to renew our safety control system are presented.

The new system, which is conducting the Ganil accelerator from the first quarter of 1990 , is emphasized afterwards. It uses a star structured architecture , VME standard processors and front-end modules activated by pDOS operating system and high level language (C and Fortran) tasks, associated with enhanced resolution color displays for real time synoptics.

## Introduction

The Ganil laboratory is operating an multiaccelerator composed of one compact cyclotron injector with k=30 and two cascaded separated sector cyclotrons with k=380. This facility for fundamental research in the fields of nuclear physics, atomic physics and solid state physics, provides fast heavy ion beams from carbon to uranium. Beam energy is ranging from up to 100 MeV/A for the ions with A < 20 to 25 MeV/A for the heaviest ions.

Radiation Control . Radiation safety control in such a "basic nuclear plant" is a key concern. It is aimed at controlling the accelerated ion beam and the experimental area so as to avoid any radiological risk for individuals. Beam penetration into controlled area is interlocked by mastering at least two upstream safety devices (e.g. beam stopper, bending magnet,) and by checking the radiological level with about 80 gamma and neutron detectors.

Access to any controlled area is regulated according to its state (Cf. Table) which evolves as indicated on Fig.1 .

| STATE | Access Condition | Beam/area | Radiolog.Surveil. |
|---|---|---|---|
| "LIBRE" | Free, gates open | No | No |
| "SURVEILLE" | Free, gates open | Yes (<1Mev) | Yes |
| "CONTROLE" | with ID-badge | No | Yes |
| "DEROGATION" | with ID-badge | Yes | Yes |
| "INTERDIT" | No access | Yes | Yes |

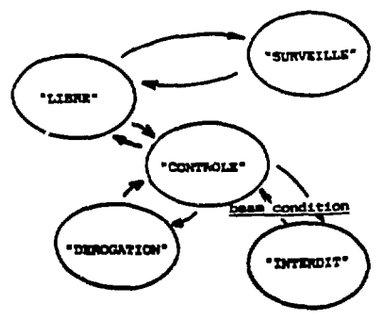


Fig 1 : Area State Transitions

Why renewing the Radiation Safety Control System ? The initial system named UGS1, which was surveying the Ganil for ten years, turned out to be inadequate to cope with the increasing needs of the Ganil operation (e.g. implementation of new safety devices or new operation modes). This is caused by obsolete processing hardware and more severely by outmoded software environment : virtually full assembly language routines , numerous patches and bulky manual documentation which departed at many places from the actual software. This linkage obviously demanded highly skilled maintenance staff with rocketted cost, while global reliability remained poor. To overcome harsh improvement conditions, decision was therefore made to renew the UGS, known as UGS2 system.

## Renewing the Radiation Control System

Choice criteria . Minimization of investment over the life of the system while improving its flexibility is a prime concern. Selecting acknowledged industry (de facto) or international open standards allows an industrial approach to system development, time saving and reliability. Also high level languages will be used to ease readbility and maintenance .

Hardware. The UGS2 System adopts a star structured architecture as shown in Figure 2 . The system hub, named UGS, is connected, via 9.6kbit noise immune asynchronous serial links, to various remote processors and devices :

- computer MITRA for data logging, off-line statistics processing and displays
- color graphic terminal for real-time synoptics and alarm messages
- main operator console and radioprotection console
- beam safety devices and radiological detectors
- local access control systems, named UGD.

Both UGS and UGD systems widely make use of VME standard processors , I/O and drive modules. About 150 VME modules are distributed within 18 crates to fit the UGS2 system and its simulation facility. These modules are selected from different international makers to meet openess, excellent performances at reasonable cost and off-the-shelves delivery conditions.

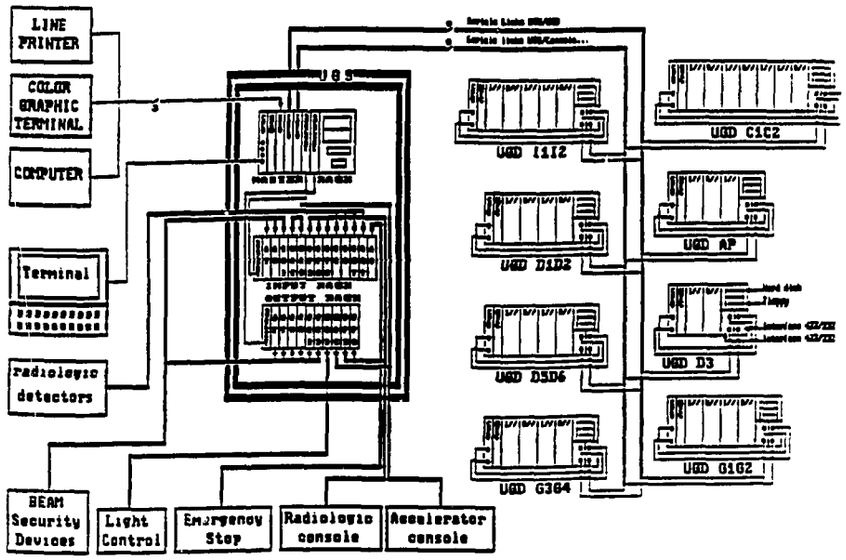


Fig 2 : UGS2 Architecture

Software . The Eyring's pDOS operating system is chosen, as it is already in use at Ganil and well known for its small, high speed kernel providing essential services for multitasking real-time applications. C and Fortran are adopted as high level programming languages.

The UGS2 software is organized around a so-called "software event bus" (FiG 3). Intertask communications are achieved via messaging and common data pools with use of mailing technics.

The UGS2 software gathers about 60 event-triggered tasks which are sorted into :
- Input tasks to handle data stemming from beam security devices, ion source, RF and beam deflection sub systems, neutron and gamma radiation detectors, and local access control systems UGD
- Processing tasks to manage the incoming information flow at the functional level ,i.e. checking the relevance of the input data according to the current experimental state, processing the accepted data and passing along decisions to output tasks for displays and actions.
- Service tasks to perform ancillary or off-line activities such as error detection, diagnostics, ..

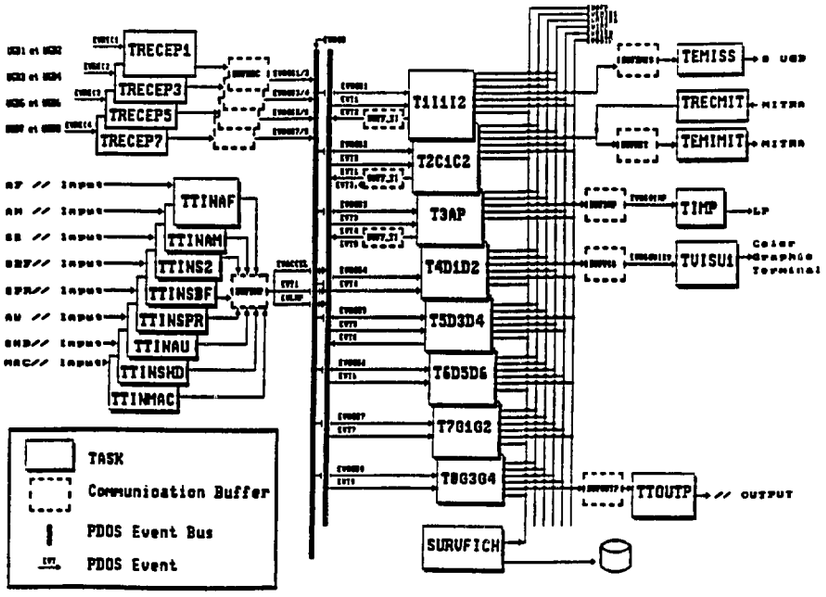


Fig 3 : Schematic Layout of UGS2 Tasking

Human interface . Human interface is mainly based on a color graphic terminal which allows operator to make decision and react in real-time fashion . This terminal visualizes information about experimental room state, safety locks, individual transit through the controlled area, as well as beam interlock and radiological level. Also a special window is devoted to color coded messages for human thru-traffic logging and tracing, and for system error or alarm message displays (Fig 4).

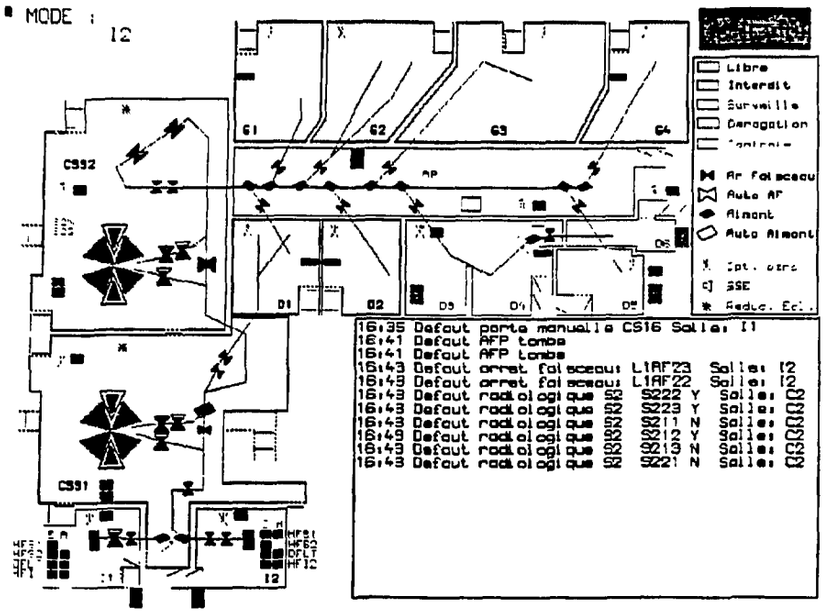


Fig 4 . Graphic Terminal Display

## Conclusion

The new radiation safety control system is surveying the Ganil accelerator plant from the outset of 1990, in a quite satisfactory fashion . This implementation required about 7 man-year efforts from design to hardware / software completion and commissioning. Color graphic oriented human interface is quickly adopted by the operator as a useful improvement . Up to now, several new operation modes and safety device installations have been taken into account by the UGS2 system in a fast and easy manner, reaching in this way the major objective of the UGS renewal project.

## Further reading

[1]. Kechavarzi, V.den Bossche, the Radioprotection Group (1987) "Definition of the UGS2 System" (internal paper, in French)
[2]. De Saint Jores, Luong, Martina (1987). "New Radiation Control System Proposal" (internal paper, in French).
[3]. Helie, Perney, Ruel (1988) "UGS2 design and programming reports" (internal reports, in French)
[4]. De St Jores, Lemaître, Martina , Ponthieux (1990). "UGS2 technical documentation" (internal reports, in French)