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SECOND COLLEGE ON
MICROPROCESSOR-BASED REAL-TIME CONTROL -
PRINCIPLES AND APPLICATIONS IN PHYSICS
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REAL-TIME CONTROL APPLICATIONS IN ARGENTINE POWER PLANTS

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1. INTRODUCTION

The applications we will take as basis are the experience adquired in the Embalse Power Station, and a diagnosis system for plant operation support.

2. DESIGN PHILOSOPHY

2.1 DEFENSE APPROACHES

Im the Embalse system one asumes that most failures are transient and that their effect should be reduced as much as posible. The defensive mechanism incorporated to the system ranges from equipment failure detectors, in the peripherals to a watch-dog timer that covers the whole system. Im between there are several check levels, program timers and devices that monitor the peripherals, program execution and executive behaviour.

When a failure is detected in the system, the program that detects the failure initiates the corrective action, depending on the kind of failure. If the failure is an irrational analog input, the program that reads the analog input will inform

it and then ignore it or correct it. If it is a bad disc transfer the transfer is aborted. If it is a periodic program failure (does not run when due, gets stuck in a loop or generates a memory protect violation) the program is retried. If the failure occurs twice, the function is aborted and informed. When the program fails, the function is transfered to the other computer. When not periodic programs fail they are not retried nor transfered to the other computer. These low priority service programs are not related to plant control and their failures can be ignored.

The computer resigns control only when it has to. With the modular system functions, the failure efects can be located and the system can run still usefully by transfering the bad function to the other computer.

2.2 Languages

Im Embalse station Assembler was used as programming language in the Digital Control Computers.
The diagnosis system for operation support uses a shell written in C language.

3 PURPOSE

The main purpose of the computer system of Embalse is the reactor control, the boiler pressure control, unit power regulation and the more complex processes associated to the reactor as heat transport pressure and inventory control, boiler level and moderator temperature control.

The operation support system is developped to help the operator in the abnormal event diagnosis.

4 Process Description

4.1 Control System

The following programs are included in the Embalse system

1) Executive program

This program handles the scheduling of program execution, establishing the normal execution time and checking when they are due. The executive system allows to run a discrete number of Jobs with different priorities. The executive main function is to administrate the

available resources, run the different programs, as a time function or by the external demand of the operator or the process. It must be able to assign different interrupt priorities.

2 Control Programs

The computer control programs are

- Stepback monitor
- Reactor Regulation System
- Boiler Pressure Control
- Unit Power Regulator
- Boiler level Control
- Heat Transport Control
- Moderator Temperature Control
- Flux mapping
- Fuel Handling System

3) Annunciation system

Annunciation system programs

Message Assembler
Alarm Page
Alarm Horn silencer
Alarm acknowledge
Return to normal supress
Alarm Summary
Alarm Jumper
Limit Alarm change
Sumary list
Historical Data Storage

Sending messages to the CRT or the printer, the annunciation system calls the operator's attention of any station equipment failure

4.2 Diagnosis system

Programs belonging to the diagnosis system

1- The reading and check program

The reading and check program is executed only when the knowledge basis is entered.

The object of the program is to verify that data is entered with the specified format.

2- Translator program

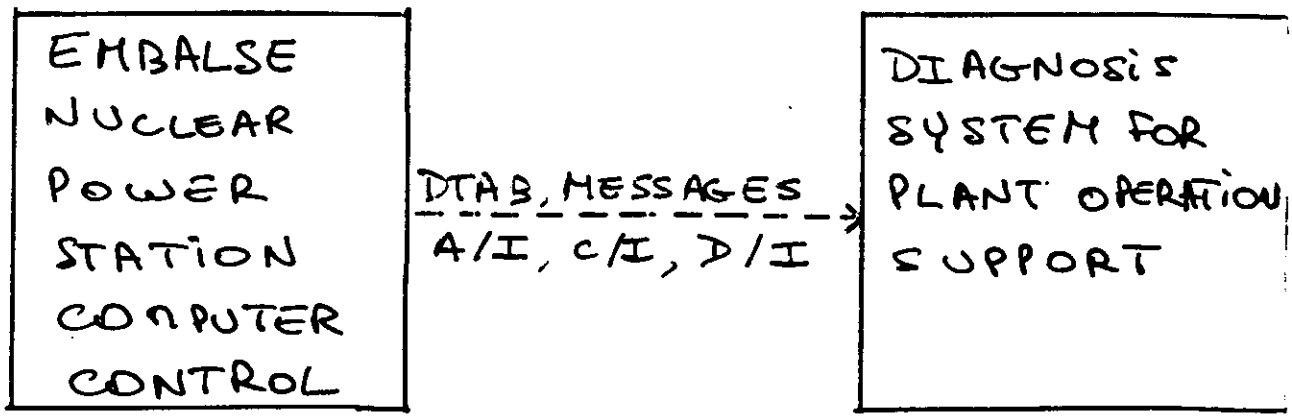
Its purpose is to generate the true-false matrix with events as columns and alarm as rows.
The ones indicate the events that are related with some alarm.
A vector that relates the number of event with it's description is also generated.

3- Search Program

This program is executing continuosly in the computer waiting for an alarm related to a plant upset.

4- Mitigation Program

It consists of the number of instructions, functions and checks to mitigate the considered event.



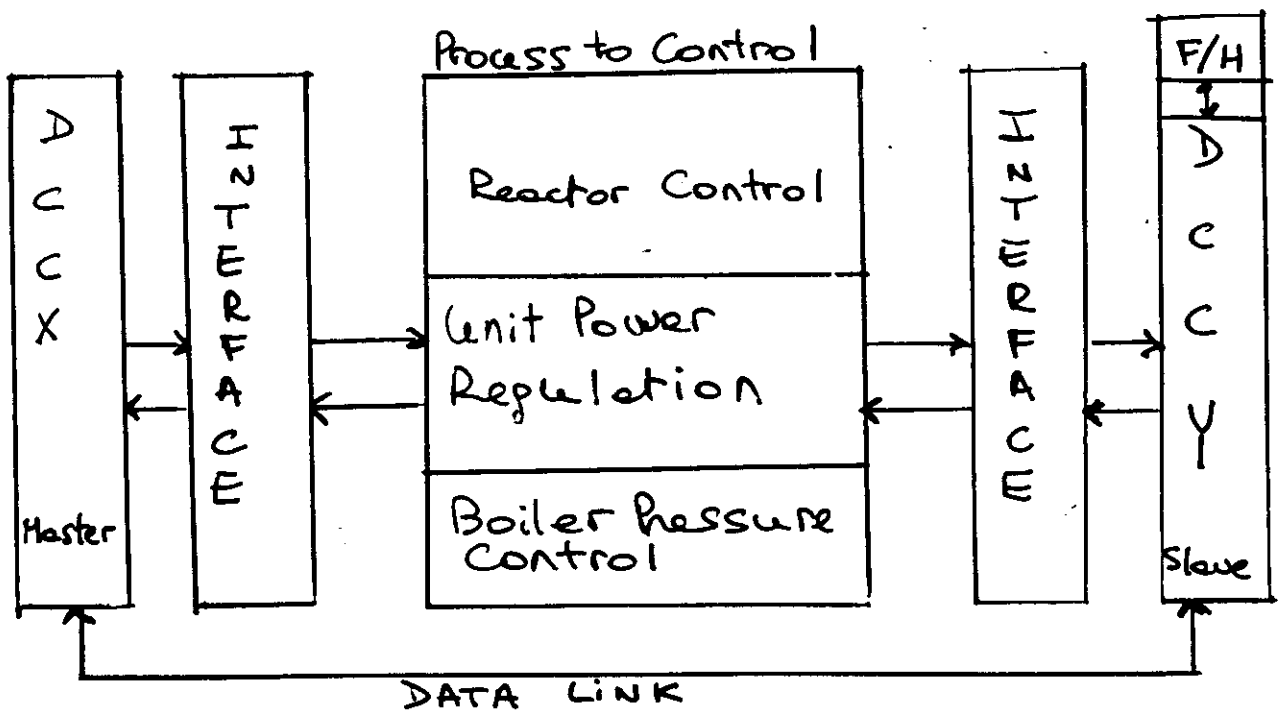
Defense Approaches

WATCH-DOG TIMER

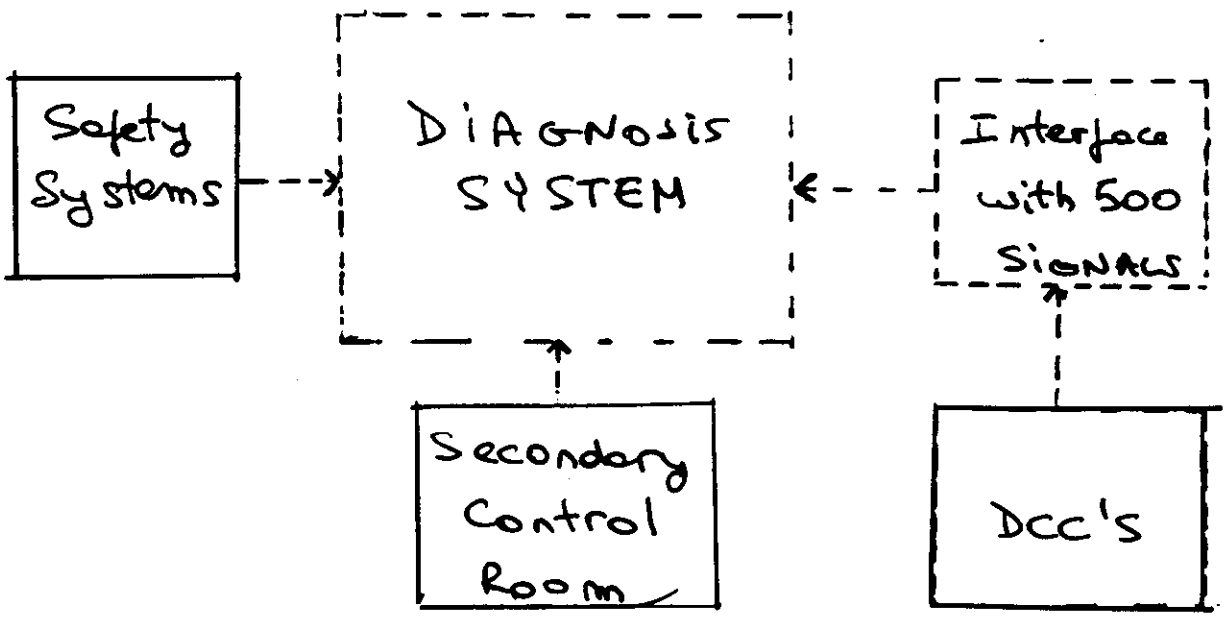
PROGRAM TIMERS

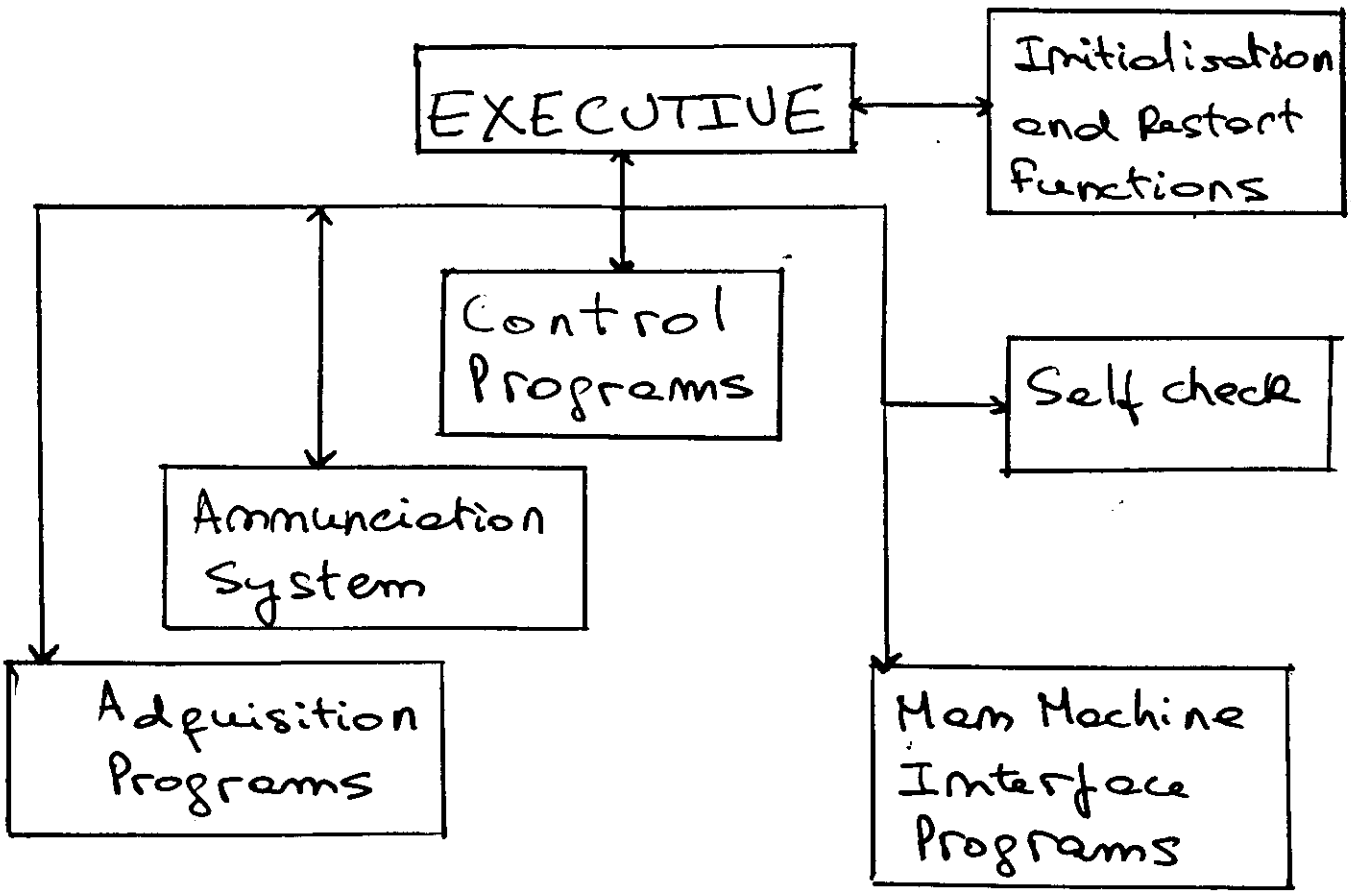
DEVICES THAT MONITOR PERIPHERALS

Equipment Failure Detectors



Diagnosis System




EXECUTIVE
Initialisation and Restart functions
Control Programs
Self check
Annunciation System
Adquisition Programs
Man Machine Interface Programs

Diagnosis System