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PROPOSALS FOR MANUAL CONTROL VIA COMPUTER

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In order to define a common policy for the use of the manual control boxes, the following project is proposed as a basis for discussion. The final decision will allow us to standardize the software and hardware.

1. Operational requirements

If we can design a facility offering the possibility of controlling one element (i.e. increase current in dipole No 20 by 1 A) and/or a combined set of elements (i.e. increase by 1% of full-scale the 13th harmonic of quadrupoles), every operational requirement will be met.

The possibility of returning to previous settings while preserving the existing ones seems likely to be useful and must be incorporated in the project.

The primary aim in the design of the hardware must be to make the use of these boxes as easy as possible.

2. Standardized hardware concept

Each manual control box is, in general, assigned to a restricted number of tasks. Therefore the front panel might have to be specially designed to facilitate its use but its interface should be standard to speed up production. Let us look at the various functional parts to see how this can be achieved.

From the operator's side, the manipulations should be restricted to a minimum. A LOGIC part linking or excluding some actions can make use easier. The operator should be kept informed of the computer action; therefore completion of operation should be transmitted to him. A DISPLAY must allow him to know the present value of the settings.

From the computer side, these manual control boxes must present data to it, receive data from it and be able to call it. This means that the hardware consists only of acquisition registers, control registers and at least one interrupt line.

This consideration leads us to believe that the manual control box should present to the computer a STATUS set by the operator's decisions and partially reset by the computer action (operation complete). The action via the computer is initiated by an INTERRUPT.

Standard hardware including the acquisition registers, the control register, the display, the logic and the interrupt, might be designed. The connection to the front panel could be made using a connector system. The front panel itself might be "made to measure".

3. Operating sequence

Due to the pulsed nature of the Linac - Booster - PS process, it seems possible to control and read parameters only once per cycle. An increase in the rate of intervention is possible but will lead to more complicated software to distinguish between pulsed and static parameters. We suggest the following sequence of operation: the operator intending to perform any action sets a given STATUS by exclusive push-buttons (exclusive by the LOGIC). In answer the computer DISPLAYS the value of the selected parameter (or set of parameters for functions). The operator initiates the operation by the INTERRUPT which is inhibited until the operation is completed (software). Then the display function continues even if no further action is required. The control sequence always follows the acquisition sequence, which provides the STATUS to the computer.

4. Basic facilities

4.1 Manual / automatic

These two modes are used for two purposes. First of all, by selecting manual action the operator will prevent (software) any action (slow drift control, optimization, etc.) on the SET of parameters accessible from his box. If the computer is already performing an action (requested from the main console), no light appears and no other action is possible.

Secondly, selecting automatic mode the operator initiates computer actions which use the set values as reference ones (see further) and allow access to this group of parameters. In automatic mode, selected display is possible.

The only convention to adopt is a natural one: one should leave the machine at peak operating condition before switching back to automatic. One will see how the following facility makes it easier.

4.2 Restore preserved / Back & Save

Let us consider the possible memory arrangement. We can store in memory two sets of data, a reference *) one and a buffered one. Asking for a Back & Save operation, the actual settings are saved in the buffer and the reference ones are set. Asking for a Restore preserved, the contents of the buffer are transferred to the process. Let us see how the operator can benefit from these two memories without troubles and what the advantages are.

The only action to be avoided is to push on Automatic when the contents of the buffer are unknown and if the situation is worse after manual actions. In fact this operation would destroy the contents of the reference memory and the operator would have to perform a complete manual setting. Otherwise, the use of these two memories allows the the operator to check if the increase (or decrease) in machine performance is due to his twiddling or not, to switch easily from one

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*) The reference set considered now is not the one which can be involved in automatic setting-up programs

setting to another and back or to keep intermediate results when searching for better adjustments.

During execution of these functions, the request button will flash and will stay brighter after completion of operation in order to keep track of the last computer action.

4.3 Functions and single parameter adjustments

The operator will be able to select a function (6HS, 6HC, etc.) which will act on a complete set of parameters; alternatively he can decide to change the value of a single parameter. After selection of the function, he is informed that the computer is ready to accept changes by switching on a light (control available). He can then choose by push-button the required number of steps in displayed units (or times 10^{nth} displayed units). By doing so he generates an interrupt requiring computer action. The computer signals back to him that the operation is completed.

5. Software organization

After an interrupt recognition, it is necessary to acquire the STATUS to know which action and which step are required. Therefore it will now slow down the process to have a unique interrupt and an interrupt request status, but the reset of this status raises some problems and would necessitate a hardware development. An alternative solution is to have one interrupt per manual control box which might be a more straightforward solution.

A schematic flow chart is attached to the present report. The following comments have to be made:

- that part of the program has to be located after the data bank refresh and before the control part;
- the recognition between stepping motors and A/D converters has to be made because it saves space and time to work with

a fixed word count and table for the control part and the data sent in repetitive mode (each cycle) to a stepping motor must be zero if no variations are required, and should be identical for a D/A convertor;

- CALL LEVEL is used to pick up the addresses and necessary factors from the disk and, as Save & Restore/Restore preserved might wait as long as roll-out/roll-in, it will not be necessary to keep the two data tables in core.

6. Front panel basic design

In order to discuss a real case, we will describe here the proposed front panel layout for the PS BLW, which includes most of the common features. A schematic drawing is joined to the present paper.

6.1 Status[1)]

The fault indicator flashes if one or more BLW are faulty (earth connection). A reset is available. If the reset cancels the fault, the indicator is switched off. If the fault remains, the indication stays at DC level. There is no individual "ready" available.

6.2 Acquisition

Independent of the mode (MAN or AUTO), acquisition is still possible. Selecting one of the power supplies (rotating selector), the computer switches on the corresponding light, displays the ss number on which the power supply is connected and displays each cycle the value of the current of a particular winding (3 digits + sign). The unit (A) and decimal point position are linked to the switch position. The reading is performed with a local trigger (better for log uniformity). If a function is selected, the computer displays the amplitude of the harmonic chosen.

6.3 Control

In AUTO mode, no controls are available. By switching on MAN the lamp illuminates if

a) no other control box is already in manual (C.B.)

b) the computer is not performing any action on the set of elements accessible from this box.

The use of "Restore preserved", "Back & Save" and "Auto" are allowed and they work as described in 4.1 and 4.2.

The modification of the value of one element or of a set of elements (function) works as follows:

By pressing the "up" or "down" button associated with one of the nixies, a counter is incremented by the number of pushes weighted by each push-button. The control is performed during the next dead time of the machine cycle and the counter is reset and the selected push-button switched off. The increment sent to the power supply is the digital value corresponding to the smallest unit multiplied by the contents of the counter.

Conclusion

These proposals seem to be able to meet all the known requirements. A decision has to be taken rather soon to allow the basic hardware design (excluding front panels) and software implementation. It is suggested to make experiments (hardware and software) on the PS-BLW to finalise the research for a "cosy" operation. The basic ideas having to be frozen, any amendments and criticisms will be welcome.

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Distribution

PS Operation
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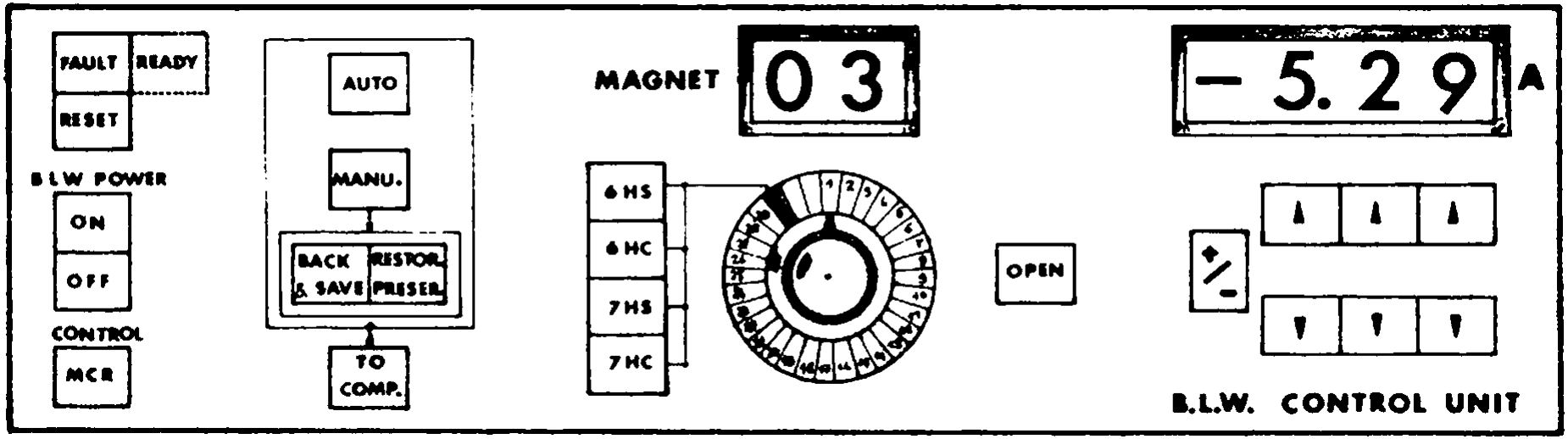
Reference

1) Réunion coordination technique SI No 28, SI/Mi DL/70-33, 25.8.70


FAULT
READY
RESET
B L W POWER
ON
OFF
CONTROL
MCR
AUTO
MANU.
BACK & SAVE
RESTOR. PRESER.
TO COMP.
MAGNET
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6 HS
6 HC
7 HS
7 HC
OPEN
− 5. 2 9
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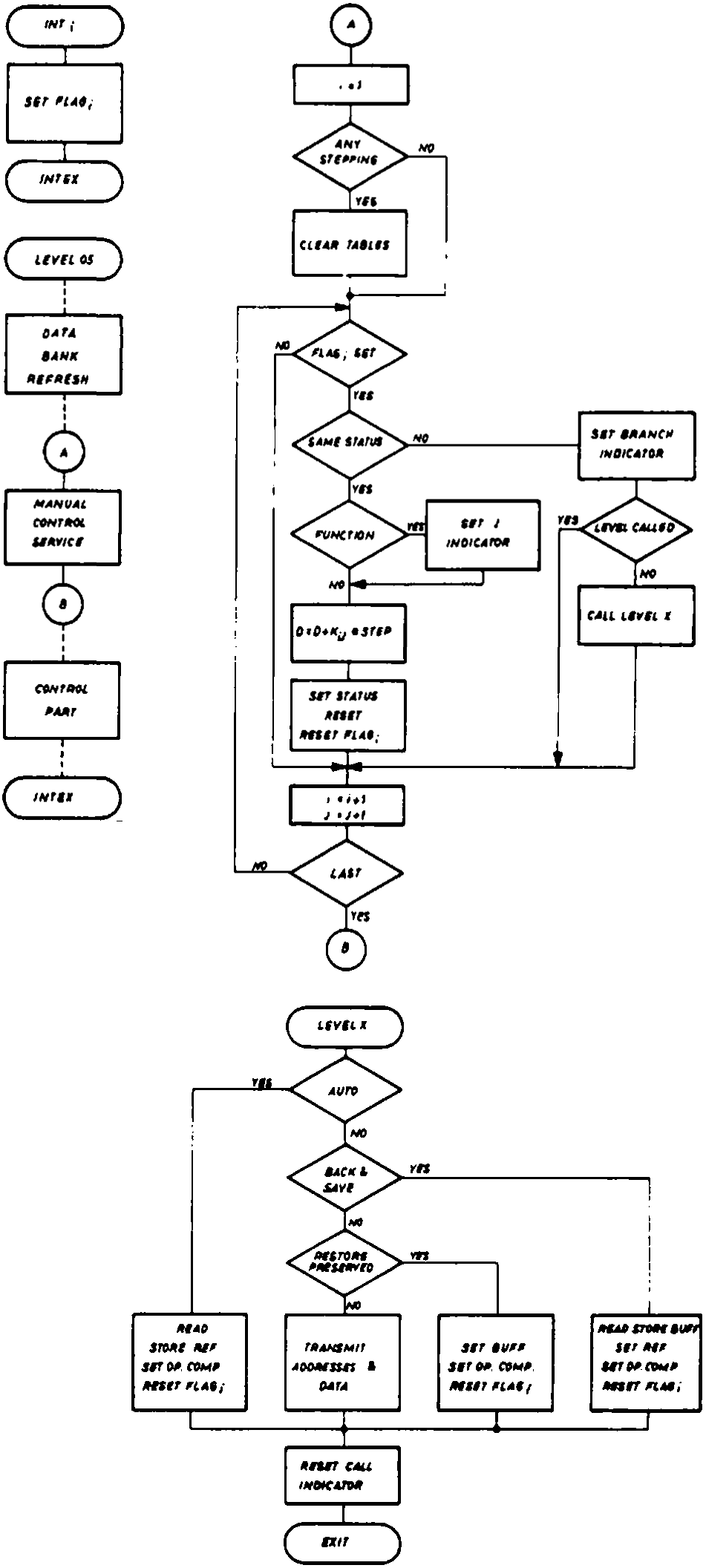
B.L.W. CONTROL UNIT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DATA BANK REFRESH
A
MANUAL CONTROL SERVICE
B
CONTROL PART
INTEX
A
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NO
YES
CLEAR TABLES
NO
FLAG ; SET
YES
SAME STATUS
NO
SET BRANCH INDICATOR
YES
FUNCTION
YES
SET J INDICATOR
YES
LEVEL CALLED
NO
NO
CALL LEVEL X
D=D+K_ij * STEP
SET STATUS RESET RESET FLAG;
I = I+1
J = J+1
NO
LAST
YES
B
LEVEL X
YES
AUTO
NO
BACK & SAVE
YES
NO
RESTORE PRESERVED
YES
NO
READ STORE REF SET OP. COMP RESET FLAG;
TRANSMIT ADDRESSES & DATA
SET BUFF SET OP. COMP. RESET FLAG;
READ STORE BUFF SET REF SET OP. COMP RESET FLAG;
RESET CALL INDICATOR
EXIT