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Controls for the AGS RF Upgrade System

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Collider Accelerator Department

Brookhaven National Laboratory

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Accelerator Division
Technical Note

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INTRODUCTION

The AGS rf system consists of 10 subsystems each of which includes cavity, Power Amplifier (PA) with the feedback amplifier, plate PS, screen PS, grid bias PS, tuning supply with the transistor bank, driver (ENI), feedback PSs, tuning supply for the feedback transformer, and the Variac rack.

PROGRAMMABLE LOGIC CONTROLLERS (PLC)- 5/40 with remote I/Os will control individual subsystems when the host PLC-5/60 with the PC 486 and "CONTROL VIEW" software will provide global control over the whole system.

LOCATION

Cavities with the rf PA will be located in the AGS ring.

Twenty-four Volt power supplies and the remote I/O chassis for the PLC will be placed in the houses just outside the AGS ring.

Power supplies, drivers, Variac racks with 480 Volt contactors and tuning systems will be located in the Building 929.

PLC-5/40 which controls each subsystem is placed in the plate power supply.

Pushbutton panels (RediPANEL) and the host PLC-5/60 will be in the RF CONTROL CENTER.

Dataliner (DL-20) and 16-button RediPANEL module will be located in the MCR.

MODES OF OPERATION

There will be five modes of operation:

LOCAL - from the PA in the ring, gives manual control of each of the PSs individually with the interlocked sequence. REMOTE/LOCAL switch in the PA is in LOCAL position.

REMOTE/MANUAL - from the rf control center, gives manual control of each of the PSs individually with the interlocked sequence. REMOTE/LOCAL switch in the PA is in REMOTE position and the AUTO/MANUAL switch on the station RediPANEL is in MANUAL position.

This mode will have the **AUX.STBY** function for the so called "*black heating*" of the filaments of the power tube. The filament voltage will be held at 4 Volts with no cooling required.

REMOTE/AUTO - from the rf control center, three operation buttons - OFF, STBY, ON, control one subsystem. REMOTE/LOCAL switch in the PA is in REMOTE position and the AUTO/MANUAL switch on the station RediPANEL is in AUTO position.

RFBLDG GLOBAL/AUTO - from the rf control center, three operation buttons - OFF, STBY, ON, control all ten subsystem simultaneously. REMOTE/LOCAL switch in the PA is in REMOTE position, the AUTO/MANUAL switch on the station RediPANEL is in AUTO position and the RFBLDG/MCR switches in rf control center and in the MCR are in RFBLDG position.

MCR GLOBAL/AUTO - from the Main Control Room, three operation buttons - OFF, STBY, ON, control all ten subsystems simultaneously. REMOTE/LOCAL switch in the PA is in REMOTE position, the AUTO/MANUAL switch on the station RediPANEL is in AUTO position and the RFBLDG/MCR switches in the rf control center and in the MCR are in MCR position.

SYSTEM START-UP SEQUENCE

The progressive sequence of turning the system "ON" is interlocked and can proceed only in the following order:

A. AUX.ON;
B. FB.AUX.ON;
C. PLATE PS ON;
D. SCREEN PS ON;

E. FB PLATE ON;
F. FB SCREEN ON;
G. TUNING SYSTEM ON;
H. DRIVER ON.

Each of the following interlocks has to be satisfied for the system start-up to begin and for the filament contactor to stay energized:

- tube water;
- PA doors except for the HV compartment should be closed;
- cables terminated;
- filament and blower 480 V switches closed;
- tube water overtemp.;
- safety ground;
- blower undervoltage;
- PA crash.

MANUAL CONTROL OPERATION

Press "AUX ON"

1. Grid bias PS comes "ON";
2. Flushing fan and tube blower are energized;
3. All PS's auxiliaries are energized.

If all air flow switches are operated and the Variac is in "LOW LIMIT" position, the filament contactor will be energized and the ramp-up routine started. If the Variac is in the "AUX STBY" position, pressing the "AUX ON" button will resume the ramp-up routine until the "HIGH LIMIT" is reached.

Ramp-up routine takes approximately 5 minutes and stops when the Variac reaches "HIGH LIMIT". When the limit is reached, the "IN PROCESS" light comes on. The warm-up process takes 5 minutes.

Press FB "AUX ON" -

The interlock has to be satisfied for the filament voltage to come "on", and is necessary for the feedback filaments to stay "on":

- air flow;

Loss or absence of the following interlocks will drop out or disallow the "High Voltage READY" status on all the PSs;

- flushing air;
- filament undervoltage;
- grid bias undervoltage;
- Variac high limit;
- timed out "in process";
- cavity water
- cavity doors;
- drive loop water;
- vacuum;
- doors;
- dummy load water;
- PA crash;
- ring crush;
- rf bldg crush;
- anode overload;
- screen overload.

After the warm-up is finished, the IN-PROCESS light goes OFF and if all the interlocks are satisfied, the **HV READY** light comes ON.

The system is now ready for the HV and the power supplies can be turned "ON" in the proper sequence.

The TURN-OFF sequence is in the reverse order:

a. DRIVER OFF;
b. TUNING SYSTEM OFF;
c. FB SCREEN OFF;
d. FB PLATE OFF;
e. SCREEN PS OFF;
f. PLATE PS OFF;
g. FB AUX OFF;
h. AUX OFF.

The Variac then starts the RUN DOWN routine. After it reaches the LOW LIMIT, the filament contactor is deenergized, the grid bias PS is turned OFF and the cool down timer, which keeps the blowers on, is set (5 min.).

AUTO CONTROL

Three operation buttons: OFF, STBY and ON.

STBY-

- If the system is in OFF state, pressing "STBY" button will bring PAs and all PSs auxiliary "ON".

- If the system is in "HV ON" state, pressing the "STBY" button will turn the HV off.

OFF-

- Turns the auxiliaries of the PA and all PSs OFF.

ON-

- If "HV READY" status is reached, all the PSs will be turned ON in the interlocked sequence.

HARDWARE AND LOGIC CONSIDERATIONS

Control voltage will be 24 Volts dc.

Screen power supplies for the power amplifier and the feedback amplifiers must be interlocked and only be allowed to be energized after the plate voltage on both amplifiers is established.

The **OFF** buttons will always be operational disregarding the modes of operation. ***ON*** buttons, however, will only be functional from the **active** mode.

The control system will be based on the PLCs. Where personal safety is concerned, the electro-mechanical relays will be used as a back-up.

Dataliner (DL-20) will display rf system fault messages in the MCR, and 16-button RediPANEL module will provide MCR GLOBAL/AUTO control. The communication to both devices will be via PLC remote I/O link.

To prevent 'bubbles", all water and air interlocks will have 2 sec. time delays.

Because there many CRASH buttons around the AGS complex, different "weights" to the different buttons has to be allocated:

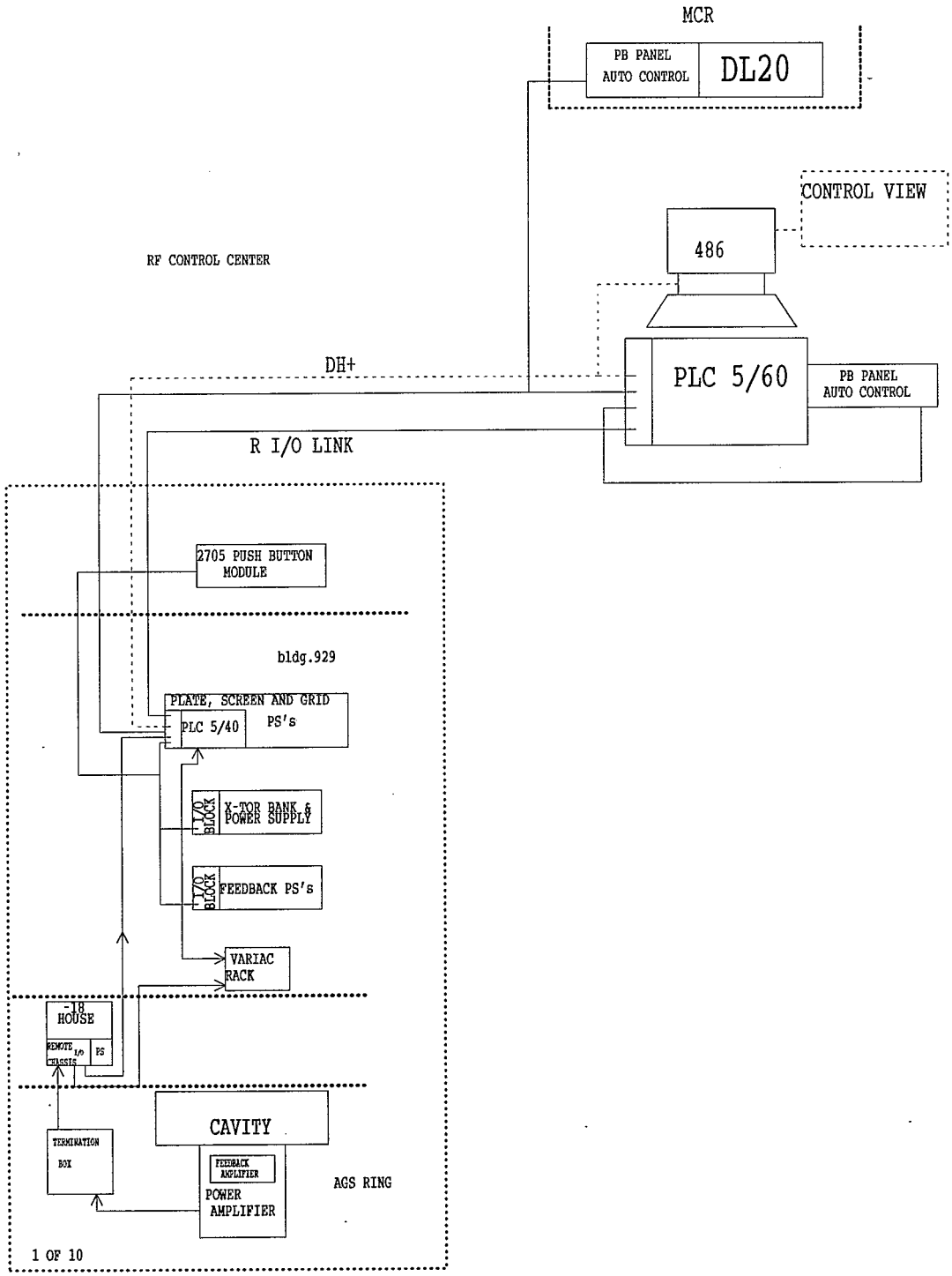
1. *PA CRASH - located in the RF PA - all power to this station except for the 24 V has to be removed;*

2. *RING CRASH - located throughout the AGS ring - 13.8 kV power has to be removed;*

3. *RF BLDG CRASH - located in the RF Bldg - will start the AUX.OFF routine.*

When the smoke detector in the RF Bldg. is triggered, the AUX.OFF routine will start.

Triggering the sprinklers in the RF Bldg. will deenergize all the power to the rf equipment.


MCR
PB PANEL
AUTO CONTROL
DL20
CONTROL VIEW
486
RF CONTROL CENTER
DH+
PLC 5/60
PB PANEL
AUTO CONTROL
R I/O LINK
2705 PUSH BUTTON
MODULE
bldg.929
PLATE, SCREEN AND GRID
PLC 5/40
PS's
I/O BLOCK
X-TOR BANK &
POWER SUPPLY
I/O BLOCK
FEEDBACK PS's
VARIAC
RACK
-18
HOUSE
REMOTE I/O CHASSIS
PS
CAVITY
TERMINATION
BOX
FEEDBACK
AMPLIFIER
POWER
AMPLIFIER
AGS RING
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