

ARGONNE NATIONAL LABORATORY

HIGH ENERGY PHYSICS DIVISION



ARGONNE WAKEFIELD ACCELERATOR

RF Operating Procedure

Author: Zikri Yusof

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Approved:

HEP-AWA Group Rep: Manoel Conde signed copy in manual Date: 06/26/2012

HEP-ESH Administrator: Leon T. Reed signed copy in manual Date: 06/26/2012

HEP-Division Director: Hendrik J. Weerts signed copy in manual Date: 07/16/2012

AWA RF SYSTEM

June 21, 2012

Start-Up Procedure

1. Before proceeding with the start-up procedure, it is usually a good idea to walk around the accelerator and determine if there are any obvious problems. A place in particular that should be checked is the pressure gauge reading of the accelerator beamline, located on top of the AWA bunker. These readings are usually in the low 10^{-9} or 10^{-10} Torr. Also make sure the power supplies to the stepper motors for the power splitters are ON. These are on the bank of racks next to the G2 solenoid power supplies.

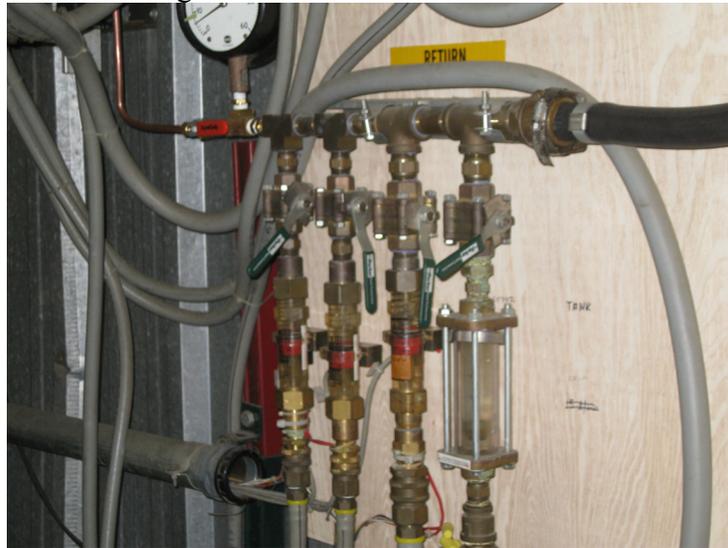


Power splitters
stepper motors
power supplies.
Verify that these are
ON before starting
the AWA Control
program

2. Start the water cooling system. This is done by pressing the two START buttons on the panel at the water cooling station. Press Start 1 button first, followed by Start 2 button.



3. Verify that the 3 red lights are on at the water flow monitor.



From this point on, the procedure that will be followed will depend on which RF system that will be turned on for operations. This procedure will describe turn-on procedure for all 4 systems. However, each of the system can be turned on independently of each other (except for RFPA II/Klystron 2 that is currently tied to Klystron 1).

4. Turn on the breakers for RFPA 1, 2, 3, and 4.



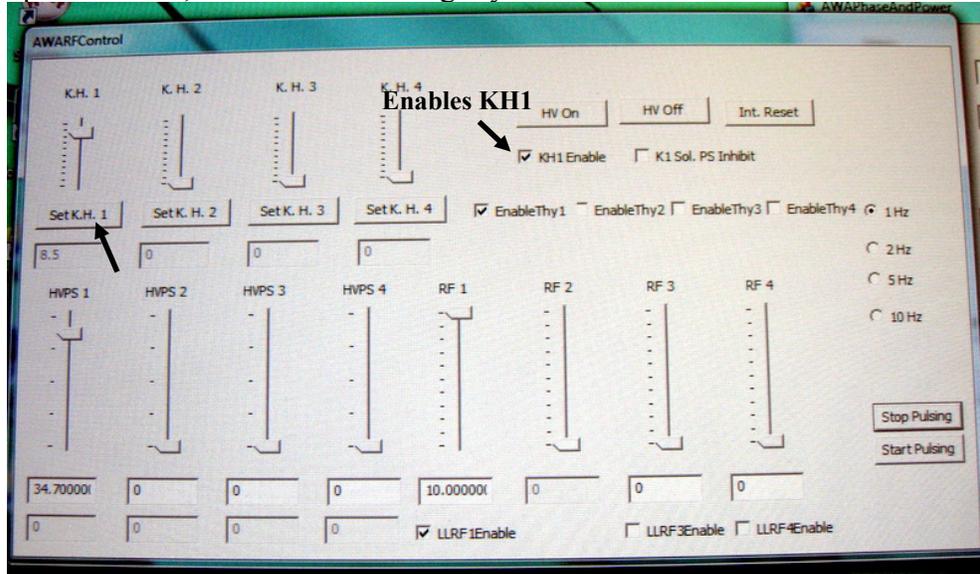
5. In the Control Room, turn on the Control Panel (RED square button on the far left, bottom row). Hit the RESET button.



6. Launch the AWA Control program.



7. Start the klystron filament. The following are done in the AWARF Control window.
 - (i) To start heater for Klystron 1, click on the KH1 Enable box to check it. Then click on Set K.H. 1 button and set it to 8.5. This automatically ramps up the current, and it will take roughly 40 minutes.



- (ii) To start heater for Klystron 2, 3, and 4, simply click on Set K.H. 2 (set it to 8.5), Set K.H. 3 (set it to 5.95), and Set K.H. 4 (set it to 5.95) buttons respectively. This automatically enables the filament heater for each of the Klystrons.
8. To run from Klystron 1, make sure EnableThy1 and LLRF1Enable boxes are both checked. To run from Klystron 2, make sure EnableThy2 and LLRF1Enable boxes are checked (yes, that is not a typo. LLRF1Enabled must be checked to run Klystron 2). To run from Klystron 3, make sure EnableThy3 and LLRF3Enable boxes are checked. To run from Klystron 4, make sure EnableThy4 and LLRF4Enable boxes are checked.
9. Turn on chillers. Walk onto the AWA bunker roof and turn on the following chillers:

- (i) G3 gun chiller;



(ii) Waveguide load chiller;



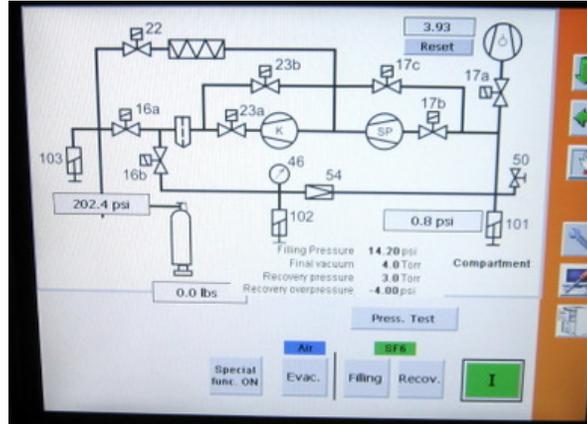
(iii) the two circulator chillers;



(iv) G2 gun and linac chillers;



10. Pause to allow for the klystron filament heater to reach nominal level.
11. When system is ready, introduce SF₆ gas into the waveguides. At the SF₆ filling station control display, touch FILLING and then touch “I” to execute the command.

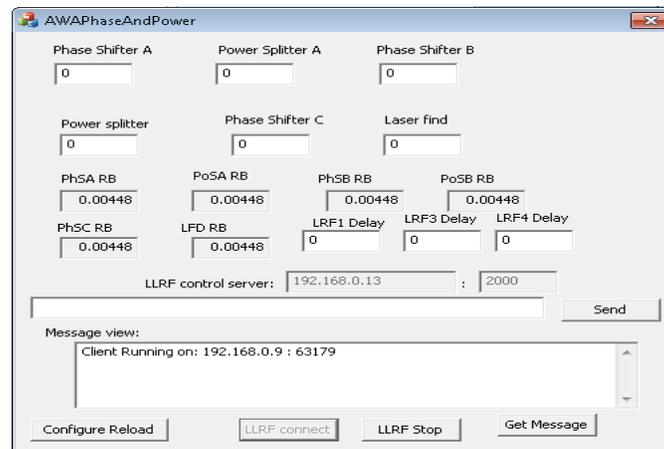


The SF₆ gas will automatically fill the waveguides and stop after it has reached the set pressure. When this is completed, open the SF₆ cylinder to stabilize the pressure (the SF₆ gas cylinder is on the main floor, not on the roof).

12. Turn on the appropriate gun solenoid power supplies, bipolar power supplies, and spectrometer magnet power supply, if necessary.
13. Verify that all the interlock lights located on top of the bunker are on.
14. Perform the survey of the AWA bunker. The survey procedure is described in the AWA SAD and in the RF Operator Training.
15. Turn on the Klystron 1 solenoid power supply by releasing the RED button to the OUT position (if it hasn't been done already), and then pushing the GREEN button in.



16. In the control room, look at the AWA Control System screen and verify that the Low-Level RF control system is running. Make sure that the connection between AWA control system and Low-Level RF control system has been established. When connection is established, the “LLRF connect” button should be greyed-out. Otherwise, click on “LLRF connect” button on AWAPhaseAndPower window.



17. Start the RF system. Insert the key into the lighted control panel and hit RESET. All the red lights should be lighted except for the CONT light for HVPS. Ensure that the TV monitors displaying the vacuum levels for G2 and G3 beamlines are on and displaying properly.
18. Press the HV ON button. The CONT light should now be on. If, by this stage that any of the lights are not on, there are problems either with the system or the interlock.
19. In the AWARF window on the computer screen, raise the appropriate HVPS to 5 kV. Pulse at 1 Hz a few times and then stop. Observe the traces on the oscilloscope for klystron current and klystron voltage to verify that they look OK and as expected.
20. Raise the HVPS to 10 kV, and start pulsing at 1 Hz and continue to pulse.
21. Using the PAGE UP key, raise HVPS slowly, keeping watch on the klystron current and voltage trace on the oscilloscope. The typical operating level for Klystron 1 is ~35 kV, Klystron 2 is ~28 kV, Klystron 3 is ~ 31 kV, and Klystron 4 is ~ 31 kV.
22. Initiate the low-level RF. In the same window, raise the appropriate RF slowly. Monitor the oscilloscope traces for the (i)gun-forward; (ii) gun-reverse; (iii) linac-

23. Once the appropriate levels are reached and the machine is running smoothly, you may raise the repetition rate to 2 or 5 Hz.

Lunch Mode Procedure

The following is the procedure to temporary put the system on hold.

1. Remove operation key from control panel.
2. Set all magnet settings to zero by loading the “mzero” file.
3. Turn off power supply to the Klystron 1 solenoids.
4. Unlock doors to the AWA vault.
5. Return operation key to keybox.

Shut-Down Procedure

1. Stop RF pulsing and pull key from control panel.
2. Ensure that the laser shutter is closed.
3. Using the control system, zero-out all magnets
4. Lower all low-level RF to zero
5. Lower all klystron voltages to zero
6. Lower the klystron filament heater to zero by entering "0" in the KH1, KH2, KH3, KH4, and KH5 boxes. The heater current will NOT drop to zero immediately. It will slowly ramp down. **DO NOT CLOSE AWA CONTROL PROGRAM, AWA CONTROL PANEL, AND BREAKER SWITCHES UNTIL ALL KLYSTRON HEATER CURRENTS HAVE REACHED ZERO.** While waiting for this to reach zero, continue with the rest of the shut-down procedure.
7. Switch off the klystron 1 solenoid power supply.
8. Close the SF₆ gas cylinder. Please ensure that this is done **before** running the SF₆ recovery system.
9. On the bunker roof, turn off (i) G3 gun chiller; (ii) waveguide load chiller; (iii) the two circulator chillers; (iv) G2 gun and linac chillers.
10. Turn on the SF₆ recovery system. It will take ~15 minutes for the pressure in the waveguide to reach ~1 atm psig. This will ensure that the waveguides are slightly over-pressured. The recovery should be switched off at this point.
11. Also on the bunker roof, turn off all magnet power supplies and spectrometer power supply (if applicable).
12. Unlock the doors to the AWA bunker.
13. Go back into the Control Room and check if klystron heater currents have reached zero. If it has, click on the KH1Enable box to uncheck it. This turns off the Klystron 1 heater ONLY. Klystron heaters for 2, 3, and 4 do not require this step.
14. Turn off the Control panel in the Control Room
15. Turn off the water system. Press RED button under "2" first, then the RED button under "1".