E951 POWER SUPPLY SAFETY REVIEW 9/06/02

IOANNIS MARNERIS

Brookhaven National Labs.

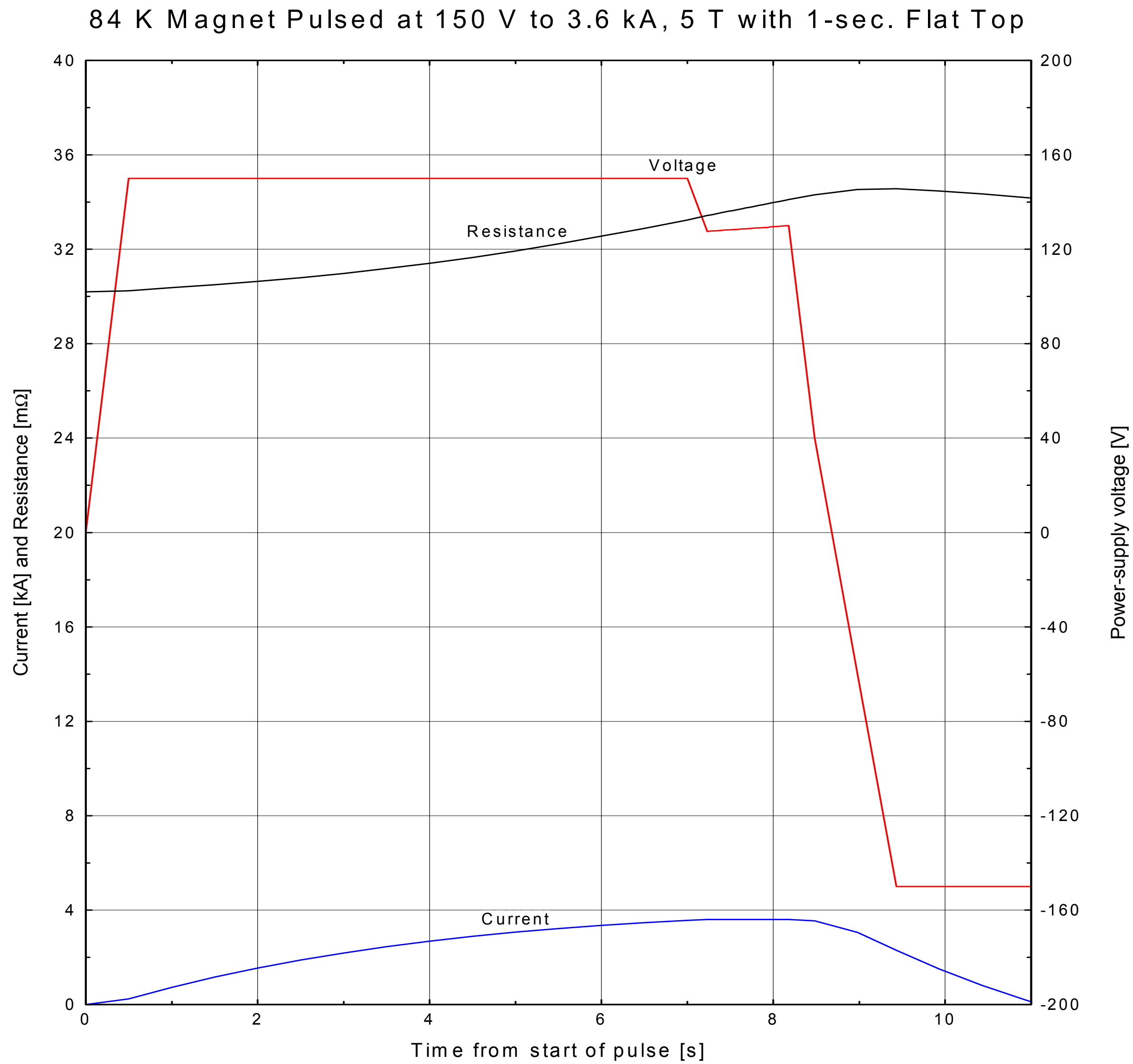
Project Goals

- The project goal is to pulse a magnet with 15 cm diameter bore, capable of a peak field near 15 T and a repetition rate of about 30 minutes.
- Provisions are made to pulse first to 5 T, then 10 T and then 15 T.
- To do this we will use 4 existing SCR type dc power supplies from the experimental area in series-parallel connection.
- Each power supply is rated at 3600 Adc, +/- 150 V

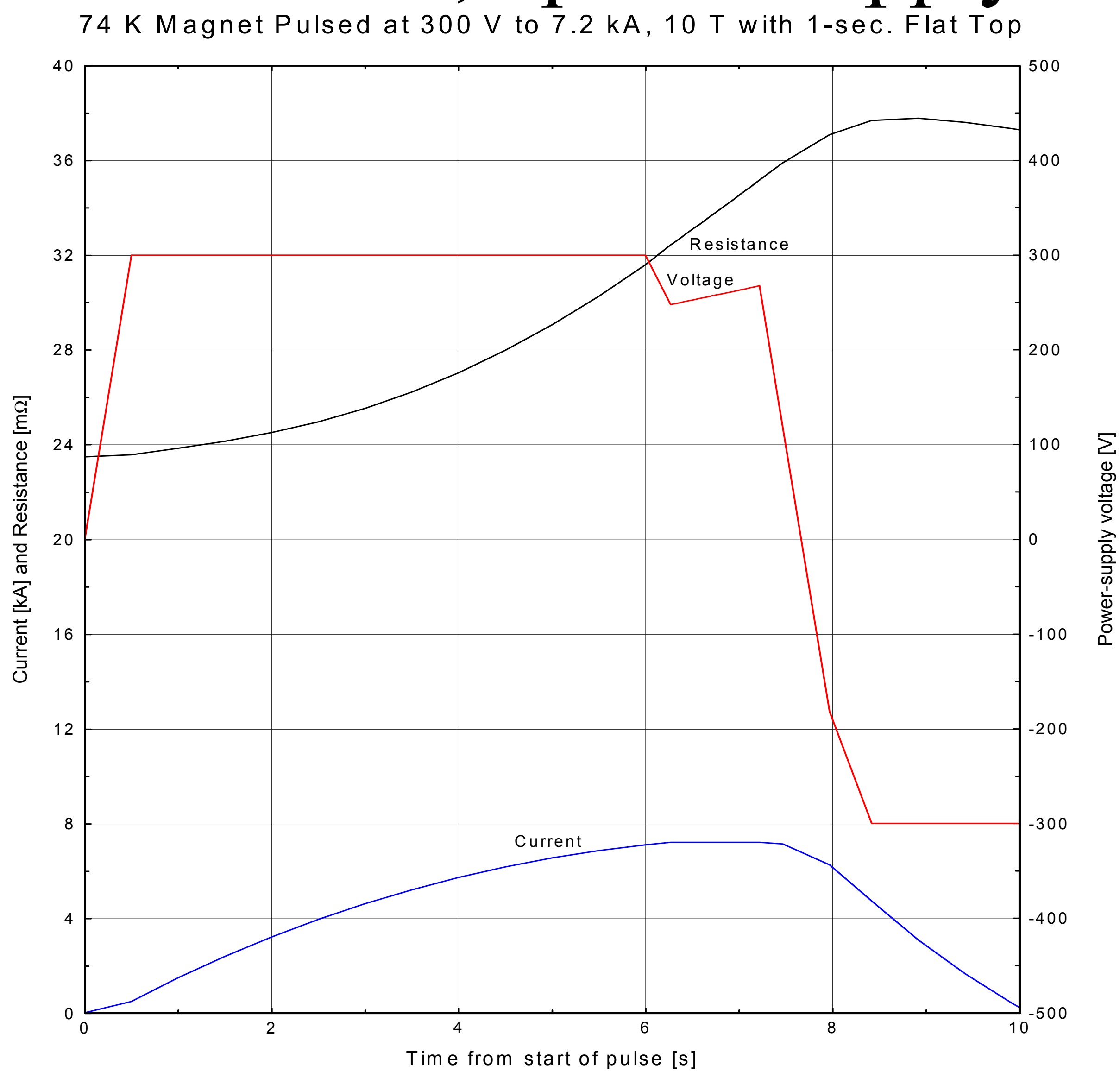
Parameters of the Pulse Magnet System with 1 sec flat top

	Units	Case 1	Case 2	Case 3
Outer radius	(cm)	30.0	30.0	40.0
Copper mass	(kg)	1943	1943	3644
Voltage	(V)	150	300	300
Peak current	(A)	3600	7200	7200
Field	(T)	5.0	10.0	14.5
Inductance	(mH)	138	138	436
Initial temperature	(K)	84	74	30
Time t1, to end of flat tap	(s)	8.2	7.3	16.3
Pulse length, tp	(s)	11.1	10.1	24.1
Initial Resistance	(mOhms)	30.2	23.5	11.0
Resistance at t1,	(mOhms)	34.1	35.3	33.0
Resistance at tp,	(mOhms)	34.1	37.2	38.2
Dissipation at tp,	(MJ)	2.70	9.1	15.2

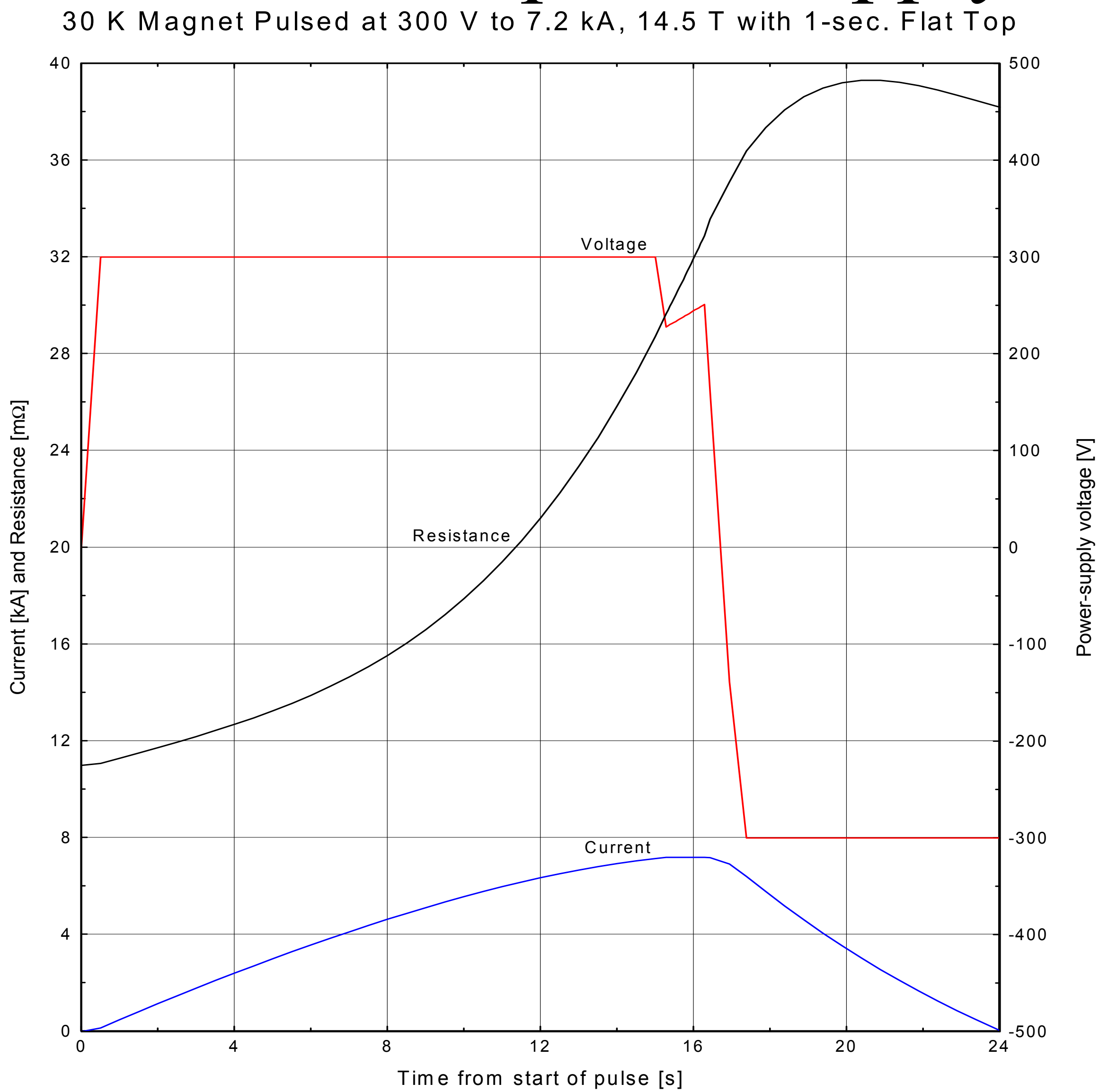
Performance of the 5T magnet with case 1 power supply



Performance of the 10T magnet with case 2,3 power supply



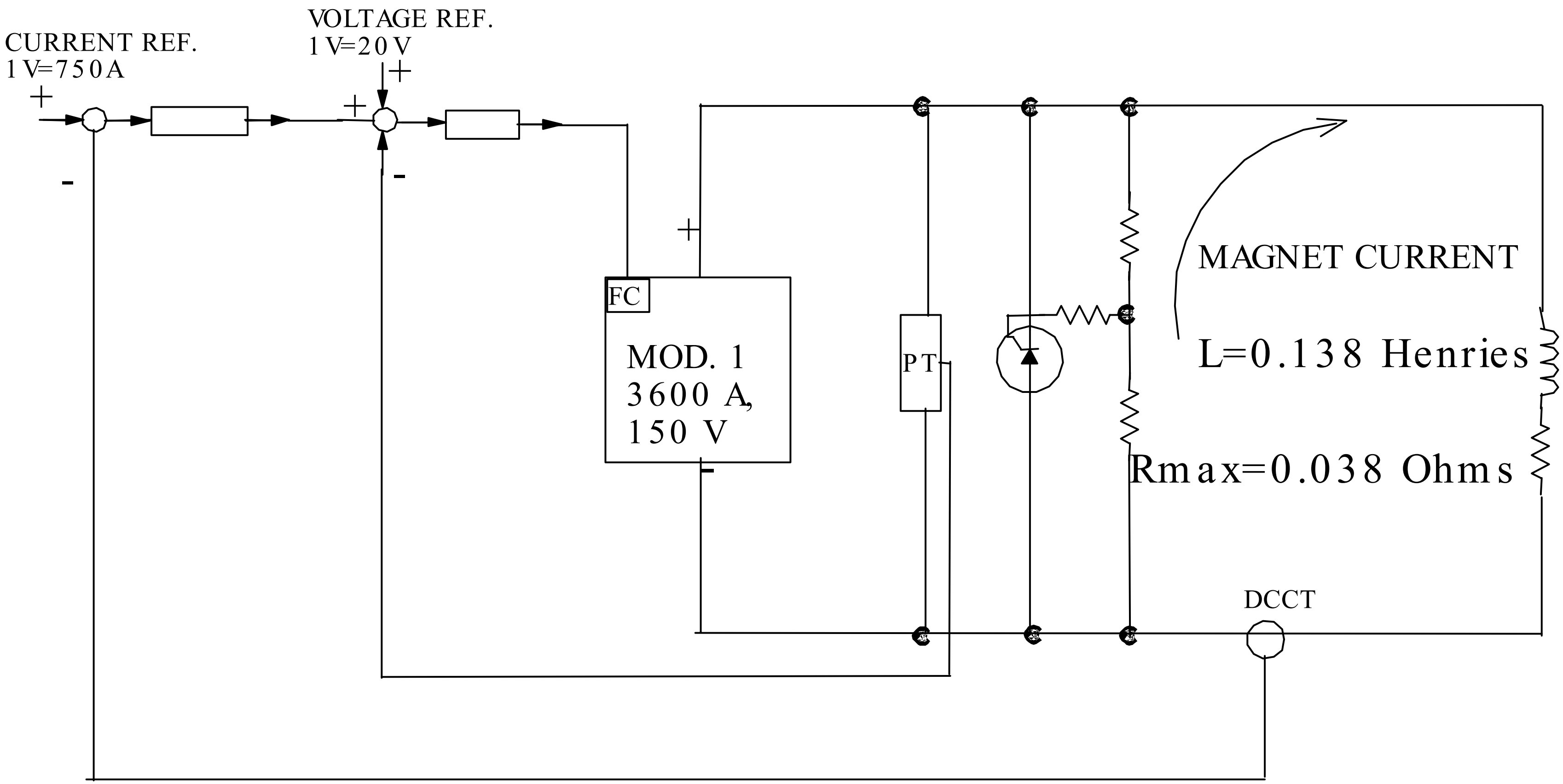
Performance of the 15T magnet with case 2,3 power supply



Case 1 power supply

- 540 KVA power supply rated at 3600 A, +/-150 V
- Thyristor-control six-pulse rectifier, available at Brookhaven Labs from previous experiments. (Model Meeker #431)
- The power supply is presently configured as DC power supply
- We need a new regulator to be able to pulse it, based on the existing design for the AGS Main magnet power supply.
- The controls and interlocks of the power supply must be updated.
- New direct current potential transformer (DCPT).
- New crowbar circuit to absorb magnet stored energy.
- Similar upgrades have been made during the Booster project with great success.

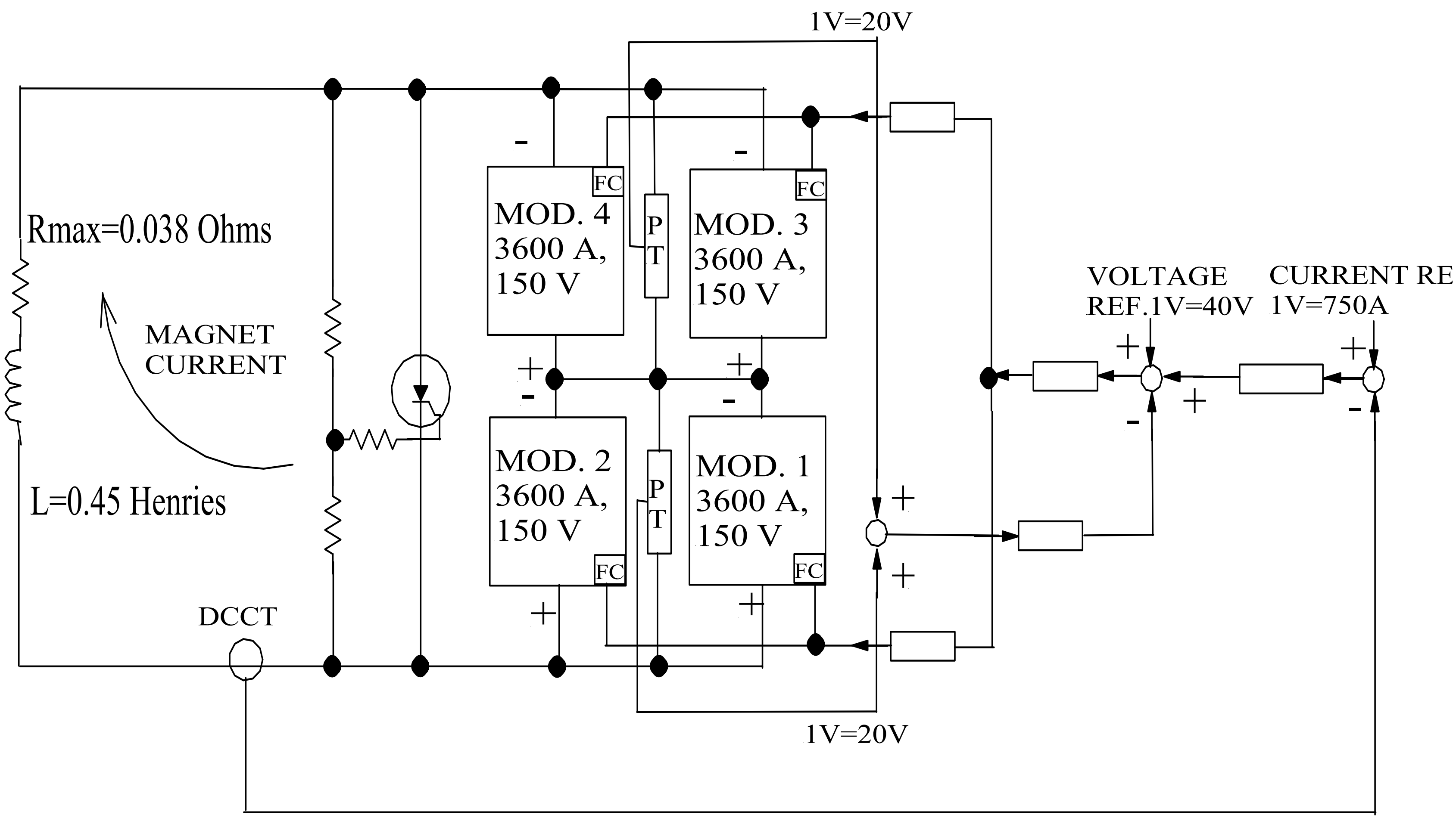
Case 1 power supply regulator



Case 2,3 power supply

- Four series-parallel, 540 KVA power supplies rated at 3600 A, +/-150 V each, Total rating 7200A, +/-300V.
- Thyristor-control six-pulse rectifiers, available at Brookhaven Labs from previous experiments. (Model Meeker #431, in parallel with # 433, and #429, in parallel with # 432,)
- The power supplies are presently configured as DC power supplies.
- We need a new regulator to be able to pulse it,based on the existing design for the AGS Main magnet power supply.
- The controls and interlocks of the power supply must be updated.
- New direct current potential transformer (DCPT).
- New direct current current transformer (DCCT).
- New crowbar circuit to absorb magnet stored energy.
- Similar upgrades have been made during the Booster project with great success.

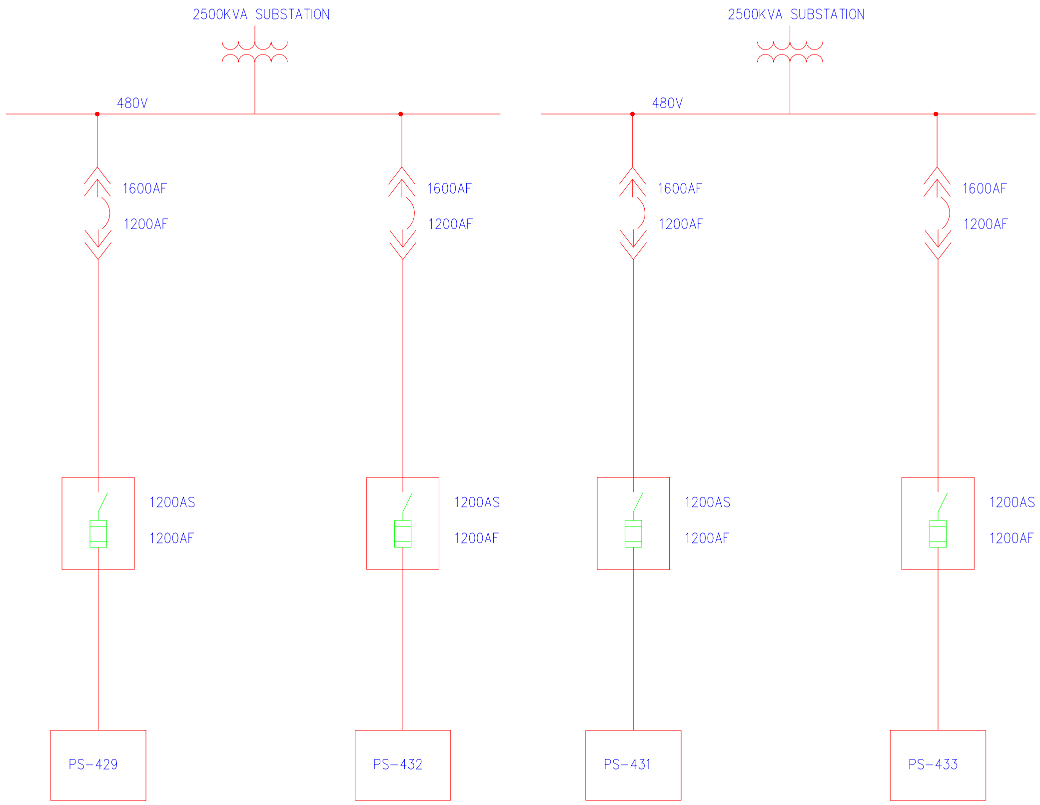
Case 2,3 power supply regulator



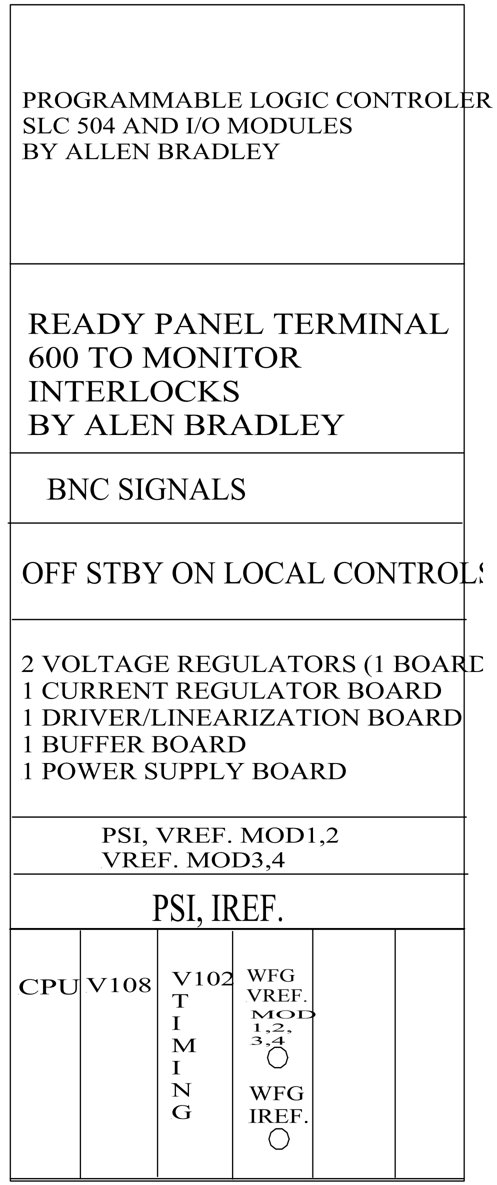
More power supply details

- The 3-phase, 480-V input power to each supply will be fed from new, lockable disconnect switches.
- Each switch will be fed from an existing AC circuit breakers in an existing substation.
- Two parallel power supplies (MOD 1 and MOD 2) will be fed from the same existing substation and the other two (MOD 3 and MOD 4) from a different existing substation.
- The power supply will be fully programmable from 0 to 7200A. It will have two voltage regulators as the inner loops and a current regulator as the outer loop.
- The anticipated overall bus resistance should not exceed 1 mΩ. 1 1/4 water cooled buss will be used we already have.
- All the old interlocks will be updated using an Allen Bradley Programmable Logic Controller (PLC).
- Minimum repetition rate for case1 magnet is 5 minutes, for case 2 magnet is 20 minutes, for case 3 magnet 30 minutes.

AC one line diagrams



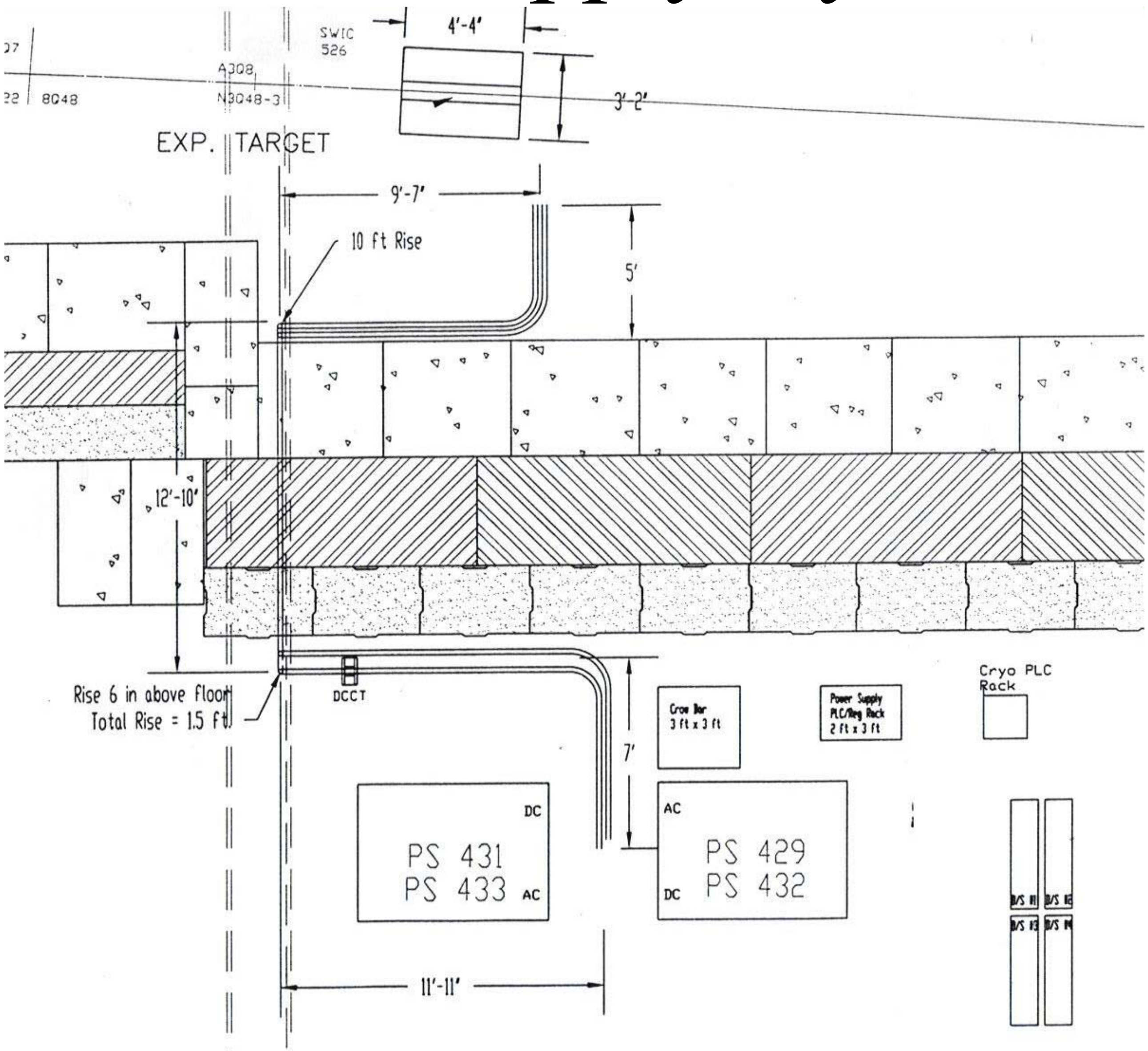
Controls rack layout



Power supply interlocks

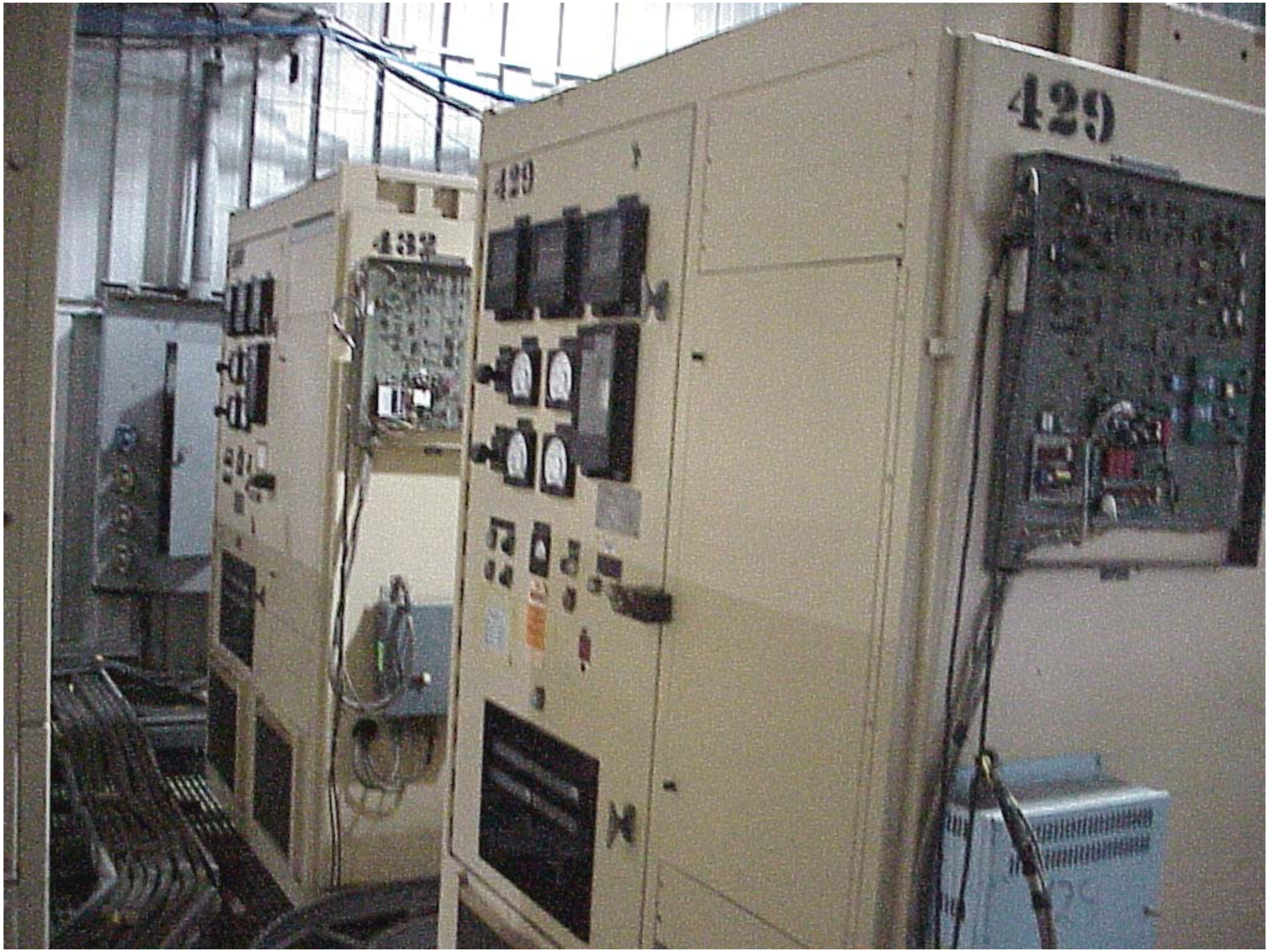
- DC overcurrent
- RMS magnet current interlock
- AC overcurrent
- Blower failure
- Ground Fault
- Magnet faults
- Magnet resistance interlock.
- Cryo interlocks
- Doors are open
- SCR overtemperature
- SCR failure
- Power supply cubicle overtemperature
- Soft start overload
- Bus water flow and overtemperature

Power supply layout



Power supplies picture 1

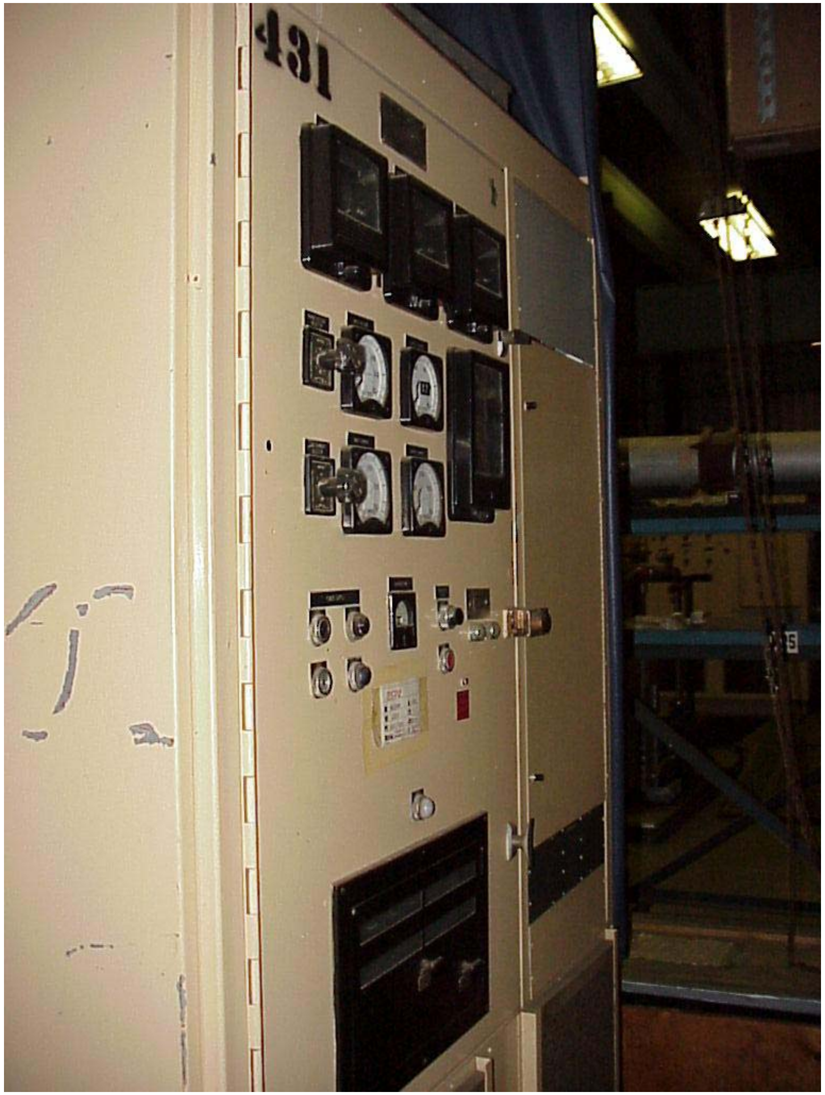
Muon Collaboration



Power supplies picture 2

Muon Collaboration

Power supplies picture 3



Power supplies picture 4