MAGNET ELECTRICAL SYSTEM (WBS 1.2)

i. Power Supplies

The electric power supply system required to operate the superconducting magnets for RHIC falls into three categories:

The main power supplies - The supplies used to power the main dipoles and the main quadrupoles are similar in that they have a ramp power section to provide a high voltage to bring the magnets rapidly up to full field, and a holding power section to maintain that current in a precise and efficient way during beam storage.

The main dipole and quadrupole power supplies are similar in design. Both use a pair of 12-pulse, phase controlled rectifier power modules. The dipole supply requires a 400 V ramp section and a 30 V holding section, while the quadrupole system uses a 90 V ramp section and a 15 V holding section. The control and regulating system will be interfaced with the main control computer for monitoring and analysis. The digital regulation system will use as its reference a zero flux Direct Current Current Transformer (DCCT), and will also reduce the sub-harmonic component of the ripple voltage through its control of the rectifier commutation. In order to control the betatron tune within $\Delta\nu = 10^{-3}$, it is required that dipole and quadrupole currents track with about 10^{-5} accuracy.

A smaller shunting supply is used to offset the current in the horizontal quadrupole string for the current in the vertical quadrupoles string.

All main power supplies are located in the service building at 4:00 (4 o'clock).

The insertion power supplies - These include the shunts to the insertion dipoles, D0 and DX, the shunts to the insertion quadrupoles, Q1-3, and Q6-9 and the trim quadrupole supplies at CQT4, 5, and 6. They will be specified in modular sizes to minimize the quantity of types of supplies to maintain, and to simplify procurement.

The unipolar insertion supplies use 12-pulse, phase controlled power sections. The bipolar insertion supplies use switch mode power sections. While these accept a current set point digitally, the regulator is a precision analog device. All units use a DCCT, as the main supplies do, as a precision current measuring device.

All insertion power supplies are located in the service buildings.

The corrector power supplies. These include the supplies for the dipole correctors, the insertion correctors, the gamma-T jump, and the sextupoles.

These smaller supplies will either be phase controlled, or switch mode units. They will use analog regulation loops around shunt or DCCT feedback. Both the current command, and current and voltage readbacks will be analog signals.

All corrector power supplies are located in the ring alcoves.

Summaries. Table 2-1 summarizes the required power supplies, showing voltage, current, and quantity. Power supplies labeled "mono" are units that do not reverse current polarity. Units labeled "bi" are bipolar supplies, and operate with either polarity of voltage or current.

Table 2-1. Power Supply Summary

Item	Polarity	Voltage (V)	Current (A)	Quantity (2 rings)
Main Power Supplies				
Dipole Ramp	mono	400	5500	2
Dipole Flat-top	mono	30	5500	2
Quadrupole Ramp	mono	90	5500	2
Quadrupole Flat-top	mono	15	5500	2
Quad H/V Trim	mono	40	300	2
Insertion Dipoles				
Type A	mono	20	2000	14
Type B	mono	20	600	7
Insertion Quadrupoles				
Type A	bi	15	150	96
Type B	bi	15	300	14
Type C	mono	15	200	48
Type D	mono	15	300	24
Type E	mono	15	450	16
Type F	mono	20	600	16
Corrector Supplies				
Dipole	bi	20	50	468
Gamma-T pulsers	pulsed	300	40	24
Skew Quads	bi	20	50	48
Octupoles	bi	20	50	48
Sextupole	bi	100	100	24
Low Beta Triplet*	bi	20	50	56

*8 a_2, 8 b_2, 16 b_3, 8 b_4, 16 b_5 correctors.