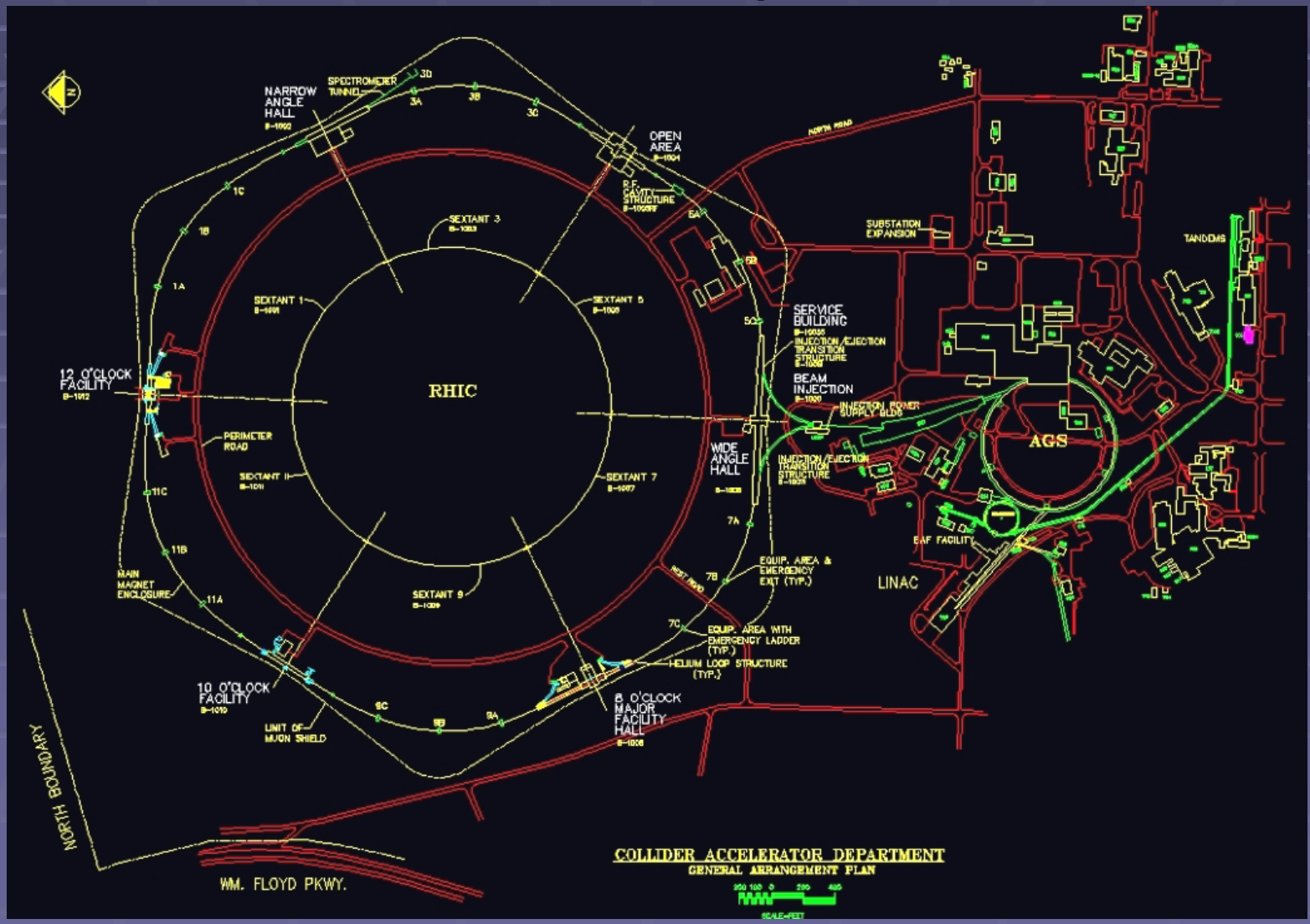
Radiation issues at RHIC

RHIC Layout

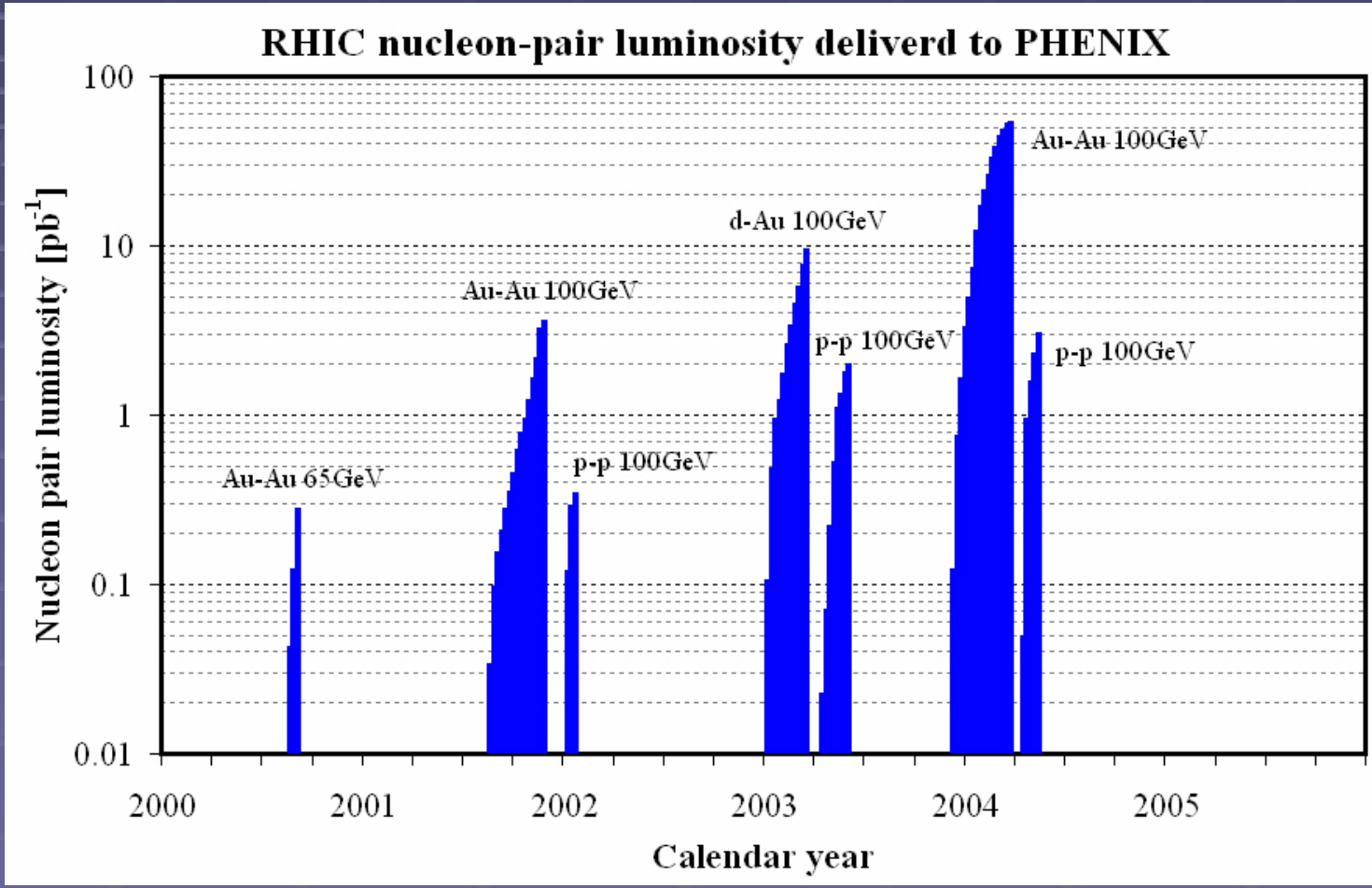

RHIC
AGS
LINAC
TANDEMS
NARROW ANGLE HALL
SPECTROMETER TUNNEL
OPEN AREA
R.F. CAVITY STRUCTURE
SUBSTATION EXPANSION
SERVICE BUILDING
INJECTION/EJECTION TRANSITION STRUCTURE
BEAM INJECTION
INJECTION BOOSTER POWER SUPPLY BLDG
WIDE ANGLE HALL
INJECTION/EJECTION TRANSITION STRUCTURE
EAF FACILITY
EQUIP. AREA & EMERGENCY EXIT (TYP.)
EQUIP. AREA WITH EMERGENCY LADDER (TYP.)
HELIUM LOOP STRUCTURE (TYP.)
8 O'CLOCK MAJOR FACILITY HALL
10 O'CLOCK FACILITY
12 O'CLOCK FACILITY
MAIN MAGNET ENCLOSURE
PERIMETER ROAD
LIMIT OF MUON SHIELD
SEXTANT 1
SEXTANT 3
SEXTANT 5
SEXTANT 7
SEXTANT 9
SEXTANT 11
NORTH BOUNDARY
WM. FLOYD PKWY.
COLLIDER ACCELERATOR DEPARTMENT
GENERAL ARRANGEMENT PLAN
SCALE-FEET

RHIC Tunnel


TELEPHONE
EMERGENCY EXT. 2222
MAIN CONTROL ROOM
THIS LOCATION 1005C

Alcove

RHIC Intensity



Equipment affected

- Recoverable errors
  - PLCs
  - Network switches
  - VME Processors (no ECC)
  - Waveform generator program memory
- Hardware problems
  - VME chassis power supplies
  - BPM chassis in ring
  - Cryo PLCs and power supplies

VME chassis Power supplies

- ~250 chassis installed at C-AD
  - 20 replaced during 2004 run
  - 15 power supply failures in alcoves
  - 3 power supply failures in service buildings
  - 2 others (loose connection, overtemp, etc.)
  - MTTR ~ 3 hours
- Failure mode
  - All alcove PS fail on the AC side
  - Switching transistors shorted
  - Feedback or PFC circuit latches up or timing is altered increasing power dissipation

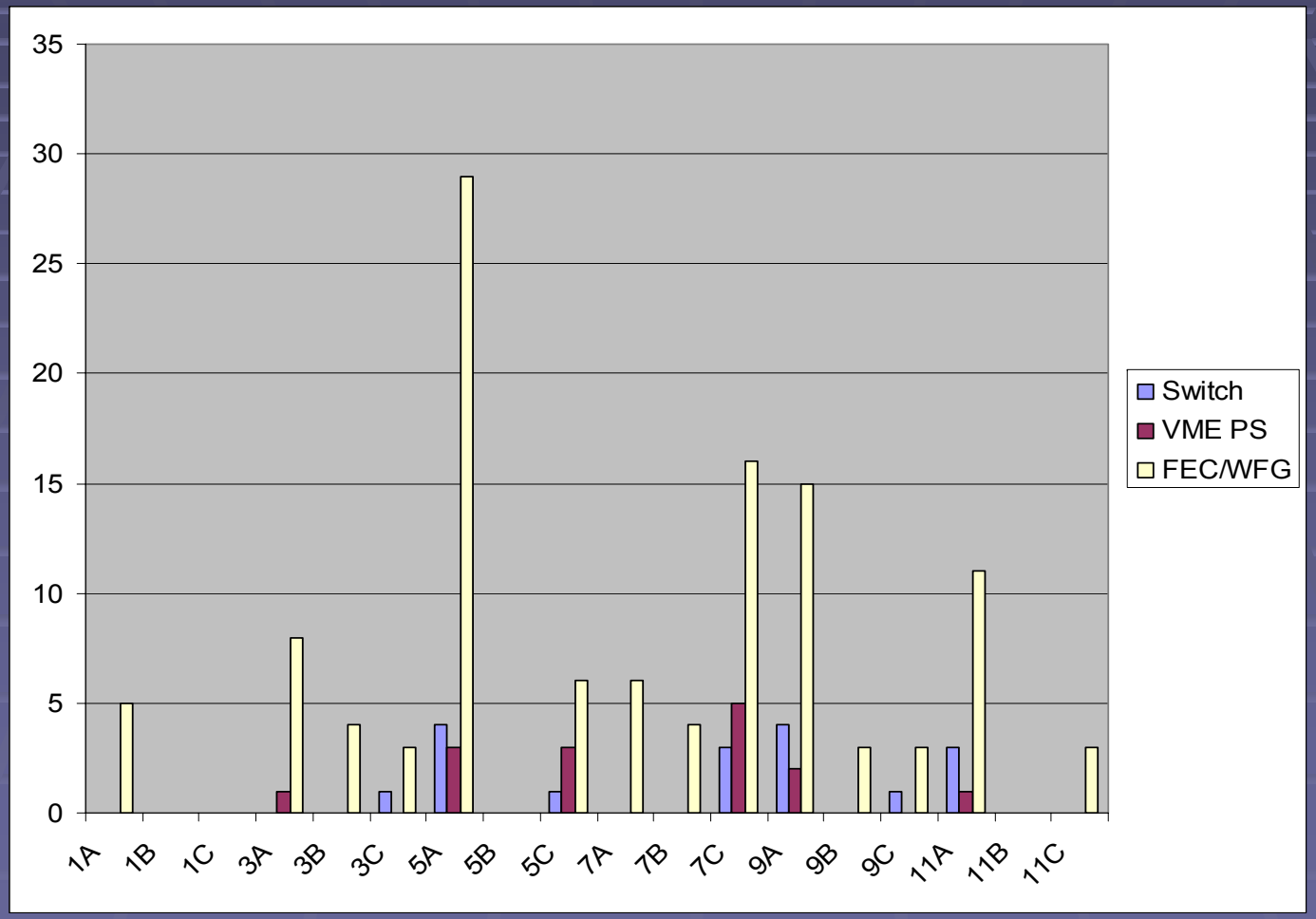
VME power supply con't

- Rad testing power supplies
  - Vicor power supply tested in the tunnel during the PP run without failure.
  - TLD neutron limits were exceeded
  - ~70 Rem Photons > 100 Kev

Beam Position Monitors

- More than 300 IFE chassis installed in RHIC
- ~Half are in the tunnel
- ~50 chassis damaged by radiation during the 2004 run
- Mostly digital circuits affected (DSP & Sram)

Controls failures FY04



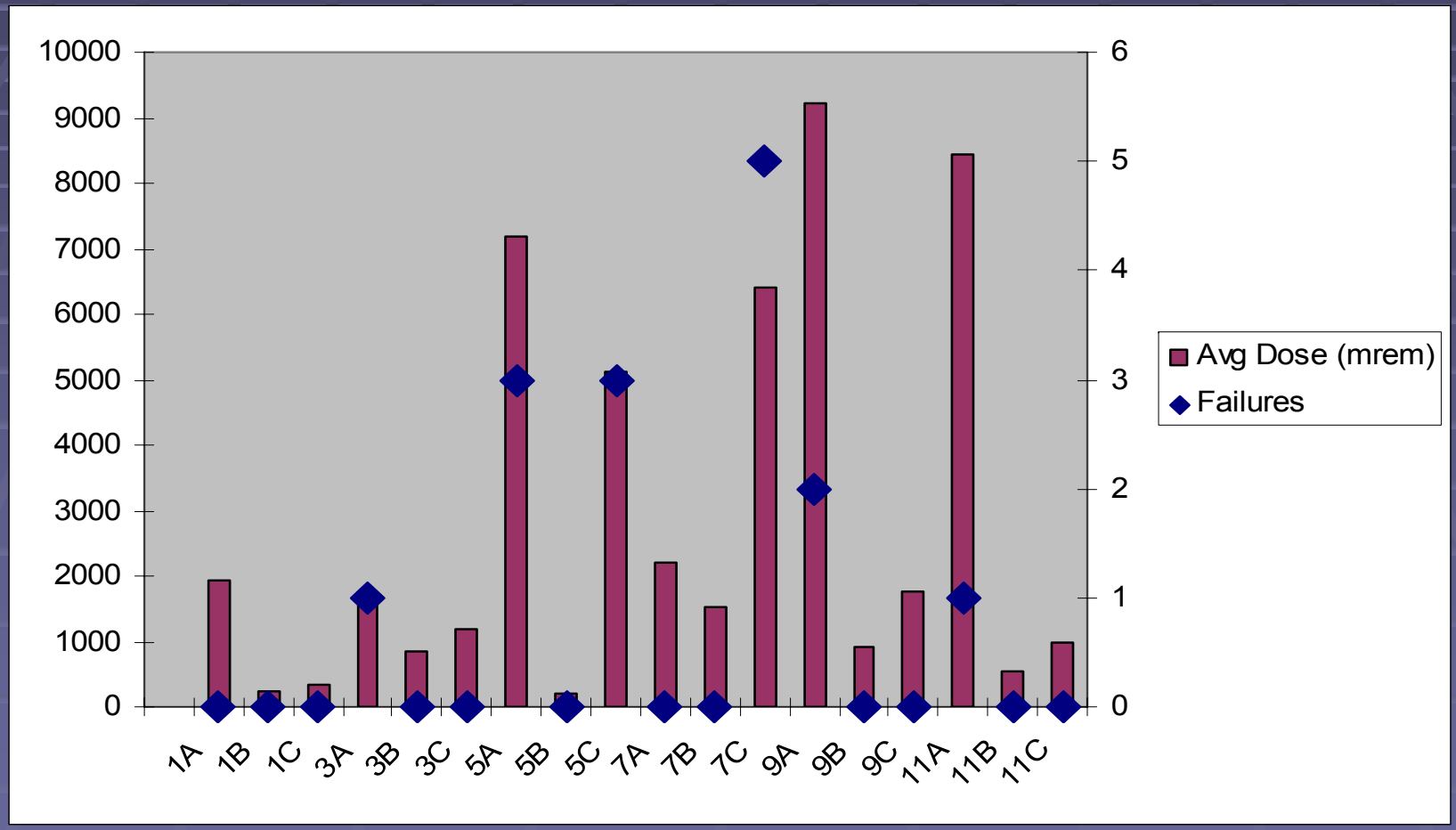
Radiation monitoring

- TLDs installed on all VME chassis in alcoves prior to start of the gold run (04)
  - Looking for correlation between controls failures and radiation levels
  - Photon (X-Ray and Gamma)
  - Beta
  - Neutron

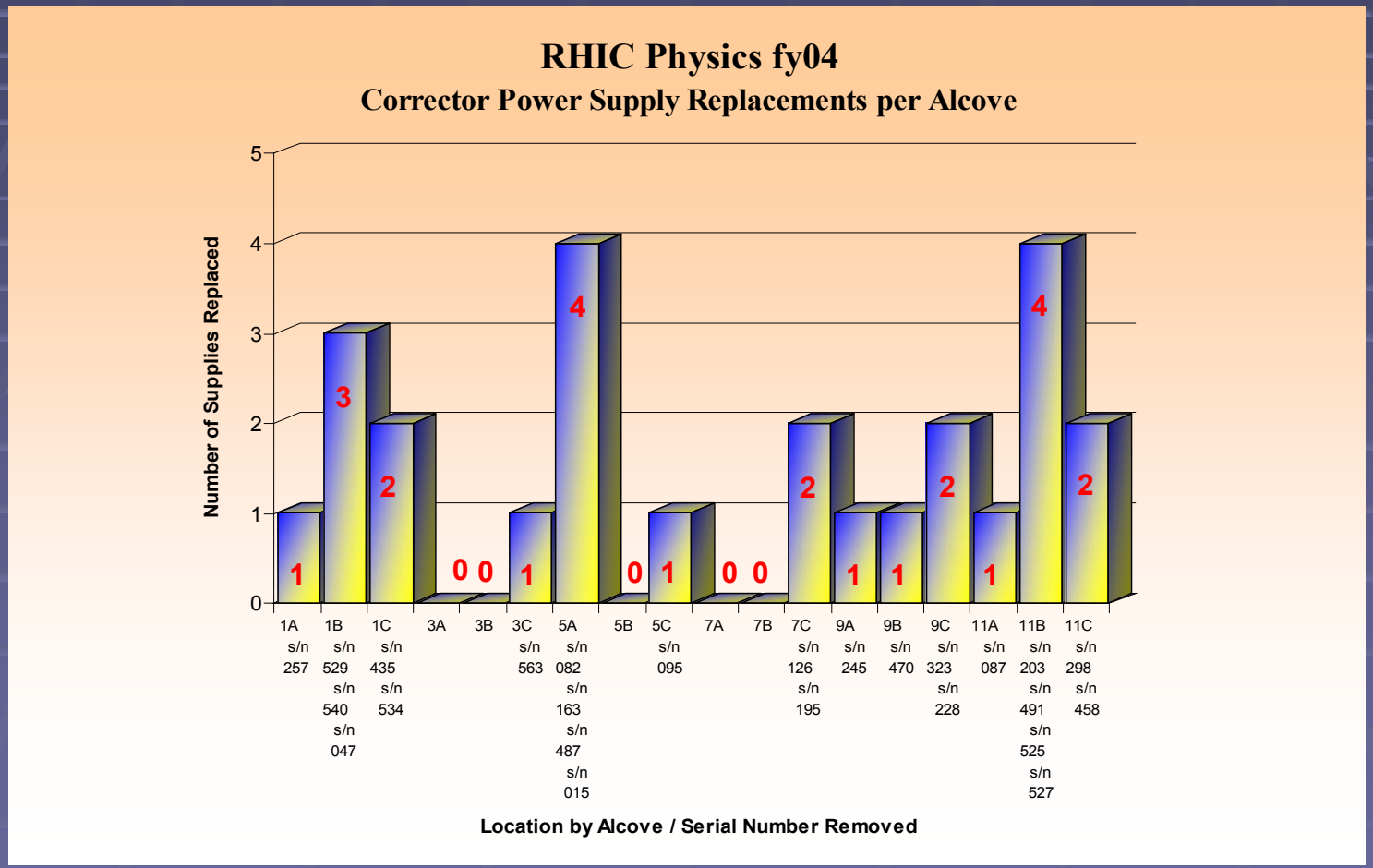
Radiation Monitoring

- Radiation Types detected
  - Fast Neutrons ~65%
  - High energy photons (>200 KeV) ~ 30%
  - Thermal Neutrons ~5%
  - Some low energy photons (<40 KeV)

Average Alcove Dose



Power Supply Stats 2004



Changes for 05

- Move equipment out of alcoves?
  - Technically possible
  - Cost prohibitive
- Switch to rad tested components where possible
  - Radiation tolerant power supplies for VME chassis
  - ECC memory for VME processors & WFG
  - Move equipment out of tunnel where possible

Changes for 05 con't

- Waveform generator memory
  - ECC memory board designed to replace existing memory
  - One location retrofitted (28 WFG)
  - Ram based gate arrays a concern?
- Moved all BPM chassis to alcoves
- Cryo PLCs – PS changed