HCAL Very Forward HV System.
Pre-design

Introduction
System layout:
  General scheme
  Power supply & Distribution cable
  Distribution box & ROBOX
  ROBOX: HV and Signal
Grounding
Design considerations
Safety Issues
Further analysis, PS specifications
Conclusions
Introduction

• The system is composed by:
  – 72 boxes (ROBOX) holding 24 photo-multipliers (PMT) each box.
  – 8 racks accommodate the front-end electronics crates and HV distribution boxes.
  – HV Power Supplies will be located into the counting room.
  – Racks and ROBOX are located in the forward region of the calorimeter.
  – Distance between racks-counting room ~150mts, distance between ROBOX - racks ~4-5 mts.

• Maximum voltage A-K per PMT = 1750V
• Individual gain adjustment per group of 8 PMTs in each ROBOX.
General Scheme

HV PS = 8 PS units

Each PS unit:
3 power supplies with
1700V-580V-275V max.

RACKS = 8 UNITS

12 QIE cards/Crate = 72 Ch.

1 HV distr. Box
9 ROBOX

24 Ch. signal

8 PMT
8 PMT
8 PMT

3 set HV

9 ROBOX per RACK
Power Supply & Distribution

PS unit

Distribution Box

Cable to ROBOX 1

Cable to ROBOX 9
Distribution box & Robox

Distribution Box

Cable to ROBOX 1

Input Filter

Resistor divider for 8 PMTs

Cable to ROBOX 9

K

Dy1

Dy2

Dy3

Dy4

Dy5

Dy6

Dy7

Dy8
Grounding

Anode

Dy8

QIE signal

QIE ref.

Cc

G

?

?
Design considerations

• Anode current
  – $<i> = 40\mu\text{A}$ for all PMT in a ROBOX (1.7\mu\text{A} / PMT)
  – $i_{\text{peak}} = 0.8\text{mA}$ per PMT

• Current per resistive divider $\sim 30\mu\text{A}$

• Current at $V1 = 1700\text{V}$ per power supply $\sim 300\mu\text{A}$

• Current at $V2 = 580\text{V}$ per power supply $\sim 200\mu\text{A}$

• Current at $V3 = 275\text{V}$ per power supply $\sim 200\mu\text{A}$
Safety Issues

• CERN Safety Instructions IS-28
  – Human body resistance @ 2KV is $R_{hb} \sim 650\Omega$
  – DC Current 0.5mA - 3mA; No reaction
  – Stored energies lower than 10 Joules are not dangerous
  – (Based on $I^2t=0.027A^2\text{sec}$. The energy should 5.4 Joules for $R_{hb} = 200\Omega$)

• The system is safe if we limit;
  the current per PS at 1 mA
  the capacitor values to 100 nF

• Energy stored in the cable $\sim 72.3\text{mJ}$
Further analysis / PS specifications

- Improvements on the 8 PMT board
- Measurement of noise attenuation – Filter design
- Over-voltage protection – Signal lines
- Pre-production board design
- Grounding integration; HV / Signal
- Define Power Supply specifications – Write document
- Power supplies should be similar to the HV PS ordered for the other part of HCAL.
Conclusions

• In 2003 we have two ‘milestones’, in March a review and in summer a test beam.

• Review
  – Prototype of distribution, ROBOX ??
  – Integration of HV/ Signal
  – Specifications of HV power supplies

• Test Beam
  – Final prototype of ROBOX
  – Final prototype of HV distribution
  – HV PS based on commercial units (prototype development starts Sep’03)