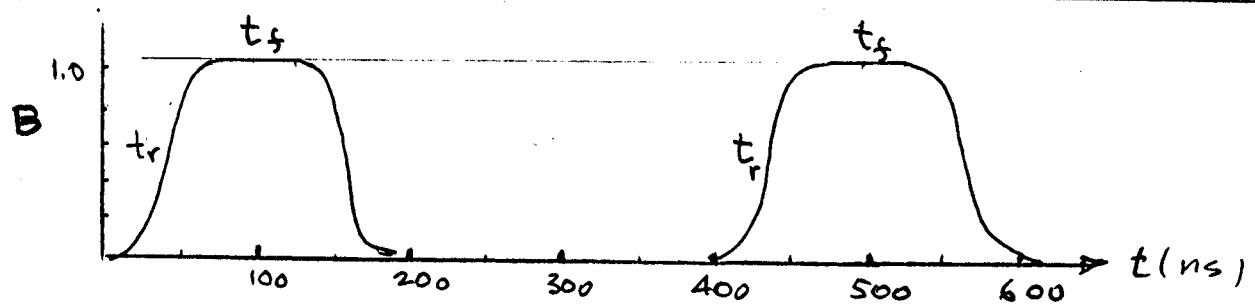
Cooling Ring Kicker Meeting

Saturday, March 9, 2002
Building 71, Room 264
LBNL

Lou Reginato

Induction Kicker



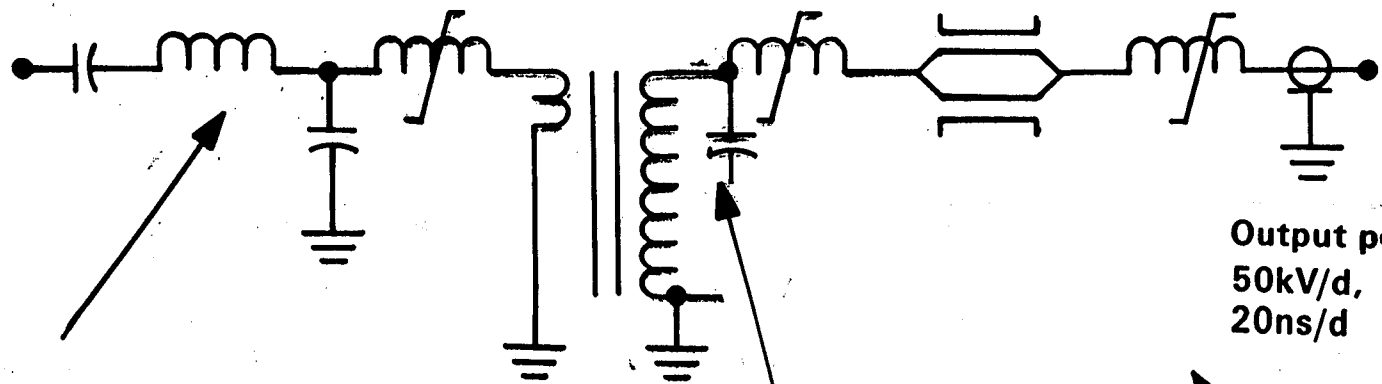
Rise time (10-90)-50ns

Flat Top (90-90)-100ns

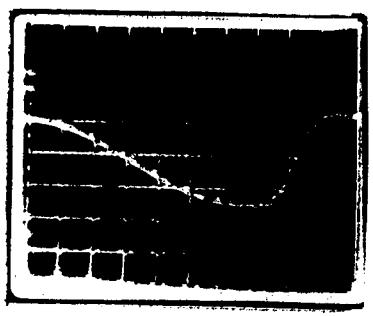
Double Pulse t_{dp} - 400ns

- The only technology that can deliver the required voltage (>100kV) and current (>100kA) is the "magnetic pulse compression".
- The only technique that can deliver a double pulse 400 ns apart is the "branched magnetics" since reset would be extremely difficult.

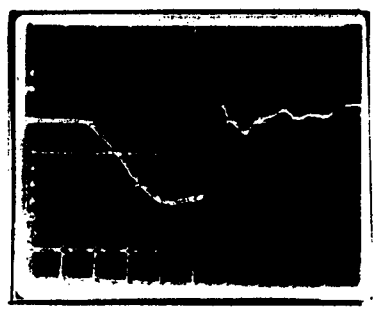
MAG 1D Simplified Schematic & Waveforms



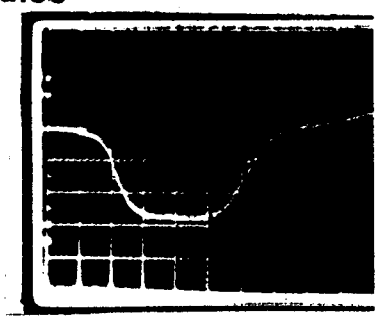
Precompression stage
10kV/d,
1 μsec/d



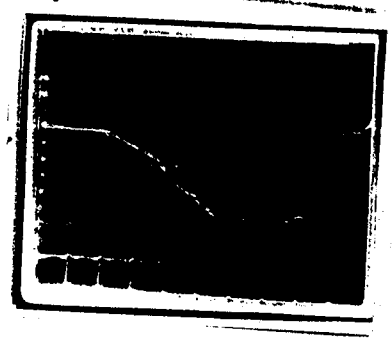
1st Stage compression
100kV/d,
500ns/d



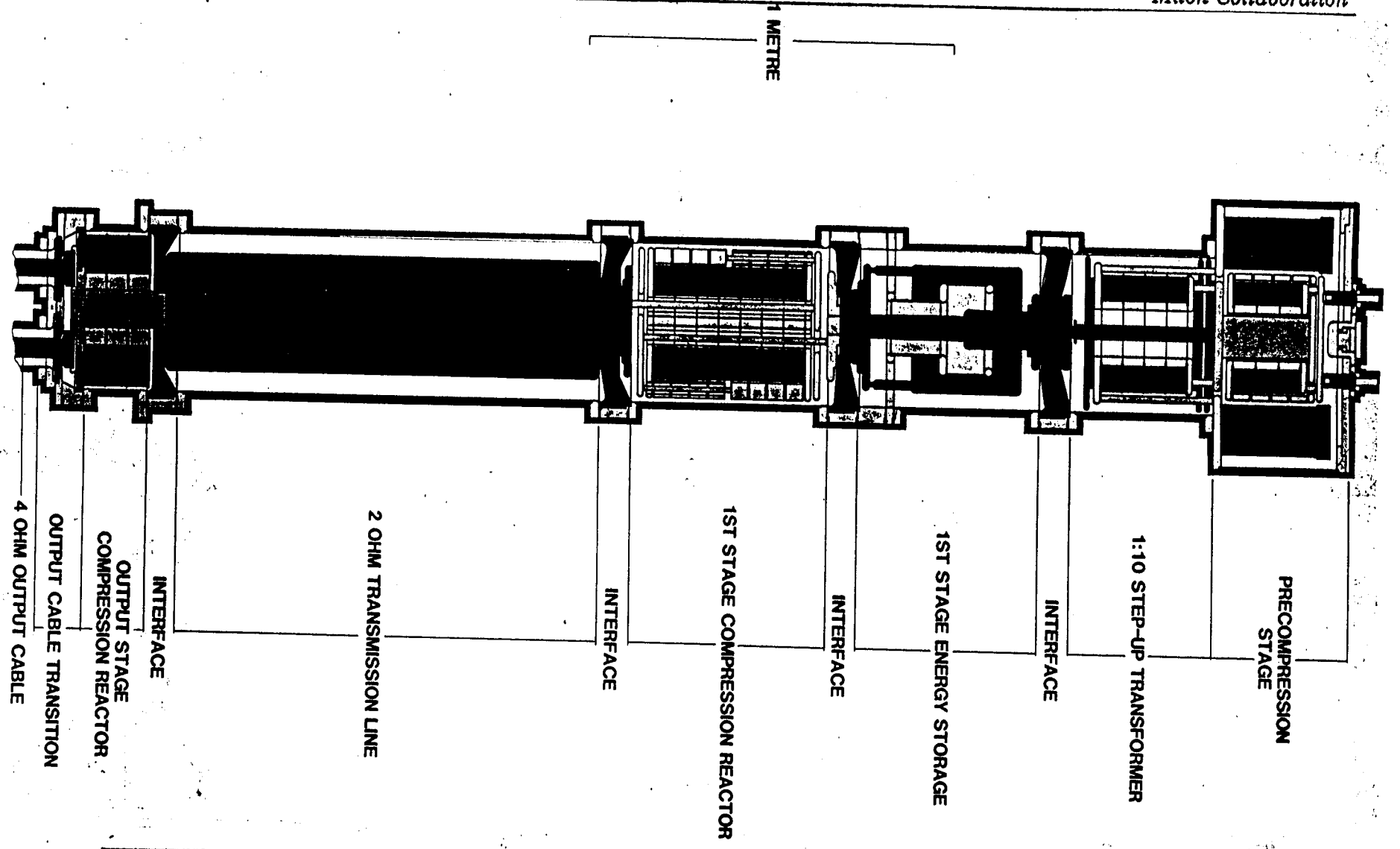
Output pulse
50kV/d,
20ns/d



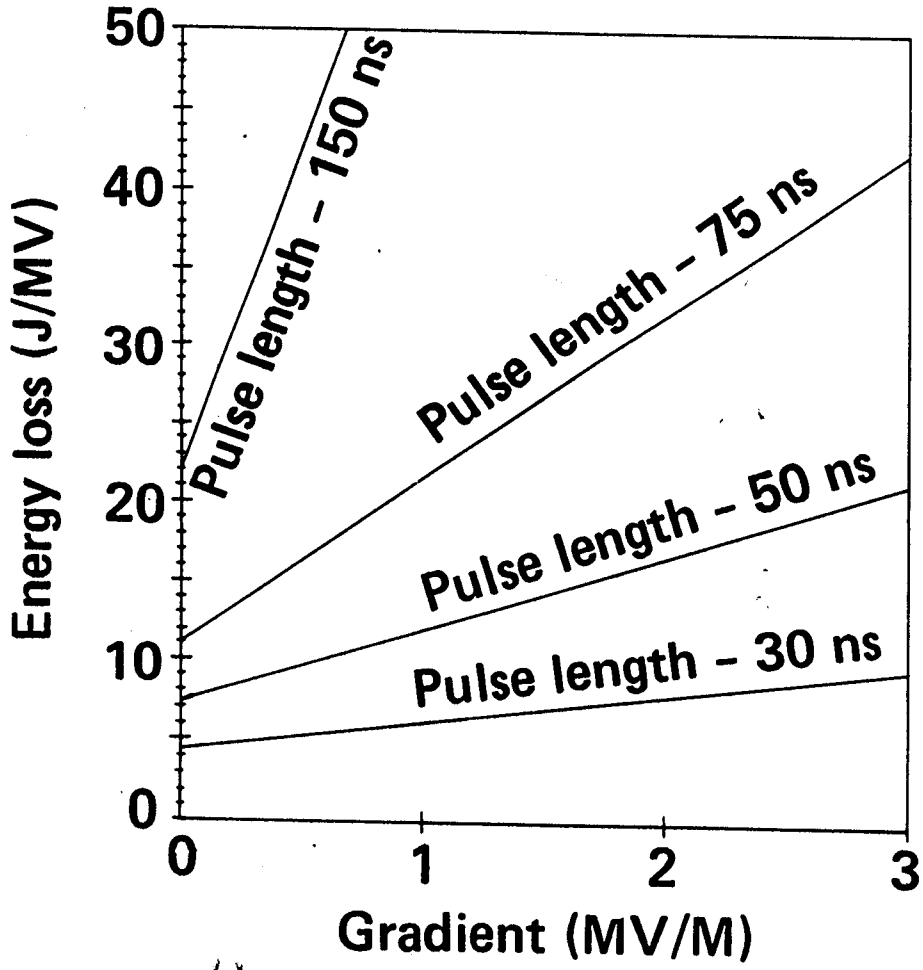
PFL
100kV/d,
50 ns/d



MAG 1D Drives ETA II



Core Loss vs Gradient

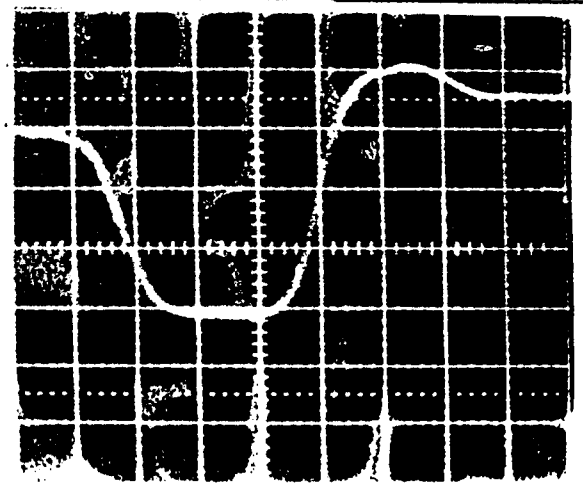


Core material - TDK PE-11 (min req vol)

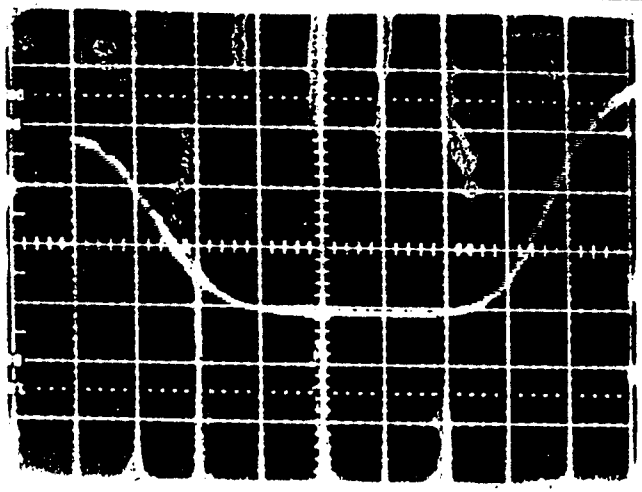
Beam pipe and focus solenoid - 6" dia

Linear pack factor - 0.8

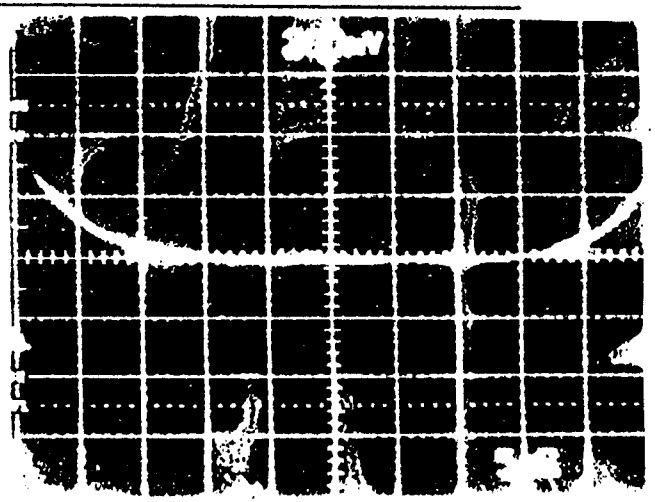
ETA II Waveforms



20 ns/
500 mv/



10 ns/
500 mv/

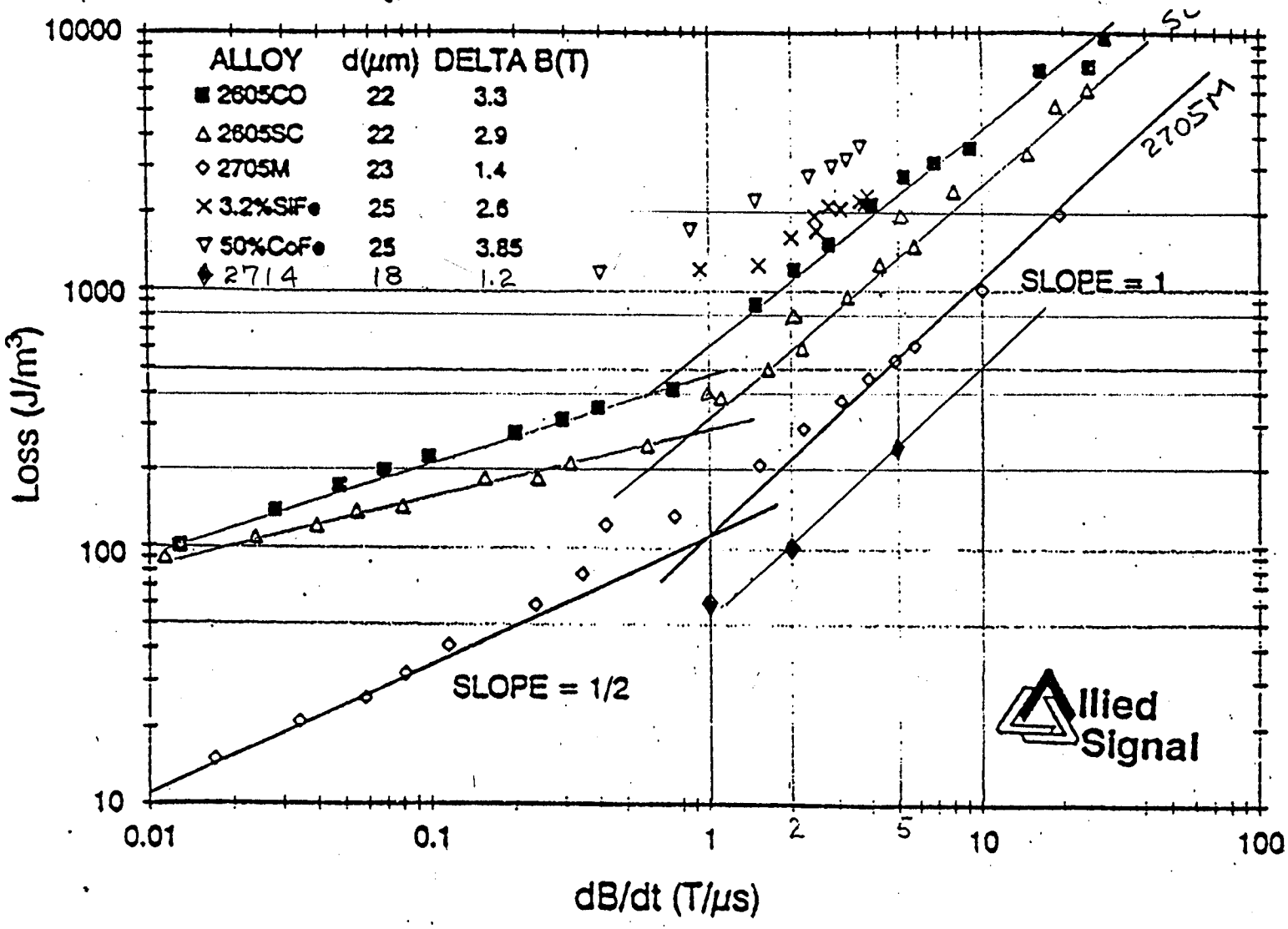


5 ns/
200 mv/

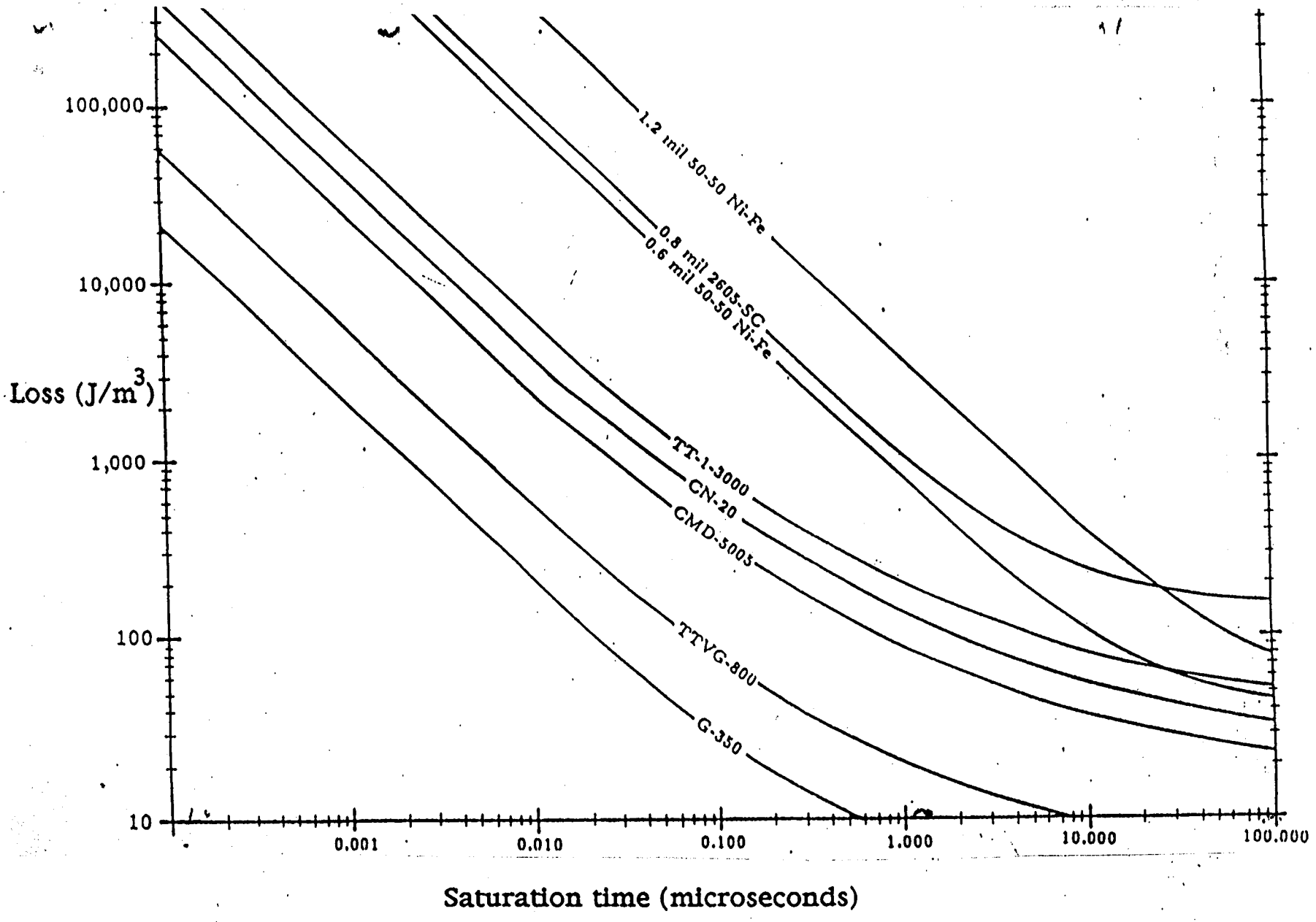
C - Probe Voltage (55 kV/V)
7Ω Load Simulated 1.2 kA Beam

Δv(%)	ΔT(ns)
± 0.5	25
± 1.0	30
± 2.0	40
± 4.5	50

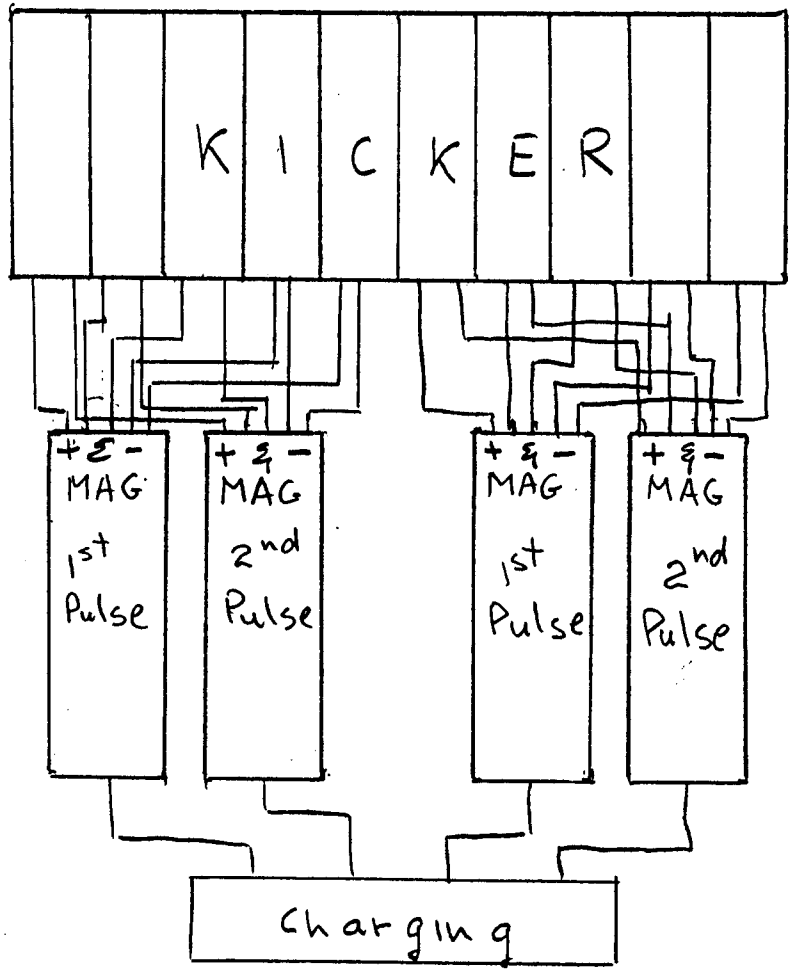
Metglas Alloys Losses

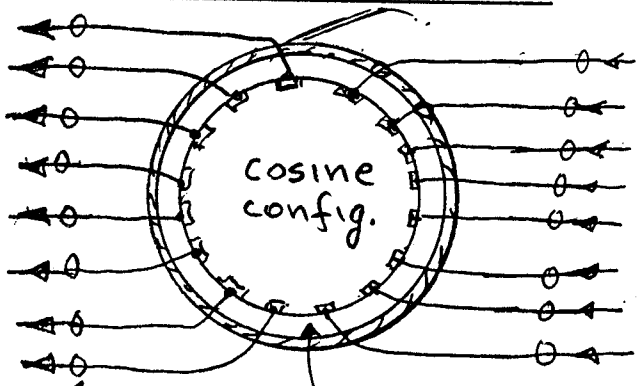


Magnetic Materials Losses vs dB/dt



Block Diagram of Kicker Drive





Coaxial cables terminated into matched impedance

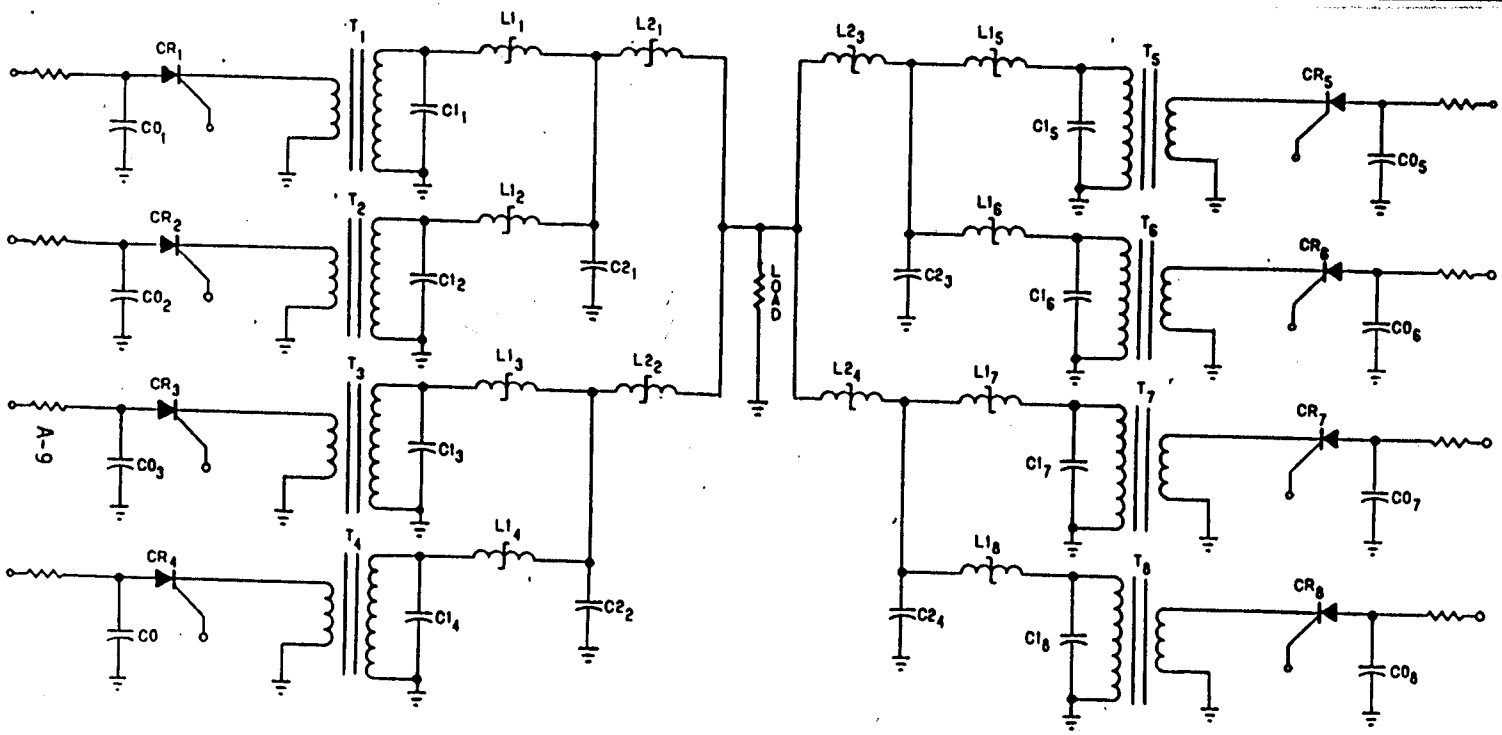
ferrite PE11B

- "Ferrite Loaded" Kicker is preferable to "air"
- The number of MAG's will be determined by the drive, rise time and impedances achievable.

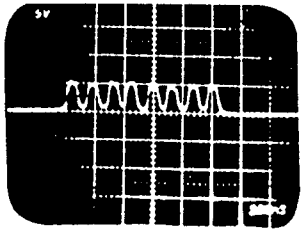
Branched Magnetics

- When the time between pulses is very short, it becomes extremely difficult to reset the MAG and recharge for the next pulse.
- A technique called "branched magnetics" was explored by Daniel Birx which allowed any spacing between pulses
- A low voltage benchtop prototype was built and tested to confirm the idea.

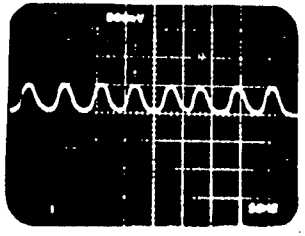
Branched Magnetics Prototype - 8 Pulse



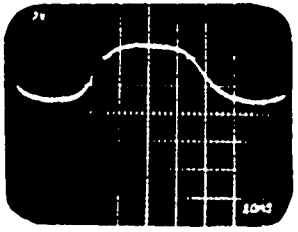
16MHz



625 V/d 100 ns/d

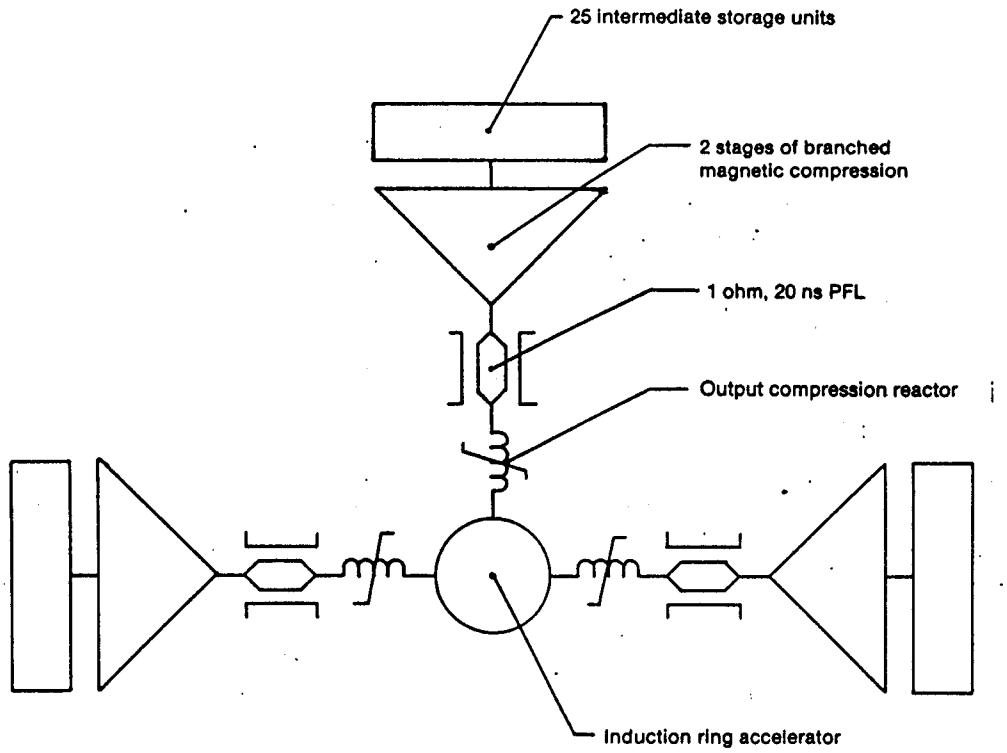


50 ns/d

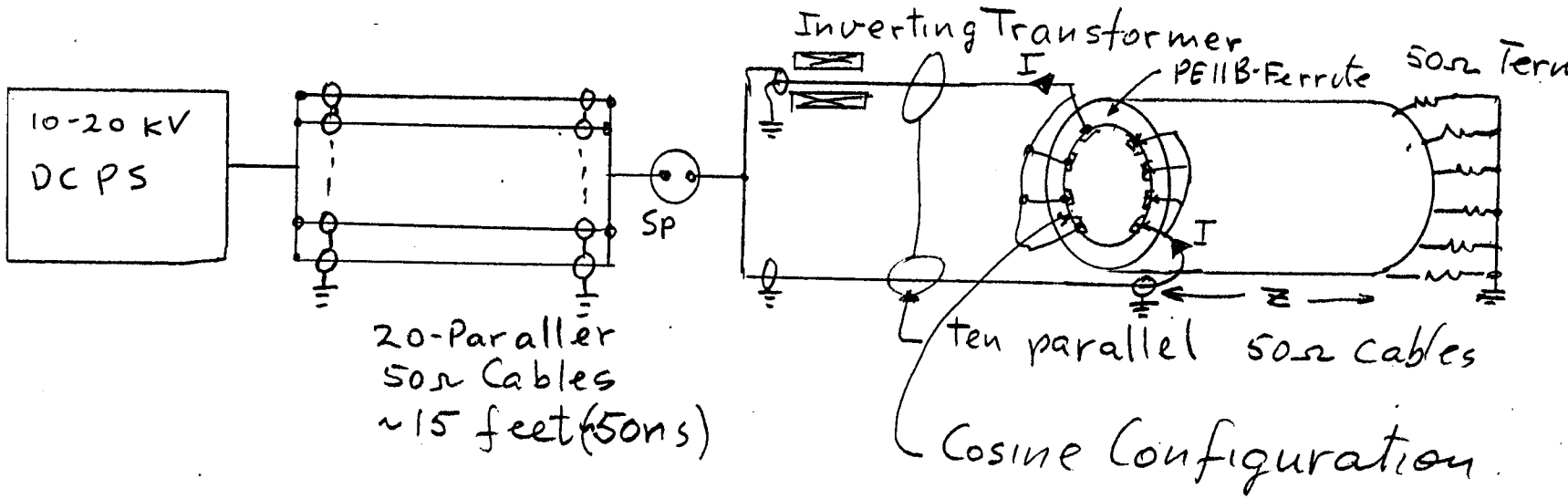


250V/d 10ns/d

Conceptual Block Diagram BM-3 Pulse



Proposed ½ Scale Kicker Magnet



- Prototype ID = 20 cm OD = 36 cm
  Length z - 25 cm & 50 cm
- Impedances, Voltages, Currents, Field Uniformity, rise time and flat top will be measured

Conclusions

- The Large Aperture Kicker and the drive system for the double pulse looks difficult but doable.
- To maintain sensible voltages (100-200kV) and proper rise time, the kicker magnet will be split into many sections (~10)
- The rise time of the MAG can be less than 50ns but the kicker field rise time will be established by the L/Z_0 of the system
- Plan to construct a ½ scale kicker using borrowed ferrites and other components.