ILC BDS Kickoff Meeting
Magnet Power Supplies
RDR Concepts and Completeness

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Topics

- Scope is magnet PS and associated controls operating at 1TeV
- Overview of the currently conceived power systems
- Cost estimate bases
- Impression of RDR completeness
- EDR areas for M & S cost reductions
- EDR Expression of Interest (EOI)

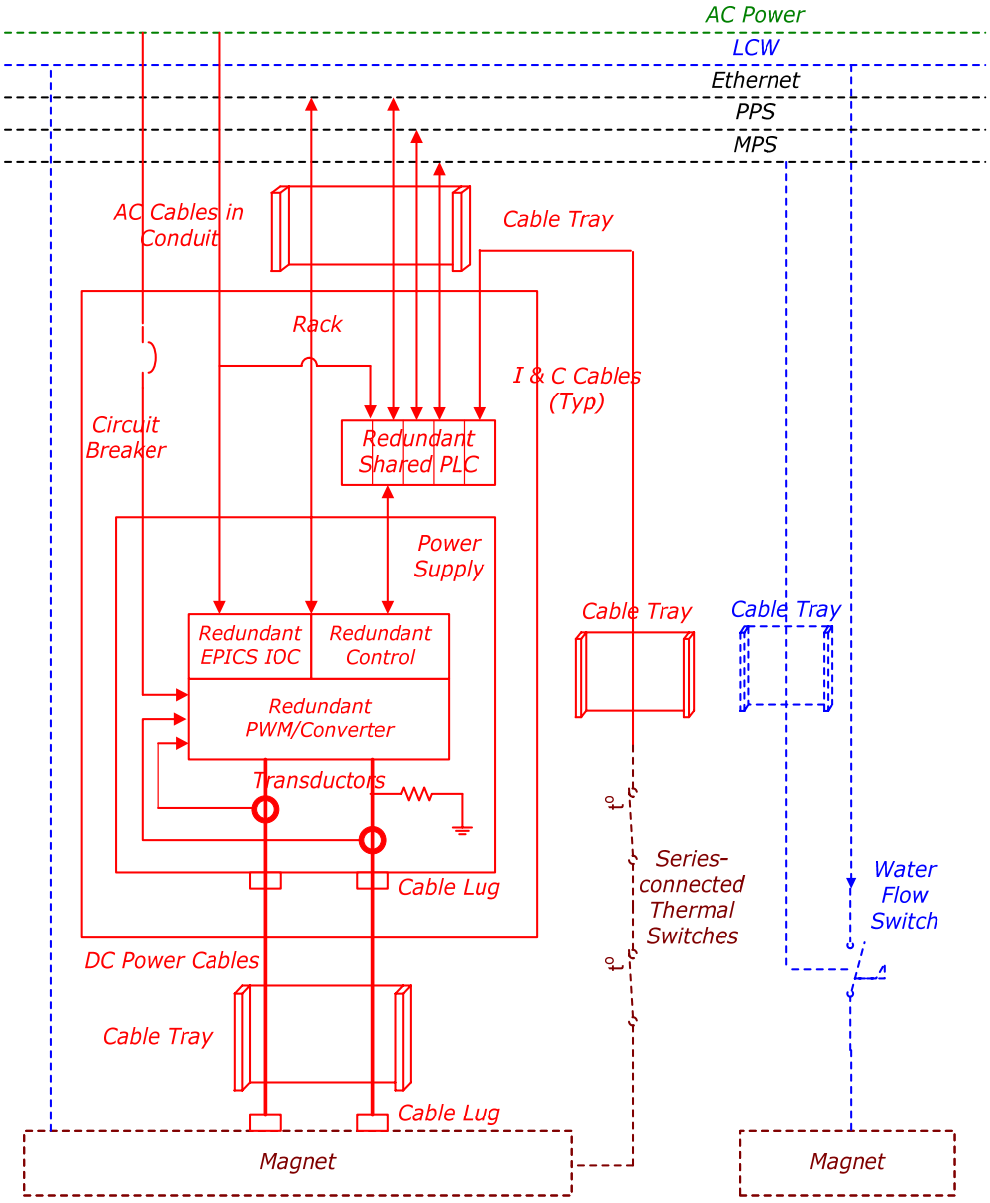
Overview of Present Systems

- Rollup as of December 2006
- 368 individually powered magnets, 276 magnets on strings

Area	Magnet Quantity	Power Systems								
BDS	644	432								
		Rack Mounted		Free Standing						
Section		Small < 2.5kW	Intermediate 2.5 < kw < 30	Large > 30kW	Septum Kickers (rating unknown)	Redundant	Normal temperature	Superconducting	Unipolar	Bipolar
e+Comm	126	6	38	30	0	74	74	0	74	0
e-e+14mr	518	166	66	62	64	358	260	98	226	132
Subtotals		172	104	92	64	432	334	98	300	132

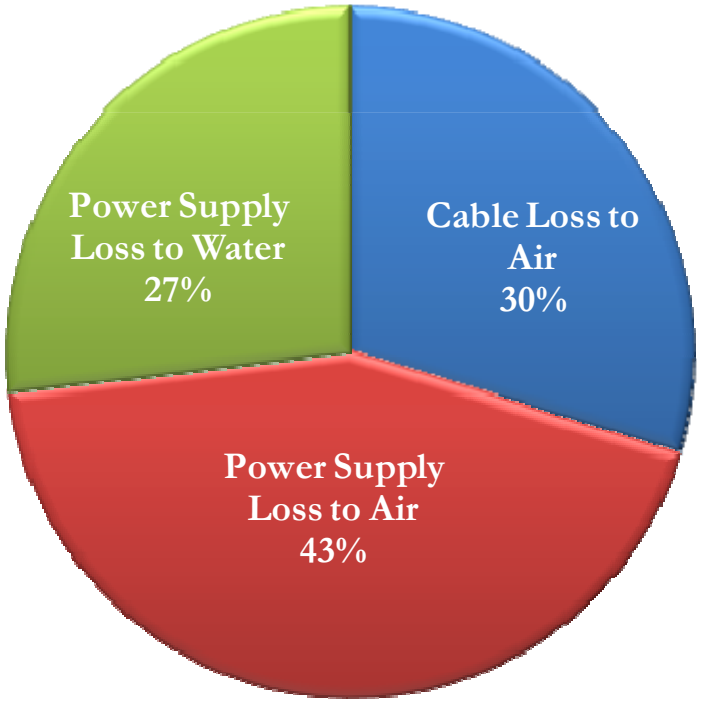
Overview of Present Systems

- Small or Intermediate, rack-mounted, unipolar or bipolar power supply, powers an individual, normal temperature magnet
- Power supplies are distributed in service tunnels adjacent to beamline. Cable runs are relatively short



Overview of Losses

Area	Magnet Power (kW) Ref Only	Cable Loss to Air (kW)	Power Supply Loss to Air (kW)	Power Supply Loss to Water (kW)	Required Water Flow (gpm)	Sum of All PS + Cable Losses (kW)
e-e+ Common	2,746	186	272	168	72	626
e-e+14mr	5,604	398	348	552	232	1,298
BDS	8,350	584	620	720	304	1,924



Water flow based on 1TeV losses and 18^{O}F rise in water

LCW water 95^{O}F in, 115^{O}F out, maximum

Beam tunnel ambient 85^{O}F to 95^{O}F

Service tunnel 60^{O}F to 85^{O}F

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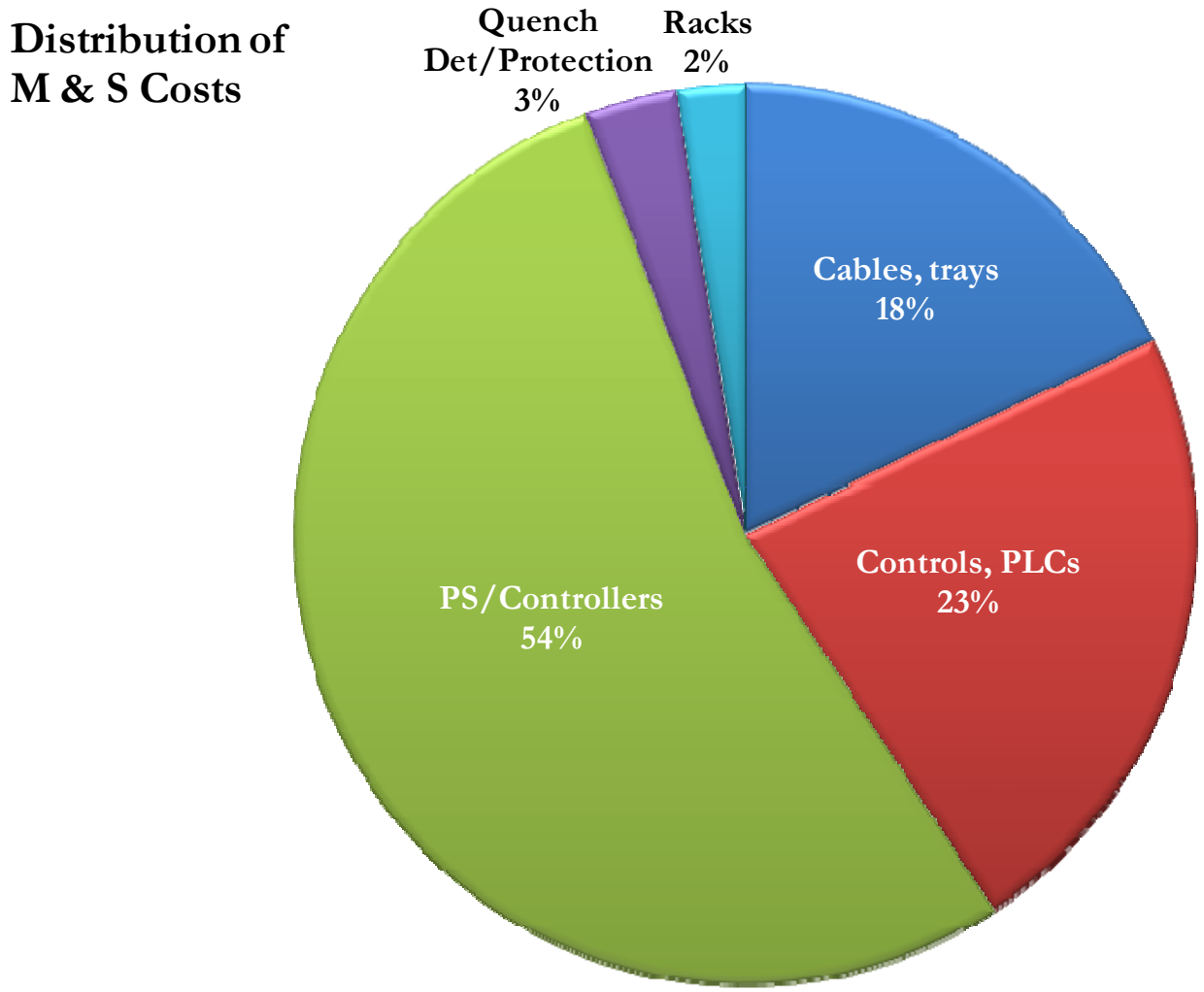
E- or e+ Common Service Tunnel	E- or e+ Common Beam Tunnel
• Length = 866m	• Length = 866m
• PS loss to air+50% cable loss=182.5kW	• 50% cable loss to air = 46.5kW
• Heat Loading = 212W/m	• Heat Loading = 53W/m
E- or e+ 14mr Service Tunnel	**E- or e+ 14mr Beam Tunnel**
• Length = 1,360m	• Length = 1,360m
• PS loss to air+50% cable loss=273.5kW	• 50% cable loss to air = 99.5kW
• Heat Loading = 201W/m	• Heat Loading = 73W/m

M & S Costs Estimate Bases

M&S=53% of total estimated BDS Power System cost



M & S Cost Estimate Basis

PS controllers, embedded EPICS IOC, redundant Ethernet interface	Cost estimates for similar controllers developed at SLAC, LBL, and PSI
PLCs, PACs, redundant Ethernet connections	On-line price lists – Allen-Bradley, Siemens, recent purchase for LCLS
AC input, DC output (54km), control cable, cable trays and conduits	Vendor quotes, recent experience, RS Means Electrical Cost Data 30th Edition.
Power supplies	Extrapolation of vendor price lists, quotes
Quench protection, dump circuit	Cornell University, FERMILAB, SLAC BaBar,
Racks	Recent SPEAR3 and LCLS purchases

EDIA and Assembly Cost Basis

- EDIA=26%, Assembly=21% of total estimated BDS Power System cost
- Estimates of EDIA and Assembly labor costs were based on reviews of recent large accelerator magnet and power supply projects at SLAC and Fermilab, where material, fabrication and EDIA labor fractions are well known
- The fractional distribution of EDIA and Assembly among several types of laborers, was assigned on the basis of project management experience
- Labor rates were those standardized by the Magnet Technical Group

RDR Completeness Estimate

- RDR focused magnet/power supply list and concepts
- All designs conceptual, very little is on paper. Written specifications, building/equipment layouts, rack profiles, wiring diagrams, cable tray or raceway layouts do not exist
- Accurate estimate of racks cannot be made until layouts and profiles are made
- Estimates include M&S for cable trays and conduits., but not raceway supports
- Environmental, facility, seismic and other Project specifications needed for design are not available
- PS RDR cost estimate is about 95% complete. All major components identified and estimated. But design detail is at a 15% level.

EDR Issues - Areas of Potential M & S Cost Reductions

Design refinement

- Update magnet/power supply list. Survey industry literature to move power systems from concepts to details. Write equipment specifications. Document facility, raceway layouts and electrical interconnections

Areas of cost reduction

- 644 magnets - 368 individually powered magnets, 276 magnets on strings. More magnets on strings to reduce power supply and controls quantities/costs
- Investigate smaller, less-expensive PLCs and PACs. Obtain additional vendor quotes based on supplying larger quantities – all components are ripe for economies of larger scale
- Many different types and many small power systems – no differentiation in stability requirements. All have two expensive, zeroflux current transductors. Define stabilities to eliminate transductors, use something less expensive

Last Slide – EDR EOI

- SLAC PCD prepared an EOI to participate in the BDS EDR
- The EOI scope consists of three parts, each spans three years (2008, 2009, 2010)
  1. EDR engineering and design of pulsed and DC magnet power systems and their controls.
  2. R & D effort to develop and build redundant bipolar PS prototypes
  3. R & D effort to develop and build a quench detection/protection system
- Expect EDR and R & D efforts will involve several electrical engineers, control engineers (hardware) and layout designers