ILC RTML Kickoff Meeting
Magnet Power Systems

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Topics

- Scope is DC magnet PS and associated controls
- Overview of the currently conceived power systems
- Cost estimate bases
- Impression of RDR completeness
- EDR areas for M & S cost reductions
- Other EDR issues

Overview of Present Systems

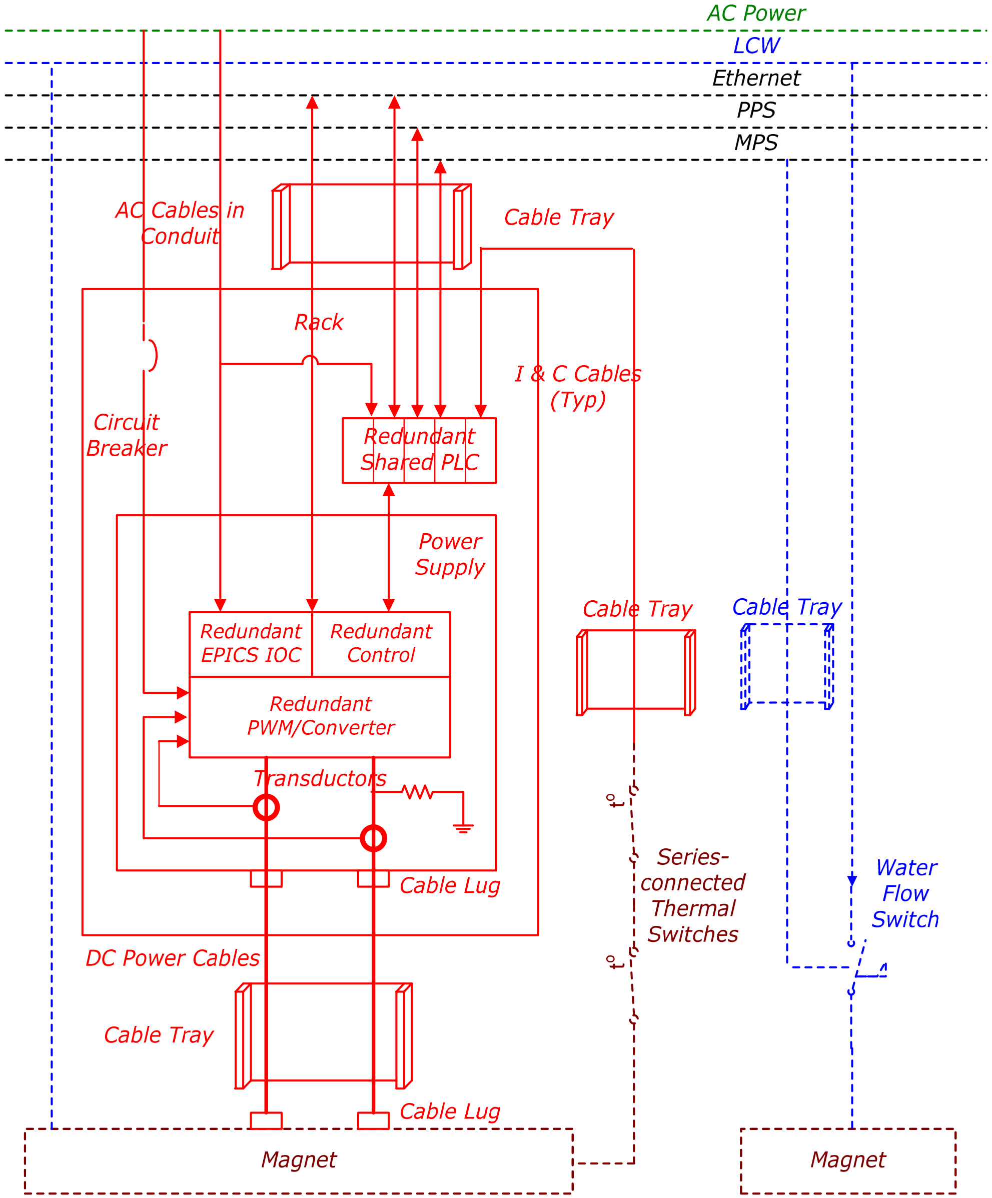
Area	Magnet Quantity	Power Systems							
RTML	4,334	3,832							
Section		Rack Mounted		Free Standing					
		Small < 2.5kW	Intermediate 2.5 ≤ kw ≤ 30	Large 80kW	Redundant	Normal temperature	Super conducting	Unipolar	Bipolar
e-	2,167	1,739	176	1	1,916	1,842	74	864	1,052
e+	2,167	1,739	176	1	1,916	1,842	74	864	1,052
Subtotals		**3,478**	**352**	**2**	**3,832**	**3,684**	**148**	**1,728**	**2,104**

- 3850 individually powered magnets, 484 on strings
- Rollup as of December 2006 (52 pulsed magnets and power supplies not included)

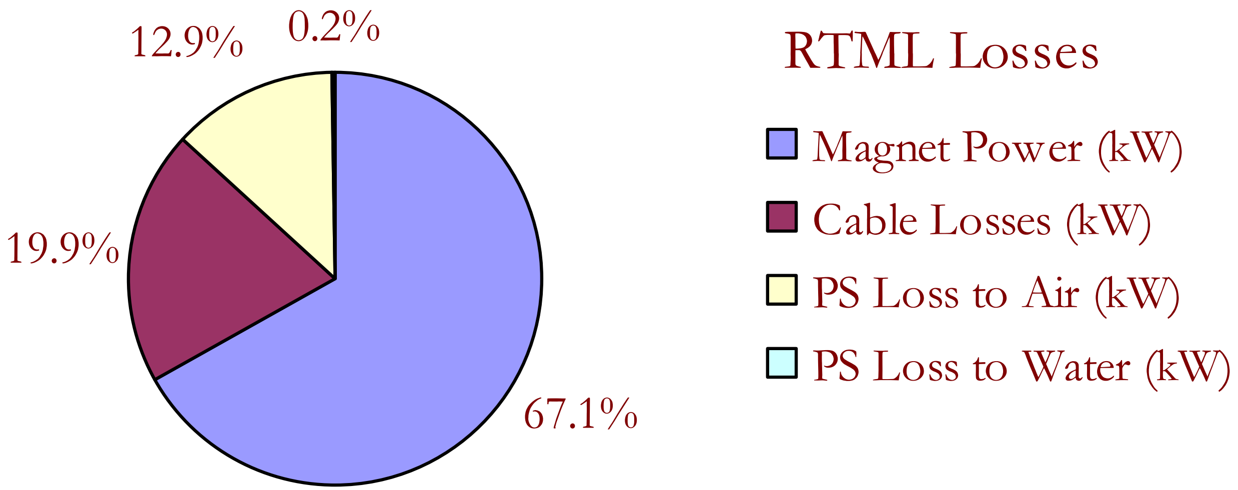
Overview of Present Systems

Unipolar or bipolar power supply, rack-mounted, powers an individual, normal temperature magnet

Power supplies are distributed in alcoves or in service tunnels adjacent to beamline. Cable runs are relatively short



Overview of Present Systems

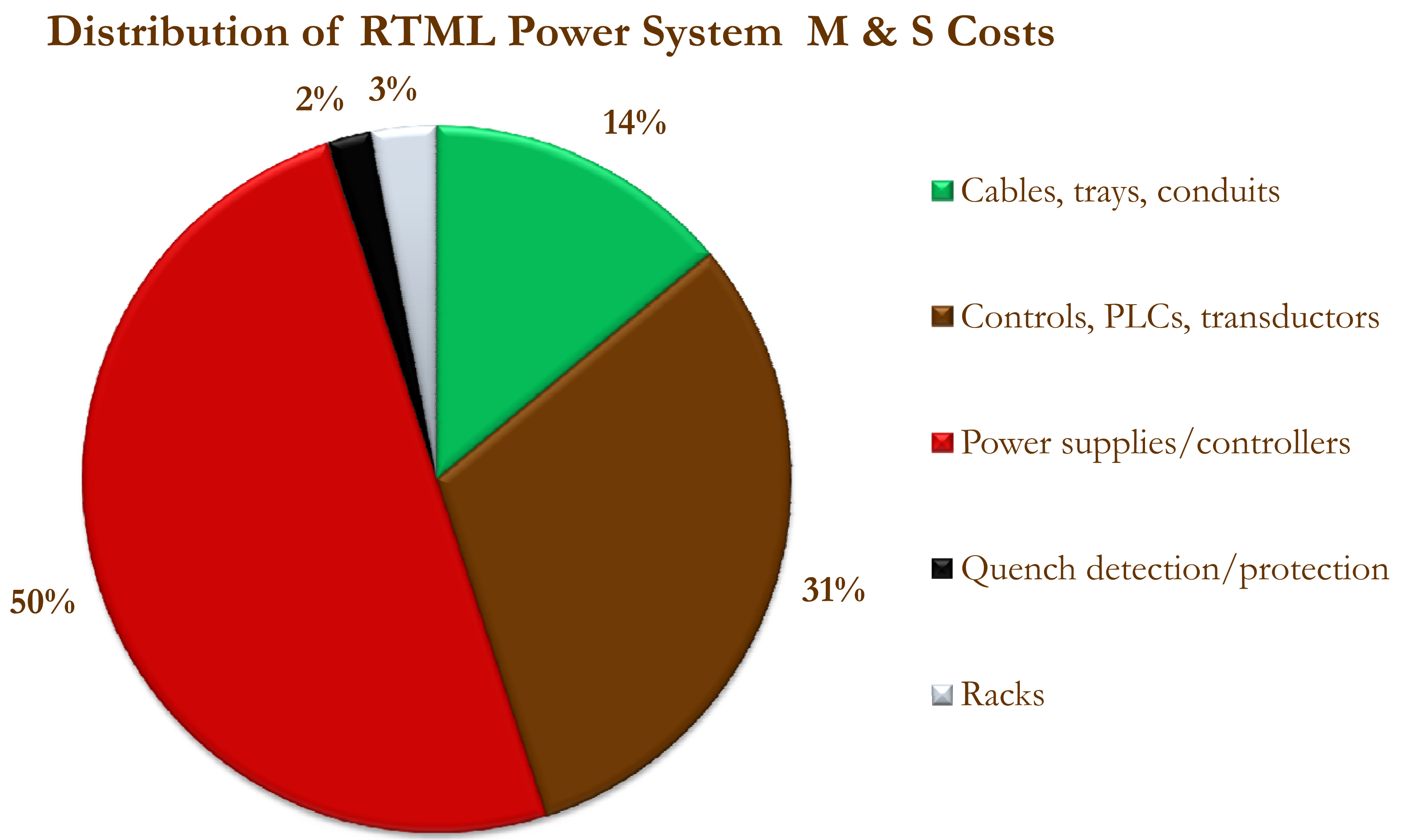


Area	Magnet Power (kW)	Cable Losses (kW)	PS Loss to Air (kW)	PS Loss to Water (kW)	Sum of All Losses (kW)	Expected Running kVA
e-	1,588	471	305	4	2,368	2,786
e+	1,588	471	305	4	2,368	2,786
RTML	3,176	942	610	8	4,736	5,572

- No water cooled cable or bus – although 8 – 4000A spin rotators are candidates for water cooled cable
- $100m^2$ of floor space needed. Does not include system considerations, clearances for safety, maintaining equipment, etc.

M & S Costs Estimate Bases

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



M & S Cost Estimate Basis

PS controllers, EPICS IOC redundant Ethernet interface	Costs for similar controllers developed at SLAC, PSI, and LBL
PLCs, PACs, redundant Ethernet connections	On-line price lists – Allen-Bradley, Siemens, recent purchase for LCLS
AC input, DC output (140km), control cable, cable trays and conduits	Vendor quotes, recent experience, RS Means Electrical Cost Data 30^{th} Edition.
Power supplies	Extrapolated vendor price lists and 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 RTML 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 focus magnet/power supply list and concepts
- Extraction line (3 per side) power supplies not in cost estimates
- The e- transfer line is about 1.2 km longer than the e+ line, with corresponding increase in magnet count
- All designs conceptual, very little on paper. Written specifications, building/equipment layouts, rack profiles, wiring diagrams, cable tray or raceway layouts do not exist.
- Accurate count of racks is not possible until layouts and profiles are made
- Estimates include M&S 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

- 4,334 magnets – 3,832 power supplies. 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 small power supplies – no differentiation in stability requirements. All have two expensive, zeroflux current transductors. Define stabilities to eliminate transductors, use something less expensive

Last Slide - Other EDR Issues

- Redundant bipolar PS development. Needed in other areas as well
- Quench detection, protection and energy dump prototype needed. PCD could draw on systems provided for SLAC tests of the prototype Main LINAC superconducting quadrupole
- Need for consistency and standardization of power system design to reduce the number of PS types, increase item quantities for price breaks
- Design effort involving electrical engineer, control engineer (hardware) and layout designers at some level to achieve the EDR goals in preparation for the pre-production phase.
- PCD would be pleased to receive an invitation to submit a work package for design and engineering of RTML pulsed and DC magnet power systems