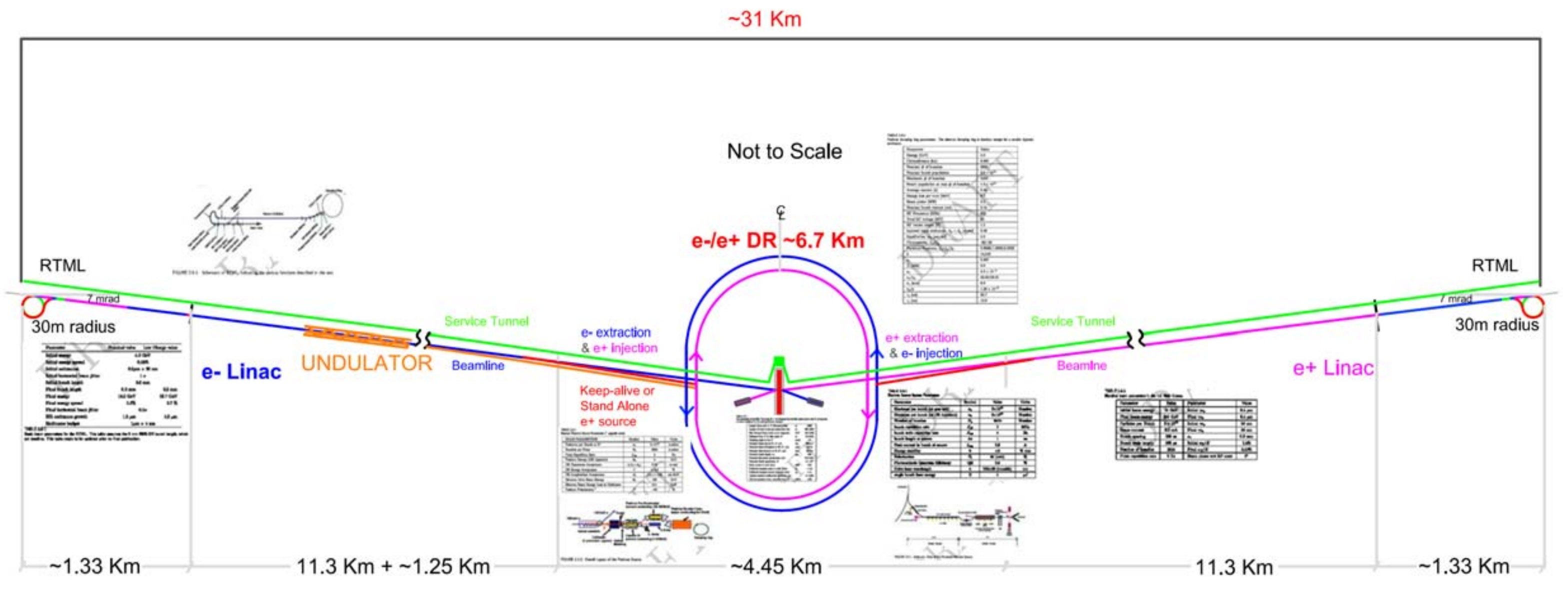
Beam Delivery System & Interaction Region KOM
Conventional Facility & Siting Overview

Fred Asiri/SLAC

Acknowledgment:
Atsushi Enomoto, Jean-Luc Baldy, John Osborne, Vic Kuchler
Jerry Aarons, Clay Corvin, Emil Huedem, Lee Hammond, Maurice Ball, Jonghoon Kim, Esther Kweon, Tanaka Masami, Tom Lackowski

RDR General Layout and EDR Plan

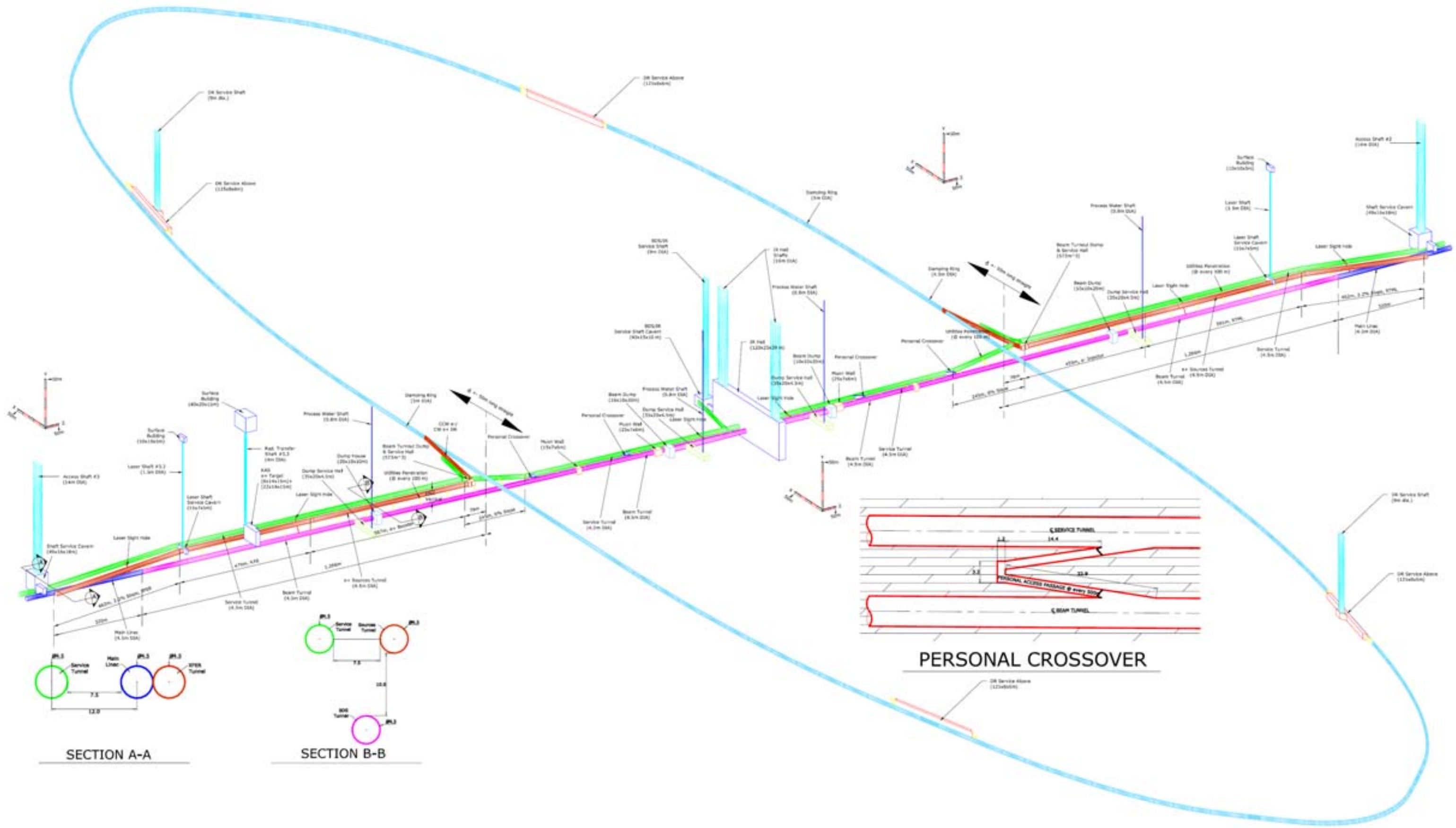


Schematic Layout - Plan View of the 500 GeV Machine

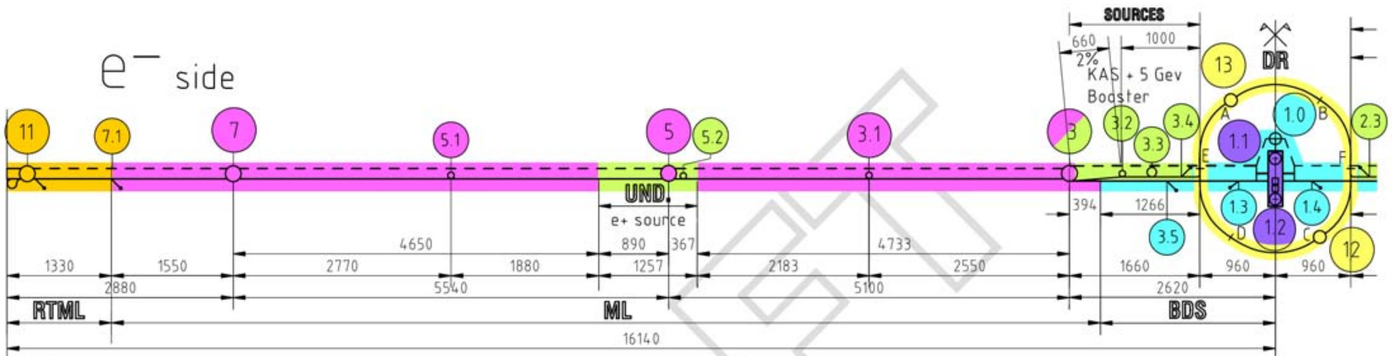
- Planning for EDR
  - **Prepare Engineering Project Description Document**
    - Defining physics requirement in RDR to engineering requirements
    - Defining boundaries, interfaces, utility needs and functional environment for each subsystem.

RDR Cost Overview

Beam Delivery System & Interaction Region are an integral part of the Central Area



Underground Structures Allocation Scheme

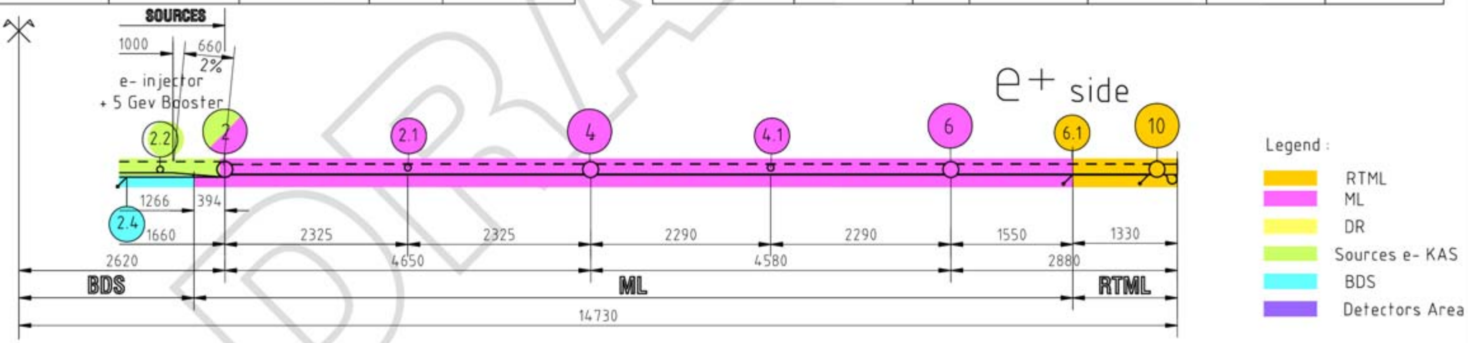


SITE / TUNNEL LENGTHS (m)

e− side + Undulator ML + RTML	e+side ML + RTML	BDS + sources	DR	TOTAL
13 914 / 27 948	12 504 / 25 128	4452 / 12 236	0 / 6704	30 870 / 72 016

TUNNELS

Area	e− inject.,KAS beam + serv	DR	RTML beam + serv	ML beam + serv	BDS beam + serv	BDS Survey
Øm	4.5	5.0	4.5 + 4.5	4.5 + 4.5	4.5 + 4.5	1.5 x 2.2



SHAFTS

Point	1.0	1.1	1.2	2	3	3.3	5.2	4	5	6	7	10	11	12/C	13/A
Øm	9	16	16	14	14	4	4	14	14	9	9	14	14	9	9

BORINGS

Point	2.1, 3.1, 4.1, 5.1	2.2, 3.2	1.3, 1.4, 2.4, 3.5
Øm	1.50		

SHAFT BASE CAVERNS

Point	2, 3,	4, 5, 6, 7,	10, 11
(LxWxH) m	49 x 16 x 18 + 3 storeys		

MUON WALL WIDENINGS

Point	1.3, 1.4
(LxWxH) m	25 x7x6 +15x7x6

SOURCES CAVERNS

Point	Undulator 5.2	KAS 3.3	2.2, 3.2
(LxWxH) m	21 161m3	6 574m3	7 X 15 X 7.5

DR ALCOVES

Point	12/C, 13/A	B, D, E, F
(LxWxH) m	75 x 10 x 10 + 1 storey	16 x 8 x 8

DETECTORS HALL

Point	1.1, 1.2	1.0
(LxWxH) m	120 x 25 x 39	40 x 15 x 15

BEAM DUMPS CAVERNS (↖)

Point	SOURCES 2.3, 3.4	RTML 6.1, 7.1, 10, 11	BDS 1.3, 1.4, 2.4, 3.5
(LxWxH) m	5 x 4 x 4		20 x 9 x 15 + 1 storey

BEAM DUMP SERVICE HALLS (↖)

Point	BDS 1.3, 1.4, 2.4, 3.5
(LxWxH) m	30x20x 10

ILC - UNDERGROUND STRUCTURES SCHEMATIC LAYOUT

AREA SYSTEM DIVISION **(2 mobile Detectors - Push Pull - modified CMS procedure)**

EUROPEAN REGION

CERN

GROUP : TS-CE
CIVIL ENGINEERING
SUPERVISOR : JL.BALDY
DESIGNER : N.BADDAMS

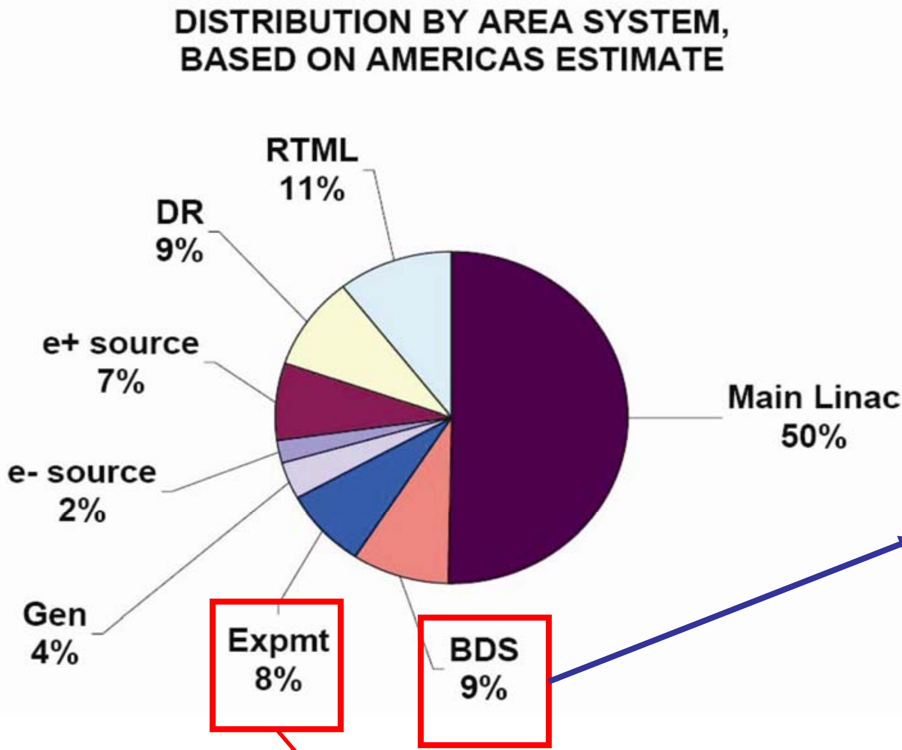
SCALE : 1/50000(A3_FORMAT) DATE : 05_DEC_2006

ILC−.CE−1.1649.0016 | SIZE 3 | INDICE G

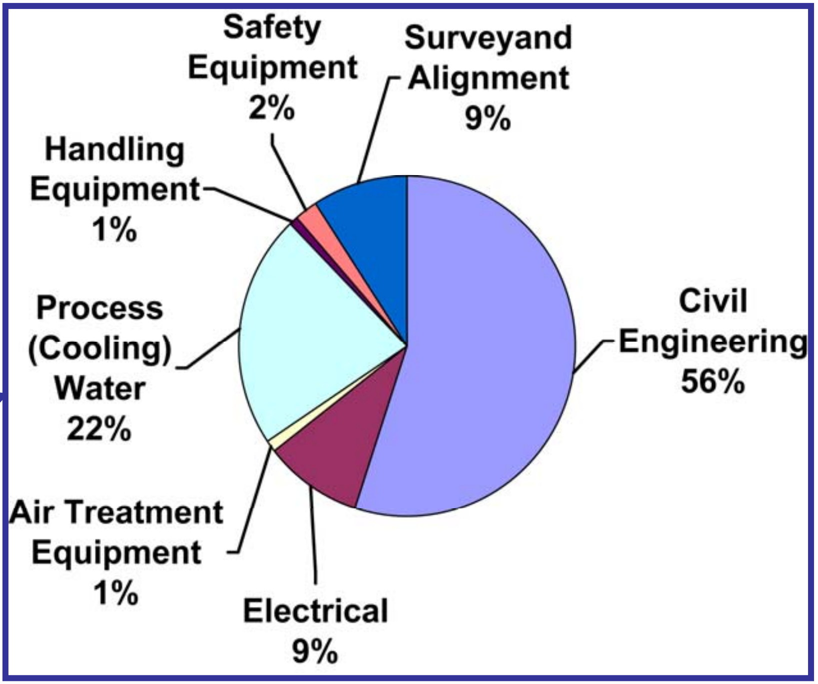
DRAFT

RDR Cost Overview

Total CFS Costs and Statistics



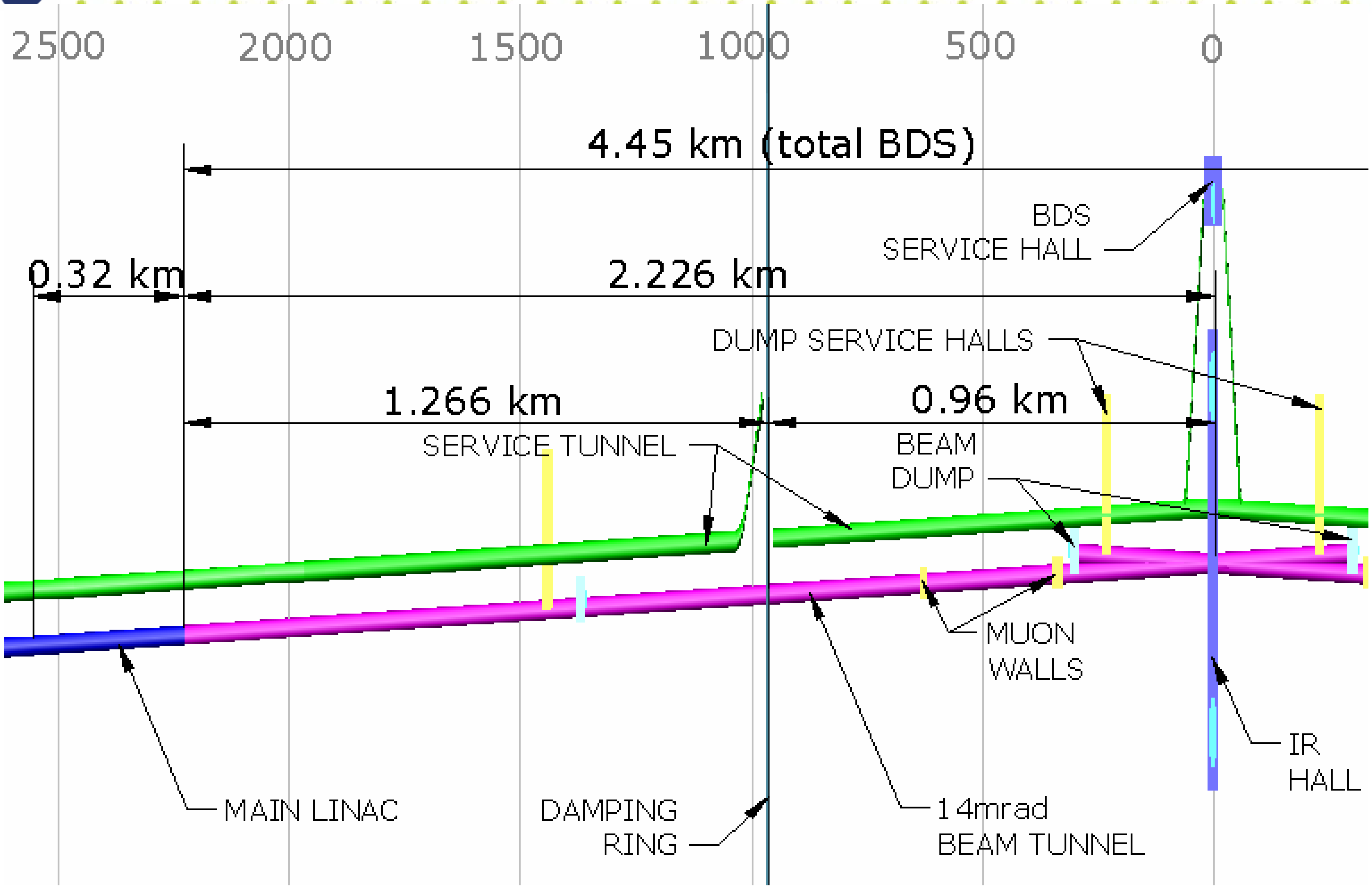
Note: Chilled Water Stations & Distribution Cost is Included in Process Water Cost rather than in the Air Treatment Cost



See Slide 10 for Cost Distribution

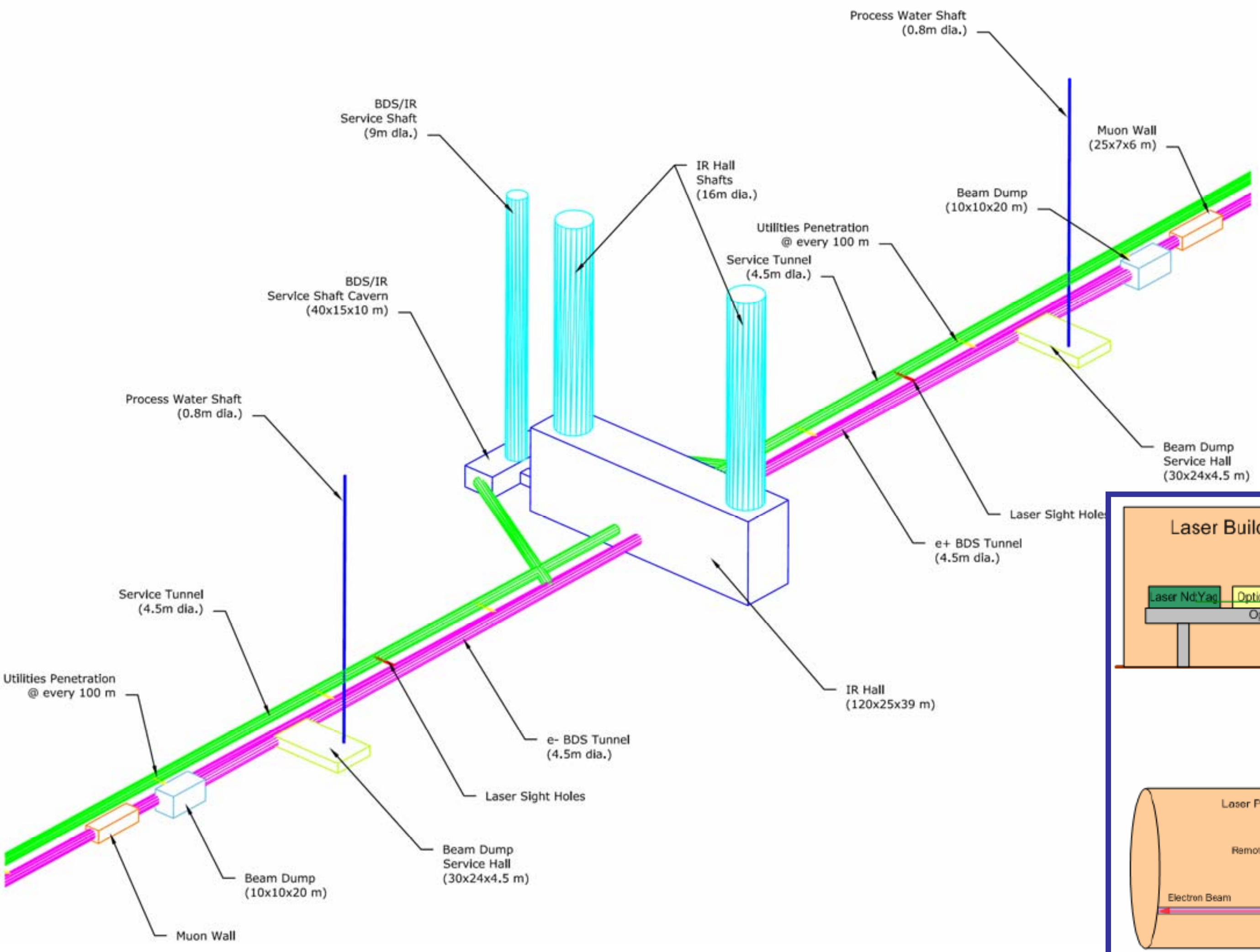
BDS Cost Distribution

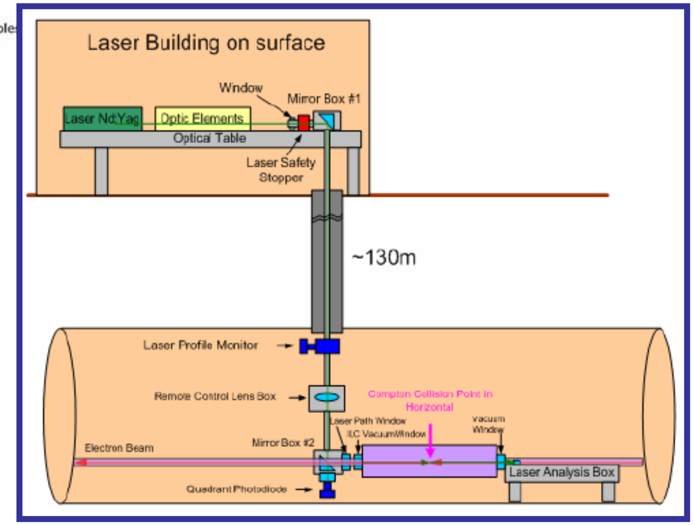
BDS Underground Structures



Snapshots at Beam Delivery Systems

Partial Scope of Structures for BDS & IR





Schematic of Compton Laser Light Source (4 Required)

Items Included in Civil Engineering for BDS

Identified Possible Inconsistencies in Cost Estimates Among the Three Regions;
e.g. Miscellanies Work:
Asian ;~ 1$M
European; ~49$M
American; ~1.3$M
This could be due to difference in book keeping. However, it will be checked in one of the CF&S parallel sessions in Fermilab.

Underground Facilities		
Shafts		
BDS/IR Service 9m dia. Shaft	129.5	vert m
Surface Grouting of BDS 9m dia. Shaft	1	ea.
BDS/IR 9m dia. Shaft, finishing (stairs, conc. wall, elev.#2)	130	vert m
BDS 800mm dia. Process Water Shafts (4 total)	518	vert m
Surface Grouting of BDS Process Water Shafts (4 total)	4	ea.
BDS Underground Potable Water (BDS/IR Service Shaft)	1	ea.
BDS Underground Sanitary Sewer (BDS/IR Service Shaft)	1	ea.
Tunnels		
e- BDS 4.5m Beam Tunnel, Point 3 to IR, TBM Exc.	2,226	lin m
e- BDS 4.5m Service Tunnel, DR to IR, TBM Exc.	1,100	lin m
e- BDS Extraction Beam Tunnel, Taper to 8 wide, D&B Exc.	2,916	m^3
e+ BDS 4.5m Beam Tunnel, Point 2 to IR, TBM Exc.	2,226	lin m
e+ BDS 4.5m Service Tunnel, Point DR to IR, TBM Exc.	1,100	lin m
e+ BDS Extraction Beam Tunnel, Taper to 8 wide, D&B Exc.	2,916	m^3
Caverns		
BDS/IR Service Shaft Base Cavern D&B Exc.	6,000	m^3
Passage from BDS/IR Service Cavern to IR Hall	375	m^3
Beam Dump, D&B Exc., (~1650m from IP) (e- BDS)	2,000	m^3
Beam Dump Service Hall, D&B Exc., (~1650m from IP) (e- BDS)	3,150	m^3
e- BDS 9m Muon Wall Alcove, D&B Exc.	630	m^3
e- BDS 18m Muon Wall Alcove, D&B Exc.	1,050	m^3
e+ Final Beam Dump, D&B Exc., (~300m from IP)	2,000	m^3
e+ Final Beam Dump Service Hall, D&B Exc., (~300m from IP)	3,150	m^3
Beam Dump, D&B Exc., (~1650m from IP) (e+ BDS)	2,320	m^3
Beam Dump Service Hall, D&B Exc., (~1650m from IP) (e+ BDS)	3,718	m^3
e+ BDS 9m Muon Wall Alcove, D&B Exc.	630	m^3
e+ BDS 18m Muon Wall Alcove, D&B Exc.	1,050	m^3
e- Final Beam Dump, D&B Exc., (~300m from IP)	2,000	m^3
e- Final Beam Dump Service Hall, D&B Exc., (~300m from IP)	3,150	m^3

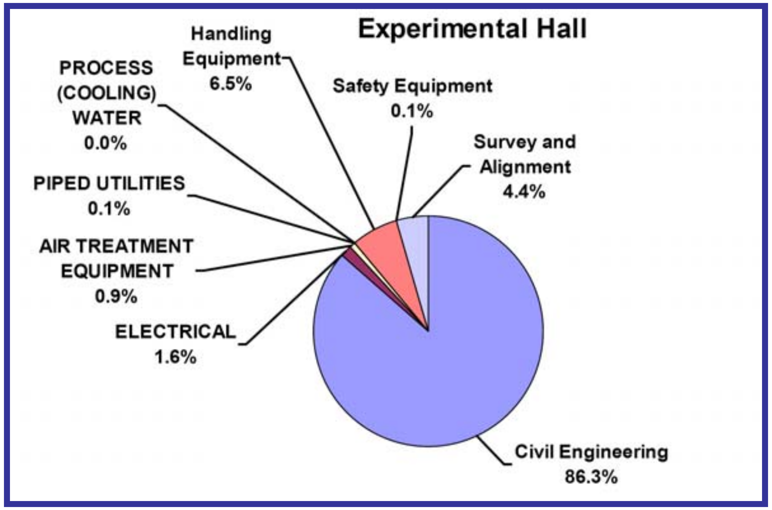
Items Included in Civil Engineering for BDS

Miscellaneous works		
e- BDS Personnel Crossovers, D&B Excavation (2 total)	241	m^3
e- BDS Utilities Penetration, Drill Excavation (22)	22	ea.
e+ BDS Personnel Crossovers, D&B Excavation (2 total)	241	m^3
e+ BDS Utilities Penetration, Drill Excavation (22)	22	ea.
e- BDS Laser Equipment Sight Holes (3)	3	ea.
e+ BDS Laser Equipment Sight Holes (3)	3	ea.

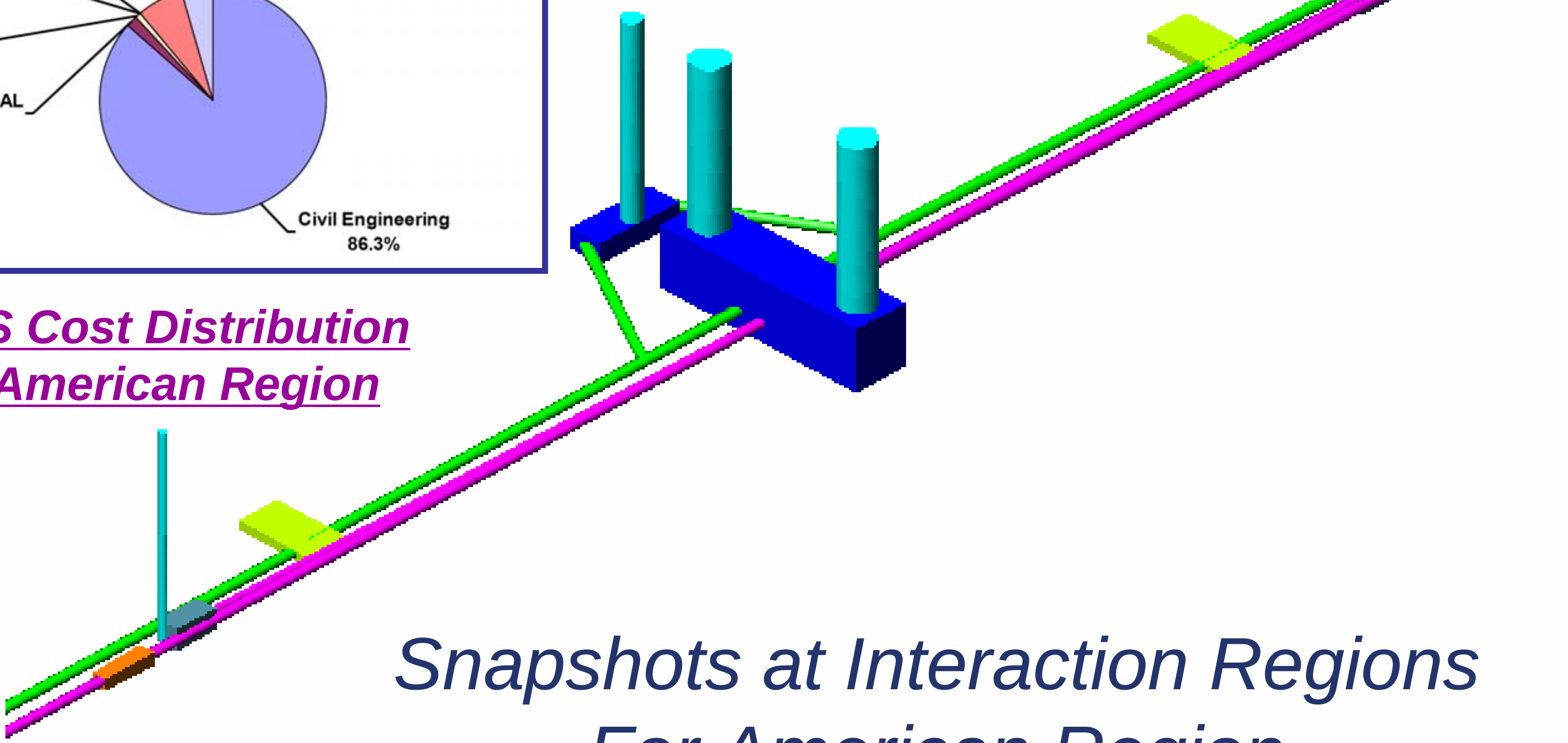
Surface Structures		
Central Lab Buildings	-	
Detector Assembly Buildings	-	
Office Buildings	-	
Service Buildings	-	
Point 1.0 Cooling Towers & Pump Station Bldg.	1,394	sq m
Point 1.0 Cooling Ventilation Building	523	sq m
Cryo- Equipment Buildings		
Control Buildings		
Workshops		
Site Access Control Buildings		
Shaft Access Buildings		
Point 1.0 Shaft Access Building	847	sq m
Miscellaneous Buildings		
User Facilities		

Identified Possible Omissions in Cost Estimates; e.g. Laser Room & Shafts
This could be due to difference in book keeping. However, it will be checked in one of the CF&S parallel sessions in Fermilab.

IR Underground Structures



CF&S Cost Distribution for American Region

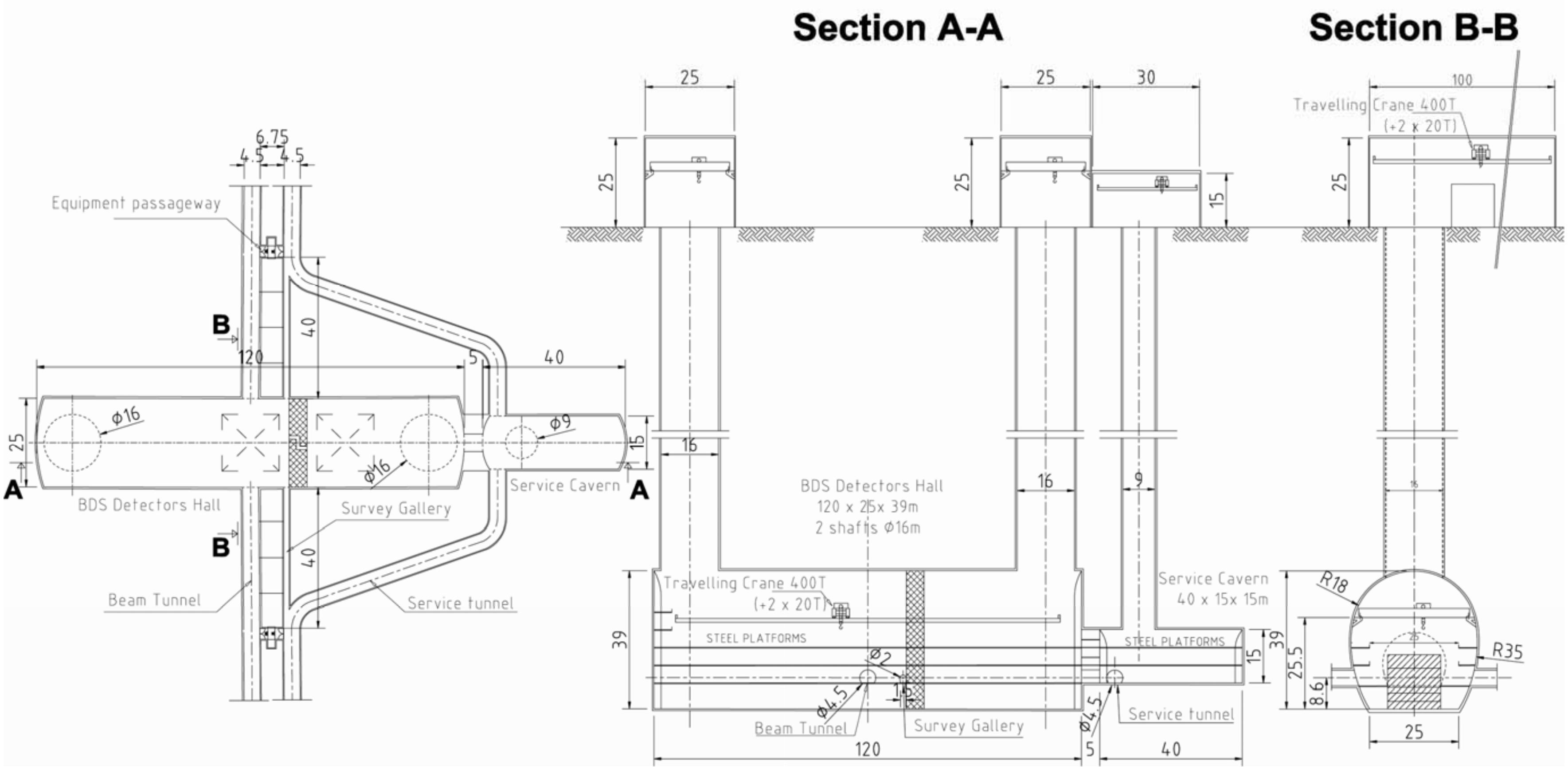


Snapshots at Interaction Regions For American Region

Scope of Structures for IR in RDR

Salient Design Features *(Under Review and Revision Since Nov. 06)*

Detector Hall, Service Cavern, Access Shafts and Surface Buildings
Plan View and Sections (for CERN Geology)

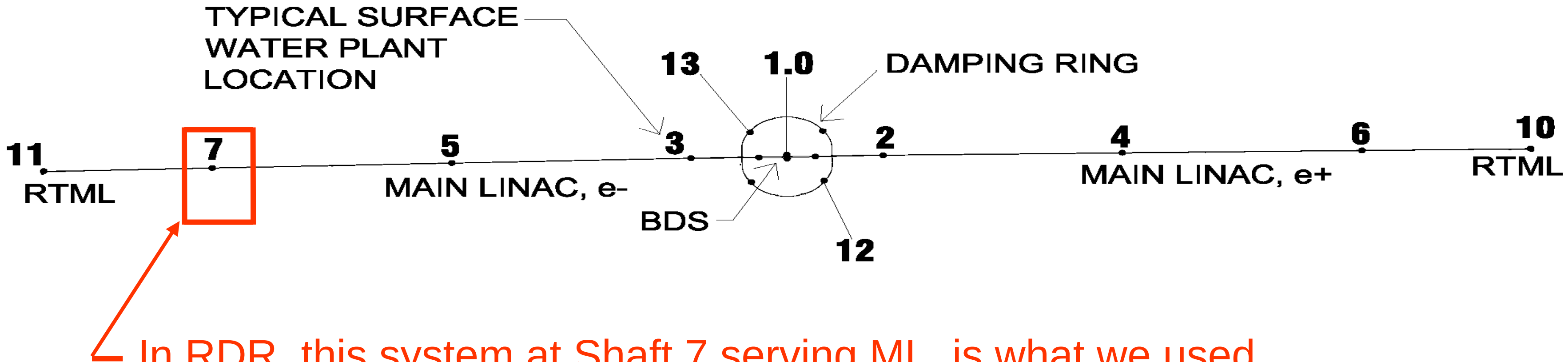


Items Included in Civil Engineering for IR

Underground Facilities		
Shafts		
Shafts, 16m dia. - Points 1.1 & 1.2 (2 total)	259	vert m
Surface Grouting of Points 1.1 and 1.2 16m dia. Shafts (2 total)	2	ea.
Points 1.1&1.2 - 16m dia. Shafts, finishing (stairs, conc. wall, elev.#2)	259	vert m
IR Underground Potable Water (Points 1.1 & 1.2)	2	ea.
IR Underground Sanitary Sewer (Points 1.1 & 1.2)	2	ea.
Halls		
IR Detector Hall, D&B Excavation 120x25x37m	116,167	m^3
IR Detector Hall, Steel Platforms (incl. all fittings)	1	ea.
IR Detector Hall, Steel Track Plates (20x80x.05m @ 8000 kg / m3)	640,000	kg
Surface Structures		
Central Lab Buildings		
Detector Assembly Buildings		
Points 1.1 & 1.2 Detector Assembly Buildings (2 total)	6,971	sq m
Office Buildings		
Service Buildings		
Point 1.1 Machine & Detector Access Building	2,090	sq m
Point 1.1 Electricity Service Building	139	sq m
Point 1.1 Cooling Towers & Pump Station Building	697	sq m
Point 1.2 Cooling Towers & Pump Station Building	697	sq m
Point 1.1 Cooling Ventilation Building	232	sq m
Point 1.2 Cooling Ventilation Building	232	sq m
Cryo- Equipment Buildings		
Control Buildings		
Points 1.1 & 1.2 Control Detector and Machine Buildings (2 total)	2,091	sq m
Workshops		
Site Access Control Buildings		
Shaft Access Buildings		
Miscellaneous Buildings		
GAS & Survey Building	1,190	sq m
User Facilities		

RDR Surface Water Plant locations

In RDR, we used simplified distribution by Area System



In RDR, this system at Shaft 7 serving ML, is what we used

RDR Process Water Schematic

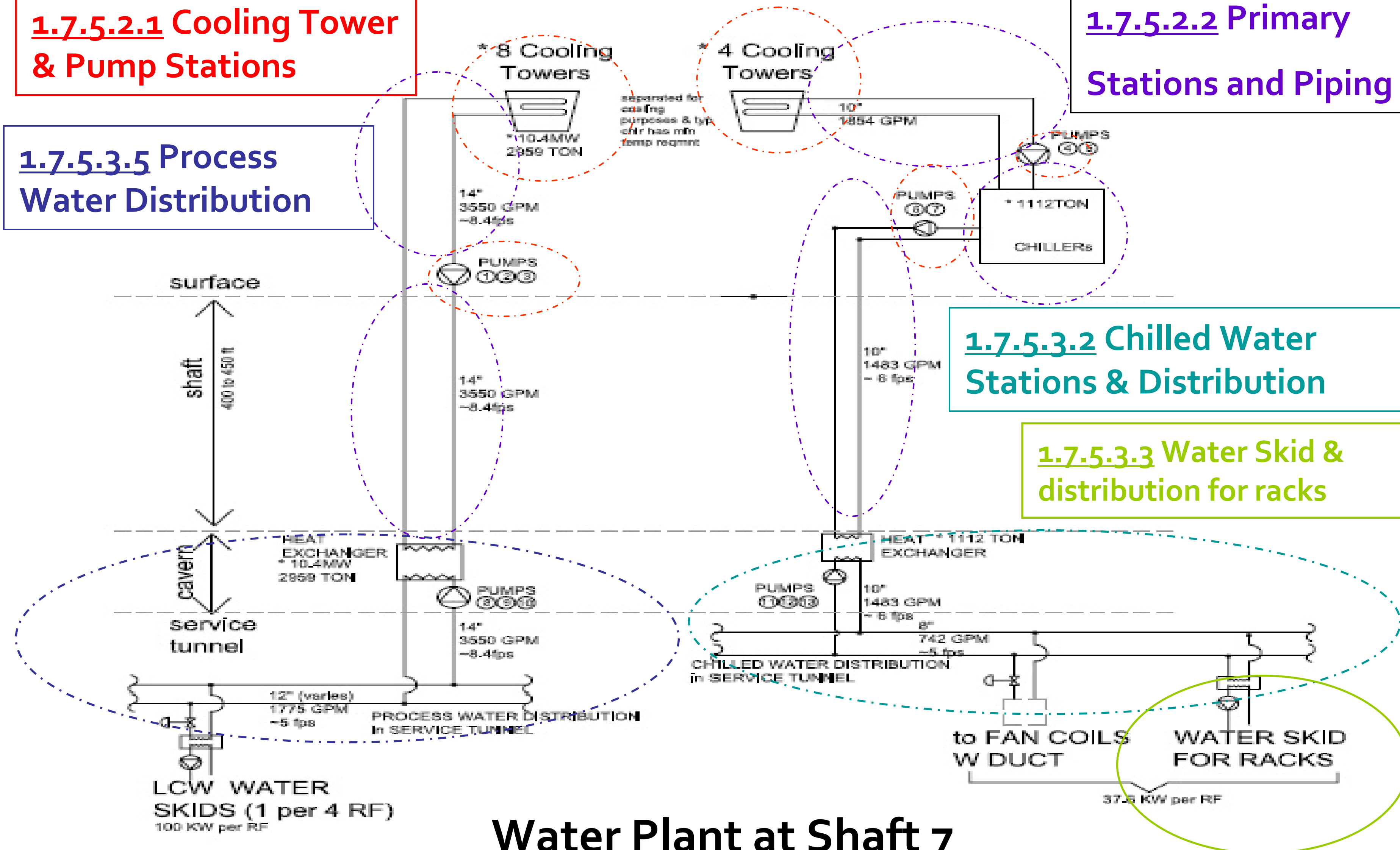
1.7.5.2.1 Cooling Tower & Pump Stations

1.7.5.2.2 Primary Stations and Piping

1.7.5.3.5 Process Water Distribution

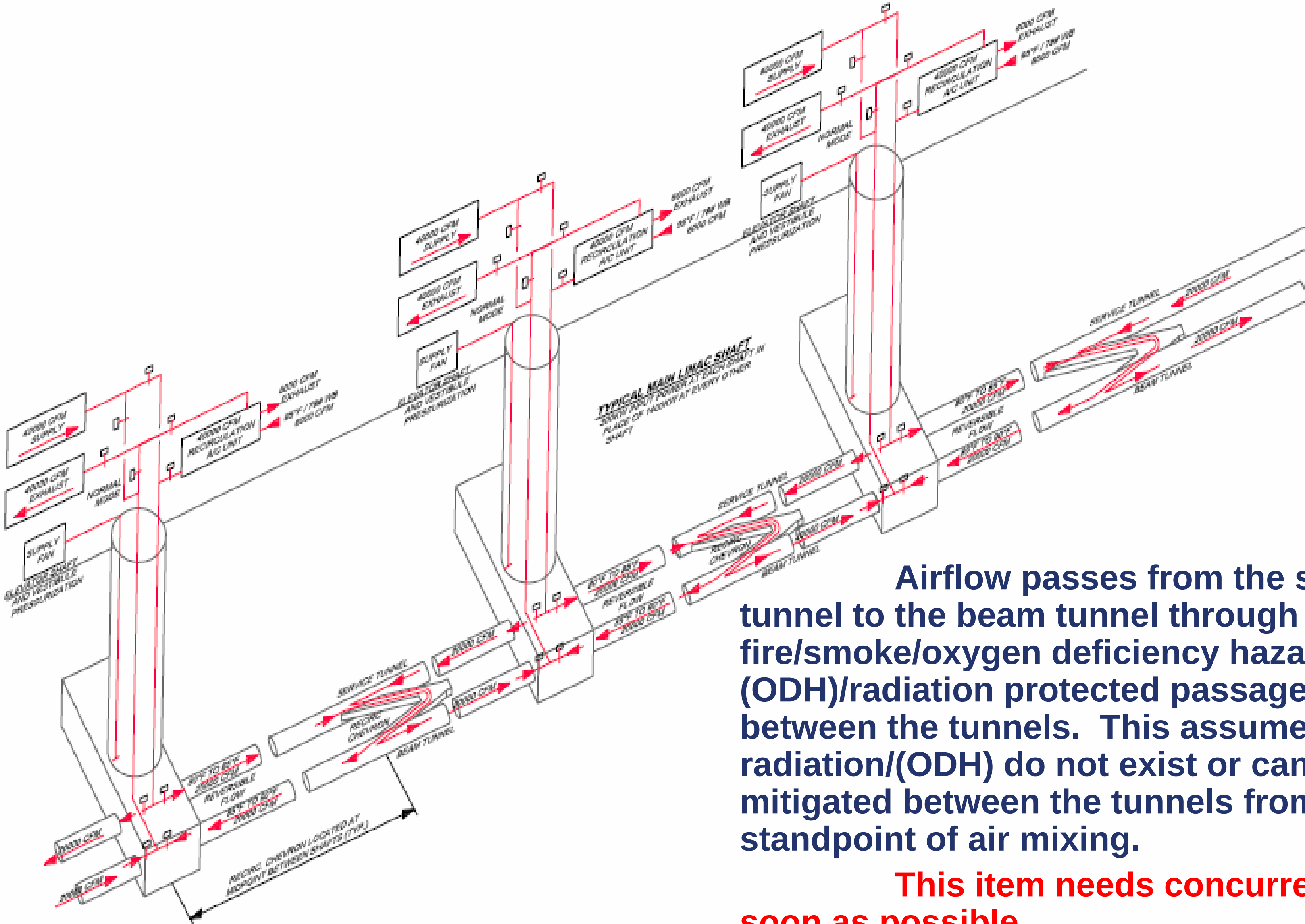
1.7.5.3.2 Chilled Water Stations & Distribution

1.7.5.3.3 Water Skid & distribution for racks



Water Plant at Shaft 7

CFS Air Treatment Layout & Its Bases



Airflow passes from the service tunnel to the beam tunnel through fire/smoke/oxygen deficiency hazards (ODH)/radiation protected passages between the tunnels. This assumes that radiation/(ODH) do not exist or can be mitigated between the tunnels from the standpoint of air mixing.

This item needs concurrence as soon as possible.

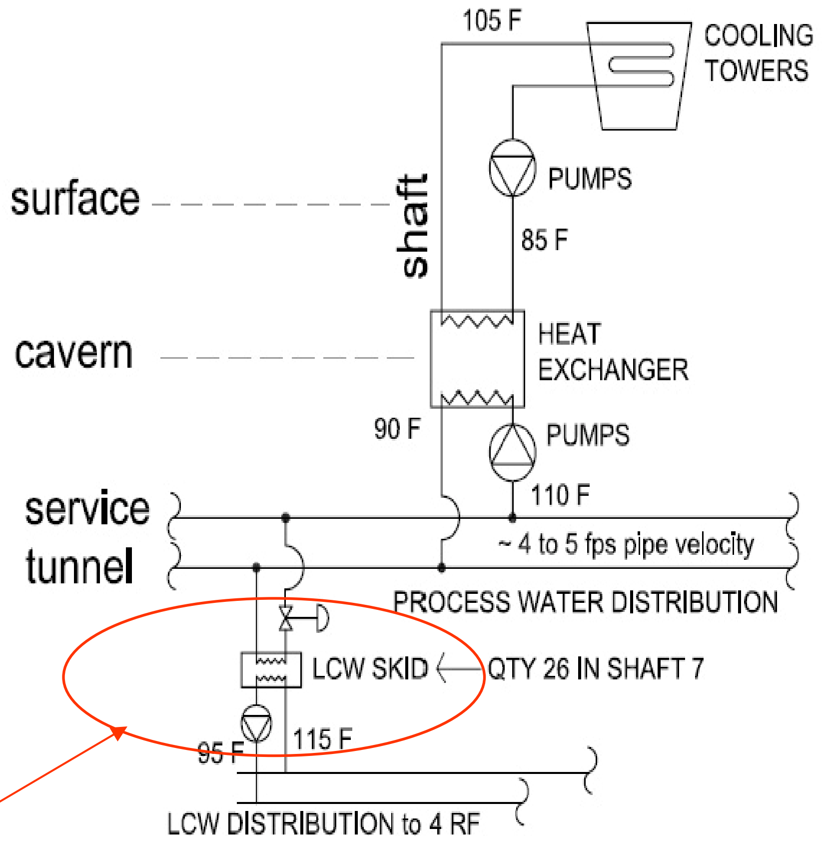
RDR Process Water Concept

What's included

- Cooling Towers for Process Water/LCW (the chilled water is separate system)
- Pumps, surface and underground
- Heat Exchanger, LCW skid
- Piping, insulation, valves, controls and other process water accessories

What was NOT included

- Cooling tower system for Cryo



1.7.5.3.1 Demineralized Water Skid

Simplified schematic based on Main Linac RF @ Shaft 7

ML RDR Process Water: Heat Load Basis- RF

Nov 27b 2006

WATER AND AIR HEAT LOAD (all LCW) and 9-8-9 ML

Components	Total Heat Load (KW)	Average Heat Load (KW)	To Low Conductivity Water: Heat Load to Water (KW)	To Low Conductivity Water: Supply Temp (variation) (C)	To Low Conductivity Water: Delta Temperature (C delta)	To Low Conductivity Water: Maximum Allowable Pressure (Bar)	To Low Conductivity Water: Typical (water) pressure drop Bar	To Low Conductivity Water: Acceptable Temp Variation delta C	to Chilled Water: Heat Load to Water (KW)	keith Jobe load to air Nov 22 06: Power fraction to Tunnel Air (0-1)	keith Jobe load to air Nov 22 06: Power to Tunnel Air (KW)
RF Components											
RF Charging Supply 34.5 Kv AC-8KV DC	4.0	4.0	2.8	40	40	18	8	10	0	0.3	1.2
Switching power supply 4kV 50kW	7.5	7.5	4.5	35	14	13	8	10	0	0.4	3.0
Modulator	7.5	7.5	4.5			28.82			0	0.4	3.0
Pulse Transformer	1.0	1.0	0.7						0	0.3	0.3
Klystron Socket Tank / Gun	1.0	1.0	0.8						0	0.2	0.2
Klystron Focusing Coil (Solen	4.0	4.0	3.6						0	0.1	0.4
Klystron Collector			45.8	*35>			2		0		
Klystron Body	58.9	47.2	0.0	*35>			5	+ - 2.5 C	0	0.0	1.4
Klystron Windows			0.0	*35>			1		0		
Relay Racks (Instrument Racks	10.0	10.0	0.0	N/A	N/A	N/A	N/A	None	11.5	-0.2	-1.5
Circulators, Attenuators & Dun	42.3	34.0	32.3					+ - 2.5 C	0	0.1	1.7
Waveguide	3.9	3.9	3.5					+ - 2.5 C	0	0.1	0.4
Total RF			100						11.50		26.07

Total Heat load to Dirty Water (per RF)		
Heat load to Chilled water (per RF)	37.6	cooled by chilled water
Heat load to LCW (per RF)	100.0	cooled by low conductivity water

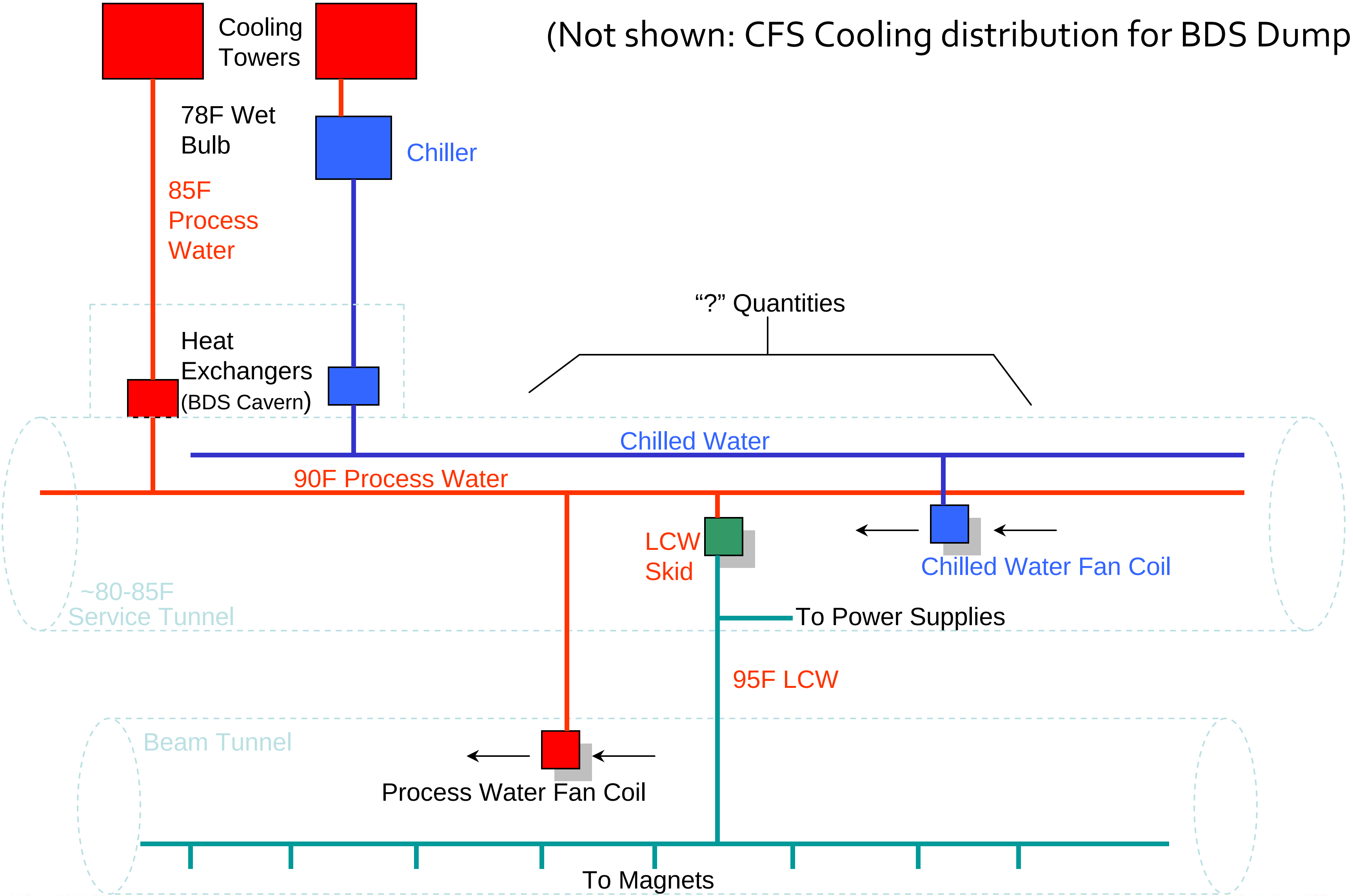
RDR Process Water: Heat Load Basis- Total Loads

Area System	LCW	Chilled Water	**Total**
SOURCES e-	2.880	1.420	**4.300**
SOURCES e+	17.480	5.330	**22.810**
DR e-	8.838	0.924	**9.762**
DR e+	8.838	0.924	**9.762**
RTML	9.254	1.335	**10.589**
MAIN LINAC	56.000	21.056	**77.056**
BDS	10.290	0.982	**11.272**
DUMPS	36.000	0.000	**36.000**
	149.58	*31.971*	**182**

Thermal Loads [MW] used for BDS

RDR BDS Cooling Infrastructure Concept

(Not shown: CFS Cooling distribution for BDS Dumps)



Process & Child Water Design Summary

- There were no detailed water cooling distributions made, other than scaling the cost from Shaft 7(ML) based on total BDS load.
  - **Except for the near surface distribution to the BDS dump which it was costed separately**
- The loads used for scaling was from Sep 06 table from P Bellomo, (adjusted-wag for 1 IR). (10.29MW LCW and .982MW Chilled).
  - **Numbers may not be right and may need to update (this effort has started)**
- There will be chilled water and process water headers in the service tunnel.
- There will be LCW distribution from a number of skids from service tunnel to the beam tunnel.
- There will be heat exchangers and pumps in the BDS service cavern for both the chilled water and process water.

Process & Child Water Design Summary, Cont.

- LCW Skid in the service tunnel supply 95F LCW to power supplies and magnets, and expected return of 115F or lower.
  - **The “ΔT” used is 20F**
- The average LCW temperature is 103 F to 105F, so the ambient in the beam tunnel is assumed to be about 100F to 105F.
  - **Note: In RDR companion document it is mentioned 84F to 90F**
- The supply water temperature stability of 1 C over 24 hrs is doable in typical LCW skid (Maurice Oct 2006).
- The air temperature stability of 2 C over 24 hrs (near thermostat space) is doable.
  - **There will be stratification (warmer near magnet) (Lee)**
- Considered just the typical HVAC inertia base vibration isolator for the pumps
- The other heat producing equipment in the service tunnel (transformer, fan-coils, pumps) was not accounted for.
  - **This needs to be updated.**

Air treatment Design Summary

- The air treatment configuration is the same as Main Linac concept.
  - **No other configuration was made to account for multiple tunnels near BDS/KAS/DR.**
- The air treatment cost includes a number of process cooled fan-coils in the BDS beam tunnel use for stabilization of air temperature, as well as picking up some load to air.
- The current cost account for CHW fan-coils in the BDS service tunnel to maintain 85 to 90F in service tunnel.
- It is assumed that the load to air from magnets in the beam tunnel is minimal.
  - **Only 63KW from air cooled magnet. (C. Spencer email Sep 20 2006)**
- It is assume 50% of cables loss to air goes to the beam tunnel and 50% in the service tunnel.
- The idea of having the rock wall absorbed some load from air is not used.
  - **All air heat load in Beam tunnel to be absorbed by process cooled fan-coils.**
  - **All air load in service tunnel will go to the chilled water fan coils.**

Air treatment Design Summary, Cont.

- Air Treatment Components in RDR:
- Large air handling systems providing heating, cooling, dehumidification, humidification.
- Fans for air purge, tunnel and shaft pressurization
- Miscellaneous ducting and accessories, dampers, insulation, etc
- Air treatment design is dependent on the ventilation requirements and the heat load criteria received from area system
- Air treatment and purge systems were not fully investigated for radiation issues
- Air treatment and purge systems configuration were not developed with consensus of any AHJ (authority having jurisdiction, even this is may not be identified some time)

Generic Approach for EDR

General Approach - Based on a Sound System Engineering Management Approach

- Functional Requirements Identification
  - **Defining physics requirement to engineering requirements**
  - **Defining boundaries, interfaces, utility needs and functional environment for each major components**
- Design Configuration Control Management
- Optimization Studies
  - **Design Alternatives Trade-Offs**
  - **Trade Studies**
  - **Constructability Studies**
  - **Value Engineering Study**

Tentative CF&S- EDR Plan

- **Generic Goal:**
  - **To Provide Facility Design that Meets Requirements at the Lowest Cost**
- **Conventional Facility Global:**
  - **To provide general conventional facility design and planning support and the development of cost estimates for the ILC EDR.**
- **SLAC In-house CF&S effort :**
  - **To focus on design solutions for the e- Source, Beam Delivery System and the Interaction Region of the ILC. This is to be augmented by contracts with specialty firms on the cost effective design recommendations and costing efforts.**

	FY08l Budget Plan		Reduced FY08 Budget Model	
WBS Level	**FTEs**	**M&S**	**FTEs**	**M&S**
WBS 2.11 Conventional Facility Design	**3.0**	**100**	**2.2**	**0**

Tentative EDR Plan for BDS & IR

- **The Actual Shape of the Caverns & Halls is Determined by Functional Usage and the Local Geology**
  - **Establish A "Dimensional Envelope" Needs for Each major component of BDS & IR system for during;**
    - **Installation**
    - **Commissioning**
    - **Operation**
    - **Maintenance**
  - **"Dimensional Envelope" Should Include all Supporting Utility as well as Functional Environment Requirements**
    - **Exiting Requirements Need to be Revisited from Installation, Maintenance and Operation Point of View**
  - **Identification of Clear Boundaries Between CFS and Each Major Components Needs to be clearly Identified**
- **Evolving Constraints and Criteria**
  - **Life Safety Egress Requirements**
  - **Construction Configuration Requirements**
  - **Operational Configuration Requirements**

Initiated Process- Excerpts from IRENG07-WGC

- Alternatives to the RDR Design Basis were Reviewed
  - Off-Set Access Shafts from Surface Assembly Buildings
  - Alterations Required to the Interaction Region for γγ Collisions
- A Number of Items were also Identified for the CFS Group to Investigate
  - Further Development of Cavern Cross Section with Realistic Crane Dimensions and Supports
  - Investigation of Alternate Shaft Configurations with Related Costs
- Substantial Changes to the RDR Design will Require Formal Review and Approval by the ILC Project Management Group

Initiated Process- Excerpts from IRENG07-WGC Criteria Examples

					Draft		J. Aarons (SLAC) 09/19/2007	
Initial Assumptions								
Push-Pull Design (RDR)								
Used GLDc Design as largest Detector Concept to size IR Hall							IRENG07 Workshop- SLAC (9/17-9/21/2007)	
Two 16 m diam. Shafts at Opposite ends of IR Hall (RDR Design)								
Exp'mt cavern dimension (in RDR)	120m x 25m x 39m H							
IR hall invert depth	>100m below surface							
Overhead Bridge cranes in IR Hall	2 primary w/ 2 auxiliary							
crane capacity (Max.)	Primary = 100 metric tonnes ea. + aux 10 ton cranes ea.							
	design to be based on hook height							
	One-time lift items can be slid into place							
	min. lift = 11 m above beamline							
	SiD	**GLD**	**GLDc**	**LDC**	**4th**	Comments	Comment from	Resolution
HALL DIMENSIONS								
IR Hall Dimension	25m x 120m x 39m H (in RDR)		31m x 120m x 39m H	30m floor x 120m x 39m H		in GLD & LDC Presentation	Tauchi-San +Norbert Meyners talk	
Floor of Detector Hall			6.9m + 1 m to the flat surface of the IR hall			2 m reinforced concrete platform (John Amman's Talk)	Tom Markiewicz	
traveling platform w/ Hillman rollers								
							Norbert Meyners talk	
sub floor trenches for cables								
fixed floor - no platform								
						showed an option for Adding 6m in IR Hall for Detector Services	John Osborne	
						do designs have enough support at base of Detector to be seismically stable?	M. Bridenbach	
width of hall	25m	39m	31 m	31m		need more width in hall to accommodate crane travel & rails - center of hook need to be over load	Clay Corvin	
Detector end cap door opening	max 2 m		max 6 m					
CRANE CRITERIA								
crane capacity per crane		~400 tonne	~100 tonnes			Height of Hall will increase based on sizes of crane	A. Herve	

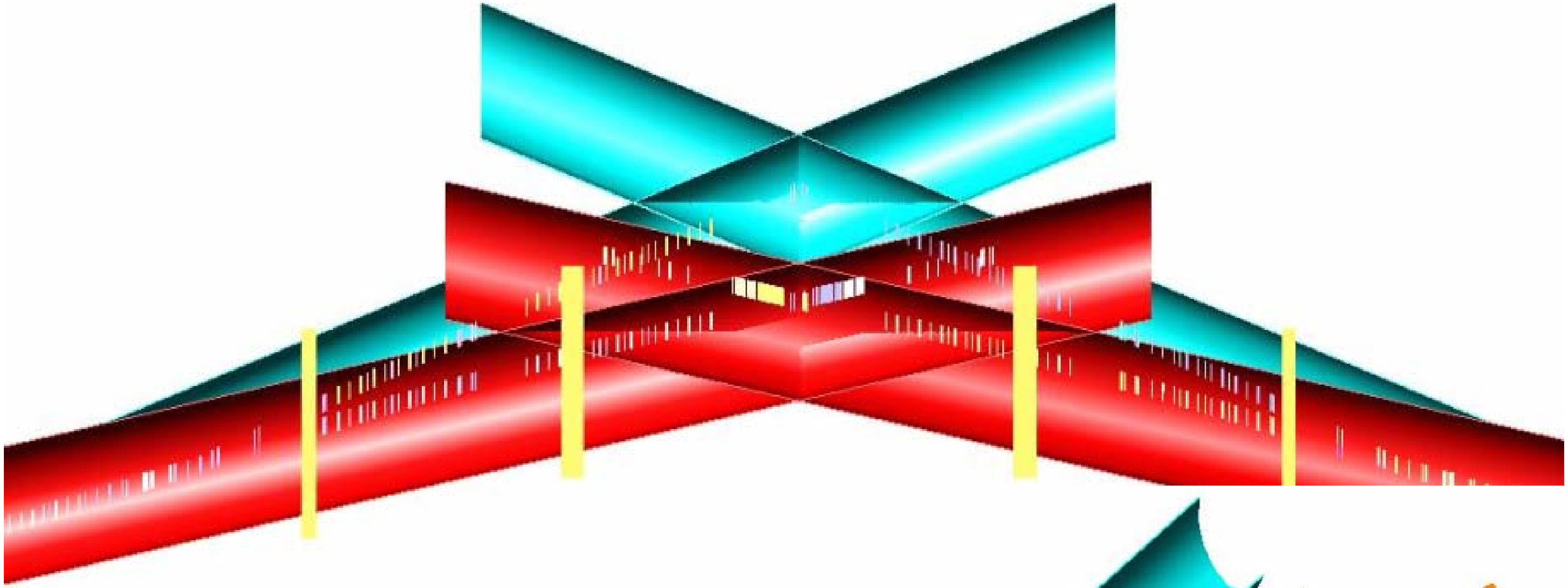
Initiated Process- Excerpts from IRENG07-WGC Temp. Stability & HVAC Criteria Examples

IRENG07 Draft Utilities Requirements

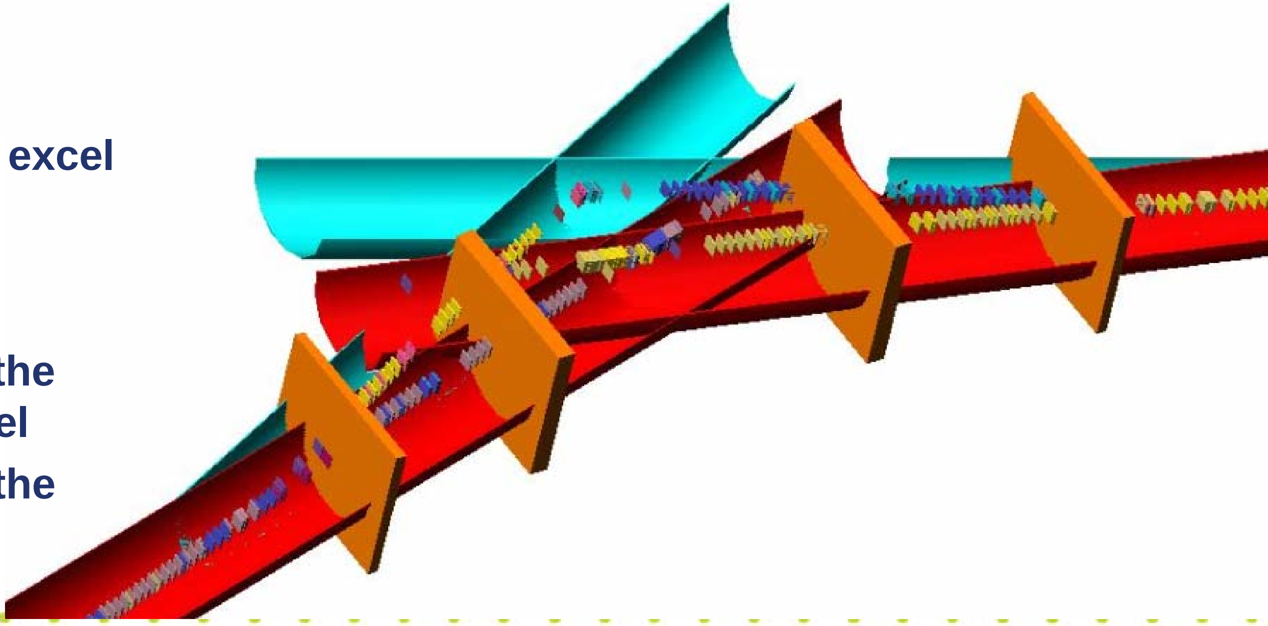
20-Sep-07

Item	Description	Generic	GLD	GLDc	LDC	SiD	4th Type
1	Hall SA End Temperature (Deg C)	21	21	21	21	21	21
2	Hall Stratified Temperature Rise (Deg C)	3	3	3	3	3	3
3	Hall Air Temperature Stability (+/- Deg C)	2	2	2	2	2	2
4	Hall Dew Point Temperature (Deg C)	13	13	13	13	13	13
5	Hall Maximum Relative Humidity (%)	60	60	60	60	60	60
6	Process Load to Hall Air per Detector (kW)	40	40	40	40	40	40
7	Process Detector Load to CHW per Detector (kW)	200	200	200	200	200	200
8	Process Load to Other CHW per Detector (kW)	100	100	100	100	100	100
9	Process Load to LCW per Detector (kW)	200	200	200	200	200	200
10	Hall Space Load to Air (W/Sq M - Dry Xfmrs, tools, pumps, lights, etc.) ???	40	40	40	40	40	40
11	Ventilation (Numer of Persons in Hall - Add separate fan coil people heat load)	100	100	100	100	100	100
12	Ventilation (Cu M/Hr)	4300	4300	4300	4300	4300	4300
13	Hall Pressurization (Negative milliBars)	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
14	Hall Pressurization Stabilization (+/- milliBar - Bubblers or Chambers)	0.05	0.05	0.05	0.05	0.05	0.05
15	Shaft/Egress Pressurization (Positive milliBar)	0.2	0.2	0.2	0.2	0.2	0.2
16	Process CHW Supply Temperature (Deg C)	16	16	16	16	16	16
17	LCW Supply Temperature (Deg C)	16	16	16	16	16	16
18	LCW Make Up Source (Accelerator? Y/N)	Yes	Yes	Yes	Yes	Yes	Yes
19	Hall ODH Purge (Y/N - Cu M/ Hr if Y)	No	No	No	No	No	No
20	Hall Activated Air Purge (Y/N - Cu M /Hr if Y)	No	No	No	No	No	No
21	Permanent Hall Smoke Purge (Y/N - If No use ventilation AHU at high-speed)	No	No	No	No	No	No
22	Thermal Dimensional Stability Provided from Skids (Y/N)	Yes	Yes	Yes	Yes	Yes	Yes
23	Sub-Atmospheric Utility Water Systems Needed (Y/N)	No	No	No	No	No	No
24	CHW Cooling for Magnets & Power Supplies (Y/N)	Yes	Yes	Yes	Yes	Yes	Yes
25	Non-Dessicant Dehumidification for Hall (Y/N - If Yes Hall surfaces are sealed)	Yes	Yes	Yes	Yes	Yes	Yes
26	Ventilation Provided by Ground Level AHU's (Y/N)	Yes	Yes	Yes	Yes	Yes	Yes
27	Hall Air Load & Dehumidification Provided by Hall Fan-Coils (Y/N)	Yes	Yes	Yes	Yes	Yes	Yes
28	All Cooling to Hall Provided by Insulated CHW to HXs (Y/N)	Yes	Yes	Yes	Yes	Yes	Yes
29	Surface to Hall CHW Pressure Interruption Provided by HXs (Y/N)	Yes	Yes	Yes	Yes	Yes	Yes
30	Utility / Detector Interface at Hall Spiggots (Y/N)	Yes	Yes	Yes	Yes	Yes	Yes
31	Compressed Air Supply Volume per Detector (Standard Cu M /Min)	200	200	200	200	200	200
32	Compressed Air Supply Pressure (MegaPascals)	1	1	1	1	1	1
33	Compressed Air Supply Oil-Free Plant at Ground Level (Y/N)	Yes	Yes	Yes	Yes	Yes	Yes

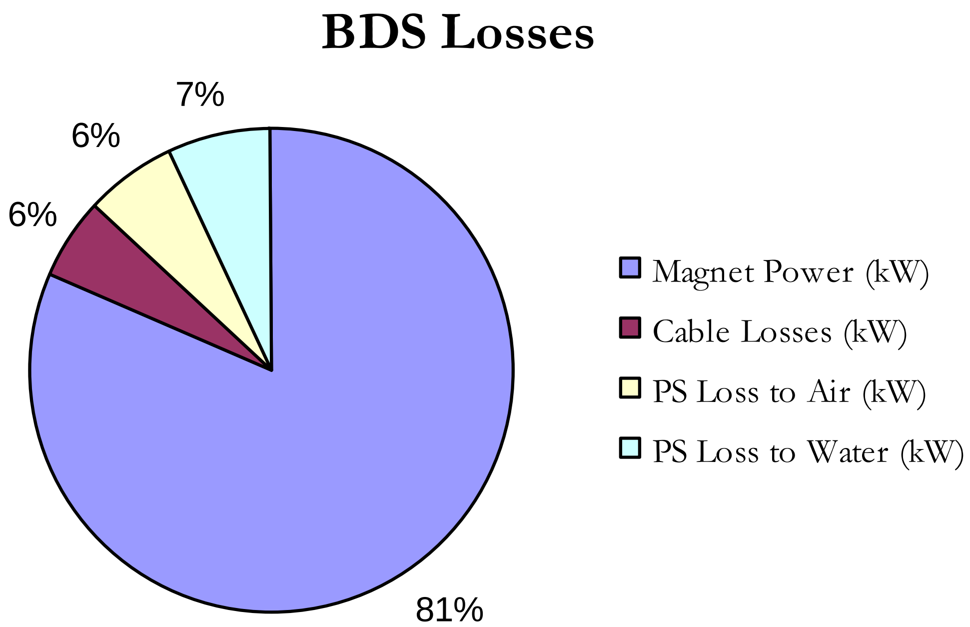
Alterations Required for γγ Option Study-Progress



- Imported magnets from excel spreadsheet by Mark Woodley
- Confirmed that 4.5 m diameter is enough for the new 25mrad beam tunnel
- Drew beam tunnels for the beam lines in 3D



Initiated Process- BDS Heat Loss Analysis



Area	Magnet Power (kW)	Cable Losses (kW)	PS Loss to Air (kW)	PS Loss to Water (kW)	Sum of All Losses (kW)
e-e+ Common	2,746	186	272	168	3,372
e-e+14mr	5,604	398	348	552	6,902
BDS	8,350	584	620	720	10,274

$100m^2$ of floor space needed. Does not include system considerations, clearances for safety, maintaining equipment, etc.