Value Engineering Session
Air Treatment
/ HVAC

November 27, 2007

Lee Hammond, FNAL

CFS

Air treatment Design Basis

- Tunnel Ventilation – Conditioned dehumidified air from surface mounted DX equipment is ducted into the service tunnel at each shaft. A volume of 15000cfm (425meter^3/min) flows at approximately 88fpm (1.6km/hr) to the midpoint between shafts where it is routed into the beam tunnel and returned to the shaft area. Conditioned fresh air at a rate of 20% is mixed into the air and it is recirculated back to the service tunnel. Air volumes for the DR and BDS are similar

- The air direction is reversible and capable of being doubled (unconditioned) during hazardous situations.

- The design temperature for the ML service and beam tunnel is 80-90F (27-32C). ML electronic's heat rejection is mainly to CHW direct cooling and FCUs with small amounts of heat to the ventilation air. AHU and FCUs used at alcoves and shaft areas.

- The design temperature for the DR tunnel is 104F (40C), using process water fan coil units, and the tunnel wall as a heat rejection source

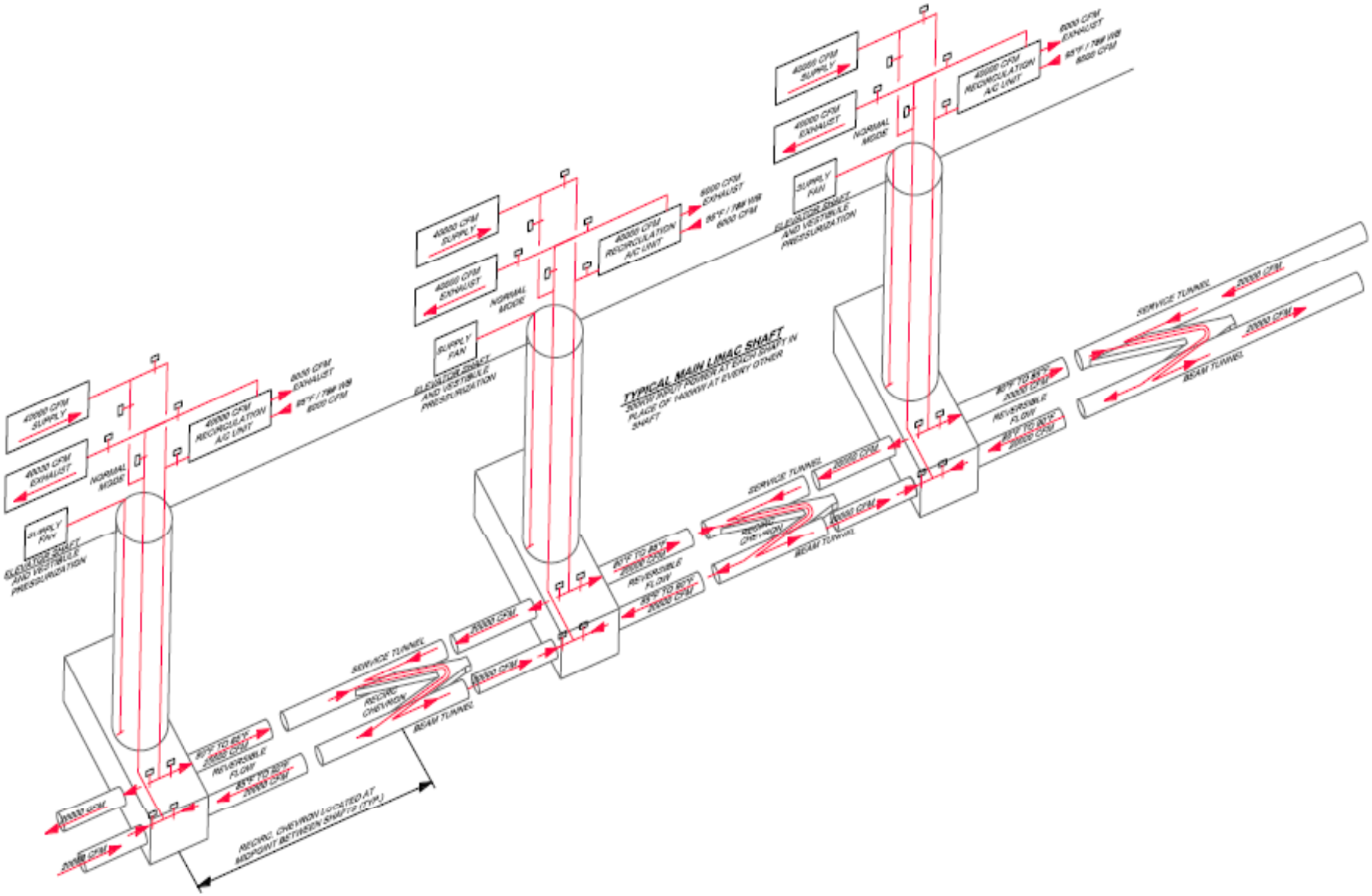
Air treatment Design Basis

- The design temperature for the BDS is 85-90F (29-32C). The low “heat to air” load is mainly absorbed by the tunnel wall. Air mixing fans will be used for temperature stability as required by the BDS.

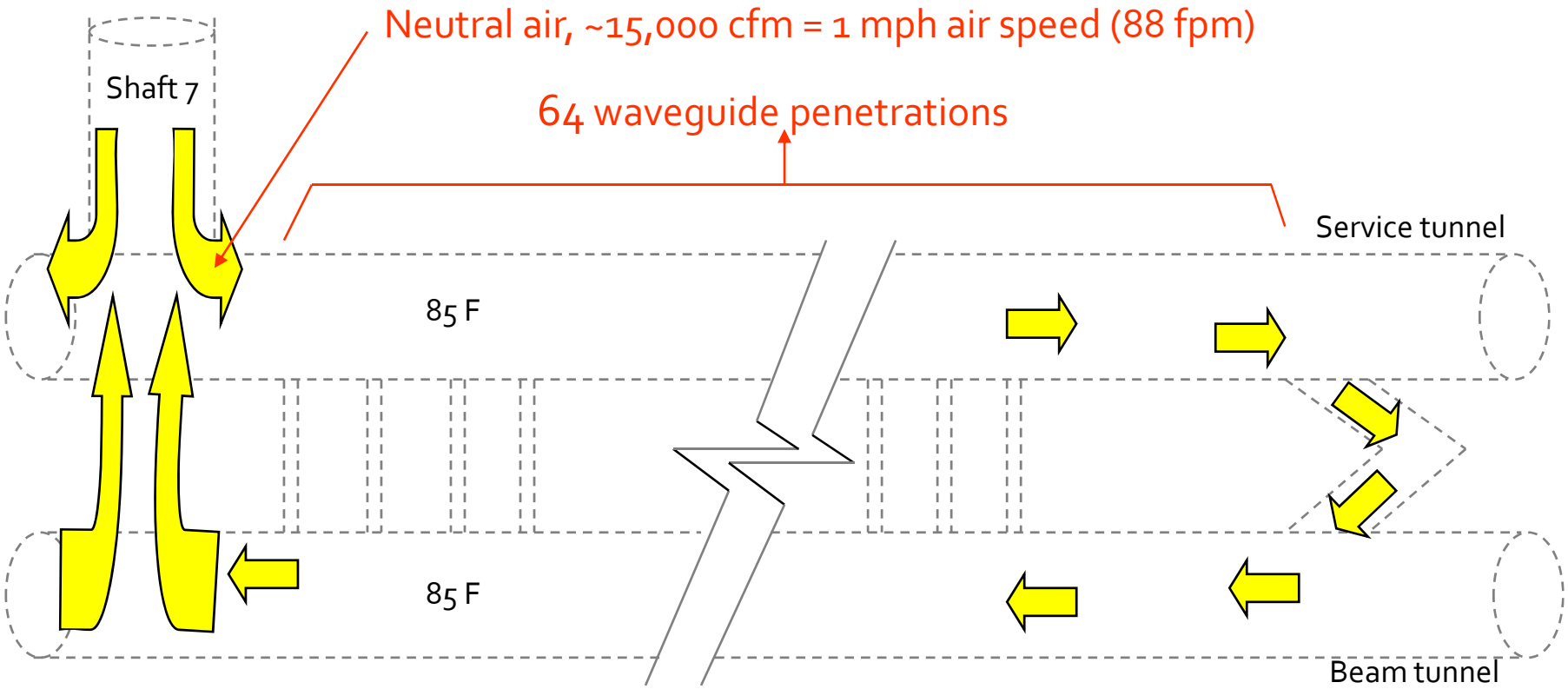
- Used the basis that airflow could pass from the service tunnel to the beam tunnel through fire/smoke/ODH/radiation protected passages between the tunnels. This assumes that radiation/oxygen deficiency hazards (ODH) do not exist or can be mitigated between the tunnels from the standpoint of air mixing. This item needs concurrence from ML group.

- AHU and FCU sizes in the alcoves and tunnels did not consider heat absorption by the rock wall. These units use chilled water from the surface as the heat rejection source.

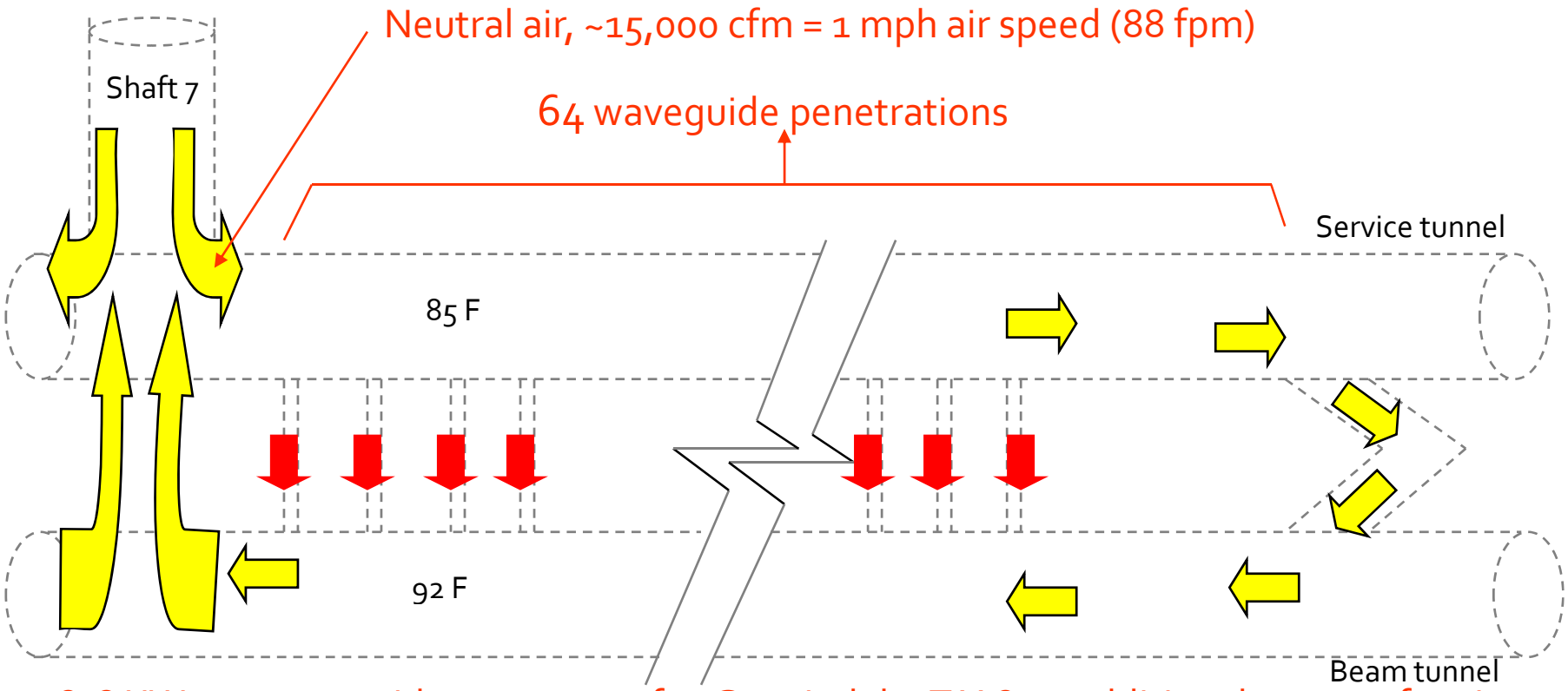
CFS Air Treatment Layout



AIR SYSTEM CONCEPT (assume no issues with mixing airflow between service and beam tunnel)



IF "Waveguide at Penetration" is aircooled and no issues with mixing airflow between service and beam tunnel



0.676 KW per waveguide pene ~300cfm @ 7 air delta T X 64 = additional 19,200 cfm air

- Waveguide load in the beam tunnel will **still** need be picked up by fancoils
- Means of air balancing at each penetration needed
- Some part of tunnel will have ~200 fpm air speed

Rock Contribution?

Oct-07

Analysis by	W/M	KW in 36m RF	Material (K in W/m-K)	Temp in (F)	Tunnel Dia-m	Temp up to what radius
Ztang - Sep 2006	130	*-4.68*	Rock (4.6)	86	5	55F (25m)
Gbowden -Jul 2003	73	*-2.63*	Earth, Sandstone, Conc (varies)	113	3	77F (10m)
SSC TP/JT - Feb 1985	29	*-1.04*	Dolomite (3.5)	65	2.5?	55F (30m)

Some discussions and preliminary investigation, but not considered

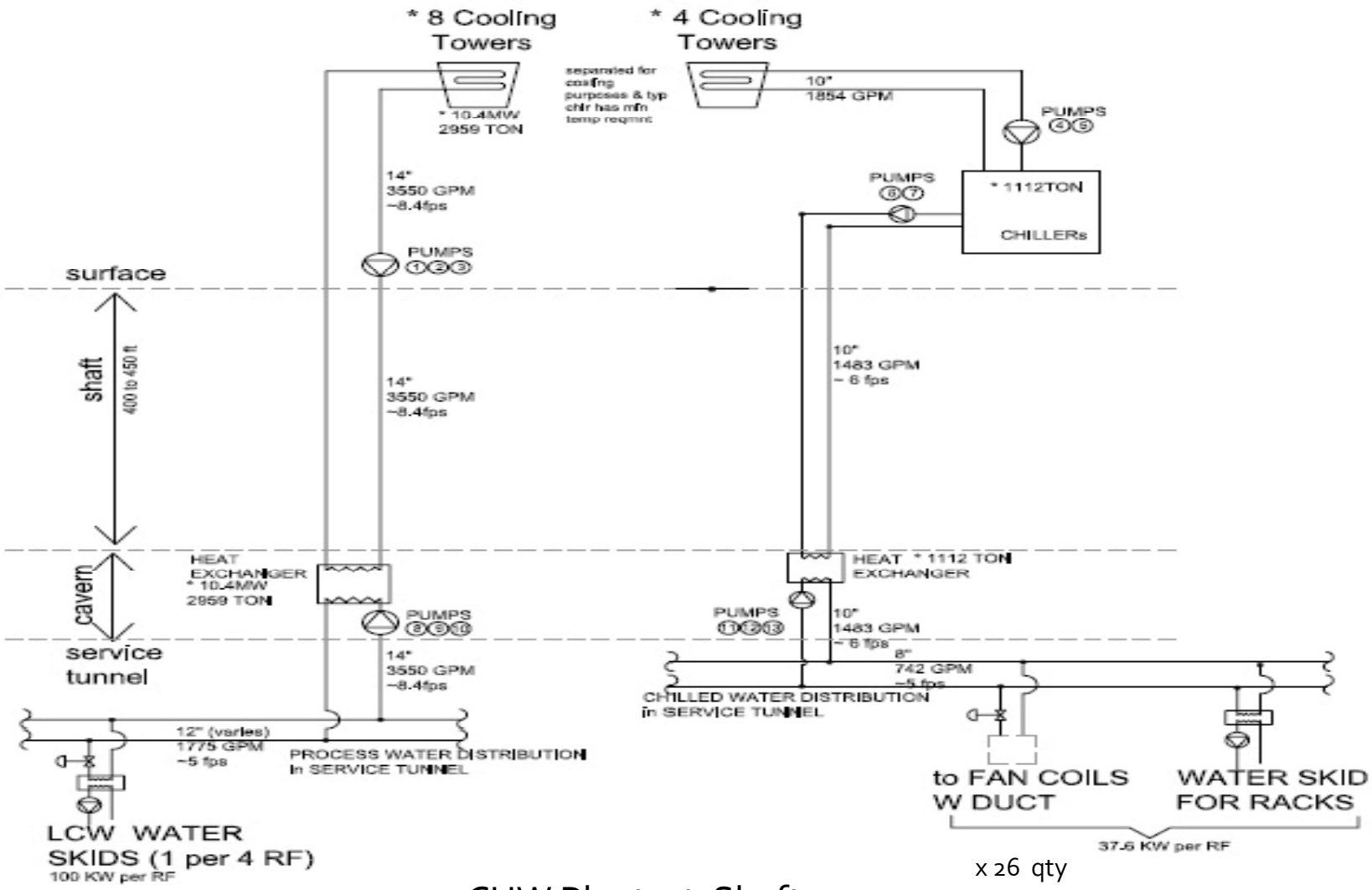
There still is considerable load to air per RF, that chilled fancoils are needed

Air Treatment WBS

- Air Treatment is about 1% (or 5.5% of CFS *when CHW system is moved to the air treatment section*)

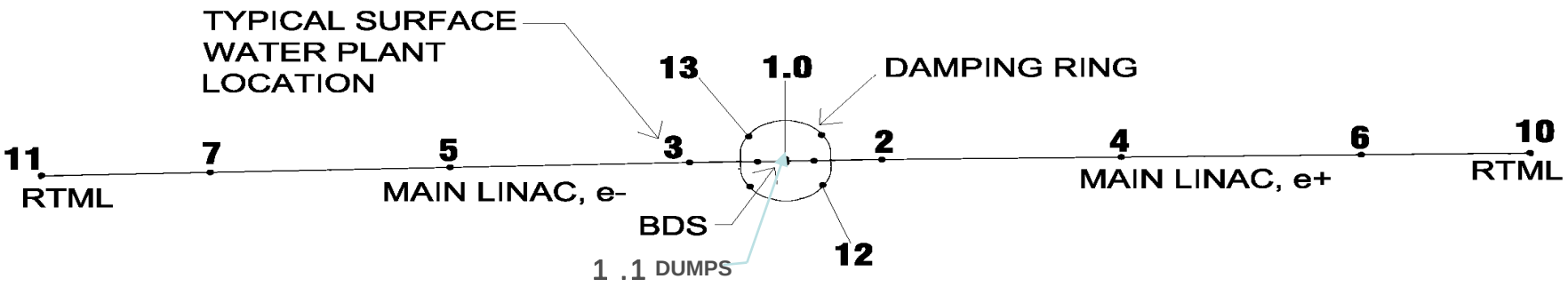
RDR		RDR Cost (America)		RDR with CHW adjustment	
1.7.1	Civil Engineering	64.3%		64.3%	
1.7.2	ELECTRICAL	13.2%		13.2%	
1.7.3	AIR TREATMENT EQUIPMENT	1.0%		5.5%	
1.7.4	PIPED UTILITIES	0.1%		0.1%	
1.7.5	PROCESS (COOLING) WATER	14.9%	Includes CHW	10.3%	Moved CHW to Air Treatment
1.7.6	Handling Equipment	1.6%		1.6%	
1.7.7	Safety Equipment	1.3%		1.3%	
1.7.8	Survey and Alignment	3.7%		3.7%	
		100.0%		100.0%	Same Totals

RDR Chilled Water Schematic



CHW Plant at Shaft 7

Surface Air/CHW Plant locations



HVAC: Cost Basis

- Used R.S.Means Cost Book for typical HVAC items such as ducting, fans, piping, insulation etc
- Used vendors budgetary quote for large dehumidification air handling systems not in R.S.Means

Air Treatment Summary

- Air Treatment Components in RDR:
  - Large DX air handling systems providing heating, cooling, dehumidification, humidification.
  - Fans for air purge, tunnel and shaft pressurization
  - Miscellaneous ducting and accessories, dampers, insulation, etc

- Chilled water systems including chillers, cooling towers, piping and accessories will be moved to the Air Treatment WBS

- Air treatment design is dependent on the ventilation requirements and the heat load criteria received from the area systems

- Air treatment and purge systems have not been fully investigated for radiation and ODH issues. Need further input on air flow configuration concerning radiation and ODH issues

- Air treatment and purge systems configuration were not developed with consensus of any AHJ (authority having jurisdiction, even who this is may not be identified for some time). Need fire protection consultant.

Air Treatment/CHW – Value engineering/optimization

- Combine currently separated Fan Systems
- All chilled water aircooled
- Consider heat rejection to cooling ponds where possible
- Dehumidification equipment desiccant type
- Air handling/dehumidification systems chilled water instead of DX
- Piping Materials, why stainless, why not PVC, copper, HDPE
- Optimize CHW temperature for electronics and air cooling