RDR PROCESS WATER
&
VALUE ENGINEERING ITEMS

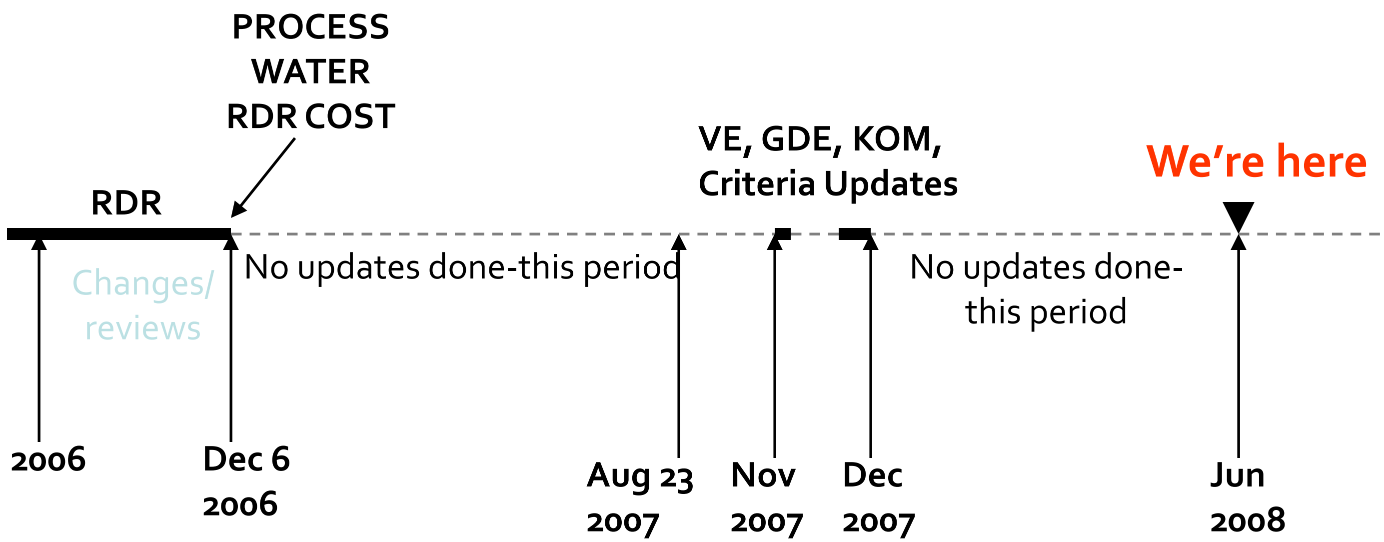
June 5, 2008

<u>**GDE Meeting-ILC CFS Workshop in Dubna, Russia**</u>

Emil Huedem, Fermilab

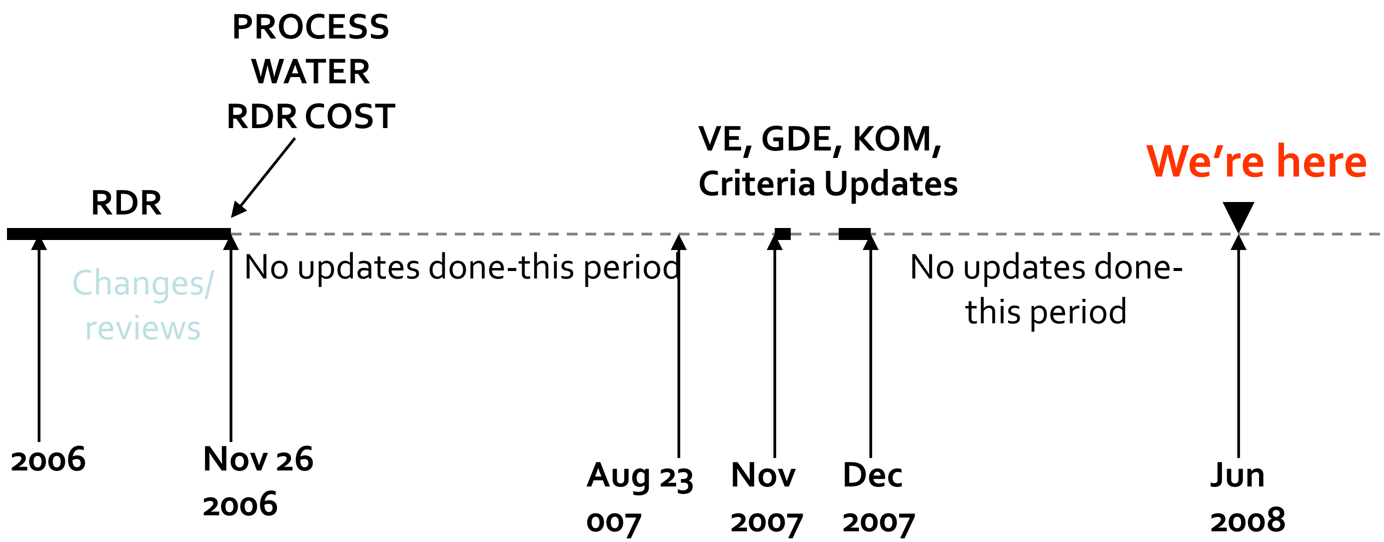
- RDR process water-Timeline
- Heat Load (RDR & Post RDR)
- Delta T
- Value Engineering items

RDR Process Water (Timeline)



- Nov-Dec 6 2006 — Concept and cost Process Water (Stop Dec 06 2006)
- Aug 23 2007 — EDR Kick Off Meeting
  (task: Get as much info and evaluate to get high delta T)
- Oct-2007 — GDE, some Updates on ML heat table
- Nov 27 2007 — Value Engineering (VE) session
  (Post RDR Delta T evaluate -more on this later in the slide)
- Dec 4 2007 — Marc list from VE list ***(more on this later in the slide)***
  interface with HLRF people re: delta T, heat load, non-cfs VE items
- Dec 18 2007 — Stopped work
  minimal interface with Atsushi, Masami, Peter..

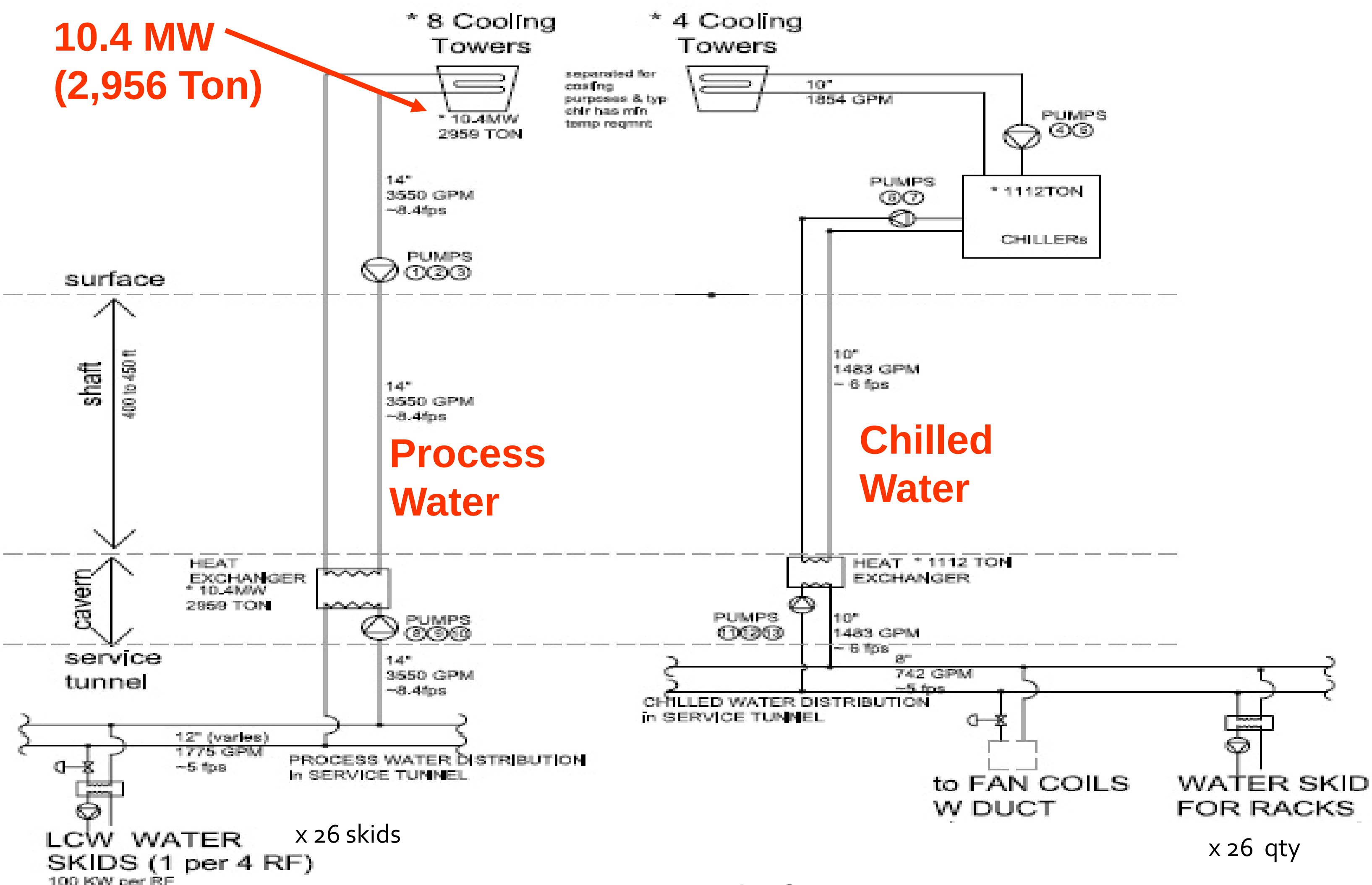
RDR Process Water (Timeline)



About RDR

- Criteria and heat loads were incomplete. Snapshot in time
- Cooling infrastructure in RDR was conceptual, and very little on paper.
- Cost was generated for shaft 7 based on info at that time
- Not a unified criteria??
- LCW part was immature.
- Instead of criteria,..Various Cost reduction discussion,

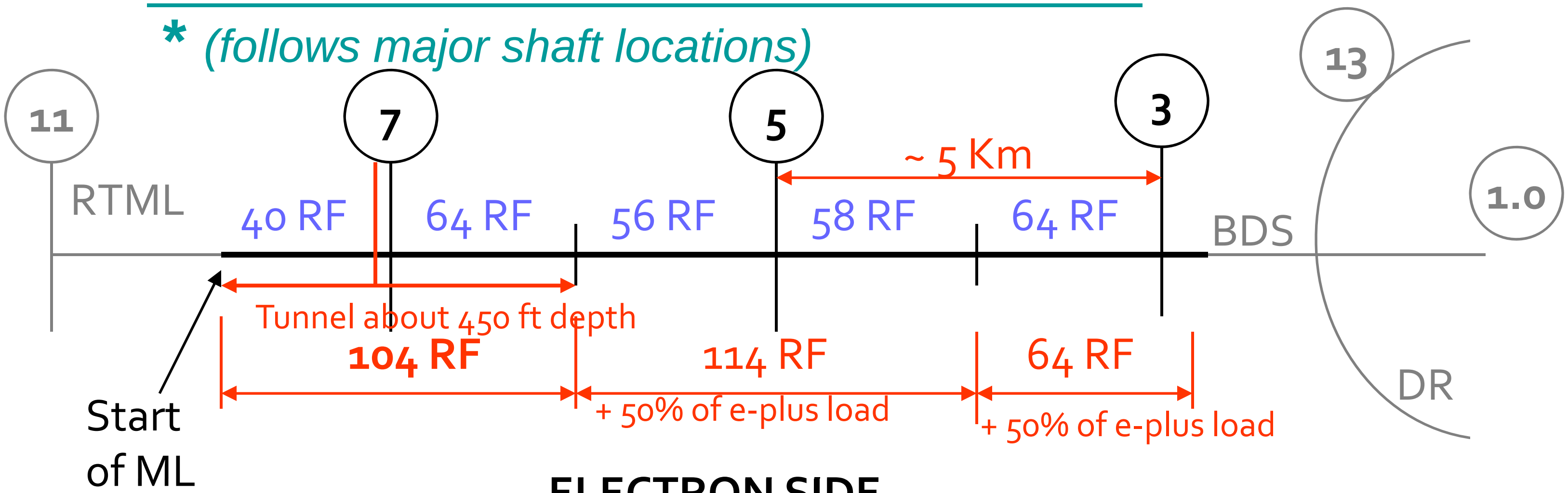
Basic Design Concept in RDR



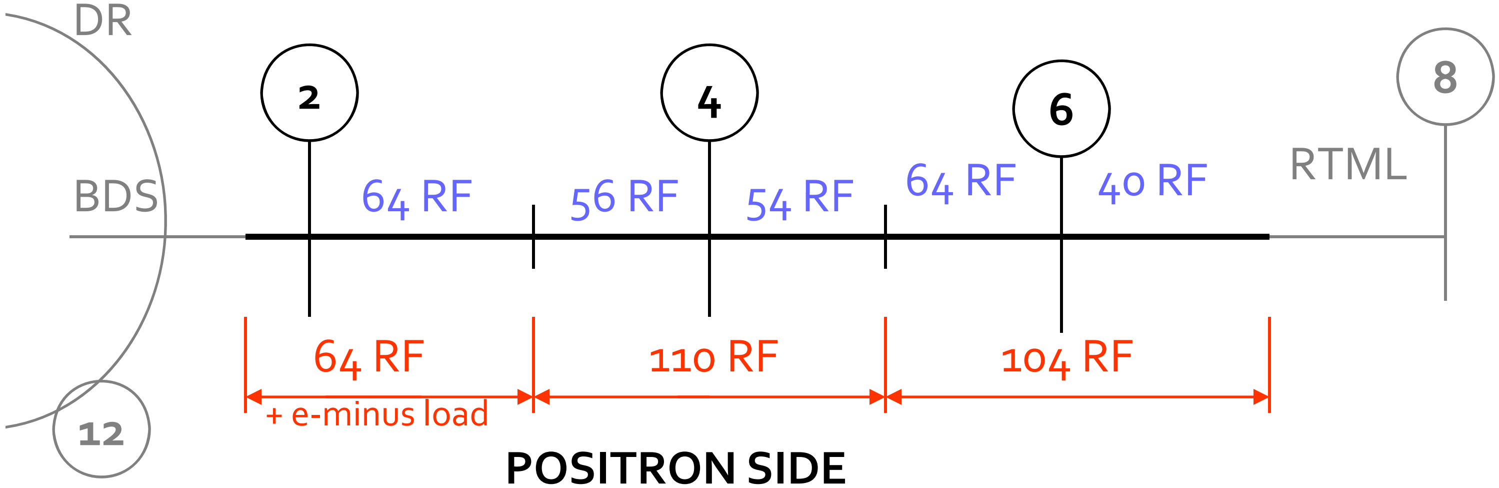
Water Plant at Shaft 7

Surface Plant Locations* used in RDR

* *(follows major shaft locations)*



ELECTRON SIDE



POSITRON SIDE

Total Heat Load RDR Nov 2006

THERMAL LOAD USED (in MW) (..and still changing....) Updated Nov 27 2006 CES

Area System	LCW	Chilled Water	Total	Sources
SOURCES e-	2.9	1.4	**4.3**	Aug 21 (Clay) 4.36;3.72;2.53 MW for LCW, 1.53;1.31;0.89 MW for Air- Numbers are PSTD (peak simultaneous thermal demand);INPTC (installed nameplate thermal capacity) ;ATL (Average thermal demand) Nov 21 2006 **Updated total loads per Clay's email dated 11/20/06**
SOURCES e+	17.5	5.3	**22.8**	
DR e-	8.8	0.9	**9.8**	Oct 16 2006 Emails Andy Wolski (Load to CHW are for equipment load to air in Alcoves only and these are 560KW from RF, and 364KW from Magnet Power Supplies per ring). The other load to air are 197KW from aircooled magnets , and 700 KW from radiation are not listed here and assume dissipated to tunnel wall. Load to LCW includes load to air to tunnel that will be transferred to process water via fancoils to maintain 104F. Nov 27 2006 **No updates from AWolski. Use old total loads, but with two less shaft for distribution**
DR e+	8.8	0.9	**9.8**	
RTML	9.3	1.3	**10.6**	May 24 (Jerry, PT) preliminary ~7 MW per RTML Oct 27 2006 Updated numbers per PTreduction (email oct 25), JS elect table & PBellomo Sep 15 table, but ignored the added 1 watt per meter to air for transfr line (ignore in tabulation for now), and ignored the added 10KW watercooled (from 100 m length) in the vertical arc (assume near shaft 2 and 3 each) Nov 27 2006 **No Updates. use old loads**
MAIN LINAC	56.0	21.1	**77.1**	Jun 1 (Shigeki et. al.) spreadsheet per RF x 624 RF Sep 18 Updated to move all charging supply to LCW, updated other heat load to air. Oct 25 2006 Marc andKeith Pushback on Load, 40% reduction in racks, remove technical components load to air, remove chw fancoils, used R Casell numbers for charging supply Nov 27 2006 **ML 9-8-9 and pushback updated heat table from C.Adolphsen and K.Jobe, Total RF used is 560. Load to air is added back. Used 100% LCW. Dirty water usage still under discussion.**
BDS	10.3	1	**11.3**	Sep 15 (Bellomo) Cable Loss to Air (1.07MW), PS loss to Air (0.982MW); PS loss to water (1.41MW); Magnet Power 14.872 MW (assume 5% magnet is aircooled). Except for PS loss to air (which will be chilled water), all other loads will be to LCW (will use process water fancoil instead of chilled water) Oct 19 2006 (Adjust LCW load, minor Cable loss to air absorb by wall) Nov 14 2006 **Adjustment for One IR w Andrei, new loads scaled based on Sep 15 PBellomo list**
DUMPS	36	0	**36**	Aug 15 (Andrei) -reconfigure such that one or two plant sized for(2) 18MW serves (6) 18MW dumps, only (2) are active at any time. Aug 25 (Fred), adjust shaft locations, (Keith) surface distribution from one plant to various drilled shaft, excluding LCW skid Nov 27 2006. **No Changes. Used old loads**
	149.58	*31.971*	**182**	

IR = None

ML RF Heat Load – RDR Nov 2006

Nov 27b 2006

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

MAIN LINAC - ELECTRON & POSITRON

Shigeki, Chris A., Ray L, R. Cassel, Clay C., Keith J, HLRF Meeting Notes/emails,

Components	Quantity Per 36m	Location	To Low Conductivity Water: Heat Load to Water (KW)	Supply Temp (variation) (C)	Delta Temperature (C delta)	Water Flow (l / min)	Maximum Allowable Pressure (Bar)	Typical (water) pressure drop Bar	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)	Power to Tunnel Air (KW)		Max Space Temp (C)	
Non-RF Components															
LCW Skid Pump 1 per 4 rf -Motor/Feeder Loss	0.25	Service Tunnel	0	N/A	N/A		N/A	N/A	None	0	1.00	0.60			based on (1) 30 HP per 4 RF from Clay Table Ema
I^2R Loss and Motor Loss (misc)	1	Service Tunnel									1.00	12.01			Clay's Email Nov 22 2006
Fancoils (5 ton Chilled Water) 1.5 Hp	2	Service Tunnel	0	N/A	N/A		N/A	N/A	None	0					(2) 1.5 HP per RF (Table 4 Ashrae Chap 28) place
Rack Water Skid	0.25	Service Tunnel	0	N/A	N/A		N/A	N/A	None	0	1.00	0.20			based on (1) 5 HP per 4 rf (table4 Ashrae Chap 28
Lighting Heat Dissipation ~1.3W/sf		Service Tunnel	0	N/A	N/A		N/A	N/A	None	0	1.00	1.65			* Clay - 14 W per sq m
~~Lighting Heat Dissipation ~1.3W/sf~~	-	~~Accelerator Tunnel~~	~~0~~	~~N/A~~	~~N/A~~		~~N/A~~	~~N/A~~	~~None~~	~~0~~					
~~People Heat Dissipation 500btuh each~~	0	~~Accelerator Tunnel~~	~~0~~	~~N/A~~	~~N/A~~		~~N/A~~	~~N/A~~	~~None~~	~~0~~					
~~People Heat Dissipation 500btuh each~~	2	~~Service Tunnel~~	~~0~~	~~N/A~~	~~N/A~~		~~N/A~~	~~N/A~~	~~None~~	~~0~~					
AC Pwr Transformer 34.5-.48 kV	0.25	Service Tunnel	1.50	N/A	N/A		N/A	N/A	None	0	0.25	0.50			* Clay email 3-14-06 typical 112.Kva oil xfmr *
Emerg. AC Pwr Transformer 34.5-.48 kV		Service Tunnel	0	N/A	N/A		N/A	N/A	None	0	1.00	1.00			* Clay email 3-14-06 typical 112.Kva oil xfmrKeith J
RF Components															
RF Charging Supply 34.5 Kv AC-8KV DC	1/36 m	Service Tunnel	***2.8***	***40***	***40***	***1.17***	***18***	***8***	***10***	***0***	***0.3***	***1.2***		**85 F** (a)	* C.Jensen email 2-27-06 183 kVa 0.84pf oil ps xfmr **Shigeki Apr 18 2006 ** Clay 5-25-06 LLRF meeting ** Sep 18 move all to LCW per Marc Ross ** Move load to Dirty Water per RCassell Oct 20 2006, **Nov 22 2006 Keith Jobe Wag on load to Air**Nov 27 2006 C. Adolphsen Email
Switching power supply 4kV 50kW	1/36 m		***4.5***	***35***	***13.6***	***7.6***	***13***	***8***	***10***	***0***	***0.4***	***3.0***			** Move load to Dirty Water per Rcassell Oct 20 2006 LCW for now **Nov 22 2006 Keith Jobe wag on load to air **Chris Jensen Post meeting notes 11 16 06 **Nov 27 2006 C. adolphsen Email
Modulator	1/36 m	Service Tunnel	***4.5***				***28.82***			***0***	***0.4***	***3.0***			* Shigeki Fukuda Email 3-1-06 **Shigeki Apr 18 2006**Nov 22 2006 Keith Jobe wag on load to air** 11-27-06 C. Adolphsen Email **12-1-06 Email from Chris Jensen
Pulse Transformer	1/36 m	Service Tunnel	***0.7***							***0***	***0.3***	***0.3***			**Shigeki Apr 18 2006** Nov 22 2006 Keith Jobe wag on load to air**11-27-06 C.Adolphsen Email
Klystron Socket Tank / Gun	1/36 m	Service Tunnel	***0.8***							***0***	***0.2***	***0.2***			**Shigeki Apr 18 2006** Marc& Keith -remove load to air/chilled - transfer all load to water**Nov 22 2006 Keith Jobe wag on load to air**11-27-06 C. adolphsen Email
Klystron Focusing Coil (Solenoid)	1/36 m	Service Tunnel	***3.6***							***0***	***0.1***	***0.4***			* Shigeki Fukuda Email 4-05-06 **Nov 22 2006 Keith Jobe wag on load to air** 11-27-06 C. Adolphsen Email
Klystron Collector	1/36 m	Service Tunnel	***45.8***	****35>***				***2***		***0***	***0.0***	***1.4***			* Shigeki Fukuda Email 3-1-06 **Nov 22 2006 Keith Jobe wag on load to air** 11-27-06 C. Adolphsen Email
Klystron Body	1/36 m	Service Tunnel	***0.0***	****35>***				***5***	***+ - 2.5 (***	***0***					* Shigeki Fukuda Email 3-1-06** Keith Jobe added stability Oct 20 2006 * * HLRF 11/16 /06 meeting** 11-27-06 C. Adolphsen Email
Klystron Windows	1/36 m	Service Tunnel	***0.0***	****35>***				***1***		***0***					* Shigeki Fukuda Email 3-1-06**11-27-06 C. Adolphsen Email
Relay Racks (Instrument Racks)	1/36 m	Service Tunnel	***0.0***	***N/A***	***N/A***		***N/A***	***N/A***	***None***	***11.5***	***-0.2***	***-1.5***			* Shigeki Fukuda Email 3-30-06 **Shigeki Apr 18 2006 (chilled water) ***Rlarsen email** RayLarsen Email 9-15-06 except reduced by 40% per Marc * Ray HLRF Meeting 11/16/06**11-27-06 C. Adolphsen Email
Circulators, Attenuators & Dummy Load	1/36 m	Accelerator Tunne	***32.3***						***+ - 2.5 (***	***0***	***0.1***	***1.7***			**Shigeki Email Apr 28 2006**HLRF 11/16/06 meeting update from 24.3 to 29.8 KW** 11-27-06 C. Adolphsen Email
Waveguide	1/36 m	Accelerator Tunne	***3.5***						***+ - 2.5 (***	***0***	***0.1***	***0.4***			* Shigeki Fukuda Email 3-30-06** Keith Jobe added stability Oct 20 2006** HLRF 11/16/06 meeting from 4 KW to 5 KW**11-27-06 C. Adolphsen Email
Subtotal RF unit Only															(a) HLRF meeting Nov 16 2006
Total RF			100							**11.5**		**26.1**			

Total Heat load to Chilled water (per R	**37.6 KW**	cooled by chilled water
Total Heat load to LCW (per RF)	**100.0 KW**	cooled by low conductivity water

POST-RDR Heat Table

- Heat Table improvement! Oct 2007, but still incomplete

Shigeki (check min Flow?)

Oct 31 2007

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

Worked with Shigeki, Chris N., Mike N., Keith J., Jensen, Cassell , Clay

MAIN LINAC - ELECTRON & POSITRON													to Chilled Water	keith Jobe load to air Nov 22 06		
Components	Quantity Per 36m	Loc							...ximu m ...wabl e ...ssure ...ar)	Typical (water) pressure drop Bar	Acceptable Temp Variation delta C	Heat Load to Water (KW)	Power fraction to Tunnel Air (0-1)	Power to Tunnel Air (KW)		Max Space Temp (C)
Non-RF Components																
AC Pwr Transformer 34.5-.48 kV	0.25	Service Tunnel	1.50			35					None	0	0.25	0.50		
RF Components																
RF Charging Supply 34.5 Kv AC-8kV DC	1/36		2.8			40	40	1.17	18	5	10	0	0.3	1.2		
Switching power supply 4kV 50kW	1/36 m	Service Tunnel	4.5			35	8.50	7.6	18	5	10	0	0.4	3.0		
Modulator	1/36 m	Service Tunnel	4.5			35	3.23	20	10	5	n/a	0	0.4	3.0		
Pulse Transformer	1/36 m	Service Tunnel	0.7	60		35	0.50	20		1	n/a	0	0.3	0.3		
Klystron Socket Tank / Gun	1/36 m	Service Tunnel	0.8	60		35	1.15	10	15	1	n/a	0	0.2	0.2		
Klystron Focusing Coil (Solenoid)	1/36 m	Service Tunnel	5.5	80		55	8	10	15	1	n/a	0	0.1	0.4		85 F (a)
Klystron Collector	1/36 m	Service Tunnel	45.8	87		38 (inlet temp 25 to 63)	18	37	15	0.3	n/a	0	0.0	1.4		
Klystron Body & Windows	1/36 m	Service Tunnel	4.2	40		25 to 40C	6	10	15	4.5	+ - 2.5 C	0				
Relay Racks (Instrument Racks)	1/36 m	Service Tunnel	0	N/A		N/A	N/A		N/A	N/A	None	11.5	-0.2	-1.5		
Attenuators	2/36 m	Service Tunnel	0	N/A		N/A	N/A		N/A	N/A	None			0.0		
Waveguide (in service tunnel)	1/36 m	Service Tunnel	0											1.166		
Waveguide (in penetration)	1/36 m	Penetration	0.676													
Waveguide (in beam tunnel)	1/36 m	Beam Tunnel	0.0								+ - 2.5 C	0		5.9		
Circulators With loads (isolator)	26/36 m	Beam Tunnel	2.49			35	0.45 per load	3 per load			+ - 2.5 C	0		0.0		
Loads	24/36 m	Beam Tunnel	30.05			35	2.25 per load	8 per load			+ - 2.5 C			0.0		
Subtotal RF unit Only			102.0													
Total RF			103.5									11.5		21.4		

NOTE : Loads, Circulators and Klystron Body Supply Temperature is critical (should have very slow supply temp variat

Total Heat load to Air/Chilled water in service tunnel (per RF)	32.9	KW
Total Heat load to LCW (per RF)	103.5	KW
Total Heat load to air in beam tunnel (ignore rock contribution for now)	5.9	KW

?? | Cassell | Jensen | Shigeki | Chris and Keith? | Chris Nantista | Loads Increasing | Beam Tunnel Temperature?

' water

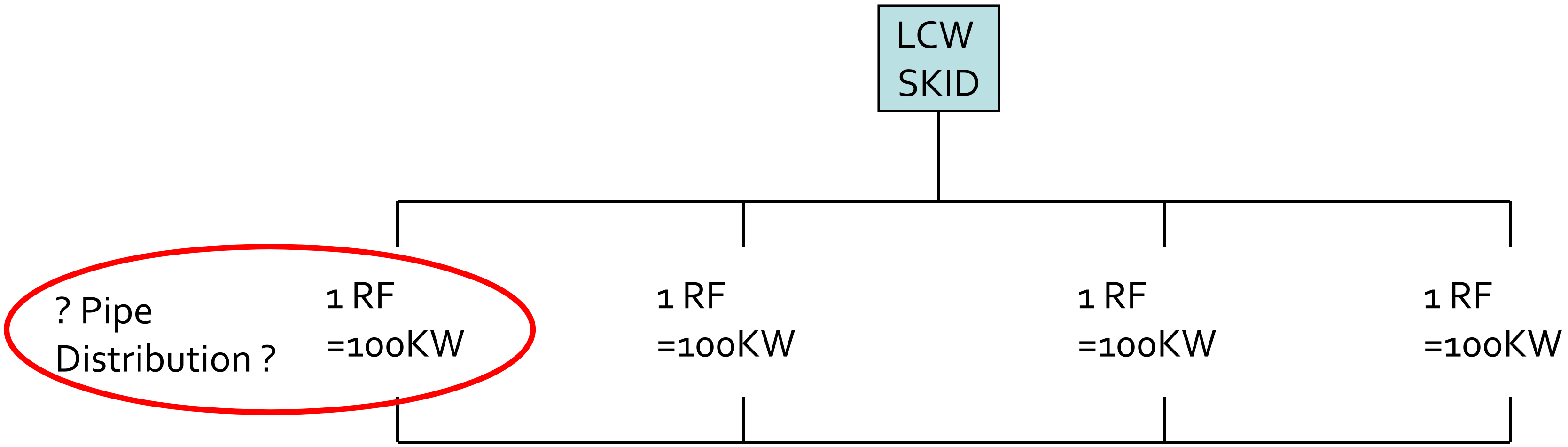
POST RDR

	Heat Load KW per RF		
	RDR	Post RDR **<u>as of</u>** Dec 07	Post RDR **<u>after</u>** Dec 07
Service Tunnel (ML RF)			
to water	100	104	
to air	26	21.4	
racks	11.5	11.5	
beam tunnel (ML RF)			
to water	included	included	
to air (wvguide)	0	5.9	
Load to air, servc tunnel, w /m	~ 684		
Servc tunnel temp F	85	104	> 104???
DR tunnel temperature F	104	85 (cooler LCW)	
Metrology reqmnt (GDE Oct 2007)		< 90F	
Air Stability		+ - 0.1 C	
Water Supply stability		+ - 0.2 C	

POST RDR High DELTA-T Evaluation

In RDR there's incomplete component criteria to evaluate the delta T.

Used **20F** delta average for Shaft 7 plant.



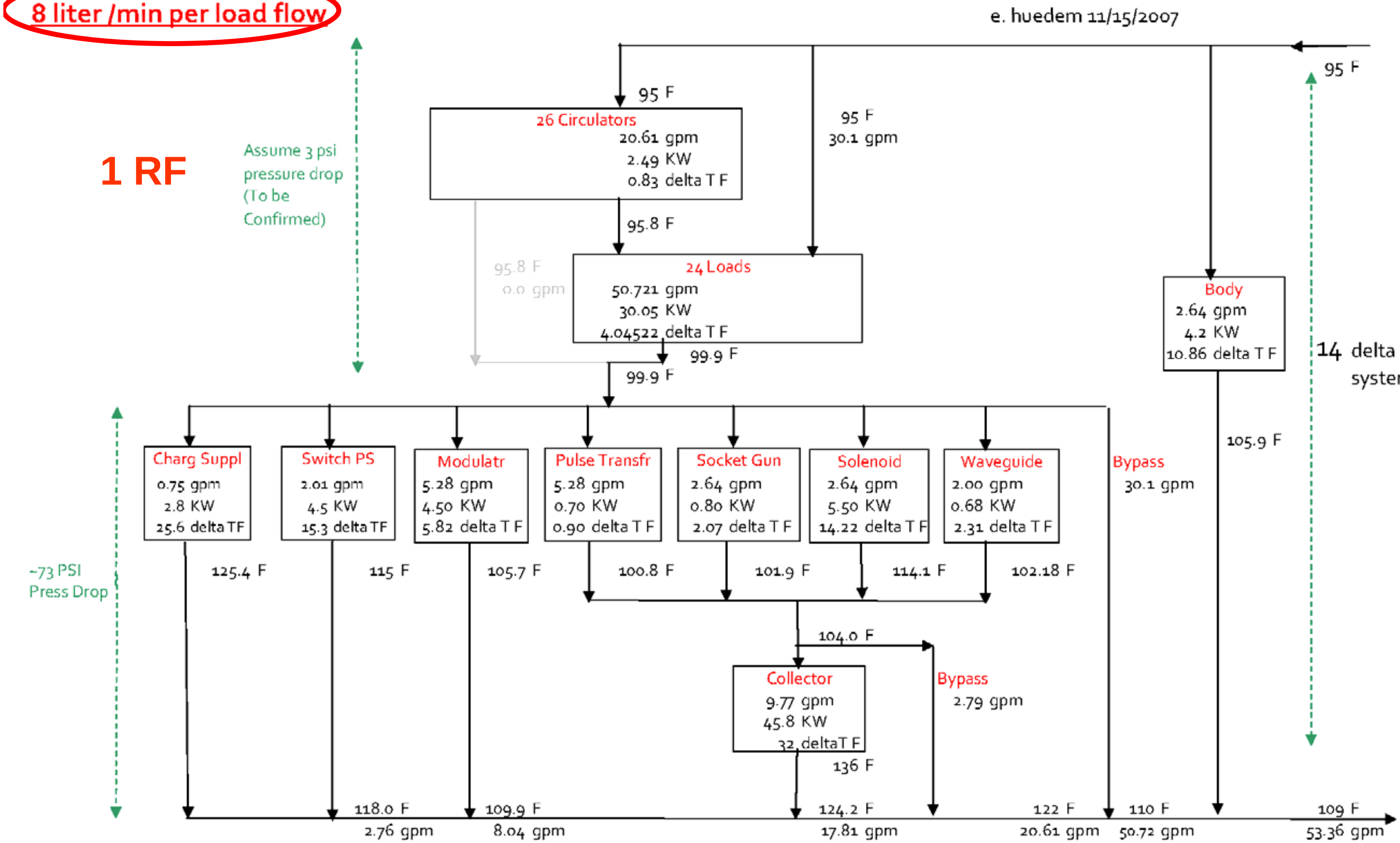
POST RDR

Post RDR- High Delta T Evaluation

MAIN LINAC RF WATER SYSTEM (based on incomplete heat table dated Oct 31 2007), excluding Transformer

8 liter /min per load flow

1 RF



POST RDR

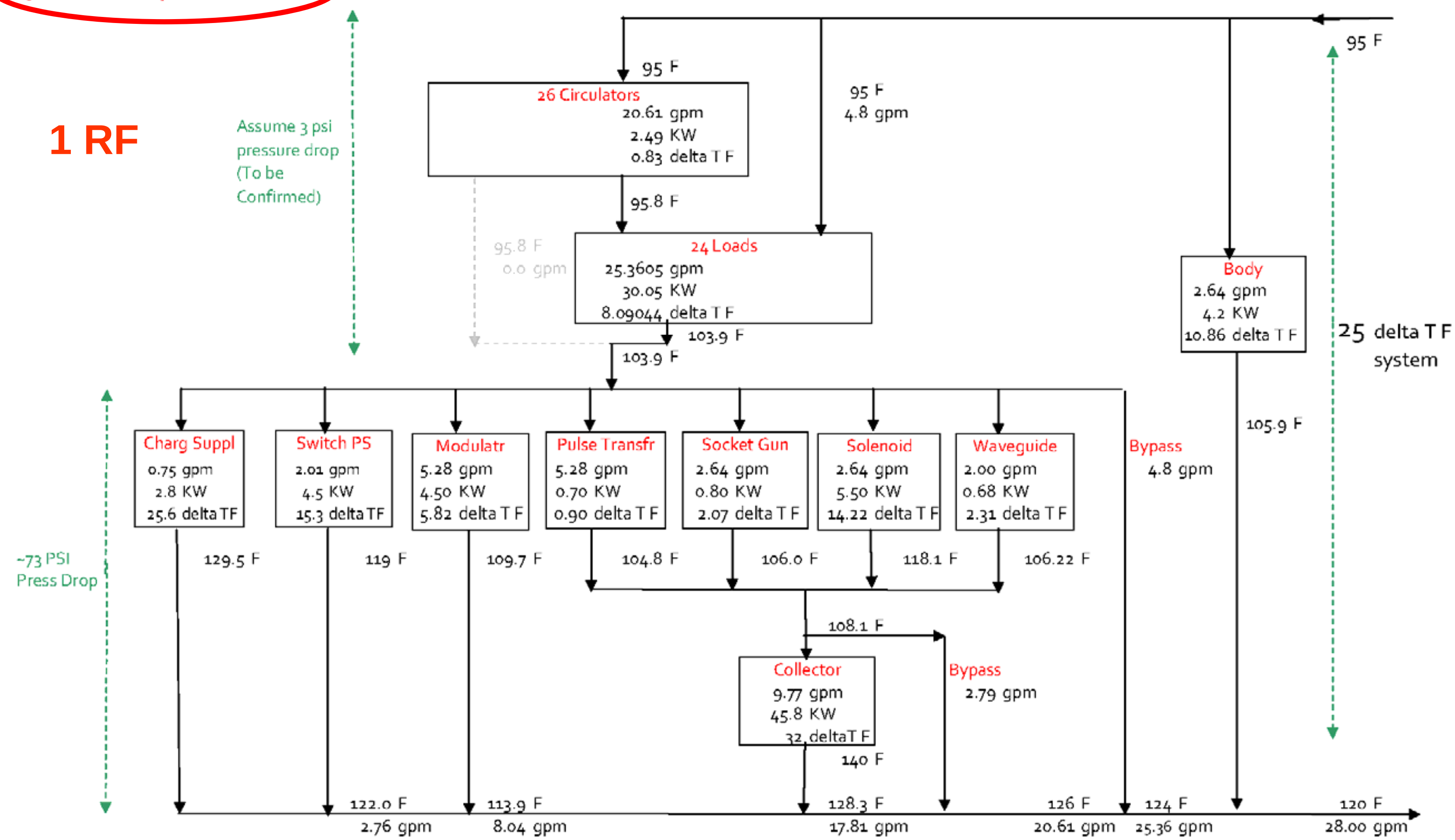
Post RDR- High Delta T Evaluation

MAIN LINAC RF WATER SYSTEM (based on incomplete heat table dated Oct 31 2007), excluding Transformer

4 liter /min per load flow

e. huedem 11/15/2007

1 RF



POST RDR

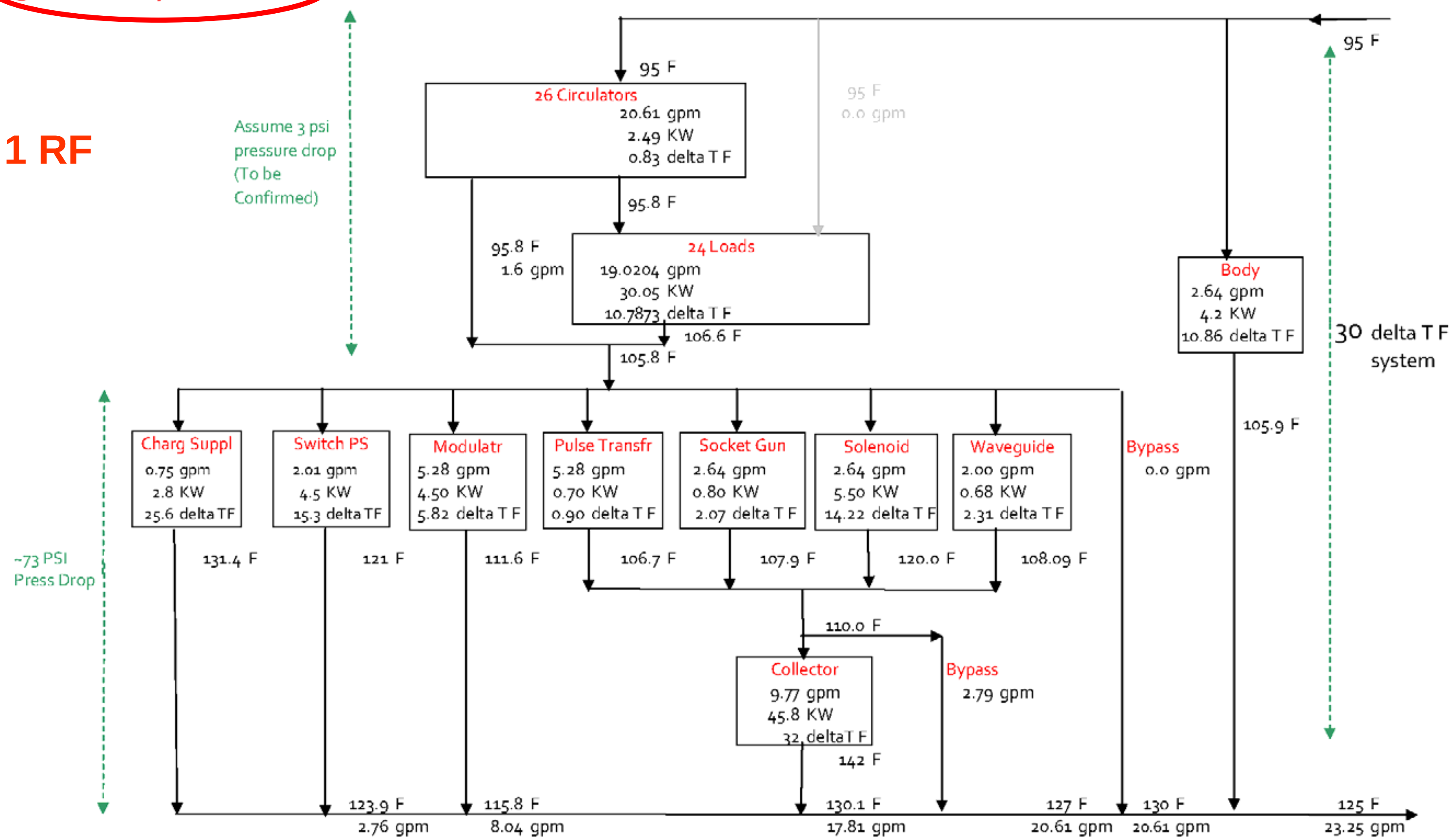
Post RDR- High Delta T Evaluation

MAIN LINAC RF WATER SYSTEM (based on incomplete heat table dated Oct 31 2007), excluding Transformer

3 liter /min per load flow

e. huedem 11/15/2007

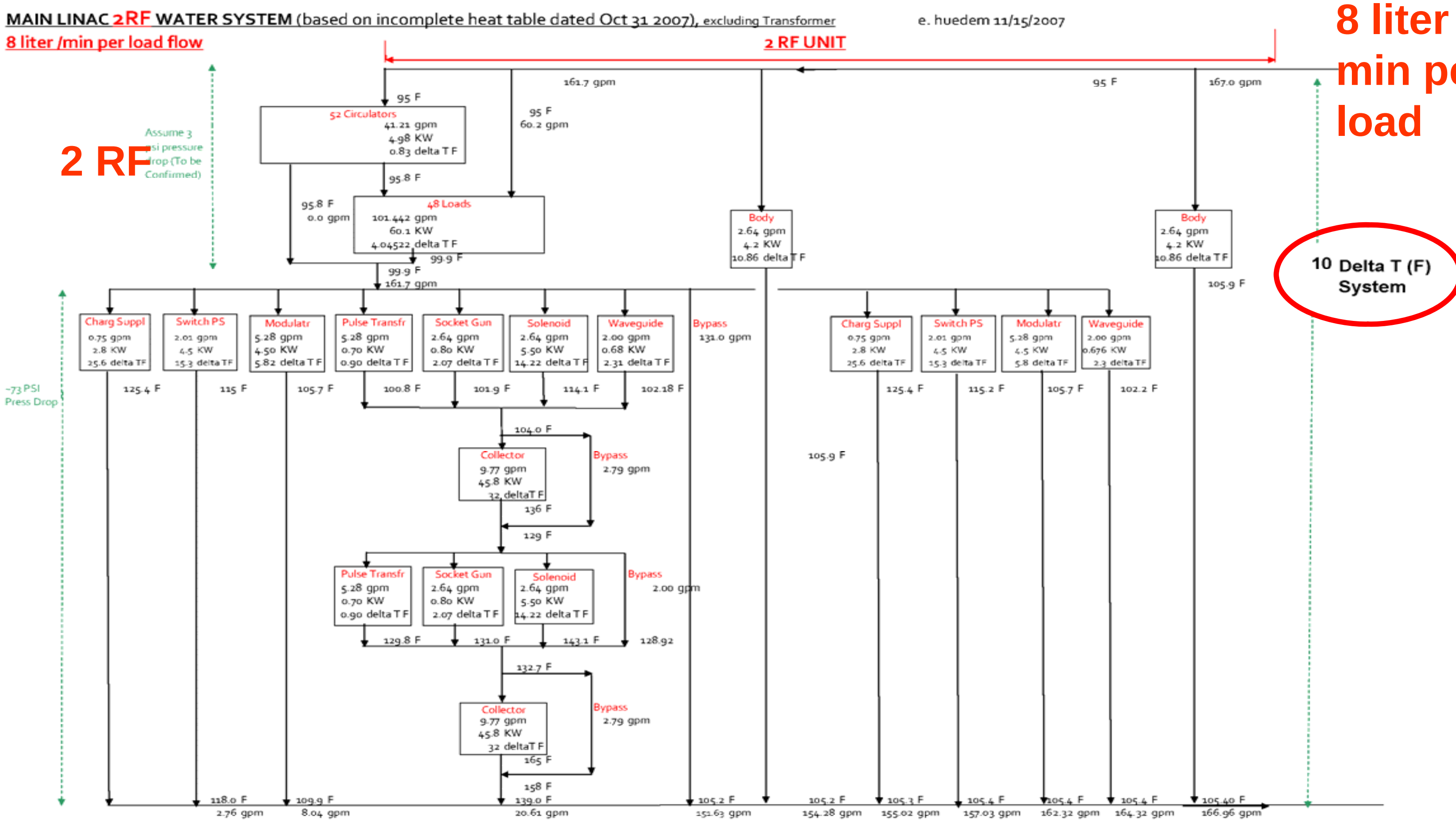
1 RF



POST RDR

Post RDR- High Delta T Evaluation

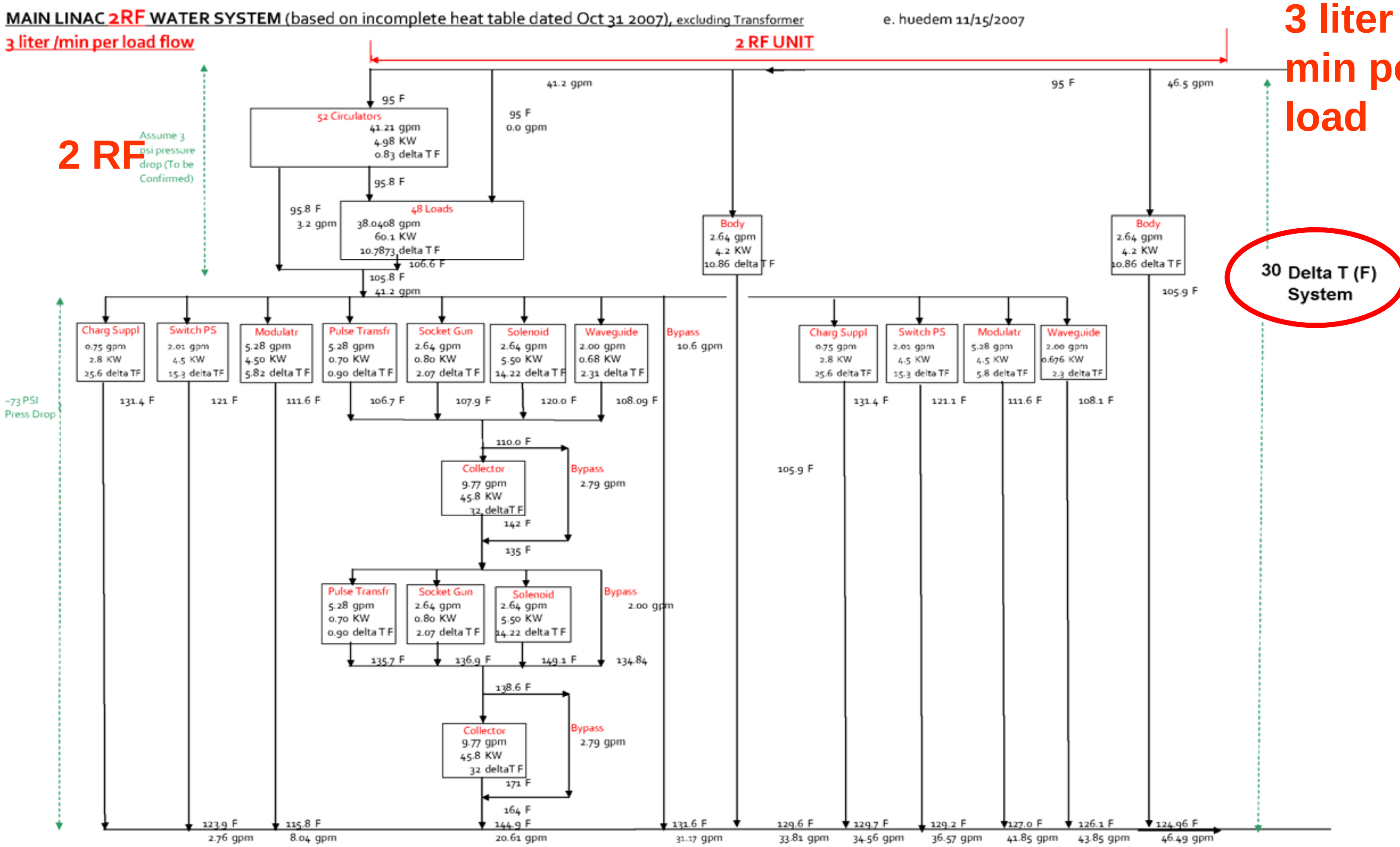
8 liter per min per load



POST RDR

Post RDR- High Delta T Evaluation

3 liter per min per load



Post RDR- High Delta T Evaluation

Nov 2007, being pursued this possibility of low-flow, high delta T Load with Chris N, Shigeki & Mike N and their vendor…as well as finding the rest of the info such as the delta P …

-----Original Message-----
From: Emil Huedem [mailto:huedem@fnal.gov]
Sent: Tuesday, November 06, 2007 9:25 AM
To: Nantista, Christopher D.
Subject: Re: Load & circulator

Chris,

When you obtain this info, can you check if the load/circulator can have lower flow -high delta T?

we're hoping to push the first 95F water into the load/circulator and the outlet of that goes to the rest such as Collector.

The collector from Shigeki has only 37 l/min flow.
The total load/circulator you noted has about 11 l/min flow x 24 (or 26) = a lot more flow than the collector, which will dilute the rest of the high delta T

Thanks
Emil

Post RDR- High Delta T Evaluation

Nov 2007, trying to find out the minimum flow in the collector. SO WHAT IS THE MINIMUM FLOW REQD FOR COLLECTOR? Question to the same group

More on this….

From: Emil Huedem [mailto:huedem@fnal.gov]
Sent: Tuesday, November 20, 2007 2:33 PM
To: Neubauer, Michael L.
Cc: 'Tom Lackowski'
Subject: Fw: ML RF Water

One question i asked Shigeki is the minimum flow for the collector. The information he gave is 37 liter per minute based on 45.8 KW actual heat dissipation at 18 C delta T. I was told by Oleg that the Klystron collector to be used for ilc is really a 300KW at 10 repetition rate, that will be used for 150 KW peak at 5 repetition rate (?), and that the **minimum flow** should **maybe** based on the either the design 300KW, peak 150KW, and not the actual 45.8KW (??), but no one knows. If that is the case, then current information need to be adjusted, and as Keith would say maybe out a circulation pump around the collector to ensure that minimum flow, and the same time obtain the high delta T at the collector.

----- Original Message -----
From: Bialowons, Wilhelm
To: Emil Huedem
Sent: Thursday, November 01, 2007 11:41 AM
Subject: RE: question

Emil, I assume the collector of the MB Klystron is designed for about 120 kW. Wilhelm

-----Original Message-----
From: Emil Huedem [mailto:huedem@fnal.gov]
Sent: Thursday, November 01, 2007 5:31 PM
To: Bialowons, Wilhelm
Subject: Re: question

Dear Wilhelm,

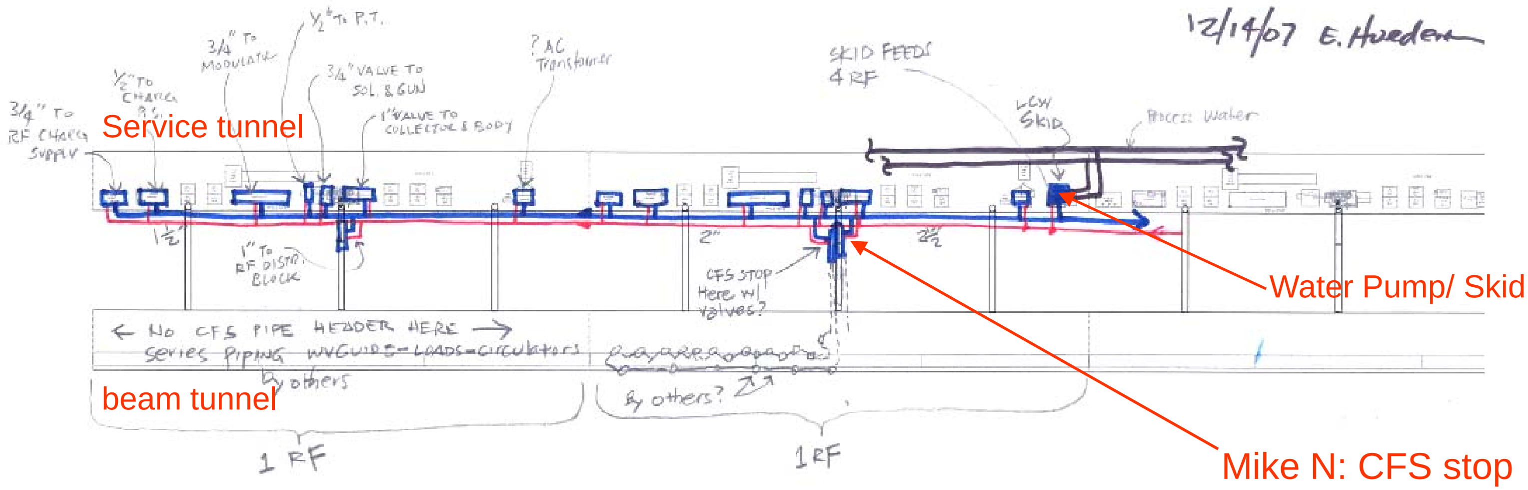
Thanks for the response.
Shigeki's flow is only 37 l/min, but he based on an actual heat dissipation of 45.8 and K=0.8.
37 l/min seems low (?right?) if i recall your discussion of minimum flow required to maintain proper velocity.
The question of whether the collector to be used is design for higher heat dissipation is what im trying to find out, or how to find out whats the colector actual design heat.

Regards from sunny but low delta-T Batavia,
Emil

----- Original Message -----
From: "Emil Huedem" <huedem@fnal.gov>
To: ""Fukuda, Shigeki"" <shigeki.fukuda@kek.jp>
Sent: Thursday, November 15, 2007 9:10 AM
Subject: Follow Up Question

> Hello Shigeki-san,
>
> Oleg told me that the ILC Klsytron/Collector to be used is sized for 300KW
> load at 10 repetition rate at rated flow of about 150 to 160 liter per
> minute. And that it will be used for 150KW ILC peak load at 5 hz repetition
> rate, but the actual heat dissipation is about 45.8 KW. With this parameter,
> can the vendor provide what the minimum flow to the collector is?
> otherwise we'll stick with the 37liter per min flow that you provided.
>
> Im working with Chris Nantista to investigate if the loads can have low-flow
> high -delta T.
>
> Regards,
> Emil

Dec 4 2007 to Dec 16 2007 Interface with Mike Nubauer (HLRF point of contact)



22 F delta to 30

From: "Neubauer, Michael L." <neubauer@slac.stanford.edu>
To: "Emil Huedem" <huedem@fnal.gov>
Sent: Sunday, December 16, 2007 11:22 PM
Subject: RE: Here is a cut at a 30F design

Hi Emil,

The current model is 22, and I'm expecting to get it to 30.

While we have been assuming the circulators need a stable operating condition. It's not clear that we need to do it with the water. (And I want to take advantage of the fact that we are trying to remove the circulators from the distribution system.) The other point is that the rf loads in the rf distribution may not be optimized in their individual cooling scheme. I suspect we can design very low pressure drop loads so they work in series.

I'm on vacation next week, and will be back at it Jan 7. Have a great holiday. Thanks for the feedback.

Mike

(From **Shigeki'**s Oct 2007 Slide) General Calorimetric Calculation

- P(kW):Average power
- ΔT (deg): delta C
- Q(liter/min) : flow rate

$$P \cdot 10^3 = \frac{4.18 \cdot Q \cdot 10^3}{60 \cdot \Delta T}$$

then

$$14.37 = \Delta T(\deg) \cdot \frac{Q}{P}(liter/\min/kW)$$

put

$$K = \frac{14.37}{\Delta T} = \frac{Q}{P}(liter/\min/kW)$$

At MLI-KOM, Wilhelm pointed out the Thales guide line parameter of cooling K Is **0.8 (liter/min/kW),** and this value is a common accepted value from the cooling of the collector (by Toshiba engineer). Toshiba has better efficiency of cooling than the K=0.8 case.Though it is nice data, we use **K=0.8** as the standard collector cooling.

Current data for collector given as 45.8 KW, and 37 l/min.

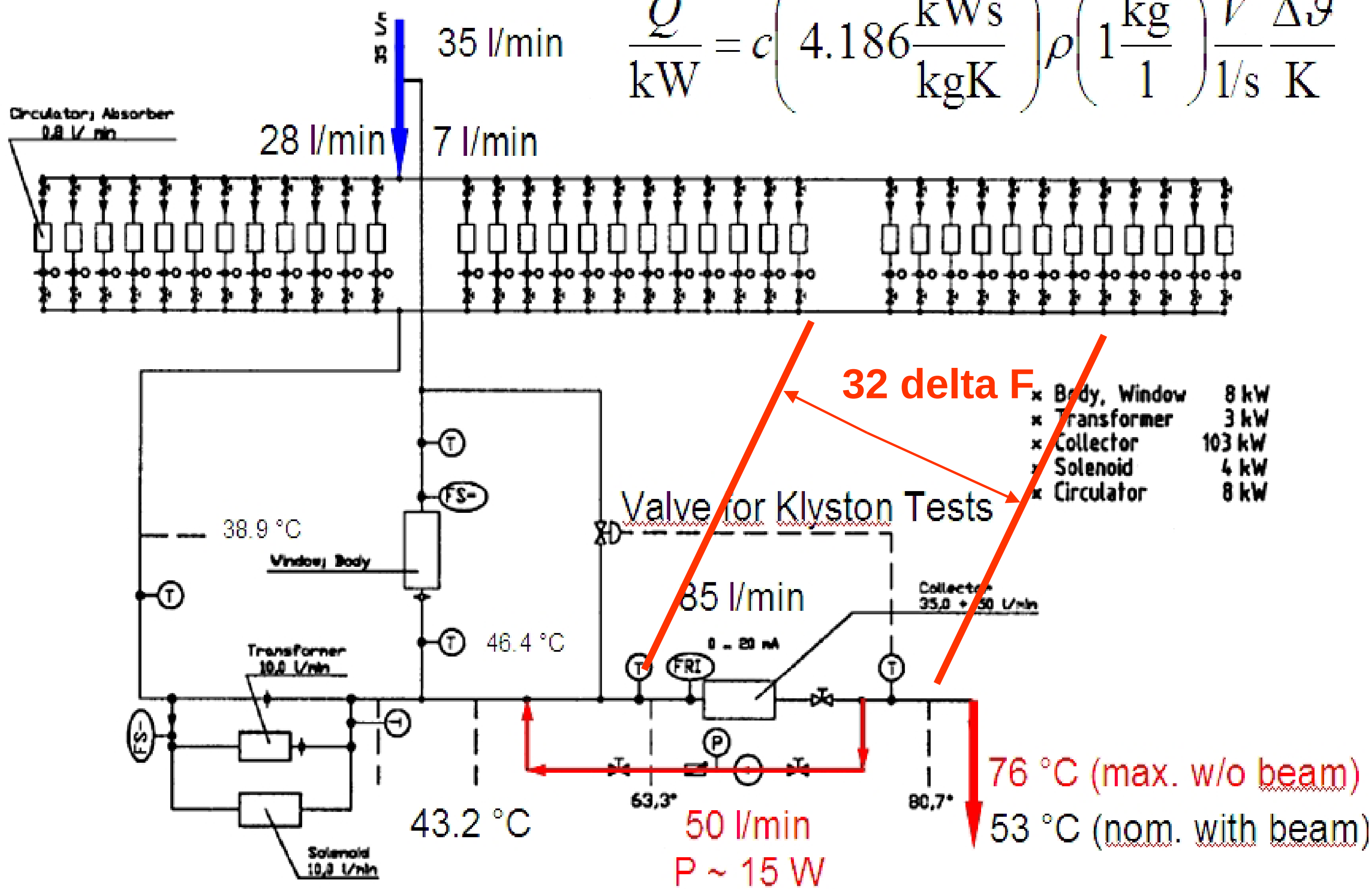
In Oct 2007, We're told that ILC will use a Klystron design for 300KW at 10 rep rate, but will be use for 150KW peak at 5 Hz rep rate, actual heat dissipation given to us as 45.8 KW at K=0.8, flow = 0.8 x 45.8 = 37 l/min.

So, should we use this 150KW load also, flow = 120 l/min ?

At K=0.8, Delta T across collector always ~32F delta T

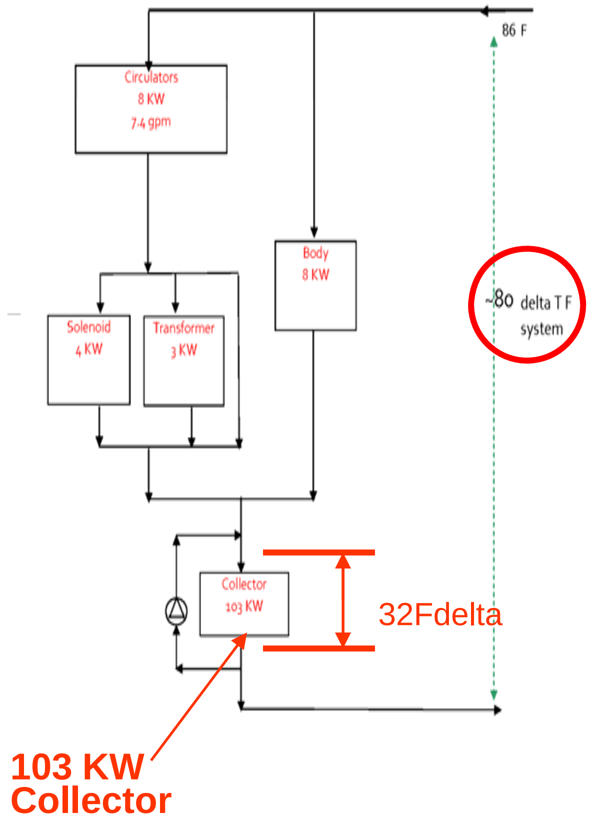
TESLA Cooling Scheme @ 5 Hz

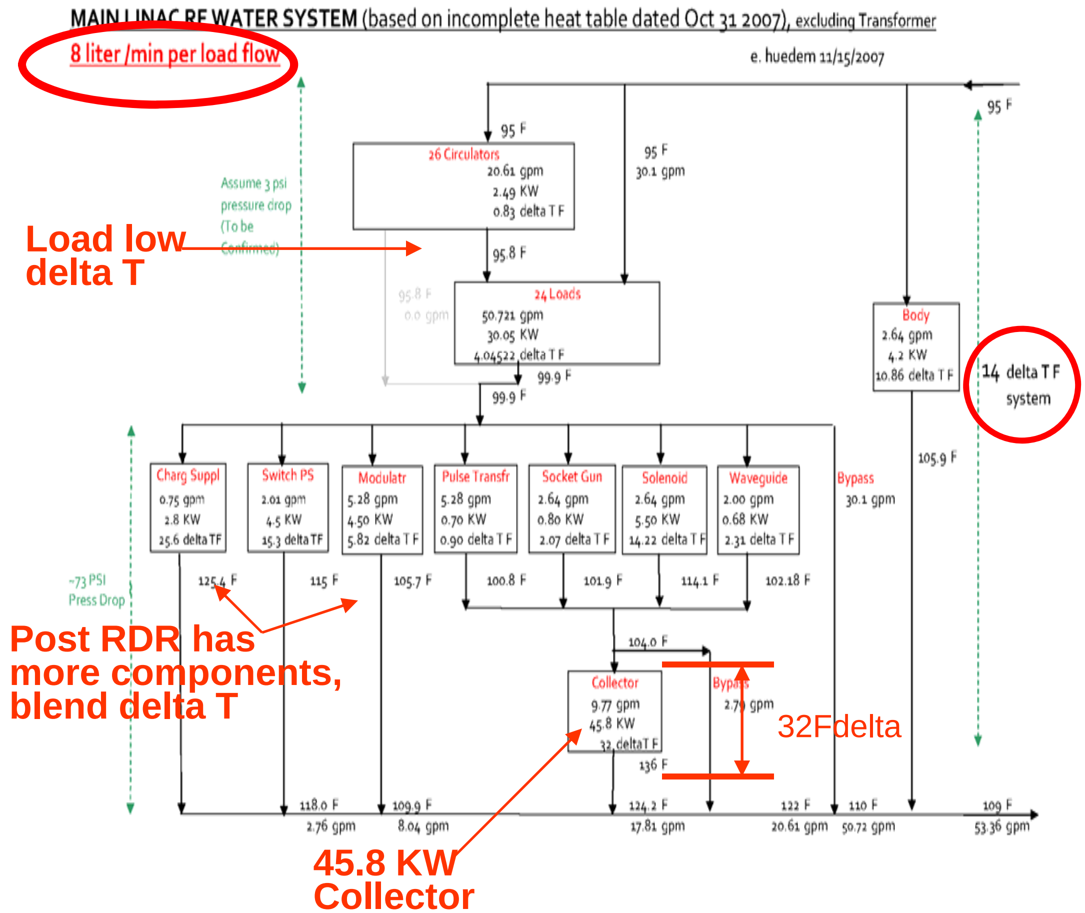
$$\frac{\dot{Q}}{\mathrm{kW}} = c\left(4.186\frac{\mathrm{kWs}}{\mathrm{kgK}}\right)\rho\left(1\frac{\mathrm{kg}}{\mathrm{l}}\right)\frac{\dot{V}}{\mathrm{l/s}}\frac{\Delta\vartheta}{\mathrm{K}}$$



Comparison – Tesla and Post RDR

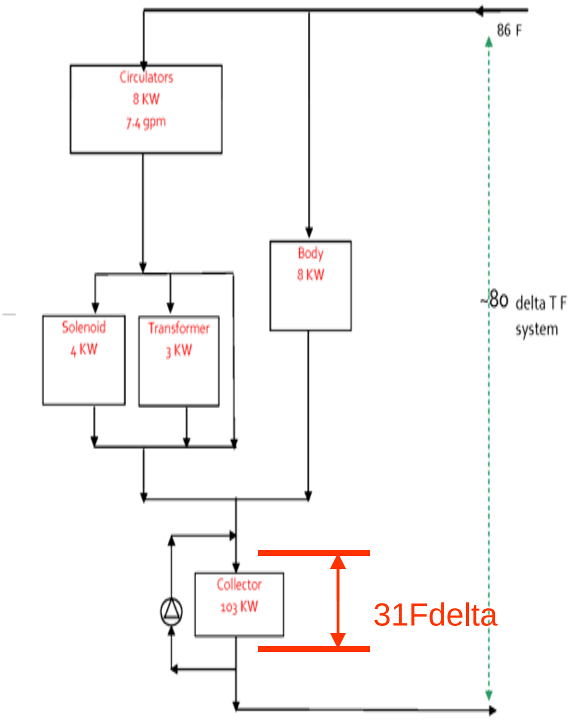
Simplified Tesla lcw diagram



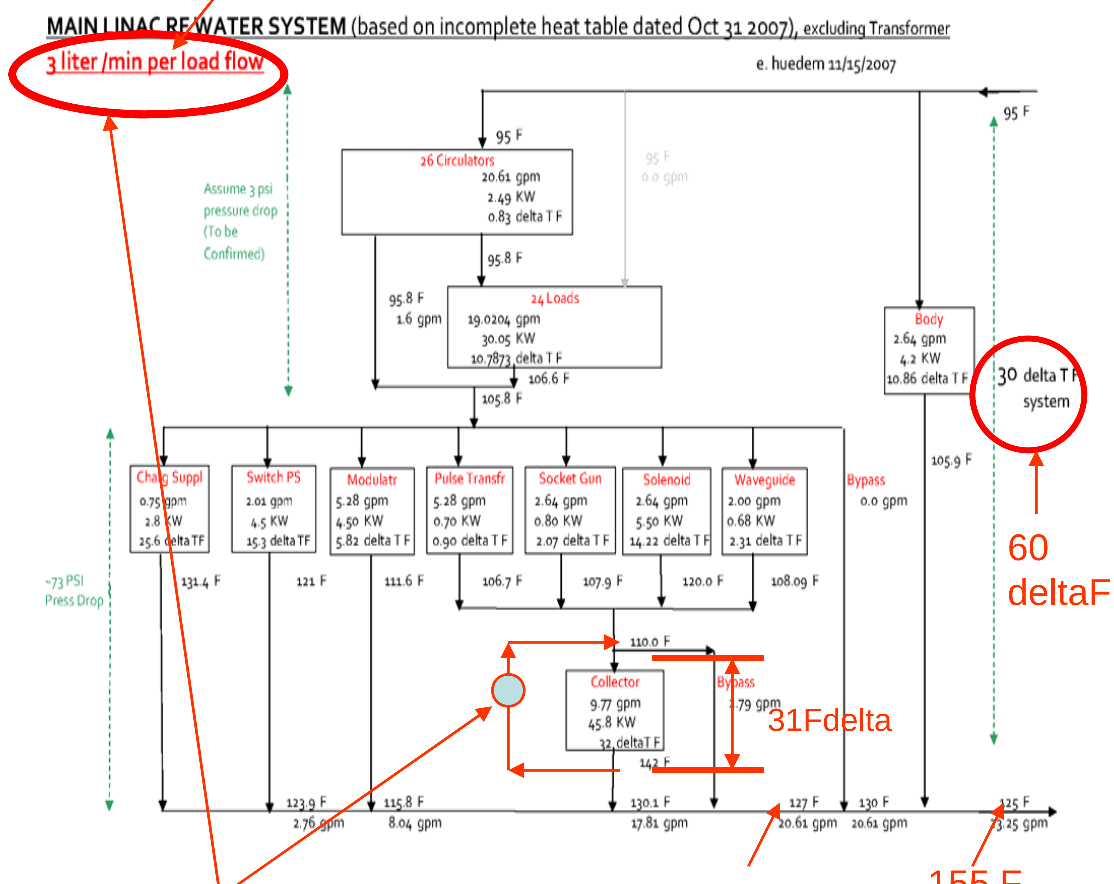


Comparison – Tesla and Post RDR

Simplified Tesla lcw diagram



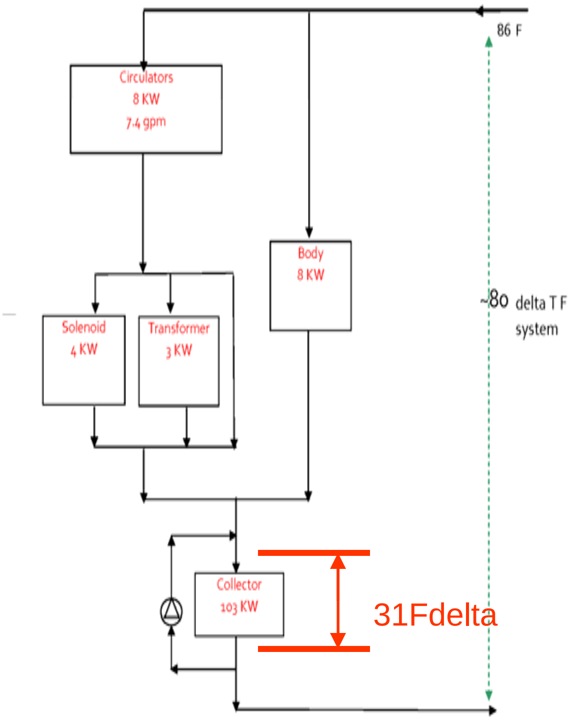
Change to low flow-high delta T



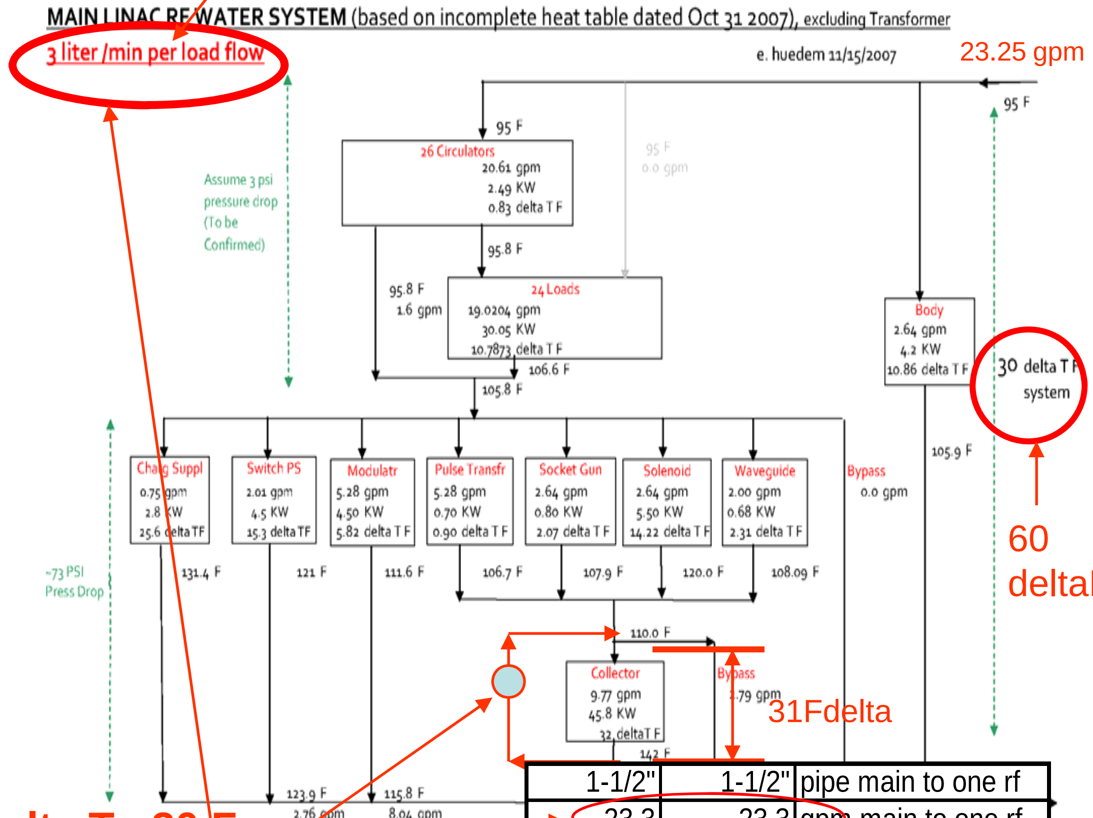
If use 150KW at K=0.8, flow =120 l/min, with modified circulator/ loads,

Comparison – Tesla and Post RDR

Simplified Tesla lcw diagram



Change to low flow-high delta T



1-1/2"	1-1/2"	pipe main to one rf
23.3	23.3	gpm main to one rf
30	60	delta T system
102	204	KW total
45.8	**150**	KW collector
36.64	120	l/min collector
9.7	31.7	gpm collector
32	32	delta T F collector

For 45.8 KW collector, system delta T= 30 F

For 150 KW collector, system delta T=60F

Delta T = Total RF Heat Load (BtuH) / (500 * gpm flow)

pipe main already consider this, just need to add feedback piping loop, and ensure Heat rejection design for the higher load

POST RDR

Specific V.E. List

DESCRIPTIONs & "color" legend (DRAFT Dec 18 2007)	Who to develop short description
(Gut-Feel) may not result to large savings	
(Gut-Feel) may result to savings. Will be evaluated? (potential cost savings TBD)	
[illegible]	
Will be evaluated by Others/HLRF, not CFS whether high cost savings impact or not	
(not shaded) = Items that Im Not Sure	
Provide one high efficiency cogen power / cooling plant on site and distribute power and 33 degree F chilled water throughout the facility, remove the power generation and chilling cost from the project cost	Steve
Eliminate one piping system by using process water as primary rejection for chilled water system w#1 (using refrigerated heat pump as fancoils and standalone chillers for racks)	Emil
Eliminate one piping system by using process water as primary rejection for chilled water system w#1 (using process cooled fancoils), warmer tunnel (item 1_15)	
Increase the delta T in the LCW and chilled water systems to 30 degrees, reduce flow, pipe size w#1	Emil
Add a chiller on the process water side w#1	Steve
Lower the temperature in the tunnel to 65 or 70 degrees to increase operating efficiency, extend equipment life, and improve operating environment w#1	Steve
Consider use of renewable energy source for use with cogen system w#1	Steve
Provide a cost analysis for reducing the overall cooling load by 5% and 10% w#1	Steve
Centralize the cooling system	Steve
Provide distributed cogen power / cryo (similar to #1 &2)	Steve
Decentralize the 345 KV substation function w/ 10, 20, 30, & 30	Tracy
Electrically engineer the distribution system to optimize and reduce cost w#9	Tracy
Provide connection to electrical utility sytem at all shafts (w/ #9)	Tracy
Optimize substation spacing w#9	Tracy
Let the electrical utility construct substations and don't include that cost in the project construction cost w#9	Tracy
Centralize the HVAC and reconfigure air flow from the ends	Lee
Pipe two chilled water coils in series, chilled water reclaim, size one for 30 degree delta T w#10	Larry
Let the temperature in the tunnel go to 104 degrees F during normal operation and local cool to 85 degrees where people are (consider increased cost for more frequent replacement)	Keith
Raise tunnel temperature to 103 degrees at all times (meets OSHA requirements) w#13	Keith
Provide air conditioned suits for personnel working in tunnel and let the temp go higher than OSHA requirements w#13	Keith
Consider oversizing electrical cables and transformers to reduce heat	Keith
Redesign the RF loads for more optimal process water flow	Mike
Modify top shaft HVAC to only process make up air, add blowers down shaft for recirculation	Lee
Reduce lighting level to egress limits	Tom
Reduce water pressure drop across components, minimize head pressure	Mike
Examine possibility of going to 2 condenser water loops instead of 3 as presently planned	Emil
Consider using low mineral content water instead of LCW w28 (design water system for low mineral water)	Keith
Allow different types of pipe materials: PVC, CPVC, HDPE, carbon fiber wrapped PE, etc in lieu of stainless steel	Rick
Consider replacing the fan coil units with a chilled water beam (radiant cooling)	Kumar
Put the water piping in the concrete slab, eliminate pipe supports	Tom
Use water cooled waveguide in the accelerator tunnel in lieu of air cooling	Mike
Provide passive convection tunnel using cooling shafts during colder months	Lee
Provide multiple modes of operation dependent on outdoor temperature	Lee
Develop loads that do not require low conductivity water	Fukuda
Use the waveguide pressurization system for cooling the waveguide (flow cooled gas inside the waveguide)	Mike
Pulse the power source for selected loads when not being used	Tom / controls
Use pressure regulators to control the hydrostatic pressure in the collectors	John Mathis
Define the maximum hydrostatic pressure for the collectors	Mike
Consider expandability of systems - modular vs centralized	Tom
Reexamine the hot changeout of modulator power supplies	Keith
Plan for a 4 month downtime during the summer	Rick
Limit the operation of the system to 72 degree wet bulb	Rick
Use CO2/radon monitoring and limit the intake of outside air to what is necessary to maintain a safe environment	Lee
Use a dessicant to dehumidify ventilation air	Lee
Evaluate each load individually to determine requirements	Keith / Mike
Establish power budgets for the relay racks (400 W / RF + 10% of power supplies)	Keith
Provide power supply that will work with warm water if necessary (quasi militarized)	Keith
Use on site ponds for make up water	
Consider using cooling ponds in lieu of cooling towers	
Give or sell heat from chillers to neighboring communities	
Increase the number of RF stations per LCW skids	
Use vapor phase cooling on the collector and generate electricity from excess energy	
Use the lowest KVA transformer to reduce heat load	
Consider use of geothermal cooling	
Use the Fox river for once thru primary cooling, eliminate the cooling towers	
Use modular systems for all equipment	
Eliminate Rack Skid and replace with just pump	Tom/Emil
Eliminate one piping system by using chilled water only as primary rejection, eliminate process water distribution	Tom/Emil

- About 50+ list from V.E. in Nov 2007, List from value engineering sessions in Nov 2007. Some appear to have real good cost reduction potentials.
- Talks located in http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=2328
- Description of each list, but no detailed evaluation **no pros/cons and cost impact evaluation done yet**
- Color coded
  - Red=Marc selected on Dec 4 2007
  - Yellow=potential VE but not necessarily cost reduction?
  - Green= by others (HLRF), not CFS
  - Gray=ignore
  - White=not sure
- Further effort stopped on Dec 18 07

POST RDR

Specific V.E. List

		DESCRIPTIONs & "color" legend (DRAFT Dec 18 2007)	Who to develop short description
		(Gut-Feel) may **not** result to large savings	
		(Gut-Feel) may result to savings. Will be evaluated? (potential cost savings TBD)	
		MARC ROSS DEC 04, 2007 DIRECTION *(LIST TO BE EVALUATED)*	
		Will be evaluated By Others(HLRF), not CFS, whether high cost savings impact or not	
		(not shaded) = Items that im Not Sure	
1	1	Provide one high efficiency cogen power / cooling plant on site and distribute power and 33 degree F chilled water throughout the facility, remove the power generation and chilling cost from the project cost	Steve
1	4	Eliminate one piping system by using process water as primary rejection for chilled water system w/#1 (using refrigerated heat pump as fancoils and standalone chillers for racks)	Emil
	4b	Eliminate one piping system by using process water as primary rejection for chilled water system w/#1 (using process cooled fancoils), warmer tunnel (item 6_15)	
1	5	Increase the delta T in the LCW and chilled water systems to 30 degrees, reduce flow, pipe size w/#1	Emil
5	10	Centralize the HVAC and reconfigure air flow from the ends	Lee
6	13	Let the temperature in the tunnel go to 104 degrees F during normal operation and local cool to 85 degrees where people are (consider increased cost for more frequent replacement)	Keith
6	15	Raise tunnel temperature to 103 degrees at all times (meets OSHA requirements) w/#13	Keith
8	16	Redesign the RF loads for more optimal process water flow	Mike
9	21	Modify top shaft HVAC to only process make up air, add blowers down shaft for recirculation	Lee
10	24	Reduce lighting level to egress limits	Tom
11	25	Reduce water pressure drop across components, minimize head pressure	Mike
12	35a	Consider using low mineral content water instead of LCW w/28 (design water system for low mineral water)	Keith
13	31	Allow different types of pipe materials: PVC, CPVC, HDPE, carbon fiber wrapped PE, etc in lieu of stainless steel	Rick
16	46	Use water cooled waveguide in the accelerator tunnel in lieu of air cooling	Mike
19	50	Develop loads that do not require low conductivity water	Fukuda
20	54	Use the waveguide pressurization system for cooling the waveguide (flow cooled gas inside the waveguide)	Mike
2	8	Define the maximum hydrostatic pressure for the collectors	Mike
4	27	Reexamine the hot changeout of modulator power supplies	Keith
8	41	Use a dessicant to dehumidify ventilation air	Lee
9	51	Evaluate each load individually to determine requirements	Keith / Mike
10	52	Establish power budgets for the relay racks (400 W / RF + 10% of power supplies)	Keith
11	53	Provide power supply that will work with warm water if necessary (quasi militarized)	Keith
NEW	NEW1	Eliminate Rack Skid and replace with just pump	Tom/Emil
NEW	NEW2	*Eliminate one piping system by using chilled water only as primary rejection, eliminate process water distribution*	Tom/Emil

POST RDR

Specific V.E. List

		DESCRIPTIONs & "color" legend (DRAFT Dec 18 2007)	Who to develop short description
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1	1	Provide one high efficiency cogen power / cooling plant on site and distribute power and 33 degree F chilled water throughout the facility, remove the power generation an	Steve
1	4	Eliminate one piping system by using process water as	

Some VE list variations of this

Provide one high efficiency cogen power / cooling plant on site and distribute power and 33 degree F chilled water throughout the facility, remove the power generation and Chilling cost from the project cost, by using alternative financing mechanism (e.g. ESPC, etc.) to transfer the construction costs of cogeneration to the project's future operating cost stream (without increase) where it can be amortized out of energy cost savings, thus practically eliminating the current costs for utility plants from the project construction. In other countries the ESPC concept might likely be replicated through investment loans. This idea would provide a centralized cogeneration plant at the central site with distribution throughout the tunnel. The cogeneration plant could likely provide cooling for the cryogenic, chilled water and process water systems and heat for desiccant dehumidifier regeneration, in addition to electrical power for the accelerator. Plant operation and maintenance is typically handled by the ESPC contractor and is also paid for out of the energy cost savings stream.

Specific V.E. List

POST RDR

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1	1	Provide one high efficiency cogen power / cooling plant on site and distribute power and 33 degree F chilled water throughout the facility, remove the power generation and chilling cost from the project cost	Steve
1	4	Eliminate one piping system by using process water as primary rejection for chilled water system w/#1 (using	Emil

Maintain reasonable (even lower) tunnel temperature to increase operating efficiency, extend equipment life, and improve operating environment.
This VE item quoted impact of high ambient temperature involving electronic equipment of various grades of construction (Hardy,Average and weak), and the Corresponding loss of equipment life. Another is the energy loss associated with electrical resisitivity of conductors in distribution and equipment.

POST RDR

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1	4	Eliminate one piping system by using process water as primary rejection for chilled water system w/#1 (using refrigerated heat pump as fancoils and standalone chillers for racks)	Emil
	4b	Eliminate one piping system by using process water as primary rejection for chilled water system w/#1 (using process cooled fancoils), warmer tunnel (item 6_15)	
1	5	Increase the delta T in the LCW and chilled water systems to 30 degrees, reduce flow, pipe size w/#1	Emil
5	10	Centralize the HVAC and reconfigure air flow from the ends	Lee
11	53	Provide power supply that will work with warm water if necessary (quasi militarized)	Keith
NEW	NEW1	Eliminate Rack Skid and replace with just pump	Tom/Emil
NEW	NEW2	*Eliminate one piping system by using chilled water only as primary rejection, eliminate process water distribution*	Tom/Emil

Use process water only as primary rejection. Eliminate Chilled water system by using multiple compressorized Fan coil (heat pump) to maintain 85F space

Specific V.E. List

POST RDR

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19	50	Develop loads that do not require low conductivity water	Fukuda
20	54	Use the waveguide pressurization system for cooling the waveguide (flow cooled gas inside the waveguide)	Mike
2	8	Define the maximum hydrostatic pressure for the collectors	Mike
4	27	Reexamine the hot changeout of modulator power supplies	Keith
8	41	Use a dessicant to dehumidify ventilation air	Lee
9	51	Evaluate each load individually to determine requirements	Keith / Mike
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11	53	Provide power supply that will work with warm water if necessary (quasi militarized)	Keith
NEW	NEW1	Eliminate Rack Skid and replace with just pump	Tom/Emil
NEW	NEW2	*Eliminate one piping system by using chilled water only as primary rejection, eliminate process water distribution*	Tom/Emil

Eliminate process water by using chilled water only as primary rejection

Specific V.E. List

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1	4	Eliminate one piping system by using process water as primary rejection for chilled water system w/#1 (using refrige...	Emil
	4b	Elimin... proce...	
1	5	Increa...	
5	10	Centr...	
6	13	Let the... people...	
6	15	Raise...	
8	16	Redes...	
9	21	Modify...	
10	24	Redu...	
11	25	Reduc...	
12	35a	Consi...	
13	31	Allow...	
16	46	Use w...	
19	50	Devel...	
20	54	Use th...	
2	8	Define...	
4	27	Reexa...	
8	41	Use a...	
9	51	Evalua...	
10	52	Establ...	
11	53	Provid...	
NEW	NEW1	Elimin...	
NEW	NEW2	*Elimin...*	

Red Item (Marc's selection from VE list)

Eliminate chilled water, use process water only for heat rejection

Consider using 30F water Delta T in RF

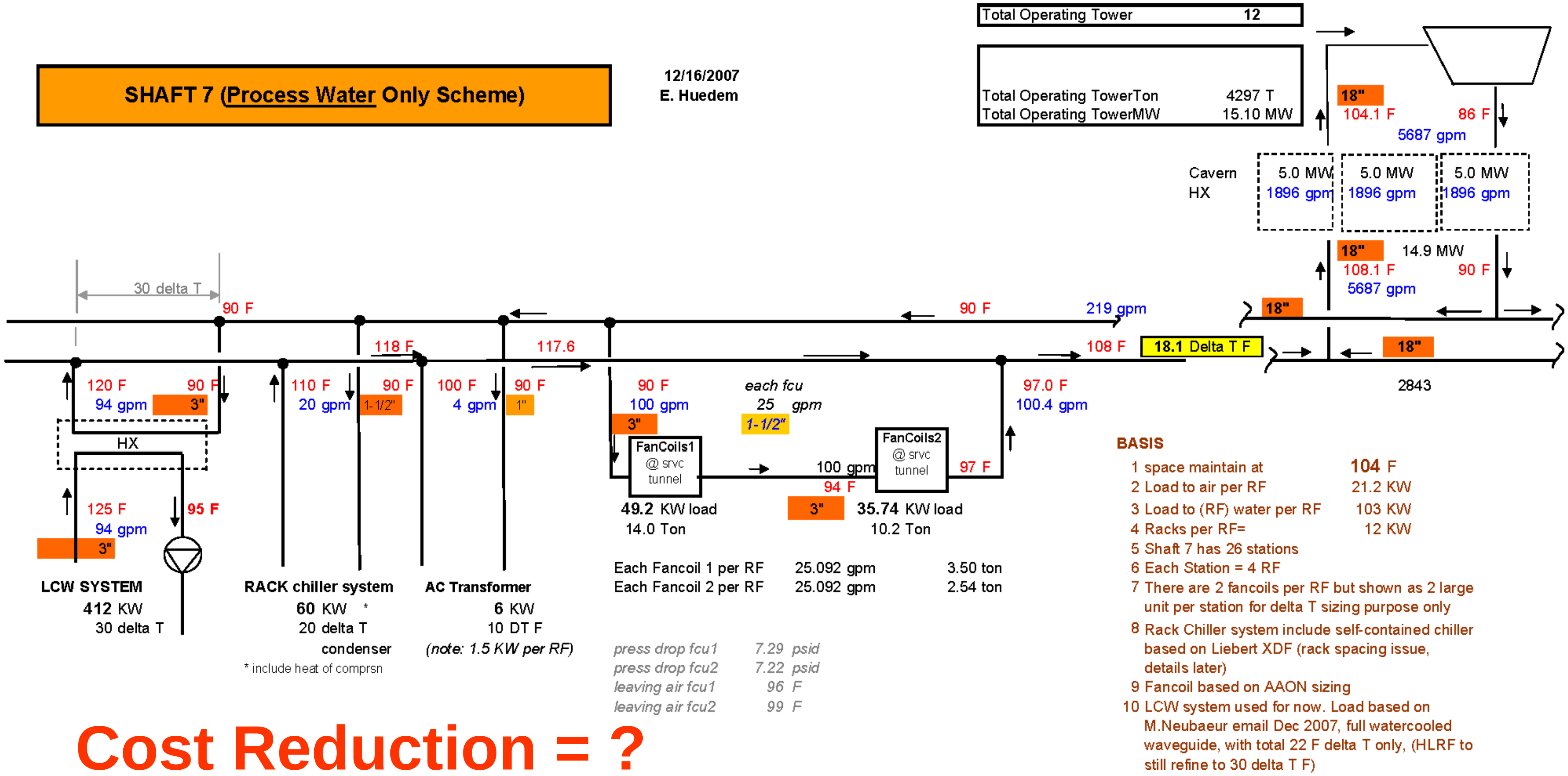
Warmer tunnel temperature to 104F during operation and local cool during maintenance

Consider low mineral content water instead of LCW

Consider using plastic pipe instead of steel/stainless steel

ACTUAL Marc Dec 4 2007 VE list

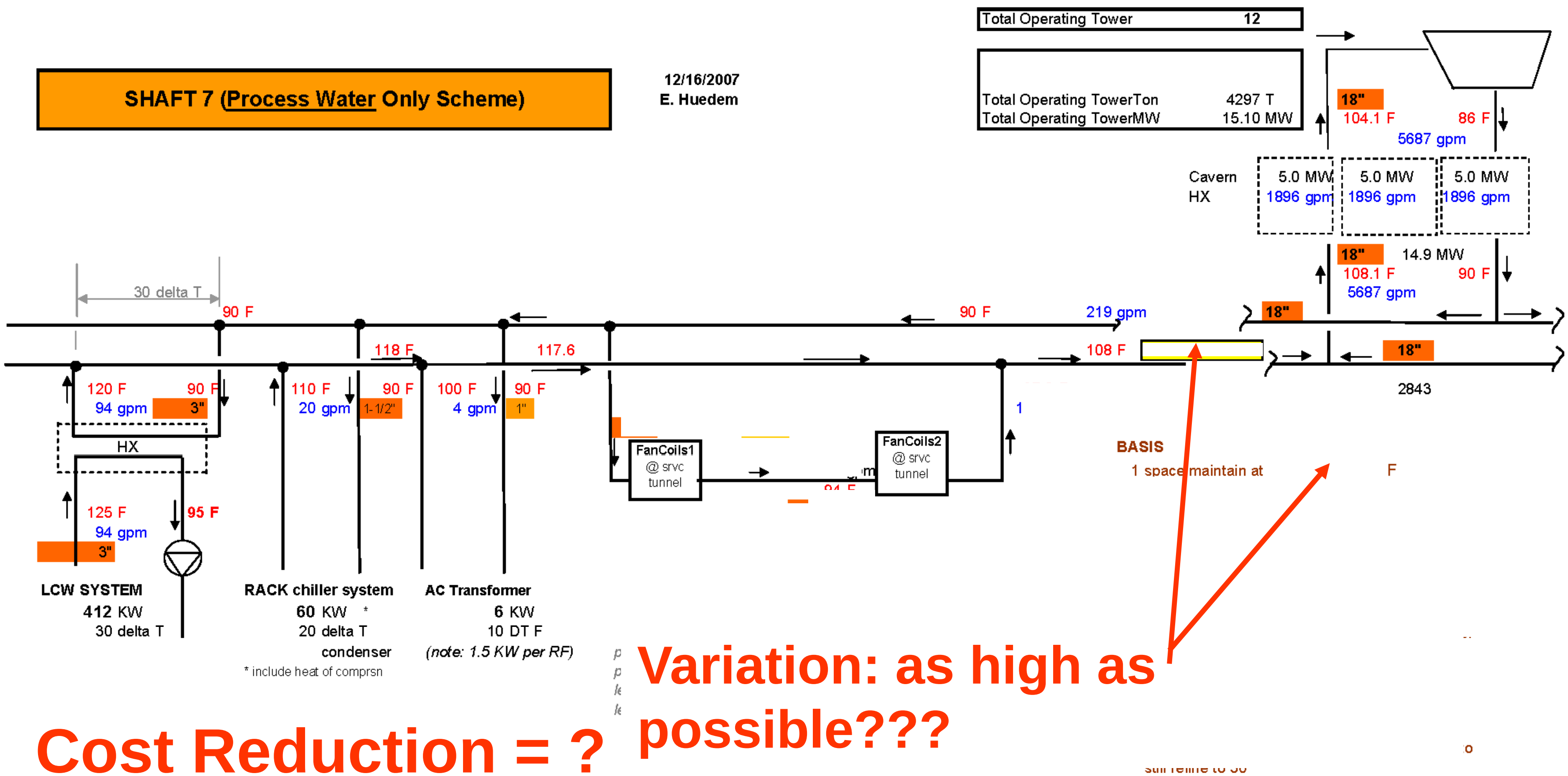
Evaluate Shaft 7 cost based on following selected list



Cost Reduction = ?

ACTUAL Marc Dec 4 2007 VE list

Evaluate Shaft 7 cost based on following selected list

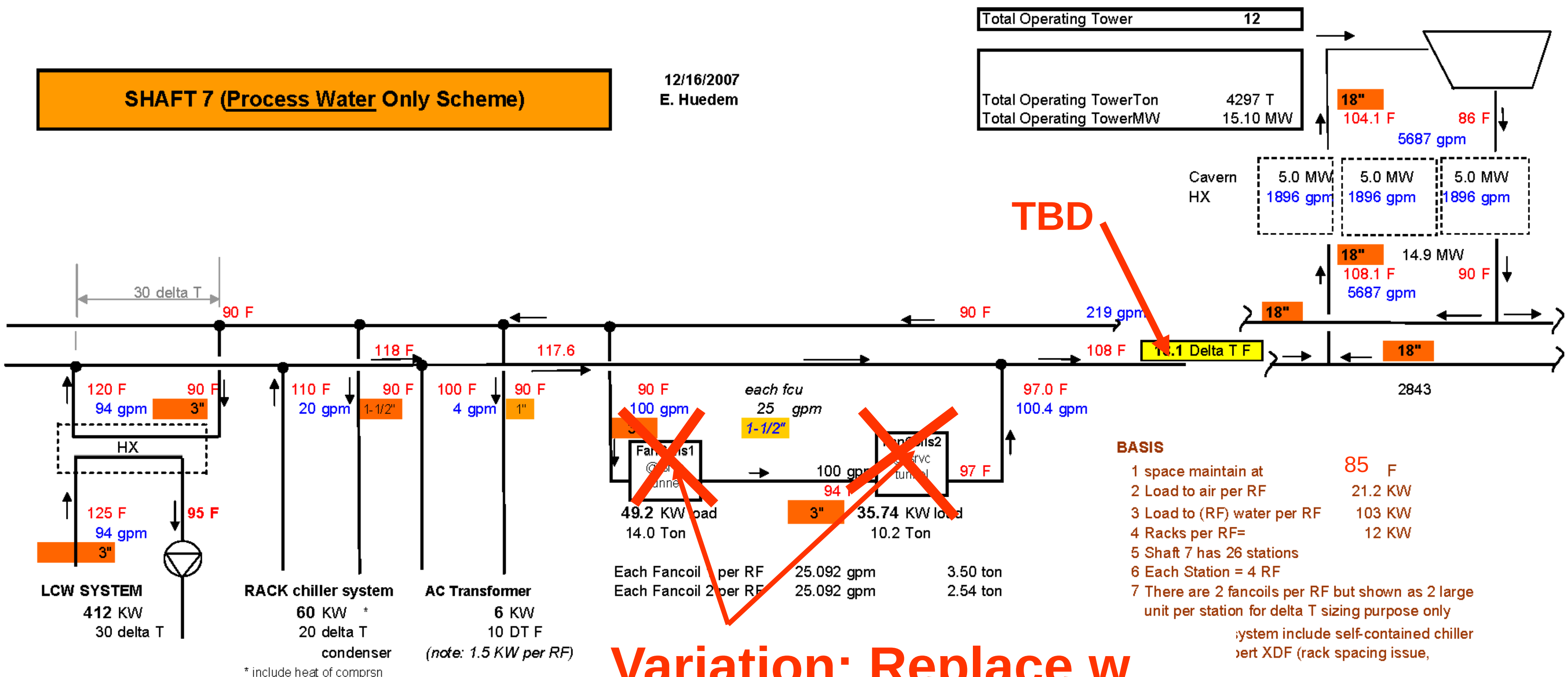


Variation: as high as possible???

Cost Reduction = ?

ACTUAL Marc Dec 4 2007 VE list

Evaluate Shaft 7 cost based on following selected list

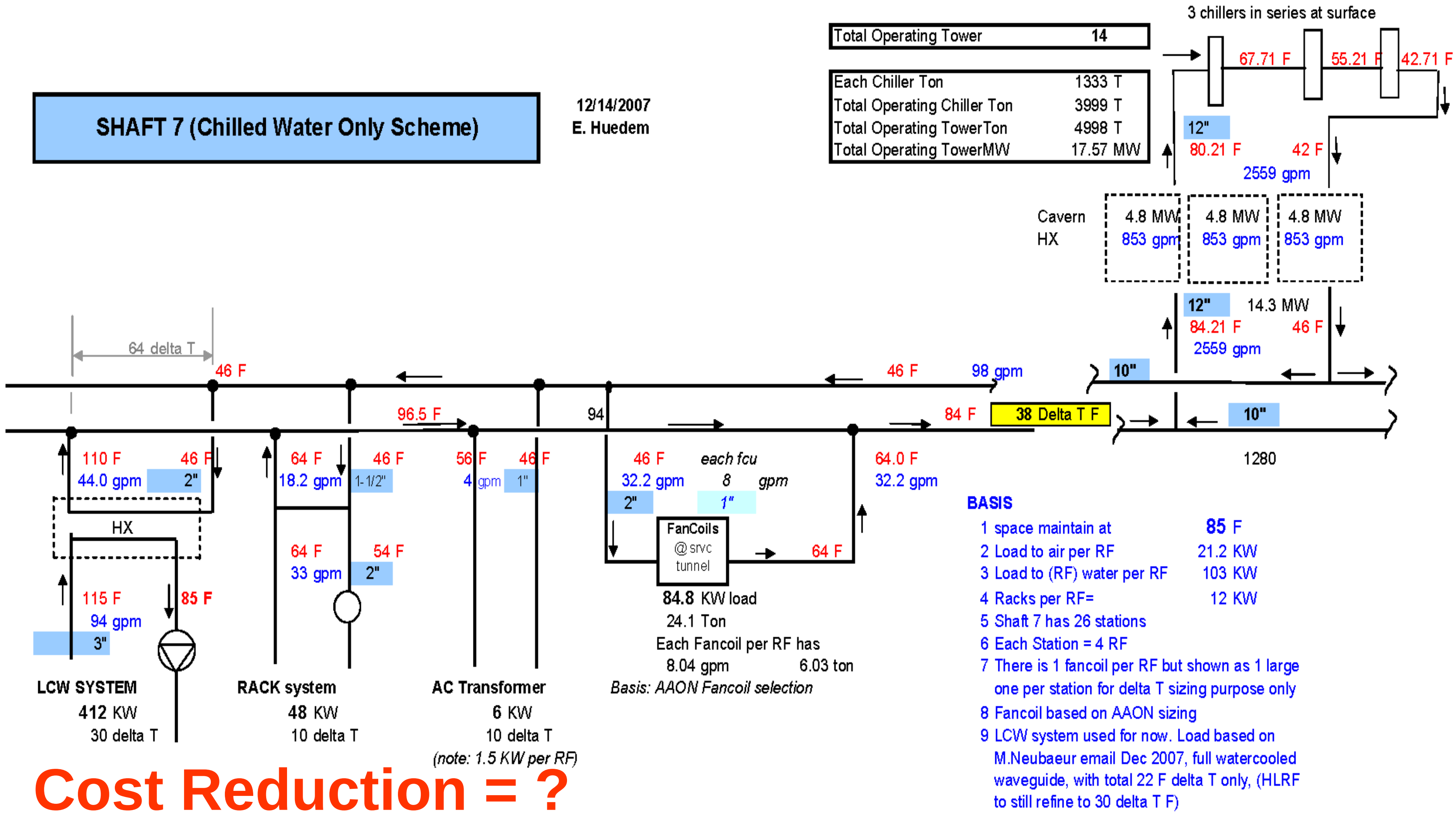


Cost Reduction = ?

Variation: Replace w compressorized fancoils, maintain 85F

ACTUAL Marc Dec 4 2007 VE list

Evaluate Shaft 7 cost based on following selected list



Cost Reduction = ?

Summary

Post RDR effort (Nov & Dec 2007) =updating HLRF heat table, delta T, value engineering session.
started investigating with HLRF low flow-high delta T "Load

The number of suggestions (VE list, one water system, learning from tesla/xfel etc) should result to improvement and **cost reduction!**, but by how much? who's costing? No effort time??

I think chilled water "only" scheme (as suggested in VE list) should at least be considered / eva;uated to find out "first cost" impact, unless the "heat load to air" in bedrock tunnel scheme is reduced much much further

From Oct GDE, it appear that heat Loads and requirement from other area system appear to be changing, increasing and tolerance tightening, so Requirement/criteria agreed by PM and area system will be important

Getting requirement/criteria is difficult,.. getting something that is agreed upon by the majority is more difficult, and it will probably take a while to get this.. For future detailed work (edr??).. it would be helpful to get what criteria/ requirement will be used as basis …