14th Meeting of SRF Group in IDT/WG2

- ✓ Introduction to WBS (Work Breakdown Structure)
- ✓ Tuner review (by Yuriy)
- ✓ Others (if any)

Attendees: A. Yamamoto, S. Michizono, H. Hayano, K. Umemori, S. Posen, S. Belomestnykh, R. Rimmer, R. Geng, M. Liepe, N. C. Lasheras, E. Cenni, L. Monaco, A. Lankford, B. List, S. Stapnes, M. Ross, D. Delikaris, P. McIntosh, Y. Pischalnikov, C. Pagani, P. Burrows, Kirk

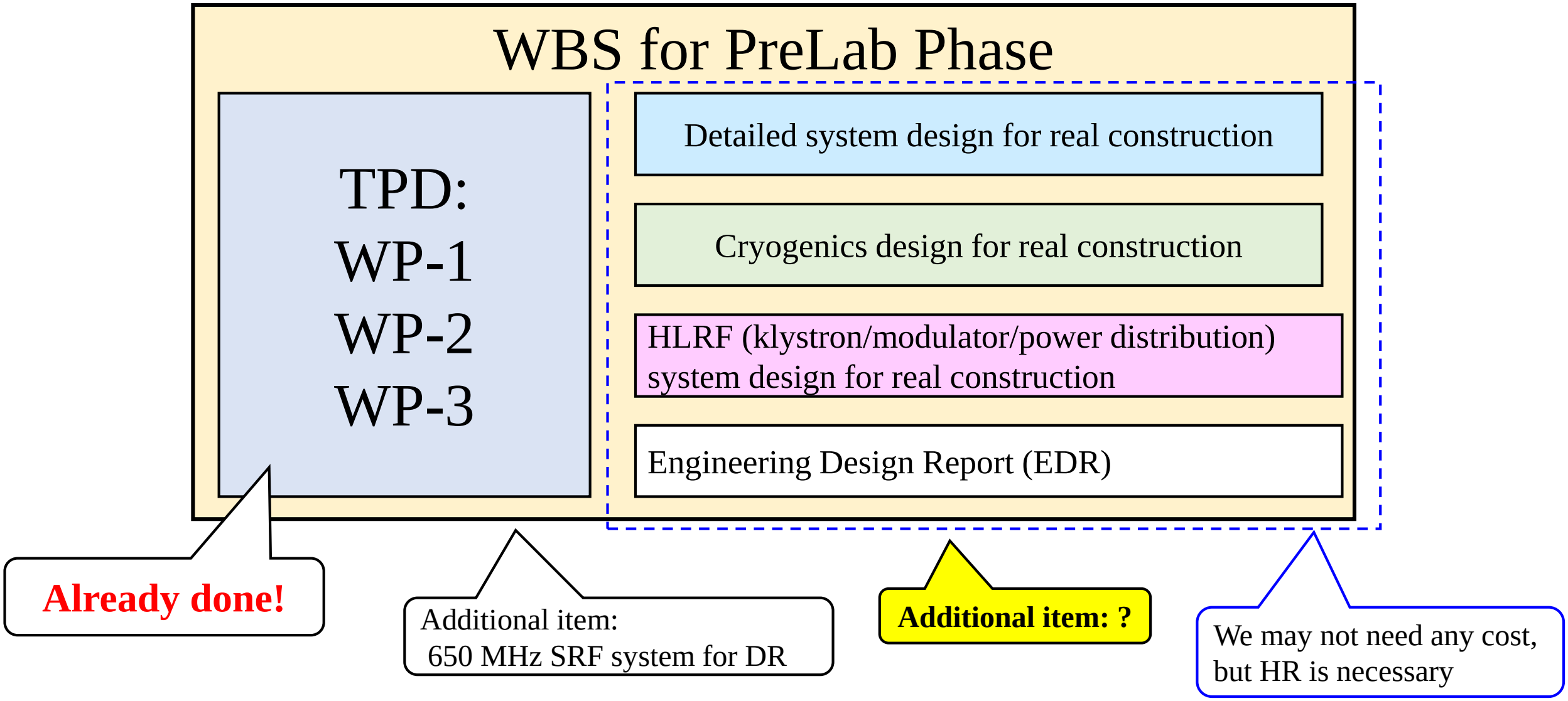
https://agenda.linearcollider.org/event/9179/

You can download 5th version of TPD

Kirk

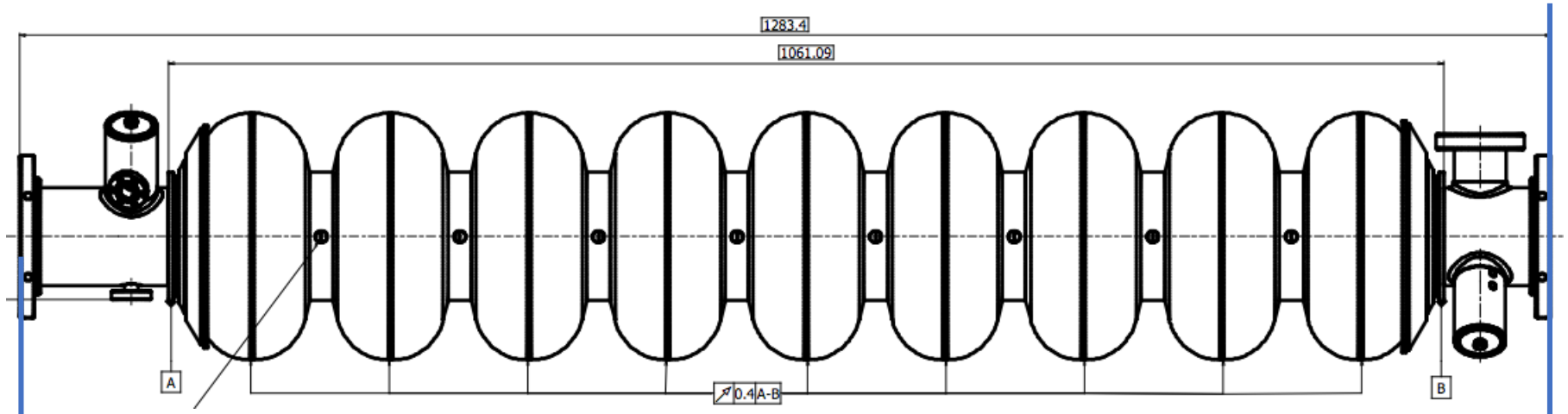
Tentative summary of WBS related to SRF

We need to consider the other materials than TPD for WBS

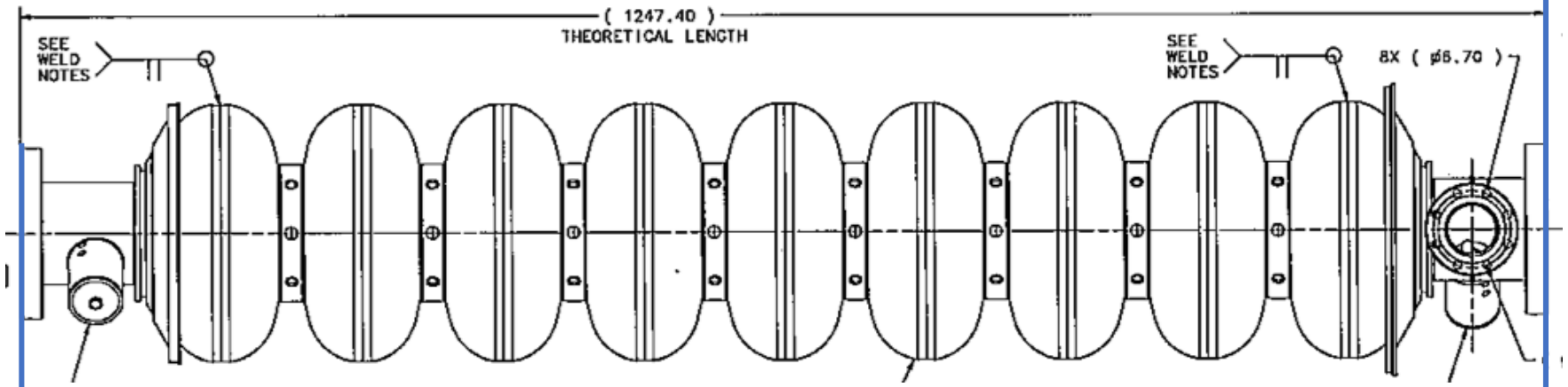


Length difference between TESLA and ILC cavities

XFEL TESLA-Cavity



ILC-Cavity



36mm

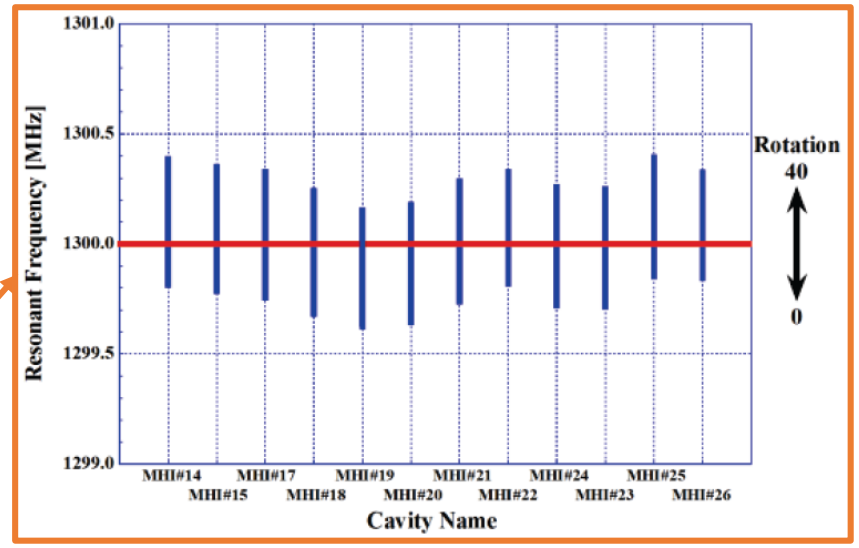
H. Hayano

Table 3.8 in TDR Vol.3 Part II

Results in STF-2

Table 3.8
Main specifications of the frequency tuner.

Tuner	Parameter	Specifications
Slow tuner		
	Tuning range	$>$ 600 kHz
	Hysteresis	$<$ 10 μm
	Motor characteristics	Step motor, power-off holding, magnetically shielded
	Motor location	Inside 5K shield, accessible from outside
	Magnetic shield	$<$ 20mG
	Heat load by motor	$<$ 50 mW at 2 K
	Motor lifetime	$> 20 \times 10^6$ steps
Fast tuner		
	Tuning range	$>$1KHz at 2 K
	LFD residuals	$<$ 50 Hz at 31.5 MV/m flat-top
	Actuator	Piezo actuator, located inside 5K shield, Two actuators for redundancy
	Heat load by actuator	$<$ 50 mW at 2 K
	Magnetic shield	$<$ 20mG
	Actuator lifetime	$> 10^{10}$ pulses



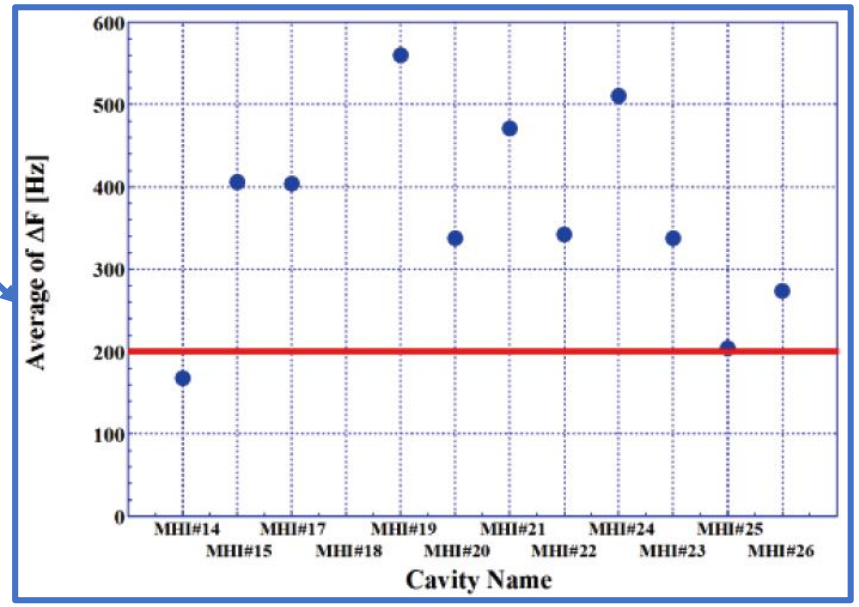


Table 2.12 in TDR Vol.3 Part I

Table 2.12
Various tuners investigated in the Technical Design Phase.

	Blade tuner	Saclay/DESY tuner	Slide-jack tuner
Type	Coaxial	Lateral-Pick-up side	Coaxial and lateral coupler side
Tuner stiffness (design)	30 kN/mm	40 kN/mm	290 kN/mm
Drive unit	Inside vessel, Stepper motor + Harmonic Drive	Inside vessel, Stepper motor + Harmonic Drive	Outside vessel, both manual or stepper motor actuation
Nominal frequency	1.3 GHz	1.3 GHz	1.3 GHz
Nominal tunable range	600 kHz	500 kHz	900 kHz
Nominal sensitivity	1.5 Hz/step	1 Hz/step	3 Hz/step
Piezo	2, thin-layer (0.1 mm), dim. $10\times10\times40\,mm^3$	2, thin-layer (0.1 mm), dim. $10\times10\times40\,mm^3$	1, thick-layer (2 mm), dim. diameter $35\times78\,mm^2$
Piezo Voltage	200 V	200 V	1000 V, operated at 500 V
Nominal piezo stroke at R.T.	55 µm	55 µm	40 µm
Nominal piezo capacitance at R.T.	8 µF	8 µF	0.9 µF

Based on S1-Global

(modified) Table 2.12 in TDR Vol.3 Part I

Revised Table 2.12 "Various tuners investigated in the Technical Design Phase."

12/Apr/2021 Revised by Yuriy + Kirk

	(SLIM) Blade tuner *[1]*	Saclay/DESY tuner *[2]*	Slide-jack tuner *[3]*	Double-lever tuner *[4]*
Type	Coaxial	Lateral-Pick-up side	Coaxial and lateral coupler side	Lateral-Pick-up side
(fit to) Beampipes of TESLA Cavity	short-short, short-long	short-long	short-short, short-long	short-short, short-long
Cavity/Tuner system stiffness	30 kN/mm	**30 kN/mm**	~~290~~ **70** kN/mm	**40 kN/mm**
Drive unit	Inside vessel	Inside vessel	Outside vessel	Inside vessel
	Stepper motor	Stepper motor	Stepper motor	Stepper motor
	Harmonic Drive	Harmonic Drive	both manual or stepper motor actuation	Planetary Gear Drive
Nominal frequency	1.3 GHz	1.3 GHz	1.3 GHz	1.3 GHz
Nominal tunable range	600 kHz	500 kHz	900 kHz	800 kHz
Nominal sensitivity	1.5 Hz/step	1 Hz/step	3 Hz/step	1.4 Hz/step
Coarse tuner hystersis	*100Hz*	*100Hz*		*45Hz*
Piezo	2, thin-layer	2, thin-layer	1, thick-layer	2 , thin-layer
	(0.1 mm), dim.	(0.1 mm), dim.	(2 mm), dim.	(0.1 mm), dim.
	10 x 10 x 40 mm^3	**10 x 10 x 36 mm^3**	diameter 35 x 78 mm^2	**10x 10 x 36 mm^3**
Piezo Voltage	200 V	**120 V**	1000 V, operated at 500 V	**120 V**
Nominal piezo stroke at R.T.	55 µm	**40 µm**	40 µm	**40um**
Nominal piezo capacitance at R.T.	8 µF	**13 µF**	0.9 µF	**13 µF**
Nominal tunable range (tested at 2K)	**2,000 Hz**	**800 Hz**	~600 Hz @500 V	**3,000 Hz**
Capability to repair (motor + piezo)	No	No	OK	OK
# of tuner operated in accelerators	8 @FNAL/FAST	800 @E-XFEL	14 @STF-2, Quantum Beam	320+180 @LCLS-II (HE)
# of tuner operated in S1-Global	2	2	4	

[1] https://lss.fnal.gov/archive/2011/conf/fermilab-conf-11-101-td.pdf
[2] LLRF Tests of XFEL Cryomodules at AMTF: First Experimental Results (cern.ch)
[3] Cryomodule Tests of Four Tesla-Like Cavities in the STF Phass-1.0 for ILC (cern.ch)
[4] https://accelconf.web.cern.ch/IPAC2015/papers/wepty035.pdf

Schedule of SRF (incl. crab cavity sub-) Group Meeting in IDT/WG2

Meeting #	Date	Contents
12	9/Mar	Discussions and preparation for the SRF session in LCWS2021
	12/Mar	**International review "debriefing"**
	15~18/Mar	**9th International Workshop on "Thin films applied to Superconducting RF: Pushing the limits of RF Superconductivity"**
	15~18/Mar	**LCWS 2021 on virtual hosted by CERN**
	25/Mar	1st Crab Cavity Meeting as the crab cavity subgroup in the SRF group
13	30/Mar	Update TPD (WP-1, 2, 3), Recent progress in KEK
14	13/Apr	WBS, Tuner review by Yuriy
15	27/Apr	
16	11/May	
17	25/May	
18	8/Jun	
19	22/Jun	
	28/Jun~2/Jul	**SRF 2021 on virtual**
	26~29/Oct	**International workshop for potential ILC experiments on virtual hosted by Japan (True name is not fixed yet!)**

The deadline of WBS is around one month later!

Questions/Discussions/Comments (memorandum) @14th meeting

Translation by Kirk

- WBS
  - Scope and Deliverables for each item should be well-considered
  - SRF Group is responsible for 650 MHz SRF system in DR?
    - We can think of the both directions, Area System and Technical Items
    - Probably, complicated matrix for HR is necessary for the both directions
    - Some people join the ML and SRF, and also DR
    - J-LAB was responsible for 650 MHz SRF system in RDR and TDR
  - Tuner design is categorized in WP-1, and tuner production in WP-2
  - The deadline of WBS is around one month later
    - Americas and Europe will start to negotiate with their governments from the end of this month
    - WBS is the useful item for this
  - In WP-3, WBS will be discussed in the next meeting
  - In the next SRF Group meeting, we can discuss more
- Tuner
  - Yuriy presented the tuner review as one good candidate for ILC
  - Bias voltage is necessary for piezo drive?
    - Change of LFD is one direction, then it is not necessary
  - When we change the design of tuner from TDR, we need to submit the change request by convention
    - Expert meeting should be organized to be discussed soon
    - This organization is Kirk's homework
  - In pulsed mode, LFD compensation is not too difficult as there are only linear changes
  - It is important to suppress ringing of cavity as much as possible

References

- KEK homepage
  - https://www2.kek.jp/ilc/en/
- Technical Design Report
  - https://ilchome.web.cern.ch/publications/ilc-technical-design-report
  - https://www2.kek.jp/ilc/en/docs/
- The International Linear Collider Progress Report 2015
  - https://www2.kek.jp/ilc/en/docs/
- The International Linear Collider – A Global Project
  - Submitted to European Particle Physics Strategy Update, 2020.
  - https://indico.cern.ch/event/765096/contributions/3295702/
- ILC Action Plan
  - https://www.kek.jp/ja/newsroom/2016/01/06/1400/
  - https://www.kek.jp/ja/newsroom/2018/04/24/1200/
- Recommendations on ILC Project Implementation
  - https://www.kek.jp/ja/newsroom/attic/20191001_%20ILC%20Project.pdf