Technical Design Report : Part 2
Chapter 3: ML and SCRF
3.2: SCRF cavity speficification

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WG3: ML-SCRF Parallel Session, 120425

Logistics

Ch	Sect Heading	Pages	Primary
	PART I: ILC R&D in the Technical Design Phase	280	
1	Introduction	10	Walker
2	Evolution of the ILC design in the Technical Design Pha	10	Walker
3	Superconducting RF technology	95	Yamomoto
4	Beam Test Facilities	70	[Editor]
5	Accelerator Systems R&D	70	[Editor]
6	Conventional Facilities and Siting Studies	10	Kuckler
7	Post-TDR R&D	10	Ross
8	Summary	5	Walker
	Part II: The ILC Baseline Reference	338	
1	Introduction and overview	5	Paterson
2	General parameters and layout	15	[Editor]
3	SCRF Main Linacs	50	Yamomoto
4	Electron source	10	Sheppard
5	Positron source	20	Gai
6	Damping Rings	25	Guiducci
7	RTML	20	Solyak
8	Beam Delivery System and MDI	25	Seryi
9	Global Technical Systems	26	
10	Commissioning, Operations, and Availability	15	Ross
11	Conventional Facilities and Siting	42	Kuchler
12	Upgrade options	20	[Editor]
13	Scope of post-TDR engineeting (tech. risk assessment)	20	Ross
14	Project Implementation Planning	20	Harrison
15	Cost and Schedule	20	Dugan
16	Summary	5	Walker

There are too many chapters to spend 3hrs on each, so we will need to prioritize

Which authors are going to the meeting?

TDR Part II: ILC Baseline Reference

1. Introduction and overview 5 pages
2. General parameters and layout 15 pages
3. SCRF Main Linacs 60 pages

4

5

6

7

8

3.1 Main linac layout and parameters	(Adolphsen)
3.2 Cavity performance and production specification	(Yamamoto, Kerby)
3.3 Cavity integration, coupler, tuners,…	(Hayano)
3.4 Cryomodule design including quad	(Pierini)
3.5 Cryogenics systems	(Peterson)
3.6 RF power and distribution systems	(Fukuda, Nantista)
3.7 Low-level RF control	(Carwardine, Michizono)

9. CFS and global systems 30 pages

10… *see later*

Detailed section outline available here

3.2 SCRF Cavity Performance and Production Specification

3.2 Cavity performance (AY, JK)

Fully functional cavity production capability in each region is mandatory for realizing the ILC project with a strong global technology basis.

The GDE has established qualification performance criteria for each step of the cryomodule production through to linac system performance specification (average beam accelerating gradient). The criteria are summarised in Table 2.1 [x-xx].

Table 1. Cavity performance specification and R&D goals

Cost relevant design parameters	ML cavity operational specification
Gradient in vertical test, including the 2nd pass*	35 MV/m at $Q0 \geq 8x10^9$, average with spread $\leq \pm 20\%$
Cavity-string gradient in cryomodule test	34 MV/m, average
Main Linac operational gradient	31.5 MV/m at $Q0 \geq 1x10^{10}$ average with spread $\leq \pm 20\%$

* Second-pass refers to a second surface process treatment of lower-performing cavities.

3.2 SCRF Cavity Performance and Production Specification -- 2

In Talbe 1, the ILC main linac operational specification is described in terms of an average cavity gradient to be achieved with an allowance for peak-to-peak gradient spread. Cavity performance is listed for two test stages: a vertical low-power test of individual cavities and a pulsed high-power cryomodule test, after a cavity has been connected to a cavity string and inserted into a cryostat. The main linac operational gradient refers to the gradient at which the cavity can operate indefinitely following installation in the main linac. The table assumes less than 3% deterioration of cavity gradient from vertical test to cryomodule test, assuming the 35 MV/m with the 90% yield to 34 MV/m on average, respectively. It also assumes an operational limit of less than 1.5 MV/m below the limit seen in the cryomodule test and an operational controls margin gradient of not more than 3%.

Fabrication and Surface-preparation Process

- Referring TDR Part 1 , SCRF technology and cavity R&D (in charge of R. Geng)

Main Parameters: to be assembled in Cavity Integration?

Components	Requirement	Subject TBD
Basic specification	Follow Tesla/EXFEL 9 cell cavity	
Input coupler	Cold-flange diameter 40 mm	Tunability
Tuner	Blade tuner located at center	Motor maitenability
LHe vessel	Made of Ti	
Magnetic shield		
Frequency	1.3 GHz	
# cell	9	
Cavity pitch length	1.2 xxx m	
xxx		
xxx		

Reference for Cavity Specification

- Technical guideline for ILC-GDE TDR and the cost estimate:
  - referring Specifications for E-XFEL SCRF 1.3 GHz Cavity, issued by DESY
    - EXFEL/001 and associated documents :Rev.B, June 2009, by courtesy of W. Singer (DESY-XFEL)),
    - The reference specification is available with ILC-GDE PMs, under permission of W. Singer (DESY-XFEL)
    - URL: http://ilcagenda.linearcollider.org/event/ILC-SCRF-TR

W. Singer

VALID DOCUMENTS
FOR THE
SERIES MECHANICAL FABRICATION
OF
SUPERCONDUCTING 1.3GHZ CAVITIES
FOR THE
EUROPEAN XFEL

(XFEL/001)

REVISION B / JUNE 23, 2009

1/2

XFEL/001

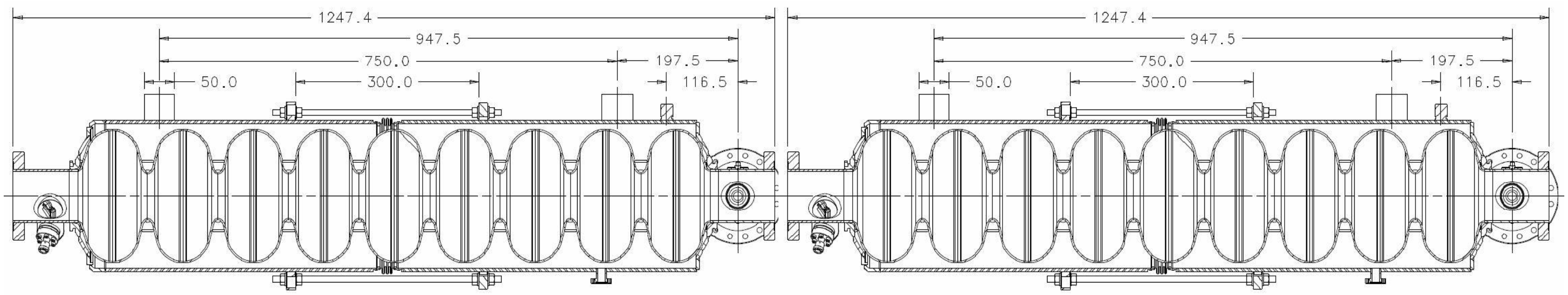
VALID DOCUMENTS

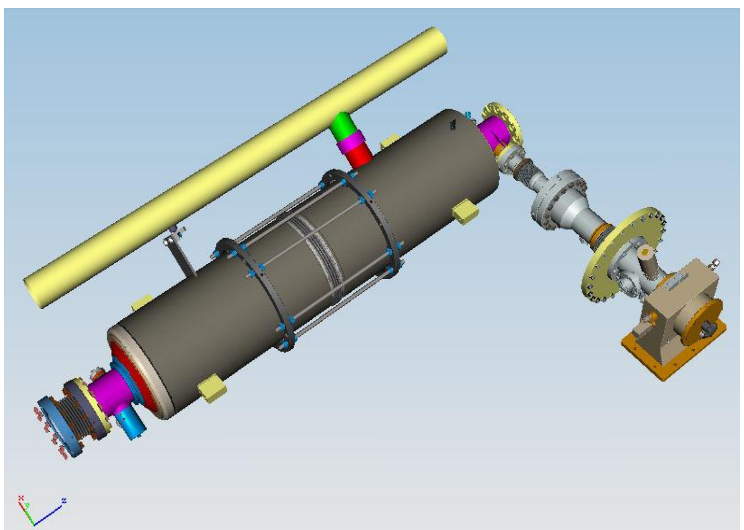
Number	Title	Re
XFEL/001	Valid Documents for the Series Mechanical Fabrication of Superconducting 1,3 GHz Cavities for the European XFEL	B
XFEL/002	Technical Specifications for the Series Mechanical Fabrication Superconducting 1,3 GHz Cavities for the European XFEL	B
XFEL/003	Quality Assurance and Quality Control Specifications	B
XFEL/004	Descriptions, Abbreviations, Drawing and EDMS numbers	B
XFEL/005	Helium Leak Tests	B
XFEL/006	Special Tools and Equipments	B
XFEL/007	Technical Specifications, Niobium Material	B
XFEL/008	Technical Specifications, NbSSTi Alloy	B
XFEL/009	Flow Chart Dumb-Bell Production	B
XFEL/010	Recommendations for the Machining of Niobium and Niobium-Titanium	B
XFEL/011	Recommendation for the Treatment of Niobium Parts (Handling, Cleaning, Etching, Welding)	B
XFEL/012	Overview List and Detailed Inspection List of Tests and Demonstrations	B
XFEL/013	Scanning of Niobium Sheets (Round Blanks)	B
XFEL/014	Frequency Measurement on Dumb-Bell, Half Cell, End Group and Cavity	B
XFEL/015	Technical Specifications for the Series Production of Helium Tanks	B
XFEL/016	Technical Specifications for Welding the Helium Tank to the Cavity	B
XFEL/017	DESY Work Instructions for Welding a Cavity into a Helium Tank	B
XFEL/018	Standards	B

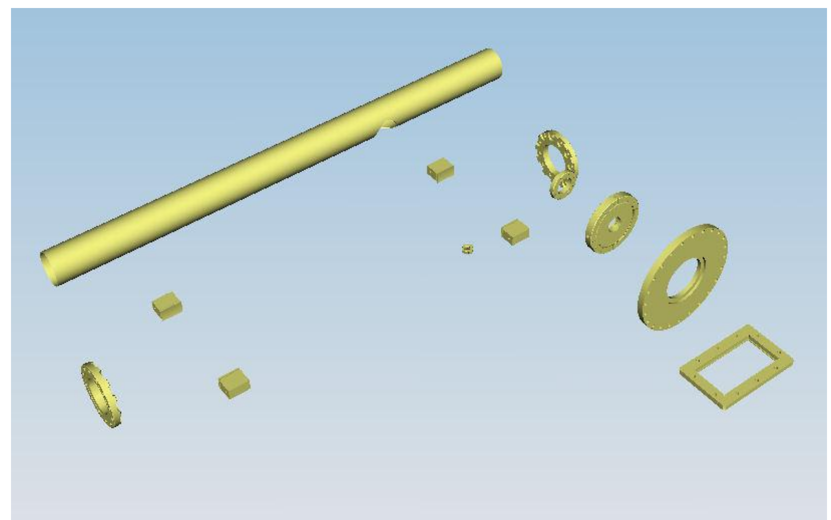
Courtesy:
W. Singer

scrf-treq

Cavity with plug-compatibility







Plug-compatible interface established

Examlple: ML Parameters

(based on KEK BTR, Jan. 2012)

	Main Linacs		Kamaboko		Upgrade (and KCS)	
	Required energy gain	GeV	235		235	
	Cavities / LPDS		39		26	
	Cavity					
	RF voltage	MV	32.70		32.70	
	phase	deg	5		5	
	loss factor (beam loading)	MV	0.04384		0.04384	
	dE/cavity	MV	32.53		32.53	
	DE per LPDS unit	GeV	1.27		0.85	
e+	# LPDS units		186		279	
	Energy gain	GeV	235.96		235.96	
e-	Required OH for e+ src	GeV	2.6		2.6	
	Total e- energy gain	GeV	237.6		237.6	
	# LPDS units (rounded)		188		282	
	Energy gain	GeV	238.50		238.50	
	Overhead (LPDS units)		2		3	
	Electron linac LPDS units		190		285	
	Positron linac LPDS units		188		282	
	Total LPDS units		378		567	
	Max. e- energy (IP)		253.44	1.4%	253.44	1.4%
	Max. e+ energy (IP)		253.50	1.4%	253.50	1.4%

9 cm overhead

original RDR RF units (26 cavities)

Kamaboko RF units (39 cavities)

Cryomodule & cavity counts

	CM9	CM8Q	cavities	quad pkg
e-	570	285	7410	285
e+	564	282	7332	282
totals	1134	567	14742	567

Example: ILC Cryomodule Counts

ILC Cryomodule count

EDMS document D*972665

			standard			
	C6Q6	C8Q2	C9	C8Q1	Cavities	QPKG
Electron source						
5GeV booster			8	16	200	16
E compressor			1		9	0
Positron source						
5GeV booster	4	8		12	184	52
E compressor			1		9	0
RTML (electron)						
1st stage compressor				3	24	3
2nd stage			32	16	416	16
RTML (positon)						
1st stage compressor				3	24	3
2nd stage			32	16	416	16
Main linacs						
Positron			564	282	7332	282
Electron			570	285	7410	285
Totals	**4**	**8**	**1208**	**633**	**16024**	**673**

Blade and Slide-Jack Tuners