STF plan overview

H. Hayano, KEK

Superconducting RF Test Facility

Comprehensive Test Facility dedicated to ILC SC-RF R&D

1. Superconducting Cavity;

fabrication, surface treatment, installation, vertical test / horizontal test,
system test with beam

2. Cryomodule;

cavity installation, alignment, cryostat operation, heat cycle test, input coupler R&D,
tuner mechanism R&D

3. Power source;

modulator development, klystron development, WG components

4. He plant;

High efficiency cryogenic system

5. Beam Instrumentation;

ILC beam generation, BPM, HOM, Low-Level RF control

6. Cavity Surface Treatment Facility;

BCP, CP, EP, HRP, clean room

Purpose of STF

STF Phase 1

1. To provide stable and reliable gradient 35MV/m with reasonable yield rate.
2. To provide reliability data of 45MV/m gradient.
3. To provide a solution to issues of existing ILC-SC engineering using KEK SC engineering experience.
4. Construct cavity treatment facility in KEK.

STF Phase 2

1. Construct assembling facility of ILC cryomodule.
2. Assemble ILC cryomodule.
3. Construct cryomodule test facility.

Both

1. To be a base facility for international collaboration.
2. To provide a basis of realistic cost estimation and mass production.
3. To promote LC researchers and industries for production of SC-Cavities and cryomodules.
4. To give an opportunity to train up young researchers and students.

Issues of existing ILC-SC engineering

1. Reliability of cavity gradient >35MV/m
2. Complexity and cost of Input coupler
3. Rigidity of cavity-jacket relating to Lorentz detuning
4. Reliability of tuner mechanism, Reliability of Piezo in cold
5. Cavity alignment after cooling down
6. Cost optimization of RF Waveguide System
7. Cost optimization of cryomodule

…

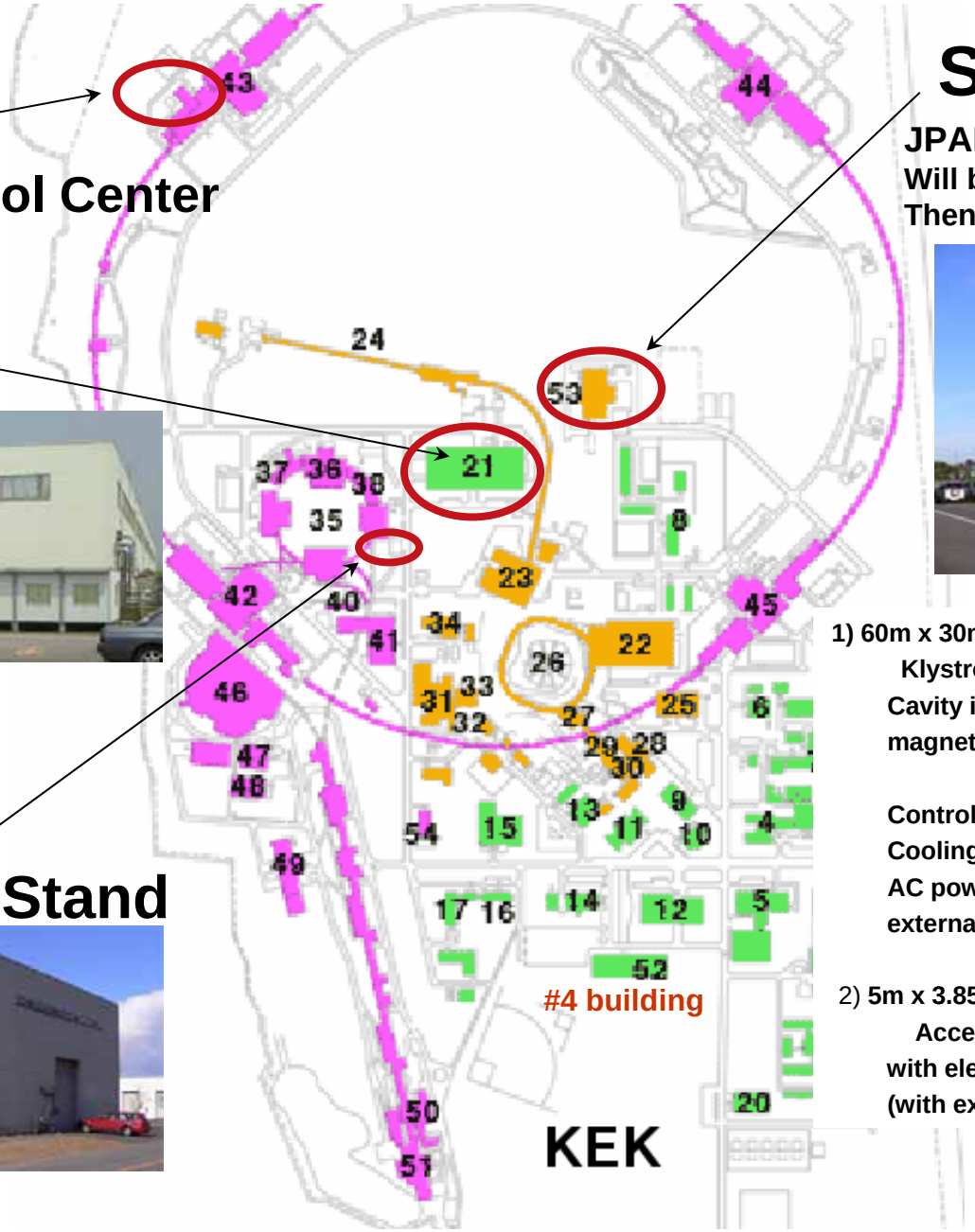
etc.

Location of Test Facilities

KEK-B
He Plant Control Center

ATF

L-band R&D Stand



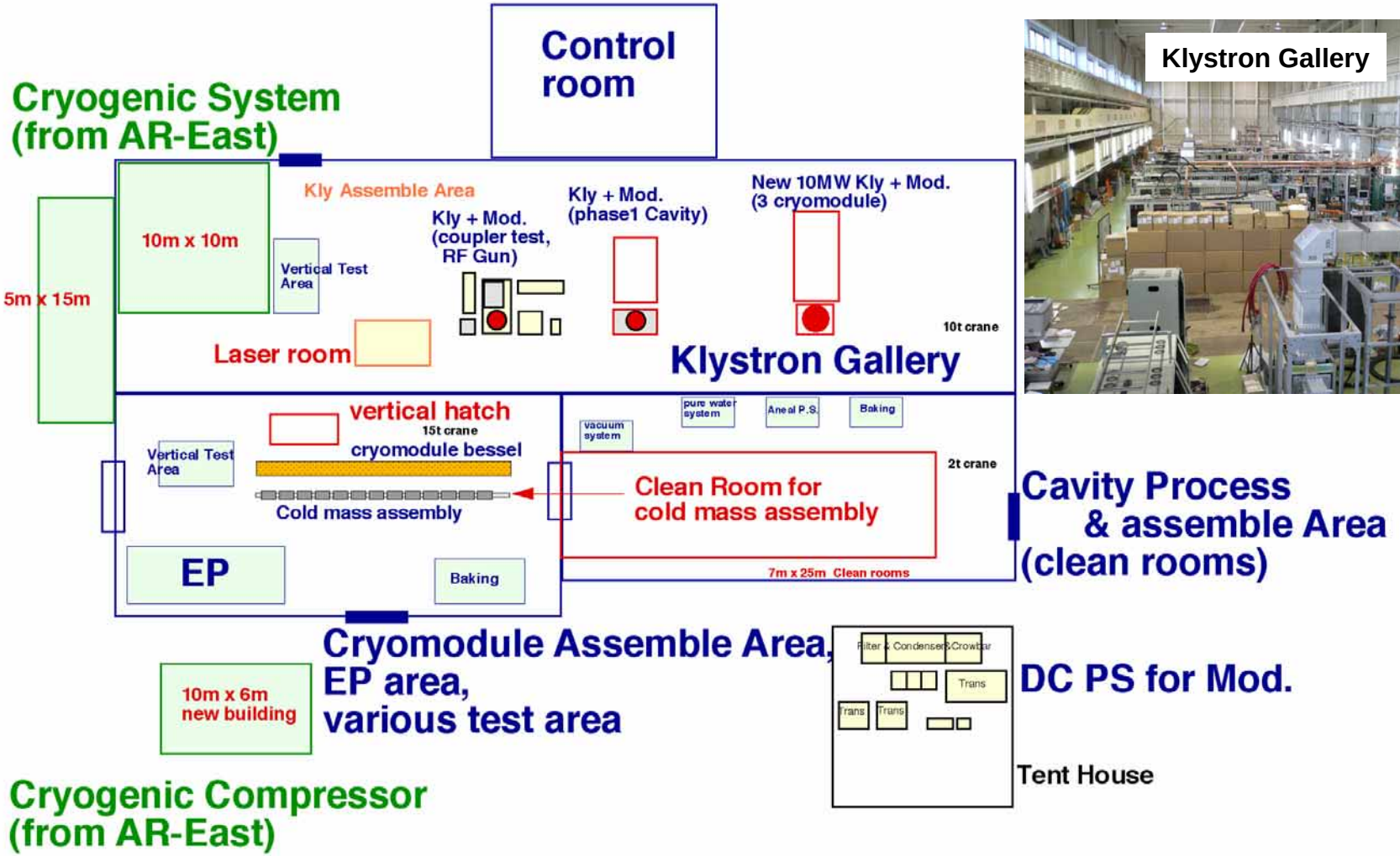
STF

JPARC Proton Linac Building
Will be empty in August 2005
Then, STF construction.

1) 60m x 30m building:
Klystron Gallery (with extendable space)
Cavity installation room
magnet power supply room
(with extendable space)
Control room (with extendable space)
Cooling water facility
AC power yard
external Tent House

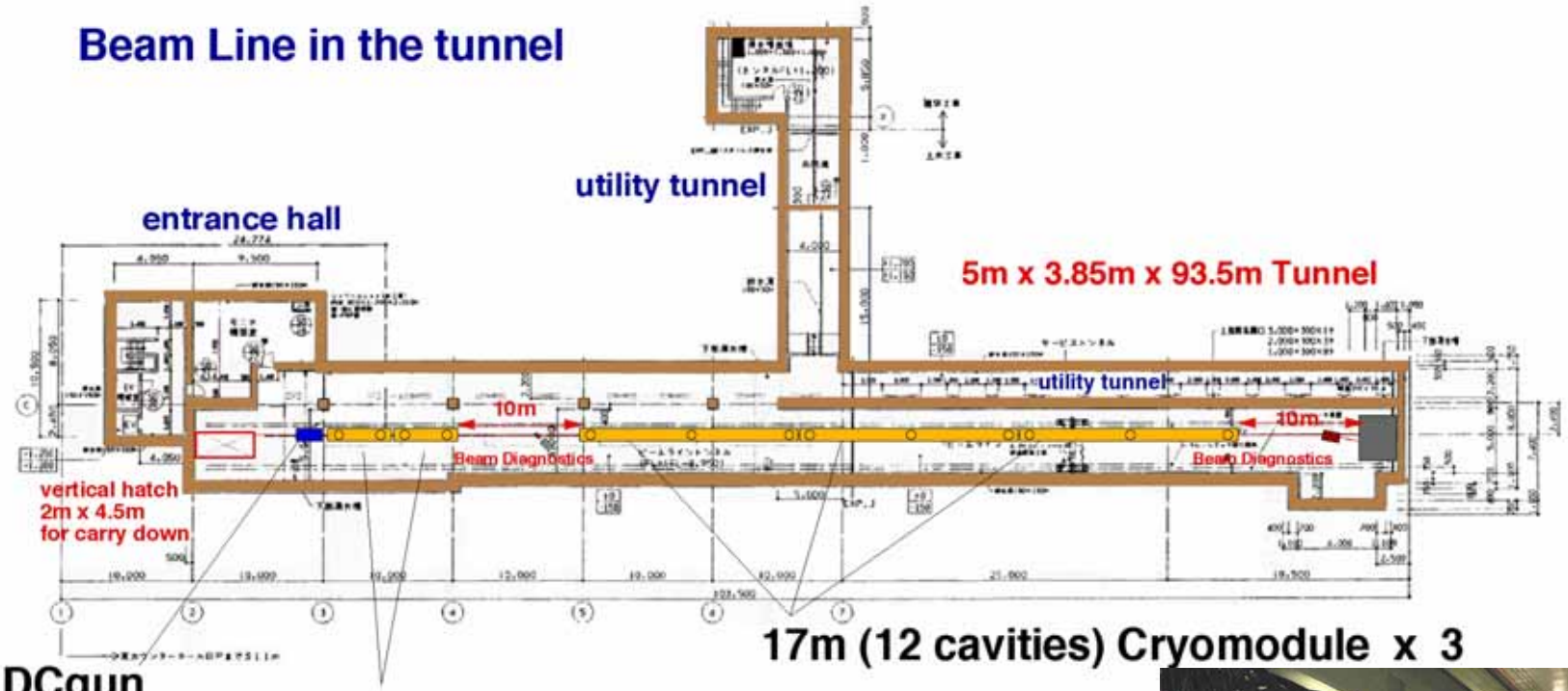
2) 5m x 3.85m x 93.5m tunnel:
Access hatch only 2m x 4.5m
with elevator
(with extendable space)

STF Building plane view



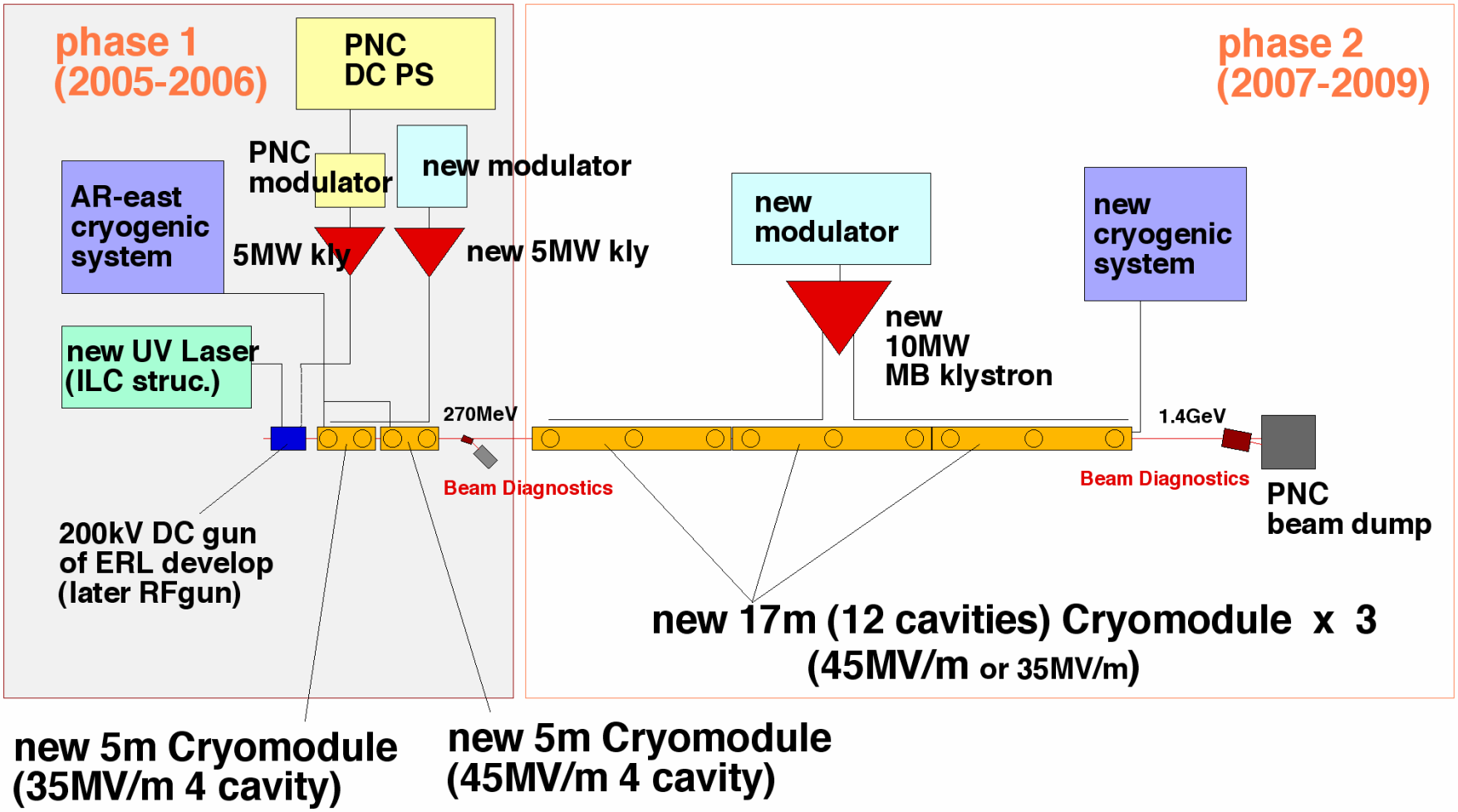
V3.0 Hitoshi Hayano, 02/20/2005

STF underground tunnel plane view



Tunnel underground

Plan of Superconducting RF Test Facility (STF)



V1.2 Hitoshi Hayano, 2/20/2005

STF Test Accelerator

-------- phase 1 ----------

(RF gun): (1.3GHz 1.5cell copper cavity 42MV/m, 3.2nC/bunch
3.2MW, 1ms klystron, 5Hz)

DC gun : DC 200kV CsTe photocathode for quick start
+ UV(262nm) Laser (337ns spacing, 2820bunches)

Test Cryomodule
: 4x 9cell TESLA SC cavity (5m cryomodule), 35MV/m
4x 9cell LL SC cavity (5m cryomodule), 45MV/m

4x 350kW + 4x 450kW = 3.2MW, 1.5ms klystron, 5Hz

Beam analyzer: energy analyzer, emittance, BPM

-------- phase 2 ----------

Accelerating Unit
: 3 set of 17m full-size (12 cavities) cryomodule
2x 10MW, 1.5ms klystron, 5Hz

STF Infra-structure

EP: build new EP(Electro chemical Polishing) facility

HRP : move High Pressure Rinse from L-band test stand

Clean room
: build new clean room for cavity assemble

Vertical Test Stand
: build new stand,
deep enough for superstructure cavity

Coupler Test Stand
: 5MW, 1.5ms klystron, 5Hz
(switch use between Test Cryomodule)

He Plant : 600W at 4K plant moving from AR-East building
(adding new 2K system)

Conceptual design of cryomodule

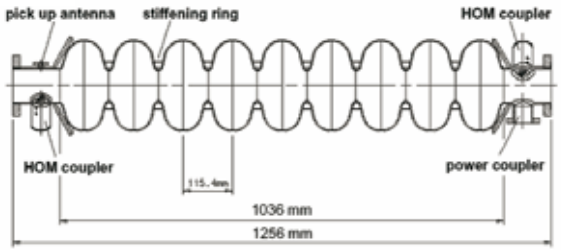
Valve Box

STF Phase 1

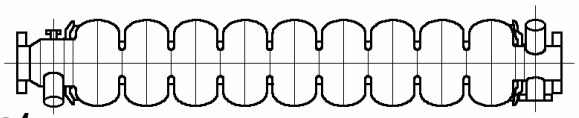
Why two module and connection?
->5m carry hatch,
->Establish weld connection in tunnel.

Weld connection

35MV/m TESLA design cavities

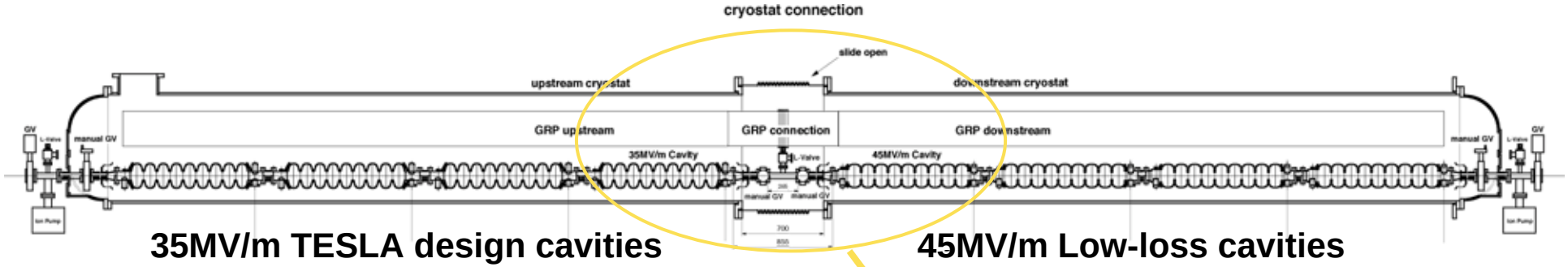


45MV/m Low-loss cavities



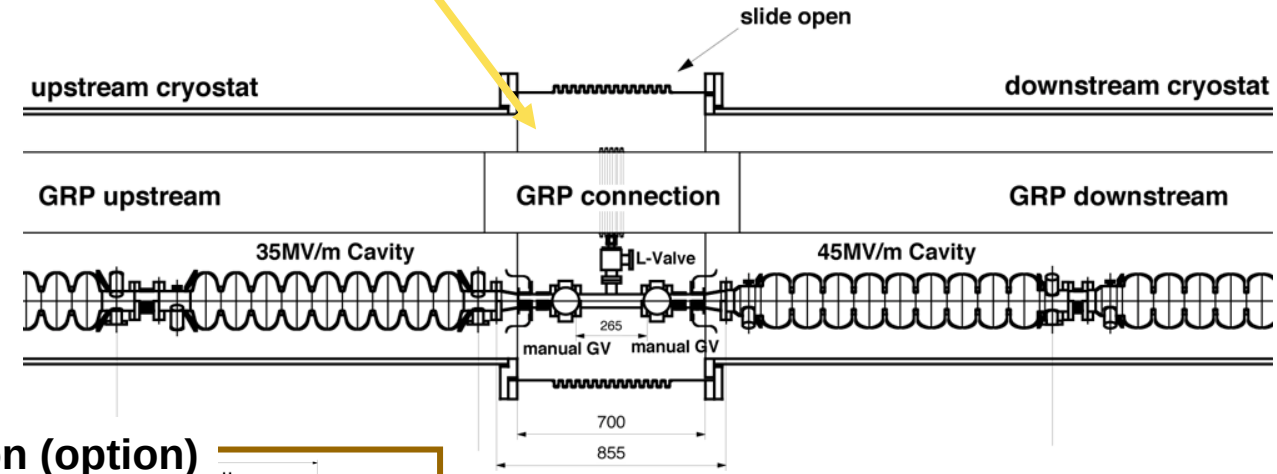
Become to 8 cavities in one cryostat
Like TTF cryomodule

Preliminary design of cryomodule whole assembly

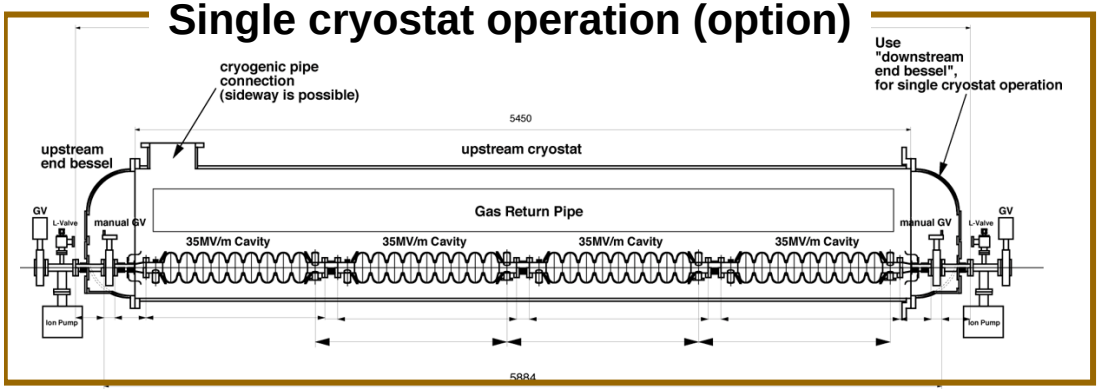


35MV/m TESLA design cavities

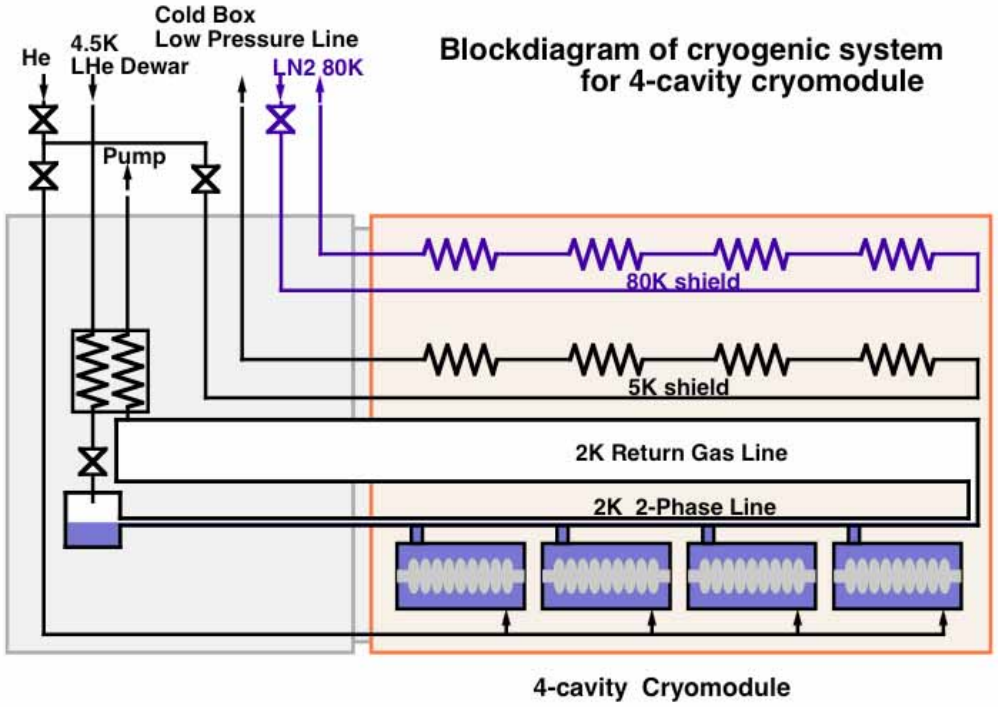
45MV/m Low-loss cavities



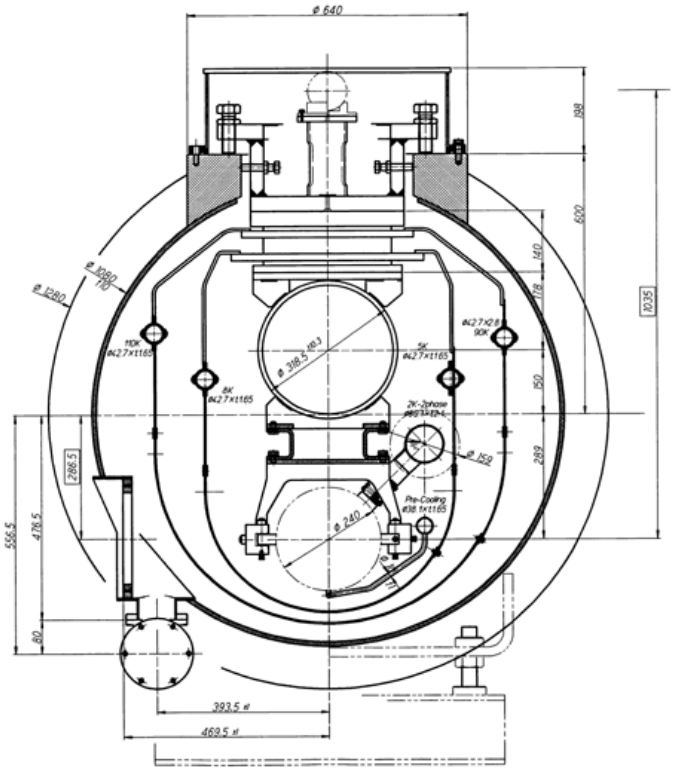
Single cryostat operation (option)



Cryomodule Cryostat Design

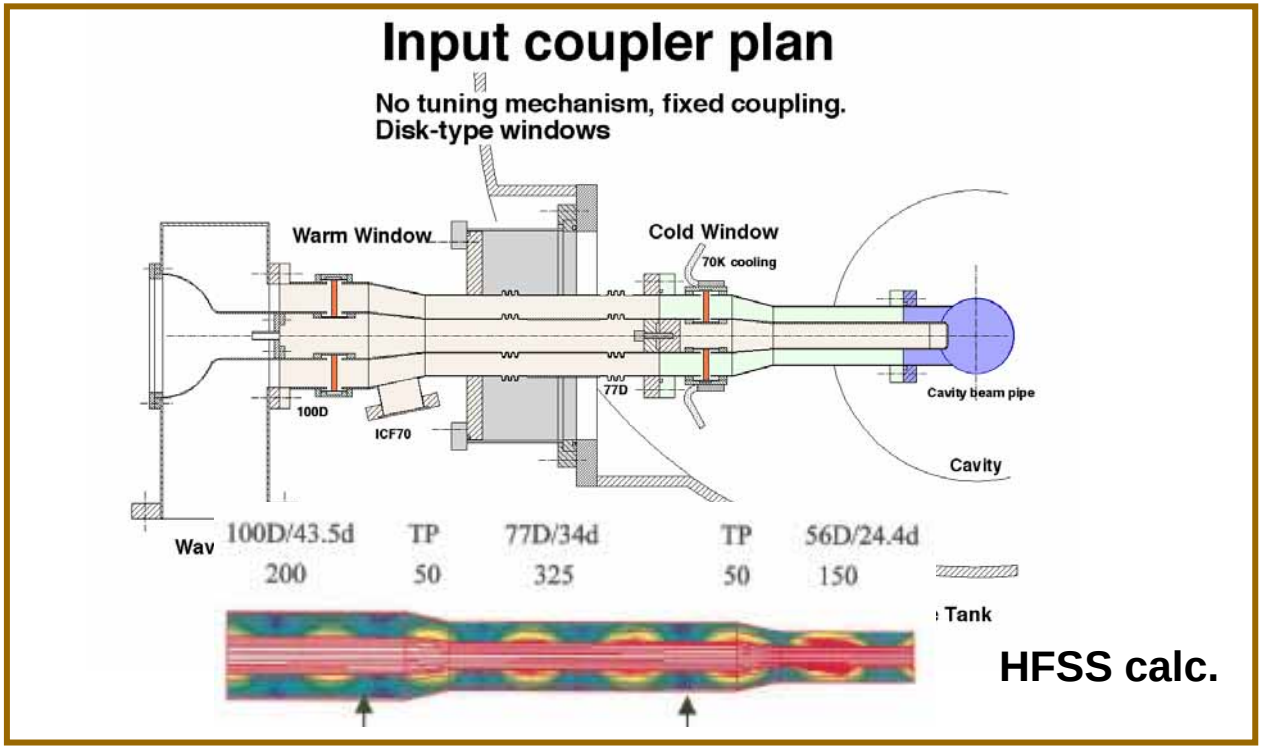


KEK cryomodule cross-section
Design is underway



Improvement Example

1. Input coupler improvement for simple & cost reduction (no tuning)



HFSS calc.

2. cavity and He jacket rigidity improvement for small Lorentz detuning

3. Simplification of Tuner mechanism, exchangeability of Piezo Element, Pulse Motor outside, etc

STF Modulator, klystron plan

1. Buy 5MW Thales Klystron, Build Pulse trans, Modify PNC Modulator putting bouncer circuit in it.

For driving cavities & Input coupler Test stand, later for RF-gun.

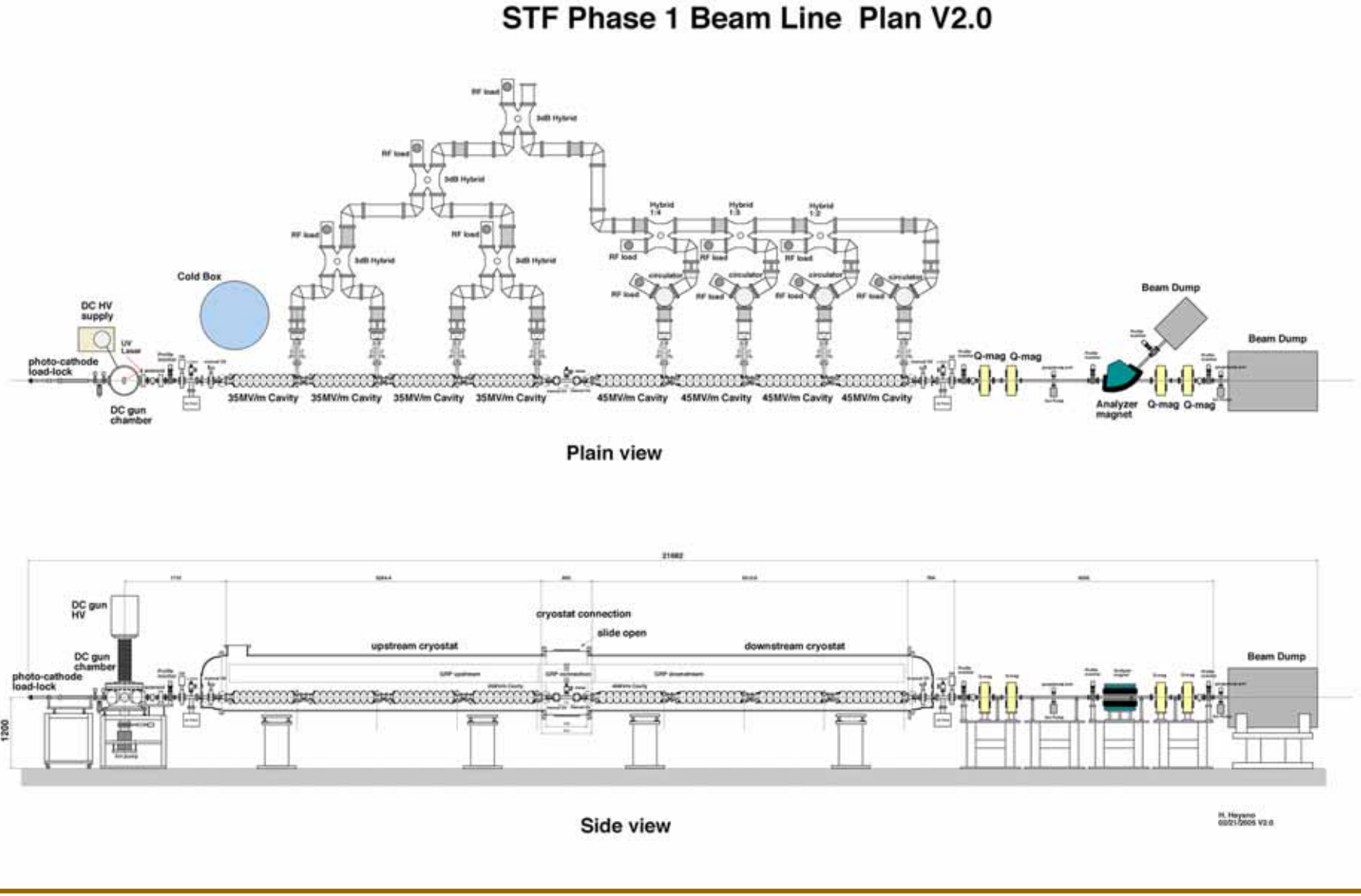
PNC modulator

TH2104C

Additional PT+Bouncer circuit
allows to use TH2104C.

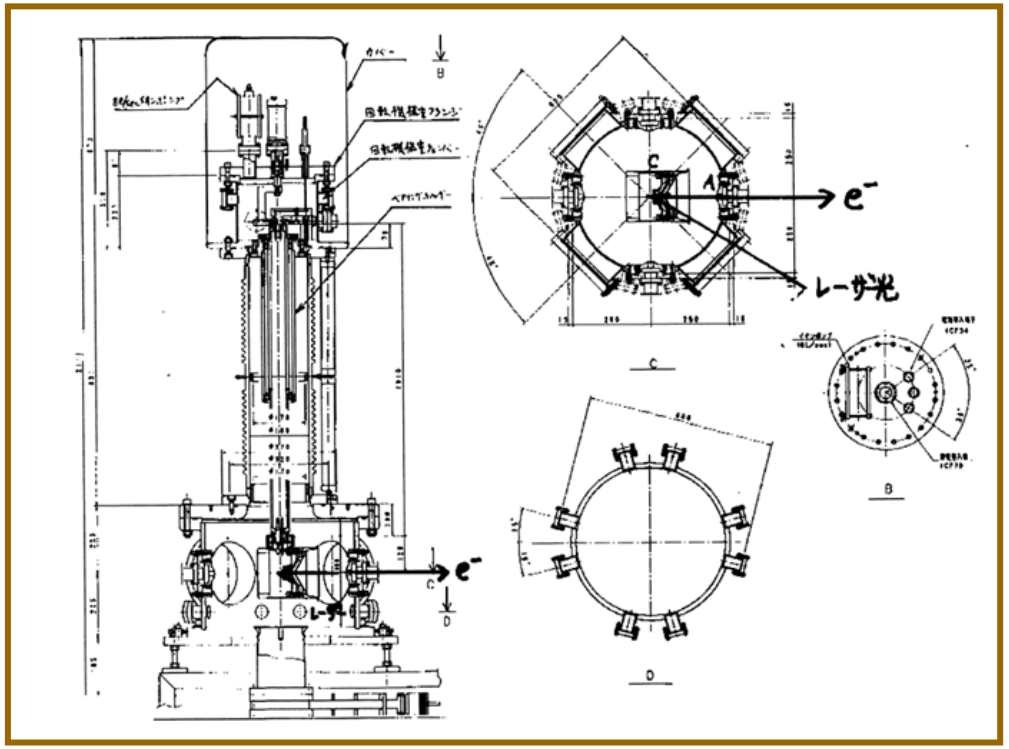
2. Build one more modulator (ILC spec.) for cavity driving (in 2006).
start investigation of technology for bouncer modulator/IGBT modulator.

STF Phase 1 Beam Line Plan



STF Beam source Plan

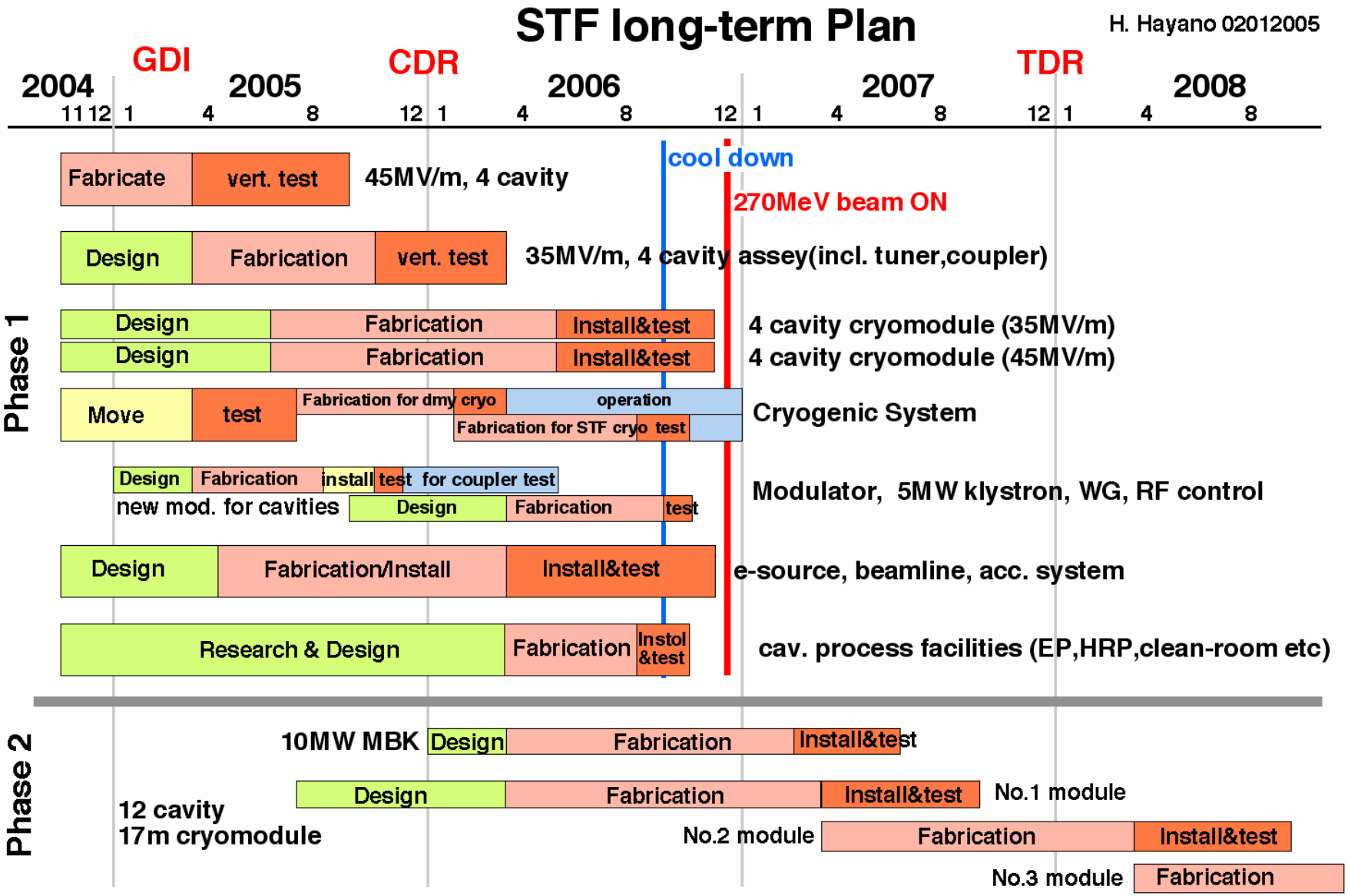
1. **Photo-cathode DC-gun (from ERL development)**



2. **RF gun cavity design & fabrication (KEK machine shop in 2005)**

3. **Photo-cathode Load-lock System (extension of ATF load-lock from ERL development)**

4. **Laser Development (in 2006)**


STF long-term Plan
H. Hayano 02012005
GDI
CDR
TDR
2004
2005
2006
2007
2008
11 12 1 4 8 12 1 4 8 12 1 4 8 12 1 4 8
cool down
270MeV beam ON
Phase 1
Fabricate
vert. test
45MV/m, 4 cavity
Design
Fabrication
vert. test
35MV/m, 4 cavity assey(incl. tuner,coupler)
Design
Fabrication
Install&test
4 cavity cryomodule (35MV/m)
Design
Fabrication
Install&test
4 cavity cryomodule (45MV/m)
Move
test
Fabrication for dmy cryo
operation
Fabrication for STF cryo
test
Cryogenic System
Design
Fabrication
install
test
for coupler test
new mod. for cavities
Design
Fabrication
test
Modulator, 5MW klystron, WG, RF control
Design
Fabrication/Install
Install&test
e-source, beamline, acc. system
Research & Design
Fabrication
Instol &test
cav. process facilities (EP,HRP,clean-room etc)
Phase 2
10MW MBK
Design
Fabrication
Install&test
Design
Fabrication
Install&test
No.1 module
12 cavity
17m cryomodule
No.2 module
Fabrication
Install&test
No.3 module
Fabrication

Sub-group organization

Cryogenic plant : Team K. Hosoyama (7)

High Power RF (inc.LLRF) : Team S. Fukuda(11)

Cryomodule (exc. Cavity) : Team S. Noguchi(3) &
Team K. Tsuchiya(2)

SC-Cavity : Team K. Saito(14)

Electron Gun : Team S. Osawa(4)

Control & Operation : Team ATF(9) & Team XTF(5)
contact: H. Hayano & N. Terunuma

Surface Process Facility : Team K. Saito(14) &
Team K. Ueno (Mec. Eng. Center)

STF phase 1 start-up status

JFY 2004 budget reallocated to

Cryogenic plant movement: March 2005
45MV/m cavity fabrication:March 2005

JFY 2005 budget

2005, 2006 plan still under planning for detail.
need input from collaborator (Asia, US, Europe)

Construction

responsible person has fixed.
detail scheduling has started (making Excel sheet).
interaction with collaborators has started.
interaction with Industry has started.
items: cryogenic system, cryostat, cavity, power source…
Detail design has just started.

end