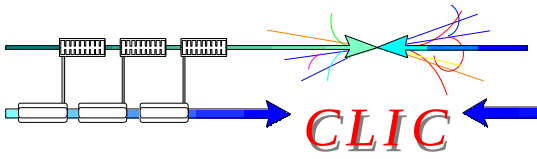


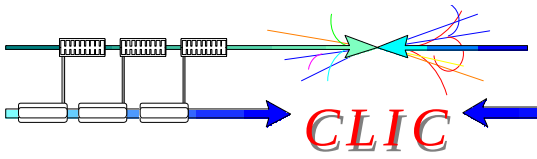
CLIC activities and resources for 2004-2009

Want to bring you up-to-date on latest developments concerning future CLIC activities
- last CLIC meeting presentation 19 September 2003

Reminder from that presentation :
Without extra resources – would take until 2013 to complete IL-TRC R1 and R2 issues, but with extra resources we could do it more quickly.

This information written-up and presented to SPC and Council in December 2003 as part of documents CERN/SPC/834 and CERN/CC/2531 by Maiani entitled "Future Projects and associated R&D"

and also by Aymar as DG designate in document CERN/SPC/835 and CERN/CC/2539 entitled "Preliminary proposal concerning CERN activities other then LHC completion for the period 2004-2010"



In this December paper, DG Designate made following statements and recommendations concerning CLIC :

"The present situation concerning the definition of a linear electron-positron collider and the perspective of its implementation inside a worldwide international cooperation are such that it is recommended to accelerate the tests of feasibility of the CLIC concept, in order to arrive before 2010 at a firm conclusion on its possible use."

"Should the launching of the linear collider construction occur only after 2010, the previous technical choice of design parameters and concept will certainly be reviewed and reassessed in the light of the LHC results. Therefore, it appears appropriate that the assessment of the CLIC design concept be available at that time, should the need of a higher energy then be recognised."

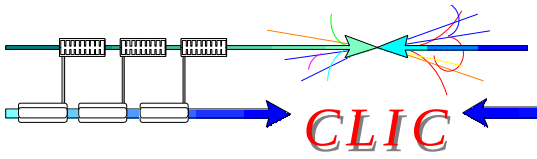
"The above recommendation to complete the CTF-3 facility faster than in the present planning would require additional resources to be committed in 2004 and 2005, which are estimated at 17.2 MCHF and 95 man-years in total."

"The present CERN budget cannot provide this level of additional resources. Only cooperation with some institutions in the Member States, including voluntary contributions "a la carte", in kind and/or in manpower, can help to fulfil this strategic goal. For this to be possible, cooperation with other European laboratories would be needed, with exceptional resources to be committed in 2004 and 2005."

It was said in this December paper that confirmation of the details of this accelerated programme would be provided in March 2004.

As a follow-up to this preliminary proposal DG asked CLIC Study Team to provide a firm proposal in the form of a paper giving the details of an accelerated programme to demonstrate the key CLIC-technology-related feasibility issues by 2009 for discussion in the March 2004 SPC and Council Meetings.

Purpose of this presentation - to tell you what's in this paper

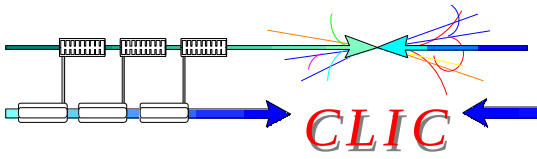


I - CLIC: Summary of physics case

In conclusion :

.... full exploration of foreseen physics will be best addressed by a high-energy, high-precision e+e- collider - important that world particle-physics community have available a choice of technologies including one allowing highest possible energy should physics results dictate such a choice.

.... a 3 TeV e+e- collider provides excellent long-term perspectives within all the speculative scenarios for physics beyond the Standard Model that we have considered. Also quite possible that some completely new phenomenon will be discovered at LHC that will be even more exciting than any of theoretical speculations discussed here, but it is imperative to anticipate the need for very high energy colliding e+e- beams to further pursue the study of such phenomena.



II - CLIC accelerated R and D programme

1. CLIC concept

   .. generally accepted that CLIC technology is the only viable technology for multi-TeV colliders.

2. Main differences with other more conventional design studies

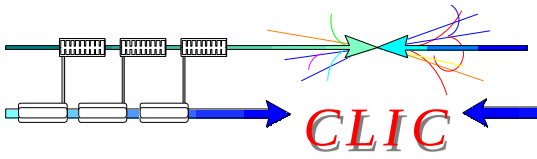
3. Advantages of the CLIC scheme

4. Disadvantages of the CLIC scheme

5. Summary of what has been achieved so far

Summarised in 590 CLIC Notes and other publications- details see

http://ps-div.web.cern.ch/ps-div/CLIC/Publications/CLICNotes.html



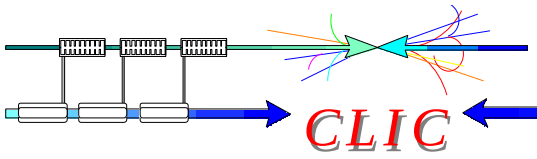
6. What remains to be demonstrated

Two categories of feasibility issues remain to be demonstrated

- CLIC-technology-related feasibility issues
- Issues common to other linear collider studies

The new CLIC Test Facility CTF3 being built to demonstrate all key CLIC-technology-related issues of CLIC two-beam scheme.

Issues common to other linear collider studies will be studied within framework of existing world-wide linear collider collaborations, and in particular in Europe, within EU FP6 Programme.



7. CLIC-technology-related feasibility issues

Proposed to focus attention initially on "CLIC-Technology-Related" issues as opposed to issues which are common to all LC studies -adopting this approach, there are three R1 (feasibility) issues and two R2 (conceptual design) issues, which have to be demonstrated first

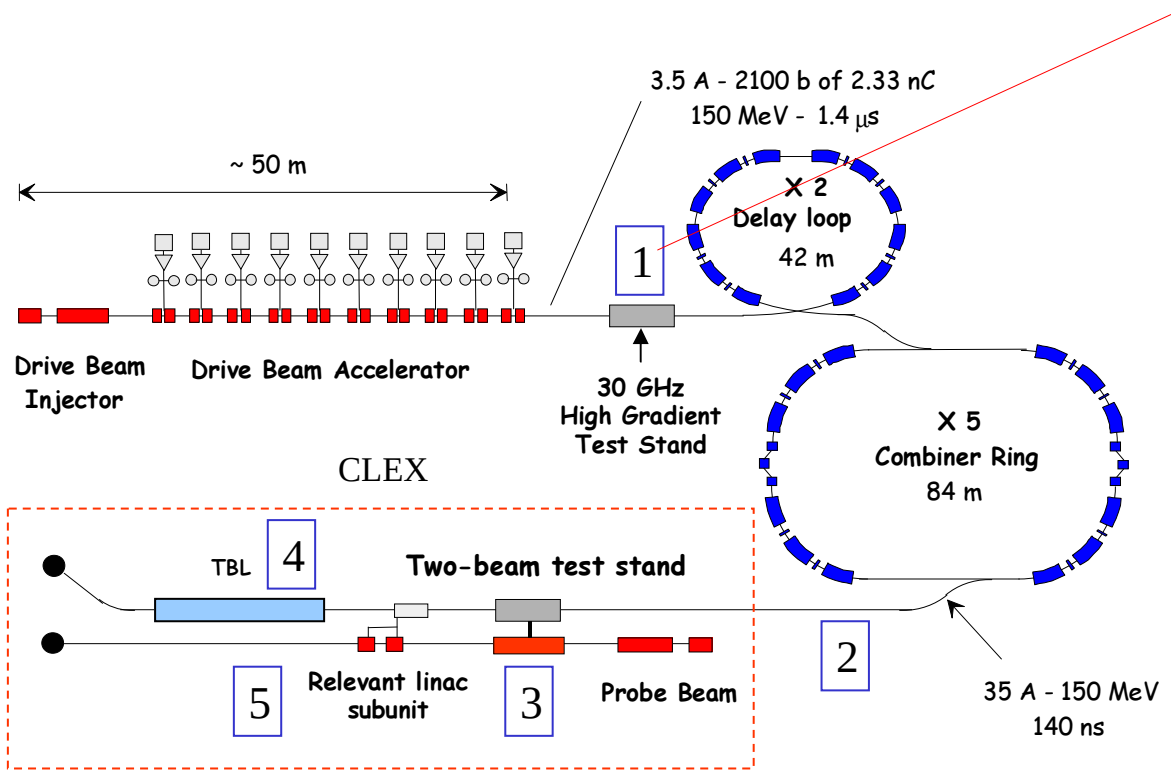
R1.1 Test of damped accel. structure at design gradient and pulse length
R1.2 Validation of drive beam generation scheme with fully loaded linac
R1.3 Design and test of damped PETS, with ON/OFF capability

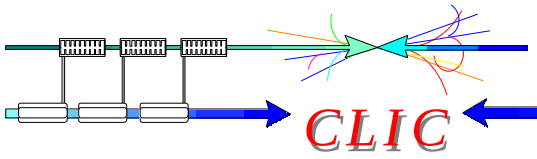
R2.1 Validation of beam stability and losses in the drive beam decelerator, and design of machine protection system
R2.2 Test of a relevant linac sub-unit with beam

All above-listed R1 and R2 feasibility issues can be demonstrated in CTF3.

8. CTF3 feasibility test locations

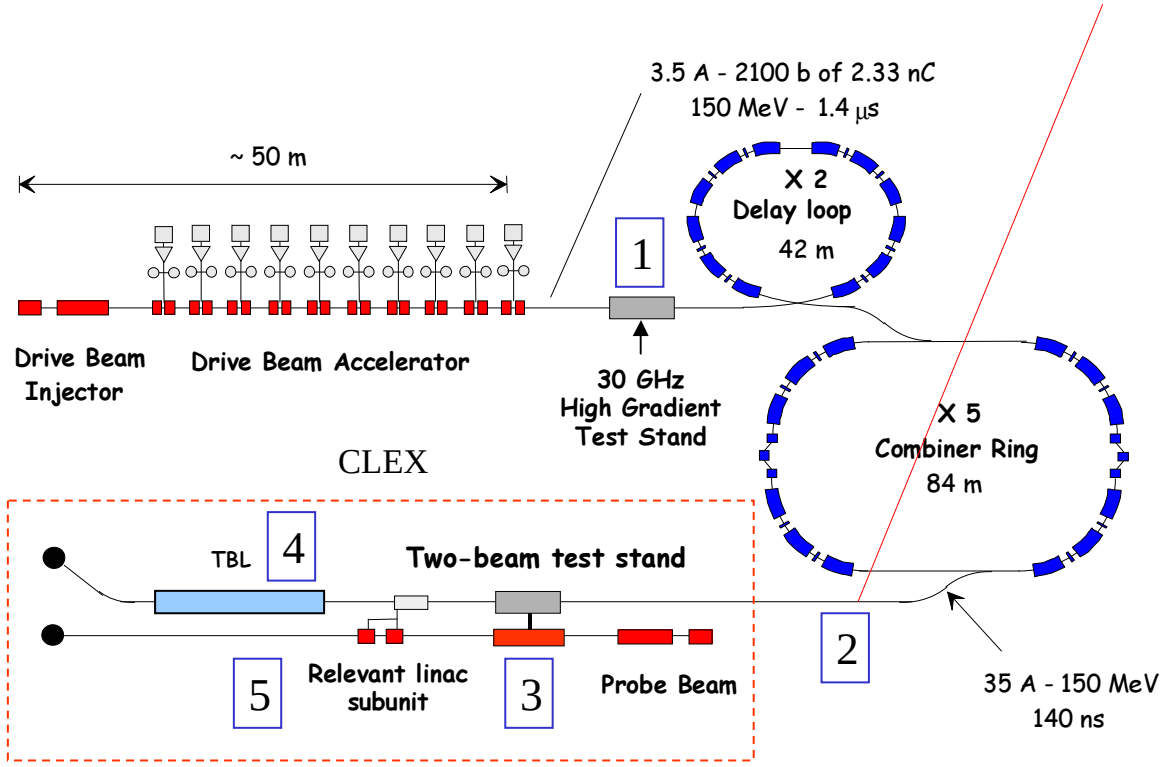
Test of damped accel. structure at design gradient and pulse length (R1.1)
requires linac-driven high-gradient test stand to be completed (location 1)

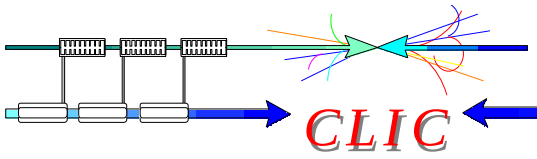




8. CTF3 feasibility test locations

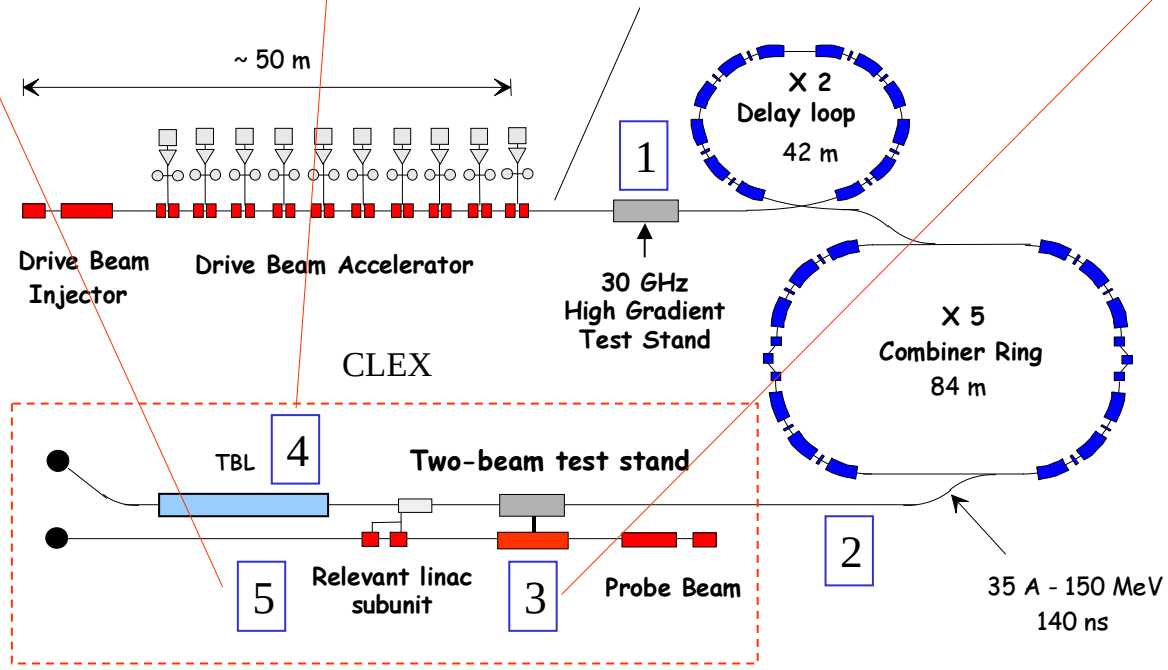
Validation of drive-beam generation scheme with fully-loaded linac (R1.2), and test of an adequately damped ON/OFF PETS (R1.3),
requires CTF3 to be completed up to and including combiner ring (location 2)

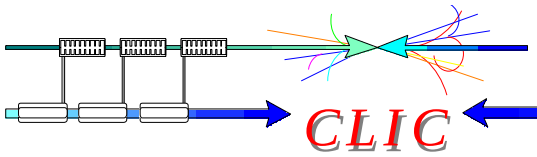




8. CTF3 feasibility test locations

Validation of beam stability and losses in drive-beam decelerator, and design of a MPS (R2.1), and test of relevant linac sub-unit with beam (R2.2),
requires CTF3 experimental area CLEX consisting of a high-power test stand (location 3), the Test Beam Line (TBL) (location 4) and the probe beam with a relevant linac two-beam module (location 5)





9. Presently funded and unfunded sub-systems

In CERN's MTP, CLIC study funded at level of 3.4 MCHF/y and 27 my/y of which 2.6 MCHF/y and 23 my/y are devoted to CTF3.

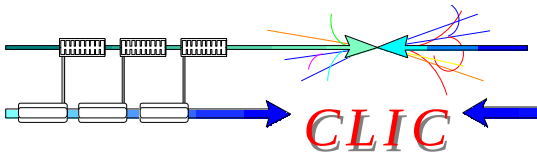
With resources available from CERN and existing collaborations with INFN, LAL, NW University of Illinois, RAL, SLAC, and Uppsala University, linac and delay loop will be completed by end of 2005.

Assuming the CERN funding rate continues until 2009, the following extra resources (with respect to the present level of funding) would be necessary to complete the above-mentioned feasibility programme.

5.7 MCHF and 14 my for combiner ring
8.5 MCHF and 38 my for CLEX including (i) power test stand (ii) linac two-beam module (iii) main-beam linac and (iv) Test Beam Line (TBL).

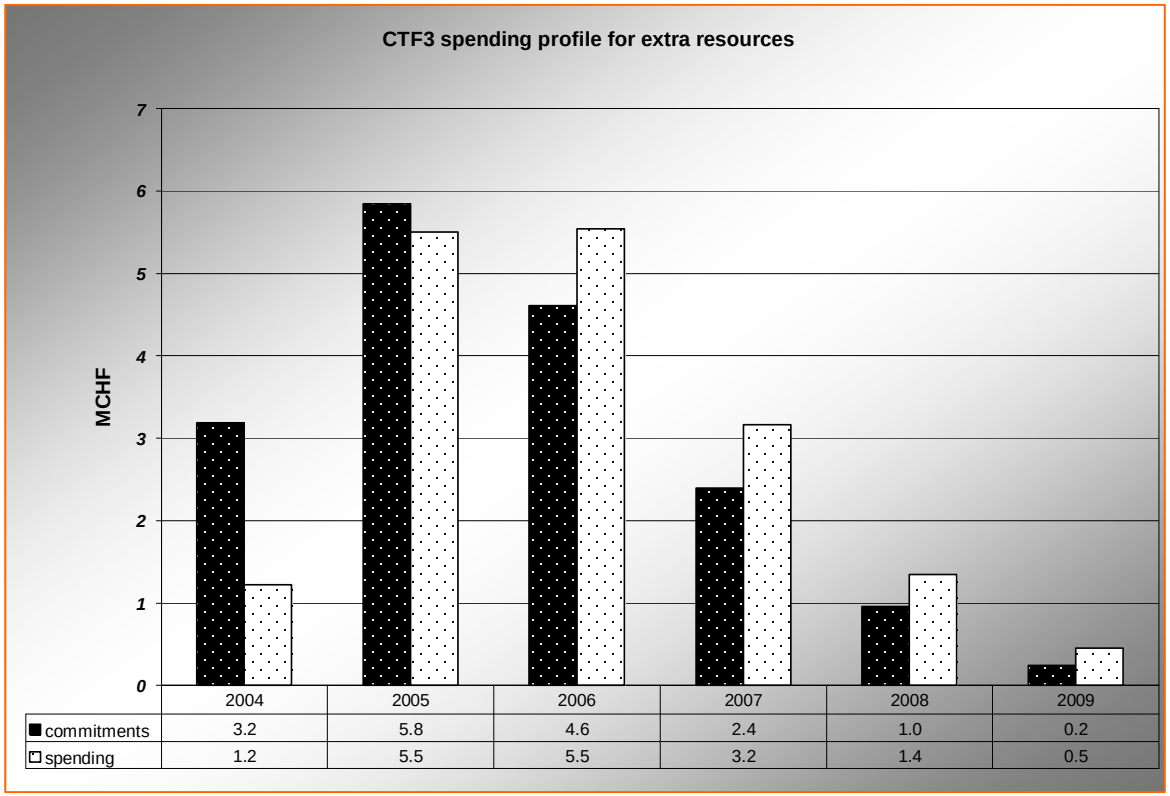
2 MCHF and 6 my to instrument and automate the linac-driven HG test stand
0.5 MCHF and 12 my for structure technology developments
0.5 MCHF and 25 my for maintenance and full-time operation of CTF3

Total of 17.2 MCHF and 95 my to demonstrate R1,R2 issues before 2010.



Extra resources

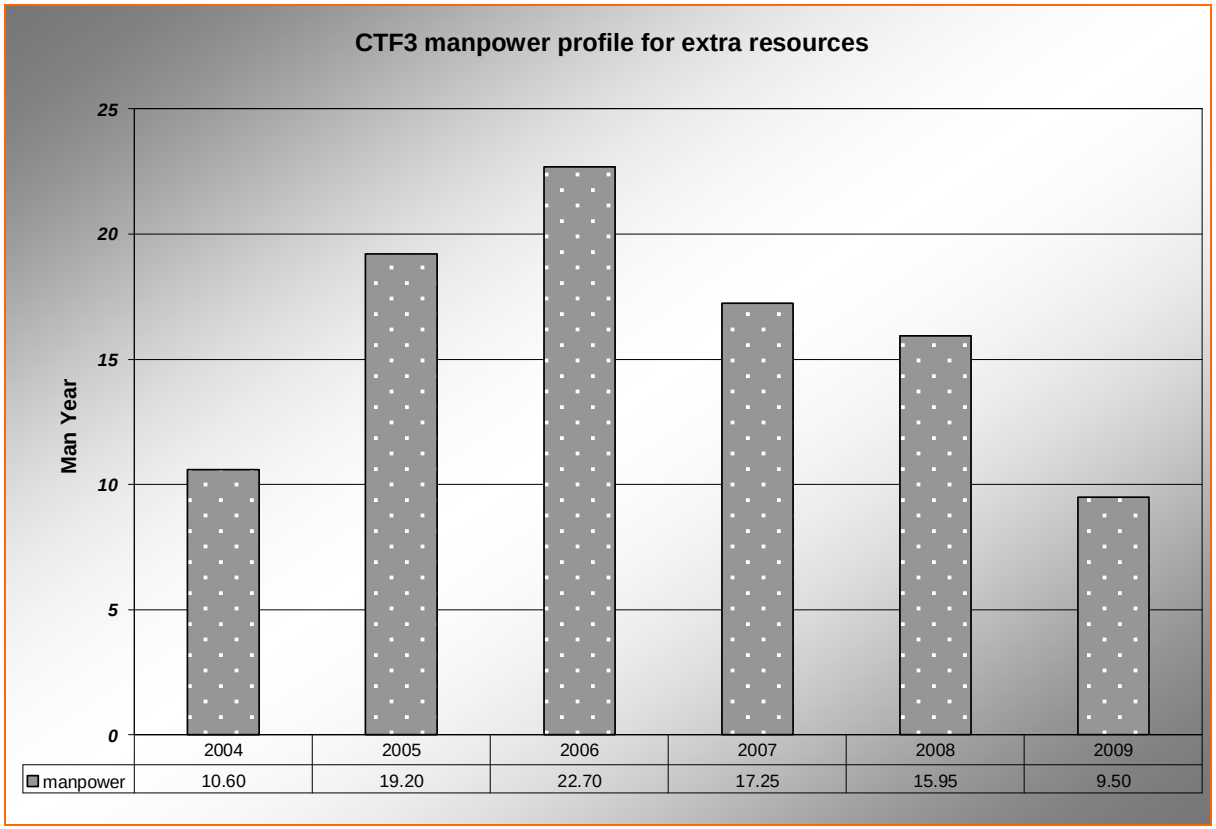
The associated spending profile is given in Fig.3

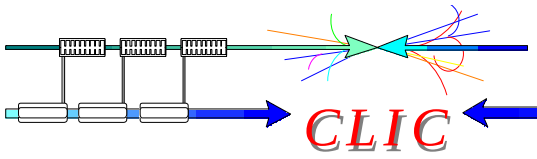


	2004	2005	2006	2007	2008	2009
commitments	3.2	5.8	4.6	2.4	1.0	0.2
spending	1.2	5.5	5.5	3.2	1.4	0.5

Extra resources

The associated manpower profile is given in Fig.4

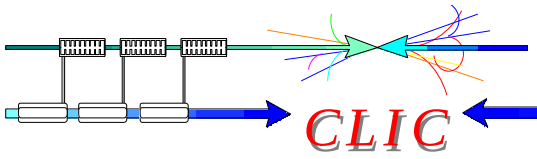




10. Planning

The important construction and installation phases together with test periods of key feasibility issues are given in Table.

	2004	2005	2006	2007	2008	2009
Drive Beam Accelerator						
30 GHz high-gradient test stand						
30 GHz high-gradient testing (4 months per year)						
R1.1 feasibility test of CLIC accelerating structure						
Delay Loop						
Combiner Ring						
R1.2 feasibility test of drive beam generation						
CLEX						
R1.3 feasibility test of PETS structure*						
Probe Beam						
R2.2 feasibility test of relevant CLIC linac sub unit						
Test beam line						
R2.1 Beam stability bench mark tests						



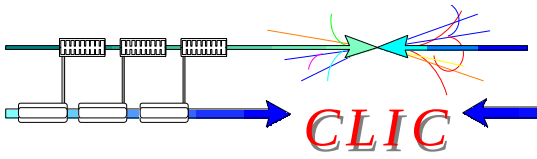
11. Stand-alone high-power 30 GHz test stand

Although this item is not included in the request for extra resources, it would be highly desirable to have a stand-alone high-power 30 GHz source (in parallel with, but independent of CTF3) to carry out the high-gradient testing.

Time required to condition structures is difficult to estimate with present state of knowledge but recent data suggests that molybdenum structures require significantly more time than copper structures.

If this proves to be correct the number of CTF3 operating hours foreseen for conditioning structures will have to be significantly increased which will put too heavy a burden on an already ambitious CTF3 test program.

In this case, it will be indispensable to have a stand-alone high-power 30 GHz source (independent of CTF3) to carry out the high-gradient testing. It should be noted that if CLIC moves on to the design stage several of these high-power 30 GHz sources will be needed to validate all the critical RF components. Such devices are not off-the-shelf items and would need some development.



12. Work packages

All the activities, including those covered by the present resources, and the activities not yet funded, which are required for the above-mentioned feasibility programme, are presented in the form of work packages in Annex 1.

The required resources (material and manpower) which are not presently available in the CERN MTP (unless specifically mentioned), are indicated together with the time schedule.

Member State Institutions are invited to contribute to this programme by providing voluntary contributions "à la carte", in cash, in kind and/or in manpower, including full technical responsibility for part, complete or several work packages.

Annex 1: CTF3 accelerated programme– work packages

Work Package	*Provider*	*Schedule*	*Resources*
1. Combiner Ring (CR), Transfer Line (TL1) to CR and Transfer Line (TL2) with bunch compressor to CLIC EXperimental Area (CLEX)	Collaborating institute or CERN	Up to and including CR: ready for installation end 2005, TL2: 2006	**Total WP1 5.7 MCHF 14 m*y**
1.1 Optics layout A reference layout exists from INFN, further optimisation and follow-up in conjunction with final integration is necessary.	Collaborating institute or CERN		1 m*y
1.2 Magnets Design and procurement of all magnets for the Combiner Ring the transfer lines and the bunch compressor. These include bending magnets, quadrupoles, sextupoles, path length wigglers, septa and corrector magnets. For most magnets a design is already available	Collaborating institute or CERN		1.85 MCHF 4 m*y
1.3 Vacuum system Design and procurement of the aluminium vacuum chambers for the 80 m circumference ring and transfer lines, vacuum pumps, pumping ports, vacuum gauges, shielded bellows. A large part of the design of equipment made by INFN for the Delay Loop can be used. Detailed design work is required.	Collaborating institute or CERN		0.7 MCHF 2 m*y
1.4 Beam diagnostic equipment Supply of 32 beam position monitors, and vacuum ports for synchrotron light. Such monitors have already been developed for the CTF3 Delay Loop. This design could be used without modification	Collaborating institute or CERN		0.53 MCHF 1 m*y
1.5 Power converters for all magnets Some power supplies are available from LPI.	CERN		1.16 MCHF 1.8 m*y
1.6 Technical services and installation cabling, water-cooling, alignment, air conditioning	CERN		1.05 MCHF 2 m*y
1.7 Control system for combiner ring and related software The system has to be compatible with the existing controls infrastructure	CERN, possibly in collaboration with external experts		0.1 MCHF 1 m*y
1.8 Fast kicker with High Voltage pulser Design and manufacture of the fast kicker system (kicker and high voltage pulser) for the CR Special attention has to be given to the impedance seen by the beam.	Collaborating institute or CERN		0.24 MCHF 1 m*y
1.9 RF distribution system for RF deflector Fabrication and installation of the complete waveguide system from the klystron to the RF deflector in the Combiner Ring	CERN		0.1 MCHF 0.2 m*y

2. 30 GHz RF power test stands			**Total WP2 2.9 MCHF 10 m*y**
2.1 Automated 30 GHz high gradient test stand Design, procurement, installation and participation in exploitation of all equipment required for the 30 GHz test stand. This includes all RF and diagnostic equipment as well as the software for automatically operating this installation. Such a test stand will be installed during 2005 in CTF3. This work package includes participation in structure testing.	Collaborating institute or CERN	Start in 2004, to be implemented in stages from 2005 to 2007	2 MCHF 6 m*y
2.2 Two-Beam test stand in CLEX Design, construction and installation of 30 GHz RF test stand for test of PETS and two-beam operation. This test stand can be built in conjunction with WP 2.	Collaborating institute or CERN	Design, fabrication: 2005/2006 Operational 2007, together with 4 in 2008	0.9 MCHF 4 m*y
2.3 30 GHz RF pulse compression system Pulse compression system (delay line or similar device) to compress the long-pulse 30 GHz power pulses obtained from the linac-driven PETS into short high-power pulses for the test stand for CLIC component testing	Development by collaborating institute	2005	CERN MTP
3. Design and construction of the CLEX building	CERN	Construction during 2006	**1 MCHF 2 m*y**
4. 200 MeV Probe beam linac Design, procurement installation and exploitation of the probe beam linac – including : Electron gun, acceleration system, optics, magnetic and diagnostic elements, vacuum system. The following equipment from the former LEP injector linac (LIL) are available : klystron / modulator, RF distribution (3 GHz), and 3 GHz accelerating structures.	Collaborating institute or CERN	Manufacture 2006/2007 Operational 2008	**1.6 MCHF 9 m*y**
5. Relevant CLIC linac sub unit with beam Construction and test with beam of one PETS structure with two CLIC accelerating structures	CERN in collaboration with other institute	Manufacture 2007 Operational 2008	**1.5 MCHF 8 m*y**
6. 35 A Test Beam Line (TBL) Design, construction, installation, exploitation and bench-marking simulation tests of a 20 m long, well-instrumented test decelerator with typically 10-15 RF power-extracting structures (PETS), to validate the CLIC drive beam stability and losses with the CTF3 beam. The making of the PETS for the TBL ia part of WP 7.	CERN in collaboration with other institute	Design 2005/2006, ready for tests in 2008	**1 MCHF 8 m*y**

7. 30 GHz structure development	Collaborating institute or CERN	ongoing 2004 – 2009	**Total WP7 3.0 MCHF 19 m*y**
7.1 Accelerating structure development: Addresses all conceptual, design, and some fabrication issues for accelerating structures. Most of this work is covered in the CERN medium term plan (MTP).	Collaborating institute or CERN	ongoing 2004 – 2009	CERN MTP
7.2 PETS development: Addresses all conceptual, design, and some fabrication issues for PETS structures (covered by MTP). Fabrication of 12 PETS for TBL in CLEX.	Collaborating institute or CERN	ongoing, proof-of-principle prototype for 2007 TBL PETS - 2008	**2.5 MCHF 7 m*y**
7.3 Structure technology development: Addresses technological and fabrication issues for accelerating and PETS structure developments (refractory metals, copper alloys, composites, 5-axis machining and metrology). The TS department at CERN would be the most appropriate place to do this work if the necessary resources can be found.	Collaborating institute or CERN	2004-2006	**0.5 MCHF 12 m*y**
8. Operation of CTF3 Support for operating the facility. This essentially concerns development of operation software .	CERN, in collaboration with other institutes	up to 2010	**0.5 MCHF 25 m*y**
The following item is not part of this request for extra resources, but is considered to be highly desirable (see chapter 12).			
9. 30 GHz stand-alone power source for development of CLIC RF equipment: Design, development, installation and commissioning at CERN of a 200 MW RF power source at 30 GHz, pulse length 140 ns, repetition frequency 50 Hz. Candidates are gyroklystron, FEM, magnicon or similar devices. Several of these devices might be combined to achieve the required power.	Development by collaborating institute or order from industry with experience with similar devices.	Delivery mid 2006, ready for operation at CERN beg. 2007	**10 MCHF 6 m*y**

SPC and COUNCIL (March 2004)

Physics case presented to SPC by J. Ellis
Physics case presented to Council by J. Engelen

Accelerated CTF3 programme presented to both SPC/Council
by Jean-Pierre – now report on outcome and discussions