# Risk registry, limitations, solutions and implications

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CLIC 09 Workshop

# CLIC risk registry

**CLIC FEASIBILITY ISSUES**

last update: 2009.07.01

| | SYSTEMS | Critical parameters | Relevant Facilities<br>Common with ILC in red |
|---|---|---|---|
| Structures | Main Beam Acceleration Structures:<br>Demonstrate high-power operation of nominal CLIC structures with damping features at the design gradient, with design pulse length and breakdown rate . | Average loaded gradient 100 MV/m<br>total/flat-top pulse length 240/160 ns<br>breakdown probability/pulse < 3·10-7 /m<br>average a/λ > 0.11<br>Long range wakefield <6V/(pC*m*mm ) | CTF2&3 (2005-2010)<br>Test Stand (2009-10)<br>SLAC/NLCTA<br>SLAC/ASTA<br>KEK/NEXTEF |
| | RF Power production structures:<br>Demonstrate high-power operation of nominal PETS with damping features at the design power, with design pulse length, breakdown rate and on/off capability | Generated power 132 MW<br>total/flat-top pulse length 240/160 ns<br>breakdown probability/pulse < 1·10-7 /m<br>Wakefield < 9 V/(pC*m*mm )<br>On/Off/adjust capability | CTF3 (2005-2010)<br>CTF3/TBTS (2008-10)<br>CTF3/TBL (2009-10)<br>SLAC/ASTA |
| Two Beam | Two Beam Acceleration and module integration:<br>Demonstrate two-beam acceleration and operation in a prototype module equipped with all critical subsystems | Two Beam Acceleration at nominal parameters as given above for individual components<br>Pulse shape accuracy < 0.1% | CTF2&3/TBTS<br>(2004-10) |
| Drive Beam | Drive Beam Production<br>- Beam generation and combination<br>- phase and energy matching<br>- Potential feedbacks | 100 A peak current- 590 µC total charge<br>12 GHz bunch repetition frequency,<br>1 mm rms bunch length<br>0.2 degrees phase stability at 12 GHz<br>7.5 $10^{-4}$ intensity stability | CTF3 (2005-2010)<br>CTF3/TBL (2009-10)<br>Simulations<br>X-FEL<br>LCLS |
| | RF power generation by Drive Beam<br>- Rf power extraction | 90% extraction efficiency | CTF3/TBL Simulations |

CRITICAL ISSUES | FEASIBILITY ISSUES

https://edms.cern.ch/nav/CERN-0000060014/AB-003093

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|---|---|---|---|
| Beam Physics | Generation and Preservation of Low Emittances<br>Damping Rings, RTML and Main Linacs | Emittances(nm): H= 600, V=5<br>Absolute blow-up(nm): H=160, V=15 | ATF, SLS, NSLSII<br>Simulations<br>LCLS, SCSS |
| Stabilization | Main Linac and BDS Stabilization | Main Linac : 1 nm vert. above 1 Hz;<br>BDS: 0.15 to 1 nm above 4 Hz depending on final doublet girder implementation | CESRTA<br>ATF2 |
| Operation and reliability | Operation and Machine Protection<br>Staging of commissioning and construction<br>Machine protection with high beam power | drive beam power of 72 MW @ 2.4 GeV<br>main beam power of 13 MW @ 1.5 TeV<br>MTBF, MTTR | CTF3 Simulations |
| Detector | Conditions for the experiments<br>Detector design and shielding compatible with short bunch interval and breakdown generated by beam beam effects during collisions at high energy | Time stamping: 0.5 nsec bunch interval<br>Beam-Beam background:<br>$3.8\ 10^{8}$ coherent/1e5 incoherent e+/e- pairs,<br>Hadrons, High muon flux | Simulations |

# Critical issues (Selected BDS related)

**LIST OF CRITICAL ISSUES** EDMS#: 918791

last update: 2009.07.01

| | SYSTEMS (level n) | Critical parameters | Parameter specification | | Crucial design choice or feasibility issue | Performance issue | Cost issue | Relevant Facilities Common with ILC in red | Working group/Review/ Committee |
|---|---|---|---|---|---|---|---|---|---|
| Beam physics | **Spent beam line design** | NA | In progress | D. Schulte<br>E. Tsesmelis | | | X | | BPWG |
| Magnet systems | **Final focus doublet**<br>Only old permanent magnet design exists | NA | In progress | R. Thomas | | X | | | CTC |
| Vacuum systems | **BDS**<br>Probably 0.1ntorr required<br>Space constraints in some magnets | NA | EDMS# 971530 | G. Rumulo | | X | X | | CTC |
| Dumps and collimators | **BDS** | NA | In progress | B. Jeanneret (collimator survival)<br>R. Tomas | | X | | | CTC (D. Schulte) |
| Dumps and collimators | **Tune-up dumps** | NA | No | to be defined | | | X | | CTC |
| **Stabilization** | Main Linac and BDS Stabilization | **Main Linac : 1 nm vert. above 1 Hz;<br>BDS: 0.15 to 1 nm above 4 Hz depending on final doublet girder implementation** | EDMS# 971672 | D. Schulte,<br>R. Nousiainen | X | X | X | CESRTA<br>ATF2 | CTC (synergy with CMWG and stabilization WG) |

CRITICAL ISSUES / FEASIBILITY ISSUES / BDS ISSUES

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| Stabilization | Main Linac and BDS Stabilization | Main Linac : 1 nm vert. above 1 Hz; BDS: 0.15 to 1 nm above 4 Hz depending on final doublet girder implementation | EDMS# 971672 | D. Schulte, R. Nousiainen | X | X | X | CESRTA ATF2 | CTC (synergy with CMWG and stabilization WG) |
| Design of combined stabilization and alignment | Active alignment system, pulse to pulse feedback | NA | In progress | D. Schulte, J. Pfingstner, H. Schmickler | | x | | | Beam Physics WG, collaboration with Stabilization WG |
| Detector infrastructure | Conditions for the experiments Detector design and shielding compatible with short bunch interval and breakdown generated by beam beam effects during collisions at high energy | Time stamping: 0.5 nsec bunch interval Beam-Beam background: 3.8 108 coherent e+/e- pairs High muon flux | No | to be defined | X | X | X | Simulations | MDI |

CRITICAL ISSUES / FEASIBILITY ISSUES / BDS ISSUES

# Detailed BDS items, work in progress

| | | | | | |
|---|---|---|---|---|---|
| | October 14, 2009, 15:30 CET | | | | |
| Area | Concern | Present risk | Expected risk | Mitigation | Alternatives |
| BDS | | Feasibility | | | |
| BDS | | High | | | |
| BDS | | Moderate | | | |
| BDS | Survivability of spoilers | High | ?Moderate | ?Beam test | Consum. spoilers; Nonlinear coll.; etc |
| BDS | Cleanness of collimation | Moderate | | | |
| BDS | Too high incoming jitter | High | | | |
| BDS | Collimation wakes underestimated | Moderate | | | |
| BDS | Crab cavity phase stability not met | Feasibility | | | |
| BDS | FD stabilization 100nm=>0.3nm | Feasibility | High | Prototype | Longer L* scheme |
| BDS | FD stabilization 3nm=>0.3nm | High | Moderate | Prototype | |
| BDS | Too high losses in extraction | High | | | |
| BDS | Survivability of large beam dump window | Feasibility | | | |
| BDS | Background from extraction line | High | | | |
| BDS | Fast meas. of beamstrah. photons in the dump | Feasibility | | | |
| BDS | Reuse of 500GeV layout cost prohibitive for 3TeV | Moderate | Low | | Insert reverse bend & dogleg; or same layout |
| BDS | Very low field (~40Gs) bends in BDS | High | | | |
| BDS | Compatibility of PM FD & stabiliz. w. anti-solenoid | High | | | |
| BDS | Ion effects with field ionization | Moderate | Low | Simulations | |
| BDS | Collective effects | Moderate | | Analysis | |
| BDS | Collim. efficiency and E-beta order | Moderate | Low | Analysis | |
| BDS | Plan to run at lower energy | Moderate | | | |

CRITICAL ISSUES / FEASIBILITY ISSUES / **BDS ISSUES**