CLIC issue: Accelerating structure

1. **Short technical description and corresponding category(ies) of issues :**

Feasibility	Performance	Cost
X	X	X

2. **CLIC nominal parameter issues and comparison with state of the art (in text and/or table):**

Parameter	Unit	Target value CLIC nominal	Present state of the art	Objective 2010	Objective 2012
Gradient	MV/m	100	below	Point 4	Point 4
Short range wake – minimum average a/λ		> 0.11			
Long range wake	V/pC/m/mm	<6			
Mechanical tolerances	µm	<2			

<u>State of the art</u> (achieved performance):

Two accelerating structures operated with:

- an unloaded accelerating gradient of 109 MV/m
- a 240 ns rectangular pulse (optimized for TD18 used as CLIC structure)
- a breakdown rate in the range of a few times 10^{-7} /m
- operation of about one thousand hours after conditioning.
- T18 design with an average a/λ = 0.128
- not equipped with high-order mode damping features

n.b. Beam loading typically reduces the gradient by 15 to 20% (18% in CLIC_G), but this may be partially compensated by a corresponding decrease in breakdown rate. The magnitude of the effect is to be studied in two beam test stand.

3. **R&D program presently set-up**:

The accelerating structure R&D program consists of the following technological, experimental and theoretical activities:

- RF design
- Fabrication and manufacture
- Engineering, integration and costing
- High-power RF test areas and testing

- High-power RF simulation and experimental studies including breakdown, dark current and pulsed surface heating.

For greater detail please see,

http://indico.cern.ch/conferenceDisplay.py?confId=52508 (CLIC meeting, Wuensch)

http://indico.cern.ch/conferenceOtherViews.py?view=standard&confId=39372 (X-band workshop, Wuensch)

http://indico.cern.ch/conferenceDisplay.py?confId=30172 (CLIC ACE, Wuensch)

http://cdsweb.cern.ch/record/1124103/files/CERN-AB-2008-045.pdf (EPAC08)

4. **What performances will realistically be achieved (Target Performances):**
    - **by end 2010**

Operate at least two accelerating structures with:
- at an unloaded gradient above 100 MV/m
- a 160 ns flat-top pulse with an appropriate beam loading compensation ramp
- a measured breakdown rate in the range of a few times 10^{-7} /m
- operation of a **few thousand hours** after conditioning
- either the TD18, CLIC_G or equivalent design with an average $a/\lambda \geq 0.11$
- **equipped with high-order mode damping features**

This will constitute the gradient feasibility demonstration.

- **by end 2012 (including FP7)**

Operate at least **five to ten** accelerating structures with:
- at an unloaded gradient above 100 MV/m
- a 160 ns flat-top pulse with an appropriate beam loading compensation ramp
- a breakdown rate in the range of 10^{-7} /m
- operation of a few thousand hours after conditioning
- **CLIC optimized design**, currently CLIC_G
- **with compact coupler**
- equipped with high-order mode damping features **and load material**
- **with all ancillary subsystems (cooling, vacuum) that are compatible with module integration**
- **Life-time issues (fatigue) addressed either through rf design or material**
- **Mechanical tolerances better than 5 µm**

This will constitute the first major performance demonstration.

5. **Comments on validation of CLIC parameters issues by comparison with Target Performances:**

Gradient will be directly demonstrated by experiment. Effect of beam will be measured at a lower level in two-beam test stand. Wakefields will be calculated. Mechanical tolerances will be measured directly by mechanical control.

6. **Optional: What additional R&D could be set-up to eventually reach the validation of nominal CLIC parameters (estimation of resources and schedule?)**