CALICE - Information For Science Committee

CALICE-UK groups

April 27, 2005

1 Background

The CALICE proposal for linear collider (ILC) calorimetry studies, covering FY05/06, FY06/07 and FY07/08, was submitted to the PPRP earlier this year. The proposal had five workpackages (WP), where WP1 was for completion of the seedcorn programme started two years ago. The other four WPs concerned longer-term calorimeter R&D work on: WP2 data acquisition (DAQ) systems, WP3 monolithic active pixel sensors (MAPS), WP4 mechanical and thermal issues and WP5 simulation and physics studies.

The proposal was considered by the PPRP at their meetings in February and March. WP1 was approved in full by the PPRP from their seedcorn funds; this will not be discussed further here. WP2, WP3 and WP5 were rated $\alpha 5$ and the overall PPRP recommendation was for almost full approval, with only a 7% reduction in new money costs.

We now understand that despite this high rating for a project which has major UK strategic importance, we are being asked to suggest further reductions in new money costs for this and the following two financial years. The original proposal was already kept close to the minimum that we thought would still allow a viable UK programme in the area of ILC calorimetry. Hence, actual reductions will be extremely hard without losing some of the institutes involved and/or adding unacceptable risk to significant parts of the proposed programme.

2 Possible cost reductions

We outline some options for reducing costs below. Our major aim is to try and preserve the programme as much as possible so as to retain UK influence and leadership long term. This is mainly done by slowing the work and hence spreading the programme out into FY08/09.

We have considered whether significant cuts could be achieved by reducing the programme and staying within three years, rather than shifting the schedule, but we believe this is not possible without making the project unviable. In particular, the only clear way to get a reduction of order £400-600k in the critical period (something like Options 2 or 3 below) and keep the three year programme would be to completely cut WP3, the MAPS workpackage. This is more expensive in terms of new money that any of the other workpackages by more than a factor of two. However, this is also the workpackage which could place the UK in the lead of ILC calorimetry and so cutting it would completely undermine the investment we have made. It would also result in the breakup of the CALICE-UK collaboration as several leading groups would withdraw. Trying to get a similar level of reduction while keeping MAPS would mean cutting both WP2 and WP5; this would remove any UK presence in DAQ (where we currently lead the global effort) and detector simulations and physics studies (which is the eventual payback and where the PPRP were extremely keen for us to be involved). It might also lead to the UK collaboration disintegrating. Despite being rated lower, we view cutting WP4 as having a minimal effect in terms of reducing costs and would lead to the loss of the Manchester group, so we considered this not to be a cost-effective option.

Options 1 and 2 below are mainly a rescheduling without a major descope. However, note the PPRP recommendation for a cut of £125k has already resulted in a loss of 2.5 staff years of effort from WP2 and WP5. This will realistically mean less effort for electronics testing in WP2 and physics studies in WP5, with a consequent lessing of the impact of the UK effort. Hence, there has been some descoping already. In addition, we do provide an even harsher Option 3 where the programme is actually cut further, but this would almost certainly result in some groups withdrawing and so would have a major impact on the long-term UK ability to lead in this area. We also believe that some of these options would leave the programme with only marginal viability. In particular, the UK has invested heavily in the development of MAPS through the technology fund and the PPRP. This technology is especially well suited to the conditions at the ILC and the UK is currently clearly leading the field for applications to ILC calorimetry. In order to succeed it will be critical for WP3 to demonstrate a working system before the detector TDR is written.

Cutting beyond the worst case presented below would definitely fall below the level we regard as realistic and would result in the UK having to withdraw from CALICE.

While pushing costs into FY08/09 may seem a sensible approach to the current funding problems, we would like to emphasise that there are extra risks and implications associated with this:

- The ILC detector TDRs are scheduled to be completed in 2009. Our programme is aimed directly at the TDRs so as to give the UK leadership and influence in the detector design. Hence, delaying this programme to only finish in FY08/09 leaves very little time for contributing to the TDR, the preparation of which is likely to take around a year, i.e. will take place through 2008/9. Hence, the delay could mean the UK has a less significant role; the gamble is that the TDRs themselves may be delayed. Note that while the funding and hence timescale of the ILC itself is still somewhat uncertain, the TDRs are not dictated by the same pressures and they will not necessarily be delayed, even if the ILC schedule as a whole slips.

- Having shifted the schedule, we would need to have the full programme approved for all four years rather than the original three years. A cut off at the end of FY07/08 would be artificial and would not allow many of the deliverables to be achieved. In addition, we would need to hire RAs to cover the whole period, which requires guaranteed funding throughout.

- Pushing costs into FY08/09 depends on there being a more favourable outcome in the next Spending Review. This may not be the case, of course. However, by 2009, on the current ILC schedule, the ILC spend must be ramping up very sharply or else the UK will not be able to contribute to it in any case. Hence, the assumption is that the ILC will be a high enough priority by that time to ensure these costs can be met.

- The overall integrated cost, both in terms of new money and total cost to PPARC, will inevitably increase (although the total in the first three FYs will decrease). This is due to requiring continuity of expertise throughout.

3 Baseline

To compare the various options, we first give a baseline for comparison which corresponds to the original proposal, modified by the PPRP's recommendations. This is what we would be asking for Science Committee to approve if there was no new problem with funding over the next three FYs. When comparing with the later options, it should be borne in mind that we have always assumed the CALICE programme would continue beyond FY07/08. This means that the lack of costs in FY08/09 here is artificial and gives a distorted view when comparing with the tables below.

These baseline costs and funding profiles for the four workpackages are given in table 1; here FY08/09 is included for ease of comparison later. The total in the first three FYs is £1403k.

Workpackage	FY05/06	FY06/07	FY07/08	FY08/09	Total
WP2	21	106	135	0	262
WP3	98	321	400	0	819
WP4	14	18	18	0	50
WP5	49	78	145	0	272
Total	182	523	698	0	1403

Table 1: Baseline new money costs in £k.

The table is not identical to the PPRP figures in the minutes of their March meeting for two reasons. Firstly, the distribution between WP2 and WP5 is changed because, to achieve the PPRP cut of £125k, we have had to cut back on RA effort that contributed to both these workpackages, giving an unavoidable reduction in both, rather than just WP2. The total of these two workpackages above is £534k, which is equal to the total recommended by the PPRP for these two, i.e. £223k and £311k. Secondly, the PPRP had worked on the assumption that the RAL/PPD staff effort in WP3 already in post (totalling 0.5 FTE) was not costed as new money. This was incorrect for FY06/07 and FY07/08 and these staff costs (totalling £80k) have been included here. (They were of course always included in the original proposal within the total cost to PPARC; this is purely a relabelling of the funds.) Hence the WP3 total here is higher than the PPRP figure by this 80k.

4 Option 1 - Overall six months delay

The first option is at this point almost inevitable, namely to delay the start of the programme by six months, from April 2005 to October 2005. We would view this option as having an acceptable risk. Table 2 shows the costs per FY. The total in the first three FYs is now £1233k.

Workpackage	FY05/06	FY06/07	FY07/08	FY08/09	Total
WP2	10	78	131	89	308
WP3	55	278	381	146	860
WP4	6	16	18	10	50
WP5	21	83	156	68	328
Total	92	455	686	313	1546

Table 2: Option 1 new money costs in £k.

There is an overall increase in cost due to having to extend some of the RA and RAL/ID effort at the end without a full reduction at the start. This is because some RAs are needed immediately for WP1 and so they cannot all be delayed by six months. Also, we would want to continue low-level contact in the first six months with the RAL staff for MAPS conceptual discussions to ensure we minimise the time lost by this rescheduling.

5 Option 2 - WP3 twelve months delay

Option 2 is similar to Option 1, except that the most expensive workpackage, WP3, has been moved by twelve rather than six months in an effort to shift more costs into FY08/09. As stated above, this risks not completing the work early enough to contribute to the TDR and so we would only propose to do this for this particular workpackage and only then because of its higher cost. We view this option as having a significantly higher risk for WP3 than in Option 1; we would hope this is only considered if absolutely necessary. Table 3 shows the costs per FY. The total in the first three FYs is now £1024k.

Workpackage	FY05/06	FY06/07	FY07/08	FY08/09	Total
WP2	10	78	131	89	308
WP3	11	155	339	392	897
WP4	6	16	18	10	50
WP5	21	83	156	68	328
Total	48	332	644	559	1583

Table 3: Option 2 new money costs in £k.

Again, total costs have risen due to the required continuity of effort into the fourth year.

6 Option 3 - Programme cut

This option is the same as Option 2 above, but with some RA effort from WP2, WP3 and WP5 cut out, resulting in an effective descoping of the programme within these workpackages. Explicitly, this option removes the RHUL RA which would result in a loss of effort within WP2 and WP5, further reducing the design and test effort for the readout electronics studies and the physics studies beyond the cut already imposed by the PPRP. In addition, this option removes the RAL/PPD RA, significantly reducing the test effort for WP3 and necessitating a reduction in the scope of tests and options for MAPS. This will require fewer possible sensor solutions to be explored. Even worse, the above RA cuts would reduce the effort at both institutes below what they consider to be the minimum viable level, which would then force them to withdraw from the collaboration. This further reduces these workpackages due to the loss of the HEFCE and rolling grant effort. In particular, the MAPS effort then loses the sensor simulation expertise at RAL/PPD, forcing this part of the workpackage to be dropped and making the programme more risky.

Table 4 shows the costs per FY. The total in the first three FYs is now £832k.

Workpackage	FY05/06	FY06/07	FY07/08	FY08/09	Total
WP2	10	78	108	64	260
WP3	11	114	234	285	644
WP4	6	16	18	10	50
WP5	21	83	133	43	280
Total	48	291	493	402	1234

Table 4: Option 3 new money costs in £k.

We consider this an extremely undesirable outcome and only include this option to demonstrate how quickly further changes beyond Option 2 cause major damage to the programme.