## Close Out Report and Post Implementation Review

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| **Project** **Name** | MAPS for CALICE (WP3) | **Date** | 7/10/09 |
| **Project Manager** | Jamie Crooks | **Division** | Detectors |

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| Summary of performance against major milestones |
| **Milestone** | **Planned Date** | **Date Complete** | **Comment** |

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| TPAC1 IDR | 4-10-06 | 19-12-06 | Initial feasibility stage took longer than expected, as initial specs proved difficult to meet. |
| TPAC1 Submission | 21-01-07 | 30-4-07 | The January shuttle was aborted in the meeting of 20th Oct 2006, in which the then current pixel design was rejected for having too high noise, and the timing spec was relaxed from 140ns to 600ns to prioritise the noise spec.The later submission deadline also allowed for the new Deep P-Well implant to be paid-for, developed and available on the April submission. |
| TPAC1 Proof of life | 30-8-07 | 29-9-09 | Some minor bugs took more time than foreseen to resolve/workaround |
| TPAC1 (working) delivered to collaborating institutes | 15-10-07 | 2-12-07 | Then used for DESY beam test in Dec 07 |
| TPAC2 PDR | Jul-07 | Aborted | TPAC2 was aborted when STFC suspended funding for this ILC project in Dec 07. The remaining funds permitted more thorough testing of TPAC1, analysis of beam test results, and another multi-project submission (TPAC1.1) |
| TPAC2 Submission | Jan-08 |
| *The project plan was significantly revised in April 2008 to reflect the changes in funding. The milestones below were defined in Project Specification doc v1.2* |  |  |  |
| TPAC1.1 Design work starts (PDR) | May-08 | 1-5-08 |  |
| TPAC1.1 Submission (FDR) | Jul-08 | 18-7-08 |  |
| TPAC1.1 Basic tests | Dec-08 | Feb-09 | Significant problems with yield: Approx 50% of devices had power-ground short. Devices had to be probed & selected for bonding. Underlying cause was never understood, although subsequent TPAC1.2 devices never showed the same problem.Intermittent bonding problems required further investigation.A design error found that caused the pixel to oscillate at low thresholds due to small parasitic capacitance.  |
| TPAC1.1 Detailed tests | Mar-09 | Aborted | The design error meant that the TPAC1.1 devices were not usable for detailed tests with source/beam. |
| TPAC1.2 Submission | end of FY08/09 | 3-3-09 | 2-Mask change re-spin of TPAC1.1 to fix pixel parasitic capacitance bug(CfI funded) |
| *The testing of TPAC1.2 then fell under the new SPiDeR project, and as such there were no TPAC1.2 testing milestones defined in this project. The information below for reference/conclusion.* |  |  |  |
| TPAC1.2 Detailed tests |  | Aug-09 | Pixel bug was seen to be fixed by the mask change – devices working well.Beam test at CERN shows promising data. |
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| **Summary of financial information at close out** |
|  | **Staff (SY)** | **Staff (£k)** | **Recurrent £k** | **Total (£k)** |
| Planned Total Cost |  | 277 | 207 | 484 |
| Actual Total Cost |  | 260 | 118 | 349 |
| Agreed Income |  | 277 | 222 | 499 |
| Actual Income |  | 260 | 118 | 349 |

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| **Comments on the Financial Information** |
| The above is the cost to the CALICE grant through WP3 in FY06/07 to FY08/09. There was also some funding through CfI and some expenditure in FY09/10 through SPiDeR bridging funds. |

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| **Project Close Out** |
| **TECHNICAL:**Final deliverables accepted Any outstanding tasks listed Any maintenance documentation complete Technical documentation archived  | YesTesting of TPAC1.2 under SPiDeR project-Copies held on CALICE project web pages and at RAL on medProj/CALICE/TPAC1.1\_resources |
| **LOGISTICAL:**Any equipment returnedAny excess materials disposed ofAny dedicated space released | No, due to continuation of testing under SPiDeR-- |
| **PLANNING:**Problem Reports clearedProject Records archived | Problem reports 1,2,3,4,5 from TPAC1 were addressed in the design of TPAC1.1Problem reports 1,3 from TPAC1.1 were addressed in the design of TPAC1.2Problem report 2,4,5 from TPAC1.1 are still active and will feed into any related design in the SPiDeR project.Project monitor system and project directory on medShr hold all relevant materials. |
| **FINANCIAL:**Final payments made to suppliersProject Codes closedFinal costs agreed | YesYesYes |

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| Assessment of the project  |
| **DELIVERABLES** Where the deliverables adequately specified?Did the deliverables meet the specification? | YesPartiallySerious design error was fixed by additional funding to make TPAC1.2 which then did essentially meet the specification.Power consumption does not meet the original specification – this has been known and expected since the very first PDR. |
| **COSTS**Were the deliverables produced within the agreed costs?Was any contingency reserve used?Was any management reserve used? | Effectively yes, given that there was a large negative adjustment in the agreed funding. This was significantly aided by CfI.Development of Deep P-Well directly benefitted this project; some contingency was used for this, with top-up funding from CfI.TPAC1.2? |
| **TIMESCALES**Were the deliverables produced within the agreed timescales?Were the project planning techniques used sufficient? | Slip in TPAC1 submission schedule was agreed at the time to allow for Deep P-Well to be developed, and the pixel design to be refined.The delayed submission of TPAC1 and the extra time spent delivering a working TPAC1 system would probably have delayed the start of TPAC2 by ~6 months if the project had continued to run as fundedYes – A more significant problem was simple lack of funding information to allow adequate planning – the STFC funding cut took many months to be defined (when it would take effect, how much of the original grant could be still available) . This was then followed by an appeal for further funding with several more months of uncertainty.  |
| **MONITORING**Was monitoring sufficient for the control of the project?Did the monitoring meet the customers needs? | YesYes – monthly meetings with customer/collaborators throughout. |
| **REVIEWS**Were the project reviews sufficient in number and scope? Did the reviews meet the customers needs? | YesYes |
| **STAKEHOLDER PLANS**Did the Stakeholder Plan cover all the stakeholder issues?Was the plan implemented effectively? | YesUpdated to reflect STFC’s desires when ILC was officially “dropped” from UK roadmap. |
| **RISK MANAGEMENT PLAN** Did the Risk Management Plan predict all the risks that affected the project?Was the plan implemented effectively?**TRAINING**Where any training needs of the staff identified?Was the training undertaken? | No – did not foresee STFC suspending funding of an approved grant mid-way through.YesNo- |
| **MANAGEMENT**Did the project manager receive the right amount of support from the team?Did the team get the leadership it required? | Yes- |
| **PROCUREMENT** Were there any problems with procurement or subcontracting? | No |
| **CAE AND EQUIPMENT**Were there any problems with the availability or performance of CAE systems or any equipment? | No |
| **SAFETY**Did any safety issues arise? | No |
| **DEPARTMENT OBJECTIVES**Did the project contribute to the wider objectives of the Department? | Yes. Deep P-well developed and demonstrated, will be used for other projects. Also high-resistivity epitaxial sensors demonstrated; also useful for other projects.Development of staff, design experience & IP blocks that will be re-used in other current/future projects |
| **PROJECT PROCESS**Have any improvements to the EID project process been identified? | - |
| **COMMENTS**Any other comments? |  |

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| **Customer views on the project**  |
| This was a difficult project for several reasons. Technically, the sensor under development was significantly different from sensors which the group had done previously. Financially, there was a large amount of disruption caused by the withdrawal by STFC of a major proportion of the funding part way through the project. Under these circumstances, keeping to only an overall six month delay as mentioned above was quite impressive.The project was only successful under these circumstances because the RAL team understood the top-level aims of the sensor and so were able to adapt to the changes. A group which simply followed fixed requirements would not have been so successful. For example, the two major innovations which arose from this work, the deep P-well and the high-resistivity epitaxial layers, were not part of the original sensor specifications. Also, members of the design team proved to be crucial in helping out during the debugging phases following the fabrication of the sensor. If this had been left to the customers alone, the project would have incurred much more significant delays. |

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| **Approval by Project Manager** |       | **Date** |       |
| **Approval by Customer** |       | **Date** |       |