To: **T. King Liu, Associate Dean for Research**
M. Wu, Microlab Faculty Director
From: **K. Voros, Operations Manager**
Subject: **January 2010 – June 2011 Report**
Date: **15 November 2011**

I. INTRODUCTION

Microlab operations wound down completely in 2010 until the lab closed at the end of December. The new facility, the Marvell NanoLab, 10 years in the making, is a reality, fully operational under new management. Staff activities revolved around completing the move and, at the same time, maintaining operations in both the Microlab and the new Marvell NanoLab. We were on target financially, with a solid deficit recovery plan in place.

This is the 24th yearly summary report I am submitting.

II. MANAGEMENT OF RESOURCES

F a c i l i t i e s

Operation of Two Labs Simultaneously Through 2010

By the end of 2009 the Marvell NanoLab, with two tools, the Crestec e-beam writer and the Leo SEM, was open for operations. 2010 went by under the motto of "maintain - move - maintain", meaning that tools were maintained and used by lab members until the very last minute just before the move, moved to the new lab site and brought up in the shortest time we were able to manage, then maintained as usual at the new site.

Because of budgetary constraints and the fact that complete shut down for the move was not an option, we managed fit up and move with Microlab and Machine Shop staff, with only three temporary positions added. Because there was limited time pressure to be out of Cory Hall and we were able to execute the move with in-house staff, bootstrapping gave us the flexibility we needed in making last minute changes in tool locations. All this placed an enormous additional work load on staff. However, we came through with flying colors.

A new Marvell lab orientation program, in addition to the standard Microlab orientation, was instituted for lab members who were qualified on the initial two tools. As fit up progressed other equipment were moved in; thus, from 2009 December through December 2010 we were operating two labs. Our plans to close the doors of the Microlab in Cory Hall in December 2010 were realized, 27 years after the Microlab and 48 years after the first integrated circuits processing lab opened in Cory Hall.

Equipment

Bob Hamilton, Equipment and Facilities Manager, and Safety Officer of the Microlab managed overall maintenance while preparing and executing equipment moves with his staff and the assistance of the Machine Shop, under the direction of Bill Flounders, NanoLab Manager.

Tool Moves in 2010-11:

- 128 semiconductor processing tools moved or newly installed in the NanoLab.
- 28 tools have been retired or decommissioned.
- Chemicals and parts storage areas were relocated as equipment move progressed.
- Equipment engineering completed their move to the David Hodges office Suite, attached to the new Marvell NanoLab in Sutardja Dai Hall, in October 2011.
- At the end of 2010 the Microlab was officially closed, with 8 tools remaining.
- The last tool to be moved was the Centura, starting in May 2011.
- In June 2011 Microlab chemicals inventory had been zeroed out in the EH&S database.

Processing

Sia Parsa's Process Engineering group also worked in high gear throughout the transition period. Sustaining processes in the Microlab, at the same time characterizing, and qualifying recently moved equipment and processes created double duty for all.

Notable in 2010-11:

- A new (refurbished) ASML 5500/300 DUV stepper was installed in the Marvell Nanolab. Extensive work, involving lens qualification, software upgrade, mask generation, manual writing, student training, was invested in this tool. The new ASML allowed us to survive the move with relatively few interruptions, because we were able to maintain and operate (although limping) the old ASML system in the Microlab.
- Moving the general lithography module, involving two GCA steppers, 3 contact aligners, wafer tracks, both, dispensers and developers, various ancillary equipment required careful planning and synchronization. The Process Engineering group had to be on top of each move and step in for characterization the minute a tool was in place.
- Each of the furnaces, atmospheric and LPCVD went through the same procedure of cleaning, calibration and test runs, until results were in spec.
- Sinks for which designs and specifications were submitted (CAD layouts and .pdf) for the new lab, were installed and outfitted with lab ware, new lab manuals written and the sinks released for lab member use.
- Processes in 3 new Lam etchers were developed and released.
- **CMOS Baseline:** a new run, CMOS 200, was started in the new lab as machinery and processes became available.

Administration

Rosemary Spivey, Administrative Manager reports on our financial status, accounts, members administration, purchasing, and inventory management. Recharge rate proposals for the Microlab/NanoLab were submitted and the account scrutinized throughout the year by the Campus Recharge Rate Committee.

Notable in 2010-11:

- The Microlab's recharge income, $4M, within budget, again in compliance, for the 23rd year in a row.
- Development of an eight-year, $1.2M deficit recovery plan for projected Microlab/Nanolab transition, included in the Fiscal Year 2010/2011 Microlab Recharge Rate Proposal and approved.
- Deficit came in below projected, which means that it may be paid off in there years.
- Move of office staff, inventory and administration related activities accomplished.

Computers

Todd Merport, Computer Operations Manager describes in his report the challenges of establishing and maintaining two, basically independent yet connected, computer systems supporting the Microlab and the NanoLab.

Our original software system was developed when the Microlab was built, 25 years ago and although constantly upgraded, the Wand/Staff software was based on 1990's computer technology and provided an alphanumeric user interface. Soon after we started planning for the new lab, we also started designing and developing a new management system for implementation as the new lab came up.

After we spent some time and effort in a joint development program with the Stanford and MIT labs, we decided to go it alone. We found that the proposed joint design was not flexible enough to adapt to local needs and also because our requirement for a sophisticated accounting module as first or of very high priority was not supported by the others. Thus, it took us longer to develop the new system, but we had time. The new lab was still a hole in the ground when we started. By the time we moved in, the software was ready and running like a charm. Todd Merport named it Mercury.

Notable in 2010-11:

- With the move of semiconductor processing tools into the new lab, Mercury was further tested and debugged in real time. Lab members accepted it without skipping a beat.
- Client-server communication speed was further improved.
- Running two systems in parallel and ending up with combined reports required clever and careful mapping and synchronizing. The administrative staff was highly satisfied with the new, unified accounting system.
- Several new modules were added, required by NanoLab management, such as on-line tests, automatic upload of equipment manual updates.
- Improvements and upgrades in the facilities management modules, both hardware and software.

Machine Shop
http://mshop-erso.berkeley.edu

The Machine Shop completed 324 jobs for 56 PI's in FY 2009/2010 and 329 jobs for 54 PIs in FY 2010/2011. Financially it rebounded, made up the accumulated deficit and finished the FY on target. This was possible because of the steady stream of jobs coming in in conjunction with the Microlab/NanoLab move, and available staff recharge time was fully booked all year. Two temporary staff, 6 months each, were added to facilitate the NanoLab move; on the occasions of major equipment moves, the entire Machine Shop staff was mobilized. (NanoLab jobs were billed at the standard recharge rate.) Without the Shop we could not have taken on the new lab fit up and Microlab to NanoLab move.

► Machine Shop Staff: (5.5 FTE)
Ben Lake, Engineering Technical Supervisor 2
Bob Amaral, Development Technician V
Chris Bowen, Development Technician IV (temp.)
Edward Hester, Development Technician IV (temp.)
Joe Gavazza, Principal Laboratory Mechanician
Alan Peterson, Development Technician V
Nancy Peshette, Administrative Assistant III (0.5)

S t a f f

The last organizational chart of the Microlab, before the final transfer, can be seen on the Microfabrication Laboratory Archive Portal – In operation: 1983-2010, http://microlab.berkeley.edu/people/orgchart.htm.

Total number of staff increased by 6.5 FTE, from the end of 2009 to 2011, for the period of the move. Of these, 3 were temporary employees, for 6 months each, one was career, and the rest were students.

Microlab/NanoLab Operations Staff (33 FTE)
A. W. Flounders, R&D Engineering Mgr 2, Technology and Operations Manager, NanoLab
Katalin Voros, R&D Engineering Mgr 2, Operations Manager

1. Equipment and Facilities (14.75 FTE)
Bob Hamilton, R&D Engineer 5, Manager
Alan Briggs, Development Technician IV
Joe Donnelly, R&D Engineer 3
David Lo, R&D Engineer 3
Brian McNeil, Development Technician V
Jay Morford, R&D Engineer 3
Evan Stateler, R&D Engineer 4
Danny Pestal, R&D Engineer 3, Supervisor
Michael Martin, R&D Engineer 1

Phill Guillory, R&D Engineer 4, Supervisor
Lou Ahtty (temp)
Louis Lucq (temp)
3 student assistants, 1.75 FTE
Mike Linan, R&D Engineer 3, Projects Mgr.

2. Process/Baseline (8 FTE)
Sia Parsa, R&D Engineer 5, Manager
Kim Chan, R&D Engineer 2
Jimmy Chang, R&D Engineer 4
Marilyn Kushner, R&D Engineer 2
Laszlo Petho, Associate Specialist – baseline
4 student assistants, 0.5 FTE each
Xiaofan Meng, R&D Engineer 4 − cryoelectronics

3. Administration (5 FTE)
Rosemary Spivey, Administrative Officer 4
Nancy Peshette, Administrative Assistant III (0.5)
Susan Kellogg-Smith, Buyer II, Procurement Manager
Eric Chu, Administrative Assistant II
Adrienne Ruff, Administrative Assistant III
student assistant, 0.5 FTE

4. Computer Support (3.25 FTE)
Todd Merport, Applications Programmer 4, Supervisor
Madeleine Leullier, Computer Resources Specialist II (0.75)
Olek Prokurowski, Applications Programmer 3
Changrui Yin, Information Systems Analyst 3 (0.5)

Financial Resources

The Microlab recharge account continued without change during the transfer period and became the NanoLab account effective 1 July 2010. This process was carried out under the advisement, approval and review by the Campus Recharge Rate committee.

There were no funds available for the move; however, we were allowed to submit to the Recharge Committee, an equipment depreciation reserve and payment plan. Additional expenses were covered from industrial donations, fund raising and BMLA/BNLA membership fees and surcharges. Because lab use remained high during the move and even increased somewhat after the transfer was completed, we were able to meet the NanoLab ‘s scheduled obligation to the reserve fund at the end of FY 2010/11.

Recharge Account Summary
30 June 2011

Microlab/NanoLab	Income	Expenditures	Performance	No of PIs Billed
FY 2009/10	$ 3,204,031	$ 3,321,822	3.7% [-]	90
FY 2010/11	$ 4,039,102	$ 3,861,049	4.4% [+]	93
6/30/2011 Payment to Reserve Fund.		$ 178,000		

Microlab/NanoLab transition expenditures totaled $ 3,177,948. A deficit of $416,252 was incurred in the Equipment Reserve Fund, which will be paid off over the next three years. (See NanoLab Operations Financial Report, Fiscal year 2010/2011, by Rosemary Spivey.)

III. COMMUNICATIONS AND CONTROL

Management

As the Chief Scientists for CITRIS, Banatao Institute@CITRIS Berkeley, **Prof. Ming Wu** continued as the Faculty Director of the Microlab and the NanoLab. The Marvell NanoLab is a research facility of CITRIS, Center for Information Technology Research in the Interest of Society, (http://www.citris-uc.org/research/emphases/nanotechnology,) located in a new engineering building, the Sutardja Dai Hall, which serves as CITRIS Headquarters.

Dr. A. W. Flounders, now the Executive Director of the Marvell NanoLab, was involved with the design and construction of the new lab and worked tirelessly with campus project management and the general contractor to ensure that our requests were taken into consideration. Bill participated in a series of difficult value engineering (i.e. cost cutting) negotiations, discussing available options with Microlab management. He was involved with acceptance and contributed to the punch list concerning the lab. Finally, mid-year 2009 we were allowed in to start fit-up activities. Phill Guillory and his staff, providing most of the electrical and plumbing installations, were transferred, along with Mike Linan, specialty gas lines designer and installer, under Bill's supervision. This was the first step in staff transfer. Next, as we started to move process equipment, Bob Hamilton and his equipment engineering staff were transferred under NanoLab management, starting in April 2010. Computer staff moved early September, process staff at the end of September, inventory and office staff in October 2010. All Microlab staff had been transferred to NanoLab management, effective 15 October 2010.

During the move and transfer period, the Microlab, under my management in Cory Hall, was sustaining operations as usual, providing recharge income for both labs. Engineering staff supported both labs, retaining equipment and process responsibilities same as before the move. Three additional temporary staff and extensive use of Machine Shop staff allowed us to operate and move simultaneously. Systems remained in place until sites in the new lab were prepared and were shut down only for the move and process testing afterwards. In spite of the disruptions lab use remained close to previous levels and we were able to meet our financial goal: closing the fiscal year in compliance with Recharge Committee rules.

Membership and Training

Microlab/NanoLab monthly membership remained high, 336, during the move. Overall, we dealt with 469 members during FY 2009/2010 and 474 during FY 2010/2011. The number of industrial members, BMLA, was 18 in January 2010, and we had 21 BNLA members in June 2011.

Starting January 2010 as the new lab opened with a few tools, a NanoLab orientation seminar was initiated, which all active members had to attend before admittance to the new lab. This was offered every two weeks at first, then as needed, to allow students to work in both labs. As of January 2011 we offered only Marvell NanoLab orientations in Sutardja Dai Hall.

Along with the transfer of equipment, the Microlab's operating manuals have been updated and transferred to the NanoLab's website, http://nanolab.berkeley.edu/labmanual/labmantoc.html. Manuals of decommissioned equipment over the years are archived at a site restricted to staff.

Outreach

Because of the lab move the Summer High School Internship program was suspended for the Summer of 2010. We had two students participating in 2011. They worked under the guidance of Jimmy Chang and Kim Chan, R&D Engineers of the NanoLab. Final reports by the interns can be seen at http://microlab.berkeley.edu/text/participants.html.

Closing Ceremony

In April 2011 we held a Microlab Closing Ceremony and NanoLab Open House. Master of Ceremonies was former Microlab Faculty Director and EECS Chair, Prof. Costas Spanos. Prof. David Hodges talked about the Integrated Circuits Lab (The Old Lab) 1962 – 1982; Prof. Tsu-Jae King Liu, immediate past Microlab Faculty Director, and Katalin Voros, Microlab Manager from 1983 – 2010, discussed successes and operations in the Microlab during the past 27 years. Katalin Voros received a Chancellor's Outstanding Staff Award 2011. Then, Prof. Ming Wu, NanoLab Faculty Director and Dr. W. Flounders, NanoLab Manager, invited the audience for a tour of the new lab, with a reception afterwards.

IV. SUMMARY

The years of 2010-11 saw the opening of the new NanoLab while operations continued as usual in the Microlab. Support from our PIs was strong throughout the year, which meant that we were able to end the fiscal year on target. We have successfully completed the relocation of the Microlab into the Marvell NanoLab by the end of 2010. The move was done by lab staff, with heavy reliance on the Cory Hall Machine Shop; financed by the Microlab/NanoLab budget and took 18 months. We managed a smooth transfer, without disruption to ongoing research projects. We can all be proud of our beautiful new Marvell NanoLab in Sutardja Dai Hall – the third reincarnation of the first IC lab built in Cory Hall in 1962.