

REPORT OF THE 2004 VISITING COMMITTEE
DEPARTMENT OF CHEMICAL AND BIOLOGICAL ENGINEERING
UNIVERSITY OF WISCONSIN

The 2004 Department of Chemical and Biological Engineering Visiting Committee met in Madison on Monday-Tuesday 5-6 April 2004. Members in attendance were:

Dr. Robert C. Armstrong, Massachusetts Institute of Technology
Dr. Kathleen Barton, retired Searle/Pharmacia
Dr. Carlos E. Garcia, Shell Chemical LP
Dr. Babatunde Ogunnaike, University of Delaware
Mr. John J. Schmid, Kimberly Clark Corporation
Dr. Lanny D. Schmidt, University of Minnesota
Dr. Jeffrey J. Siirola, Eastman Chemical Company
Dr. Harry L. Spiegelberg, retired Kimberly Clark Corporation
Dr. Arthur W. Westerberg, Carnegie Mellon University
Dr. David Yarusso, 3M Company

The meeting started at 4:00 on Monday afternoon with a reception and graduate student research poster session in the Engineering Hall. This was followed by an informal tour of some of the current CBE remodeling and infrastructure renovation projects.

The committee then adjourned to the Fluno Center for dinner, after which Professor Kuech presented his State of the Department report covering the current status of the faculty, undergraduate program, graduate program, research, and priorities. In summary, priorities for the department include continued faculty hiring to a target level of 20-21; continued revamping of the undergraduate and graduate programs; remodeling and renovation of existing space for new faculty research, for new undergraduate laboratories, and for new graduate student offices; and planning for a centennial celebration next year.

The board meeting continued at the Fluno Center on Tuesday starting with a visiting committee breakfast, followed by a review of departmental statistics by Professor Kuech. Faculty age distribution has flattened with recent successful recruiting efforts. Undergraduate enrollment remains reasonably steady producing more than 90 graduates per year. The number of BS graduates per faculty member is the highest in the College of Engineering. In 2003, chemical engineering graduates matched those from computer science for the highest median starting salaries. A two-course biology requirement (cellular biology and biochemistry) has been implemented and three bio-related electives (biochemical engineering, biological process modeling, and biological molecule design) are under development. The number of PhD graduates is also steady and the number of graduates per faculty member is also the highest in the college, as is research expenditure per faculty member.

Professor Abbott described three cornerstones of the present graduate program which are each currently under review. These include coursework (currently 18 credits of required

CBE courses, 6 credits of electives, and 12 credits in a minor), the qualifying examinations (three written examinations (undergraduate level thermodynamics, kinetics and reactor design, and transport) taken in January of the first year), and the preliminary examination (ideally a thesis proposal defense consisting of a written report and an oral examination to be completed by the end of the second year). There is a feeling among some especially newer faculty that the extensive coursework requirement delays the initiation of research, and may be too rigid for the preparation needed for specific research areas or not entirely appropriate for students from outside chemical engineering.

With respect to the qualifying examinations, 50% of the carefully screened and admitted graduate students nevertheless fail to pass all three on the first attempt, although 90% eventually pass and are admitted to the PhD program to begin research. There are suspicions that some material may be more advanced than the typical undergraduate level. It has been suggested that undergraduate final examinations be used for the qualifying examinations, and that all must be passed prior to the preliminary examination (rather than as a condition for admission to the PhD program and initiation of research).

Finally with respect to the preliminary examination itself, there seems to be a trend to make the examination a draft thesis defense rather than a research proposal defense (its original intent). The examination is currently taken in the month 30-52 (instead of prior to the beginning of detailed research), includes a report typically greater than 100 pages in length (essentially a thesis draft based on results already obtained), with the oral portion a presentation of results rather than a dialog over a research plan. It is being suggested that the preliminary examination report take the format of a grant proposal with a 20-page limit due in month 18, that the oral examination emphasize discussion and take place prior to month 21, and that the preliminary examination committee be integrated with the thesis committee and include an interim progress review meeting in year 4.

Professor Yin discussed infrastructure renewal projects. These include basement and first floor renovations for new research space, a new polymer instructional laboratory, and new graduate student office space. \$181k has been allocated in 2004, \$330k has been requested in 2005, and about \$100k will be needed in both 2006 and 2007 to complete the project.

Professor Yin also discussed laboratory safety procedures which were raised as a concern by the 2002 visiting committee. A chemical and biological safety course is now completed by all entering CBE graduate students. Laboratory safety managers have been designated for each research group. Chemical Hygiene Plans have been created and Material Safety Data Sheets assembled. All laboratories have completed written self-audits on chemical, biological, and radiation safety and have been inspected by the campus Safety Department. Plans include more formal regular safety training, document updating, audits, inspections, tutorials, and lectures to institutionalize and reinforce a safe laboratory practice culture.

Professor Root discussed the recent accreditation activities. ABET will conduct a focused visit this fall to examine outcomes assessment procedures. The department has a number of assessment tools in place from which useful information for curricular improvements has been obtained and will document these fully in a report prior to the visit. Also the educational objectives for the program have been revised slightly to emphasize that they are objectives for student achievement rather than objectives for faculty performance.

After a break, Professor Lynn described his work on synthetic polymers for gene delivery, Professor Shusta described biology within the Chemical and Biological Engineering department and elsewhere at UW, and Professor Ray shared photographs depicting the history of the department and initial plans for a centennial celebration on 12-14 August 2005.

Following lunch with faculty and students, the visiting committee split into three groups to meet with undergraduate students, graduate students, and junior faculty. From the undergraduates, we heard the following:

- Students are impressed with the technology, computers, etc. available.
- Students like the study areas, tutoring opportunities, the community of students who move through the curriculum together, co-op and intern opportunities, the people at career services, and the strength of the program.
- Students would like more exposure to real unit operations earlier in the program or perhaps have a portion of the unit operations laboratory earlier in the program.
- Students would like to see more of the biological and other applications to show up in undergraduate curriculum such as examples, homework, and in the design course.
- Concerns about quality of advising are the same as we heard last time.
- Concerns about variable quality of TAs (course proficiency and communication), particularly in departments outside CBE (chemistry, physics, and mathematics).
- Quality of undergraduate instruction varies significantly among professors.
- Students would like more opportunities for undergraduate research especially for those interested in continuing to graduate school. Communication of existing undergraduate research opportunities might be improved.

From the graduate students we learned:

- All students were in agreement on supporting changes of preliminary examination focus, timing, and report size.
- Students believe there are too many course requirements or at least it is incompatible with starting research in that same time frame.
- Students believe qualifier examination is a black box. You can't see your score unless you fail. Both junior faculty and students believe it doesn't test what it is claimed to test. Students don't understand purpose of the examination. Students suggested that they should be required to take and pass the corresponding

undergraduate course if they fail the qualifying examination but they don't want to take the qualifying examination again.

- However, some graduate students could see value of qualifiers in leveling background of people from different backgrounds.
- A suggestion was made to replace the qualifying examination with set of required graduate (entry) courses which must be passed.
- Graduate students were concerned that they didn't have a real opportunity to teach and to learn teaching methods in order to prepare them for an academic career. It was suggested that graduate students be allowed to teach small group tutorials and offload grading to paid undergraduates.
- Students said that for most of them, the spring visit to department proved to be crucial to their decision to come to UW for graduate school.

From the junior faculty we learned:

- Students not doing any research until their third year. They are spending two years as super-undergraduates focusing on qualifiers and courses. This is especially a problem for junior faculty because they don't have any advanced graduate students to get the research program going.
- Junior faculty strongly support move to an earlier preliminary examination.
- They believe they could drop to eight courses and still have a very strong program.
- New faculty are very happy here.
- Research space offered to new faculty is good.

The visiting committee then reached the following conclusions related to the Chemical and Biological Engineering program which we shared with the faculty, and summarized for Dean Percy.

We believe the priorities the department has established (faculty hiring, undergraduate and graduate curriculum changes, and space renovation) are timely and appropriate. We endorse the process the department is going through to improve the graduate qualifier and preliminary examination processes. We support the department objective to increase the number of faculty to 20-21 based on both research and instructional needs.

We see the strengths of the department include the vision to not only change the name, but to back up that change with relevant curricular changes, faculty hiring, collaborations, and leverage with other strong bioscience programs at UW. We are impressed by the quality of the recently hired faculty, the continued emphasis on textbook publication, and the efforts to convert existing space into more usable formats. We are especially pleased with the response to our previous laboratory safety concerns.

We still worry, however, whether the priority for CBE renovation funding compared with other needs will be sustained within the college of engineering over the duration of the project.

We believe a functioning educational outcomes assessment is in place and recommend that its procedures and recent data results, interpretation, and resulting faculty actions be fully documented prior to the next ABET visit. We note, as has the faculty, the results of the latest EBI senior exit survey which found that the lowest levels of achievement in comparison to the peer group institutions were in relatively soft areas (health and safety, ethics and ethical responsibilities, environmental issues, oral communications, political, global, and societal context issues, etc.). Progress in these areas will be an agenda topic at our next review.

And, while we are pleased with the response to our previous safety concerns, we also believe that there remains additional work that can be done on safety issues. There is not the level of continuous safety inspection/improvement process that you would find in industry. There are not safety/hazard reviews of new research processes in advance. We would encourage continued emphasis on creating a safety culture and formalizing safety processes in graduate and undergraduate programs. This will also be an agenda topic at our next review.

Overall the committee was very pleased with the health of the department and stands ready to assist in addressing some of the improvement areas or other matters which arise. Professor Kuech and the faculty and staff are to be complimented for their dedicated efforts toward continual improvement of an already world class program.

The meeting adjourned at 4:15 Tuesday.

Submitted by:
Jeffrey J. Siirola
2004 Visiting Committee Chair