Rensselaer
THE HOWARD P. ISERMANN DEPARTMENT OF
CHEMICAL AND BIOLOGICAL ENGINEERING

June 4, 2009

Wynn M. Goering
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Dear Dr. Goering:

Attached is the report of the Academic Program Review Team for the review of the Department of Chemical and Nuclear Engineering conducted from April 27-29, 2009. As described in the report, the APR team was favorably impressed with the accomplishments of the Department. We have, however, made a number of suggestions in the report that we hope the Department will find useful.

On behalf of the other members of the APR team, I want to express our appreciation to all those individuals that planned the schedule and made the arrangements for our visit. All the pre-planning made for an efficient use of our time while in Albuquerque. Lastly, I would like to thank the department chair, faculty and staff members of the ChENE Department for their cooperation and assistance during our visit.

Sincerely,

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Report of the Academic Program Review Team for the Department of Chemical and Nuclear Engineering at the University of New Mexico

Summary

The Academic Program Review (APR) team was favorably impressed with the accomplishments of the Department of Chemical and Nuclear Engineering given their relatively limited resources. The department has a number of excellent faculty members who have established well-funded, productive research programs. Each faculty member publishes on average more than 4 papers per year and their work is highly cited. A distinguishing feature of this department is the extremely productive research centers that have been established by faculty in the department. The centers have helped create a first rate research environment with excellent facilities and equipment. Another distinguishing feature of the department is the emphasis and impressive results in achieving diversity in their program.

While the APR team was very impressed with the Department, several challenges were identified during the visit that the department should address to improve its undergraduate and graduate programs. First, a balance must be established between enabling the centers to thrive, and simultaneously, maintaining a vibrant department. The department budget, aside from salaries, has shrunk dramatically in the last few years to the point where it is difficult to see how the department can function, much less provide a quality education. This is due to a number of policy decisions, including the F&A split between centers and the department. The F&A apportionment is critical and must be addressed. Although the centers are an integral part of the department, they have created a culture where "Let's Make a Deal" appears to have become the operational standard in the departmental and university negotiations. This culture has led to an appearance of separation between the elite faculty and center directors and the other faculty in the department. Further, this has created the potential for scenarios where individuals may have a tendency to consider themselves above the organizational structure of the department.

The department needs to devote significantly more effort and resources to graduate recruiting. The departmental advisory board has not met since 2004 and we strongly suggest that this board meet on a more regular basis for ABET accreditation and for facilitating ongoing improvements in the department. The department currently does not have a strategic plan and the faculty needs to develop one that has a clear focus, goals, set of priorities, and establishes a common "branding" for the department. The process of establishing a strategic plan, possibly through a long overdue departmental retreat, will also help to create more cohesion within the department and will assure that all faculty members are "on board" with a commonly accepted plan.

A consistent faculty-mentoring program across the entire department is lacking. A department mentoring program including both direct and indirect mentoring, with accountability, should be instituted.

We will now address the specific questions that the APR team was requested to address (note: for some questions, separate responses will be given for the chemical and nuclear engineering programs).

Question 1a. How does the undergraduate program for chemical and nuclear engineering compare with other well-respected programs across the country?

Chemical Engineering Response: The committee had a very favorable impression of the undergraduate students. Obviously, a lot of thought has gone into creating a broad educational experience for the undergraduate chemical engineers. Almost all the seniors came to the meeting with the APR team. The students appeared to be very intelligent and enthusiastic and we were impressed with how many undergraduates are involved in research (more than half of the seniors). Six or seven students went to the national AIChE meeting and presented posters on their research. In addition, half of the seniors were continuing on to graduate school, which is significantly higher than in most chemical engineering departments. The students indicated they were satisfied with the education they had received. The diversity of the students was impressive and admirable. There were a large number of women in the program, a significant number of foreign-born undergraduate students and a significant number of under-represented minorities. We note that the tuition is quite low and that a quality undergraduate education is provided at a bargain.

Specific Comments:

1. The senior seminar is an excellent idea and presenting ethics in the seminar is commendable. However, some students complained that others copied solutions for homework assignments from solution manuals and that some of the faculty were aware of this and did nothing about it. Given the seminar content, this certainly sends mixed messages about ethics to the students and this situation should be addressed.
2. Some students complained that grading was not strict enough and that grades were curved so that everyone did well, even if they did not perform well on exams. This clearly bothered students who had worked hard to master the material. Moreover, grade inflation appears to be an issue in the chemical engineering program. The average GPA of juniors and seniors is 3.4/4.0, with only one student having below 3.0. It also appears that some courses could be taught more rigorously. This issue raises concerns about how well the students are being prepared for graduate school or industry.
3. In some courses, faculty missed a significant number of classes. In one course, the instructor was gone for half the classes during the semester. Either a TA taught the course or the class was canceled. Clearly, this affects the quality of the educational experience. Expectations of faculty teaching responsibilities should be made clear.
4. Some of the high-performing faculty in research do not teach undergraduate classes so the students do not get to benefit from their expertise and experience.
5. Even though many students are going to graduate school, the students could be better informed about what the benefits of graduate school are. For example, while many of the juniors we met with were interested in graduate school, they seemed to believe that a master's degree in Chemical Engineering improved career opportunities more than it actually does.
6. The chemical engineering program offers five concentration areas, but each of these only requires two courses to satisfy the area requirement. Further, at present it appears that most of the students select the bio option. The APR team recommends that the curriculum should be modified so that each concentration area has more specialized courses or that the number of concentration areas be reduced.

7. Some additional smaller issues were raised such as not getting homework back on time for one course and a lack of communication between faculty teaching lectures and faculty teaching labs on the same topics. There appears to have been some inconsistency with different professors teaching the labs each year concerning different assumptions about students' background knowledge for the labs. The students were not impressed with the technical writing course, and perhaps more writing emphasis needs to be integrated into the other classes. Finally, the students could use more help with finding jobs, at present it does not appear that the faculty are actively helping with this.
8. The undergraduate program is smaller than most programs at other universities as is the number of students per faculty member. It appears that this number is relatively constant. However, the APR team does not view this as a problem, in that it enables the faculty to continue to develop their research programs and the undergraduates to have more undergraduate research experience.

Nuclear Engineering Response: The program must take leadership responsibility and play a significant role on the national stage so that it becomes well known for their visible leadership and research successes. It is suggested that a faculty representative become actively involved in the Nuclear Engineering Department Heads Organization (NEDHO) and strive for a visible leadership role, including taking a turn serving as Chair of NEDHO. While USN&WR rankings are nothing more than a "beauty contest" (where deans and department heads/chairs vote based upon how well they know the faculty, undergraduates, and research programs at each of the country's nuclear engineering programs), if they know more about UNM's program, they might be favorably inclined to vote for a higher position. In addition, there is a clear and direct correlation between faculty size and ranking in nuclear engineering – the larger the faculty size, the higher the ranking. More faculty means more research, more graduate students, more postdocs, more publications, more students graduating, and greater visibility resulting in higher rankings.

Specific comments:

1. The juniors were unanimous in their praise for the professors of the NE program. They feel that the professors care for them, they are generally very good lecturers, have an open door policy, and are well rounded in their knowledge of the nuclear industry.
2. The seniors indicated that they felt unprepared for the senior level Monte Carlo course in the area of probability theory. In addition, the course instructor indicated his disappointment with the knowledge and motivation of the students taking his course. A comprise might be to replace this course with one designed to provide hands on experience in developing input for and implementing the industry standard code, MCNP, which seems more appropriate at this level.
3. Students feel that when they provide feedback to faculty that they are honestly listened to and their input is considered when improvements to the program are made.
4. The ChNE 101 course is especially effective as an introductory course in nuclear engineering since it includes a simple experiment and exposure to faculty research activities. This introductory freshman course is viewed by the students as a very positive experience that initially attracted them to the nuclear engineering major.

Question 1b. How does the graduate program for chemical engineering and nuclear engineering compare with other well-respected programs across the country?

Chemical Engineering Response: Most of the faculty members appear to be active in research. Although some faculty are extremely productive (three faculty members have h-indices above 30) and are well known, the graduate program is not considered a top department. The graduate student enrollment is much smaller than other departments of comparable size, and the department has more of an emphasis on master's students as compared to other Chemical Engineering Departments. The number of PhD students per faculty is low, and this is a problem since this is an important criterion used to compare graduate programs. Moreover, many of the graduate students were undergraduate students at UNM. A significant fraction of the research is carried out not by graduate students but by postdocs and research faculty. In addition, only six of the ChE faculty members have degrees in chemical engineering and it is not clear how active the faculty are in the AIChE (the chemical engineering professional society). This is important since visibility in the AIChE affects department standing, graduate recruiting, and faculty recruiting.

Some of the graduate courses in the department could be more rigorous with grading that is reflective of students' performance. At present, the average GPA of master's students (the only data available) is 3.84/4.0. The faculty appear to want to not lose students from the program, and thus a significant question is raised about the quality of the students. This may be reflected in the concern by Sandia about hiring UNM students.

Nuclear Engineering Response: The research areas of the six research active faculty are well defined and for all but the recent hire, are well established, but seem not to overlap. All six nuclear engineering research active faculty members have a generally accepted teaching load while maintaining an active research program. Some consideration should be given to meshing the various programs of transport methods development, computational strategies in multiphysics and transport theory, space nuclear applications, nuclear instrumentation and plasma physics, to make a more cohesive departmental research footprint.

The department should have more interactions and participation with the New Mexico national laboratories. There is a need to innovate to find a creative way to make this happen. This could come in the form of making a UNM education more accessible to those at national laboratories. This would include allowing double counting undergraduate and graduate credits. In addition, support could come from the establishment of Endowed or Governor's chairs to grow the nuclear engineering program in conjunction with the laboratories missions.

Question 2. Are the undergraduate laboratory facilities and experiments adequate and competitive with other strong programs? Do you have suggestions for improvements in this regard?

Chemical Engineering Response: The undergraduate laboratory facilities and experiments are excellent and are certainly competitive with other ChE programs. The ChE undergraduates take 4 semesters of undergraduate labs, which appears to be an excellent educational experience. The interface between the labs and the courses is an innovative approach. The undergraduate laboratory has much more space than other ChE departments with two to three times as many students. Further, it has a staff person to help run the lab (note: this is unusual for programs with

such a small number of students who take the lab). Some safety issues that should be addressed were observed during the walk-through. Finally, it would be useful to include new experiments that reflect the cutting-edge research in the department in the undergraduate lab experience.

Nuclear Engineering Response: Overall, the committee felt that the nuclear engineering laboratories and experiments were competitive and similar to those used in other nuclear engineering programs. The NE students gain valuable laboratory experience on a well-maintained AGN nuclear reactor including decay counting experiments designed by their most recent hire, Adam Hecht. It is clear that Dr. Bob Busch is a significant element of the NE teaching mission. His teaching of 6 NE courses per year and maintenance of the reactor laboratory enables the research faculty to perform their research without an excessive teaching load. His service should be recognized as necessary to departmental operation and the present and future accomplishments of the NE program. Since Bob is nearing retirement, some serious thought should be given to his replacement. Additionally, some students felt rushed in the detector laboratory and felt that they would have been better served if more time had been available to them to perform their laboratory experiments.

Question 3. What strategies might help use to improve the success of our graduate student recruiting?

Chemical and Nuclear Engineering Response: The low number of PhD students is one of the most pressing problems in the department. The graduate recruiting and acceptance approach needs to be fundamentally changed if the graduate recruiting is to improve. The present policy of making offers only to students to work with specific faculty on an individual basis (based on available research funding) is untenable if the graduate program is to grow. The department must be able to accept graduate students as early as possible without the students committing to work on a specific project. The number accepted should be based on how many projects are available, and allowance made for many of the students not accepting the offers. The department may also want to re-visit an earlier policy where graduate students were not assigned to a research project until after the fall semester started. The department, college, and university should consider fund raising for graduate fellowships or identifying other resources to support graduate students in the first part of their (uncommitted) graduate study. Improved graduate student recruiting is critical for new faculty to be successful.

Better visibility is needed to increase the number of graduate student applicants. The department should also strongly consider bringing in potential students for visits. The excellent facilities and the nice location should help in this regard. A decreased emphasis on the masters program should also occur as the number of PhD students grows. The department might want to consider recruiting undergraduates whose majors are not in chemical or nuclear engineering. The graduate student stipend is low compared to other engineering programs, and the department should consider raising it.

Questions 4: Do we have enough faculty to compete effectively for funding opportunities in the various research focus areas that we have targeted. If adding faculty were possible, what research areas would you recommend strengthening?

Chemical and Nuclear Engineering Response: The total number of engineering faculty has stayed the same for 20 years. While stagnant faculty numbers makes it difficult to advance, the department's approach of using centers, research professors, and affiliated researchers from Sandia National Labs has created an environment where it can compete effectively for funding in chemical engineering, as indicated by the $6 million expenditures last year. The next hire in the department should probably be in the nuclear engineering program.

New hires in nuclear engineering need to be strategically chosen based upon the distinct focus areas for the program. One possibility would be to hire in the chemical-nuclear area with an emphasis in nuclear non-proliferation. More faculty in nuclear engineering would make it easier for the department to be recognized in the national rankings of nuclear engineering programs. With this in mind, the hiring of Adam Hecht into Nuclear Engineering was a visionary hire in light of the choice of a non-proliferation research focus. His knowledge of instrumentation will enhance this research focus and every effort to encourage his participation should be made.

Finally, it is important that new hires be adequately and appropriately mentored, both formally, and informally, to ensure their success – in a small program, it is critical that junior faculty be carefully recruited to fit within the agreed-upon focus areas of the program, and then be completely supported by all faculty and staff, but especially by the department chair, program lead, senior faculty, etc. This is especially important, since there was evidence that was brought up (concerning ChE) during the APR visit that some actions by senior faculty may have undermined the success of some junior faculty.

Question 5: What are best or suggested practices for effective coordination of departmental administration and the administration of affiliated centers in order to maximize the positive impacts of these centers? Specific issues that are of interest include financial coordination and cooperation, balancing of faculty workload expectation and duties, and reporting/credit for productivity.

Chemical and Nuclear Engineering Response: The department budget, aside from salaries, has shrunk dramatically in the last few years to the point where it is difficult to see how the department can adequately function, much less provide a quality education. Clearly, something has to be done to enable the department to continue to function productively. This problem should be addressed at the university, school, and department levels. The centers contribute tremendously to the department by creating opportunities for first-rate interdisciplinary research, outstanding equipment, and an infrastructure for competing at the national/international levels. However, this presents some unique challenges within the department. The challenge is how to maintain the excellence of the centers while assuring the vibrancy of the chemical and nuclear engineering programs. Some suggestions include: F & A policy modification so that the indirect cost recovery of the centers are more equally shared with the department, well-defined release time and workload policies, strategic decisions about how to spend limited resources, clear rules on when proposals are to be submitted through the centers, and well defined policies and procedures related to the identification, selection, administration, and continuance of the centers. The lack of clear guidelines related to the relationship between the centers and the department should be addressed and proper policies be instituted to assure the vibrancy of both the department and the centers.

Question 6: What are the suggested practices for effective administration and coordination of interdisciplinary degree programs that are largely supported or led by department faculty? Specific issues that are of interest include impact on enrollments in department programs, student credit hour generation, and faculty workload credit.

Chemical and Nuclear Engineering Response: While the creation of interdisciplinary degree programs are highly desirable, careful consideration should be given to the impact of these programs on the traditional educational programs in the department. In chemical engineering, half the faculty do not have chemical engineering degrees, which limits who is available to teach the chemical engineering core courses. This problem is exacerbated by the existence of these additional programs. A more formal policy on workload credit is recommended. A strategic plan where the roles of the interdisciplinary degree programs and faculty hiring are discussed in the context of the overall mission of the department is also clearly needed.

The medical physics program does not seem to add much to the national credibility and recognition for the nuclear engineering program – the most important factor in increasing the recognition of the program by its peer institutions, department heads, and faculty. Is this really an important core mission and direction for the department and nuclear engineering program? The question of its continuation should be addressed.

Question 7: Do you see opportunities that either of the programs in the department is not recognizing or capitalizing on?

Chemical and Nuclear Engineering Response: The union of chemical and nuclear engineering is unique in the US. For this reason, the ChENE Department should take full advantage or their unique position. In this regard, the faculty should find ways to use the research strengths of the department synergistically. This would point to developing a research program in fuel cycles. In addition, there is significant potential for increasing the interactions with the national laboratories in New Mexico if such a program were established. For this to occur, however, encouragement through additional resource allocation needs to be made by the upper state administration, university, and the national labs.

Additional Comments from the APR team

Mentoring: A consistent mentoring program across the entire department is lacking. The, expectations are not clear and there is minimal feedback. Lab space was not ready for some of the new faculty and start up funds were not available for retrofitting the labs. Faculty were not given guidance about writing mid promotion packages. Some of the junior faculty have not received adequate mentoring, and some of the senior faculty have not treated junior faculty with the respect they deserve. On the other hand, other junior faculty felt that they had received adequate mentoring. A department mentoring program including both direct and indirect mentoring, with accountability, should be instituted with the realization that the assistant professors are the department's future. This should be done or there is a danger of the department losing its junior faculty. Yearly written reviews of all faculty members should be done.

Effective use of resources: As described above, one necessity is for the university and the college to resolve the distribution of funds between the department and the centers. In addition, it should be determined if it is possible to re-allocate resources within the department. In particular, it appears the department could be more efficient. Some suggestions/comments in this regard: The undergraduate classes are small and some ChE faculty appear to teach little if at all. In addition, the department has two lecturers who only teach. Is it possible to not fill one of those positions when it becomes vacant and use the salary for graduate student recruiting and department expenses? Is it possible to combine some ChE and NE courses? Does the department need to teach a materials science course or is there one in mechanical engineering? Although the 4 UG labs are a good educational experience, what are the priorities of the department? Could 3 lab courses be taught instead to free up faculty time? Is it possible to offer fewer courses for the new biomedical degree or to use some current courses? Teaching graduate courses to 8 students may be an inefficient use of resources.

ABET concerns: Retaining ABET accreditation for engineering programs is an important measure of the externally perceived quality of the programs. It is highly recommended that both programs pay particular attention to preparing for the Fall 2010 visit and place appropriate resources, faculty and staff time to achieve a successful outcome.

The Department claims to use its Advisory Council as an important assessment and evaluation tool; however, the last meeting of the Advisory Council was in 2004. Since the Advisory Council is included in the department's assessment process as shown in Figure 1 of the self-study it appears that the department is not regularly asking the Advisory Council to assess its programs. This is too long between opportunities to receive feedback from the Advisory Council. More regular use of the Council is an important signal to ABET that the programs take the ABET process of continuous improvement seriously. The review team recommends that the Department convenes the Advisory Council at least once, but preferably twice – once in Fall of 2009 and once in late Spring of 2010 - and possibly either right before or right after the ABET team visits campus.

The Program Educational Objectives (PEOs) for both programs appear to be closer to objectives for graduates to achieve at graduation than for objectives to be achieved and assessed by graduates a few years after graduation. The PEOs should be reviewed with this and other new/revised definitions by ABET-EAC, in mind. They should also be reviewed by each program's constituents prior to the ABET visit and self-study preparation.

Additional Suggestions

The department should produce a high quality brochure and a constantly updated web site.
The department should consider having a reception at the AIChE and ANS meetings.
The university should make an effort to create endowed chairs for the top faculty in the department.
The department should undergo its own fund-raising efforts.
A space committee should be established that would re-allocate space so that new faculty members have sufficient space to be successful.
An effort should be made to create endowed positions for graduate students to enable part of their first year to be covered by the university.

Graduate stipends should be increased.
TA lines from central administration should be provided to give the department more flexibility.
An awards committee should be established.
A formal workload for faculty should be established.
The department needs to have a well defined set of policies that are transparent and consistent.

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