Bioengineering Graduate Program Review

1. PROGRAM OVERVIEW

1.1 Program Mission and Organization

Background -- The Department of Bioengineering was organized in 1974 as a graduate academic program in the College of Engineering. The Department's history goes back to the late 1950s when there was a growing interest in the College of Medicine in applying modern techniques of cardiovascular monitoring, diagnosis, and surgery. The Department of Bioengineering and Biophysics was established in the early 1960s by medical informatics and medical computing pioneer, Dr. Homer Warner. Several pioneers in transplant surgery in the mid-1960s recruited for an outstanding individual to develop a program in "artificial internal organs" to complement the growing activities in surgery. The University recruited artificial organs pioneer, Willem J. Kolff, in 1967. Kolff rapidly developed an Institute for Biomedical Engineering and a large research program focusing on artificial kidneys (hemodialysis), artificial hearts, and cardiac assist devices. Kolff was already internationally known and recognized as the "Father of Artificial Organs" back in 1967. His presence at the University of Utah immediately attracted many students, scientists, and engineers who wanted to work with him. Dr. Kolff was a researcher, physician, and inventor and was not particularly interested in academic degree granting programs. Many of the students who came to work with him wanted to earn degrees. Dr. Warner's Department of Biophysics and Bioengineering was not equipped to provide these students with an appropriate degree program. So in 1974 that department was administratively reorganized into the Department of Medical Informatics in the School of Medicine and the present Department of Bioengineering, a graduate degree-granting department within the College of Engineering.

Bioengineering at Utah has focused on Biomedical Engineering, the application of engineering principles, methods, and tools to problems and needs in medicine and surgery. The first chair of the present Department of Bioengineering was Curtis Johnson, an electrical engineer/bioengineer recruited from the University of Washington, which already had an active program in biomedical engineering. Dr. Johnson's interests and activities in bioinstrumentation led to an initial emphasis on instrumentation and strong and close interactions with the Department of Electrical Engineering. Curt Johnson developed extensive collaborations with the College of Medicine and with many components of University Hospital and the LDS Hospital. Fortunately, there was already a strong culture fostering interdisciplinary collaboration, so the Department and its activities grew. The 1990 Graduate Council review (see below) recognized these activities and programs.

Organization and Administration -- The organization of the Department includes:

Co-chairs: Kenneth W. Horch and Joseph D. Andrade -- Professors Andrade and Horch share the administrative duties so they can maintain nearly full teaching loads and competitive research programs.

Director of Graduate Studies: Richard D. Rabbitt

Directors of Undergraduate Studies: Douglas A. Christensen and Kenneth W. Horch

Graduate Admissions Committee: Vladimir Hlady, Chair

Graduate Curriculum Committee: Richard D. Rabbitt, Chair

Undergraduate Curriculum Committee: Kenneth W. Horch, Chair
Industrial Advisory Board Coordinator: Joseph D. Andrade

Current Mission and Directions -- Our mission in 1974, and our mission now, is to provide outstanding educational opportunities for graduate students in Bioengineering and to conduct research and development in the general area of bioengineering.

Biobased Engineering -- About 6 years ago we had the opportunity to compete for a Department Development Award from the Whitaker Foundation. We thought long and hard about a unique new direction for the Department. In the early 1980s that uniqueness was bioinstrumentation and artificial organs, due to the vision and leadership of W. J. Kolff and C. Johnson. Although we had grown and had a very good reputation as one of the leading graduate programs (see 1990 Council report, below), it was clear that we were no longer as unique as we had once been. It was also clear that the general broad field of BIOLOGY was rarely represented in BIOengineering, because biomedical engineering was focused on humans and their anatomy, physiology, and pathology. Bioengineers were very successfully applying their physical science-based tools to medicine, but were largely ignorant of the much wider field of Biology. So we proposed a program in Biobased Engineering, arguing that Bioengineering, and indeed Engineering in general, potentially had much to learn from the basic science of Biology. We received a Whitaker Foundation Development Award in 1993, which – together with strong support and commitment from the University of Utah – led to a 50 percent growth in the faculty over the last six years and to initiation of a Biobased program. The Whitaker Foundation and the University of Utah have made substantial investments over the past six years in a greater biological focus in Utah's bioengineering program and in the research opportunities available to graduate students.

The Whitaker Development Award was made to fund the creation and development of the Biobased Engineering Program at the University of Utah, based on the concept of transferring fundamental knowledge from molecular biology, cell biology, and organismal biology to the applied field of biomedical engineering. The recognition of the expanded and future role of biology in engineering disciplines has been a guiding principle behind the effort to foster the emergence of a new kind of Bioengineer: one trained to draw from the principles and concepts of living biological systems. Thus, Utah's Bioengineering program is now educating graduate bioengineers in the combination of traditional engineering disciplines with life science tools, the recognition of the principles of biological structures and their use within artificial constructs, and the understanding of the functions of biological machines and the way they are regulated, in order to mimic such principles in man-made machines.

One cornerstone of the Biobased Engineering Program was Whitaker Foundation and University support for the recruitment of the new group of faculty whose training and research efforts embraced the biobased engineering philosophy. The new faculty members have developed courses and research laboratories that give bioengineering graduate students an extensive exposure to biological systems so that they can effectively participate in a new biology-based approach to the solution of engineering problems. The transition is an ongoing process and an ongoing and essential theme of the Whitaker-supported changes in Bioengineering at Utah. Our journey in implementing biobased concepts in engineering is by no means simple: there are no recipes nor established pathways. The natural sciences are regularly tempted to ignore their important role in applied fields and engineering. Biobased Engineering will not be fully accepted or applied until we have produced a generation of engineers with firm foundations in both biology and engineering and they, in turn, have made their own contributions to the field.

Undergraduate Program --The field of Bioengineering has also changed and matured during this period. The success and popularity of the field has resulted in a strong interest in the study of bioengineering at the undergraduate level. Undergraduate programs have developed, evolved, and grown in popularity in recent years. Generally, industry has encouraged this growth, because of the valuable inter- and multi-disciplinary skills and interests of these new engineers.

The Department's strong Industrial Advisory Board and the College and University higher administration encouraged the development of an undergraduate program. We began the planning and development of a full undergraduate program two years ago and received full approval last fall. Although an open enrollment program for the first two years, the size of the

upper division class is limited to 35 students to guarantee high student quality and an excellent educational experience. It is expected that some 100 freshman students will eventually make up the pool from which the 35 upper division students are selected.

Thus, the Department's mission expanded significantly effective Fall 1999 with the implementation of an undergraduate degree-granting program in Biomedical Engineering, the first such program in the Intermountain West. Our mission now includes the provision of outstanding undergraduate education, as well as related professional activities.

Industrial Interactions – The Department's strong interactions with industry were already noted in the 1990 Council report (see below). Those interactions have expanded. Local industry was involved in the planning of the undergraduate program; they also continue to provide input on the graduate program. The Department seeks the input and advice of industry through its Industrial Advisory Board and through several University—industry and related centers:

Center for Biopolymers at Interfaces, V. Hlady, Director
Center for Controlled Chemical Delivery, J. Kopecek, co-Director
Center for Neural Interfaces, R. Normann, Director
Center for Non-Invasive Imaging, S. Johnson, Director
Center for Bioelectric Field Modeling, Simulation, and Visualization (NIH-NCRR), C. Johnson and R. MacLeod, co-Directors
Keck Center for Tissue Engineering, P. Tresco, Director

Seminars, Retreats, and, Meetings – Our Graduate Seminar is a source of information and interaction for faculty, technical staff, and students. Faculty often have visitors who are asked to give seminars, workshops, and informal discussions, either as part of the regular seminar series or as special events. The Seminar meets each Friday and runs the entire academic year. Over recent years, this regularly scheduled seminar series has been augmented with Faculty Recruitment Seminars in the spring semester. The Autumn 1999 Seminar schedule is—

Autumn 1999 Graduate Seminars
Department of Bioengineering, University of Utah
Fridays, 2:00 PM, 501 Biopolymers Research Building

Aug. 27	Dr. Thomas Baldwin, Chairman, Department of Biochemistry, U of Arizona Assembly of the Bacterial Luciferase Heterodimer
Sept. 17	Dr. John Hayes, Department of Anesthesiology, U of Utah Selected Topics in Microvascular and Cardiovascular Research
Sept. 24	Dr. David Stocum, Dean of Science and Professor of Biology Indiana U-Purdue U, Indianapolis Regenerative Biology and Engineering: A Millenial Revolution
Oct. 11-15	Dr. Lev Blumenfeld, Institute of Chemical Physics, Russian Academy of Sciences Lecture Series-- Oct 11 Hemoglobin as an Honorary Enzyme Oct 13 Molecular Engines in the Living Cell Oct 15 Biophysics in the new Millenium
Oct 22	Dr. Vladimir Hlady, Department of Bioengineering, U of Utah The Vroman Effect in Protein Adsorption
Oct 29	Dr. Pedro Mendes, National Center for Genome Research, Santa Fe Biochemistry by Numbers: Computer Simulation of the Behaviour of Biochemical Pathways
Nov. 12	Dr. Ed DiBella, Department of Radiology, U of Utah

Cardiac Imaging with SPECT, PET, and MRI

Nov 19 Dr. James Bassingthwaighte, Department of Bioengineering, U of Washington
The Physiome Project

Dec 10 (?) Dr. Bernard Palsson, Department of Bioengineering, UC San Diego
Metabolic Dynamics and Engineering

In addition to the seminar series, special lectures, and workshops, there are a variety of regular group meetings available for student and faculty participation. The semiannual meetings of the Center for Biopolymers at Interfaces and its industrial members provide opportunities for student interaction with industry representatives. Graduate students and faculty also participate in numerous other seminar series across campus.

The Department holds monthly faculty meetings in which the undergraduate, graduate, and related activities are discussed and planned. Program planning, particularly long-range planning, is discussed extensively at an annual faculty retreat held every June or July.

Research Areas -- The Department's strengths at the time of the last review in 1990 were in the areas of electronic instrumentation, medical imaging, biomaterials, and artificial organs. In the past decade the Department has developed considerable strength in the areas of—

Biomechanics
Biomolecular Engineering
Computational Bioengineering
Tissue Engineering
Neuro-Engineering/Neuroprostheses
Drug Delivery
Biocompatibility

Much of this growth and development was made possible by the Whitaker Foundation Department Development Awards. The current strengths are also represented by the specialty areas in the graduate and undergraduate programs outlined in Section 4.

1.2 Program Planning

Undergraduate Program -- The Department is committed to development of an outstanding undergraduate program. As very little College or University support was made available with which to launch and conduct the program, we are seeking external funds. Fortunately, the Whitaker Foundation has a Special Opportunity Awards program with which to found new, "special," initiatives. We submitted a proposal to them in mid-July 1999 requesting nearly $1,000,000 over 3 years to develop and implement an accelerated BS/MS program in Biomedical Engineering. If funded, this program will provide stipend support for outstanding undergraduates seeking dual BS/MS degrees. The grant would also provide substantive faculty and technical staff support which would greatly aid the undergraduate program as well as the unique BS/MS dual degree program. The proposal includes a University commitment for one additional FTE faculty member with which to augment the undergraduate program. We will, of course, seek National Science Foundation and private foundation support as well. We also expect University resources for the program to develop as the enrollment grows. Given the size of the University of Utah, the College of Engineering, and of our department, we expect to limit growth of the program to a maximum of 50 students per year (and that includes the joint BS/MS students if that accelerated program is indeed funded).

We are making efforts to provide innovative, and effective, pedagogical materials and instruction for the undergraduate program. The freshman course, Introduction to Bioengineering (BioE 1101, 1102), pioneered by R. Rabbitt, is utilizing a unique physical-law approach to introduce students to common principles underlying the function of biological systems and biomedical devices

(details are available at the course web site: http://webct.cc.utah.edu). The faculty are now in the process of developing the junior and senior year undergraduate courses and labs. Several faculty are developing textbooks and related teaching materials.

Research Directions and Graduate Program – The Department is in the process of evaluating future research directions for the next decade. The expanding graduate and undergraduate student populations at the University of Utah and nationwide make expansion of the Department probable. Faculty attrition and departmental expansion combine to offer a unique opportunity to increase research breadth and consolidate strengths. We plan to submit a major "leadership award" proposal to the Whitaker Foundation and a second major proposal to a new philanthropic foundation. A number of areas are being considered and will be more fully developed within the next year. New areas being discussed include pediatric bioengineering, metabolic engineering, bio-modeling/simulation, biotechnology, and tissue engineering.

We are also preparing a proposal to the Whitaker Foundation for the final phase of the Department Development Award, which includes a new FTE position. This effort is being led by V. Hlady in the area of "Biointeractive Materials." Biomaterials, a traditional strength of the Department, has evolved from basic research in polymer surface chemistry, surface physics, and surface engineering for biocompatibility to the design of a new generation of materials that are active participants in tissue healing, through drug delivery and tissue engineering. The University of Utah is investing resources throughout the campus in the development of a vast array of molecular biology tools that can be used in molecular, cell, and tissue engineering to build a new generation of more interactive and effective materials on a cost-effective scale. The first significant step in this direction was enabled in 1998 by a major gift from the Keck Foundation to establish the Keck Center for Tissue Engineering. The center, directed by Dr. P. Tresco, is developing novel biomaterials, constructs, and tissue-engineered systems directed primarily at repair and treatment of the nervous system.

The Whitaker Continuation Award, "Engineering of Biointeractive Materials," will be used to establish an educational and research program that will provide an environment for material/ surface science and engineering faculty and students to meet, collaborate, and utilize the tools of molecular and cell biology. We also propose to further develop our existing efforts in the development of biointeractive materials and to initiate research and development of some, if not all, of the following novel biointeractive materials thrust areas:

engineering multi-enzyme/multi-protein complexes, which will include non-traditional materials and will act as molecular processing and sensing "devices" within diseased or damaged tissues
engineering of thin films incorporating microchannels, oriented proteins, macromolecules, viral particles and other "natural" nanostructures, for the purpose of structure and information transfer across interfaces and for sensing
engineering of micro-crystal based structural materials, based on biomineralization-like processes that are regulated by compartmentalized proteins

We are also very interested in using our existing strengths in new areas. A good example where this has already happened (and relevant to the Interactive Materials discussion above) is the work and interactions of Dr. R. Stewart, one of our newer faculty hired under the Biobased Engineering program. Dr. Stewart's expertise is in protein biochemistry and protein engineering, specifically in "motor" proteins. His unique skills and interests have led to a very successful and well-funded "private" research program. But he has also developed several very productive collaborations: with J. Kopecek he is developing a set of novel, dynamic biomaterials which can be made to change shape and other properties under appropriate stimuli; with J. Andrade he has developed a set of new luciferase enzymes now being used in biosensors employing bioluminescence. We expect many of our faculty to develop strong "personal" research programs AND develop a set of interactive, collaborative projects utilizing the skills of two or more faculty.

Some faculty do this more rapidly and more effectively than others. To try to facilitate such interactions, at the June 1999 Retreat faculty were asked to list six areas which they would like to

develop or expand towards in the next five to ten years. We are now discussing these areas to facilitate new faculty interactions and collaboration.

We are also aware that the entire field of Engineering is likely to change dramatically in the next several decades, with a growing emphasis on biologically based approaches to engineering problems and activities. Bioengineering is having a major influence on Engineering because undergraduate bioengineering programs are attracting a significant fraction of ALL engineering students. Many faculty now work on Bioengineering topics. Engineering itself is changing and developing a strong interest in and reliance on Biology, Physiology, and Medicine. We fully expect that nearly every engineering department and program will begin to develop a biological or biobased component. As the "biologization" of engineering develops, there will be a need for courses in basic quantitative biology for engineers. Indeed, the Whitaker Foundation Teaching Materials Editorial Board is actively seeking teaching materials for such courses.

With the establishment of an undergraduate program in biomedical engineering, with a major Whitaker Foundation Department Development Award in the general area of Biobased Engineering, and with the establishment of undergraduate study tracks allied with traditional engineering disciplines, the Department is well placed to cooperate with and be highly responsive to (given appropriate resources) the College of Engineering's expected interest in biological and biobased approaches to Engineering.

There is also growing interest in the health and biological science community in applying engineering and physical science tools and techniques to the life sciences. New initiatives in computational biology, metabolic modeling and simulation, biomathematics, mathematical biology, and related areas will all provide unique opportunities, and indeed responsibilities, for the Department of Bioengineering.

Department Size – The Department has now grown to 14 regular faculty (representing 10 state-supported FTE positions), 23 research faculty, and 34 adjunct faculty. Several have partial appointments in other departments, including Physiology, Pharmaceutics, Anesthesiology, Medicine, Radiology, Computer Science, Electrical Engineering, and Materials Science and Engineering. The graduate program now includes about 90 students.

Given the present size of the Department, the faculty growth expected as a result of the Whitaker proposals, expansion as a result of undergraduate program growth, the size of the College of Engineering, and the size of the University of Utah, we expect the Department to grow to about 20 FTE state-supported faculty positions over the next 10 years. This would mean greater than 50 student/year undergraduate program and a graduate program of perhaps 130 students. Such growth would, of course, require major new facilities and related resources.

1.3 1990 Graduate Council Review and Actions

The March 1990 Graduate Council Report is provided below in italic font.

University of Utah
Report of the Graduate Council on the
Department of Bioengineering

March 1990

The Graduate Council has completed the study of the Department of Bioengineering under the Review of Graduate and Undergraduate Programs by the University Senate on November 6, 1989.

The External Review Consultants were:

Professor Thomas McMahon
Department of Biology
Harvard University
Cambridge, Massachusetts

Professor Jack E. Lemons, Chair
Department of Biomaterials
University of Alabama
Birmingham, Alabama

Professor Anthony G. Gristina
Orthopedic Surgery
Wake Forest University
Bowman Gray School of Medicine
Winston-Salem, North Carolina

The Thesis Reviewer was:

Professor Pierre M. Galletti
Professor of Medical Science
Division of Biology and Medicine
Brown University
Providence, Rhode Island

The Internal Review Committee was composed of three senior members of the University of Utah faculty:

Professor Allen B. Edmundson
Department of Biology

Professor Mendel F. Cohen
Department of Philosophy

Professor John E. Greenlee
Department of Neurology

The following information and recommendations from the Graduate Council are based primarily upon the reports of these reviewers, the self-study documents submitted by the Department, and the responses made by Professor Joseph Andrade, Chair of the Department, and Professor David Pershing, Dean of the College of Engineering.

Department Profile

The Department of Bioengineering is one of seven departments in the College of Engineering. This is a very strong, nationally prominent department with an overall excellent faculty and graduate program. Its principal weaknesses are those which arise from overextending its strengths. The department has only 5 FTEs, which it has enterprisingly leveraged into partial support for 11 regular faculty (7 professors, 3 associate professors, 1 assistant professor). In addition, there are 13 research faculty and 3 adjunct faculty. A major strength of the department has been its outstanding success in attracting and maintaining extramural support for its research programs.

The multi-disciplinary nature of the field of bioengineering is reflected in the profile of the department itself. The strongly research-oriented faculty are committed to the application of sound engineering principles to a variety of medical/biological problems, particularly those involving artificial organs, prosthetics, biomaterials, and bioinstrumentation. This endeavor brings them into collaborative, on-site interaction with numerous other departments, especially in the Colleges of Engineering and Pharmacy and in the School of Medicine. Consequently, laboratories are located not only in the Merrill Engineering complex, but across the breadth of the university campus, as well as in Research Park and at area hospitals. Nearly all of the faculty have joint appointments, and many have

their primary appointment in another department. The tremendous success of the faculty in effectively working with local bioscientists is another of the department's major strengths; at the same time, the separation and remoteness of many of the faculty, along with their students, leads to obvious weaknesses for a department and its graduate program.

The department admits 12-15 graduate students per year and maintains a steady-state population of 50-60 students in its M.E., M.S., and Ph.D. degree programs. The quality of the students accepted into the program is generally high, with the average entering GPA at 3.46 and GRE percentiles at 87th (quantitative) and 80th (analytical). The principal concern of students, faculty, and internal and external reviewers alike, is the lack of financial support for first-year graduate students. Without teaching assistantships or tuition reduction waivers, these beginning students feel pressured to select a funded mentor in order to secure a stipend. Such decisions are sometimes premature for the student, and also unfair for the faculty member, whose research grant is then used to support personnel who spend most of their time in the classroom.

Despite the handicaps of limited state support for faculty and students, and widespread dispersal of the department, all reviewers were readily impressed with the overall high level of excellence which the Department of Bioengineering has achieved in research and graduate education.

Summary

<u>Strengths</u>

The research accomplishments of the faculty have earned for the department a very prominent national reputation. All external reviewers considered the department to be one of the beset in the country, certainly within the top 10 nationally. The department has enjoyed a history of extraordinary leadership and boasts several genuine "superstars" amongst its faculty.

The faculty are committed to effective interaction and collaboration with the medical/biological scientific community. The classical barriers that frequently exist between engineers and physicians, biologists, and even physical scientists have been adroitly overcome by the bioengineering faculty.

The Department of Bioengineering is a regional resource for technology transfer, and has helped shape the area's image as the "bionic valley."

The graduate core curriculum is viewed as solidly coherent, yet sufficiently diversified to meet the educational needs of a multidisciplinary field like bioengineering. The faculty present a broad range of research endeavors from which the students may choose.

The overall quality of the graduate students accepted into the program is generally high, despite some reservations and claims of "unevenness" by two of the external reviewers.

<u>Weaknesses and Recent Developments</u>

It was agreed by faculty, students, and reviewers alike that the major weakness in the graduate program is the lack of financial support for first-year students. The department competes for the best students with other nationally prominent bioengineering programs (e.g., at MIT and Duke), but is unable to offer competitive stipends to its prospective first-year students.

The department has recently obtained funds for two one-year fellowships, and has submitted training grant proposals to federal, corporate, and foundation entities in an aggressive campaign to raise money for graduate student stipends

Given the achievements of this department in research and graduate education, its level of state support is meager (only 5 FTEs), and faculty salaries are low (25%) below other major programs, according to one external reviewer).

The recent state legislature funded the College of Engineering Budget Initiative included in the University of Utah budget, and it is hoped that this will improve the

department's level of state support.

Physical dispersal of the faculty and graduate students across campus and off-campus sites is a continuing obstacle for departmental unity.

> *This problem may be partially alleviated in the future with construction of the new Biomedical Polymers Building near the University of Utah Medical Center. Problems related to tracking student performance and progress will now be handled by the central administration of the department (Chairperson, Director of Graduate Studies, and Department Administrative Officer) in quarterly inquiries and meetings with students. Some satellite groups of the department (e.g., bioengineering faculty located in the Department of Radiology of the School of Medicine) have organized an advisor system, as well as journal clubs and weekly students meetings, to foster student unity and monitor student progress.*

There is need for concern for the quality of some students' dissertations. The dissertation reader rated the three Ph.D. theses provided by the department at 1, 2, and 4 (scale 1-5, with 5 being the highest rating). Two M.S. theses were rated 4 and 5.

A number of organizational concerns pertaining to the graduate program were raised during the review process, and have since been addressed by the department. They are:

Clarification of the requirements for the Ph.D. degree.
Parallel rather than sequential tracks leading to the M.S. and Ph.D. degrees.
Plans for inaugurating an engineering-based physiology course.
Addition of industrial and clinical internships to the curriculum.
Increased laboratory exposure in all required core courses.
Institution of an annual faculty retreat for coordination and long-range planning of research and graduate education programs.

<u>Recommendations</u>

The department should continue to seek funds from all possible sources (federal, state, corporate, foundation) to provide support for graduate student stipends, particularly for first-year students.

The small number of FTE's and low faculty salaries in the department requires immediate attention and corrective action by the College of Engineering and the University Administration. In addition to more FTE, a greater return of reimbursed overhead to the department, such as that done at some other schools, might serve as another possible source for added revenue to the department. This recommendation was made by two of the external reviewers.

Continuing efforts should be made to foster greater interaction and communication amongst the widely dispersed faculty and graduate students in the department.

Procedures should be developed to ensure quality of graduate dissertations.

Procedures should be developed to monitor the new internship program.

> *In sum, the Department of Bioengineering is to be commended for its demonstrated excellence in research and graduate education, in spite of a history of very limited state support.*
>
> *It is recommended that the Department be reviewed again in its next regular cycle.*

The 1990 Review, although quite complimentary, noted several weaknesses:

lack of financial support for first year students – although this is still a serious problem, the situation has improved due to student fellowships available through our Whitaker Foundation Department Development Award, the recently endowed Campbell Graduate Fellowship, and the College of Engineering Graduate Fellowships. The Whitaker Fellowships have supported a substantial number of entering graduate students over the last five years (see Section 3). These

fellowships will not be available, however, after the conclusion of that award about two years from now. The Department is working closely with the Dean of Engineering to develop fellowship support from philanthropic sources, as well as preparing to submit another Whitaker proposal and a training grant application.

meager state FTE support and low salaries –the state FTE support has increased substantially, particularly in the last 5 years due to the required FTE "matches" for the Whitaker Award. Salaries, however, are another problem. Salaries have not improved. Faculty salaries are low relative to peer departments, and the gap is increasing. This is a serious problem.

physical dispersal of faculty and students –since the 1990 review the Biomedical Polymers Research Building (BPRB) was constructed in "Upper Campus" and now houses about half of the Department, including a satellite department office; our "dispersal" is now focused in two buildings: Merrill Engineering and BPRB. The fact that those facilities are about 15 minutes apart does provide a barrier to interaction and communication. The College of Engineering is well aware of the situation and is planning a new engineering building which, when constructed, will be able to house the entire department.

quality of student dissertations – we now require one tenure-track "core" faculty member on all M.S. thesis committees and two on all Ph.D. dissertation committees; supervisory committees have been informed of the need for high quality and rigor; and the co-Chairs are now comprehensively reviewing finished theses for quality prior to the final department signature.

graduate program organizational concerns – the six points noted in the recommendation (see Report above) have all been addressed and implemented (indeed, these were already addressed and implemented prior to the March 1990 Report).

Patrick A. McMurtry
Associate Dean, The Graduate School
310 Park Building
Campus

April 22, 2000

Dear Dr. McMurtry,

Thank you for your letter of April 5 and the reports from the external and internal consultants. We have reviewed the reports and submit the following response:

Background:

Our preparation for the Graduate Council review has resulted in considerable discussion and has already resulted in changes in our processes and activities. This is, indeed, we believe, one of the major objectives of the review process. As a result many of the suggestions and recommendations made by both the external and internal reviewers have already been, or are in the process of being, implemented. We will, therefore, make only very brief responses to each of the review reports.

Ernest Stokely:

A number of his comments refer to the review process itself, and are therefore best considered by the Graduate Council.

He felt that the most serious deficiency noted during the visit was "… no clear, concise, focused vision…". We are now well on our way in the development of a long-range vision and strategic plan. Portions of the plan were shared with a Whitaker Foundation site visit team during a site visit in February. That particular Dept. Development Grant has now been funded. We are now preparing a more extensive Leadership Award application to Whitaker and other foundations. The Department now has an active, ongoing planning process.

Dr. Stokely was also concerned with the fact that the Department has two co-chairs rather than a single chair. This was also of some concern to the Whitaker Foundation, and to other reviewers. The issue is being addressed by Dean Stringfellow and by the Department faculty.

His recommendations related to courses, curriculum, and recruitment are all being addressed. Some of these are discussed below.

Antonios Mikos:

Although Dr. Mikos' report was extremely brief, the discussions during his visit were very helpful. He encouraged us to develop a more effective graduate student fellowship program, particularly to assist in the recruitment of outstanding 1st year graduate students. The inputs of both Stokely and Mikos, coupled with the faculty's ongoing interest in recruiting absolutely outstanding graduate students, has led to the development of a new Department Graduate Fellowship Plan, which is now being adopted by several other departments in the College of Engineering, and has indeed been strongly endorsed by Dean Stringfellow.

Dr. Mikos also addressed the issue of the housing of the Department in a single building

in the near future. The problem of multiple buildings was also addressed by Dr.Stokely.

J. T.Mortimer:

His major concern was with the funding mechanism at the University of Utah. His suggestions should of course be brought to the attention of Vice President Pershing and President Machen.

He was also concerned with the fact that the Department has a number of fractional FTE faculty; this issue was also confusing for Dr.Stokely. The Department has been attempting to solidify its fractional FTE appointments for those faculty that desire to do so. Many of our fractional FTEs prefer this arrangement, and we will continue to accommodate them. During the last year the fractional appointments of 3 professors have been significantly increased. We feel we make very effective use of our limited state FTE resources.

He also suggested a formal review progress to evaluate students. This had already been implemented by the Director of Graduate Studies and is likely to be expanded in the next several years.

Internal Review Team:

They were concerned about a possible lack of depth in some key areas, expressing concern about a potential lack of critical mass. This is being addressed in the Department's planning process, specifically the issue of key areas for development and critical mass.

They also commented on the need for a new faculty mentoring program and for improved administrative staff support. A mentoring program has now been established; three senior faculty are serving as mentors for four junior faculty. The administrative staff problem has been greatly alleviated by the appointment of a new, highly effective secretary for the Biopolymers Research Building office. In addition a technical staff person has been added, with a major responsibility to assist faculty in the laboratories required for the new undergraduate program and for the existing graduate program.

The internal committee also addressed the issue of student funding and fellowships, discussed above. They also recommended that the chairs and administrative staff more closely monitor the activities of graduate supervisory committees and individual students to be sure that appropriate mentoring and supervision is taking place.

Summary:

We have not addressed the positive aspects and commendations presented in the various reports. In general all the reviewers were pleased with the Department's activities and progress. Most of the recommendations have been or are being seriously considered by the faculty and the co-chairs. Indeed, many have already been implemented. The others will continue to be discussed. The input from this Graduate Council Review will be a major discussion item at the upcoming annual faculty retreat on June 9, and much of that will become part of the Department's master plan and strategic plan.

The reviewers' recommendations regarding budgetary needs, particularly for the new undergraduate program, and consolidated space for the entire Department are ongoing

problems which the Administration must address.

We thank you, and the others involved with the Graduate Council review process, and particularly the internal and external reviewers, for this valuable input.

Please let us know if any further response or information is required.

Sincerely,

J. D. Andrade	K. Horch	R. Rabbitt
co-chair	co-chair	Director of Graduate Studies