Level II Request for a BSEE and MSEE programs at Montana Tech

1. Introduction

Currently, Montana Tech of the University of Montana offers a Bachelor of Science Degree in General Engineering and Masters of Science Degree in General Engineering. Within the Bachelor of Science Degree, students choose from the following emphasis options: Civil Engineering; Electrical Engineering (EE); Mechanical Engineering; Welding Engineering, or no option. The General Engineering BS degree is accredited by the Accreditation Board of Engineering and Technology (ABET) while the options are not accredited. Within the MS degree, students have the choice of an EE option, or no option. When awarded a degree, the student's transcript reads

"B.S. in General Engineering, Electrical Engineering Option," or

"M.S. in General Engineering, Electrical Engineering Option."

Montana Tech of the University of Montana proposes that the Electrical Engineering option in both the B.S. and M.S. degrees be offered as a standalone Bachelor of Science Degree in Electrical Engineering and a Master of Science Degree in Electrical Engineering. This change will allow Montana Tech to seek ABET accreditation for the BSEE portion of the degree. The primary purpose of the change is to improve the marketability and job opportunities for the graduates.

Through internal review and consultation with an external ABET expert, Montana Tech fully expects that the change proposed here will require no added faculty, laboratories, or costs. The BSEE program proposed here is anticipated to meet the requirements for a standalone EE accredited degree. Accreditation will be sought upon approval of the proposal by the BOR. Also, the proposed degrees will be housed within the General Engineering Department and maintain their multi-disciplinary character.

In addition to improving student opportunities, the proposed changes will also help support a growing externally funded research program at Montana Tech. In partnership with MSE Technologies and federal government national labs, Montana Tech has recently been awarded a $2,000,000 federally funded research grant to develop intelligent electric power technologies. The award is part of an expected $9,000,000 over three-year award. The majority of this money will be dedicated to conducting research at Montana Tech. Tech's principal goal is to develop a world-class educational and research capability. The proposed degrees are the backbone to this capability.

2. Background, Objective, and Need

The primary objective of the proposed changes is to improve the marketability of and opportunities for Montana Tech graduates. After completing a rigorous degree program, Montana Tech students deserve the opportunity to compete for professional jobs on a level playing field. The proposed changes will provide this opportunity.

The current B.S. in General Engineering/EE option provides the graduate with a general engineering background with focused emphasis in EE. Graduates gain both the breadth of the general engineering degree and the depth of the traditional EE degree. Students can select upper-division design courses in the areas of instrumentation and control, and electric energy. The instrumentation and control emphasis is a long-standing tradition of the program that serves many needs in the process and minerals industries. The electric energy focus has been developed over the last few years primarily through externally funded research grants to serve the growing demand in the electric power industry. Electric energy technologies focus on the production and delivery of electric power. Modern power production examples include fossil fuel, hydro, wind, and fuel cells. Power delivery typically refers to high-voltage electric power grids.

Electrical Engineering is the largest engineering discipline in the world and serves nearly every modern industry. Approximately one-fourth of all engineering graduates today are of the electrical discipline. Electrical engineers are the principal technologists in areas such as communication systems, computer design, electronics, automation, and energy. The growing demand for electrical engineering expertise is especially acute in the energy industry. There are approximately 290 ABET-accredited BSEE programs in the United States, and the number continues to grow. Within the region, this includes three programs in Idaho (two added since 1999), two in North Dakota, two in South Dakota, one in Wyoming, and one at Montana State University – Bozeman, as well as Montana Tech's proposed program.

There are far fewer General Engineering/EE option programs, with the trend that some are re-accrediting as BSEE programs as proposed by Montana Tech. For example, Idaho State University re-

accredited the B.S. General Engineering/EE option as a BSEE degree in 1999. Their primary reason for the re-accreditation is the same as Tech's (i.e., improved marketability and competitiveness of students).

Despite the success of the current EE option, many potential employers that are not familiar with the program will not consider graduates for positions for which these graduates are qualified. Many employers require an ABET accredited EE degree and do not recognize the General Engineering degree with an EE option as a viable substitute. This occurs primarily because the EE-option portion of the General Engineering degree is not accredited, therefore, upper-level EE courses do not receive the scrutiny and evaluation that they would under an ABET accredited BSEE degree. Therefore, potential employers cannot be assured of the quality of the program. By offering the EE option as a standalone degree, Montana Tech will be able to seek ABET accreditation as a Bachelor of Science in Electrical Engineering program thus assuring quality graduates to potential employers. Renaming the M.S. program to a MSEE program will also benefit student marketability and opportunities.

A second issue in marketing General Engineering/EE option students relates to the method many companies use to search for potential employees. When looking to fill an electrical engineering position, the first contact many applicants will have with the company is the Human Resources (HR) department. The HR staff is typically instructed to screen all candidates with an ABET accredited BSEE or MSEE degree. This immediately removes General Engineering/EE option students. Use of web-based and automated searching software has made the problem worse.

This issue is best illustrated by comments from industry experts in their letters of support for this proposal (see Appendix I). Two examples include the letters from Dr. Matt Donnelly and Mr. Bob Morris. Dr. Donnelly is a senior member of the research staff at Pacific Northwest National Laboratory (PNNL). PNNL is a US Department of Energy (USDOE) national research laboratory employing approximately 4000 researchers and staff located in Richland, WA. His duties include directing and managing several million dollars of USDOE research funding aimed toward the electric energy industry. In this capacity he works closely with many universities and electric energy industrial entities. Also, he is a well-recognized research leader in the industry. In evaluating Montana Tech's proposal, he makes several points, one of them being:

"*A second point I would like you to consider is the changing approach to recruiting within HR departments at large firms such as PNNL. I have appended a currently outstanding job requisition from PNNL's Energy and Engineering Division. Using web-based tools for submitting resumes and applications, most of the initial screening is now being handled by HR professionals with little expertise in my technical area. It would take a highly skilled HR staff member within my firm to recognize that Montana Tech has a high quality EE option within the General Engineering degree. It is more likely that prospective candidates would be screened as not meeting the Minimum Requirements (no EE degree) before the resume ever came to my desk.*"

Mr. Bob Morris is a Montana Tech graduate and has held positions of increasing responsibility at Schweitzer Engineering Laboratories (SEL) since 1991; this includes a Vice President position. SEL is a major supplier of control system components for the electric power industry employing over 1000 people located in Pullman, WA. In relating his experiences, Mr. Morris states:

"*When a job opens up at a company, the first screen is usually a non-technical Human Resources (HR) professional. If the resume doesn't say EE, the HR people discard it before it gets to the hiring manager. Let's remove this obstacle and give the bright, hard working students of Montana Tech a fighting chance. An ABET recognized EE degree will help elevate the General Engineering program to the same prominence as the Petroleum, Mining, Environment Engineering, and Geology/Geophysics degrees.*"

Other letters of support in Appendix I echo similar concerns. From industry, this includes a letter from Mr. Jeff Ruffner, General Manager and Senior Vice President at MSE Technologies in Butte, and a letter signed by the members of the General Engineering Industrial Advisory Board (IAB). The IAB members consist of senior engineers and business leaders from several Montana and Northwest Regional companies and government agencies that employ engineers. A third letter is from students at Montana Tech who are currently in the electrical program. A student survey showing unanimous support was conducted at a student meeting and is contained in Appendix II.

2.1. Industry Needs

Montana Tech's BOR-approved vision is: ***To be a leader for undergraduate and graduate education and research in the Pacific Northwest in engineering, science, energy, health, information***

***sciences and technology*.** Consistent with this vision, the current EE-option programs have focused on serving the needs in the process, minerals, and energy industries. To serve these industries, the General Engineering department offers upper-division elective courses in the areas of instrumentation and control, and electric energy and power. Serving these industries and focus areas will continue to be the principal mission of the new BSEE and MSEE programs proposed here.

The projected demand for engineers in the electric energy industry is especially sharp. It is a well-documented fact that growth of the industry's infrastructure has not kept up with demand over the last four decades. Recent indicators of this include the significant increase in power outages over the last decade; this includes the massive outages experienced by the western North American power system in August and July 1996, and the August 2003 east-coast power outage. These are the first massive outages since the northeast coast outage in 1965. Many government and private sector studies have indicated that to alleviate the growing problem, the electric energy industry must apply advanced technology solutions over the next several decades. This is resulting in significantly increased federal government research funding in this area. Because modern electric power systems represent the largest and most complex engineering systems in the world, the projected demand for electrical engineers has been characterized in several studies to be significant.

Testimony on the regional industry needs are provided from several experts in the attached letters of support. One of these is given by Mr. David Gates, Vice President of Transmission Operation at NorthWestern Energy located in Montana, in his letter of support for this proposal, he states:

"*The electric power industry is facing something of a crisis due to the lack of new electrical engineers trained in power engineering. NorthWestern Energy itself recently experienced a disappointing lack of qualified candidates for its most sophisticated electrical engineering positions in the area of Transmission Planning. I am pleased to see that you recognize this need and are proposing a solution.*"

Dr. Donnelly adds to this point with:

"*Finally, I would like to bring to your attention the burgeoning need for engineers in the energy arena. The energy industry is currently bracing for massive retirements as over half of the workforce is expected to retire within the next 7-10 years. This has been reported in numerous journals and periodicals. … Clearly there is a need for more EE graduates in the region and in the nation*."

Because of its abundant natural resources, Montana has considerable potential for participating in the future national energy market. Currently, Montana is a major electric energy exporter despite the fact that Montana has yet to develop fully many of its resources. In a typical year, Montana produces double its consumption for electric energy with the over production transmitted to entities in other states. This occurs despite the fact many of our natural resources have yet to be developed. For example, Montana produces nearly zero energy from wind turbines; yet, it has one of the greatest wind resources in North America. It is the opinion of Montana Tech that the sustainable and environmentally sound development of these natural resources will be done by the hands of Montana's brightest graduates.

To compound the engineering problems faced by the electric energy industry, the industry has a significantly graying population of engineers; at the same time, many universities have reduced energy programs over the last few decades. Many estimate a large demand for power engineers in the near future. Experts estimate that approximately 50% of the engineering workforce in the electric industry will retire within the next 10 years resulting in a significant demand. Here in Montana, NorthWestern Energy is sharing in this crisis (see letter of support from Mr. Gates). In order to serve the industry needs, Montana Tech has added courses focused on electric energy and initiated industry-funded research projects. The goal is to continue to serve the industry in the extend future.

Under the new BSEE and MSEE programs proposed here, these activities will continue. The new advantage is that graduates will have improved marketability resulting in improved job opportunities and competitiveness.

3. Program relationship to the Role and Scope of the institution

Montana Tech of The University of Montana is a specialty institution emphasizing science and engineering, with occupational programs through graduate work. The vision is to be a leader for undergraduate and graduate education and research in the Pacific Northwest in engineering, science, energy, health, information sciences and technology. Its mission is to meet the changing needs of society by supplying knowledge and education through a strong undergraduate curriculum augmented by research, graduate education and service.

4. Please state what effect, if any, the proposed program will have on the administrative structure of the institution. Also indicate the potential involvement of other departments, divisions, colleges, or schools.

There will be no effect on the administrative structure of the institution. The program will remain under the direction of the head of the General Engineering department. This helps the program maintain the interdisciplinary nature.

5. Similar programs offered in Montana, the Pacific Northwest, and states bordering Montana. How similar are these programs to the one herein described?

There are approximately 290 ABET-accredited BSEE programs in the United States, and the number continues to grow. Within the region, this includes three programs in Idaho (two added since 1999), two in North Dakota, two in South Dakota, one in Wyoming, and one at Montana State University – Bozeman, as well as Montana Tech's proposed program.

6. Please name any other accrediting agency(ies) or learned society(ies) that would be concerned with the particular program herein proposed. How has this program been developed in accordance with criteria developed by said accrediting body(ies) or learned society(ies)?

The General Engineering B.S. degree is accredited by the Accreditation Board of Engineering and Technology (ABET) while the options are not accredited. ABET accredits the B.S. or M.S. but not both. Accreditation will be sought for the BS EE if approved.

7. Program Curriculums

7.1. BSEE Program

The new BSEE program will maintain principally the same goals and curriculum as the current EE option. That is, the program will maintain the breadth in general engineering areas while providing the depth of a traditional BSEE program. Students will be offered advanced courses in the areas of instrumentation and control, and electric energy systems. Consistent with ABET policy, the curriculum is centered around fulfilling program objectives. The individual program sets its objectives and then through the use of outcome assessment feedback, it carefully readjusts its curriculum to meet the objectives. The objectives of the BSEE program are provided in Table 1.

Table 1: BSEE program objectives.

The objectives of the BSEE program are to produce graduates who:
1. work effectively on cross-discipline and cross-functional teams, communicating and coordinating with co-workers, clients, contractors, and public agencies;
2. can successfully complete an advanced degree;
3. can apply the principles of mathematics, science, and general engineering science fundamentals (i.e., statics, dynamics, thermodynamics, fluid mechanics, and electric circuits) to solve modern technological problems;
4. are proficient in applying electrical engineering fundamentals to solve modern technological problems; and
5. can design and analyze advanced electrical engineering systems in the areas of instrumentation and control systems, or electrical energy systems.

Objectives 1 and 3 allow the proposed BSEE program to retain the multi-disciplinary nature of the current General Engineering Degree/EE option program. These two objectives are critical to continuing to serve the needs of the process, minerals, and energy industries. In order to meet these two objectives, students will be required to complete many more fundamental general engineering science courses than in a "typical" BSEE program. For example, students in the proposed program must complete 14 credits in fundamental engineering mechanics; this compares to 3 engineering-mechanics credits required in the BSEE program at Montana State University – Bozeman. This is the reason the program requires 136 credits.

Objectives 4 and 5 provide the depth of the program in electrical engineering. The program focuses upper division courses in the areas of instrumentation and control, and electric energy systems. Both these areas are fundamentally multi-disciplinary; therefore, objective 3 strongly supports object 5. For example, in the energy arena, nearly all electric power systems are driven by a thermal or fluid based

systems (this includes fossil fuel, hydro, wind, and fuel-cell based systems). Therefore, it is important for a technology expert in the energy arena to understand the basics of thermodynamics and fluid mechanics; topics left out of many traditional BSEE programs.

Table 2 shows the proposed BSEE curriculum. As stated earlier, the program is the same as the current BS General Engineering/EE option program except for one minor change: ENGR 3350, Mechanics of Materials, has been replaced with a second computer programming elective. This change was implemented based upon the assessment that the program needed more computer-programming exposure. Also, the content of ENGR 3350 was deemed to be of minimal values in meeting the program objectives. The curriculum includes 10 credits of professional electives. Allowed professional electives may be selected from the undergraduate courses listed in Table 3 and the non-seminar graduate courses listed in Table 4.

The professional elective courses in Table 3 allow students to develop expertise in the areas of instrumentation and control or electric energy (often termed power systems). Students desiring to emphasize in instrumentation and control would be advised to select professional elective courses ENGR 4420, 4450, 4460, as well as 5 more credits selected from ENGR 3290, 4470, PHYS 4536, GEOP 4300, or appropriate graduate-level courses. Alternatively, students interested in electric energy would be advised to select professional electives ENGR 4500, 45100, as well as 4 more credits selected from ENGR 4450, 4460, 4520, 4340, or appropriate graduate-level courses.

In addition to the elective and graduate courses listed in Table 3 and Table 4, Tech is currently actively planning to have upper-division and graduate courses from MSU-Bozeman taught on the Tech campus via MetNet (MT Educational Televised Communication Network). This is being planned through a cooperative effort between Tech's General Engineering Department and MSU's Electrical and Computer Engineering Department. The current projected start date for the first course is Fall semester 2006. Similarly, some of Tech's upper division courses will be taught via MetNet on the MSU campus.

The goal of the curriculum is to fulfill the objectives stated above. The curriculum was developed based upon consultation with industry experts, review by Montana Tech faculty, review of other similar programs, and review by an ABET expert. Industry experts included many from the process controls and electric energy industries. The ABET expert, Dr. Subbaram Naidu, visited Montana Tech this past fall semester. Dr. Naidu is a Professor and Associate Dean at Idaho State University. He was the principle leader in developing ISU's new EE program and has been an ABET program reviewer for the past several years. He has extensive knowledge and experience in the ABET requirements.

All courses shown in the BSEE curriculum in

Table 2 currently exist at Montana Tech. Also, the curriculum has been approved by Montana Tech's curriculum review committee and the full faculty.

Table 2: BSEE Curriculum

Freshman year, Fall Semester	Credits	Freshman year, Spring Semester	Credits
CHEM 1056 Gen Chem I	3	MATH 1530 Calc II	3
CHEM 1136 Chem Lab I	1	PHYS 1046 Gen Phys	3
MATH 1520 Calc I	3	CHEM 1066 Gen Chem II	3
ENGR 1010 Intro Engr Calc&Problems	3	Social Science Elective	3
ENGL 1046 Engl Comp (C)	3	*Approved Electives	1
ENGR 1050 Intro to General Engring	1	**Computer Programming Elective 1	3
*Approved Electives	2	**Total**	**16**
Total	**16**		

Sophomore year, Fall Semester		Sophomore year, Spring Semester	
ENGR 2050 Engr Mechanics-Statics	3	ENGR 2150 CAD and problem solving	2
MATH 3256 Matrices and Linear Alg.	3	ENGR 2060 Engr Mechanics-Dynamics	3
MATH 2510 Calc III	4	MATH 2236 Differential Equations	3
PHYS 2076 Gen Phys	3	ENGR 2530 Electric Circuits	3
PHYS 2096 Phys Lab	1	ENGR 2550 Electric Circuits Lab	1
**Computer Programming Elective 2	3	PHYS 2086 Gen Phys	3
Total	**17**	PHYS 2106 Phys Lab	1
		Total	**16**

Junior year, Fall Semester		**Junior year, Spring Semester**	
MATH 3316 Statistics	3	****Signals & Systems	3
ENGR 3260 Fluid Mechanics	3	ENGR 3270 Digial Circuit Design	3
ENGR 3550 Circuits II	3	ENGR 3570 Electronic Design	4
PHYS 3036 Electronics	3	PHYS 4056 Electricity and Magnetism	3
ENGR 3210 Technical Writing	3	ENGR 3540 Electric Machines	3
Humanities Elective	3	***Professional Electives	2
Total	**18**	**Total**	**18**

Senior year, Fall Semester		**Senior year, Spring Semester**	
ENGR 4440 Communication Systems	3	Humanities Elective	3
ECON 2600 Economics	3	MEC 3630 Engr Economy	3
ENGR 4410 Control Systems Theory	3	ENGR 4040 Professional Engineering	1
ENGR 4270 Intro. Microprocessors	3	ENGR 4940 Seminar	1
ENGR 3340 Thermodynamics	3	ENGR 4920 Engineering Design (W)	3
***Professional Electives	3	***Professional Electives	6
Total	**18**	**Total**	**17**

PROGRAM TOTAL	**136**

*Approved electives -- do not include CHEM 1006, 1016, 1026, MATH 0XXX, 10XX, 11XX, 13XX, PHYS 1026, 1036

- HPER credits are limited to 2 credits.

**Computer Programming Elective -- select two from: CS 2136, CS 2146, and CS 2156

***Professional Electives -- must be selected from: ENGR 3290, ENGR 4420, ENGR 4450, 4460, ENGR 4470, ENGR 4500, ENGR 4510, ENGR 4520, PHYS 4536, GEOP 4300, graduate level Electrical Engineering courses, or concent of advisor.

****ENGR 3580 or GEOP 4460

Table 3: Undergraduate professional elective courses.

COURSE	**Credits**
ENGR 3290 Printed Circuit Board Construction	1
ENGR 4420 Control Systems Lab	1
ENGR 4450 Instrumentation and Control	3
ENGR 4460 Instrumentation and Control Lab	1
ENGR 4470 Analog and Discrete Network Synthesis	3
ENGR 4500 Power System Analysis	3
ENGR 4510 Power System Protection, Operation, Control	3
ENGR 4520 Power Electronics	3
PHYS 4536 Methods of Theor. Physics	**3**
GEOP 4300 Intro. to Artificial Neural Networks	3

7.2. MSEE Program

Similar to the B.S. program, the new MSEE will maintain principally the same goals and curriculum as the current M.S. General Engineering/EE option program. Course offerings allow students to emphasize in instrumentation and control, or electric energy systems. Other areas of emphasis may be tailored to the students' needs.

The program can be completed under Montana Tech's thesis or non-thesis policies. Under the thesis option, students must complete 20 credits of course work, 2 credits of seminar, and 8 credits of thesis research. Thesis students must also pass a thesis defense. Under the non-thesis option, students must complete 34 credits of course work and 2 credits of seminar; also, at least 6 credits of the course work must be special problems. Non-thesis options students must pass an oral and comprehensive written exam.

Course work must be selected using Table 4 as a guideline. Also, selective courses taught from MSU-Bozeman over MetNet will be allowed in the MSEE program. Students select at least 11 credits of courses from Table 4. The remaining courses may be selected from 4000-level or 5000-level engineering, math, or science courses with approval of the advising committee. All courses listed in Table 4 currently exist at Montana Tech.

Table 4: MSEE courses.

Required		Credits
ENGR 5940	Engineering seminar	1
ENGR 5150	Graduate writing seminar	1
ENGR 5380	Advanced Signals and Systems	3
Select 2 courses from the following		
ENGR 5220	Engineering Optimization	3
ENGR 5270	Embedded Controllers	3
ENGR 5370	Random Signals	3
ENGR 5400	Discrete-Time Control Systems	3
ENGR 5410	Advanced Control Systems	3
ENGR 5550	Power System Dynamics and Control	3

8. Faculty, Facilities, Equipment, and Research Support

The staffing, facilities, and equipment requirements for the new programs will be the same currently dedicated to the General Engineering/EE option programs. No additional resources will be required for the new programs. Also, this change will have no effect on the administrative structure of the institution as the program will be housed within the General Engineering Department.

Currently, an equivalent of three and one-half full-time tenure-track teaching faculty will be dedicated to the EE programs. Within the General Engineering Department, two faculty are dedicated 100% time to the EE programs, one is dedicated 67% time, and one is dedicated 33% time. Also, 50% faculty support is provided by the Geophysical Engineering Department. This staffing level allows all required courses for the BSEE degree to be taught as scheduled in

Table 2. Professional elective courses ENGR 4470, 4500, 4510, and 4520 are taught on an every-other-year basis; all other professional elective courses are taught once per year. Also, at least two graduate-level course from Table 4 are taught every year, except the seminar courses which are taught every semester. Several of the faculty dedicated to the program have national or international expertise in their respective areas.

In addition to the above faculty, Tech is currently conducting a search for a new tenure-track electrical engineering faculty position that will be funded initially by a research grant for the first five years. Because the grant has an educational component, this position will also have teaching duties.

Based upon review of similar EE programs within the Northwest region and review by the ABET expert, the laboratory facilities available at Montana Tech are of excellent quality. Teaching laboratory facilities include an electrical engineering laboratory, an electric machines lab, and an instrumentation and controls lab.

8.1. Research Support

Over the past 10 years, Montana Tech has received steadily increasing support through externally funded research dedicated to electric energy research. Most recently, this includes a multi-million dollar grant dedicated to the development of intelligent electric power technologies. This support enables Montana Tech to hire the tenure-track position described above as well as non-tenure-track research faculty, award graduate research assistantships, and fund state-of-the-art laboratory development. Tech's principal goal under this grant is to develop a world-class educational and research capability. The proposed degrees are the backbone to this capability.

In partnership with MSE Technologies, Montana Tech is scheduled to receive a $2,000,000 federal congressional earmark in the federal FY06 budget dedicated to intelligent electric powers research. The overall expected funding for the grant is $9,000,000 over three years. The principal goal for the grant is to develop a world-class research capability at Montana Tech in the area of intelligent electric power and to help serve the US Department of Energy research needs in this area. The majority of this money will be dedicated to intelligent electric power research to be conducted at Montana Tech. This money will be used to hire research faculty with international reputations, pay graduate-student stipends, and develop and conduct laboratory research. The research also has a strong undergraduate participation component.

Prior to this most recent grant, faculty at Montana Tech have secured over $1,000,000 of private and

federal government research grants over the past 10 years primarily in the electric energy area. The majority of this research has been directed toward the applications of wind energy and intelligent power system control.

9. Capital Outlay, Operating Expenditures, and Physical Facilities

Estimated Enrollment: The enrollment history for the General Engineering/EE option programs is summarized in Table 5. Although some growth is expected in the program after the proposed change, it is assumed the change will not be significant. If growth does occur, it is expected that the current staffing and facilities could accommodate approximately 15 B.S. graduates per year. With the increased research funding, it is expected that the number of M.S. graduates will increase to approximately 5 per year. For budget preparation purposes, estimated enrollment are the existing MTECH students in the electrical engineering option that are expected to switch to the major. The curriculum contains 136 credits. The average student takes 5 years to graduate. The average annual credit load is 27.2.

Table 5: Number of General Engineering/EE option graduates (Note: prior to 2002, the options was call the Control System option).

	2005/6 (expected)	2004/5	2003/4	2002/3	2001/2	2001/0
BS Graduates	10	9	5	5	12	8
MS Graduates	2	2	1	3	2	3

REVENUE

Use of Current General Operating Funds The funds currently allocated to the option in the general engineering program will be reallocated to the major. Of the general fund this amounts to 9,741,434 + 843,789 of general fund and COE reallocation for 2058 fte or 5143 per fte. Of the 5143 $/fte 56% is allocated to instruction.

Gross Incremental Tuition Revenue

Tuition revenue is calculated as the tuition for 10% out of state and 90% instate for the flat spot with an average of the upper and lower division

Reductions to Incremental Tuition

Tuition revenue is reduced by 44% that is allocated outside of instruction.

Program Fees

Engineering students pay a $90/semester program fee. $70 is allocated directly to the engineering programs. $20 is shared in the other related engineering labs.

External Funds

Grant funding from Federal Earmark will contribute 1 fte faculty for 5 years.

Equipment Fees

Equipment fees are allocated to General Engineering on the average of 25,000 per year. EE would receive 1.4 of that allocation on the average

Expenditures
Personal Services

The program requires 3.5 FTE. Actual salaries were utilized with 31% benefits. 8% was added each year to allow for promotions and increases.

Operating Expenses

1/4 of the operating expenses for General Engineering were re-allocated to Electrical engineering. This is a paper transaction since the program will continue to be housed under the general engineering

umbrella.

Equipment

The equipment is sufficient and currently funded through the equipment fees. That rate will likely continue with some influx from the grant.

NEW FACILITIES AND SPACE

Current space in the Science and Engineering facility is sufficient to satisfy the needs of the program.

EVALUATION OF THE PROGRAM

Reviews:
Faculty in the School of Mines and Engineering - September 23, 2005
Graduate Council – November 18, 2005
Montana Tech Curriculum Review Committee – November 22, 2005
Montana Tech Faculty – December , 2005

Consultants:
Dr. Subbaram Naidu, visited Montana Tech this past fall semester as a consultant to the program. Dr. Naidu is a Professor and Associate Dean at Idaho State University. He was the principle leader in developing ISU's new EE program and has been an ABET program reviewer for the past several years. He has extensive knowledge and experience in the ABET requirements.

10. Appendix II: Student Survey
The following survey was conducted at a student meeting of the Montana Tech student chapter of the Institute of Electrical and Electronic Engineers (IEEE). Most of the students in the club are upper division EE students. 15 students attended the meeting and responded to the survey.

Student Survey
Fall 2005

Montana Tech's General Engineering Department is considering pursuing accreditation of the Electrical Engineering options as standalone BS in Electrical Engineering and MS in Electrical Engineering degrees.

Currently, the EE option degrees read:

"BS in General Engineering, Electrical Engineering option"
"MS in General Engineering, Electrical Engineering option."

The new degrees would read:

"BS in Electrical Engineering"
"MS in Electrical Engineering."

Only minor curriculum changes will be required to accredit under the new names. Also, the program will continue to be housed within the General Engineering Department. The program will continue to focus on instrumentation and control, but, we will also add courses to allow students to focus in the area of energy and power systems.

The principal purpose for the change is to provide graduates with more job opportunities outside the traditional process industries that currently recruit Tech graduates. For more information, please see Professor Dan Trudnowski, SE 308.

As part of the proposal, we would like to poll the students. Please complete the following survey.

1. Are you currently enrolled in the BS or MS General Engineering, EE option program?

   Yes No

   Yes = 12 students
   No = 3 student

2. Do you support the above stated proposal?

   Yes No

   Yes = 15 students
   No = 0 students

3. Comments:

   - I support the BSEE 100%. Looking for jobs now it seems all that is recruited is BSEE. I have never seen a job description requiring someone to have a BSGE/EE option, only BSEE. As an upcoming graduate, I want the best placement opportunities as possible.
   - The implementation of a "BS in EE" will enhance the electrical program and bring new job opportunities to those students in the program.
   - Could you get this through before I graduate please.
   - What was the hold up?
   - I also think you should eliminate any aspect of General Engineering in the EE because for the most part it does not pertain to EE's and those skills will more than likely never be used. If the companies want a General Engineer then they can hire one.
   - Please get this in place before I graduate.
   - GREAT!!