

## **AC 2007-2322: DEVELOPING A NEW PROGRAM IN MARINE ENGINEERING TECHNOLOGY: ONCE THE PROGRAM BEGINS TO TAKE SHAPE, WHAT NEXT? HOW CAN WE KEEP ITS MOMENTUM MOVING FORWARD?**

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# **Developing a New Program in Marine Engineering Technology: Once the Program Begins to Take Shape, What Next? – How Can It Keep Its Momentum Moving Forward?**

## **Abstract**

In 2006, the Department of Engineering Technology, in the Batten College of Engineering and Technology at Old Dominion University, began a sustained effort to promote and develop a strong course of study in Marine Engineering Technology<sup>1,3</sup>. Located in Norfolk, Virginia, Old Dominion University, and particularly the Department of Engineering Technology, is uniquely positioned to deploy such a program with strong ties to the world's largest Naval Base, superlative shipbuilding, maintenance and repair facilities. Development of such a program in support of one of the regions largest industries however, is not without challenges.

The Marine Engineering Technology program's goal is to provide the student with the skills necessary for success working in the commercial or naval ship design field and includes exposure to basic ship characteristics, the unique aspects of ship design, familiarization with ship construction processes and techniques, various shipboard systems, basic shipboard operations and maintenance principles and philosophies. This paper expands on the insight developed in an attempt to expand an existing TAC of ABET<sup>3</sup> accredited program to meet the needs of an industry segment. This paper also details the insight garnered from meeting with local professional society chapters and the type of support that is out there for others seeking to expand programs of interest of local industry. This paper also details the to-date progress of this program. It also highlights the collaborative process between industry and academia in the development of new curricula to meet the needs of a particular industry segment, and how a program can make effective use of industry experts in strengthening the curriculum being offered.

## **Introduction**

The Department of Engineering Technology<sup>1</sup> in conjunction with members of its advisory board has begun a sustained effort to promote and develop a strong course of study in Marine Engineering Technology. Old Dominion University, and particularly the Department of Engineering Technology, is uniquely positioned to develop such a program. Located in Norfolk, Virginia with strong ties to the largest Naval Base in the world and superlative shipbuilding, maintenance and repair facilities<sup>4</sup> (Virginia's Electronic Labor Market Access List names over 40 organizations employing individuals in Naval Architecture and Marine Engineering in Hampton Roads). This list includes Northrup Grumman Newport News, a \$4 billion world-class shipbuilding enterprise, and the Norfolk Naval Shipyard and has resulted in high interest for development of such a program in support of one of the regions largest industries. A full scale program in this area will establish the Batten College of Engineering and Technology as a center of excellence in the area of Marine Engineering Technology. In taking full advantage of our proximity to some of the United States largest employers in this sector, opportunities for research funding and support are limitless.

The Marine Engineering Technology program primary goal is to provide the student with the skills necessary for success working in the commercial or naval ship design field. Recommendations put forth by a panel composed of advisory board members of the Mechanical Engineering Technology (MET) program and local selected industry leaders in the Hampton Roads Maritime sector included: exposure to basic ship characteristics, the unique aspects of ship design, familiarization with ship construction processes and techniques, various shipboard systems, basic shipboard operations and maintenance principles and philosophies. Initial development has focused on creating an Emphasis in Marine Engineering Technology to complement the existing options (Manufacturing Systems, Mechanical System Design, and Nuclear Technology) in the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC of ABET) accredited Mechanical Engineering Technology (MET) program<sup>3</sup>. Within the existing MET program, students have the flexibility to choose senior electives with options in either Mechanical Systems Design or Manufacturing Systems. Some times, students choose a combination of courses from the two areas.

Senior electives available to students in each of the two areas are given below in Table 1. A third option in Nuclear Technology is available to graduates of US Navy’s Nuclear Power School or students who have completed a course of training for nuclear operators through an articulation agreement with Virginia Dominion Power<sup>3</sup>. These students must take MET 471, Nuclear Systems I, and MET 472, Nuclear Systems II, as part of their senior electives. By adding this fourth option in Marine Engineering Technology allows students to be in an accredited program, meeting the MET program criteria, as the new option evolves. Students in the existing options and the proposed Marine Engineering Technology Option would still take common courses in areas such as computer-aided drafting, statics, strength of materials, dynamics, thermodynamics, fluid mechanics, automation and controls, and computer solid modeling. All four options then culminate in three senior technical electives and a senior project that integrates course work with a practical project assignment in the student’s area of interest. Upper-division general educational requirements may be accomplished by completing a minor in Engineering Management.

Table 1 – Senior Electives within MET Curriculum

<b>Manufacturing Systems</b>	<b>Mechanical Systems Design</b>
MET 400, Computer Numerical Control in Production	MET 440, Heat Transfer
MET 410, Advanced Manufacturing Process	MET 460, Refrigeration and AC
MET 415, Introduction to Robotics	MET 450, Energy Systems
MET 430, Mechanical Subsystem Design	MET 430, Mechanical Subsystem Design
MET 445, Computer Integrated Manufacturi	EET 360, Elect. Power & Machinery
EET 360, Elect. Power & Machinery	

<b>Nuclear Technology</b>
MET 440, Heat Transfer
MET 460, Refrigeration and AC
MET 450, Energy Systems
MET 471, Nuclear Systems I
MET 472, Nuclear Systems II
EET 360, Elect. Power & Machinery

Three new senior technical electives were developed, with the first being offered in Spring 2006. These electives<sup>1,3</sup> are outlined as follows:

1. Principles of Marine Engineering I:  
This course of study includes: Fundamental Principles of Naval Architecture including nomenclature, geometry, stability, hydrostatics, structures, and motions; Ship Design Processes; and a basic introduction to Shipboard Systems such as HVAC, refrigeration, power generation, propulsion, hydraulics, electronics, cargo handling systems, seawater systems, freshwater systems, and fuel, lube and other oil systems.
2. Principles of Marine Engineering II:  
This course of study builds upon the previous course and provides a more in-depth look at shipboard systems and introduces topics such as basic shipboard operations, and ship specifications.
3. Principles of Maintenance Engineering:  
This course of study looks at maintenance systems: predictive, preventative and corrective; large scale maintenance systems, principles of reliability engineering, maritime logistics, planning for maintenance and repair, using and ordering spare parts, technical manuals, system specifications, and shipyard operations.

The development of the three additional courses, combined with existing courses at the MET senior elective level, produce the Emphasis in Marine Engineering Technology is as shown in Table 2.

Table 2 – Senior Electives within MET Curriculum  
Marine Engineering Technology Emphasis

<b>Marine Technology*</b>
MET 440, Heat Transfer
MET 460, Refrigeration and AC
MET 450, Energy Systems
<b>MET 475, Principles of Marine Engineering I</b>
<b>MET 476, Principles of Marine Engineering II</b>
<b>MET 485, Principles of Maintenance Engineering</b>

EET 360, Elect. Power & Machinery

\*It should be noted that additional senior elective courses are listed to accommodate those students with non-traditional degree paths with practical work experience or training in the Military and the Shipbuilding and Repair Industry. In those cases students with the assistance of the program advisor may elect to substitute a related course in lieu of MET 475, MET 476 or MET 485 based on applicable experience.

Many students in the MET program enter with education and training from a wide variety of sources. Articulation agreements already exist with the Northrup-Grumman Newport News Shipbuilding Apprentice program, the Virginia Community College system, Virginia Dominion Power, and the US Navy Nuclear Power School. Many of the transferring students have some experience in the Maritime industry and are prime candidates for this program. Additionally, the Hampton Roads NROTC program (administered by Hampton University, Norfolk State University and Old Dominion University) is one of the largest NROTC units in the country. It is the belief of the MET Advisory Committee, and the special committee formed from academia, industry and the MET advisory committee, that the population exists within the region and within the existing programs to make this program is not only feasible but highly desirable to not only the student population but the employment market of this region.

The initial course offering of the course Principles of Maintenance Engineering in Spring 2006 as an elective attracted 25 students. An educational path incorporating the various routes into the program coupled with a proposed Master's level graduate program is shown in figure 1.

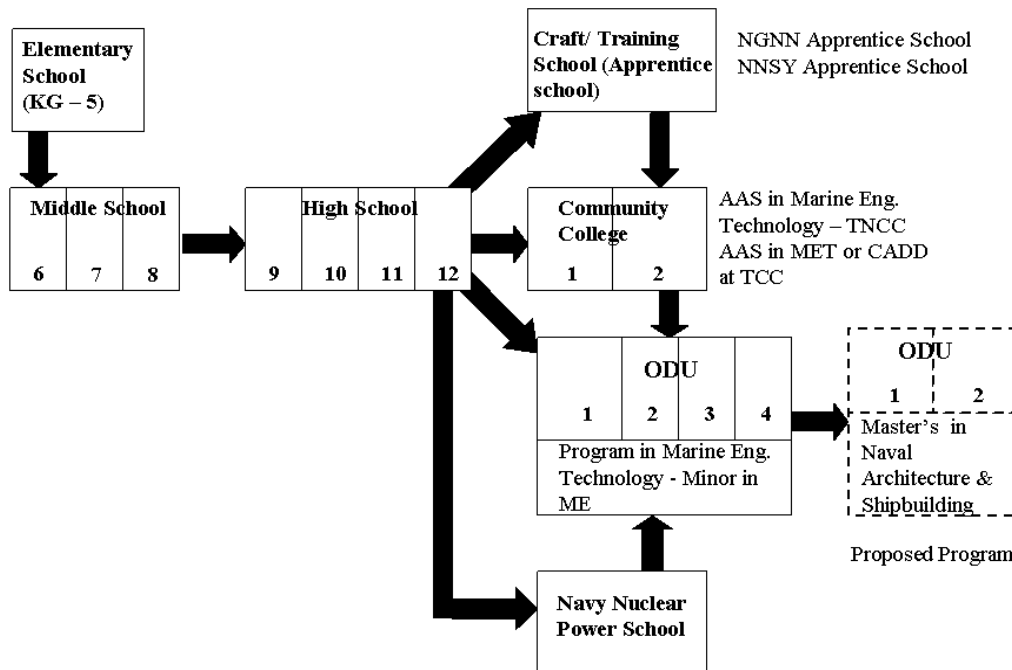


Figure 1 – Educational Path for Marine Engineering Technology Program

The initial offering of the first course in the program was in the Spring of 2006. The course offered was the MET 485 – Maintenance Systems Engineering<sup>3</sup>. Since the development of the program occurred during the 2004-2006 ODU course catalogue, the initial course was taught as an MET 495– Topics course while awaiting the publication of the 2006 -2008 ODU course catalogue. Student response to the course offering was strong with a final registration of 25 students<sup>5</sup>. The second new course offered was Principles of Marine Engineering I, MET 475 in Fall 2006. Current student course evaluations are not available at this time, but feedback to the instructor has been positive. Notably the students responded positively to guest lecturers from the existing marine industry in the Hampton Roads Area. The last course in the option, Principles of Marine Engineering I, MET 475

### **Working with an Advisory Committee**

An industry advisory committee has been established from the local maritime industry. Members include: Dr. James Hughes – Manager Academic Programs - Apprentice School- NGNN; Capt. Malcolm Branch, USN (ret.) – Executive Director – Virginia Ship Repair Association; Ms. Norine Bradshaw – Senior Manager – AMSEC, LLC; Mr. Doug Smith – Six Sigma College – NAVSEA; and Capt. Dick Whalen, USN (ret.) – Military Affairs Liaison – ODU. The industry advisory committee, program and departmental faculty, and the college’s assistant dean for assessment will continually monitor and guide the program toward its initial accreditation. While input from the advisory committee initially has proven invaluable, convening the advisory committee on more than a handful of occasions during the academic year is a daunting task.

### **Resources that have Proven Invaluable**

Local Chapters of Professional Societies. Many professional organizations have local chapters in Hampton Roads. By establishing contact with them, many of the organizations readily extend an invitation to their monthly chapter meeting to discuss how they may become involved with a new program, as they have with the Marine Engineering Technology program we established. An initial search of local professional societies yielded the following organizations that had strong ties to the region’s Marine Engineering and Naval Architecture community.

- American Maritime Modernization Association (AMMA)
- American Society of Naval Engineers (ASNE)
- American Society of Quality (ASQ)
- International Council on Systems Engineering (INCOSE)
- International Society of Logistics (SOLE)
- Peninsula Engineers Council (PEC)
- Project Management Institute (PMI)
- Society of Naval Architects and Marine Engineers (SNAME)
- Tidewater Association of Service Contractors (TASC)
- Virginia Ship Repair Association (VSRA)
- The Marine Technology Society

Initial contact was made with several of the organizations listed. Several extended invitations for discussions with the department as to how they may be of assistance in establishing our new program. Many have provided member support and assistance to the students and faculty in refinement and development of curriculum and support for the program - most notably VSRA, SNAME and ASNE. Of the three, ASNE and its local membership has had the greatest impact on the development and continued progress.

## ASNE and ODU

The American Society of Naval Engineers (ASNE) was founded in 1888 to foster research and development in the new technology of steam propulsion and in new materials as applied to naval warships. ASNE has since expanded its breadth of interest to all engineering matters as related to naval ship design, maintenance, and operation. Current national membership is comprised of over 5,000 engineers engaged in shipboard hull, mechanical, and electrical systems; combat systems; hydrodynamics; naval architecture; nuclear and conventional propulsion; aircraft systems; and a potpourri of traditional engineering disciplines as applied to Naval ships<sup>6</sup>. Locally there are approximately 500 members of the ASNE Tidewater Chapter<sup>7</sup>. Offering to assist in the development of the program has been a tremendous asset. Providing a potpourri of guest lecturers over the various topics covered in the class to bring their 'real-world' experience to the classroom.

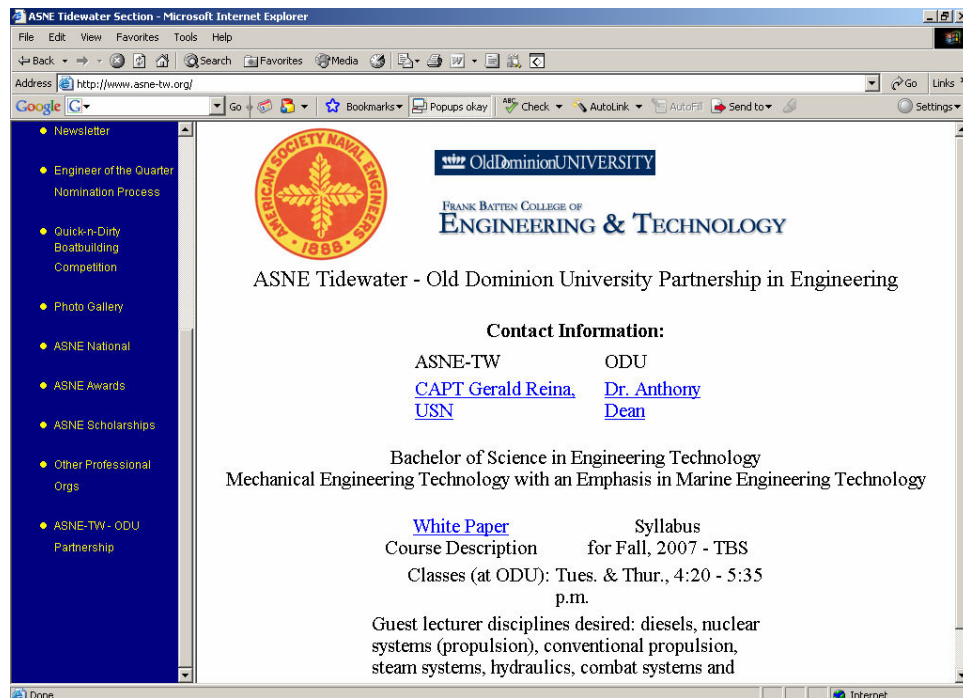


Figure 2- Request for Guest Lecturers posted on asne-tw.org

The strong ties with a sponsoring society have additionally improved student performance in the classroom. The students actively involved in the class have received recognition and excellent feedback from industry for their study in several of areas in Marine Engineering. Of the 40 abstracts selected to proceed to full paper for the upcoming Fleet Maintenance Symposium

2007<sup>7</sup>, sponsored by ASNE, 5 abstracts selected were written by students in the Fall 2006, Principles of Marine Engineering I class. As the process was a blind review, reviewers had no knowledge that the papers were student papers as opposed to papers written by high ranking US Navy Personnel (Admirals/Captains and other senior officers), Industry Leaders, and Academics in the Marine Engineering field. Additionally one student paper has also been selected for presentation during National ASNE Day hosted annually in Washington, DC. Additional encouragement has lead students to organize teams for such events as the ASNE- *Quick & Dirty Boat Building Competition*<sup>7</sup>, and seek out mentors from industry to guide them in their career choices and assist them with developing Senior Design projects in the Marine Engineering Area.

The college administration has taken note of the progress of the program and has sought out external funding for scholarships for students wanting to study Marine Engineering Technology. Because of the apparent success of the program, and feed back from both the students and ASNE, several spin off programs are in development and/or being considered:

- **BS/MS Engineering Accelerated Program with Marine Engineering Technology/ Marine Engineering Concentration:** The accelerated BS/MS (Bachelor of Science/Master of Science) and BS/ME (Bachelor of Science/Master of Engineering) programs available at BCET are designed to provide a unique opportunity for suitably qualified students to obtain an undergraduate degree and a graduate degree in engineering in a period of only five years after graduating from high-school. The program for marine engineering concentration is planned for qualified students to advance smoothly from undergraduate education to graduate admission. Successful graduates of these programs will have opportunities into higher-than entry-level engineering positions and will be prepared for rapid advancement in their careers in the marine engineering domain.
- **Certificate in Marine/Naval Engineering:** BCET now offers an advanced certificate program in naval architecture and marine engineering. These graduate certificate programs provide the working professional the opportunity to further their knowledge and to fill a need in this fast moving and high demand technological field. The programs will enable participants to understand the marine engineering systems and their interactions with marine environment and the necessary engineering methods for design, analysis and construction of complex marine vessels. Students must complete 3-credit graduate-level courses. Enrollment will begin in Fall of 2007.
- **The Institute for Ship Maintenance, Repair and Operations:** This BCET institute works to make ship repair and operations more cost effective, while meeting or exceeding environmental requirements. This institute offers industry an interface with academia to provide assistance in a variety of projects for both the government and private sector.
- **Maritime Institute:** In addition to course offerings at BCET, ODU's School of Business and Public Administration (SBP A) maintain the Maritime Institute that offers courses in areas related to port operations, maritime transport, international supply chain management and logistics.

- National Institute of High Performance Crafts at ODU: a nationally focused center of excellence providing new technological concepts for the advancement of naval power and national security of the United States.
- Graduate Program with Marine Engineering Concentration: The modern approach in this marine engineering concentration collapses the divide between two traditionally distinct fields of naval architecture and marine engineering and enhances it by broader concepts of systems engineering and analysis. Modern design and engineering of new ships is expected to follow this holistic approach. The program will provide traditional courses in hydrodynamic and hull form characteristics, structural design of the hull, maneuverability, impacts of marine environment, exterior and interior arrangement, design aesthetics, engineering systems, main propulsion, marine power systems, steering, anchoring, cargo handling, communications, and weapons systems. The program will also provide enhanced courses in life cycle engineering, lean and six sigma manufacturing, concurrent engineering, ocean engineering, aerospace engineering, and others. The graduate program in marine engineering is expected to be established by 2008.

## **Conclusions**

Input from ASNE has lead to investigative study in offering a full 4- year interdisciplinary program in Marine Engineering Technology, which is compatible with current two-year programs in Marine Engineering Technology being offered at Thomas Nelson Community College, Tidewaters Community College, and the Northrup Grumman Newport News Apprentice School. In this proposed curriculum, Marine Engineering Technology will be introduced at the freshman level with its incorporation into the colleges Freshman Engineering Program - Exploring Engineering and Technology land II. Additional courses in Basic Ship Building, Naval Architecture, Marine Electrical Systems, and Marine Husbandry and Support Facilities will be offered in the sophomore and junior years. The student will then take the currently developed MaET senior electives to round out the degree. It is also anticipated that this full degree plan will provide the regions maritime industry better prepared co-op and intern candidates, and allow for input back into the program to properly access the effectiveness of the courses being offered to develop the types of individuals needed to meet our regions largest industry.

A four-year Bachelor of Science in Marine Engineering Technology is in development. A conceptual plan for this degree, based on the current MET degree plan is presented in Table 3. College and industry support has been increased and has lead to several initiatives that have built on the initial development and interest in the Marine Engineering Technology Concentration.

Additionally, ASNE and ODU have re-established ties and have begun a Student Chapter of the organization with strong support from the local ASNE chapter. Parent Chapter members continually volunteer to give guest lectures, sponsor senior design projects, and host students at various functions. Without the continued support of the local ASNE chapter, the continued success of the program would not have occurred.

Table 3 – Proposed MaET Curriculum  
Marine Engineering Technology

Year and Semester	Course (Dept., Number, Title)	Category (Credit Hours)				
		Communications	Mathematics	Physical & Natural Science	Social Science & Humanities	Technical Content
1-1	MET 100, Engineering Graphics					3
	ENGN 110, Explore Engineering & Tech I					2
	MATH 162M, Precalculus I		3			
	CHEM 115N, Foundations of Chemistry			4		
	ENGL 110C, English Composition	3				
1-2	MET 230, Computer-Aided Drafting					3
	ENGN 111, Explore Engineering & Tech. II					2
	MATH 163, Precalculus II		3			
	PHYS 111N, General Physics			4		
	Gen Ed, Literary Perspective (L)				3	
2-1	MaET200, Basic Ship Building Processes					3
	CET 200, Statics					3
	MATH 211, Calculus I		4			
	PHYS 112N, General Physics II			4		
	ENGL 131C, Intro to Technical & Scientific Writing	3				
2-2	CET 220, Strength of Materials					3
	OTS 231, Materials and Processes Technology					3
	MET 240, Computer Solid Modeling					3
	COMM 101R, Public Speaking	3				
	Gen Ed, Social Science Perspective (S)				3	
3-1	MET 300, Thermodynamics					3
	MET 310, Dynamics					3
	MaET 320, Basic Naval Architecture					3
	CET 345, Materials Testing Laboratory					1
	EET 305, Advanced Technical Analysis		4			
	MaET 350, Marine Electrical Systems Technology					3
	EET 355, Electrical Laboratory					1
3-2	MET 330, Fluid Mechanics					3
	MET 335, Fluid Mechanics Laboratory					1
	MET 350, Thermal Applications					3
	MaET 360, Marine Support Facilities					3
	MET 370, Automation and Controls					3
	MET 386, Automation and Controls Laboratory					1
	Gen Ed, Upper Div Cluster (or Minor)*				3	

Year and Semester	Course (Dept., Number, Title)	Category (Credit Hours)				
		Communications	Mathematics	Physical & Natural Science	Social Science & Humanities	Technical Content
4-1	MET 387, Power and Energy Laboratory					2
	MaET Senior Elective (MET 475)					3
	MaET Senior Elective (MET 485)					3
	ENGN 401, Fundamental of Engineering Review					1
	Gen Ed, Upper Division Cluster (or Minor)*				3	
	Gen Ed, Historical Perspective (H)				3	
4-2	MaET 435W, Senior Design Project					3
	MaET Senior Elective (476)					3
	Gen Ed, Upper Division Cluster (or Minor)*				3	
	Gen Ed, Fine & Performing Arts Perspective (A)				3	
	Gen Ed, Philosophical Perspective (P)				3	
TOTALS REQUIRED FOR DEGREE		9	14	12	24	68
PERCENT OF TOTAL		7.1	11.0	9.5	18.9	53.5

\* A minor requires one additional three credit course (a total of four). Most MaET majors may choose to Minor in Engineering Management or some other technical area which would increase the technical content of the program.

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