



Internal Combustion Engine Division Newsletter

Editor, Tony Siegel

Summer 1998

Chair's Message



Carl McClung

As the "new guy" in the Internal Combustion Engine (ICE) Division Chair's responsibility, I'd like to discuss with you some background regarding why I feel you, as interested engine

oriented engineers, need to be actively involved in the activities of ASME ICE Division. Along with the "features and benefits" of ICE Division participation, I'd like to touch on the scope of current technical challenges in the heavy duty diesel and gas engine industry. I'd like to start by telling you about the ICE Division; who we are, what we are and why we think you should be interested.

First, we are a broad international group of engineers interested in internal combustion engines. "Internal combustion" (as opposed to external combustion) is the only limitation to the scope of our engine activity. All of the functions in the industry are represented in the ICE Division; users, manufactures, suppliers, consultants, educators, regulators and service providers. The "what" part of our ASME ICE Division description is perhaps best characterized as the function of "facilitator". We facilitate the presentation, discussion, publication, debate and analysis of engine technology. We are not

(continued on page 2)

ICE Website Set to Expand

The Division's website (<http://www.asme.org/divisions/ice/>) has been used to post listings of Associates and various committee memberships along with dates and places for upcoming conferences. The preliminary program for the 1998 Spring Technical Conference (STC) was available on our website. An informal survey at the STC revealed that almost all Associates had internet access, and most had e-mail.

Currently, our conferences are announced by distributing the preliminary program to 3,500 members compiled by ASME International and the ICE Division. Besides the expense of printing and mailing, this traditional style of announcing our technical conference is inefficient. In the future, the ICE Division will distribute postcard-style announcements referring the addressee to the ICE website location, where the preliminary program will be found, along with registration information. In addition, the announcements can also be distributed using internet e-mail.

Because the website is not subject to the same limitations associated with printed material, the ICE Division will be able to post the conference program, registration for hotel and conference, illustration of conference facilities, attractions, or other information to enhance the appeal of our conferences. Additional information on the technical papers can be offered

(continued on page 3)

1998 FTC at Resort

The 1998 Fall Technical Conference will be held at the Peek 'n Peak Resort and Conference Center at Clymer, New York on September 27-30, 1998. The resort is situated in southwestern New York and includes one thousand acres of beautiful countryside. There is a large indoor pool, whirlpool and sauna in which to relax. The conference will be hosted by the National Forge Company with Andy Pope chairing the local arrangements committee.

The technical program is as rich as the natural beauty of the location. There is not a main theme for this meeting but the number of papers submitted on the subject of engine emissions reflects the de facto interest in that subject. The overall program is broad in scope with coverage of many aspects of engine design and development. At the time of this write-up (early summer) 51 papers and one oral presentation are in the planned sessions. A quick look at the first three sessions on Monday morning includes the following examples of the wide array of topics:

- "High Efficiency, High Speed Gas Engines"
- "Common Rail Fuel Injection Systems"
- "Probabilistic Approach To Engine Balance"
- "Operational Results of a Linear Engine"
- "Investigation of Cylinder Liner Scuffing Phenomena"
- "Ten Questions on Locomotive Exhaust Emissions Regulations"

(continued on page 3)

Index

Chair's Message.....	1
ICE Website Set to Expand.....	1
1998 FTC at Resort.....	1
Past Chair Shares Thoughts	2
Great Meeting at Ft. Lauderdale.....	4
1997 FTC A Success.....	4
EPA Setting Exhaust Regs.....	5
Future Conference Dates and Locations.....	6
Awards Presented.....	7
WONG Joins Executive Committee.....	8
New ICED Associates	8
MSHA Proposes Mine Regulations.....	8
ASME History and Heritage Program.....	9
Literature Search is Easy.....	9
The Progress of Chinese Vehicle Emission Control.....	9
The 1998-99 Member-Get-A-Member Campaign.....	10
Outsourcing of Engineering Will Trend Slowly Upward.....	10
Call for Papers.....	11
Internal Combustion Engine Division Leaders.....	12

Chair's Message

(continued from page 1)

limited to, but tend to focus on, heavy duty diesel and gas burning engines. Our scope includes design, development, control, application, problem solving and operation of these heavy duty engines.

We think you should be interested in the ASME ICE Division because we offer a variety of low cost alternatives to expand your engineering knowledge, provide a venue to meet acknowledged experts in the field and offer a forum to present your technical work to your peers in the industry. ICE Division does this by organizing focused Engine Technical Conferences twice a year (Spring and Fall). Each conference provides a technical program that includes forty to fifty critically reviewed engine topic technical papers as well as key lectures by industry experts, panel discussions on key engine topics, interesting social events and most importantly the opportunity to network with other engineers in the field. ICE Division publishes all written papers presented at these conferences and provides the best of these papers for publication in the ASME Journal of Engineering for Gas Turbines and Power.

Two conferences are scheduled in the next twelve months. These are the '98 Fall Technical Conference, September 26-30th in Clymer, New York which is sponsored by the National Forge Company. and the '99 Spring Engine Technology Conference on April 25-27th in Columbus, Indiana, hosted by Cummins Engine Company.

The challenges facing the Internal Combustion Engine Industry and particularly the heavy duty reciprocating engine are staggering as we look beyond the year 2000. Gaseous fueled and diesel engines provide the vast majority of chemical energy conversion for the world's population, second only to municipal power sources. The industry, appearing stable to slow paced to outsiders, is facing a virtual revolution in new technology and competitive pressure from within. The large heavy duty reciprocating engine is facing it's first comprehensive emission requirements. EPA non-road emission requirements for mobile applications rated above 750 Hp, European IMO emission requirements, Best Available Technology (BAT) emission requirements for North American state-controlled sites and more stringent European T. A. Luft requirements all face the engine industry. In addition, there are competitive pressures from a host of new high technology gas and diesel burning engine products from major manufacturers, including alliances between formidable U.S. and European engine manufacturers. Also, several locomotive manufacturers have plans for new engines that may have future application in non-locomotive applications. When you add to these developments the priority that customers are demanding for order of magnitude improvements in reliability and durability to improve their life cycle cost performance, the heavy duty engine market is in a dynamic situation.

The gas fueled market is facing priorities that drive the need for unique new technology. The fuel supply pipeline infrastructure is being expanded rapidly worldwide. Gas fueled engine users on the consuming end of the pipeline (the clean fuel end) are demanding thermal efficiency and fuel consumption characteristics that exceed diesel cycle capability without loss of reliability or durability. Users on the supply end of the pipeline (the less pure fuel mix as it comes out of the ground) are demanding reliable, continuous low cost operation without regard to changing fuel characteristics. Both are a tall order to deliver in addition to emission compliance.

What does all of this mean to the engine engineer, and how does ICE Division fit in this picture? ASME ICE Division is the professional forum for internal combustion engine engineers to review these technologies. ICE Division provides the opportunity for reciprocating engine engineers to come together, network, discuss issues and review common problems. ICE Division provides the forum to stay abreast of heavy duty engine technology in your field!

ICE Division has the focus and the tools (conferences, publications, contacts and

protocols). We do need you, the non-participating engine engineer to make this system complete. If I can help with any questions or if you would like to join us, please contact me at (765) 448-2633, or Fax: (765) 448-2232.

Carl L. McClung

Past Chair Shares Thoughts

As the Past Chair of the Internal Combustion Engine Division, I have been asked to provide a few words with respect to my reflections concerning the division over the last several years. As you might expect, the Past Chair has a unique view of the division. He is able to see what can be accomplished, and look back over the past few years with pride (and relief)!

Let me review the process of serving on the Executive Committee of our division which includes serving as Chair. An individual who is elected to serve on the Executive Committee must commit to serve a total of seven (7) years, and during this period will progress through various assignments until his sixth year when he will serve as Chair of the division. The seventh year is devoted to serving as Past Chair to help aid in the continuity of the division's activities. This process has served the division well, and is looked upon quite favorably by the other divisions and by the ASME as a whole.

As you might expect, accepting the responsibility of serving on the Executive Committee is a major commitment, but associated with this commitment are several rewarding features. In particular, the Executive Committee works with some of the most talented individuals in our industry. We get to participate in a process which often begins with vague concepts that develop and become accomplishments. This is a rewarding process, and those of us on the Executive Committee are in a unique position to appreciate and enjoy these results.

I am quite proud of where the division is today and where we are headed. The division's technical conferences have evolved over the last ten years to their current status as the premier venue for presentation and publication of ICE papers. Not too many years ago, the division published only a dozen or so papers a year. Today, the division sponsors two dynamic conferences each year and typically publishes over 70 papers each year. In addition, the number of enthusiastic Associates has continued to increase over the years. Yes, the division has accomplished much, and we should all be proud of these accomplishments.

As I look back over the past several

(continued on page 6)

ICE Website Set to Expand

(continued from page 1)

including abstracts of the papers that make up the sessions. In addition, changes to the conference can be easily accommodated, such as deleting unavailable papers, reconfiguring the session architecture, or adding special or timely panel discussions. Links to other interesting sites can also be formed, enhancing communications between the ICE Division and commercial, university and government groups with engine engineering interests.

As you might guess, expanding our Division's use of this form of communication will require additional effort and experimentation. Professor Chris Rutland, a relatively new Associate from the University of Wisconsin, has volunteered to be Chair of the Website Committee. Under his leadership, the Division plans to more effectively market and communicate Division activities. As our abilities in this area grow, it is planned that the Newsletter will be distributed via the ICE website, and communications between session organizers and authors will be incorporated to facilitate processing technical papers. If you would like to be a part of this website expansion, please contact Chris Rutland at 608-262-5853 or e-mail him at rutland@me.engr.wisc.edu to volunteer your time, expertise and ideas for the future. It's your website.

Terry Ullman

1998 FTC at Resort

(continued from page 1)

The conference is full of papers of interest to an engine engineer which will be presented in three parallel sessions on Monday and Tuesday.

The technical activities of the conference will start on Monday, September 28 at 8:20 A.M. After the conference opening speech by the ICE Division Chair, Carl McClung, the Soichiro Honda Award Lecture will be delivered by Professor Hiroyaki Hiroyasu. Prof. Hiroyasu is a world renown expert on spray development, spray-plume interaction and combustion within diesel engines. Presently he is the director of the Spray and Combustion Laboratory at the University of Hiroshima.

Another important technical activity of this meeting is the inclusion of some papers originally presented at the CIMAC meeting in Europe in May 1998. These papers were selected by an expert group and reviewed again in conformance to the ASME review process. Thus, the American audience will get a timely

exposure to some important contributions from the CIMAC meeting.

Technical papers will be presented in sessions entitled: Engine Design; Lubrication; Friction; Engine Combustion; Natural Gas and Alternative Fuel Engines; In-Cylinder Flows and Advanced Analysis. They will be published in three symposium volumes that will be available at the Conference at a reduced price. After the Conference the volumes will be available at full price from the ASME Order Department Tel: (800)-843-2763.

On Tuesday, September 29 a special session will be held on the topic of "Controlling Diesel Engine Particulates in Underground Mines". This session will last about three and a half hours and will consist of seven short, fifteen minute oral presentations covering the subject from the perspective of Government, Industry, Labor, Manufacturers, Engines and Emissions Control groups. An open discussion with all panelists will follow the presentations. This is a new effort and format to cover an important issue, particulate emissions, from the different perspectives of relevant stake holders.

Two invited presentations are planned after lunch on Monday and Tuesday. On Monday the topic will be "Government, Industry, University and Research Lab Cooperation for New Product Development". This will be the fourth presentation in a series covering the topic from a different perspective in each meeting. On Tuesday, the lunch presentation will explain the Activities of the ICE Government Relations Committee.

Additional information on the technical program is available on the ASME website (<http://www.asme.org/divisions/ice/>) for those who are interested in further details. Meetings of the Executive, Administrative, and Technical committees are planned for Saturday, September 26 and Sunday, September 27. There will be an Associates meeting and an orientation session for new Associates on Sunday afternoon.

Conference social activities are also planned including an Early Bird reception at the resort main Lodge starting at 6:00 P.M. on Sunday. On Monday night there will be a wine tasting featuring wines from the region followed by a Great Western Barbecue Cookout prepared on the picturesque deck of the Lodge and songs by the local quartet "Intrigue" which specializes in the good old songs of the early 1900's. On Tuesday evening there will be FREE rides to the top of the mountain on the Ski Chair Lift. A reception and the traditional Honors and Awards Banquet will follow.

The Spouses/Guest's Program includes two fun days of sight-seeing in this charming area. On Monday we will visit scenic Niagara Falls – one of the seven natural

wonders of the world-- where the group will view several falls from different vantage points on the American side of the border. They will ride the famed Maid of the Mist boat for a close encounter with Horseshoe Falls and have lunch at the Red Coach Inn located 1500 feet from the Falls and overlooking the Rapids. This is an Olde English Inn with the servers dressed in English Tudor period costumes.

On Tuesday the Spouses/Guests will tour the "Birthplace of the Oil Industry" – Drake's Well Museum in Titusville, PA where the world's first oil well was drilled by Colonel Edwin Drake in 1859. The group will be treated to a musical and historic session and sing-along involving fun songs from the mid-1800's. Lunch will be at Kelly's Sugar and Spice, an Amish restaurant exhibiting many beautiful crafts from the area. Later, we will visit the DeBence Antique Music World to listen to an incredible collection of musical instruments from all over the world. The instruments span two centuries and have been lovingly restored by Mr. DeBence.

All conference participants and spouses/guests are invited to tour both the Cummins Engine Company in Jamestown, NY and the National Forge Company in Irvine, PA on Wednesday morning. The National Forge Company is a world class manufacturer of high quality crankshafts for engines and compressors in the 800 to 6,000 horsepower range. Its Irvine plant is a fully integrated manufacturing facility with its own melting, forging, heat treating and machining capability. The Cummins facility will provide a chance to view the manufacturing of the L10, M11, and M11 Plus engine models that cover a range between 280-450 horsepower. State-of-the-art technology is employed in automated material handling and gauging, flexible CNC machining centers and computer assisted assembly, test and paint operations.

As at previous ICE Division Conferences, participants will enjoy the unique environment that surrounds this group of talented people with a common interest in engines. Those attending are sure to be rewarded by stimulating technical discussions and friendly social interaction throughout the conference.

Dr. Teoman Uzkan and Andy Pope

Great Meeting at Ft. Lauderdale

It was a new location for the ASME-ICE Division, but one that was well attended. Perhaps that should come as no surprise with the many attractions of the Florida Gold Coast and the superb events arranged by the local host, Dynalco Controls. On the social side, the Sunday evening program set the pace with a casual cocktail party incorporating the many amenities of the conference hotel and the ability to choose from among the surrounding excellent restaurants for dinner. Perhaps the highlight of the social events was the "Drums of Polynesia" performance following the Monday evening dinner. A professional entertainment troupe, assisted by a few of our own Associates, led the group through a journey of the islands of the South Pacific.

On the technical side, the meeting tone was set with the excellent keynote address, "In-Situ Measurements in Diesel Engines: What Can We Learn?", by Dr. Bill McLean of Sandia Laboratories in Livermore, CA. The address highlighted the advanced optical based experimental capabilities which have been developed at Sandia and that allow a revised picture of the diesel combustion process in an engine. The meeting included 14 technical sessions, two of which were hosted by the Environmental Engineering Division of ASME. This collaboration gave members of each Division a unique opportunity to interact and exchange ideas. The technical sessions also included a special panel discussion on emissions measurement techniques and associated standards.

All the written papers for the Spring '98 meeting were bound in three proceedings volumes. Those books are now available for purchase from ASME Technical Publications. The 1999 Spring Meeting will be held in Columbus, Indiana, hosted by Cummins Engine Company. See the Call for Papers in this Newsletter for details on paper offer submissions and be sure to plan to attend the meeting.

Stuart R. Bell

1997 FTC A Success

The Fall Technical Conference of the Internal Combustion Engine Division was held in Middleton, Wisconsin on September 28 through October 1, 1997. It was hosted by the Engine Research Center of the University of Wisconsin-Madison where Prof. David E. Foster is the director. The local arrangements were organized by Prof. Christopher Rutland who did a beautiful job of running a smooth meeting with the help of his fine staff. As with other engine related meetings held at this location, the special

contributions of Profs. P. Myers and G. Borman were evident. The conference was attended by over 150 engineers and scientists from all over the world in addition to the large group of student assistants from the center. Participation by such a large number of students from the local ASME Student Chapter contributed a new dimension to this conference.

The participants enjoyed a unique environment of interacting with a highly specialized group of people who are mainly interested in engines. Each person brought to the conference his unique experience (some of it decades-long) in engine design, development and utilization. Participants were rewarded by stimulating discussions both in and out of the technical sessions as well as opportunities to refresh old friendships and to establish new ones during social activities.

The technical program was rich, rewarding and covered almost every aspect of engines. There were 43 technical presentations, one Special Soichiro Honda Lecture, two Invited Lunch presentations and One Tutorial workshop. Technical Papers and the Honda Lecture are available in three conference volumes that can be obtained from the ASME Order Department by calling (800)-843-2763.

The technical activities of the conference started with the presentation by Prof. Emeritus Gary Borman entitled "Pathways to Achieving A New Generation of Engines for Personal Transportation". This was the Soichiro Honda Award Lecture for 1997. Professor Borman stated that, as we move into the twenty first century, the spread of affluence to a greater portion of an ever growing world population, coupled with dwindling reserves of crude oil, will make it imperative that we simultaneously protect our environment and enhance the fuel efficiency of transportation vehicles. Although reduced vehicle weight is the major contributor to conservation, it is argued that safety considerations limit the vehicle size reduction. The engine thus remains an important component in meeting the needs of the new century. His lecture first specified those areas of engine design which provide the best opportunities for changes that will meet the needs of fuel economy and reduced emissions at affordable costs. He then concentrated on defining pathways to achieving such goals. In particular, the tools available to perform the needed studies were cited. The lecture ended with a discussion of the types of programs and methods of technical interchange required to produce a new generation of engines. A copy of Prof. Borman's Lecture is available in the symposium volumes.

The lunch presentation series on the subject of "Industry, Government, Uni-

versity and Research Laboratories Coordination for New Product Development" continued at this conference. On Monday, Ms. Cheri Langenfeld presented the Government perspective to all conference participants. She was the third speaker on the series topic within the last two years. Ms. Langenfeld is the director of the Department of Energy, Chicago Field Office, with about 600 federal employees under her. Her office is responsible for more than \$2.4 billion in federal Research and Development programs and related cooperative activities, and hence she was very well qualified to talk about the subject.

The Tuesday lunch session was organized by the Government Relations Committee of the ICE Division. Mr. Dennis Achgill from the Allison Engine Company is the Chair of the Policy and Issues Committee of the ASME Board of Government Relations. He first gave an overview of the Government Relations activities and structure within the ASME organization. Then Mr. Nelson Milder and Ms. Stacy Jarboe, both from the ASME Washington Office, described the ASME Policy regarding position papers and the current Government Relations Activities and Issues. The session ended with suggestions from the speakers on how to pursue an issue through the Washington maze.

A tutorial workshop was held on "The Fundamentals of Computer Aided Silencing". It was conducted by Dr. Larry Ericson, VP of Research for Nelson Industries which has long been a leader in the field of passive and active noise reduction and silencing. Dr. Ericson is a world renowned expert on the subject. The workshop included theoretical background, applications and future directions. More than 35 people attended the workshop.

On Wednesday, a tour of the Engine Research Center was held which consisted of four parts. Prof. D. Foster presented a brief history of the Engine Research Center and gave an overview of its current status, staff, projects and capabilities. The second part of the tour focused on various engine experiments in the lab. Many of the engines are single cylinder versions of modern production diesels. Next, the tour covered out-of-engine experiments, which were either for development of diagnostic tools or for basic studies of physical phenomena that occur in engines. The last part showed the large computational facility consisting of a Cray J916 Supercomputer and 16 advanced graphic workstations devoted to CFD engine simulations and model development. During the tour student research assistants were available to describe their projects and special wall charts covered the objectives and highlights of the research work.

The social side of the conference was superb. The welcoming reception on Sunday allowed old friends to come together and new friendships to begin. On Monday, the spouses/guests tour included a trip through Wisconsin's gorgeous fall scenery and was climaxed by a visit to one of Wisconsin's unique attractions, The House on The Rock. The house, originally built as a week-end home and a collector's museum, has been expanded to include unique displays such as doll and carnival carousels, old town shops and automated musical instruments. The evening dinner was at the Monona Terrace, with a very unique architectural presentation about the development and construction of that beautiful center. On Tuesday, the spouses tour included a visit to the famous Frank Lloyd Wright building, which was completed in 1951 as the First Unitarian Society Meeting House, and the Helen Louise Allen Textile Collection. The Awards banquet was held on Tuesday night to honor various people for their contributions to Engine Technology and for distinguished service to the ICE Division activities. Mr. Carl McClung was the MC.

In summation, the Fall Technical Conference was a very successful one. The contributions of numerous people for making it a success are greatly appreciated by those who attended. Now its technical presentations are in the three volumes on the shelf and its social interactions are in the memories of the participants. Neither of these will be forgotten.

Dr. Teoman Uzkan

EPA Setting Exhaust Regs

The U.S. Environmental Protection Agency (EPA) is in the final stages of developing stringent new standards for diesel engines used in a wide range of nonroad applications, including construction, agricultural, railroad, industrial equipment and marine. These initiatives are in response to the 1990 Clean Air Act Amendments which specifically directed the EPA to study the contribution of nonroad engines to urban air pollution, and to regulate them if warranted. The proposed standards would reduce emissions from a typical nonroad diesel engine by up to two thirds. The latest information on all mobile source regulations is available electronically from the EPA OMS Web site at <http://www.epa.gov/OMSWWW/>.

Nonroad Diesel Engines

Under EPA regulations, compression-ignition (CI) engines greater than 37 kW must comply with "Tier 1" emission stan-

dards that are being phased in between 1996 and 2000. However, engines used in underground mines (regulated by the Mine Safety and Health Administration), locomotives and marine vessels are not included in these standards. Under Tier 1 standards, the EPA projects that NOx emissions from new CI nonroad engines will be reduced by over 30 percent from the uncontrolled levels.

In 1996 the EPA, the California Air Resources Board (CARB) and the manufacturers of nonroad CI engines signed a "Statement of Principles" that outlined further emission reductions in NOx emissions, and HC, CO, and PM standards for CI nonroad engines. From this agreement, EPA issued a Notice of Proposed Rulemaking (NPRM) in September 1997 that included proposed Tier 2 and Tier 3 emission standards as given in Table 1.

Locomotives

The Final Rule for exhaust emission standards for locomotives and locomotive engines was published in the Federal Register on April 16, 1998. The primary focus of the locomotive rule is NOx reductions and, when fully implemented, will result in more than a 60 percent reduction in NOx from uncontrolled levels.

The locomotive program consists of three separate sets of standards, with the applicability of a particular standard dependent on the date a locomotive is manufactured. The first set of standards, Tier 0, applies to locomotives originally manufactured between 1973 and 2001. The Tier 0 standards will be phased in over a two year period beginning in 2000.

The second set of standards, Tier 1, applies to locomotives manufactured from 2002 through 2004. These locomotives will be required to meet the Tier 1 standards at the time of original manufacture and at each subsequent remanufacture. Locomotives manufactured in 2005 and later will be required to meet the Tier 2 standards at the time of original manufacture and at each subsequent remanufacture. All three Tier standards for the

line-haul duty cycle are contained in Table 2.

Diesel Marine Engines

On May 11, 1998, the EPA signed an Advance Notice of Proposed Rulemaking (ANPRM) to invite comment from all interested parties on EPA's plan to propose emission standards and other related provisions for both new propulsion and auxiliary marine compression-ignition (CI) engines at or above 37 kilowatts (kW). The engines covered by this proposal are used for propulsion or auxiliary power on both commercial and recreational vessels for a wide variety of applications including, but not limited to, barges, tugs, fishing vessels, ferries, runabouts and cabin cruisers. The Notice of Proposed Rulemaking (NPRM) for Marine CI engines is expected to be published in November 1998, and the Final Rulemaking complete by November 1999.

The proposed emission control program for CI marine engines at or above 37 kW will in many cases be an outgrowth of, and depend on, EPA's proposed emission control program for other land-based engines. However, instead of basing the program on the land-based nonroad Tier 1 program, this new proposal will look to the newer Tier 2 nonroad and locomotive programs. EPA intends to draw on both of those programs for elements such as standards, compliance program and manufacturer flexibility provisions.

The EPA reports that domestic and ocean-going CI marine engines account for approximately 4.5 percent of total mobile source NOx emissions nationwide. However, because of the nature of their operation, the contribution of these engines to NOx levels in certain port cities and coastal areas is much higher. To address these emissions, EPA's proposal outlines a control program for CI marine engines that builds on EPA's programs for on-highway and land-based nonroad diesel engines, EPA's recent locomotive rule and Annex VI of the International Convention on the Prevention of Pollution from Ships (MAR-

Table 1. Proposed Standards and Implementation Dates for Land-Based Nonroad CI Engines Rated Over 37 kW

Rated Power (kW)	Standard Level	NMHC+NOx (g/kW-hr)	CO (g/kW-hr)	PM (g/kW-hr)	Implementation Date
37 - 75	Tier 2	7.5	5.0	0.40	2004
	Tier 3	4.7	5.0	—	2008
75 - 130	Tier 2	6.6	5.0	0.30	2003
	Tier 3	4.0	5.0	—	2007
130 - 225	Tier 2	6.6	3.5	0.20	2003
	Tier 3	4.0	3.5	—	2006
225 - 450	Tier 2	6.4	3.5	0.20	2001
	Tier 3	4.0	3.5	—	2006
450 - 560	Tier 2	6.4	3.5	0.20	2002
	Tier 3	4.0	3.5	—	2006
>560	Tier 2	6.4	3.5	0.20	2006

Table 2. Line-Haul Duty-Cycle Locomotive Standards

Tier	HC (g/kW-hr)	CO (g/kW-hr)	NOx (g/kW-hr)	PM (g/kW-hr)
Tier 0	1.3	6.7	12.7	0.80
Tier 1	0.7	2.9	9.9	0.6
Tier 2	0.4	2.0	7.4	0.27

POL), developed by the International Maritime Organization (IMO).

If the emission standards and other requirements for those CI marine engines that use the same technologies reflected in EPA's on-highway, land-based nonroad, or locomotive rules are implemented, EPA would expect to see NOx and PM reductions on a per-engine basis comparable to those achieved by engines subject to those rules. The standards that EPA is considering applying to very large CI marine engines were intended by IMO to result in a 30 percent NOx reduction. EPA continues to investigate IMO's anticipated reductions for those engines, based on the age and other characteristics of the U.S. fleet.

The emission control program contemplated by EPA is intended to cover all new propulsion or auxiliary compression-ignition engines of 37 kW or greater offered for sale, introduced into commerce, or imported into the United States for installation on a vessel that is registered or flagged in the United States. Engines produced for installation on vessels not registered or flagged in the United States may be covered by an export exemption, as long as those vessels are not operated solely within United States. With regard to size, EPA's proposal is intended to cover all new engines from a 37 kW engine used on a small recreational vessel to a 30,000 kW or larger engine installed on an ocean-going container ship. However, EPA is considering setting different standards for different size categories of CI marine engines.

Category 1: Engines Similar to Land-Based Nonroad — EPA is considering defining as a first category of CI marine engines those engines that are derived from land-based nonroad CI engines or that use similar technologies. These engines would have to meet Tier 2 and Tier 3 nonroad engine standards as given in Table 1.

Category 2: Engines Similar to Locomotive Engines — EPA is considering defining as a second category of CI marine engines those engines that are

derived from locomotive engines or that use similar technologies. The EPA is considering two ways to address emissions from engines in this category. The first approach would be to apply the NOx emission limits contained in MARPOL Annex VI, as given in Table 3. These limits would apply to new engines constructed on or after January 1, 2000. Alternatively, due to their relatively high contribution to the NOx and PM inventories on a per engine basis, more stringent emission limits may be appropriate for these engines. Thus, the second approach would be to apply the numerical emission limits for new locomotive engines to these CI marine engines (see Table 2).

Category 3: Low Speed, High Horsepower Engines — The EPA is considering defining a third category of CI marine engines as low speed, high horsepower engines that are used for propulsion purposes on ocean-going engines or Great Lakes freighters. These engines, which are typically larger than those derived from locomotive engines, are manufactured in very small numbers. For such new engines, the EPA is considering setting standards that are consistent with MARPOL Annex VI.

At the international level, emissions from marine vessels will be regulated by Annex VI of the International Convention on the Prevention of Pollution from Ships (MARPOL). The IMO has finalized NOx emission standards that target a 30 percent reduction from uncontrolled levels, and these will apply to all vessels used in international voyages beginning January 1, 2000. Table 3 contains the IMO's NOx limits, which are intended to apply to new engines greater than 130 kW installed on vessels constructed on or after January 1, 2000, or which undergo a major conversion after that date. The entire Annex will acquire the force of law in the United States only after it is ratified by Congress. Although, as of May 1998, the IMO Standard was not published, it will be available from IMO as publication IMO-664E.

Steven G. Fritz, P.E.

Table 3. Marpol Annex VI Marine Engine Emission Standards

Engine Speed	HC (g/kW-hr)	CO (g/kW-hr)	NOx (g/kW-hr)	PM (g/kW-hr)
<130 rpm	None	None	17.0	None
130 rpm–2000 rpm	None	None	45*n ^(-0.2)	None
> 2000 rpm	None	None	9.8	None

Past Chair Shares Thoughts

(continued from page 2)

years, I recognize that the division continues to evolve and becomes better year by year. Some of this progress is slow, but some comes quickly. In all cases, it is quite satisfying to participate in the growth and development of the division. I am confident that this growth and development will continue, and I look forward to even greater accomplishments by this division in the near future.

In the Chair's Message by Carl McClung, he has invited those of you reading this Newsletter (who are not already participating in the division's activities) to join our group. I want to second his invitation. You will quickly learn that working with this group is both a technically rewarding activity as well as a personally satisfying experience. Please contact me or any of the Executive Committee to learn more about how you can be a full participant and begin to realize the benefits of active participation.

Let me conclude by saying that it has been a real honor and pleasure to serve the ICE Division. I have met and worked with a number of very special individuals, and I look forward to many more years of association with the ICE Division.

Jerry Caton

Future Conference Dates and Locations

Mark your calendar now so you won't forget to attend these important conferences:

1998 Fall Technical Conference
September 27–30, 1998

Hosted by National Forge Company
Meeting at Peek 'n Peak Resort and Conference Center
Clymer, NY

See Call for Papers in this Newsletter

1999 Spring Technical Conference
April 25–28, 1999

Hosted by Cummins Engine Company
Meeting at Holiday Inn Conference Center
Columbus, IN

See Call for Papers in this Newsletter

1999 Fall Technical Conference
October 16–20, 1999

Hosted by University of Michigan
Meeting at Crowne Plaza
Ann Arbor, MI

2000 Spring Technical Conference
April 8–12, 2000

Hosted by Southwest Research Institute
Meeting at Menger Hotel
San Antonio, TX

2000 Fall Technical Conference
September 23–26, 2000

Hosted by Caterpillar, Inc.
Meeting at Holiday Inn Brandywine
Peoria, IL

Awards Presented

The following Awards were presented during the 1997 Fall Technical Conference in Middleton, WI.

Ice Division Speaker Award



Charles A. Amann

For the able presentation of his paper "Seeking a New Engine at the General Motors Research Laboratories 1950-1975," presented at the 1996 ICE Division Fall Technical Conference, Youngstown, Ohio.

ASME Dedicated Service Award



Bruce M. Chrisman

For dedicated voluntary service to the Society marked by outstanding performance, demonstrated effective leadership, prolonged and committed service, devotion, enthusiasm, and faithfulness.

ASME Internal Combustion Engine Award



Benny Ballheimer

For distinguished contributions to internal combustion engine theory and application; particularly to current production Caterpillar four-stroke cycle turbocharged diesel and gas engines.

Richard S. Woodbury Award



Garin M. VanDeMark, P.E.

For eminent achievement or distinguished contribution to the management of those engaged in design, development, application, and operation of internal combustion engines.

ICE Division Speaker Award



J. Rod Thomas

Combustion and Emissions," presented at the 1997 ICE Division Spring Technical Conference, Fort Collins, Colorado.

For the able presentation of his paper "The Legend Project: An Experiment Designed to Identify the Effects of Combustion Chamber Shape and Charge Condition on Gas Engine

ICE Division Meritorious Service Award



Peter C. Enslin

to the benefit of the Engineering profession and the A.S.M.E.

For many years of loyal service and worthy contributions on numerous committee assignments within the Internal Combustion Engine Division. For guidance and leadership in division activities

ICE Division Meritorious Service Award



Steven G. Fritz, P.E.

to the benefit of the Engineering profession and the A.S.M.E.

For many years of loyal service and worthy contributions on numerous committee assignments within the Internal Combustion Engine Division. For guidance and leadership in division activities

ICE Division Meritorious Service Award



Reda M. Bata, Ph.D.

to the benefit of the Engineering profession and the A.S.M.E.

For many years of loyal service and worthy contributions on numerous committee assignments within the Internal Combustion Engine Division. For guidance and leadership in division activities

ASME Retiring Chairman Certificate



David B. Aldag, P.E.

Internal Combustion Engine Division from 1992 to 1997 and serving as Chairman 1996 to 1997.

In testimony of the high regard of his co-workers and the deep appreciation of the Society for his valued services in advancing the engineering profession as a member of the Executive Committee of the

ICE Division Meritorious Service Award



Dennis N. Assanis, Ph.D.

Engineering profession and the A.S.M.E.

For many years of loyal service and worthy contributions on numerous committee assignments within the Internal Combustion Engine Division. For guidance and leadership in division activities to the benefit of the

ICE Division Citation



Hugh A. Williams, Jr., P.E.

performance of the GM unit injector. For his valuable service to ASME/ICE Division.

For outstanding achievements in the development of medium speed turbocharged diesel engines with particular emphasis upon improvements in thermal and combustion efficiency: for contributions to the design and

ICE Division Meritorious Service Award



Joseph R. Barcroft, P.E.

Engineering profession and the A.S.M.E.

For many years of service and worthy contributions to numerous committee assignments within the Internal Combustion Engine Division. For guidance and leadership in division activities to the benefit of the

WONG Joins Executive Committee



Dr. Victor W. Wong

Your ICE Division is guided by eight dedicated members who serve as its officers. Together they make up the Executive Committee, listed elsewhere in this Newsletter. Six of

them rotate through a variety of assignments during their seven-year commitment, eventually becoming Chair and then Past Chair before retiring from office. The other two are the Treasurer and Secretary who serve in those posts for a number of years. Each year the committee invites an engineer into its ranks as the "New Member" to begin the rotation cycle. Obviously, the future success of the Division depends upon recognizing and choosing those with fine leadership qualities to become the incoming New Member. This year they have selected Dr. Victor W. Wong for that position.

Dr. Wong received his education at Dartmouth College, Indiana University and M.I.T. He earned his Ph.D. in Mechanical Engineering, holds a Masters Degree in Business Administration and is a Registered Professional Engineer. He is currently situated at the Massachusetts Institute of Technology where his respon-

sibilities include: Lecturer for the Department of Mechanical Engineering; Principal Research Scientist and Program Manager for the Transportation Propulsion Energy Laboratory; and Manager of the Sloan Automotive Laboratory.

Dr. Wong's current research activities include engine design, performance, combustion, emissions and lubrication system measurements and modeling; and studies of piston slap and engine vibration, alternate-fuel fired engine characteristics, fuel-additive effects on engine deposits, knock and octane requirements. His research interests include engine/fuel interactions, advanced engine systems, engine and vehicle performance, emissions and health effects.

Prior to joining M. I. T., Victor held positions at Cummins Engine Company and at Detroit Diesel Allison Division, General Motors Corporation. He is the recipient of the 1991 SAE Lubricants Award for Research on Lubricants and the 1994 Society of Automotive Engineers Arch T. Colwell Merit Award for Outstanding Contribution to Literature which Advances the Technology of Self-Propelled Vehicles. Dr. Wong is a member of Phi Beta Kappa, Sigma Xi, American Society of Mechanical Engineers, The Combustion Institute, Society of Automotive Engineers and the Society of Tribologists and Lubrication Engineers. He holds patents for a "Method and Apparatus for Removing Carbon Particles from Engine Exhausts" and for a "System and Method for Reducing Particulate Emissions from I.C. Engines."

Tony Siegel

MSHA Proposes Mine Regulations

On April 9, 1998, the U.S. Mine Safety and Health Administration (MSHA) proposed a rule that would establish new health standards for underground coal mines that use equipment powered by diesel engines. The proposal is designed to reduce the risks to underground coal miners of serious health hazards that are associated with exposure to high concentrations of diesel particulate matter (DPM). Underground miners are exposed to far higher concentrations of DPM than any other group of workers. According to MSHA, evidence indicates that such high exposures put these miners at excess risk of a variety of adverse health effects, including lung cancer.

In underground coal mines, MSHA's proposal would require the installation of high-efficiency filters on diesel-powered equipment to trap diesel particles before they enter the mine atmosphere. Following 18 months of education and technical assistance by MSHA after the rule is issued, filters would first have to be installed on permissible diesel-powered equipment. By the end of the following year (i.e., 30 months after the rule is issued), such filters would also have to be installed on any heavy-duty outby equipment. No specific concentration limit would be established in this sector; the proposed rule would require that filters be installed and properly maintained. Miner awareness training on the hazards of DPM would also be required.

Under the proposal, light-duty diesel-powered equipment would not be required to use diesel filters. However, MSHA asked for comment as to whether there are some types of light-duty equipment whose DPM emissions should, and could feasibly, be controlled.

MSHA considered an alternative approach of simply proposing a concentration limit for DPM in underground coal mines, instead of requiring that all engines be equipped with a high-efficiency filter. Such an approach would provide underground coal mine operators with the flexibility to elect any combination of engineering controls they wish as long as the concentration of DPM in the mine remained below a set level. However, MSHA was not confident that there is a measurement method for DPM that would provide accurate, consistent and verifiable results at lower concentration levels in underground coal mines. The problem arises because coal dust contains organic compounds that might be mistaken for DPM in the methods otherwise validated for use at lower DPM concentrations. MSHA indicated it will be continuing to explore questions about the

New ICED Associates

The Associates group of the Internal Combustion Engine Division consists of those members from our division who take active roles in accomplishing our objectives and who participate in our programs. Since the publication of the 1997 ICED Newsletter, the following individuals have been elected to this group. Please offer them your congratulations. If you are interested in becoming an Associate, please contact any of the Executive Committee members listed in this Newsletter.

John M. Clarke
Caterpillar, Inc.
Peoria, IL

Dr. Mahesh Gundappa
Radian Corporation
Research Triangle Park, NC

Edward P. Kelleher
Liberty Technologies
Sandston, VA

Donald Lambert
Miratech Corporation
Tulsa, OK

Robert L. Miller
Caterpillar, Inc.
Peoria, IL

Dr. Cornelius N. Opris
Caterpillar, Inc.
Peoria, IL

Dr. Ramesh B. Poola
Argonne National Laboratory
Argonne, IL

Dr. Bruce A. Reichert
Kansas State University
Manhattan, KS

Dr. Christopher J. Rutland
University of Wisconsin
Madison, WI

Richard E. Walker
Federal Mogul Glacier-Clevite
McConnelsville, OH

measurement of DPM in underground coal mines in consultation with NIOSH.

In the near future, MSHA intends to propose a separate rule to reduce DPM exposures in underground metal and nonmetal mines. Comments on the proposed rule must be received on or before August 7, 1998. Contact: Patricia W. Silvey, Director; Office of Standards, Regulations, and Variances, MSHA, 703-235-1910.

Steven G. Fritz, P.E.

ASME History and Heritage Program

The Internal Combustion Engine Division together with the ASME Central Ohio Section are joint sponsors of a National Historic Mechanical Engineering Heritage Collection. The collection, entitled Cooper Agricultural Steam Engines, is located at the Knox County (Ohio) Historical Museum in Mount Vernon, Ohio. All of the engines were manufactured by the C. & G. Cooper & Co., forerunner of the Cooper Cameron Corporation. The engines were manufactured in the 1853-1886 time period. One portable engine, a farm engine and two traction engines are located at the museum. The portable engine was returned from the Ford Museum in Dearborn, Michigan several years ago. The other three engines in the museum reveal the evolution of the steam tractor: (1) horse drawn and horse steered; (2) horse steered but self-propelled; and (3) self-propelled and self-steered.

The ASME History and Heritage Recognition Program began in September 1971. Heritage Collections mark contributions of several objects with special significance to the historical development of Mechanical Engineering.

Mel Helmich, past Chair and Secretary of ICED, served as the nominator of the collection and author of the dedication brochure. A dedication ceremony is planned for Thursday, September 17, 1998, at the Knox County Museum starting at Noon. Any interested party is welcome to attend.

Mel Helmich

Literature Search is Easy

On occasion, an engineer needs to search the literature for technical data, even when there is negligible call for it in his job. Do you remember when you had to page through bound volumes of index material, scanning abstracts and tracking authors?

Engineering Information Inc., the old standby for looking up technical information in literature has introduced an elec-

tronic way to look up things. The service is available on the internet and technical articles that were published as early as 1970 are available. Your screen displays the author(s), title(s), source(s) and abstract(s). Copies of a complete article are available for a price. The service saves a lot of time that would be spent digging through hard copy indices.

Go to their web site, www.ei.org (be sure to use .org) and walk through some of the links. The key words that describe the search service are Compendex and Engineering Village.

A free thirty day trial is available. For a company or institution, an annual subscription fee is offered. An individual can sign on for a considerably lower rate. College libraries may have the service so if you are a student, you may already have access.

Engineering Index is not the only search service available. Dialog is another, and it covers other databases such as marketing, business, National Technical Information Service as well as technical literature. (800-334-2564)

SAE has their own index service that covers SAE articles. Chem Abstracts is another.

Linda Hall Library will perform a search for you in many technical disciplines. Their e-mail is search.lhl.lib.mo.us (lhl is LHL in lower case letters). The phone contact is 1-800-662-1545 ext #767 or 816-926-8767. They can fax you a one page sheet describing their service.

Tel-Tech is a search service. They also field a network of Tech Experts who can assist with a technical question. Subscriptions are available, usually best suited for organizations with a larger requirement for a literature search. (800-367-8358)

Happy searching!

Dave Aldag

The Progress of Chinese Vehicle Emission Control

This is a summary, prepared by Martin Heinrich, of a paper authored and presented by Mr. Chengqiao Lu of the Research Institute of Petroleum Processing, SINOPEC, Beijing 100083, P. R. China. The paper was presented at the 1998 Spring ASME-ICE Division Engine Technology Conference on April 27, 1998. --ed.

Chinese automotive and fuel industries are expected to develop rapidly along with the fast growing economy in China. It is estimated that the total number of privately owned vehicles in China will double between the years 1995 and 2000, and that the production of passenger and personal cars will gain the most attention. Fuel economy and environmental protection have become two major issues for the developing Chinese automotive industry.

China's Fuel Industry response to improving vehicle emission control includes:

- Stopping production of low octane (70 motor octane number, MON) gasoline by the year 1998
- Phasing out leaded gasoline by the year 2000
- Increasing production of high octane (>90 research octane number, RON) unleaded gasoline
- Increasing use of gasoline detergent additives for unleaded gasoline when fuel injectors are used (to reduce formation of intake valve and injector deposits associated with China's high olefin content fuel)
- Expanding the availability of unleaded (>90 RON) gasoline in China (unleaded gasoline has been provided since 1997 in eight of China's largest cities including Beijing, Shanghai and Guangzhou)

The use of unleaded gasoline can reduce lead pollutants in the environment and allow the use of catalytic converters on vehicles to reduce exhaust hydrocarbons (HC), carbon monoxide (CO) and oxides of nitrogen (NOx) emissions. Three things, according to the author, must be done before catalytic converters can be installed on vehicles. First, unleaded gasoline must be provided with a guarantee of quality. Second, unleaded gasoline should not be limited to several large cities but rather be provided throughout the entire nation. Finally, the automobile industry should do their best to improve vehicle emissions performance.

Generally speaking, unleaded gasoline should be provided to the market before vehicles are equipped with catalytic converters. China needs to establish a fuel quality control system for the fuel transportation and refueling processes. China needs to price unleaded gasoline slightly below leaded gasoline to discourage misfueling. Finally, manufacturers need to provide engine exhaust valve seat materials compatible with unleaded gasoline, and thereby avoid excessive valve seat wear. Valve seat wear is currently being examined by many Chinese automobile manufacturers.

A major concern in China is the lack of a fuel quality control system. Many Chinese refiners are small in size. Neither large nor small refiners have the responsibility for fuel distribution and resultant fuel quality. The author states that it is imperative to remedy this chaotic situation. The refinery and oil companies should be responsible for the fuel distribution system and the quality, as is the practice in many other countries.

China's automotive manufacturers are also working to reduce vehicle emissions. Chinese automotive factories produce

vehicles using technologies from many countries. Approximately 70 percent of the total vehicle production meets the European emission standards ECE 15.03 and ECE 15.04, while the rest are currently being upgraded. Three major vehicle emission sources can be categorized as:

- Crankcase Emissions (Blowby Gas)
- Fuel Evaporative Emissions
- Exhaust Emissions

Engine exhaust emissions include HC, CO and NOx. To reduce these pollutants, different technologies are applied to improve fuel combustion in the engine. These technologies include low crevice volume, improved combustion chamber design, more reliable ignition systems, advanced ignition timing strategies and lean-burn engine technology. Chinese engines feature a moderate compression ratio and, in some cases, external exhaust gas recirculation (EGR) to reduce levels of NOx emissions. These and other strategies are under consideration by Chinese automobile manufacturers. When vehicle emissions performance is improved, it is anticipated that two or three of the vehicle pollutants (HC, CO or NOx) can be reduced further.

Additional vehicle emissions control can be obtained with the implementation of exhaust catalysts. The use of a catalyst is best accompanied by the use of electronic ignition, an electronic fuel injection system (EFI) and unleaded gasoline with detergent additives. A Chinese joint venture with the Bosch Company has been established in Shanghai to produce a closed-loop system incorporating the electronic fuel injector. Electronic fuel injection was put into production in China in 1997 by this joint venture. Research work in exhaust gas catalysis is on-going. It is expected, with the availability of unleaded gasoline in China, that catalysts on vehicles will be possible in the next few years.

Chinese vehicle emission standards are also developing. According to the China Automotive Technology Workshop (held in 1995), the first step for China is to reach vehicle emission control close to the U.S. 1975 standard by the year 2000. The subsequent goal is to reach vehicle emission control close to the European 1993 standard after the year 2000.

Further improvements will be realized once air quality monitoring, risk assessment studies, and cost/benefit analysis confirm the need to further reduce vehicle emissions. Future vehicle technology improvements include three-way catalysts with oxygen sensors and closed loop fuel control, unleaded gasoline with detergent additives, electronic ignition, electronic fuel injection and charcoal canisters. The application of exhaust catalysts with fuel injectors and closed-loop control not only improves the emissions

performance of the vehicle, but also increases fuel economy and engine specific power.

In summary, the upgrading of vehicle emission control in China has been a systematic effort. A coordinated effort to phase-out gasoline lead was established with the help of the Chinese EPA, the Ministry of Machinery, oil companies (China Petrochemical Corporation, SINOPEC and China National Petroleum Company, CNPC), the Bureau of National Taxation, the Department of Transportation, the Science Committee and the transportation management organizations. If this coordinated effort continues, placement of catalytic converters on Chinese vehicles will be possible at the end of the century.

For additional information, please refer to the published paper in ICE-Vol. 30-1, Engine Emissions and Environmental Issues, Volume 1, Paper No. 98-ICE-78 from the 1998 Spring Technical Conference of the ASME Internal Combustion Engine Division.

About the Author:

Mr. Chengqiao Lu has worked in the petroleum industry for over 45 years. He graduated from the Chemical Engineering Department of Tsinghua University in Beijing, China, in 1952. He worked in Yumen Refinery as an engineer and manager from 1951 to 1957, and then studied lube oil additive technology at the Russian BHUNHN Research Institute. Beginning in 1959, he worked six years in synthetic lubricants research as the department head of the China Petroleum Research Institute (CPRI) and became the vice president of CPRI in 1965. From 1982 to 1991 he was president of the Research Institute of Petroleum Processing

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(RIPP) and then became chairman of the technical and economic committee of RIPP. He is knowledgeable in refining technologies and oil products, including motor fuels and lubricants. Mr. Chengqiao Lu is a former chair of China Refining Society and is now a board member of the China Petroleum Society, SAE China, and the honorary chair of China Grease Association.

Martin Heimrich

Outsourcing of Engineering Will Trend Slowly Upward

New Survey Shows 5-Year Trend Similar to Previous 5 Years

Corporate outsourcing of engineering functions and services in the United States is expected to increase only slightly over the next five years, virtually mirroring the increase of the previous 5 years, according to a landmark survey recently conducted for The American Society of Mechanical Engineers (ASME International).

The survey was commissioned by the ASME Committee on Issues Identification, and was conducted by surveying 3,000 industry leaders and U.S. ASME members who are vice presidents and directors in engineering positions, and presidents or owners in non-engineering positions. A follow-up survey was conducted among the respondents about past trends in outsourcing.

Overall, the survey determined that the amount of engineering work outsourced is expected to increase from 27 percent to 29 percent, mirroring the increase over the past five years, which was 25 percent to 27 percent.

Within that trend, however, outsourcing of some functions is expected to increase more slowly over the next five years, compared to the previous five. Those include product design, plant/operations/maintenance, and software programming functions (5-10 percent more slowly); and systems design, product engineering, and research and development functions (15-20 percent more slowly).

Conversely, outsourcing of computer information and testing/reliability/quality control functions will increase 15-25 percent more rapidly over the next five years, compared to the previous five.

The survey found that companies prefer to outsource "special needs" that require specialized skills rather than functions considered to be corporate core competen-

CALL FOR PAPERS

THE INTERNAL COMBUSTION ENGINE DIVISION of the ASME WILL HOLD TWO TECHNICAL CONFERENCES IN 1999.

**The 1999 Spring Technical Conference will be held April 25-28, 1999, in Columbus, Indiana
Hosted by Cummins Engine Company**

**The 1999 Fall Technical Conference will be held October 16-20, 1999, in Ann Arbor, Michigan
Hosted by the University of Michigan**

Papers are invited for publication and presentation for topics related to all types of automotive, light-duty and heavy-duty internal combustion engines. Papers may address any aspect of the design, development or application of compression-ignition (diesel), spark ignition, rotary or reciprocating engines. Examples of topics of previous papers include in-cylinder emissions control, alternative fuels, engine cooling, lubrication systems, fuel injection and ignition systems, design analysis, catalysts, computer simulation of basic engine processes, novel combustion systems, operation and maintenance, control systems, heat recovery, bearings and materials.

All accepted papers will be available at the respective conference and papers will be considered for the Journal of Engineering for Gas Turbines and Power. ASME review and publication policies will apply.

Please complete an ASME paper offer form (M&P 1903) and send the form and an abstract of the paper to the Technical Program Chair and Proceedings Editor:

Dr. Stuart R. Bell
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The University of Alabama
Central Receiving 2nd Street
PO Box 870276
Tuscaloosa, Al 35487-0276
Phone: (205) 348-1644
Fax: (205) 348-6419
E-mail: sbell@coe.eng.ua.edu

Important Dates For Spring Conference

**August 26, 1998 (Call Dr. Bell if late)
November 15, 1998
January 15, 1999**

**Offer of Paper, One Page Abstract
Draft Manuscript Due for Review
Camera Ready Paper Due**

Important Dates For Fall Conference

**March 31, 1999
May 14, 1999
June 28, 1999**

TAKE ADVANTAGE OF THIS OPPORTUNITY TO PUBLISH, PARTICIPATE AND SHARE

cies. In most cases, engineering functions are considered to be "core competencies," and are less likely to be outsourced than some other business functions.

The survey found some variation within major business sectors: trades/services (e.g., wholesale, retail, business/financial services, education, engineering services), industrial/utilities (e.g., mining/construction, electric/gas/utilities), and manufacturing (e.g., chemical/petroleum, metals, machinery, electrical equip., transportation equip., controls). Among those three sectors, the largest outsourcer is expected to be trades/services, followed by industrial/utilities and manufacturing.

The percent of engineering outsourcing in the trades/services sector averages 43 percent today, and is expected to remain the same over the next five years. The percent in the manufacturing sector averages 27 percent today and is expected to

increase to 29 percent over the next five years. The industrial/utilities sector outsources an average of 20 percent of its engineering functions today, a percentage that is expected to increase to 23 percent over the next five years.

Although the overall effect of outsourcing on mechanical engineers is expected to be no greater than for other engineering professions, certain members of the profession are expected to be more heavily impacted over the next five years. Those include senior-level mechanical engineers (primarily due to cost savings), those who perform finite element analysis (primarily due to personnel specialization and computer software costs), those who perform computer-aided design and drawing (primarily due to expensive hardware and expense of hiring/training CAD engineers), and those with specialty skills (primarily due to lack of in-house

capability and scarcity of specialized engineers).

David A. Wieland, Chair of the ASME Committee on Issues Identification, noted that "The survey was important because, for the first time, real data are available showing trends that will affect the mechanical engineering profession," he said. "This survey shows that, contrary to the belief of many engineers, outsourcing of engineering services is not expected to dramatically increase in the future." Wieland went on to point out that increased corporate outsourcing of engineering has been an ongoing concern to many engineers. "This survey shows the engineering areas most likely to be affected by outsourcing, and may also provide insight into opportunities for entrepreneurs and technical services companies," Wieland said.

By Francis Dietz

Internal Combustion Engine Division 1998-1999

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