

# RELIABILITY SOCIETY NEWSLETTER



Editor: John Peter Rooney

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## PRESIDENT'S MESSAGE

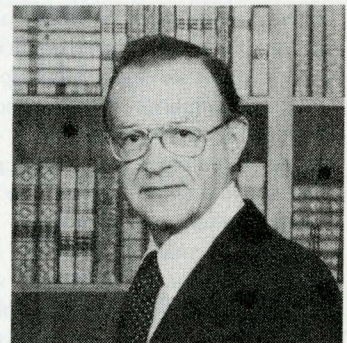
On behalf of the Reliability Society I want to salute ADCOM members C. R. Knight and J. J. Naresky on the occasion of their retirement from their positions in the ARINC Corporation and Civil Service respectively. In terms of contribution to reliability discipline, its development, practice and management, one would be hard pressed to find their equal.

Ray Knight, upon retirement, was the Executive Vice President-General Manager of components, equipments and systems. He has contributed significantly to the development of the concept of reliability as a product characteristic capable of quantitative measurement. This he detailed in two classic ARINC research monographs which set forth the theoretical basis for reliability and its associated measures. That vision is today recognized by the requirements specified in the measurement, prediction and demonstration of reliability in the procurement of military, space, and industrial systems. Also, in looking back, it must be acknowledged that it was on Ray Knight's initiative that the WSEIAC (Weapon System Effectiveness Industry Advisory Committee) study was launched. The fruit of that labor was the development of techniques for appraising system effectiveness and its concomitant measures.

Joseph Naresky has amassed 37 years of federal service, 27 of which were directly connected with reliability effort. Long before reliability became recognized as an engineering design function and longer still before it became an academic discipline, this fron-

tiersman of technical development produced the first reliability design handbook *Reliability Factors for Ground Electronic Equipment*. The book, circa 1954, was a precursor of many reliability texts to follow and it established conceptually and in practice the inextricability of synthesis and reliability. To be sure, this was a milestone in reliability discipline development. Joseph Naresky must also be cited for the care and feeding of the U.S. Air Force's reliability programs. For the past ten years, as the first and only chief of the Reliability and Compatibility Division of RADC/Griffiss, every reliability initiative, innovation, program, and research effort was touched by his inspiration, guided by his competent hand, prodded by the pressure of Vistula flowing in his veins, and anointed by his imprimatur.

Reliability discipline is richer today for yesterday's contributions of these, our distinguished colleagues, and honored Fellows of IEEE.



T. L. Regulinski

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## ADCOM OFFICERS' REPORTS

### Technical Operations

#### B. Retterer, VP, Tech. Operations

The function of this activity is to provide a national forum to address technical issues related to the Society field of interest. This work is accomplished through a series of subcommittees. It is our intent to highlight the scope of each subcommittee activity in the next several issues of the Newsletter.

The Subcommittee on Human Performance Reliability will be spotlighted in this issue. Dr. A. Siegel is chairperson of this committee.

The field of interest for the subcommittee is considered to include (1) development and analysis of methods and concepts for measuring and implementing human performance reliability considerations in all phases of the system development cycle; (2) dissemination of information relative to human performance reliability and integration of this information among industrial, governmental, academic, and consumer organizations; (3) encouragement of the consideration of all aspects of human performance during the preliminary design, development, test, and evaluation of man-machine systems; (4) maintenance of liaison with other groups having similar and related interests such as the Human Factors Society, the Society of Engineering Psychologists, and the American Society of Mechanical Engineers.

Dr. Siegel recently reviewed some of the current issues in the Human Performance field and provided the following report.

"Human performance reliability and its effects on operability and maintainability have received increased emphasis. The Three Mile Island incident serves to point up the need in this area. From the human performance reliability point of view, a number of techniques have been emphasized for application. The Naval Sea Systems Command has developed and distributed a *Human Reliability Prediction System User's Manual*. This Manual describes various analytic and simulation techniques for both predicting human performance reliability and integrating calculations of human performance reliability with calculations of equipment reliability to provide metrics which describe overall (equipment and human performance) system reliability. These techniques consider human failure to be similar to component failure. There was also an emphasis on deriving the information for such calculations from special tests. Such an approach was followed by Sandia relative to nuclear energy plants. It possesses the advantage of allowing a prediction for specific work teams and equipment configurations. The approach also possesses implications for personnel selection and training.

"The development of automatic test equipment which will be applicable across classes of systems and which will do away with the generic and special test equipment which has proliferated, represents a second important area of heavy emphasis. Such developments are represented by the navy's VAST system and the Air Force's MATE system. Such systems are heavily software and operator interface oriented. Their utility and cost/effectiveness in certain applications remains to be demonstrated. Their success will depend to a significant extent on the method of data entry and the data display techniques employed. Color graphics have been heavily relied on in this latter regard. A body of information about the hieristics employed by maintenance technicians when troubleshooting advanced equipment needs to be actualized before the operator interface in such systems can be fully optimized. Moreover, such developments will possess downstream design impact because the equipment to be tested will ultimately need to be compatible with such multiple automatic test devices."

### Membership

#### J.L. Victor, VP, Membership

##### ACTIVITIES

Letters were sent to 417 members of the Reliability Society, whose dues were in arrears.

Membership Application Form was inserted in the July '79 issue of the *Newsletter*.

An application form was developed for the Reliability Society *Transactions*.

##### RESULTS

Since 28 February, 1979, the Reliability Society membership has increased by 235 members. End of July '79 total was 2699 members, which is below our goal of 3000 members for December, 1979.

Outstanding effort by the Washington/North Virginia Chapter during May 14, 15 and 16, 1979, produced 47 new applications. This is 20% of our total growth, since February, '79. Our congratulations and thanks to everyone who helped achieve these results. Mr. C. L. Hackley, Chapter Chairman and Mr. Paul Koskes, Program Chairman for the three day tutorial on Accelerated Testing of Semiconductors, deserve special mention.

##### FUTURE EFFORTS

With the renewed chapter activities in the Autumn, opportunities will arise for all members to sign up interested people. Help reach our 1979 membership goal.

## Meetings

#### C.M. Baird, VP, Meetings

The 1979 International Reliability Physics Symposium which was held in San Francisco in April was highly successful by any reasonable measurement. The technical program was well planned, of high technical value, and was highly rated by the attendees. A record attendance of 776 also contributed to the success of the conference. Congratulations to the entire committee and thanks for your efforts. Thanks also to the Reliability Society members whose continued interest and attendance make these conferences possible and beneficial. Plan now to attend the next Symposium, April 8-10, 1980, in Las Vegas.

Planning is well underway for the Annual Reliability and Maintainability Symposium to be held in San Francisco, January 22-24, 1980. A large number of excellent papers were submitted and the resulting technical program will provide valuable information for R&M practitioners. Plan now to be a part of this excellent technical interchange.

By the time you read this you should have received the program for the Product Liability Prevention Conference to be held October 22-24, 1979, in New York. A very enlightening program has been planned for your benefit. A limited number of copies of Proceedings from past PLP Conferences are available free of charge to Reliability Society members. Send your request, with your membership number, to:

R.M. Jacobs  
Consultant Services Institute, Inc.  
23 Rumson Road  
Livingston, NJ 07039

## CHAPTER NEWS

### Boston Chapter News By S. Eames, RCA

On Thursday, 26 April 1979, the Reliability Chapter, Boston Section of the IEEE held the 17th Annual Spring Reliability Seminar at the Hillcrest Nims in Waltham, Massachusetts. The Seminar was well attended (65 people) by the following companies: ASEC, ATC, DEC, ESD, The Foxboro Company, GTE Sylvania Inc., Higher Order Software, Honeywell Electro-Optics Ctr., Itek Corporation, Kaiser Engineers, LDP Hardware Assurance, MITRE Corporation, Raytheon Company, Raytheon Service Company, RCA Corporation, Sanders Associates Inc., and TASC.

Ms. Naomi McAfee from Westinghouse Electric Corporation in Baltimore, Maryland gave the keynote address on System's Effectiveness of Today's Designs.

There were seven presentations at the Seminar ranging from Device Physics of Failure and Failure Rates to Software Test and Life

## EDITORIAL

This issue is in a new format, which will be continued, for the convenience of the reader, in future issues of the *Newsletter*.

- (1) President's report or message
- (2) VP's, Treasurer's and Secretary's reports
- (3) Editorial
- (4) Reports from ADCOM Chairmen
- (5) Chapter News
- (6) Members' contributions: letters, comments, etc.
- (7) Members' accomplishments: awards, promotions, etc.
- (8) Reports on meetings sponsored by the Reliability Society
- (9) Welcome to new members
- (10) Biographies of ADCOM and Chapter officers
- (11) Call for papers
- (12) Announcements: symposia, meetings, etc.
- (13) Miscellany

Clearly, with such an ambitious table of contents, I'll need a lot of help from the members. Please send all your inputs to:

Editor, *Newsletter*  
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Plymouth, MA 02360

The *Newsletter* is published four times a year. The deadlines are  
Jan., 1980 Issue . . . . . Oct. 22, 1979 Deadline  
April, 1980 Issue . . . . . Feb. 18, 1980 Deadline  
July, 1980 Issue . . . . . May 5, 1980 Deadline  
Oct., 1980 Issue . . . . . Aug. 11, 1980 Deadline

I look forward to your inputs, your comments, and your ideas.

John Peter

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Editor: John Peter Rooney, Old Colony Estates, 16 Sansome Street, Plymouth, MA 02360.



Mr. John S. Chipchak discussed the development of "A Unified ORLA and LCC Model." Optimum Repair Level Analysis (ORLA) and Life Cycle Cost (LCC) are conventionally specified individually with identification of respective guidance/requirements documents. Mr. Chipchak demonstrated the interrelationship between the symbols, definitions and cost equations of ORLA and LCC. He showed how LCC becomes an extension of ORLA and how this substantially decreases the overall effort in performing ORLA/LCC evaluations.

"Power Supply Reliability - A Customer Viewpoint" was presented by Arsene G. Bajakian (Raytheon Co.). Mr. Bajakian addressed the MTBF requirements of power supplies and how they should be written and computed. Emphasis was placed on how a power supply design should be reviewed for the reliability engineering parameters and component application and derating.

Mr. David C. Audette spoke on the "TWT Reliability In Airborne Equipment." Over the past 12 years Sanders Associates Inc. has utilized over 52,000 TWT's (Traveling Wave Tubes) in airborne ECM equipment. These TWT's have accumulated over 2,000,000 device hours in equipment tested per MIL-STD-781. On this basis Mr. Audette demonstrated that the failure rate predictions of TWT's from MIL-HDBK-217B are off by a fraction of two, i.e., the MTBF is actually twice that predicted.

Dr. Moisey Lerner (Sanford Process Corporation) presented his paper, "Reliability Prognosis of Electrical Capacitors Subjected to a Non-Sinusoidal Voltage," which was coauthored by Dr. Leonid Lipchin of Higher Order Software, Inc. Dr. Lerner stated the failure rate of electrical capacitors used in electrical and communications systems remains comparatively high. He believes this is due mainly to a rather poor-predictability of the lifetime of capacitors when they are subjected to a non-sinusoidal signal. He proceeded to discuss the reasons for this and possible solutions to this problem.

The final presentation of the day was on the paper entitled "Device Physics of Failure Evaluation Techniques." This paper was coauthored by Joseph L. Cyr, Robert A. Fritz, and Allen D. Zubatkin, all of Assurance Technology Corporation. Techniques available to evaluate the physics of failure of electronic and electronic chemical devices have undergone significant improvements in most recent years. The gentlemen from ATC discussed a piece of evaluation equipment used in this area, the Scanning Electron Microscope (SEM). The presentation centered around four basic categories of failure analysis and case histories representative of these four categories.

An alternate paper entitled "Automated LSA Tools," which was coauthored by Mrs. Susan Eames and Mr. Edward Naas of RCA Corporation, was published in the Seminar proceedings.

The final event of the Seminar is the Annual End of the Year Banquet. Everyone enjoyed a roast beef dinner which was followed by an awards ceremony and the announcement of next year's officers. The election results were:

CHAIRMAN—Mark Snyder (GTE Sylvania, Inc.)  
 VICE-CHAIRMAN—Michael Johnson (RCA Corporation)  
 TREASURER—Wilfred Aubert (Sanders Associates, Inc.)  
 SECRETARY—Susan Eames (RCA Corporation)

## Washington/Northern Virginia Chapter News

The officers of the Washington/Northern Virginia Chapter of the Reliability Society for the year beginning July 1, 1979 have been elected:

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 14000 Georgia Ave.  
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## New York/Long Island Chapter

In accordance with the bylaws of the Reliability Society, the following officers were elected to serve as officers of the New York/Long Island Chapter from July 1, 1979 to June 30, 1980:

OFFICER	PHONE NO.
Chairman: Donald W. Matteson	(516) 261-7000, x292
Vice-Chairman: Victor J. Bonardi	(516) 531-0105, x2226
Secy.-Treasurer: Joseph J. Drvostep	(516) 752-3530
Program Chairman: Ernest Leonard	(516) WE1-4500
Publicity & Facilities Chairman: Joseph J. Gerry	(516) 427-7500, x357

## Members' News

General Membership Committee Chairman T.L. (Tom) Fagan has been appointed a *Congressional Fellow*. During his year's appointment, Tom will work full time in Washington, DC, but will maintain his residence in Pennsylvania. He will also continue to serve as Chairman of the General Membership Committee. Congratulations, Tom!

*Editorial Aside:* There's plenty of space here for your accomplishments, awards, etc. Publish a book? Let us know. President of a new company? Let us know.

WRITE!

# Report on IEEE Joint Computer/Reliability Society Meeting on Software/Hardware Reliability at TRW

IRVING DOSHAY  
 TRW, 1 Space Park  
 Redondo Beach, CA 90272

The meeting was held at TRW Forum on May 24, 1979. There were 90 persons in attendance with the largest part of the turnout from the Computer Society. Speaking on the panel were Dr. Algirdas Avizienis, Dr. Robert Brodsky, Dr. Herbert Hecht, Dr. Randall Jensen, Dr. Myron Kayton, and Mr. Norman Palley. As chairman of the Los Angeles Chapter of the Reliability Society, I chaired the meeting, and Mr. Myron Lipow coauthor of the text, *Reliability: Management, Methods, and Mathematics*, which was recently reissued in a second edition that includes an added software reliability section, was the moderator of the meeting. Mr. Lipow is also coauthor of a book entitled, *Characteristics of Software Quality, Software Reliability: A Study In Large Project Reality*, published by North Holland. Mr. Lipow has recently served as the guest editor of the *IEEE Transactions on Reliability*, covering software reliability to be published in August of this year.

The following questions were submitted beforehand to be addressed by the panel:

- Can software reliability be measured and predicted in ways similar to hardware reliability?
- Can tradeoffs between hardware and software reliability/maintainability be realistically made?
- What is the status of software versus hardware fault-tolerant design technology?
- Can maintenance and maintainability concepts similar to those used for hardware be developed and applied to software?
- Can failure modes and effects analysis be a useful tool for detection and control of failures for both software and hardware?
- Are there useful analogies to test techniques in discovering design faults of hardware and software?

### Panelist Presentations

The initial presentations by the panelists were limited to approximately seven minutes each. Dr. Avizienis, a member of the UCLA faculty and a Fellow of the IEEE, led off the presentations with a discussion on fault-tolerant computing systems, on which he has done much research. His point was that the main objective is to attain reliable computing, involving both the aspects of software and hardware. He stated seven key factors in accomplishing that objective. He pointed out that fault-tolerance was first accomplished in the hardware design. His response to the question of how to accomplish this in hardware involved both fault detection and correction algorithms, which were (hardware or software) programmed into the computer control design of the system. In software, he indicated that a similar approach as used for the hardware could be applied. He pointed out the common aspects of hardware and software and indicated that the transfer of experience from hardware fault tolerant design could be effected in the software design to detect and circumvent the faults. A common problem was indicated to be incorrect design and specification. Also, the use of fault avoidance through verification and validation was discussed.

Recovery blocks were shown as an approach to implementation of alternate programs and switching techniques.

Dr. Brodsky, who is a professor and head of the Aerospace Engineering Department at Iowa State University, on leave of absence at the Hughes Aircraft Space Center Communications Group, had a general view of the application of hardware and software in space vehicle applications. He indicated a major change in spacecraft technology was about to occur that could be generally described as a complexity inversion. This included the use of designs, which were previously relegated to ground applications and that, now, are about to be used in space. With such systems he indicated there were no real areas of tradeoffs for hardware versus software. The primary basis of accomplishing reliability and maintainability in spacecraft were through the use of backup systems (in hardware), and he indicated similar techniques were applicable to software. In ground systems for support of the spacecraft vehicles, tradeoffs were suggested as more practical. He pointed out that software systems would have to be more intelligent in the future, and that more flexibility for design innovation was possible there. FMEA techniques, he indicated, could be more practical for software through the use of simulation. He stated that current designs do not sufficiently tie the hardware to the software. He noted that the use of simulation techniques are a basis of tying the hardware and software performance evaluation together.

Dr. Hecht, President of SoHaR, which is a software and hardware reliability consulting organization, was previously Director of Computer Technology in the Advanced Programs Division of the Aerospace Corporation. He also had a prior background in hardware, as head of the Helicopter and Light Aircraft Controls at the Sperry Rand Corporation. He stated that he did not believe software reliability can be reasonably well predicted at this time noting that "the millennium is not yet at hand." "We can, however, measure software reliability," he stated. He showed two measures, that of a software failure ratio and a software failure rate, for indicating the lack of ability of software to perform, or to be the cause of a system fault. Failures per number of runs were shown as the basis of determining failure ratio, while failures per unit time were shown as the measure of failure rate. He gave an example of the range of failure ratios being from .13 to .26 when plotted in month-to-month computation of the ratio. In addition, his example reflected a decreasing slope. Also, he showed a plot of hardware versus software failure rates, which indicated that the hardware reflected about as much variability on a month-to-month basis as did the software. Failure rate was also noted to reflect a decreasing slope, in his examples.

Dr. Jensen, who is currently the chief computer scientist at Hughes Aircraft Company and an author of four books on computer software technology and reliability, stated that he had a different approach to the subject of software reliability. He indicated that attaining reliable software was mostly a matter of interaction of design and user factors. He illustrated a cost equation that involved



a look at the whole process. The complete design to user interfaces and functions were reflected in his illustrated examples. He pointed out that software is primarily a mental process, in its development, and does not relate very well to the physical factors that are found in hardware. He did, however, concede that environment was a key aspect of software reliability as well as hardware reliability. He made some analogies of software and hardware test techniques and pointed out that fixing faults in software usually adds many more new ones. He stated that fundamentally software is more complex than hardware, and thus it requires more in depth approaches to effecting high reliability is software.

Dr. Kayton, Senior Staff Engineer at TRW, currently responsible for Command and Control R&D, as well as math modelling for ocean thermal energy plants, focused his attention on software tests. He provided an example of evaluating how long it might be necessary to test software based on the cost tradeoffs that are pertinent. He used data from three projects as a basis of effecting tradeoffs of the amount of testing required to assure a cost optimized sufficiently reliable software product. He noted that the faults per run came close to about 30 percent in the sample model, and that the software producer had a different view in his result than did the utility company that was the software user. In the optimization studies he found that the software producer would be looking for about 700 to 1300 runs for verification of software reliability, in a typical example, as compared to the requirement for between 3000 to 6000 runs from a viewpoint of the utility company.

Mr. Norman Palley, formerly of the Rand Corporation, past Chairman of the Los Angeles Chapter of the Computer Society and now Senior Analyst at Allison Technical Services, concentrated on small systems. He is currently involved in biomedical systems wherein the software is very critical to the control of medical data monitoring. He noted that these small systems had high complexity software, despite the fact that the hardware part of the system is less complex. The software, he stated, was basically the algorithms, which, according to Mr. Palley, do not fail, since they do not change by themselves with respect to time. He indicated that hardware methods do not seem to be applicable to the problems related to software. Changes in the code were indicated to be the most likely cause of software problems. His approach to minimizing the problems, which he stated were essentially errors in the algorithms, were possible through the use of techniques to trap these errors. He also noted that many of the problems are related to the users, and he described techniques of minimizing those errors by self-testing of the user in his application of the software. He also suggested that user errors might be avoided by increasing the hazard of failure of the system. With that approach it would be more likely that the system would not function and therefore indicate that a problem existed, rather than the system continuing to operate and produce erroneous results.

#### Panel Discussion

The discussion that followed these presentations were centered around the interpretations that were offered and the challenges to those interpretations. One of these had to do with the interpretation of the algorithms as the basis of the software design, and the fact that the algorithm did not change by itself, but may not satisfactorily perform in the environment of the data input with which it was being used. Agreement was reached that more than the algorithm was involved in the software, and that indeed the software performance depended on the environment, which primarily included the reaction of the algorithms with the data input stream.

It was agreed that the environment was key to failures of the software, since the environment cannot be entirely predictable (as often is the case with hardware). It was suggested that developing requirements for the design of the software was essential to successful software design. However, it was also noted that this was true, as well, with the development with hardware designs. The increasing complexity of electronic hardware with performance defined in terms of logic states, as reflected in very large scale integrated circuits, highlighted the problems with hardware that are very similar to the problems with software. In fact, development of adequate hardware can be closely related to the development of adequate software to interpret the hardware performance. It was agreed by three panelists that much of the development of improved reliability and maintainability of software, as well as hardware, could be obtained through the use of redundancy techniques, and further, that the software and hardware should be more closely related to meet the challenge of growing complexity in the combined hardware/software system design. Much comment was received from persons in the audience as to the time limitation for the panel that was presented. There was keen interest expressed in the subject and general agreement that there was a need to further explore this area of hardware/software reliability maintainability in a more thorough and in depth seminar. Considerations are currently in progress for planning such a seminar on a one day basis next year.

#### Some Observations by the Meeting Chairman On the Need for Quantitative Software Models Software Reliability Prediction

Prediction of software anomalies is highly speculative at this juncture in the development of software reliability technology. However, it is readily recognized that software reliability is dependent on the specific software code complexity and the data environment of the processing units and variability, variety and consistency of that data. Moreover, if that input data is changing with time, it may also be expected that the range of the processing algorithms may be periodically exceeded and require updating. Experience in prior software programs and comparisons of program complexity and data environment to the system software requirements has been successfully used as the basis of making an initial software MTBF prediction. To accomplish this on one known project, a compilation was made of known anomalies of a comparable prior software program, which was used for processing military data during an entire year. That program, which was approximately 2x as complex (estimated number of program statements), reflected 26 anomalies which were critical enough to interrupt the data processing. On that basis it was indicated that the new system may experience approximately one critical software anomaly monthly (after the proven software is accepted by the customer). However, a more in depth approach, as well as data from prior experience is sorely needed.

#### Software Design Maintainability

Maintainability and maintenance of software are significant considerations for an in depth approach to software design. The use of modular structured format for coding of software units provides ideal conditions for rapidly accessing and effecting temporary processing work-around, deletions, additions, or subsequent revisions. These inherent design characteristics are particularly important to the implementation of the software maintenance concept and the achievement of the required system availability. Consideration of these capabilities in current software design technology in con-

sonance with adequate models to optimize their use for minimum life-cycle-cost are areas for much needed work.

#### Software Maintainability and Preventive Maintenance

Software maintainability predictions have been successfully developed, were based on the ease of accessing and displaying the program routines for rapid work-arounds. In some cases, it was even shown that certain software MTTRs may be expected to be a fraction of the time for comparable hardware anomalies. Software

replacements that are effected periodically may even be interpreted as software preventive maintenance, since replacements will minimize the repetition of the past experienced problems. Ideal times for periodically effecting software preventive maintenance was successfully derived from the same data used in software reliability predictions as noted above. Since software was effected, the idealized time was selected on the basis of minimal anomaly periods. 20 days was the selected time for the noted availability evaluation. However, further study for optimization of the period is another suggested area for needed models.

## Welcome To New Members

*New members of the Reliability Society are welcomed by the printing of their names and addresses. Chapter chairmen are requested to examine these listings, and to contact members in their chapter, inviting them to the chapter activities.*

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## ANNOUNCEMENT IEEE Colloquium On

# LARGE DATA SYSTEMS IN OIL AND GAS EXPLORATION

As a part of the 1980 International Symposium on Circuits and Systems, the Institute of Electrical and Electronics Engineers in cooperation with the AAPG and SEG announces a one-day colloquium on "Large Data Systems in Oil and Gas Exploration." This will be held on Monday, April 28, 1980 at the Shamrock Hilton Hotel in Houston, Texas. Through a series of invited talks, the colloquium will present and discuss modern concepts in petroleum exploration. The operational emphasis will be on a serious dialogue between the attendees from the engineering, geology, geophysics, and petrophysics disciplines.

The MORNING SESSION will be devoted to the Seismic Data System, and will focus on the overall imaging concept as well as migration and modeling. This session will begin with a special paper on the key geologic premises for the habitats of hydrocarbon.

The AFTERNOON SESSION will have a synergistic theme: This in recognition of the fact that exploration decision making is becoming increasingly dependent on the comprehensive use of surface and borehole geologic/geophysical data, and that digital computers are playing important roles in handling the large data bases needed for this purpose. The applications of well logs in exploration will be the special topic of this session.

Further inquiries concerning this very special meeting may be directed to the Colloquium Chairman: Dr. Kamal C. Jain, Shell Oil Company, P.O. Box 831, Houston, Texas, 77001. His telephone is (713) 241-3367.



# 1980 INTERNATIONAL RELIABILITY PHYSICS SYMPOSIUM

April 8—10, 1980 • Caesar's Palace • Las Vegas, Nevada

## CALL FOR PAPERS

The eighteenth annual symposium, cosponsored by the IEEE Group on Reliability and the Electron Devices Society, emphasizes reliability physics as the link between part reliability and part design and process technology.

**The 1980 Symposium will emphasize the reliability physics of LSI and VLSI devices from design through processing, packaging, and testing.** Papers are especially solicited in this area; however, work in all areas of reliability physics will be included in the program.

Papers should deal with work on:

- Physics of Failure Mechanisms—Quantitative models and mechanisms for component failure.
- Failure Analysis Techniques—Application to specific problems in failure analysis.
- Accelerated Testing and Screening—Emphasizing the physical mechanisms which validate testing and screening techniques.
- Design and Process Control for Reliability—Relating specific design concepts and process controls to part reliability

In the following or related areas:

- LSI (Microprocessors, Memory, etc.)—MOS, bipolar (especially low power Schottky and I<sup>2</sup>L), SOS and CCDs
- Semiconductor/Insulator Interfaces, Contacts and Metalization
- Packaging, Bonding, Die Attach, Coatings and Encapsulation
- Hybrids (Materials, Processes and Components)
- Displays, Sensors, and Solar Cells
- Microwave, Optoelectronic, and SAW Devices
- GaAs Devices and Interface Effects on III-V Devices
- New Devices (DMOS, VMOS, HMOS, and Magnetic Bubble Devices)
- New Technologies (VLSI, Low Temperature CVD Deposition, and Dry Process Etching)
- Passive Components

In addition to the normal verbal presentations, a special poster session is planned for significant papers on very specialized subjects and papers with a high mathematical content. In this session authors will display significant data, equations and a summary of their work on posters and be available during the entire session to discuss their work.

**The deadline for submission of abstracts is October 22, 1979.** Prospective authors are requested to notify the Program Chairman before September 15, 1979, of their intention to submit an abstract and the topics to be discussed. Authors must submit a 50 word descriptive abstract and a 300-500 word summary appropriate to describe a 20 minute paper or a poster presentation with 10 placards.

Both the abstract and summary must clearly state: (1) the purpose of the work, (2) how it advances the knowledge of reliability physics, and (3) the results of the investigation. The **50 word abstract**, suitable for publication in the advance program, should be typed on a separate sheet, and include the title of the talk, name and affiliation of the author(s), complete return address, and telephone number. The **300-500 word summary** must be submitted in a single-sided, double-spaced type-written format suitable for immediate reproduction and review purposes. No photographs or drawings are permitted because of printing restrictions. The title, name and affiliation of authors, complete return address, and telephone number should appear on the first page, and the paper title and author's name on each subsequent page. Forward abstracts and summaries to:

Dr. Murray H. Woods, Technical Program Chairman  
1980 International Reliability Physics Symposium  
Intel Corporation  
3065 Bowers Avenue  
Santa Clara, CA 95051  
(408) 987-8080

A limited number of late news papers reflecting important new developments will be considered on a space available basis. Please call the Technical Program Chairman to discuss the details of your late news paper as soon as you can.

Criteria used by the program committee to select papers for the symposium are:

- The work must be new and previously unpublished.
- Evidence of quantitative results and analytical models of studied phenomena must be given in the abstract.
- The purpose and results of the work and how it advances the state of the art must be clearly described.

Authors of accepted papers will be required to submit their slides and paper manuscripts for review by their session chairman before March 1, 1980. Visual aid legibility is mandatory. Only 35mm slides will be permitted. Papers will not be approved for presentation if the slide quality is unacceptable. Final versions of manuscripts for all papers must be submitted at the symposium for inclusion in the Proceedings.

For general conference information contact:

Mr. Glen T. Cheney, General Chairman  
1980 International Reliability Physics Symposium  
Bell Laboratories  
555 Union Boulevard  
Allentown, PA 18103  
(215) 439-7628



## SEMINARS FOR INDUSTRY

STAT-A-MATRIX-INSTITUTE, a non-profit training and certification organization, is now offering its courses at the Rutgers University Continuing Education Center. The Rutgers location has been selected because it offers an atmosphere that is conducive to intensive, in-depth education experience. The tuition includes all meals.

### Introduction to Reliability, Availability, and Maintainability, October 29–November 2, 1979, \$695

This seminar is designed to establish the fundamentals of probabilistic analysis and its applications to the fields of reliability, availability, maintainability, and safety. These concepts are basic to the design and operational deployment of aerospace, military, transportation and energy systems, and components. Reliability, availability and maintainability are vital measures of quality in every modern complex system. Any transportation system such as rail, air, highway or sea, possesses huge amounts of kinetic energy which lead to important safety problems. Similarly, the safety of nuclear reactors and petrochemical plants and storage facilities, with their large potential energy is of prime importance.

### The 17th Annual Reliability Engineering and Management Institute

**Place:** Ramada Inn, 404 North Freeway, Tucson, Arizona 85705

**Presented by:** University of Arizona, College of Engineering and Honeywell Information Systems, Arizona Computer Operations, Phoenix, Arizona

**Objective:** Cover the following subjects:  
**Reliability Engineering Theory and Practice**  
Mechanical Reliability Prediction  
Reliability Testing and Demonstration  
Maintainability Engineering  
Product Liability  
Reliability and Maintainability Management

**Dates:** November 12–16, 1979

**Fee:** \$495.00

**Continuing Education Units:** 3.0

**Contact:** Dr. Dimitri Kececioglu, Professor Aerospace and Mechanical Engineering Dept. Aeronautical Engineering Building #16 University of Arizona Tucson, Arizona 85721  
Telephone: (602) 626-2495, (602) 626-3901, or (602) 626-3054

### Probabilistic and Statistical Methods in Mechanical and Structural Design

**Place:** Ramada Inn, 404 North Freeway, Tucson, Arizona

**Presented by:** The University of Arizona College of Engineering

**Objective:** The objective of this short course and workshop is to provide practical information on engineering applications of probabilistic and statistical methods, and design under random vibration environments. Modern methods of structural and mechanical reliability analysis will be presented. Special emphasis will be given to fatigue and fracture reliability.

**Dates:** January 7–11, 1980

**Continuing Education Units:** 3.0

**Contact:** Dr. Paul H. Wirsching Associate Professor of Aerospace and Mechanical Engineering The University of Arizona Tucson, Arizona 85721  
Telephone: (602) 626-3159 or (602) 626-3054

### Election News

By the time you receive this issue, you should have already received your ballot.

There are two candidates for the post of president, as petition candidate Irwin Feerst has withdrawn, because of ill health. Information on Mr. Schneider and Mr. Young is presented here; alphabetical order of surnames determined the order of listing.

Please consider the statements of Mr. Schneider and of Mr. Young. Please examine the candidates for other positions and the two constitutional amendments. Whatever your decision, **VOTE!**



IEEE COMPUTER SOCIETY

OCTOBER  
9-11, 1979

# WORKSHOP ON QUANTITATIVE SOFTWARE MODELS for RELIABILITY, COMPLEXITY, and COST: AN ASSESSMENT OF THE STATE OF THE ART

CONCORD HOTEL · KIAMESHIA LAKE, N.Y.

This workshop will focus on a critical assessment of existing models with emphasis on the extent and form of their actual use in all phases of the software development life cycle.

### Symposium Committee

#### Conference Chairman

Dr. Henry Ruston, Polytechnic

#### Conference Vice-Chairman

Mr. Myron Lipow, TRW

#### Treasurer

Mr. John McKissick, Jr., G. E.

#### Technical Program Chairman

Dr. Martin L. Shooman, Polytechnic

#### Tutorials Chairman

Dr. Victor Basili, U. of Maryland

#### Membership Chairman

Ms. Lorraine Duvall, ITT Research

#### Local Arrangements Chairman

Dr. Glenford J. Myers, IBM

#### Publications Chairman

Dr. John Musa, Bell Labs.

#### Registration Chairman

Mr. Alan N. Sukert, RADC

### ATTENDANCE

In order to allow informality of interaction, the group size will be limited. All authors who submit papers will be invited to attend whether their papers are accepted or not. Other prospective attendees should write to the Program Chairman stating clearly how their expertise will contribute to the goals of the workshop.

Address all correspondence to:

Dr. Henry Ruston  
Polytechnic Institute of New York  
333 Jay Street, Brooklyn, N. Y. 11201





# Product Liability Prevention Conference

## PLP-79 Reducing Liability Exposure

### TOPICS AND SPEAKERS

- Congressional Legislative Plans
- Liability Reduction Technologies
- European Status of Product Liability
- Product Liability Defense Practices

### PRACTICAL WORKSHOPS

- Prediction Systems
- Good Manufacturing Practices
- Economics of Design Review in Product Liability
- Product Safety and Loss Control

### PANEL DISCUSSIONS

- Insurers
- Attorneys
- Engineers
- Management
- Regulators

PLP-79 Conference to be held at The Roosevelt, Madison at  
45th Street, New York, N.Y. 10017

**October 22, 23 & 24**

For more information on PLP-79, contact Richard M. Jacobs, or Luke J. Daidone  
of Product Liability Prevention Conference, 23 Rumson Road, Livingston, NJ 07039  
201-992-3811 or 201-992-2495

### SPONSORING ORGANIZATIONS



American National  
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Applications  
—Electronics  
—Reliability  
—North Jersey  
Section  
—Product Safety  
and Liability  
Committee



American Society  
of Safety  
Engineers



Institute of  
Electrical &  
Electronics  
Engineers  
—Reliability  
Society



American Society  
for Metals  
N.J. Chapter



American Society  
for Testing and  
Materials

ASME Safety  
Division

PLAN NOW

TO ATTEND THE ANNUAL

### RELIABILITY SOCIETY AWARDS LUNCHEON

**WHEN:** January 22, 1980 at 12:30 PM

**WHERE:** San Francisco Hilton and Tower  
(Location of 1980 ANNUAL R&M SYMPOSIUM)

**WHY:** Honor the recipients of the Reliability Society Awards  
Meet your Society Officers  
Enjoy fellowship with Society Members  
**Cheap Lunch** subsidized by the Society

### ADVANCE REGISTRATION FORM

### RELIABILITY SOCIETY AWARDS LUNCHEON

NAME \_\_\_\_\_

COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

### MAIL TO:

J. J. Naresky  
P.O. Box 1355  
Branch P.O.  
Rome, NY 13440



**QUESTIONNAIRE**

- A. About the respondent:**
- |  | Yes   | No    |
|--|-------|-------|
| 1. Registered Professional Engineer<br>State _____ Discipline _____  | _____ | _____ |
| 2. Graduate of ECPD accredited engineering college   | _____ | _____ |
| 3. Graduate in field other than engineering (e.g., physics, mathematics, business administration, etc.)<br>Specify field _____ | _____ | _____ |
| 4. Non-graduate practicing engineering   | _____ | _____ |
- B. About the question:**
- |   | Yes   | No    | conditional |
|---|-------|-------|-------------|
| 1. Do you favor universal registration for engineers?<br>Why? _____<br>_____<br>_____ | _____ | _____ | _____       |
- C. If your response is conditional, which of the following do you consider important:**
- |  |       |       |
|--|-------|-------|
| 1. Graduates of accredited Engineering schools should be eligible for registration without examination based on experience   | _____ | _____ |
| 2. An initial grandfathering period should be permitted  | _____ | _____ |
| 3. All applicants should be required to pass an examination (no grandfathering, no exception for degrees) in addition to experience<br>State examination _____<br>National examination _____ | _____ | _____ |
| 4. The word "universal" should be eliminated. IEEE should encourage voluntary registration, but not universal registration   | _____ | _____ |
| 5. An industry exemption should be favored (i.e., only engineers dealing directly with the public require registration)  | _____ | _____ |
|  | Yes   | No    |
| 6. IEEE should oppose registration. Universal or otherwise   | _____ | _____ |

**Instructions**

Please send the completed questionnaire to:

Arthur Breipohl  
Dept. of Electrical Engineering  
University of Kansas  
Lawrence, KS 66045

**MISCELLANY**

**MIL-HDBK-217 REVISED**

Revision C to MIL-HDBK-217 (Reliability Prediction of Electronic Equipment) has been completed. The document masters have been released by RADC to the Navy Publications and Forms Center, 5801 Tabor Ave., Philadelphia, PA 19120, for reproduction and dissemination.

This revision is based upon recently completed study contracts for the analysis of millions of hours of field operation reliability data, and provides changes to the following sections:

- 2.2 Discrete Semiconductors
- 2.5 Resistors
- 2.6 Capacitors
- 2.7 Inductive Devices
- 2.8 Rotating Devices (Motors)
- 2.9 Relays
- 2.10 Switches
- 2.11 Connectors
- 2.13 Connections

Other changes include the addition of new airborne environments for all sections of the Handbook to show the effects of equipment installation on long mission aircraft (transports and bombers) and on high performance aircraft (fighters and interceptors).

As in earlier versions of the Handbook, two prediction procedures, part stress analysis and part count, are provided as well as the equations for model variables for use in computer programming of the prediction procedure. These prediction procedures will be continually updated as new information becomes available. Work is now underway to develop reliability models for new parts which will be added to the Handbook when completed.

The Handbook is oriented toward reliability prediction of military electronic equipment; it provides a common basis for predicting and comparing predictions on military proposals and contracts.

For further information contact RADC Project Engineer L. Gubbins, 315/330-2951, Autovon 587-2951.

**CALL FOR PAPERS**

The Eighteenth Annual Spring Reliability Seminar has been scheduled for April 24, 1980. The Seminar will be hosted by the IEEE Boston Section Reliability Chapter. The theme of this year's Seminar will be "The Growing Dependence on the Assurance Sciences."

A Call for Papers is issued in the following broad topic areas:

- Reliability
- Maintainability
- Availability
- System Safety
- Integrated Logistics Support
- Life Cycle Cost/Design-To-Cost
- Reliability Improvement Warranties
- Software Reliability
- Human Factors Engineering
- Reliability Growth

Interested authors should prepare and submit an abstract of 300 to 500 words, accompanied with a biographical sketch, by November 30, 1979. Selected authors will be notified by December 28, 1979. Completed papers, suitable for reproduction in the Seminar Proceedings, will be required by March 14, 1980.

Abstracts and biographical sketches should be sent to:

Mr. Gary Kushner, Technical Program Chairman  
GTE Sylvania  
10-682  
66 "B" Street  
Needham, MA 02194

Questions concerning the Seminar may be directed to Mr. Edward L. Naas, Seminar Chairman, c/o RCA Corp., P.O. Box 588, MS-7-2, Burlington, MA 01803, or by telephone at (617) 272-4000, Extension 2327.



## POSITION STATEMENTS OF PRESIDENTIAL CANDIDATES

### Burkhard H. Schneider

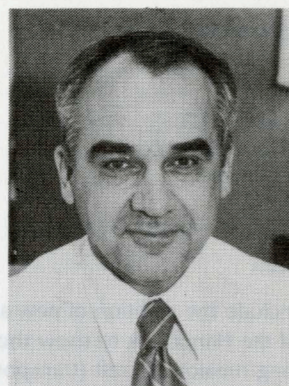
The IEEE is a pioneer among technical societies in the development of professional programs for its members. From our base of technical activities, we have built constructive, far-reaching programs in the professional area. The key issue now is balance. If we are to grow, we must emphasize both the technical and professional roles with meaningful cooperation between the two. Strong, competent leadership, at all levels of the Institute, is required to achieve future growth.

To assure prosperous and challenging careers for its members, the IEEE must participate with government decision makers in developing technically sound policies on vital issues, such as energy, R&D funding, and venture capital. This must be done in concert with many of the worthwhile existing programs which directly impact the work environment of our members. New efforts for portable pensions, as well as preparation for future changes in the job market, are required *now*.

The Institute's total effectiveness depends on its prestige as a scientific and technical organization. Our already strong technical programs must be vigorously pursued and expanded to provide greater service to the applications-oriented member. Also, we must recognize the close interrelationships between societal and technical problems.

The IEEE is a very democratic organization. We must continue to make every effort to listen to all points of view and respond to worthwhile suggestions. The fundamental objective is to keep the IEEE moving forward—financially healthy, with effective leadership, and with a good balance of technical and professional programs.

**Burkhard H. Schneider** is Vice President-Divisions of The Detroit Edison Company, Detroit, Michigan. In this position, he is responsible for the engineering, construction, and maintenance of the company's subtransmission and distribution system, as well as customer service, marketing, and the company's meter activities. Mr. Schneider's entire professional career has been with Detroit Edison, which he joined in 1949 after graduation with a B.E.E. degree from Cornell University. He has extensive experience in the area of power system planning, station and substation design, interconnection technology and administration, power system research and development, environmental affairs, as well as engineering of both nuclear and fossil power plants. After holding various supervisory positions, Mr. Schneider was appointed Director of the General Engineering Department in 1970 and Director of the Generation Planning and Research in 1974 and was named Asst. Vice President



in 1978. In April 1979, Mr. Schneider was named to the position of Vice President-Divisions. Mr. Schneider is a registered professional engineer in the State of Michigan.

**IEEE Activities—(S'43-M'50-SM'55)** OFFICES: Board of Directors, 1975-78; Secretary-Treasurer, 1975-76; Director Region 4, 1977-78. COMMITTEES: Ad Hoc Committee on Registration, 1977-78; Audit, 1975-76; Budget, 1973, Chairman 1974; Executive, 1975-76; Finance Chairman, 1975-76; Technical Activities Board, 1973; TAB OpCom, 1973; TAB Finance, 1973-74; Chairman, 1974; Investment, 1975-76; IEEE Employee, 1978-79; Chairman, 1979; Individual Benefits and Services, 1978-79; United States Activities Board, 1977-78; USAB Controller, 1978; USAB OpCom, 1978; Life Member Fund, 1975-76; IEEE Foundation Board, 1977-79; Treasurer, 1977-79; RAB Nominating, 1979. REGIONS: Region 4 Committee, 1977-79; Chairman, 1977-78; Region 4 Operating, 1977-79; Chairman, 1977-78; Region 4 Advisory, 1979; Region 4 Nominating, 1979. SECTIONS: Michigan: Director, 1954-57; Vice Chairman, 1957-58; Secretary-Treasurer, 1958-59; Chairman, 1959-60; AIEE/IRE Section Merger Committee, 1962; in addition, numerous Section committee offices during the period 1949-63. AIEE DISTRICT II: District Personnel Development Committee, 1960-62; District Executive Committee, 1958-60; CONFERENCES: 1961 AIEE Fall General Meeting. Hospitality; 1961 Cement Industry Conference, Treasurer; 1965 Summer Power Meeting, Vice Chairman. SOCIETIES/GROUPS: PES Council, 1965-71; PES General Meetings Committee, 1965-68; PES AdCom 1969-71; PES Finance Chairman, 1969-71; IEEE Representative to U.S. National Committee of the World Energy Conference, 1970-74.

### Leo Young

IEEE's prestige rests squarely on its technical excellence. Without first rate publications and technical activities the Institute is nothing. I would endeavor to maintain that technical excellence, encourage the dissemination of more practical information. As Author, Editor, Conference Chairman, Society President, Division Director, etc., I appreciate the extent of the problem.

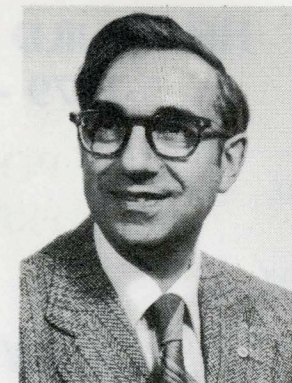
IEEE cannot ignore the bread-and-butter issues either—incomes, jobs, pension rights, etc. As Chairman of the Pensions Task Force for four years, Chairman of the Individual Benefits and Services Committee, Chairman of USAC (now USAB), etc., I have demonstrated my commitment to enhance engineering as a profession.

IEEE must interact constructively with governmental bodies, and provide the best possible technical inputs to our political decision makers. As an active contributor to IEEE's Technology Policy Conferences for several years, as spokesman for IEEE on technology and pension issues in and out of Congress, I feel we have only just begun. If elected, I would endeavor to implement *Phase III*: to integrate technical and professional activities to be mutually supportive, while making the Institute more responsive to our members' career needs, technical and otherwise.

IEEE members have a clear choice this year between very different candidates. The other candidate, has specialized in nontechnical positions (treasurer, controller, finance, real estate), whereas I have come up through the technical ranks. Compare our records and qualifications.

Whatever the outcome, IEEE will surely be the winner when there is a meaningful choice.

**Leo Young** earned his Doctorate in Electrical Engineering from the Johns Hopkins University, Baltimore, where he held the Lamme Scholarship. He also received honors degrees in physics and mathematics from Cambridge University, England. Before joining the Naval Research Laboratory in 1973, he was staff scientist and program manager of Stanford Research Institute (1960-73), and advisory engineer at Westinghouse (1953-60). He has lectured at universities in California, Maryland, New York, Washington, etc., and in several European countries, and plans to visit Japan. He is Navy liaison representative on the U.S. National Committee of URSI. His microwave filter designs are widely used in industry; he has published over one hundred papers, 20 patents and 14 books, won the IEEE Microwave Prize in 1963, and was elected Fellow in 1968. He helped start IEEE professional activities, has worked hard



for more rational pensions, and received the USAB citation of honor in 1978.

**IEEE Activities—(M'54-SM'56-F'68)** OFFICES: Board of Directors, 1979, 1971-74; Executive Vice President, 1979; Division IV Director, 1971-74. COMMITTEES: Antennas and Waveguide Standards, 1965-66; Computer Aided Design Analysis and Realizability, 1966-67; New Technical and Scientific Activities, 1966-67; Technical Activities Board, 1969, 1971-74; Standards Coordinating Committee 14 (Quantities and Units) 1970-79; Committee on Man and Radiation (COMAR), Chairman, 1972; Constitution, 1972; Nominations and Appointments, 1972-73, 1977; Long-Range Planning, 1977-78; United States Activities, 1972-74, Chairman, 1974; Pensions, Chairman, 1975-78; Individual Benefits and Services, Chairman, 1978; Technology Policy Conference, 1978-79; International Activities, 1979, Chairman. SECTIONS: Baltimore, AP/MTT Chapter, Secretary, 1959-60; San Francisco, MTT Chapter, Chairman, 1963-64; Washington, MTT Chapter, Executive Committee, 1973-1979. GROUPS/SOCIETIES: Microwave Theory and Techniques: Administrative Committee, 1965-72, Chairman, 1969, Vice Chairman, 1968; Transactions Editorial Board 1959-78; Operations, Chairman, 1970, Microwave Magnetics Standards, Chairman, 1969-70; Microwave Measurements Standards, Chairman, 1968-69; Technical Committees Coordinator, 1968-69, National Lecturer, 1968. Circuits and Systems: Optical, Microwave and Acoustical Circuits, 1977-79. CONFERENCE PROGRAM COMMITTEES: IEEE International Convention (now ELECTRO), 1968, 1977; International Microwave Symposium, 1963-80, Chairman, 1966; International Solid State Circuits Conference, 1968; IEEE/DoD Power Tube Conference, 1978; Antennas and Propagation Symposium, 1978. REPRESENTATIVE: European Microwave Conference, 1969-78; Joint Societies Employment Advisory Committee of California, 1971-72; Engineers and Scientists Joint Committee on Pensions, 1976-78.



IEEE Presidential candidate and current Executive Vice President Leo Young discussing an interesting point of Senate Bill S-1428, *The IRA-Employee Plan Coordination Act of 1979*, with Senator Alan Cranston of California, Congressman Jim Corman (Van Nuys, California), and former IEEE President John J. Guarrera. Senate Bill S-1428 was introduced on June 27 by Senator Cranston. Its companion bill HR-628 was previously introduced into the House on January 15 by Congressman Corman. IEEE has been pushing hard for these two bills through its Pensions Task Force, of which Bob Barden is this year's chairman while Leo Young was chairman from 1975 through 1978. The purpose of the two bills is to legislate the LERA (the Limited Employee Retirement Account). LERAs would benefit employees who are not vested in their employer's pension plan, as well as employees covered by poor plans, by allowing them to contribute to their own tax deferred pension plan similar to an IRA (Individual Retirement Account).



# HELP BUILD OUR PROFESSIONAL SOCIETY 1979 – GOAL – 8% INCREASE

*What's New In  
Reliability &  
Maintainability?*

*Questions About  
Reliability of  
Electronic Devices?*

## TRY RELIABILITY SOCIETY!

Fellow Reliability Society Members,

Please tear off the application for IEEE and Reliability Society membership and give it to an acquaintance who should be a member but who could never find an application.

Note the 50% reduction due to the half-year left in '79.

Thank you in advance.

*Thomas L. Fagan  
Membership Chairman*

IEEE Service Center  
Attention: Member Services  
445 Hoes Lane  
Piscataway, NJ 08854

NEWSLETTER/ Oct., 1979

- Yes—please renew by membership in the Reliability Society.
- I am presently an IEEE member—enclosed is a check for \$7.00 for the Reliability Society.
- My IEEE membership also has lapsed—enclosed is a check to cover IEEE membership (\$55.00 in US, \$52.00 in Canada) and Reliability Society membership (\$7.00).

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

IEEE Membership No. \_\_\_\_\_

Send Form 3579 to IEEE, 445 Hoes Lane, Piscataway, N.J.08854

