Reliability Society Newsletter

Editors: Gary Kushner and Mark Snyder

Vol. 36, No. 1, January 1990 (USPS 460-200)

Invitation To RS Members Attending RAMS

Dear Reliability Society Member,

You are invited to attend the IEEE Reliability Society ADCOM (Administrative Committee) Meeting to be held on the Monday (January 22) before the RAM Symposium. The meeting will start at 1:00 in the Biltmore Hotel, Los Angeles, CA. You will meet your President Bernie Bang and the rest of the Society officers. If you are a member of the Reliability Society and are at the Symposium, please come join us.

Bernhard Bang
President IEEE Reliability Society

ADCOM Meeting/Annual Awards Dinner

Past presidents of the Reliability Society honored at the October Adcom meeting. From L to R: Val R. Monshaw, Thomas L. Fagan, Bernhard Bang (President), Harry E. Reese, Naomi J. McAfee, Alan O. Plait, J. W. Thomas.

The Reliability Society AdCom held its Annual Awards Dinner in conjunction with the meeting in Ellicott City, Maryland on Oct. 19 and 20, 1989. The Society commemorated its 40th anniversary by honoring its past presidents. In addition, a very special 40th Anniversary Song was written and performed by Howard Kennedy and J. W. Thomas. The lyrics are published in this issue of the Newsletter.

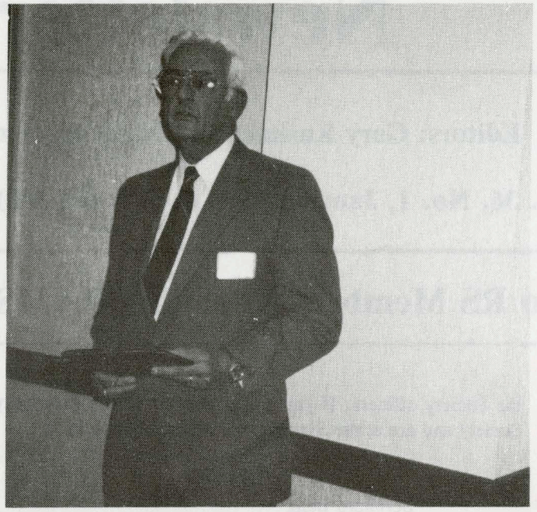
Also, the Chapter Awards Committee Chairman, Dale Butler, announced the results for the 1988–1989 year:

Place	Chapter
1	Denver
2	Boston
3	Washington/Northern VA
4	Philadelphia
5	Cleveland

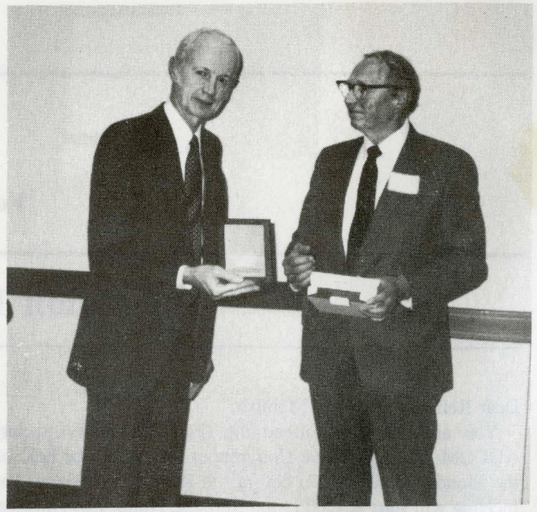
The responses included information on chapter activities, technical publications, and membership growth. Bob applauded the efforts of each participating chapter and the thoroughness and completeness of their responses.

The winning chapters and their chairmen are shown. The AdCom congratulates you and your officers for outstanding efforts on behalf of our members.

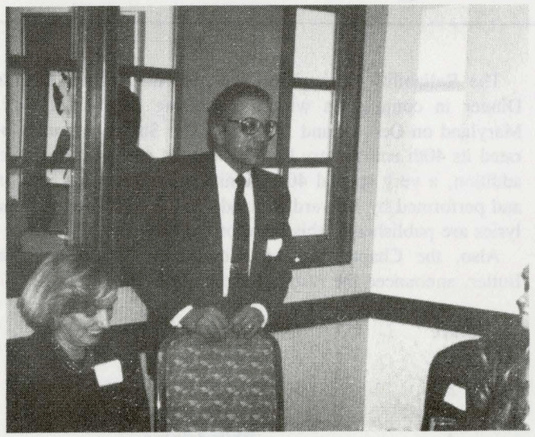
ADCOM Committee Honoring of Past Presidents and 40th Anniversary



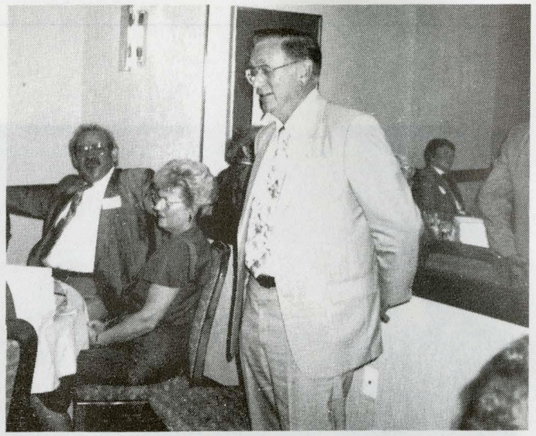
Howard Kennedy begins the Past Presidents Recognition Ceremonies.



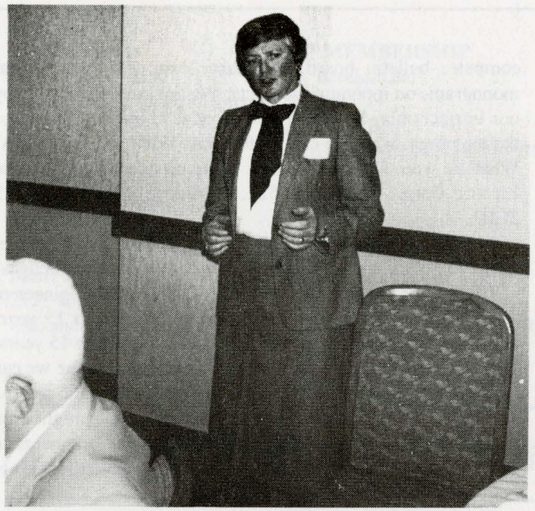
Harry Reese (President, 1969–1970) accepts plaque from Bernhard Bang.



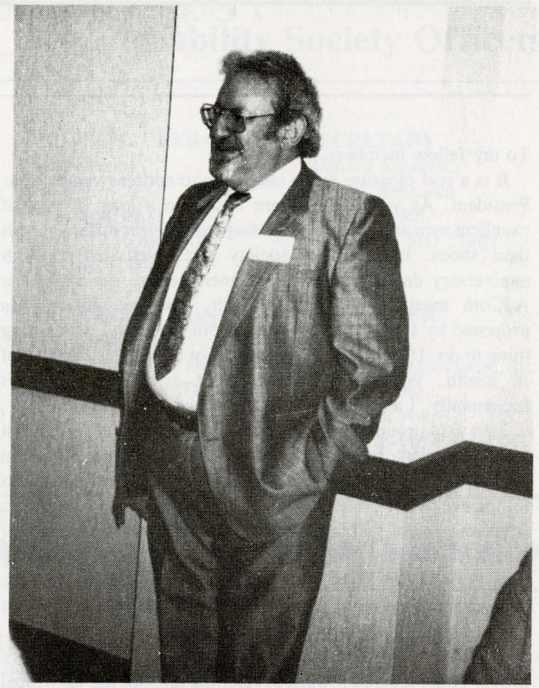
Val Monshaw (President 1971–1972)



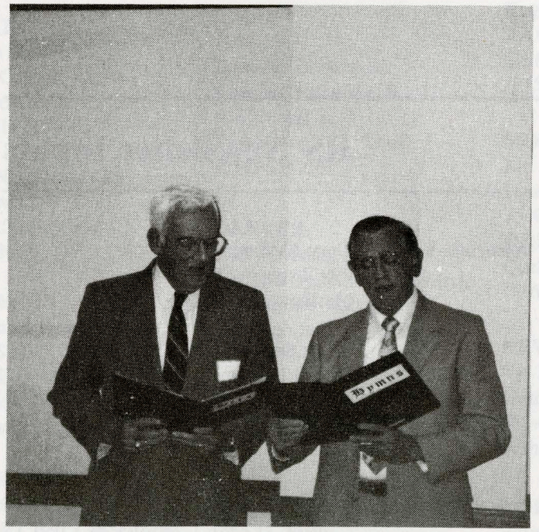
J. W. Thomas (President, 1975–1976)



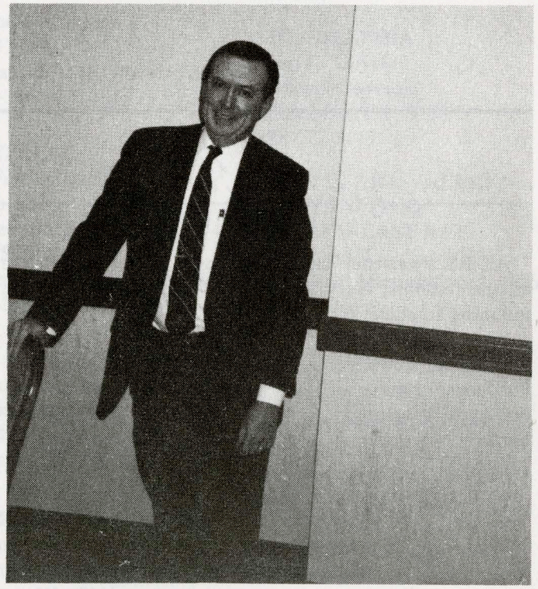
Naomi McAfee (President, 1983–1984)



Alan Plait (President, 1985–1986)



Howard Kennedy and J. W. Thomas perform that old sentimental tune, "Reliability Group 40th Anniversary Song."



Tom Fagan (President, 1987–1988)

President's Message

To my fellow members,

It is a real pleasure and a challenge to address you as your President. As you know, there has been a long history of excellent men and women preceding me and is it difficult to fill their shoes. In fact, our society just celebrated its 40th anniversary during the normal dinner meeting preceding the AdCom meeting on October 20th. The celebration was proposed by Dr. Victor Wonk, our 5th president, as a fitting thing to do. Unfortunately, he could not be with us because of ill health. We wish him well and a speedy recovery. Incidentally, I am the 18th president (there is a long list!).

I am very proud of our society and the things it is doing. Just look at the many fine publications you receive. Not all of them contain exactly what each of you is looking for, but there is a lot for everyone! I have been reading through the proceedings from the latest "Reliability and Maintainability Computer Aided Engineering Workshop." It is great that we are doing this. Your society started this and continues to support it. This is an example of recognizing a challenge and meeting it—not without a lot of planning and hard work, however.

This brings up another subject, my agenda for my term of office. I plan to work toward developing aids for the individual Reliability and Maintainability engineer to better serve his/her advancement through education and appreciation of the reliability function. We (the AdCom) are thinking of a computer bulletin board, videotape loan, and instructional monograms on individual subjects. We are moving, guided by our instinct only. Wouldn't it be wonderful to hear from you, the members, what we can do for you? What are your ideas? What do you want us to do? Write to me: Westinghouse Electric Corp., P.O. Box 1521, Baltimore, MD 21203, MS 3G07.

Alternatively, call me: (301) 765-7340, or fax it to me: (301) 765-5070, anyway you wish! What are your challenges?

This brings me to a new subject. The R & M engineer of today's tasks are different compared to those 10 to 15 years ago. The change will be even greater in the next 5 to 15 years. How about giving me your ideas and concerns. Maybe we can get a dialog going, published in the newsletter for all to see and discuss. Don't be afraid to express your views. We might even learn something that would allow us individual engineers to prepare for the future and for the AdCom (heaven forbid) to help you.

Thank you for your support.

Bernhard A. Bang

RS Newsletter Inputs

All RS Newsletter inputs should be sent to one of the associate editors, **Gary Kushner** or **Mark Snyder**, per the following schedule:

For October Newsletter:	by July 25
For January Newsletter:	by Oct. 25
For April Newsletter:	by Jan. 25
For July Newsletter:	by Apr. 25

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Presidents of the Reliability Society 1950–1984

	R. F. Rollman	1950–52
*	Leon Bass	1952–54
	Victor Wouk	1954–58
*	P. K. McElroy	1958–61
*	L. J. Paddison	1961–64
	Marion P. Smith	1964–66
	Ed F. Jahr	1966–68
—	Harry E. Reese	1969–70
—	Val R. Monshaw	1971–72
	C. Ray Knight	1973–74
—	J. W. Thomas	1975–76
*	Joe J. Naresky	1977–78
	T. L. D. Regulinski	1979–80
	Carl M. Bird	1981–82
—	Naomi J. McAfee	1983–84
—	Alan O. Plait	1985–86
—	Thomas L. Fagan	1987–88
—	Bernhard A. Bang	1989–90

* Deceased
— attended 40th Anniversary Dinner.

Reliability Group 40th Anniversary Song

To be sung to the tune of "Dearie (You're much older than I)"

VERSE I

Dearie, do you remember back to Nineteen and Forty-Nine?
The first year in Reliable time.
Harry Truman sat in the White House,
We had won the big war—

Or we thought we had, my dearie,
Do you recall when Japanese rode in Chevrolets
The TV market was RCA's,
The Yankees beat the Dodgers,
Sammy Baugh was flying high.
Do you remember? If you remember, well, Dearie,
You're much older than I.

VERSE II

Dearie, do you recall when we learned sine waves were Ripplely,
And there was no I triple-E.
We used slide rules—Had no computers,
Software was just lingerie.

Test your memory, my Dearie,
Do you recall when vacuum tubes were our pride and joy,
Transistors only a kind of toy,
ICs were unheard of,
And chips were served with fish?
Do you remember? If you remember, well,
You're older than you might wish.

VERSE III

Dearie, do you remember when the engineer had I-squared Rs,
The statistician, confidence bars?
We did our thing, they did their own,
We never thought we would meet.

Test your memory, my dearie,
Do you recall when we thought Kolmogorov and Smirnov was
A vodka drink that would give us a buzz?
Regressing was depressing,
But we loved E, R, and I.
Do you remember? If you remember, well, Dearie,
You're much older than I.

VERSE IV

Dearie, do you recall when we first used probabilities,
A way to state the vagaries
Of failures, fixes, graceful degrading?
Now we have a new tool.

Test hypothesis, my dearie,
Was that a constant lambda fit ev'ry kind of part,
The exponential we took to heart
But Dearie, we were leery
'Cause we knew that things wore out.
We used a bathtub to fix the math flub,
Archimedes', no doubt.

VERSE V

Dearie, do you recall when folks like Rollman, Wouk, P.K., and Bass found they had a critical mass,
Formed a Group to share information
In the old IRE?

Test your memory, my Dearie,
Do you remember that the Group aimed at QC then
Forty years prior to TQM?
Those guys were indeed wise,
R&M they next would try.
Do you remember? If you remember, well, Dearie,
You're much older than I.

VERSE VI

Dearie, remember other Chairmen—Paddison, and Smith and Jahr, Harry Reese and Val Monshaw,
Ray Knight and our tenor, Bill Thomas,
Joe Naresky, Carl Bird?

Then we had Thad Regulinski,
And from the distaff side, Ms. Naomi McAfee,
Alan Plait was the next we'd see,
Fagan served with Reagan,
And now it's Bernie Bang.
Do you remember? If you remember, well, Dearie,
You're just one of the gang.

VERSE VII

Dearie, it's been a "warm and human" first forty years for all
Who answered to the "ility's" call.
Hail to members, both old and recent
They made the group what it is.

Rest you memories now, Dearies,
And raise your glasses in a toast to this awesome bunch
And join us in the hopeful hunch
That we'll do many great things
And a steady course we'll keep.
We'll say good night now, and leave you right now
'Cause the old folks are falling asleep.

Chapter Inputs

Denver Chapter

The October meeting was on Software and Hardware Reliability: Contrasts, Comparisons, and Integration. Sam Keene and Rick Follenweider led the discussion.

Concurrently, we held our 17th consecutive monthly meeting on software R & QA. The October S/W meeting was Managing Software Test Operations.

On the personal side, a couple of the key leaders in the Denver Chapter lost their jobs. The Denver Chapter network has provided a lot of support and we are pleased to say that both members found better job opportunities on a timely basis.

Cleveland Chapter

The Cleveland Chapter has had two good meetings so far in the '89-'90 activities:

1. Our first meeting was on Neural Networks. A video conference on neural networks was held at NASA on Sept. 27, 1989. The purpose of the conference was to address a broad spectrum of neural network issues. Feature speakers included Dr. James Anderson of Brown University, Tom Schwartz of Schwartz Associates, and Dr. Bernard Widrew of Stanford University. The conference was jointly sponsored by NASA and the composite chapter of R-07, IM-09, IE-13, and EMB-18.

2. Our second meeting was Reliable Industrial Power Systems. This meeting was part of the Distinguished Lecturer Program being setup in Cleveland. The meeting was joint with the Cleveland Section and IAS.

Our distinguished speaker was Mr. Dan Lave. Dan is an independent consultant specializing in system design and protection for electric utility and industrial applications. He was chief electrical engineer for Bechtel Power Corporation in Western Europe working on several nuclear power plants. This was a special treat for our Reliability Group.

We plan to have three more meetings:

Date	Topic	Coordinator
11/23/89	Mid-year Social	Yuhas
3/16/90	''Space Station Power''	Diedrich
4/7/90	''Reliability Growth''	Bream

We are still working on getting the RAMs meeting in Cleveland.

A special committee has been set up to study our home study membership development course. We will try to keep this project moving.

All in all, here in Cleveland we are having Fun serving our members and look forward to expanded activities in the future.

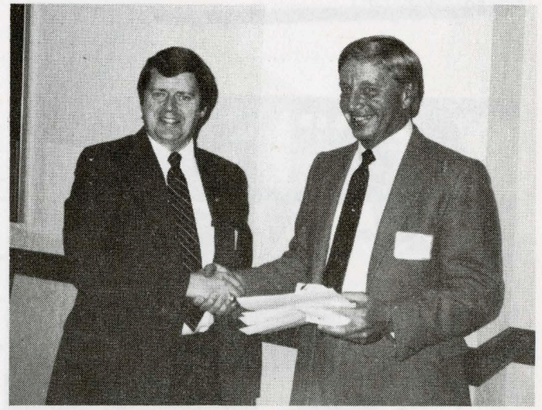
Boston Chapter

The Boston Section has continued their busy schedule with the traditional October Chapter meeting at the Hanscom Air Force NCO club. The speaker at this meeting was Mr. John Gaudet, Consultant and Instructor in Total Quality Tools and Practices, who spoke on the subject ''DOD's Total Quality Management Initiative—What is its Impact?'' This dinner meeting was enjoyed by 46 active participants. In place of the November Chapter meeting, the Boston Section is presenting its annual Fall lecture Series. This year the subject is, ''Reliability Mathematics'' and is being presented in 4 sessions over a 6 week time frame. Avery Hevesh, a Principal Engineer at Raytheon is the lecturer.

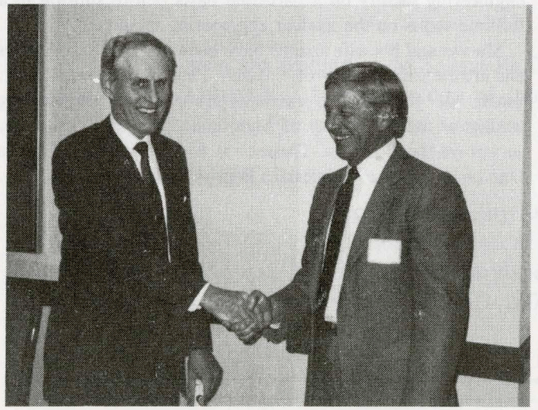
As a new service to the members of the New England Reliability Council, the Boston Reliability Chapter continued with the Technology Development (TD) Workshops. During this activity year there have been two meetings, one in September and one in October. The September TD workshops focused on the subject of PC Tools for RMA. Several members made presentations on their experiences designing, tailoring, and utilizing PC Programs. The October TD workshop was a general meeting to discuss and identify common areas of interest to the participants. The identified interest areas will be used to plan subsequent TD workshops.

Chapter Awards

Dale Butler, Chapters Committee (right), and Juan Hernandez, Denver Chairman, accepting First Place Award.



Don Simpson (left) accepts Second Place Award for Boston Chapter on behalf of Jane Cabral, last year's chairperson.



William Breslyn, Washington/Northern Virginia Chairman, accepts third place.

Annual IEEE Reliability Society Award

The Annual IEEE Reliability Society Award is presented each year to an individual who has made significant contributions in the field of reliability. These contributions can be in the areas of scientific development, professional achievement, or management. Selection of the winner is based on the overall impact of his or her contribution on the advancement of reliability theory, education, engineering, or its management. The award is presented at the Reliability Society awards function in January each year.

The recipient of the 1989 Annual Award is Dr. Marvin Roush. This award has been presented to Dr. Roush for enhancing Reliability Education, creating the ''Center for Reliability Education'' at the University of Maryland, and helping to bridge the gap between the University and Industrial environments.

Dr. Marvin Roush with Fran Lorin, one of the graduate students in the Reliability Engineering Program at the University of Maryland.

Marvin L. Roush is a professor at the University of Maryland where he has been on the faculty since 1966. He is currently Director of the academic program offering M.S. and Ph.D. degrees in Reliability Engineering and has been Director of the Center for Reliability Engineering since 1985.

Dr. Roush is currently a member of the editorial board of the *Reliability Engineering and Systems Safety* journal and a member of the Aerospace Industries Association taskforce on Ultra-Reliable Electronic Systems. He was the representative of the IEEE Reliability Society to the IEEE Technical Activities Advisory Committee during the 1986–87 period.

Marvin Roush was a member of the ASQC panel for the National Educational Quality Initiative Conference in 1989. In 1988, he was the recipient of the Austin T. Bonis Award given by the Reliability Division of ASQC.

Dr. Roush received his B.S. degree from Ottawa University and the Ph.D. degree from the University of Maryland, both in physics. He then spent a year at the Los Alamos National Lab in New Mexico as a faculty member of Texas A&M University before joining the faculty in physics at the University of Maryland. In the early 1970s, he joined the engineering faculty on a part-time basis before shifting to a fulltime status on the nuclear engineering faculty.

Marvin and his wife Joanne have been married for 34 years and are the parents of three children: Paul, Brenda, and Mark. Mark, the youngest, is currently an electrical engineering student at the University of Maryland. Dr. Roush currently serves on the Board of Trustees at two institutions, Ottawa University and the Midwestern Baptist Theological Seminary.

Initiatives in Technical Operations

The Technical Operations area would like to find ways to meaningfully take initiatives that better meet the technical needs of our membership, enhance the professionalism of reliability members, and advance the state of our knowledge in Reliability and Maintainability. Some initial thoughts.

- Build a working group of committees in each technical focus area
- Develop a working paper on each area
- Publish survey articles in the newspaper or transactions
- Invite more interaction of the general membership with technical focus leaders via the newsletter
- Establish bulletin boards at IEEE to encourage dialogue in key focus areas
- Host a working group, workshop, or conference on focus activities
- Coordinate a special issue of the transactions on a focus area

The purpose of the Technical Operations Committees is to promote dialogue and development within the committees of the topical area. If you have suggestions as to R&M technical needs and/or you would be interested in participating with a Technical Operations Committee, please contact:

Dr. Samuel J. Keene
IBM
TR4/003C
Boulder, CO 80302
(303) 924-7711
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Questionnaire Results

Mechanical Reliability Committee

IEEE RELIABILITY SOCIETY

12 October 1989

COMMITTEE MEMBERS:

Bernhard Bang	Samuel Keene	Richard Doyle
James Raze	Douglas Holzhauer	Chuck Hamstra
Ken Blemel	Bruce Blackford	David Weis

INTRODUCTION:

The committee responded exceptionally well to the Mechanical Reliability Questionnaire that was sent out in the spring of 1989. The results are enlightening and at the same time indicate tasks which are both urgent and necessary for the benefit of the IEEE Reliability Society and the electronics industry. There are many tasks outlined and the goals are extremely high. However, by approaching the task in an organized manner and scheduling tasks we should make great headway in the various topics listed below.

In addition to the results of the questionnaire there is also a section which lists some reliability theories that were mentioned in the responses; a section that lists some of the biographies; and a section that summarizes the immediate tasks.

QUESTIONNAIRE RESULTS: The results were received from six of the committee members and the information was tallied and ranked in order of highest priority to lowest priority. The following will give a brief summary of the question and a ranking of the responses.

Question 1—What mechanical failures should this committee consider?

Answer—1. Cyclic loading (thermal)
2. Thermal stresses (max/min)
3. Fatigue stress (mechanical)
4. Aging and thermal aging
5. Mechanical shock loading
6. Mechanical stresses steady-state loads.

Question 2—What electrical mechanical components are we most concerned with?

Answer— 1. ICs
2. Connectors
3. Power semi-conductors
4. Wiring harnesses
5. Circuit boards, card guides, attaching structure
6. Relays
7. Low-power semi-conductors
8. Magnetic devices
9. Motors and rotating equipment
10. Switches
11. Capacitors and resistors
12. Chassis structure
13. Mounting brackets and attachment parts.

Question 3—Should we determine parametric relationships for various mechanical failures?
Answer—60% say no.

Question 4a—Should we use mechanical failure prediction models generated by others?
Answer—See section on theory at the end of this report.

Question 4b—List popular mechanical prediction models:
1. EPRI
2. British Mod.
3. NASA fatigue studies
4. Hughes life predictions
5. Eagle Technologies-Fort Bellvoir
6. GE Reliability Study (two volumes)

Question 5—Should we include radiation hardening of electronics as an environmental parameter?
Answer—85% said yes.

Question 6—(Answer)
We should study ''on/off'' wear-out versus the ''on all of the time'' failure rates. This theory will define the hours of life removed from the electronics each time the switch is cycled on and off.

We should develop costs/benefit models for this condition. There was a unanimous response in favor of this study.

Question 7—(Answer)
The committee should meet at least once a year. Two recommended meetings are likely candidates. These are the reliability and maintainability symposium and/or the reliability physics symposium. The following is the schedule of these meetings:

1990 Annual Reliability and Maintainability (R&M) Symposium will be held at the Biltmore Hotel in Los Angeles on January 30 through February 1, 1990.

The 1990 international Reliability Physics Symposium will be held at the New Orleans Marriott Hotel on March 26 through 29, 1990.

The preference was expressed to be in conjunction with the R&M Symposium. Therefore, this will be the first meeting of the subcommittee (just prior to the symposium).

Question 8—(Answer)
The committee should publish guidelines for Mechanical Reliability of Electronic Components. Again, this was a unanimous response. The guidelines should include derating criteria, design rules, and methods for estimating the probability of failure. Also we should provide guidance for the CAD (computer aided design) tools.

Question 9—(Answer)
The committee should publish biographies of Mechanical Reliability models so that we might review the models that are available. A unanimous response in favor of this.

Question 10—(Answer)
This committee should work with other societies, however, we should first outline our tasks, goals, and get started before contacting and working with the other societies. Some of the societies include the ASME, the SAE, the AIAA, and government organizations including NASA, NSF, DOD including the center for computer aided acquisition and support (CALS).

Question 11—(Answer)
This committee should assist in developing failure models for
1. The physics/physics affects
2. Screening tests
3. Derating criteria
4. Developing failure models for design processes and standard methods for failure prediction
5. Review and compare present information on mechanical reliability
6. Develop reliability and maintainability information on spinning data (disk storage).

Question 12—(Answer)
This committee will be most effective in:
1. Sponsoring tutorials
2. Chairing mechanical reliability sessions
3. Reporting on new technologies related to:
   a. packaging
   b. spacecraft
   c. surface mount technology

4. Establishing mechanical reliability requirements for national quality awards
5. Recommending mechanical reliability requirements for government contracts
6. Recommending mechanical reliability requirements for DOD-CALS (computer aided acquisition and logistics support)
7. Reviewing government, industry, and academic studies on mechanical reliability.

Question 13—(Answer)
This committee will be least effective in:

1. Testing and generating test data
2. Performing studies
3. Generating reliability and maintainability tools and formulas
4. Developing standard cost techniques

Question 14—(Answer)
Activities to be performed over the next two years include:

1. In-depth literature searches
2. Survey methods for mechanical reliability prediction as applicable to electronic devices
3. Publish summary reports and recommend further research
4. Define mechanical failure prediction and how it fits electronic reliability prediction
5. Generate biographies
6. Provide comparisons of existing works
7. Guidelines for formulation of a electro-mechanical Mil. Handbook or an addendum to Mil. Handbook 217
8. Chair conference sessions on electro-mechanical reliability
9. Sponsor tutorials on electro-mechanical reliability
10. Develop a charter for the mechanical reliability committee of the IEEE Reliability Society
11. Sponsor a symposium
12. Provide national quality award recommendations

THEORIES:
Several theories were generated by the people that were answering the questionnaire. Some of these theories are listed as follows:

1. Develop a criteria where the designer may design with a ''what if failure'' in mind.
2. Design to optimize part operating life.
3. Develop design rules.
4. Statistical methods for reliability prediction include:
   a. SN curves (Moody diagram)
   b. cumulative damage
   c. stress strength interference curves
   d. extreme value statistics
5. Develop specifications for failure rate predictions.
6. Persuade design engineers to think about probability of failure in their design.
7. Develop methods for estimating probability of failure.
8. Develop public guidelines for electrical mechanical reliability including derating criteria.
9. Develop a mechanical reliability model with cost and availability.

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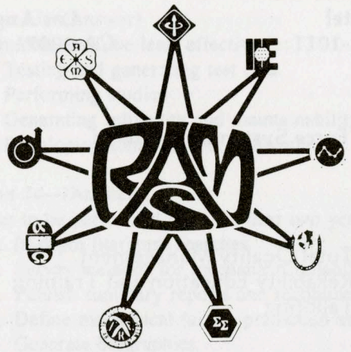

THEME

Product Assurance Progress Report

- Total Quality Management
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- TESTING FOR RELIABILITY
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TQM Analysis Training Text Produced by RADC

The Systems Reliability and Engineering Division of the Rome Air Development Center has written a training text on analysis methods useful in Total Quality Management (TQM) activities. The text describes the creation and use of Process Flow Charts, Ishikawa (Cause and Effect) Diagrams, Statistical Process Control Charts, Histograms, Pareto Charts, Scattergrams, and the Shewhart Cycle. A simple example of Statistical Design of Experiments is also provided. The techniques described are frequently mentioned in the TQM literature, but seldom discussed in depth. The text attempts to provide practical instruction in their use, and, to aid comprehension, describes the techniques via a mythical scenario in which they are introduced to an untrained but willing manager.

The text is titled "An RADC Guide to Basic Training in TQM Analysis Techniques." Copies may be obtained from:

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RELIABILITY CHAPTER
CENTRAL NEW ENGLAND COUNCIL
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CALL FOR PAPERS

The Twenty-eighth Annual Spring Reliability Seminar has been scheduled for April 19, 1990. The seminar will be hosted by the IEEE Boston Section Reliability Chapter. The theme of this year's seminar will be

"Reliability Trends: Calculation versus Application Today and Tomorrow."

A call for papers is issued in the following broad technology and management topic areas:

- Reliability
- Maintainability/Supportability/Testability
- Availability
- System Safety
- Integrated Logistics Support
- Life Cycle Cost/Design-to-Cost
- Reliability Improvement Warranties
- Software Reliability/Quality Assurance
- Human Factors
- Reliability Growth
- CAD/CAE/CAL/CAM/CAT

Interested authors should prepare and submit an abstract of 300 to 500 words, accompanied with a biographical sketch, by February 5, 1990. Selected authors will be notified by February 16, 1990. Completed papers, suitable for reproduction in the seminar proceedings, will be required by March 9, 1990.

Abstracts and biographical sketches should be sent to:

Ruth Evans
Data General Corporation
4400 Computer Drive
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Questions concerning the seminar may be directed to
Ruth Evans at (508) 870-7828 or Sid Gorman (508) 440-4149

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March 26-30, 1990 (Monday through Friday Morning)

in Los Angeles

This course is believed to be the only course in existence that brings the latest R&M technology to its participants.

Overview: This course is tailored to the forward thinking design, reliability, maintainability and system engineers. It presents the the latest theories and practices in R&M engineering and the related "ilities" that have emerged in the last few years. Basic R&M practices are briefly reviewed, and new theories that resolve current erroneous practices and conflicts are discussed, including the Universal Flaw Theory, the Roller-Coaster Curve (replacing the standard bathtub curve), and the unending aging theory for stress screening. Other topics include: reliability prediction beyond Handbook 217; graphical Weibull prediction with test data; relationship between predictions, screening, growth, and demonstration; reliability development growth test vs. reliability qualification tests; new customer requirements and the Air Force Avionics Integrity Program; problems with and solutions for software reliability models; software test adequacy and new test techniques; designing for hardware testability; fault tolerance/masking/recovery techniques; methods for test generation and partitioning; prognostics vs. diagnostics for maintainability; the variability problem in maintenance; zero maintenance systems; stress screening vs. longer run process controls; and Taguchi Off-Line approach. This course makes use of case studies, examples, and interactive discussions of concepts and ideas to clarify the material covered.

Lecturers: Irving Doshay, Allan S. Golant, Gene Lee, Myron Lipow, John G. Malcolm and Kam L. Wong. These lecturers are pioneers in their specialty areas. Most lecturers have over 25 years of industrial experience. Three are authors of reliability books. Two received P.K. McElroy awards for best papers presented at the Reliability and Maintainabilty Symposia.

Units: 3.0 CEU

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DATE	CONFERENCE	PLACE	CONTACT
1990			
Jan. 23–26	1990 Annual Reliability and Maintainability Symposium	Los Angeles, CA	V. R. Monshaw RCA Corporation Astro-Electronics P.O. Box 800 MS 55 Princeton, NJ 08540 (609) 426-2182
Mar. 26–29	1990 International Reliability Physics Symposium	New Orleans, LA	Alfred Tamburrino Member, Board of Director RADC/RBRP Griffiss AFB, NY 13441 (315) 330-2813
CALL FOR PAPERS			
Apr. 19	28th Annual Spring Reliability Seminar	Framingham, MA	Ruth Evans Data General Corp. 4400 Computer Dr. Westboro, MA 01580 M/S F017
June 5–8	International Symposium on Reliability and Maintainability	Tokyo, Japan	ISR&M 1990 Tokyo Union of Japanese Scientists and Engineers 5-10-11 Sendagaya, Shibuya-Ku, Tokyo 151 Japan
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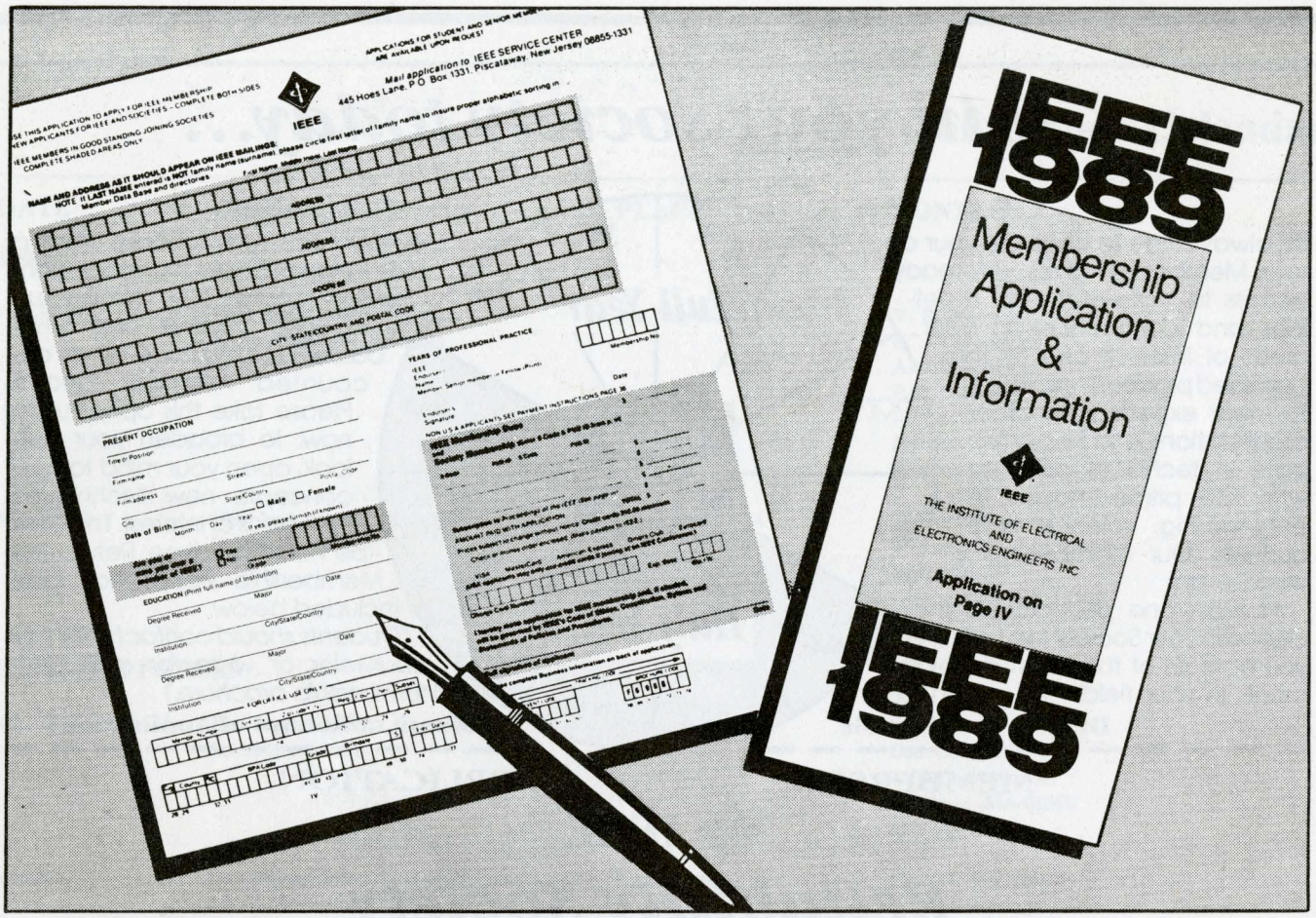
June 12–15	17th Inter-Ram	Hershey, PA	Mr. Roy R. Fray Technical Program Chrmn. SAIC, Suite 1250 160 Spear St. San Francisco, CA 94105 (415) 855-2441
1991			
Jan. 29–31	Annual Reliability and Maintainability Symposium	Orlando, FL	V. R. Monshaw RCA, Astro-Electronics P.O. Box 800 MS55 Princeton, NJ 08540 (609) 426-2182
Apr. 8–11	1991 International Reliability Physics Symposium	Las Vegas, NV	Alfred Tamburrino Member, Board of Director RADC/RBRP Griffiss AFB, NY 13441 (315) 330-2813
Sep. 24–26	1991 IEEE Autotestcon	Anaheim, CA	Robert C. Rassa Mantech Advance Systems International 150 S. Los Robles Ave. Suite 350 Pasadena, CA 91101



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