Reliability Society Newsletter

Editor: Susan Eames
Vol. 30, No. 2, April 1984 (USPS 460-200)

President's Report

Naomi McAfee
President

It has been a good year for the society. Membership has increased by over 5%, a new chapter has been formed in Tokyo and a joint chapter, in conjuction with the Instrumentation and Measurement and the Power Engineering Society, has been chartered in Ottawa. The Denver Chapter received the Outstanding Chapter Award. the Central New England Chapter was second and the Washington/Northern Virginia Chapter was third.

New Society brochures were designed and printed and the efforts to develop a home study course have almost come to fruition. The Technical Committees have continued to represent the Society in an outstanding manner and to develop significant positions and documents. One of the most oustanding of these was the "Status of Reliability Technology."

Two outstanding symposia were held: "Annual Reliability and Maintainability Symposium" and "The Reliability Physics Symposium." Publications continued to be published on schedule and a special edition of the *Transactions* addressed Reliability management.

A history is being compiled as part of the IEEE Centennial Celebration. Research has unearthed the facts that the Society has gone through five changes in names and is the only society with a song.

The Awards Committee completed its deliberations and chose an Outstanding Recipient, Dr. Charles F. Hall, who headed the NASA Pioneer Program. The outstanding reliability and the scientific contributions of the Pioneer Space Probe have been truly extraordinary.

Two of our members were elected fellows: Dr. Thaddeus L. Regulinski and Dr. R. J. Van Overstraeten. Dr. Regulinski is the Sr. Past President of the Society and continues to serve in many ways.

Financially we have remained healthy due to the vigilant attention of our Treasurer. He states that he has little control over the situation but does his utmost to anticipate the machinations of IEEE Headquarters.

This has been a very successful year for the Society due to all of the support and efforts of all of the officers: Messrs. Bird, Coppola, Fagan, Feigenbaum, Malec, Plait, Regulinski, and Shumaker. They and their outstanding committees have made the job of President very easy. I thank them for their outstanding support and look forward to working with them throughout 1984.

RS Newsletter Inputs

All RS Newsletter Inputs should be sent to the Editor, Gary Kushner, 499 Brigham Street, Marlboro, MA 01752 per the following schedule:

For October Newsletter: by July 15
For January Newsletter: by October 15
For April Newsletter: by January 15
For July Newsletter: by April 15

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IEEE RS Newsletter
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Reliability Society Newsletter is published by the Reliability Society of the Institute of Electrical and Electronics Engineers, Inc. Headquarters: 345 East 47th Street, New York, NY 10017. Sent automatically and without additional cost to each member of the Reliability Society. Printed in U.S.A. Second-class postage paid at New York, NY and at additional mailing offices. **Postmaster:** Send address changes to Reliability Society Newsletter, IEEE, 445 Hoes Lane, Piscataway, NJ 08854.

Chapter Reports

Chicago

The current Chicago Chapter's Officers are as follows:

Chairman: **Arun K. Hundiwal**
TRW Eagle Controls Division
1405 W. Fullerton Ave.
Addison, IL 60101

Vice Chairman: **Warren R. Foxwell**
522 N. Home Ave.
Park Ridge, IL 60068

Secretary: **Rod Garcia**
Electrodynamics
1200 Hicks Road
Rolling Meadows, Il 60008

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Program Chairman: **Hugh C. Edfors**
Rel Tek Engineering Assoc.
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Naperville, IL 60540

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Beltone Electronics Corp.
4201 W. Victoria St.
Chicago, Il 60646

Publicity Chairman: **Ray Schirmer**
Electrodynamics
1200 Hicks Rd.
Rolling Meadows, IL 60008

The following is the schedule of IEEE Reliability Society of Chicago's next three meetings:

March 28, 1984:
Topic: I.C. and Discrete Semiconductors Failure Analysis
Speaker: *Hugh C. Edfors,* Rel Tek Engineering Assoc.

April 25, 1984: (Jt. with Electron Devices Society)
Topic: Power Interface I.C. and their Reliability Effects
Speaker: *Mark Heisig,* Manager, Application Engineering Interface Products, Sprague Semiconductor Div.
Place: Luis', Addison, Illinois

May 30, 1984:
Topic: Reliability of Hybrid Circuits
Speaker: To be announced

IEEE Centennial Medal Winner. Chicago Section will be awarding the IEEE Centennial Medal to Mr. Hugh C. Edfors of the Reliability Society, at the Recognition Dinner to be held on April 28, 1984. The medals are being awarded to commemorate the Institute's 100th Birthday. Mr. Hugh Edfors was nominated on the basis of his services to the IEEE Reliability Society.

Cleveland Chapter

The Cleveland Chapter is having a good year. We plan to have 5 meetings:

Date	Topic	Coordinator
10/4–5/83	CECON '83	Lapine
11/17/83	Radiographic Inspection	Lalli
2/18/83	Dinner/Theater Social	Shepard
3/15/84	Data Acquistion	Tath
4/19/84	Instrumentation	Peabody
5/17/84	Space Station	Kiessling

Several papers for the Transactions are in the mill. Six AdCom members have reviewed our home study course. Kam Wong has prepared Chapter 1. Hank Malec is incorporating the reviewer comments into Chapters 7 and 8. Vince Lalli is caring for the rest. Naomi McAfee is negotiating with John Wilhelm for the RS contractual agreement for the course. We plan to mention in Table 1-1:

Date	Event
July, 1949	Formation of the Professional Group on Quality Control
July, 1955	Formation of the Reliability and Quality Control Society
Sept, 1978	Formation of the IEEE Reliability Society

All-in-all, we are having fun serving our membership here in Cleveland.

V. R. Lalli, Chairman

Denver Annual Software Reliability Meeting

When: April 27, 1984 - 8:00 am–4:00 pm

Where: Ford Aerospace & Communications Corporation
10440 State Highway 83
Colorado Springs, CO 80908

Subject: Software Reliability

The Denver Chapter of the Reliability Society is holding its Second Annual Software Reliability Symposium at Ford Aerospace & Communications Corporation in Colorado Springs, CO.

The symposium will address current developments in software reliability with emphasis on implementation of software reliability improvement programs and their impact on software design.

For additional information contact Ron Watts at (303) 594-1329 or Juan Hernandez at (303) 594-1323.

Jim Kaiser

Los Angeles

The 1983/84 year started with a September meeting on buying microcomputers and the use of computers for networking radio. In October a meeting was held on Better Computer Standards, followed by a panel discussion. The November meeting featured a presentation by TRW Vice President, Emery Reeves, on "The Rescue of TDRS Flight 1 in Space," or how we saved a hundred million dollar satellite from becoming a piece of "space junk." In December, 47 attended a three-day minicourse on Hardware/Software Reliability.

1984 started out with a meeting on "Robotics." One speaker demonstrated a programmable robot, and another speaker had a slide and videotape presentation on a remote control camera for testing antennas for far-field response in a near field.

Future meetings already scheduled include a Fault Tolerant Tutorial in February; a one day seminar on Test, Diagnosis and Repair in March; another March meeting on Improving Software Productivity; and an April meeting on Human Considerations in Designing Software.

Meetings are planned for May and June to complete the year's presentation.

Sam N. Lehr

Santa Clara Valley

The Santa Clara Valley Reliability Chapter held its first meeting of the 1983–84 season in November 1983. The talk was appropriately titled, "Quality and Reliability: A Spectrum of Awareness and Career Opportunities." Three speakers were invited to speak. Dave Burgess of Hewlett Packard represented the industry. Dr. Ken Haughton of University of Santa Clara presented the academic viewpoint. Cathie Orlowski of Whelan & Associates talked about professional planning. All the speakers were well received.

In January 1984, Richard Kramer, Director of Reliability at National Semiconductor talked about the Evolution of Corporate Quality Environment. It was a dinner meeting and was attended by 75 people. Mr. Kramer's talk addressed the philosophy and focus needed as a company evolves a quality environment and some of the lessons learned in the process. Needless to say, it was a very successful meeting.

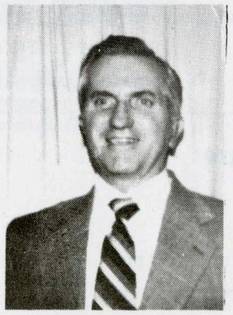
On February 14, 1984 the Chapter held a talk on Advanced Analytical Techniques in semiconductor technology. The speaker was Giorgio Riga of Riga Analytical Lab.

Ajit Goel represented the Chapter at the IEEE AdCom meeting in San Francisco on January 23, 1984.

We have a busy year ahead of us.

Ajit Goel

Reliability Society Album
AdCom Members



J. R. Adams

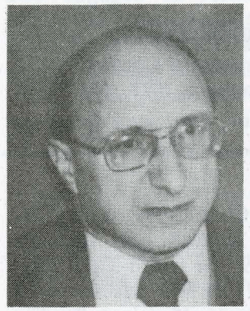
J.R. Adams is currently a group leader and a Senior Systems Engineer on the Shuttle Star Tracker Program. Other programs Mr. Adams has worked on include: GPS and Crosslink Drive Systems, SIR-B and MGT Antenna Systems, and Standard Star Trackers. As manager of component technology st STC, Adams was knowledgeable in and responsible for: New Component Technology; Failure analysis of all electrical and electronic components; Reliability prediction and design reviews; Component part procurement specifications; and Vendor liaison and interface.

Initially at STC, Adams was Quality Assurance Engineer responsible for failure analysis and corrective action on STC's tape drive systems where he suggested, planned, and organized STC's Component Technology and Engineering Department.

During his first employment at BASD, Adams designed spacecraft systems. One major system design was for three ATM solar instrument thermal control systems. These designs were successful in meeting program cost, schedule, and flight performance requirements. As a result, NASA recognized BASD and the design team with a state-of-the-art award for the 70°F ± 0.25°F absolute temperature control system on the NRL experiment.

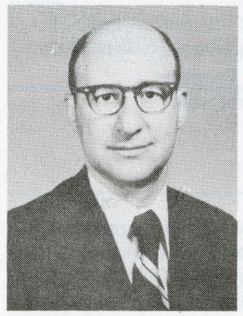
While at RCA Semiconductor, Adams was an applications engineer for industrial devices where he assisted customers in resolving design problems. Later, he was a field engineer and office manager for the Colorado, New Mexico, and Utah areas.

Mr. Adams graduated cum laude from the University of Denver in 1959. He is a Life member of Tau Beta Pi, a member of Eta Kappa NU, and served as the Denver Chapter Chairman, 1982–1984.



G. Constantinides
Chairman Standards and Definitions Committee

Mr. Constantinides is a Senior Vice President of Columbia Research Corporation. He has more than 30 years of experience in DOD related engineering and management with primary emphasis in the product assurance disciplines. He has served as Manager of System Effectiveness for Computer Sciences Corporation and as a senior R&M specialist for the General Electric Company and the Bell Telephone Laboratories. Mr. Constantinides has a BSEE from Lafayette College, a Master of Engineering Administration/Operations Research from the George Washington University and is a senior member of IEEE and ASQC, ASQC Certified Reliability Engineer, and a member of ASNE. He is currently serving as Chairman, Standards and Definitions for the IEEE Reliability Society Administrative Committee.



Anthony Coppola
Treasurer

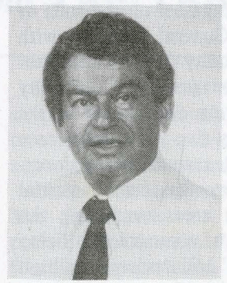
Mr. Anthony Coppola, Treasurer of the Reliability Society, is chief of the Reliability and Maintainability Engineering Techniques section of The Rome Air Development Center. He is responsible for developing methods for predicting, demonstrating, and improving the reliability and maintainability of Air Force electronic systems. He is the director of the RADC program to apply Artificial Intelligence techniques to improve fault detection and isolation. He holds a Bachelor's degree in Physics and a Master's in Engineering Administration, both from Syracuse University. He is a Fellow of the IEEE.

Philip H. Eisenberg
Chairman of Advanced Reliability Techniques, Committee

Mr. Philip H. Eisenberg is Director of Reliability Engineering for Northrop Corporation's Electronics Division where he is responsible for high reliability programs such as MX missile guidance system reliability. His nineteen years of professional experience in the area of high reliability and failure mechanism analysis include active supervision of such programs at Litton and Northrop, and of the physics of failure and physics of control programs for the Minuteman effort at Rockwell.

Mr. Eisenberg has been associated with the International Reliability Physics Symposium since 1964 by serving on its Management Committee, presenting papers, and chairing sessions. He has been actively associated with the Advanced Techniques in Failure Analysis Symposium since its inception, serving most recently as Technical Program Chairman. He has chaired a workshop and a session on reliability at the 1979 conference of the International Society for Hybrid Microelectronics.

He is Chapters Coordinator for the Los Angeles Council of the IEEE, a member of the Administrative Committee for the Components, Hybrids, and Manufacturing Technology Society of the IEEE, and has served as chairman of the Los Angeles Chapters of the Electron Devices and Reliability Groups. He has twenty publications which include chapters in two books, as well as seven patents. More recently, he served as Guest Editor for the Special Issue of the IEEE Reliability Transactions on Failure Analysis. He has conducted U.S. Government study programs in reliability physics for the Air Force, Navy, and NASA. He has given invited presentations at the IEE Integrated Circuits Conference and the Institute of Physics in England, and at the Technical University in Denmark. After receiving his BS Degree from Northeastern University, his graduate curricula included studies in mathematics, engineering, and management.



Kurt Greene
Representative to Standards Board

Kurt Greene is the Staff Director of the Technology Division of the Defense Material Specifications and Standards Office (DMSSO). This office, reporting to the Deputy Under Secretary of Defense-Research and Engineering, is the focal point for establishing the policies and procedures that direct the DoD standardization efforts. This includes the development and maintenance of the MIL

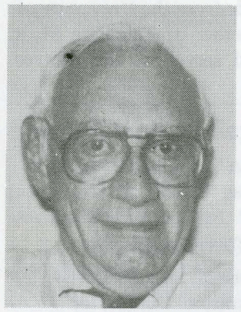
series specifications and standards, as well as the methods and controls of how such documents are utilized in acquisition programs.

Prior to assuming his present position, he was President of QRC Incorporated, a Washington, DC, area engineering consulting and technical services firm specializing in the product assurance sciences.

Mr. Greene's professional experience includes affiliation with the Astro-Electronics Division of the RCA, where he was responsible for the analysis of the system reliability functions and the formulation and implementation of formal Engineering Reliability Programs on major space projects; the United States Testing Company, as Manager of the Electronic Component Division, in charge of test and evaluation engineering programs; the IT&T labs, where he was head of the Reliability and Test Section and directed studies and evaluations to provide reliability data to equipment design and product groups.

The author of numerous technical papers, Mr. Greene is a senior member of the IEEE, a member of the IEEE Reliability Group Administrative Committee. He was the General Chairman for the 1981 Annual Reliability and Maintainability Symposium and is active in various aspects of professional society activities at the national and local levels. Mr. Greene is the recipient of the Institute of Environmental Sciences (IES) 1983 Reliability Test and Evaluation Award.

Mr. Greene has a Bachelor and Masters Degree in Electrical Engineering.



Samuel Lehr
Los Angeles Chapter
Chairman, 1982–1984

Samuel Lehr received his B.S. Ch. E. from the City College of New York in 1939 and his M.S. N.E. from the University of Cincinnati in 1959. He joined TRW Electronics and Defense Sector in 1959 and has served as Reliability Project Manager and Assistant Project Manager for Product Assurance and many spacecraft programs. He is now Manager of the Reliability and System Safety Department for the Electronics System Group of TRW.

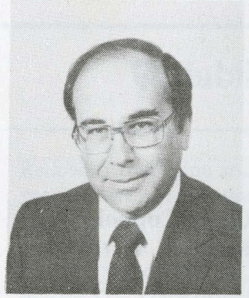
Prior to joining TRW, he was employed for 12 years by the General Electric Company in Pittsfield, MA and at Evendale, OH. Prior to that, he was employed by the U.S. Navy office as an inspector of naval materials.

He has presented several papers, and in 1963 received the Wm. C. Tuller award for the best paper at the Electronic Components Conference in San Francisco in 1961. He is a registered Professional Engineer in the Commonwealth of Massachusetts.

Harold C. Jones
IRPS Representative

Mr. Jones is a Senior Advisory Engineer on the staff of the Westinghouse Space Division General Manager with responsibility for Reliability and Quality Control consultation. His background includes ten years as a faculty member of the Electrical Engineering department at the University of Maryland, and twenty-five years experience in industry. He has held increasingly responsible engineering and management positions in the environmental simulation, reliability and quality areas, including the reliability and quality management of a program utilizing large scale production of "in house" LSI devices, and high reliability hybrids. He has published 15 papers in these fields, many by invitation.

Mr. Jones received his BS in EE from Illinois Institute of Technology in 1949, and his MS from University of Maryland in 1961. He is past president and Fellow of the Institute of Environmental Sciences, and a member of Tau Beta Pi and Eta Kappa Nu, a senior member of IEEE, and a registered professional engineer in the state of Maryland.



Maurice J. Shumaker
Vice President,
Membership

Mr. Shumaker is System Integration manager in the Space and Electronics Systems division of Martin Marietta Denver Aerospace and is responsible for integrating a complex spacecraft with its upperstage booster, the Space Shuttle, and the system's related worldwide communications system. His responsibilities also include overall system reliability and logistics. Before his current assignment, he managed Advanced Special Programs where he was responsible for the performance of engineering study contracts and Independent Research and Development (IR&D) activities.

Before joining the Special Programs area, Mr. Shumaker headed the reliability organization for the Tactical Flag Command Center program. He also established and defined the electronics piece parts program for the Space Shuttle Command, Checkout and Monitor Subsystem.

Mr. Shumaker was Systems Reliability Manager for the Viking '75 mission to Mars program. Mr. Shumaker has also engaged in reliability/maintainability/system availability planning and assessment, and in logistics and spares planning for several launch vehicle and space programs, including Titan I, II and early versions of Titan III.

Mr. Shumaker received his diploma in Radio Engineering Technology from Valparaiso Technical Institute in 1955. He has completed courses toward the MBA at Columbia. Mr. Shumaker has authored or coauthored many articles and studies which have been published in conference/symposia proceedings, magazines and NASA contractor reports. He has been honored by Martin Marietta on several occasions for these publications. Mr. Shumaker is a Senior Member of IEEE, Vice President of Membership of the IEEE Reliability Society and a founding member and officer of the Denver, Colorado chapter of the Reliability Society.

Maintainability Matters

Richard Kowalski

AMC 1984 Open Forum

The Avionics Maintenance Conference (AMC) 1984 Open forum was held on February 1-3 at the Red Lion SEA/TAC in Seattle, WA. The AMC is an air transport industry organization dedicated to the goal of improving the reliability of commercial aircraft avionics and reducing the cost of ownership through improved maintenance concepts and practices. A summary of Conference activities will appear in the next *Newsletter*.

Report Summaries

1. H. D. Rue and R. O. Lorenz (Hughes Aircraft). "Study of the Causes of Unnecessary Removals of Avionics Equipment," RADC-TR-83-2, January 1983 (ADA 127546). The authors investigated the causes of unnecessary removals of selected avionics equipments. It was reported that 32.7 percent of all removals of the selected equipment were necessary. The following causes were found:

1. Ineffective Built-In-Test	22%
2. Ineffective or Missing Test Equipment	17%
3. Ineffective Supervision/Support	17%
4. Ineffective Technical Orders	12%
5. Inaccessibility	12%
6. Management Directives	7%
7. Test Equipment Difference	7%
8. Inadequate Skill	5%
9. Inadequate Feedback	1%

2. H. B. Dussault (RADC), "The Evolution and Practical Applications of Failure Modes and Effects Analyses." RADC-TR-83-72, March 1983 (ADA 131358). This report surveys the evolution of failure effects analysis techniques from the 1950's to the present. Sixteen individual techniques are discussed which range from the early approaches such as tabulation of failure modes and effects and fault tree analysis to more recent developments such as testability analysis and hardware/software interface analysis. The uses and merits of each technique are also discussed. A bibliography of 41 items provides additional sources of information for more detailed study of these techniques.

Highlights from TAB/TAB OpCom Meetings

Numbering of the Named Technical Divisions. TAB OpCom approved the numbering of the ten technical Divisions as follows (1984 Directors' names are in parentheses):

I. Circuits and Devices (B. Liu)
II. Industrial Applications (I. N. Howell)
III. Communications Technology (A. F. Culbertson)
IV. Electromagnetics and Radiation (E. W. Pugh)
V. Computer A (O. N. Garcia)
VI. Engineering and Human Environment (E. Fromm)
VII. Power Engineering (R. F. Lawrence)
VIII. Computer B (M. G. Smith)
IX. Signals and Applications (S. H. Durrani)
X. Systems and Control (H. W. Sorenson)

Outside Consultant Study of IEEE. TAB reiterated its support for a centennial study of the organizational structure of the IEEE and encouraged each of the Divisions to appropriate $5K towards it.

Three-Year Review of Technical Appraisal Committee. The Committee was continued for another three-year period, the Committee's initial view of the importance of focusing on education technology was endorsed with the suggestion that the committee furnish specific recommendations to TAB OpCom as to what might be done to stimulate activities in this area in conjunction with individual IEEE Societies.

"Energy in Perspective." TAB received, accepted and approved for distribution the revised Energy Committee Slide Show noting that ongoing revisions should be proposed in order to keep the presentation up-to-date.

AdCom Vice Presidents' Reports

The following summarizes the status of the IEEE Reliability Society's membership and related areas as of AdCom meeting number 126, January 23, 1984. Included is status information regarding current membership size, Chapters, Chapter Awards and Professional Development (i.e., Reliability Home Study Course).

Membership. As of November 30, 1983, Reliability Society membership had reached 3,479 worldwide compared to 3,325 members at the same time in 1982. This increase of 154 members since 1982 ranks our society 10th compared to the other 31 sister societies in terms of membership growth. Our 4.8% growth is just about the 4.7% average of all societies and is indicative of the continuing interest in and significance of the field of Reliability in today's world. It is interesting to note that 12 of the 32 IEEE Societies actually experienced reductions in membership with one Society shrinking by 9.6%.

Chapters. In a letter dated November 22, 1983, Mr. Don Suppers of IEEE Field Services formally informed the Tokyo Section of the approval for the "...establishment of the Tokyo Reliability Chapter on November 14, 1983." The Interim Chairman is Mr. Noboru Takagi.

To help build membership at the local Chapter level, this writer has forwarded to each of the 16 currently active chapters 75 copies of the current (1984) *Your Invitation To Join The Reliability Society.*

Chapter Awards. Chapter Awards Committee Bob Jaquess reports that he has had poor response to date regarding the questionnaires he sent covering the Awards Program. An Awards Committee meeting was held the morning of January 23, 1984 prior to this AdCom review and discussed possible rules changes for this year's Awards Program.

Maurice J. Shumaker

Meetings

AUTOTESTCON

The last conference was held in Ft. Worth, November 1-3, 1983. Advanced registration was 730 with a total attendance of 1,034. A total of 93 papers was presented. There were 75 exhibitors. RS endorses this conference and does not share in the financial operation. The sponsors are the Aerospace and Electronic Systems Society and the Instrumentation and Measurement Society of IEEE. The AdCom representative sits on the Board of Directors. The next conference will be held in Washington, DC at the Sheraton Washington, the site of the Democratic party convention during the 1984 elections. It should be exciting!

INTER-RAM

RS endorses this power systems reliability conference. The last conference was held in Montreal, Canada, May 25-27, 1982. There were 275 attendees, over 60 technical papers, and 15 exhibitors (mostly utility companies). The host organization was Hydro-Quebec. Next, the conference will be held April 4-6, 1984 in Las Vegas, NV. The host will be the Nevada Power Company. This intersects with IRPS. The Board is expecting to incorporate within the next year or so. At that time, it is expected that the endorsing organizations will be asked to provide earnest money (about $1k each) with an even split of profits or losses. It should be noted that the 1983 conference earned a net of some $20k.

TSRS

The Total Systems Reliability Symposium attracted about 145 attendees in a panel/workshop forum. The general consensus was that the symposium was successful and should go again. However, I reminded the management participants that the symposium is in time (and maybe material) conflict with the RAMS, which was conceded. At this point, no one has picked up the banner to run the next conference, but if one is planned, AdCom should be aware of the details and the proposed date of the meeting. We sponsored this symposium and will share in what looks like a modest surplus, with the Computer Society.

Technical Operations

All committees are actively working toward their objectives. The following is a summary of activities at the close of 1983.

1. Human Performance Reliability—Arthur Siegel, Chairman

The goals for the present year, established at the outset, included: (1) development of a human performance reliability "speakers list," and (2) maintaining liaison with the IEEE Power Engineering Society, which is developing a number of techniques and publications germane to human performance reliability and its integration with probabilistic risk assessment. Toward the third quarter of the year, a third goal was established: providing a suitable chapter for the new Reliability Handbook. The progress towards each of these goals is described categorically below.

Goal 1—Speakers List. No progress was made towards this goal.

Goal 2—Liaison With Power Society. Four documents, under development, were critically reviewed and appropriate technical comments were supplied. Because of the number of other reviewers involved, it is difficult to know the impact of the comments on the final products.

2. Health Care—Vernon Gardner, Chairman

Two new Position Papers have been proposed:

a. "Food and Drug Administration Medical Device Approval Process" which includes the following recommendation: "Either the food and drug laws should be amended to require an independent failure mode analysis before consideration by the FDA or the FDA rules pertaining to approval should include this requirement."

b. "Medical Device Design Process" which includes the following recommendation: "The Food and Drug laws should be amended to require that Registered Professional Engineers be required to actively direct the design of medical devices and systems."

In addition, a proposed legislative agenda worksheet has been initiated to implement the above two new proposed Position Papers.

3. International Reliability—Marion Smith, Chairman

The work of the International Electrotechnical Commission (IEC) continues in the area of reliability and maintainability through IEC Technical Committee #56. USA participation involves several AdCom members in the US Technical Advisory Group (TAG) for IEC TC-56. Dr. Lee Weaver is the US TC-56 TAG chairman. NOTE: Participation is open to all interested persons or organizations.

4. Mechanical Reliability—Henry Hegner, Chairman

The primary objective of the IEEE Mechanical Reliability Committee for 1983 was to aid communications between those involved with the reduction of mechanical failures through Mechanisms of Failure; Detection, Diagnosis and Prognosis; Materials Durability Evaluation; and Design. The symposiums held by the Mechanical Failure Prevention Group (MFPG) during 1983 made progress toward this objective by means of symposiums in the areas of materials durability evaluation and design as summarized in the attached report.

The Spring 1984 MFPG meeting will address "Failure Mechanisms in High Performance Materials: and will also be held at NBS on May 1-3, 1984. The emphasis of this meeting will be the identification and interpretation of degradation and failure modes in high performance materials. Details are also included in the attached report.

5. Energy—Henry Wolf, Chairman

Though the goal of generating a draft position paper on alternative energy technology assessments was not achieved in 1983, the effort continues in 1984. Interest remains high in the subcommittee efforts and active voluntary support makes accomplishment of the position paper goal in 1984 more likely.

6. Software Reliability—Iry Doshay, Chairman

The committee continued its close association with the Computer Society's Software Reliability Working Group and the EIA G-41 Reliability Committee in joint development of software reliability guidelines and standards.

7. Systems Screening—Bill Wallace, Chairman

Activity has been slow towards the development of systems screening procedures and standards. However, progress is expected during a planned symposium for September 1984.

8. Standards and Definitions—Gus Contantinides, Chairman

The following documents were reviewed and comments were forwarded to the preparing activity:

a. MIL-STD-1546, Parts, Materials and Processes Management Program for Spacecraft and Launch Vehicles.

b. Draft MIL-STD Avionics Integrity Program.

Revision 3 to the DOD Reliability Standardization Document Program Plan is being reviewed.

11. Quality Assurance Management

Consideration is being given to organizing a new Quality Assurance Management Committee. Efforts would initially include liaison with the committee being formed by the Communications Society. They are organizing a session for Globe Com 84. Additional information will be available at the meeting.

Irwin A. Feigenbaum

Welcome to New Members

The names and addresses of new member who joined from October 1, 1983 through December 31, 1983 are listed below. For U.S.A. members, they are listed by alphabetic order of their state. Members outside the U.S.A. are listed by alphabetic order of their country's English name.

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The Status of Reliability Technology, 1983

Philip Eisenberg
Chairman, Advanced Techniques Committee

INTRODUCTION

The commercial and military markets are pushing the semiconductor industry into new technological frontiers, such as CAD, CAM, robotics and computer simulation of wafer design and electronic assembly.

A great deal of emphasis is being put on upgrading the quality and integrity of silicon crystalline wafers. This includes reduction of imperfections and the control of impurities in the silicon. [1–3]

The semiconductor industry is now heavily involved with automation not only to improve reliability and integrity but to reduce human judgement [4] in manufacturing processes. The human operator should also be displaced as he is a carrier and the source of impurities responsible for contaminating semiconductor devices. [5–6]

The human inspector should also be replaced because of the boredom and fatigue in monitoring the very dense and complex wafer patterns. [7–8] Automation of die and wire bonding are being implemented for these very same reasons. [9–10] And finally, the human operator is the carrier of electrostatic charges by virtue of triboelectric generation, and is not welcome near any electronic devices. [11] Great strides have been made in controlling and reducing the triboelectric generation of charges by controlling the environment. [12–14]

Some advances have been made in improving radiation hardness of some electronic devices by using thinner oxides and lower processing temperatures. [15] The lower temperatures are known to lower the amounts of trapped oxide sites at the silicon-silicon dioxide interface.

SILICON MATERIALS FOR VLSI AND VHSIC

Monocrystalline silicon will be the basic material for VLSI and VHSIC in the next decade. Probably because the silicon process technology is so advanced that no other material technology will be able to compete with it in terms of workmanship, quality and reliability. In addition, silicon has its stable passive oxide which is a diffusion barrier and a convenient gate for MOS devices.

Although it is realized that the majority of defeats in silicon wafers is photolithographic in origin, defects in the basic raw silicon are becoming more significant. There is no doubt that if VLSI development is to continue, the quality and purity of the basic silicon must improve. These requirements put a very stringent demand on the basic silicon material requiring higher purity and virtually defect free crystalline silicon. This higher quality silicon is not only necessary for higher yields but is required to make the ever shrinking devices functional.

The literature suggests that deliberately doped silicon impurities can cause deleterious effects when these silicon impurities are positioned interstitially. Therefore, the silicon wafers must be essentially defect free when used to fabricate devices approaching one million active devices per silicon chip.

Oxygen concentrations in the silicon crystal material is very critical. Electrical performance of IC components and device yields can be improved if the oxygen concentration is controlled in the silicon crystal.

Controlling oxygen is silicon can enhance intrinsic impurity gettering, decrease silicon crystal warpage and the formation of stacking faults. Oxygen concentrations in silicon can be controlled by the use of magnetic fields during crystal growth. This type of crystal growing is called Magnetic Czochralski (MCZ) and the advantages can justify its added expense.

New crystal growing techniques have been developed to grow high restivity silicon (70 ohm centimeters) by the Czochralski method. This development will add to the flexibility in the design of high speed memory devices (VHSIC).

Bipolar technology requires higher processing temperatures which induce significant amounts of impurities. The transistor base widths are less than one micron and impurities, dislocations, and stacking faults can easily cause device failures. Optimum oxygen concentrations can intrinsically getter these bulk impurities. This gettering technique can be supplemented with extrinsic gettering such as mechanical or laser back side damage.

In CMOS, NMOS and CCD technology, component density is much higher and wafer warpage is a more critical requirement. In this technology a low oxygen concentration should be specified.

The charge coupled device (CCD) technique requires the most stringent silicon requirements. These devices require low alkali impurity levels, zero defects, and a minimum amount of oxygen concentrations.

AUTOMATION OF SEMICONDUCTOR PROCESSING

Automation in the semiconductor industry is essential for yield improvement, reliability, standardization and consistency. Automation is also welcome because it eliminates human judgment in manufacturing processes. The semiconductor industry is now ripe for automation as very few new processing techniques have been realized recently and more emphasis should be put on process effectiveness rather than technical innovation.

A recent editorial [4] reports that the front end processes such as crystal growth, epitaxial, oxidation and diffusion are the backbone of semicondutor devices. All these processes require extreme care and control if a reliable product is to be obtained.

In 1983, a great deal of attention has been given to silicon crystal growth and the effect of silicon properties on device performance. The Czochralski silicon growing technique is the major source of silicon for the manufacture of integrated circuits. Silicon crystal growing can conveniently be completely automated. Automation of silicon growing equipment will eliminate human judgement and handling. Reprogrammed automation of crystal growing equipment can control all the parameters as well as tailor the crystal characteristics. An added feature of crystal growing automation is the application of a magnetic field during crystal growing to reduce temperature fluctuations at the crystal-melt interface. This condition minimizes crystal striations and is instrumental in controlling the oxygen content in the crystal silicon.

It has been recognized that manually handling silicon wafers or even having humans nearby contributes significantly to wafer contamination. The amount of contamination contributed by human operators to clean rooms has been well documented.[5]

The only way to eliminate operator involvement is to totally automate the wafer processing operations including photoresist application, spin, bake, etching, and stripping.

This complete automation suggests going a step further that is to also replace human operators in wafer inspection, and in die and wire bonding; where boredom and fatigue increase with integrated circuit density and complexity.

IMPLEMENTATION OF AUTOMATION

In 1983, Western Electric Company had the foresight, resources, and technology to automate the semiconductor manufacturing and coordinating the device processing all the way to final assembly and test. This tight integration of manufacturing and control led to standardization and improved reliability.

This was all reported in the *Bell System Technical Journal,* January 1983, Vol. 62, No. 1, part 2, where Western Electric did all this in the production of its 3B20D Processor and IMERT Operating System. The major design objective was to meet the stringent reliability requirements of electronic switching systems and real time control of a variety of Bell System Applications. The memory system provides a high-reliability, high performance, main-frame memory for use in the Central Control and Input/Output System. The memory system is designed using state-of-the art 64K dynamic random access memory devices and high speed TTL compatible gate-array integrated circuits. These devices are packaged and interconnected on the multilayer printed wiring boards with high pin-out connections using computer aided design (CAD) tools to assure optimum thermal and electrical performance.

Western Electric Going Commercial for Reliability

In the late 1960's, Bell Labs started producing their own IC chips and justified their production because of better reliability and producing the IC's at comparable costs. They are now entering the commercial market for semiconductor devices. This is the first time that American Telephone and Telegraph Co. subsidiary will peddle its semiconductor chips in the open market. AT & T's management is giving the blessing, to go ahead, and financial support to go "public". This company is already a high volume producer, generating $350 million dollars of integrated circuits per year for its own internal equipment divisions.

Western Electric has selected and is featuring the 256K memory chip to enter the commercial market and will be the first U.S. producer to do so. Sales of this memory chip are expected to reach a spectacular 3.7 billion a year in 1989. Western is already producing 80,000 256K RAM's a month all for its internal consumption. This marketing will lower the cost of the product by spreading the fixed costs over a broader base.

ELECTROSTATIC DISCHARGE (ESD) AND ELECTRICAL OVERSTRESS (EOS)

The semiconductor industry is becoming more concerned about failures and dormant (latent) failures being caused by electrostatic discharge (ESD) and electrical overstress (EOS).

In a paper [11], presented at the 1983 Electrical Overstress/Electrostatic Discharge Symposium, it stated that there are three principal sources of electrostatic discharge which can damage semiconductor devices. The first and most common is generated triboelectrically in body movement.

The second source of ESD is associated with a "discharge" from a charged IC device. A device may become moderately triboelectrically charged by sliding in shipping tubes or by automatic IC handlers. The third source of electrostatic discharge is the triboelectric charge generated in the assembly of hardware such as long telephone wires. The charge can be transferred from system to system and is a major concern to semiconductor and equipment manufacturers.

Another paper [12] presented the extent of this type of ESD/EOS failure mechanisms in semiconductors. These failures are junction burn-out, oxide punch-through and metallization burn-out. Two different failure investigations were made to show the effects of EOS and how material and manufacturing process defects contribute to the failures. These ESD/EOS failures were documented by optical and scanning electron microscope pictures.

Another paper [13] identified the value of implementing electrostatic discharge (ESD) controls to prevent failures. The implementation of ESD controls and procedures resulted in cost savings which exceeded all expectations. And finally, ESD latent defects present a serious problem to electronic systems if the ESD latently damaged devices cannot be screened out.

ADVANCES IN RADIATION RESISTANCE IN VLSI DEVICES

Many military and space applications require the ability of electronic devices to withstand large doses of radiation. Recent advances in processing technology indicates that high performance MOS (HMOS) devices increase their radiation resistance. This fortunate process development opens up more application options for military and space use.

Tests show that RAMS fabricated with this new process [15] have three times the total-dose gamma radiation tolerance than RAMS made with the older NMOS technologies. This improvement in radiation hardness was attributed to the thinner oxides used to fabricate the devices. The new (HMOS) process uses 400 Å oxides compared to the 1000 Å oxides used in the older NMOS process.

The lower processing temperature used for the HMOS 1000°C vs. 1100°C for the NMOS technique may also explain the radiation hardness. Lower processing temperatures are known to create fewer trapped hole sites at the Si–SiO_2 interface and cause less threshold voltage shifts under irradiation.

The lower processing temperature has the additional advantage of having less alkaline impurities and reduced silicon warpage. Thinner oxides also provide tighter control of metallization and optical alignment.

This new fabrication technique indicates that process technology rather than circuit design is the key necessary to produce radiation resistant devices and brings more flexibility to VLSI for military and space applications.

VHSIC DEVELOPMENTS

The VHSIC program is aimed at developing silicon integrated circuits that will be fast enough and reliable enough to ensure continuing U.S. superiority in defense electronics. [16] The goal is the pilot production in 1986 of processors containing 250,000 gates, operating at clock speeds of at least 25 megahertz and performing several billion operations per second.

One problem that has to be overcome is lithography to achieve the program's one half micron goal. One possible solution is the use of holography to obtain the half micron optical barrier. An optical system has been developed [17] which uses laser holograms to create the circuit pattern on the wafer. The laser hologram projects the circuit image uniformly and defect-free over the entire wafer. The developer claims the entire wafer can be printed with a single exposure eliminating the step and repeat operation. Therefore, dust and fingerprint images are not capable of being reproduced as these defects cannot be transmitted by the hologram. It has been estimated that the laser-holographic technique can approach the 0.125 micron range.

The manufacter has also produced a laser holographic inspection system capable of separating out all defects in one raster scan. This technique can lead to fully automatic wafer inspection.

VLSI SPURS PROGRESS

In the last 12 months, packaging and production, industrial technology, and testing have all hummed with activity. [18] Users are still struggling to choose the best package for large- and very large-scale integrated circuits. At least one package, the pin-grid array, has gained ground, and the Bell System ushered in a new variation of its version, the Pinbell package. Meanwhile, designers of video games and home computers began to use the smallest of all IC packages: The bare chip itself, bonded to a small printed-circuit board.

As for PC-Board assembly, active and passive components, which have usually been inserted into boards, are increasingly being mounted on the board surface. As surface mounting saves both space and expense, it continues to gain favor with some of the largest electronics firms. The technique now has almost all the ingredients of a winner; a full line of miniaturized passive and active components in leaded and unleaded versions, as well as automatic placement and soldering equipment.

COMPARING STANDARD CELLS AND GATE ARRAYS

Gate arrays provide a faster implementation of complex monolithic circuits than the standard cell approach. [19] But beyond some unit volume, a denser standard-cell chip is sure to be more economical; only a constraint on the turnaround time or a need for frequent design updates would then indicate selecting a gate array. In principle, the performance of a standard-cell design betters an array in the same technology, so an aggressive design may also end up in the cell-library arena regardless of any other applicable constraints.

The mainstream of new array designs now are typically 2,000-gate chips in 3-micrometer silicon-gate complementary-MOS technology, for a chip area in the neighborhood of 50,000 square mils. Development costs for a 2,000-gate array vary from vendor to vendor, but $40,000 is a typical quote with about 25% of that in tooling costs. For standard cells on the other hand, tooling accounts for about half the development cost.

As geometries shrink, tooling gets more expensive, so the development cost penalty of cell-based designs compared with gate arrays can be expected to increase.

SEMICONDUCTOR HOUSES SHARPEN C-MOS SKILLS

While continuing the race for smaller and speedier chips, the electronics industry has nevertheless begun a subtle shift in emphasis: exploiting device density to create more highly integrated components, instead of just smaller ones. The once-clear division between semiconductor and component technology has become lost as logical functions begin sneaking into memory and even linear parts and as microprocessor chips add cache memory and linear capability. Driven by this trend to more complex circuitry on single chips, the machinery for semiconductor manufacturing has already begun to slip out of the optical and into the X-ray realm.

As usual, monolithic memories lead the way to vertical advance in component technology. Even as production lines are spinning out 64-K dynamic random access memory chips, worldwide attention has veered to 256-K dynamic RAMS and preliminary designs for megabit chips. And even while semiconductor manufacturers continue to optimize such high-speed devices as these for the computer industry, they are further refining technology like that for electrically-erasable programmable read-only memory for the merchant market. Designs like point-of-sale terminals will enjoy faster, denser EE-PROM chips that nonetheless retain standard pinouts.

Similarly, with the software marketplace demanding compatibility in the face of advances in microprocessor design, semiconductor houses are plotting cautious courses toward full 32-bit processor chips. As these 32-bit powerhouses begin to trickle into the market in the next two years, system designers will begin to experiment with alternative system architectures. Multiprocessor systems will become much more common, challenging the software industry to utilize the hardware to its full speed and capability.

Along with these microprocessor-based "mainframes," a growing class of portable computers will gain a major boost next year, when complementary-MOS designs for CPU and memory chips join new flat-panel displays. As the semiconductor houses squeeze these complex circuits into dense C-MOS chips, C-MOS technology will further refine techniques like trench isolation. On the other hand, display markers will highlight thin-film transistors built right on the display substrate.

NUCLEAR POWER PLANT SAFETY

The Three Mile Island disaster has prompted concerns regarding the safety features in nuclear power plants. In this regard, nuclear plant safety has high hopes through the study of in progress malfunctions and transients (large changes in plant parameters with safety implications), by using advanced hardware and software tools. [21] These nuclear power plant analyzers are different from plant simulators. Simulators are used to train personnel using the system as a replica of the plants control room. An analyzer on the other hand uses a computer system and several cathode-ray tubes with a keyboard to develop and verify operating procedures, assess operator performance and public risk.

When these analyzers are fully developed they may be used by nuclear-plant operators to formulate procedures and options for action during crisis such as loss of coolant by small pipe breaks and transients.

The following literature supplied by Anthony Coppola are some recent advances and developments at RADC/RBET, Griffiss AFB, NY, and new developments regarding MIL-STD-1562.

1. DOD Standardization Activity: In 1983, the Air Force Systems Command (AFSC), was delegated the authority to act for the Secretary of Defense as manager of Reliability and Maintainability Standardization. AFSC in turn, delegated the responsibility to the Rome Air Development Center (RADC). RADC's duties will be to work with the preparing activities in all three services to maintain the currency of R&M standards and handbooks. RADC will publish biennial standardization plans for both reliability and maintainability. In September 1983, RADC published a Reliability Maintainability Technology Transfer Fact Sheet to report progress in R&M standardization activities. New issues of the fact sheet will be printed as warranted. Its editor is Mr. Preston MacDiarmid, RADC/RBER, Griffiss AFB, NY 13441, (315) 330-2702.

Standards and handbooks published in 1983, included MIL-STD-470A, Maintainability Program for Systems and Equipment. The standard was reformated for ease of tailoring and includes a revised set of data item descriptions.

Also published was notice 1 to MIL-HDBK-217D, Reliability Prediction of Electronic Equipment. The major changes include the addition of more airborne environments and an interconnection failure rate model.

In progress are: notice 1 to MIL-HDBK-472, Maintainability Prediction, to add a new maintainability prediction technique better suited to use in early design tradeoffs; and notice 1 to MIL-STD-785B, Reliability Program for Systems and Equipment Development and Production to add new tasks dealing with thermal management, analysis and validation, and to modify some existing tasks.

New standards expected to be drafted in 1984, will cover Derating, Bayesian Reliability Demonstration, and Environmental Stress Screening. In addition, a new version of the RADC non-electronic Reliability Notebook will be available in early 1984. This will provide failure models for mechanical and electro-mechanical devices not covered in MIL-HDBK-217.

2. Device Standardization: Device reliability is governed by MIL-STD-883, Test Methods and Procedures for Microelectronics, and MIL-M-38510, Microcircuits

General Specification for. In 1983, both documents were revised. The new versions, MIL-STD-883C and MIL-M-38510F, provide standardized radiation hardness assurance requirements, revised PIND acceptance criteria, deletion of Class C, control of non-JAN "lookalikes," new test methods for thin film corrosion, random vibration and substrate attach, a new test procedure for custom monolithic silicon microcircuits, and other changes. News of microcircuit reliability developments is presented by the Rome Air Development Center LSI/Microprocessor Reliability Status Report, published as needed by RADC/RBR Griffiss AFB, NY 13441. The report includes a summary of military specifications for microcircuits and QPL status.

3. Laser scanning of microcircuits: Mr. Daniel Burns of RADC reports that two papers presented at the 1983 International Physics Symposium discussed the use of nondestructive laser photoscanning techniques to characterize the latchup sensitivity of CMOS structures and to locate active latchup paths in CMOS LSI, and a third discussed related electron beam techniques. He also noted the reporting of a technique for estimating the alpha-particle sensitivity of dynamic RAMS by means of a scanning laser which simulates the alpha-particles with photons. Mr. Burns is working in these areas at RADC and invites interested parties to contact him at RADC/RBRP, Griffiss AFB, NY 13441, (315) 330-2868.

4. Application of finite element analysis to microelectronics: The finite element method, which is the fundamental technique used in practically all computer aided mechanical analyses efforts, is being applied to microelectronics at RADC according to Richard Mair, chief of the RADC System Engineering Section. Originally developed and applied to large complex structures, the finite element method is being used at RADC to model very small microelectronic devices in order to simulate the response of these devices to thermal loadings. RADC is using NISA (Numerically Integrated Elements for Systems Analyses), a finite element program developed by Engineering Mecchanics Research Corporation. NISA is presently running on RADC's Honeywell 8/440 Computer and is being used to perform thermal and thermal stress analyses of microelectronic devices with internal heat sources. Outputs of the analysis can include temperature vs. time, steady state temperature, and thermal stress data.

5. Failure Modes and Effects Analysis: In 1983, RADC published a report, RADC-TR-83-72, The Evolution and Practical Applications of Failure Modes and Effects Analysis, discussing the various methods available for performing a FMEA from the original tabular FMEA to sneak circit analysis. The report is available from the National Technical Information Service under catalog number AD-A131358. RADC also completed a study performed on contract by Hughes Aircraft to develop an automated FMEA technique. Report will be available in early 1984.

6. R&M Organizational listing: A Guide to Government Reliability, Maintainability and Quality Assurance Organizations was prepared by RADC under their report number RADC-TR-83-49. It lists agencies in all three services, NASA, FAA, NSA and NBS with RM&QA responsibilities. It is available from the National Technical Information Service under number AD-A130465.

7. Dormant Reliability: A comprehensive plan for studying the effects of dormant and storage conditions on weapon system reliability and developing design and testing strategies for systems subject to periods of nonoperating conditions was developed by the Air Force under the chairmanship of the Air Force Human Laboratory. It was intended as a FY-84 initiative but has not, as yet, been funded. Should funds be denied, portions of the initiative will likely be pursued by individual laboratories under existing fund lines, though probably not until FY-85.

8. Commercial vs. Military Equipment: A decision model for deciding between the selection of militarized or commercial equipment for use in Air Force systems was developed by Rockwell Collins on contract to RADC. The model considers 20 operational factors and life cycle cost impacts. It is described in RADC-TR-83-29, Reliability, Maintainability, and Life Cycle Cost Effects of Commercial Off-The-Shelf Equipment, available from NTIS.

9. Automated Reliability Predictions: Another company has become a source for a reliability prediction computer program. Powertronic Systems Inc., P.O. Box 29109, New Orleans, LA 70189, offers a program for either MIL-HDBK-217C or MIL-HDBK-217D predictions. The program, called Reliability Prediction Program, RPP, is designed for small business computers and requires 64K of memory, multiple disc drives, a CP/M operating system, and CBASIC language. This makes at least four commercially available computer programs for predicting reliability. RAP 217 is offered by PROMPT, The Software Company, 26503 Hillsfall Court, Newhall, CA 91321, for the Apple II+ and other microcomputers. PROMPT has expanded the number of using machines by providing programs on 5¼ inch disks with MS DOS. MS DOS operates on most of the computers with 8088 microproscale computers, the SYSCON Corporation offers *217 Predict* and Management Sciences has PREDICTOR.

For military contracts, RADC-ORACLE is available for automating predictions. Unlike the other programs, ORACLE is not installed on the users computer. It remains on the RADC computer, and is exercised through communications links, such as the ARPA computer network, from terminals in the users locations. ORACLE is furnished for use on government agencies which must first make appropriate arrangements with RADC.

10. R&M Parameter Translation: Addressing DOD Directive 5000.40, which requires the translation of contract reliability requirements to operational reliability, was a study by Boeing on contract to RADC which ended in October 1983. The final report will be available in early 1984 and will provide models for correlating between factory and field reliability as well as a discussion of the interrelationships of all R&M terms currently used in DOD Directives, regulations, standards, and handbooks.

11. R&M Engineers Toolkit: In 1983, RADC began an effort to compile information and data most useful to the practicing R&M engineer in the day-to-day performance of his job. In 1984, RADC expects to publish a reference and training document of about 150 pages containing checklists, formulae, standard SOW and specification inputs, tailoring guidance and illustrative examples.

12. Artifical Intelligence: In 1983, the Institute for Defence Analyses prepared a report on Artifical Intelligence (AI Applications to Maintenance, as part of a study for DoD on ways of improving the R&M of weapon systems. In addition, exploratory studies on AI applications to testing were initiated by the Rome Air Development Center, the Air Force Human Resources Laboratory and the Naval Air Engineering Center. The Air Force Wright Aeronautical Laboratories completed a study of Integrated Testing and Maintenance Technology (ITM), which is intended to produce self-sufficient avionics systems without need for external test and support equipment or intermediate level repair of modules. ITM applied AI to fault classification. Results will be available in 1984 from AFWAL/AAAS, Wright Patterson, AFB, OH 45433.

In 1984, RADC will begin studies to formulate design concepts for "smart" Built-In-Test, using the principles of AI to attack the problems of false alarms, detection of intemittent faults, and coverage now plaguing BIT applications. RADC is also sponsoring a study by the Air Force Institute of Technology to develop a maintenance expert system applying AI techniques to the location of failures in F-15 components tested at the Warner-Robins Air Logistic Center. A demonstration of the system is scheduled for December, 1984. Maintenance expert systems are also in development by various academic and industrial agencies.

13. Testability Figures of Merit: In 1983, The Boeing Co. completed a study for RADC to develop figures of merit rating the testability of assemblies and equipments. The technique builds on a method developed by Grumman which provides a testability figure of merit for printed circuit boards. To this, Boeing added consideration of the connections between the boards and access to external connections. The method is intended to help design and evaluate testability in electric systems. A report will be available from RADC in early 1984.

14. Restructure of MIL-STD-1562: RADC/RBRA is presently restructuring MIL-STD-1562, "Lists of Standard Microcircuits", using the Microcircuit Reliability Assessment Program (MRAP) as the data base.

MRAP is a computer program which was developed and is maintained in-house at RADC to track electronic devices to MIL-M-38510, "Microcircuits, General Specification for." Detail specification (slash sheet) activity is monitored from the time that a device is selected as a potential standard parts candidate through its inclusion on the Qualified Products List (QPL).

The data base for MRAP, which is updated continuously, includes information on every microcircuit which is currently covered, or is projected to be covered, under a MIL-M-38510 specification as well as many devices considered for standardization but not recommended for new military equipment design.

MRAP includes the detail specification status, the most recent revision or amendment, the QPL status, and usage recommendations. In addition, the technology, generic part number, function, and reliability gate count (when available) are included for each microcircuit entry. This dynamic feature allows MRAP to identify devices not recommended for new design due to poor reliability history, device obsolescence or diminishing sources. MRAP has been used as a preferred parts list for new system designs, and to evaluate system parts lists for making recommendations for replacement of nonstandard parts.

The new MIL-STD-1562 will contain five categories of device selection as follows:

1. Section I—Preferred Parts. All devices listed in this section have a dated military specification and a QPL source (either Part I or Part II). The devices have no known reliability or availability problems and are recommended for use unconditionally. However, some emerging technologies such as advanced low power Schottky devices which are not listed in this section do provide additional performance advantages in speed and/or power and will be the preferred types once a QPL source is available. These new devices will be listed in Section II, Future Looks, until QPL status is achieved. It is recommended that the Qualified Products List be used to determine when these devices having a preferred technology have been qualified. Usage of these new devices would then be recommended and will be included in Section I of the next revision of MIL-STD-1562.

2. Section II—Future Looks. Devices listed in this section are those that have been selected for electrical characterization and are potential candidates for MIL-M-38510 specification or that have an active DESC drawing. It also includes devices that have a dated military specification, such as some microprocessors and their support chips, but as yet have no QPL source. As discussed previously the use of devices or technologies in this section may be preferred over those in Section I *once a QPL source is available.* Therefore, consideration should be given to using these devices in system or equipment designs if a QPL source is expected to be available at the time device procurement is required.

3. Section III—Logistics or Continuous Replacement Only. This section contains devices which are not recommended for new designs because of diminishing sources, or a replacement device listed in Section I is now available which performs the same function. However, because of the criticality of form and fit, the device is required for logistics support in many existing equipment or systems. All devices in Section III that do not have QPL sources will be identified by an asterisk.

4. Section IV—Inactive or Suspended Military Specification Activity. This section contains those devices for which a MIL-M-38510 specification was prepared but qualifica-

tion activity was never initiated or has been suspended. It also includes devices which have had QPL status that has been cancelled or expired and there is no indication that the device manufacturer intends to requalify. Wherever possible, devices listed in this section will also have a recommended preferred device to be used for new designs.

5. Section V—Not Recommended Under Any Circumstances. Devices with known reliability problems or those that cannot be procured in a military version are identified in this section. Devices listed in this section will also have a preferred device listing for new designs.

The new MIL-STD-1562 will have a cross-reference by generic part number to MIL-M-38510 slash sheets to identify what section the device is in. The circuit description provided in both MIL-STD-1562 and MRAP will be retained, except the technology type and the gate counts will not be included. The intent of MIL-STD-1562 is to provide a preferred list of recommended devices for DOD equipment and since systems or equipments are generally designed using the same class or family of devices, the technology listing does not appear worthwhile. However, if this information is deemed necessary it can be added. Gate counts, while necessary for making reliability predictions are not a design consideration and will not be included in the new MIL-STD-1562. Plans are being made to include the gate count information currently in MRAP in future revisions to MIL-HDBK-217. The new MIL-STD-1562 is intended to be a dynamic document while maintaining its same basic format and simplicity.

The following represents inputs from the IEEE Society technical chairmen on new developments in these respective areas of interest.

Human Performance Reliability—Arthur Siegel, Chairman

Human performance reliability is adequately represented in the new addition of "The Handbook of Reliability Engineering and Management," to be edited by W. Ireson and C. Coombs, Jr., and to be published by the McGraw Hill Book Company. This is being done to attempt to extend the current human engineering oriented coverage to include a greater emphasis on human performance reliability. Currently, it appears that the proposal will be accepted by the editors.

A partial review of recent thinking on methods for measuring human performance reliability was completed in order to set the state for a future program into the development of a symposium/set of papers/edited compendium in the area. These is a need for integrative constructs on how to define and measure human performance reliability into overall summary measures. Such a collection would help to achieve these goals.

The "design for people" concept, introduced in a paper (with K. LaSala), at the annual RAM Meeting is currently being considered within NAFSEA. Depending on the extent of adoption, a considerable impact on system reliability could be achieved.

Comments on methods for modeling human decision making reliability were transmitted to the NRC.

Standards & Definitions—Gus Constantinides, Chairman

The primary objective of the Standards and Definitions Committee is to continue the review and critique of proposed reliability and/or maintainability standards, specifications handbooks, etc., upon request. Specifically, the committee will:

1. Implement the formal review of specifications, standards, etc.

2. Acquaint Society Members, and other potential sources of specifications for review, of the committee's charter and availability to perform this function.

3. Upon receipt of a proposed specification for review, establish a review panel comprised of appropriate members to accomplish this independent review and critque.

4. Summarize and coordinate review comments and disseminate to Vice President, Technical Operations, President of AdCom, the source requesting review (DOD agency or other), all members of the review panel and Standards and Definitions Committee.

The following documents have been reviewed in 1983 by the committee: (a). MIL-HDBXXX, Electronic Reliability Design Handbook, Volumes I and III, Proposed, A. Feduccia, RADC, Sponsor. (b). Publication EE090-CA-PRO-010/8131, RELTEST, Low Cost Reliability Demonstration and Test Procedures, W. Wallace, NAVALEX, Sponsor. (c). IEEE Standard 352, R. Olson, IEEE Working Group Chairman, Sponsor.

Nuclear Systems Safety & Reliability—Jerry Fussell, Chairman

The Working Group on Risk Evaluation of Radioactive Waste Management serves as a "third-party" peer review body on regulations and studies involving risk evaluations of radioactive waste. The group is actively critiquing regulations such as 10 CFR 60 (NRC) and 40 CFR 191 (EPA) in an effort to help provide coordination and commonality in assumptions and methods in these regulations.

Project 831, Guide for Qualitative Common Cause Failure Analysis of Engineered Systems, is being re-evaluated by the Working Group on Qualitative Common Cause Failure Analysis. Recent advances in common cause failure analysis methods may result in the guide being "out-of-date", thus making publication of the current draft inappropriate.

The new Working Groups were formed in 1982. These are:

1. *Working Group on PRA Procedures Guide.* The purpose of this Working Group is to perform an independent review and evaluation of the PRA Procedures Guide being developed by the ANS, IEEE and NRC (NUREG/CR-2300). Dr. W. E. Vesely, of Battelle Laboratories, chairs this Working Group.

2. *Working Group on Reliability and Safety Methods in Non-Nuclear Industries.* The purpose of this Working Group is to review and evaluate reliability and safety methodologies currently in use in non-nuclear industries, with the objective of identifying those methods that are applicable and useful in nuclear industry applications. Dr. Armand Lakner of the NRC, chairs this Working Group.

The dependent failure analysis document will describe concepts of systems interactions analysis and common cause failure analysis. A procedure will be included for performing dependent failure analyses that integrate these analyses in a manner that makes dependent failure analysis of probabilistic risk assessment accident sequences a tractable problem.

David Campbell of JBF Associates has replaced David Wagner as secretary of the committee. Plans are being formulated to establish a working group whose charge will be to produce a document describing methods for performing dependent failure analysis as part of nuclear power plant probabilistic risk assessments.

International Reliability—Marion Smith, Chairman

Principal international activity involves IEC Technical Committee 56-Reliability and Maintainability. Summary of activity:

During March and April, the following Working Groups Meetings have been scheduled:

WG1—Definitions
WG3—Equipment Reliability Testing
WG6—Maintainability

A new Working Group WG10 on Reliability Aspects of Software has been formed with Jim Ronbeck of Canada appointed Secretary.

Dr. L. A. Weaver of the United States attended a WG3 meeting in Venice, in March. Other IEEE Reliability Society Members, from countries such as Sweden and Germany, also participated.

The Swedish National Committee has agreed to undertake the sponsorship of the secretariat for IEC TC#56. This should provide good continuing international support needed for operation of this international activity. The sponsorship of the secretariat had remained open since the United States relinquished this position at the beginning of 1983.

IEC TC#56 Working Group Meetings have been held in 1983 as follows:

Working Group 1 Definitions-A fifth set of additional terms to be included in IEC Publication 271 is in draft form.

Working Group 3 on Equipment Reliability Verification met in March. Documents are in preparation on the following subjects: Guidance for the design of test cycles for equipment reliability testing, and test for the validity of a constant failure rate assumption. A draft document on Reliability Growth has been prepared and is to be circulated as a TC#56 secretariat document.

Working Group 6-Maintainability-Documents in preparation in this area include the following: Maintainability Studies During Design, Collection Analysis and Presentation of Data Related to Maintainability, and Preliminary discussion has been held on the possibility of a mathematical appendix for the Maintainability Guide.

Working Group 9-Failure Modes and Effects Analysis-Draft documents are in preparation on fault tree analysis and reliability block diagrams.

Working Group 10-Software-Involved in preliminary discussions with no documents yet being produced.

Dr. Lee A. Weaver of the University of South Florida continues as the U.S. Technical Advisor to IEC TC#56. Note: U.S.A. coordination internally on International Reliability and Quality Standards matters is worked via the American National Standards Institude Committee Z1 on Quality Assurance. At a meeting of the Z1 committee on September 14th, Dr. Weaver will review IEC TC#56 matters with U.S. representatives of ISO TC#69 and ISO TC#76 as well as members of ASQC.

Health Care—Vernon Gardner, Chairman

Based on decisions reached at the Committee on Health Care Meeting the drafts on which were reported for Meeting No. 124 were further revised. Early in August each member of the Committee received copies of the following revisions for review:

The Charter

It was suggested that the title be changed to "IEEE Committee on Engineering in Health Care". Here are a few quotes:

"The basic objective of this committee shall be to assist in the formulation of health care legislation, policy, regulation, and legal interpretation (as amicus curiae) in the United States of America through the provision of professional engineering counsel, based on the best resources the IEEE can bring to bear on the issues".

"4.1 Membership on the committee shall comprise three classes: (a). Appointed members to be appointed by the-Chairman-. (b). Representative members may be appointed by IEEE Societies having a substantial interest in engineering in health care. Each Society shall have the privilege of appointing a single member. (c). Liaison members may be appointed by other IEEE entities or other organization having a substantial interest in engineering in health care upon invitation of the Chairman. Liaison members shall be nonvoting."

Three position papers

All of which stress the need for professional engineers being represented in health care:

CEHC-OA	Institute of Medicine Proposal for Health Care Technology Assessment Entity.
CEHC-OB	Government Advisory Panels/Committees for Health Related Issues.
CEHC-OC	Government Positions Responsible for Management of Health Related Engineering.

Mechanical Reliability—Henry Hegner, Chairman

The Mechanical Failures Prevention Group held two symposiums. The IEEE Reliability Society endorsed and participated in these meetings. The first symposium ad-

dressed "Mechanical Properties, Performance and Failure Modes of Coatings", and was held at the National Bureau of Standards (NBS), Gaithersburg, Maryland from May 10–12, 1983.

The Spring 1983 MFPG meeting focused on the fact that the use of coatings is growing and will continue to grow because they offer certain economic and technical advantages over the use of uncoated materials. Although a wide variety of materials and application techniques are available, much less is known about the properties of specific coatings and the measurement of those properties. To explore these questions, a symposium was organized around the following session topics:

Measurement of Coating Properties
Coatings for Improved Lubricant Capacity
Field-Applied Coatings for Corrosion Resistance
New Coating Technologies
Coatings for Wear Control of Concentrated Contact
Coatings for Erosion Control
Coatings for Corrosion Control

Papers were solicited on the characterization of coatings for fatigue, wear, corrosion, erosion, adhesion, strength, lubrication, effectiveness, hardness, and impact. Of interest were new techniques for measuring these properties or improved coatings for such environments. Demonstrations were also included in the program.

The Fall 1983 meeting of the MFPG was held at NBS, Gaithersburg, Maryland on November 29–30 and December 1, 1983. The objective is to establish a forum for the interaction of the academic, government, and industrial technical communities aimed at enhancing the technology base for the prevention of mechanical failures. Another important goal is to establish working linkages with the new and emerging research centers, representing a scientific resource of significant dimension and the leading edge for technology advancement in many vital areas.

Sessions, currently being organized, will focus on:

Technology Application & Utilization
Computer Information and Data Acquisition Systems
Composite Materials
Nondestructive Evaluation and Failure Prevention

The Spring 1984 MFPG meeting will address "Failure Mechanisms in High Performance Materials", and will also be held at NBS on May 1–4, 1984. The emphasis of this meeting is the identification and interpretation of degradation and failure modes in high performance materials.

IEEE Energy—Henry Wolf, Chairman

The purpose of the Energy Committee is to recommend policy and establish position papers on energy related topics of interest to the IEEE membership and to educate and technically advise the several levels of government in matters dealing with energy issues. It is organized around AdHoc subcommittees that study the current issues and generate draft position statements for review and approval of the entire committee. The current subcommittees include:

Current Issues	Fusion
Education	Solar Power Satellites
Speakers Bureau	Breeder Reactors
Nuclear Waste	Congeneration and Conservation
Renewable Energy	

The list of Institute approved position papers, which are reviewed and updated periodically, includes the following:

Conservation	Solar Energy
The Need for Nuclear Power	Solar Power Satellite
Electricity in the U.S.	Breeder Reactors in the U.S.
Fusion Power	Nuclear Waste Management
Municipal Solid Waste	

The recently approved Nuclear Waste Management legislation closely reflected the position of the last mentioned position paper.

Another activity of note includes developments of a brochure providing educational information on fusion power and associated devices.

A proposal to form a subcommittee on Energy Technologies Assessment was accepted by the Energy Committee with H. Wolf, appointed as Chairman. This subcommittee is being organized, its scope defined, and a position statement being drafted.

Maintainability—Richard Kowalski, Chairman

The 1983 objectives for the Maintainability Committee (MC) are:

1. To provide an interface between the IEEE Reliability Society and other technical organizations on matters of interest to the MC.

To accomplish this objective, we will expand our current circle of contacts to identify the principal activities and concerns of these organizations and to inform them of Reliability Society activity of interest to them. We will exchange information on conferences and symposium announcements, review of past meetings, and availability of conference proceedings or other documentation.

2. To contribute to the "Maintainability Matters" column in the Newsletter. The information obtained in (1) will form the basis of "Maintainability Matters" column. The principal difficulty in this area is keeping information timely in light of the publishing lead times required for the Newsletter.

3. Develop a core group to conduct MC activity. A subobjective of this effort is to introduce new faces into MC and Reliability Society activities. Past efforts to involve, on a regular basis, contacts with other technical organizations have not been successul. This year we will work to recruit either government or industry personnel with maintainability interests.

4. Interface with other Technical Organizations. Continue to work with the Avionics Maintenance Conference (AMC) and publish a summary of this annual meeting in the Newsletter.

Software Reliability—Irv Doshay, Chairman

A three-day meeting with the Computer Society Software Reliability Working Group was held at TRW from June 28–30, 1983. Results of the meeting were summarized and circulated via EIA. Information on O&M phase software metrics was reported.

Meetings were held with the EIA G-41 Reliability Committee at Palo Alto, California on October 5–6, 1983. Software Reliability Working Group met at Norden Systems on October 11–13, 1983.

Screening, Systems—William Wallace, Chairman

The area of Environmental Stress Screening of Electronic Equipment has been quiet over the last several years. Since the introduction by the Navy of NAVMAT P-9492 and the Rome Air Development Center's Report (number TR-82-87), entitled Stress Screening of Electronic Hardware, little has been published by the DOD. The Services are still busy implementing these guidelines in individual equipment specifications. While a number of contractors are now endorsing random vibration and temperature cycling, the "fear factor" of damaging hardware is still being argued. The trend of gradual acceptance is taking place, but DOD managers are being pushed toward requiring Stress Screening for all electronic contracts. Commercial concerns are showing more interest, but it is quite difficult to make a judgment as to just what extent implementation has progressed.

Several DOD agencies have been collecting and analyzing data from numerous contractors producing hardware for all types of platforms. Field data are being examined to evaluate the Effectiveness of Screening. Current documentation plans published at the DOD level call for the development of a military standard on environmental stress screening. The publication dates are unknown, but copies will be obtained during coordination for AdCom review.

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IEEE Press Publishes Book on Spread-Spectrum Communications

The publication of *Spread-Spectrum Communications,* a Special Issue Book, has been announced by the IEEE Press, book published arm of the Institute of Electrical and Electronics Engineers, Inc. The volume was sponsored by the IEEE Communications Society and edited by Charles E. Cook and Fred W. Ellersick, MITRE Corporation, Laurence B. Milstein, University of California, and Donald L. Schilling, City College of New York.

Spread-spectrum communications systems have many important applications, including communicating in the presence of intentional (jamming) or unitentional interference, combating multipath problems, and providing multiple access to a communications systems shared by many users.

This book addresses these and other applications, considering both military and commercial situations.

The reprinted papers take the reader from the early history of spread-spectrum communications systems to the new technology being developed today that will allow more efficient use of spectrum spreading.

The book is formed around a special issue of the *IEEE Transactions on Communications,* to which have been added several additional papers and introductory comments to each part.

The 26 papers are divided into five parts, as follows: Perspectives; Interference Rejection; Code Division Multiple Access; Nonlinear Effects; New Systems, Technology, and Uses.

This volume provides essential information for those directly involved with spread-spectrum communications as well as for those interested in learning about this important field.

Spread-Spectrum Communications is clothbound and priced at $39.95. IEEE members can purchase the book for $23.95. This 296-page volume may be ordered postpaid from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854.

dressed "Mechanical Properties, Performance and Failure Modes of Coatings", and was held at the National Bureau of Standards (NBS), Gaithersburg, Maryland from May 10–12, 1983.

The Spring 1983 MFPG meeting focused on the fact that the use of coatings is growing and will continue to grow because they offer certain economic and technical advantages over the use of uncoated materials. Although a wide variety of materials and application techniques are available, much less is known about the properties of specific coatings and the measurement of those properties. To explore these questions, a symposium was organized around the following session topics:

Measurement of Coating Properties
Coatings for Improved Lubricant Capacity
Field-Applied Coatings for Corrosion Resistance
New Coating Technologies
Coatings for Wear Control of Concentrated Contact
Coatings for Erosion Control
Coatings for Corrosion Control

Papers were solicitated on the characterization of coatings for fatigue, wear, corrosion, erosion, adhesion, strength, lubrication, effectiveness, hardness, and impact. Of several were new techniques for measuring these properties or improved coatings for such environments. Demonstrations were also included in the program.

The Fall 1983 meeting of the MFPG was held at NBS, Gaithersburg, Maryland on November 29–30 and December 1, 1983. The objective is to establish a forum for the interaction of the academic, government, and industrial technical communities aimed at enhancing the technology base for the prevention of mechanical failures. Another important goal is to establish working linkages with the new and emerging research centers, representing a scientific resource of significant dimension and the leading edge for technology advancement in many vital areas.

Sessions, currently being organized, will focus on:
Technology Application & Utilization
Computer Information and Data Acquisition Systems
Composite Materials
Nondestructive Evaluation and Failure Prevention

The Spring 1984 MFPG meeting will address "Failure Mechanisms in High Performance Materials", and will also be held at NBS on May 1–4, 1984. The emphasis of this meeting is the identification and interpretation of degradation and failure modes in high performance materials.

IEEE Energy—Henry Wolf, Chairman

The purpose of the Energy Committee is to recommend policy and establish position papers on energy related topics of interest to the IEEE membership and to educate and technically advise the several levels of government in matters dealing with energy issues. It is organized around AdHoc subcommittees that study the current issues and generate draft position statements for review and approval of the entire committee. The current subcommittees include:

Current Issues	Fusion
Education	Solar Power Satellites
Speakers Bureau	Breeder Reactors
Nuclear Waste	Congeneration and Conservation
Renewable Energy	

The list of Institute approved position papers, which are reviewed and updated periodically, includes the following:

Conservation	Solar Energy
The Need for Nuclar Power	Solar Power Satellite
Electricity in the U.S.	Breeder Reactors in the U.S.
Fusion Power	Nuclear Waste Management
Municipal Solid Waste	

The recently approved Nuclear Waste Management legislation closely reflected the position of the last mentioned position paper.

Another activity of note includes developments of a brochure providing educational information on fusion power and associated devices.

A proposal to form a subcommittee on Energy Technologies Assessment was accepted by the Energy Committee with H. Wolf, appointed as Chairman. This subcommittee is being organized, its scope defined, and a position statement being drafted.

Maintainability—Richard Kowalski, Chairman

The 1983 objectives for the Maintainability Committee (MC) are:

1. To provide an interface between the IEEE Reliability Society and other technical organizations on matters of interest to the MC.

To accomplish this objective, we will expand our current circle of contacts to identify the principal activities and concerns of these organizations and to inform them of Reliability Society activity of interest to them. We will exchange information on conferences and symposium announcements, review of past meetings, and availability of conference proceedings or other documentation.

2. To contribute to the "Maintainability Matters" column in the Newsletter. The information obtained in (1) will form the basis of "Maintainability Matters" column. The principal difficulty in this area is keeping information timely in light of the publishing lead times required for the Newsletter.

3. Develop a core group to conduct MC activity. A subobjective of this effort is to introduce new faces into MC and Reliability Society activities. Past efforts to involve, on a regular basis, contacts with other technical organizations have not been successul. This year we will work to recruit either government or industry personnel with maintainability interests.

4. Interface with other Technical Organizations. Continue to work with the Avionics Maintenance Conference (AMC) and publish a summary of this annual meeting in the Newsletter.

Software Reliability—Irv Doshay, Chairman

A three-day meeting with the Computer Society Software Reliability Working Group was held at TRW from June 28–30, 1983. Results of the meeting were summarized and circulated via EIA. Information on O&M phase software metrics was reported.

Meetings were held with the EIA G-41 Reliability Committee at Palo Alto, California on October 5–6, 1983. Software Reliability Working Group met at Norden Systems on October 11–13, 1983.

Screening, Systems—William Wallace, Chairman

The area of Environmental Stress Screening of Electronic Equipment has been quiet over the last several years. Since the introduction by the Navy of NAVMAT P-9492 and the Rome Air Development Center's Report (number TR-82-87), entitled Stress Screening of Electronic Hardware, little has been published by the DOD. The Services are still busy implementing these guidelines in individual equipment specifications. While a number of contractors are now endorsing random vibration and temperature cycling, the "fear factor" of damaging hardware is still being argued. The trend of gradual acceptance is taking place, but DOD managers are being pushed toward requiring Stress Screening for all electronic contracts. Commercial concerns are showing more interest, but it is quite difficult to make a judgment as to just what extent implementation has progressed.

Several DOD agencies have been collecting and analyzing data from numerous contractors producing hardware for all types of platforms. Field data are being examined to evaluate the Effectiveness of Screening. Current documentation plans published at the DOD level call for the development of a military standard on environmental stress screening. The publication dates are unknown, but copies will be obtained during coordination for AdCom review.

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Goodyear Scientist Elected Fellow of The Institute of Electrical and Electronic Engineers

Dr. T. D. Regulinski, Staff Engineering Consultant for the Goodyear Aerospace Corporation, was elected Fellow of the IEEE. The grade of Fellow viewed by IEEE as one of unusual professional distinction is conferred only by invitation of the Board of Directors upon a person of outstanding and extraordinary qualifications and experience who has made important contributions to one or more disciplines within the Electrical Engineering Academic Field. Dr. Regulinski's Fellow Citation was "for contributions to research and education in the discipline of reliability".

Dr. T. D. Regulinski

Dr. Regulinski received Bachelors and Masters degrees in Electrical Engineering from Manhattan College and New Jersey Institute of Technology, respectively, in 1950 and 1954 and his Doctorate in 1976 from the University of Bradford, West Yorkshire, England. Prior to joining the Goodyear Aerospace team, he was a tenured professor of electrical engineering at the Air Force Institute of Technology, where he developed a graduate curriculum in Systems Reliability Engineering and Systems Modeling. For this he was cited with the Meritorious Civilian Service Award by the Department of the Air Force. Additionally he headed the Post Doctoral program there and conducted

research in computer networks modeling and qualification, physics of failure analysis, and software/hardware reliability. In his current position as a staff engineering consultant, he is conducting research in geoscience information networks, computer-aided interactive training systems, and stochastic analysis of remotely sensed data. Dr. Regulinski has published over 60 technical papers in various professional journals and is an Associate Editor of *IEEE Transactions on Reliability.* He has testified before a number of Congressional Committees, was President Carter's nominee for membership on the Nuclear Oversight Commission, and served on the Presidential Commission for Economic Revitilization. Presently he is serving on the IEEE Congressional Fellows Committee, is a NATO referee for the Advanced Studies Institutes, and is a member of Accreditation Board for Engineering and Technology. He received the Citizen of the Year award from the Ohio Omega Psi Phi, and the Outstanding Engineer award from the Ohio Society of Professional Engineers.

Dr. Regulinski is listed in the *American Men and Women of Science,* and *Who's Who in Engineering,* and is a member of Tau Beta Pi, Eta Kappa Nu, and Sigma Xi.

Conference and Course Calendar

DATE	CONFERENCE OR COURSE	LOCATION	MORE INFORMATION
May 7–10	1984 IEEE International Symposium on Circuits and Systems	Queen Elizabeth Hotel Montreal, Canada	Dr. R. Schaumann (612) 373-2483
May 14–16	34th Electronic Components Conference	Hyatt Regency Hotel New Orleans, LA	Leo Feinstein Sprague Electric Co. 115 Northeast Cutoff Worcester, MA 01606
May 21–23	Custom IC Conference	Rochester, NY	Dr. Savvas Chamberlain (519) 885-1211 x3330
May 30–June 1	1984 IEEE MTT-S International Microwave Symposium	San Francisco, CA	Donald Chambers (415) 857-2936
June 4–8	Reliability and Quality Control	University of Missouri-Columbia	A. P. Basu (314) 882-8283
June 6–8	ICCE (International Conference and Consumer Electronics)	Westin Hotel Rosemont, IL	Marvin Gottlieb (312) 775-1151
June 18–20	Sixteenth Power Modulator Symposium	Key Bridge Marriott Arlington, VA	Leonard Klein (212) 620-3377
Juen 18–21	IQEC	Anaheim, CA	Opt. Soc. of America (202) 223-8130
June 18--24	Fifteenth Power Electronics Specialists Conference	Gaithersburg, MD	Dr. Donald Bosack (312) 640-4410
June 19–22	CLEO '84	Anaheim, CA	Opt. Soc. of America (202) 223-8130
Oct. 22–24	1984 International Symposium on Noise and Clutter Rejection in Radars and Imaging Sensors	Tokyo, Japan	Prof. Hisanao Ogura (075) 791-3211 x620
Dec. 17–20	National Conference on Quality and Reliability	Bombay, India	Prof. M. N. Gopalan Indian Inst. of Techn. Bombay, India

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