

## DEVELOPMENT OF MANAGING RELIABILITY

from the academic papers

### PAST

The emergence of the large system during and after the second world war forced the basic change in the conventional manner of producing and developing minor products. Until quite recently it was generally accepted that while reliability was essential to military, space and electronics but not in other industries. With a few exceptions, however, it was not given comparable importance. The emphasis on reliability has been made not so much because of the type of industry but as an inevitable consequences of the ever growing complexity of the modern industrial systems. The industrial shores which were thought to have little to do with reliability are being visited with the wave of reliability as they became part of the ever growing web of the large system.

Hiroshi Shiomi, Professor, Chuo University  
Statistical Quality Control, Vol. 38, No. 6 1987, pp.57—61. "Interaction between QC and R (4) — Technology and Reliability"

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### PRESENT

Companies which have successfully adopted quality control activities emphasize, perhaps only naturally, the reliability aspect. In fact the reliability is already an inherent part of every stage of industrial development from conducting market survey, planning, designing and developing a product, pre-production planning, production itself, selling the product and providing after-sale services or subcontracting the production to outside sources or even procuring materials. Without these there cannot be a good quality. However recognizing the importance of reliability and permitting it to effectively function is altogether different. I do not believe that the importance of reliability is fully recognized so as to be made a systemic part of the TQC activities or the quality assurance program.

Hajime Makabe, Professor, Tokyo Institute of Technology  
Statistical Quality Control, Vol. 37, No. 12 1986, pp.72—77 "Nodal point between QC and R (3) — Significance of Reliability in Quality Assurance"

### FUTURE

Reliability engineers are invisible supporters of the drama. They are taken for granted when there is no accident and only recognized when there is one. This feature appears to be constant in any age.

There will be more technological innovations towards the 21st century and they will be incorporated in the larger social system. New technology contains many unknown factors and because of this one cannot deny that they will not become the cause of some social panic. Man must survive constantly in an environment of unknown risk. This is a challenge to the reliability engineers who are increasingly called upon to exercise their ingenuity in every expanding area.

Hajime Karatsu, Professor, Tokai University  
REAJ Magazine '87, Vol. 8, No. 4 1987, pp.19—21  
"Reliability in the 21st Century"



# SAFETY OF LARGE SYSTEMS

Dr. Jiro Kondo, President, Science Council of Japan



The innovation in automatic control, information processing and systems engineering has enabled man to build large systems such as the chemical industry, nuclear reactor, jumbo aircrafts and space shuttles. These systems which are operated by very few men achieve mammoth outputs. Indeed the advent of the large systems have made it possible for man to achieve high production efficiency as well as put the fruits of the scientific development to the benefit of ordinary people.

Once there is an accident, however, the expensive system is not only destroyed but a catastrophic consequences involve the general public. It follows, therefore, that the operation of a large system requires a constant improvement of both performance and safety.

One has only to recall the tragic accident of Union Carbide's toxic gas leakage in Bhopal, India in December of 1984 in which 2,000 people were killed with 200,000 seriously injured out of a population of 700,000.

Similarly the crash of Boeing 747 serving the Japan Airlines domestic route in August 1985 took the lives of 520 people on board.

The midair explosion of the US Space Shuttle Challenger in January 1986 claimed the lives of the seven astronauts and substantially delayed the US space development program.

The explosion of the 4th unit of Chernobyl nuclear power station in the USSR in April 1986 killed two operators and exposed many fire-fighters to

nuclear radiation. While it is reported that the death toll was 31 in the Soviet Union, the accident had far reaching consequences with the radiation fallout reaching all areas of Europe polluting the fresh food products and damaging national economies and causing millions of people to be concerned about their health for long period. The accident is said to have caused a delay of approximately 10 years in the nuclear development programs of European countries.

The lesson that can be drawn from these accidents is that the calamitic consequences does not happen suddenly but that it is a consequence of a small misalignment of part of the system, not even the whole, which over time expands to reach such proportions. In this process a cause leads to certain effects which in turn trigger grave consequences. The chain effect of this cause and effect relations is effectively explained with the Process Decision Program Chart (PDPC Method) developed by the author.

The method, originally developed for Dynamic Decision Making is suited to represent the time sequence of the cause and effect relations between the dynamically evolving environment (situation) and the human activity (decision) and is widely applied in quality control, as a new tool.

Analysis of major accidents suggest that in many cases they are caused by human error. It follows, therefore, that in order to prevent the reoccurrence of accidents, the logical conclusion is to find ways to prevent human error. This of course is easier said than done.

In the first place it is only human to make mistakes.

Secondly one might be able to content that increased redundancy will increase reliability but this holds in a machine system but not in a human system. In the latter the increase of operators does not necessarily produce more reliability because of the inevitable delay in decision making or confusion involving a greater number of people.

Thirdly an increasingly complex situation poses increasing limits on the human ability to make intelligent judgements. In a complex situation and under faster pace of change man often prove to lack adequ-



ate decision making capability.

What then can be done to prevent human error? The following are some suggestions.

## 1) Education in systems engineering:

Sixty years ago when Charles A. Lindbergh crossed the Atlantic on the Spirit of St. Louis, he knew his aircraft as well as his own body.

The pilot of Boeing 747 that crashed in 1985 had no idea that the vertical tail of his plane, located some 70 meters from the cockpit, had been broken. It was understandable that he did not decide to land at sea.

## 2) Computer Aided Operation:

As the systems are constantly updated it is desirable that the computer is programmed to instruct an appropriate manner of operation. The computer can be programmed to instruct safe operation through analyzing a complex sets of cause and effect relations.

There are people who suggest that the best way will be to build a totally automated factory operated by computers. But it is logically impossible to produce a computer program which takes into consideration all the odds and unpredictable events.

There is a psychological aspect as well. Today the automatic navigator device on an aircraft does most of the job leaving the pilot little to do during flight. It should follow that the airliners can operate without pilots just as the jet coasters in an amusement park but it is unlikely that people accept to travel if it is totally unmanned. This is because people want to believe that the trained pilot will make the right judgement if any when an unwarranted situation occurs.

Computer Aided Operation is only effective as an auxiliary tool to support the pilot system. If PDPC program can be created with a computer it will be possible to find a safe mode of operation under a complicated situation.

## 3) Quality Control Circle activities (QCC):

When people operate a low reliability system the operators tend to make few mistakes because they give full attention. Conversely people tend to make mistakes when operating a high reliability system because they take the system for granted.

It is difficult, on the other hand, to constantly motivate the system operators to have the incentive to perform well. The QCC has proved effective in heightening the operator morale and thus prevent mis-operation. It is desirable to install the QCC on a

large scale in operating large systems such as the nuclear power plant and the repair and maintenance of aircrafts.

Increased safety for the large systems should not be limited to the operating and maintenance stages. In fact it should be given priority from the design and manufacturing phases. To be sure it should be given sufficient attention from the pre-design planning stage.

This is where the man-system harmony becomes crucial. It basically means that there should be a unity between oriental philosophy and western science and technology. Prince Shotoku (574–622) promoted the idea that “unity should be of foremost importance.” Put in other words he emphasized harmony. If the system characteristics are designed to harmonize with human nature, man can reasonably operate the system to its fullest safety.

This sort of thinking and approach is useful when designing and operating systems which are composed entirely of humans or those formed by man and machine.

The Soviet defense system came under scrutiny when a Cessna 127 was piloted across the Soviet border and was permitted to land in the Red Square in Moscow. No amount of radar detection network, interception fighters, anti-air missile and a million and a half army (including the reserve corp) could not prevent a nineteen year old West German youth from piloting a propellar driven small aircraft into the Soviet territory.

The defect of the management system of the US National Aeronautics and Space Agency was pointed out by the President's Special Committee following the Challenger's fatal accident. The harmony between man and large system is vital.

Science Council of Japan has set forth a special committee devoted to study the problems of man-system interface.





# The 17th Reliability and Maintainability Symposium

The JUSE sponsored 17th Reliability and Maintainability Symposium was held for three days from June 2 to 4 at Ohtemachi, Tokyo with 660 people attending. Energetic discussion took place in the three meeting rooms.

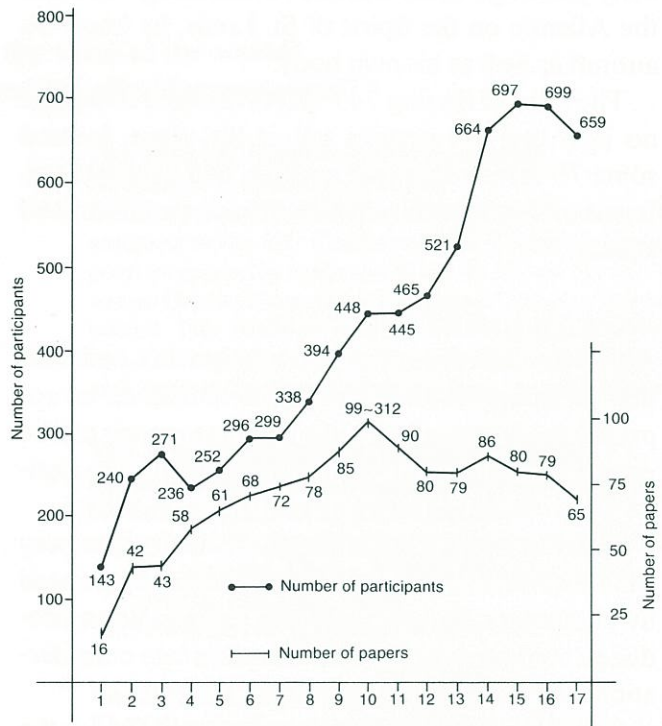
The keynote lecture was delivered by Dr. Noboru Tagaki, Professor Emeritus of Tokyo University and President of IEC 1977 to 1980. The special lecture was delivered by Dr. Jiro Shindo, President of Science Council of Japan on the theme of "Safety of Large Systems." (See page 2—3)

The following are the session subjects for this year and the number of papers reported under each subject.

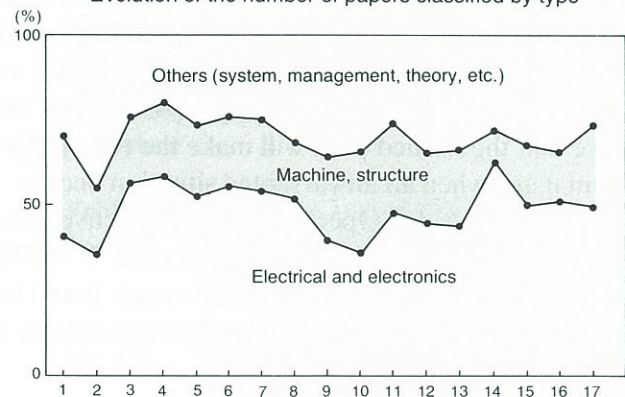
- Reliability on System: 4
- Reliability on Parts: 4
- Reliability and Machinery: 2
- Reliability Activities and Management: 7
- Reliability on Design: 4
- Collection and Analysis of Reliability Data: 5
- Reliability on Tests and Failure Analysis: 16
- Reliability and Maintainability: 7
- Reliability and Safety: 1
- Reliability and Software: 3
- Reliability on Parts: 4
- Reliability and Machinery: 2
- Quality Control and Reliability: 3
- Poster Session: 6

Cumulative number of participants and papers since the 1st Symposium in 1971 is in the right column.

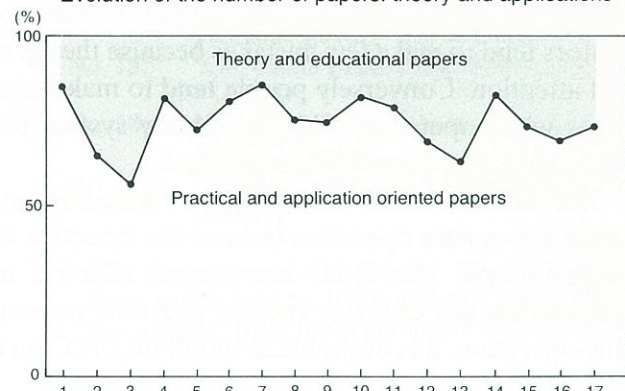
Number of participants and papers at Reliability and Maintainability Symposium



Evolution of the number of papers classified by type



Evolution of the number of papers: theory and applications



Number of Participants in Reliability Engineering and Management Seminars					
	Period (days)	1986 FY		Established in	Accumulative No. of participants*
		Frequency (times)	No. of participants		
RE Management Course	4	3	267	1966	2,149
RE Basic Course	15	3	247	1960	3,541
RE Introductory Course	4	7	687	1965	4,721
RE Six Day Osaka Course	6	2	167	1980	1,038
RE Course on EMEA · FTA	2	11	1,229	1976	5,110
RE Course on Design Review	Tokyo: 3 Osaka: 2	8	815	1977	3,702
RE Course on Probability Paper	2	1	45	1981	299
RE Course on Tests	3	2	176	1983	710
RE Course on Failure Analysis	3	1	100	1986	231

\*as of March 31, 1987



## Recommended Papers in the Symposium by Vote of the Participants

Symposium on Reliability and Maintainability selects and awards "recommended papers" by vote of the participating members.

To count as an effective vote the participants are asked to fill in the form (provided below) and sign their names.

1. Content: (5 points) judged on creativity, usefulness, completion and universality
2. Presentation: (5 points)
3. Use of references and data: (3 points)

The following are introductions of the three papers selected this year quoted from the English language report which is being edited for later publication.

### DURABILITY OF FLOPPY DISKS

Shinji Sugimoto, Information Processing Group, Fujitsu Limited

With the development of two-sided disk drives and thin-type drives, the head pressure has gradually increased to the extent that it affects the film on the disk. This has deteriorated the durability.

If catastrophic failure occurs on a floppy disk being used for a personal computer, word processor, or other data equipment, it may destroy the data on the floppy disk, causing an uncorrectable fault. In particular, if a fragment of film is removed from the disk, it contaminates the head. It is sometimes difficult to remove this contamination completely by running a head cleaning disk. Therefore, the head or drive may need to be replaced.

We have conducted various tests in order to eliminate failures due to deteriorated durability. Reported below are the tests conducted to evaluate the durability of the disks under ideal conditions and the durability under specific temperature and humidity conditions. Acceleration tests were also conducted to evaluate the durability of disks at various speeds and head pressures.

### THE CONSIDERATION ABOUT DEVICE'S ELECTROSTATIC TROUBLE

Takahide Uyeno, Takashi Yamazaki, Hiroshi Hizaki and  
Takaaki Numajiri  
Reliability, Quality and Control Dept., 2nd LSI Division  
NEC

Recently, the concern about device's electrostatic trouble is increasing rapidly in the electronic industry. According to more fine pattern and more high speed devices are developed, the damage voltage for electrostatic discharge is dropping more and more.

So, devices are degraded or destructed easily on the product lines. Therefore, device maker and user are driven by necessity to study electrostatic phenomena more than now. That is, they must grasp the generated mechanism and the charged level of electrostatic is caused on their product lines. Further, they have to grasp the damage voltage

for electrostatic is discharged from the charged body actually, and for a proper ESD (Electrostatic Discharge) test equipment.

Accordingly, it's necessary to take countermeasures for ESD precaution of device by investigating these problems.

Then we made some experiments to investigate the influence of charged human body for devices, and make a report obtained results.

### PROBLEMS IN PRESSURE COOKER TEST (II)

Hiroyoshi Yoden, Keiko Toi, Tosio Yamamoto and  
Hiroyuki Yoshida

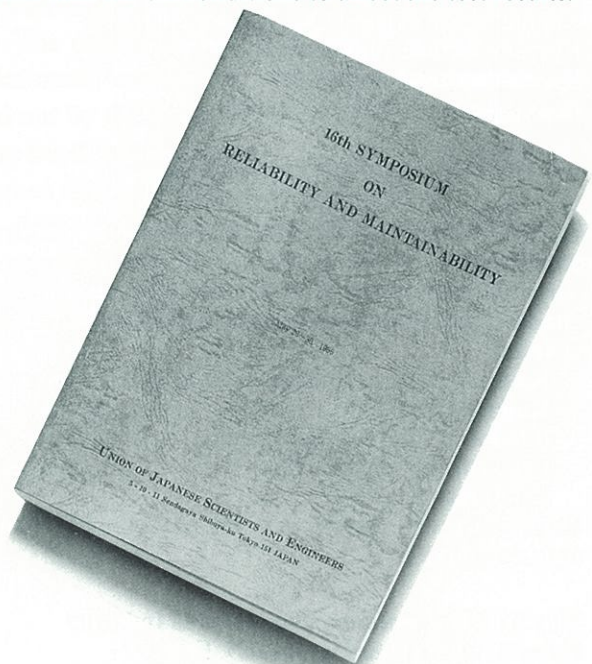
Reliability Engineering Section  
TABAI ESPEC CORPORATION

Pressure cooker tests (hereinafter abbreviated as PCT) are highly accelerated life tests used to evaluate the moisture resistance of the plastic encapsulated ICs.

These tests are rapidly coming into wide use.

The PCT, however, raises problems yet to be solved, such as the use of a pressure vessel, which do not allow identification of its internal state due to its construction, and the lack of established methods of measuring humidity under conditions of more than barometric pressure.

In addition, this test which is an accelerated life test under a high stress produced by temperatures of more than 100°C pressure of more than atmospheric pressure and moisture close to 100%, involves the risk of causing factors other than the set conditions to affect the test results.



Subscriptions to the English language report of 17th Reliability and Maintainability Symposium is available at JUSE at ¥3,000 per copy with ¥400 postage.



# “Quality — the Word of the World” 1987 QUALITY MONTH PLANNED

Theme of the Month: “Quality — the word of the world”  
“Let’s expand QC, first for customer”

## The 25th QC Conference for Top Management

November 16, Monday, in Tokyo

Theme: “Hard reality; search and think strategy”

Keynote lecture: Mr. Shoichiro Toyota, President of Toyota Motor Co., Ltd.

Special lecture: Mr. Taichi Sakaiya, Critic  
A foreign guest (under negotiation)

## The 37th QC Conference for Manager and Staff

November 17, Tuesday to 20, Friday, in Tokyo

Theme: “Towards more market-in — go forward to prosperity with collaboration”

Keynote lecture: Dr. Hajime Makabe, Professor of Tokyo Institute of Technology

Special lecture: Mr. Hideo Sugiura, Honda Motor Co., Ltd.

Workshop themes:

Workshop 1: “Search for the real customer”

Workshop 2: “Small group, medium group, the masses”

Workshop 3: “Overseas procurement, domestic demand expansion”

Workshop 4: “Lifecycle-quality”

Papers from overseas are welcome (Please in English).

## The 26th QC Conference for Foreman

November 11, Wednesday to 13, Friday, in Tokyo

Theme: “Let’s expand QC, first for customer”

Keynote lecture: (undecided)

Special lecture: (undecided)

Case reports are being collected.

## The 17th All Japan QC Circle Conference

November 10, Tuesday, in Tokyo

A total of sixteen reports from chapter representatives are expected.

The following numbers of reports were assigned to the chapters according to the numbers of their QC Circles registered:

Kanto: 4, Tokai: 3, Chugoku & Shikoku: 2, Kyushu: 2, Kinki: 2, Hokkaido 1, Tohoku: 1, Hokuriku: 1  
(Okinawa Chapter is not entitled to send a representative to the national conference since it does not have yet 1,000 registered QC Circles.)

Each concerned chapter is in the process of selecting its representatives.

## The 3rd QC Conference for Service Industry

November 26, Thursday and 27, Friday

Theme: “Let’s expand the circle of QC, let’s improve the quality of services”

Emphasis is given each year to increasing TQC promotion case reports rather than QC Circle activity case reports.

## The 18th QC Conference for Consumer

November 2, Monday, in Tokyo

“Numerical data will help us live better.” is the sub-theme assigned to the QC Conference for Customer. Survey reports prepared by trainees taking JUSE sponsored “Seminar on Quality Control for Consumer Leaders” will be presented. This year five subjects have been adopted for Tokyo, and eight for Osaka. Forty-five housewives in Tokyo and forty in Osaka are studying their specific subjects.

## The 28th Quality Month Lecture Meeting

Lecture meetings will be held this year in the following cities with the dates to be decided later:

Sapporo, Hachinohe, Nagano, Urawa, Shizuoka, Nagoya, Kanazawa, Osaka, Himeji, Hiroshima, Matsue, Takamatsu, Fukuoka, Naha

There will be two speakers for each city.

## The 28th Quality Month Slogans

The following five slogans have been adopted out of 821 applications which have successfully passed the primary elimination:

“TQC: unity of man, sum of wisdom, linkage of management”

“Create quality by putting yourself in user’s place”

“Data and facts: the key to quality assurance”

“Standardization: Once a rule, always a rule”

“QC circle activities by all members: bright future for the workplace”

## Publishing Plan of the Text of 1987 Quality Month”

- No. 179 “Expensive Yen, Management and Quality Control” (designed for managers)
- No. 180 “to be decided later” (for middle management)
- No. 181 “See the Hard Facts” (for staff)
- No. 182 “Deming Award Belongs to All — After a Series of Failures” (for medium size companies)
- No. 183 “Quality Control for Services Industry” (for services industry)
- No. 184 “Training Strong Shop Leaders — QC Way of Problem Solving” (for shop stewards)
- No. 185 “QC Circle Leader is a Shining Sun” (for QC Circles)
- No. 186 “3rd QC Circle Activities Analysis Report” (for QC Circles)
- No. 187 “Quality Control Can Also be Mine” (for consumers)

The above-mentioned Quality Month Slogans and Texts will be sold by JUSE and JSA (Japan Standards Association) from the beginning of October, 1987.



## Japanese Quality Control Features Reviewed by 44th QC Symposium

The JUSE sponsored QC (Quality Control) Symposium held biannually, in spring and autumn, has provided a landmark of the progress of the QC activities in Japan as experts meet to discuss the topical issues.

The 44th Symposium was held at a hotel in Hakone for three days beginning June 4 with the participation of 68 invited experts and 45 quality related directors and managers of subscribing companies.

It was at the earlier symposium of the same kind held in 1969 when the first international quality control conference convened in Japan that the presently used "Six Features of Japan's Quality Control" had been adopted. In conjunction with the third international conference scheduled to be held in Japan in October it was thought appropriate to review "Six Features of Japan's Quality Control." After due discussions the June symposium adopted ten features of Japan's quality control which is to be announced at the forthcoming international conference in October.

## The Difficult Situation of Japanese Companies and QC Circle Activities 19th QC Circle Symposium

The 19th QC Circle Symposium jointly sponsored by JUSE and the QC Circle Headquarters was held at a Hakone hotel on July 4—5 with 112 advisors attending from the Headquarters.

At the symposium the following case reports were presented: Nippon Steel, Nissan Motor and Aishin Seiki from the manufacturing sector, Kajima Corporation from the construction industry, Ringer Hat (franchise restaurant) from the services industry and Pentel Co. and Komatsu Ltd. representing the companies operating abroad. A general report of the service industry was also presented.

On the first day of the symposium the case reports mentioned above were reported to the plenary session. On the morning of the second day discussions were held in smaller groups representing the above four categories and in the afternoon a general discussion took place following the group reports. The symposium adopted the direction for the QC Circles for the future with a view to contributing to achieving a breakthrough of the present dire state of the industries.

## 1987 Spring Conference on Quality Control in Nagoya SQC Award Presented

Two QC conferences, one during the QC Month in November and the other in spring, are held every year in a

local industrial city for the benefit of the QC staff and managers of the companies. This year's spring conference was held in Nagoya with the theme: "Quality First — Planning for the Future" with the participation of 800 people and the presentation of 83 papers.

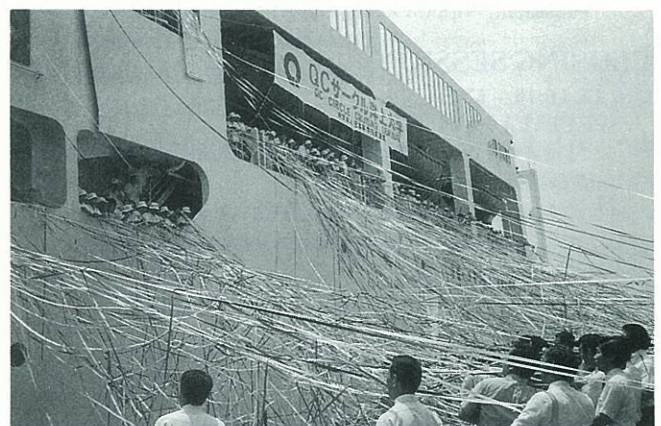
At the conference SQC Award (certificate and a present) is presented to excellent papers selected from those published in the SQC magazine JUSE from January to December of the previous year. The selection is made by the editorial committee of the magazine for having made "an outstanding contribution to the quality control activities". This year three awards were presented to Toyobo Co., Toyota Machine Works and Yasukawa Electric Manufacturing Co. for their papers on reducing defects and improving precision and performance.

## 17th Quality Control Study Team Visits 5 European Countries

JUSE 17th QC Study Team headed by Dr. Y. Kondo (Professor Emeritus of Kyoto University) visited Europe for 14 days starting May 23. The team visited Citroen Co. in France, Nissan Motor in England, Olivetti in Italy and Daimler-Benz and Siemens in West Germany before attending 31st EOQC Convention in Munich. The team met old friends and made many new ones before returning home.

## 21st QC Circle Cruising Seminar on its Route

The 21st QC Circle Cruising Seminar (sponsored by JUSE since 1971) left the Port of Tokyo on July 8 with 435 participants aboard the chartered vessel, "Shin-Sakura Maru." The participants will join one of the two courses; "QC Circle Leader Course" or "QC Circle Promoter Course" as the boat makes port calls on Hong Kong and Keelung before returning July 21.





**ICQC '87 Tokyo**

# INTERNATIONAL CONFERENCE ON QUALITY CONTROL 1987 TOKYO

***"QUALITY FIRST — Again & Ever"***

## HIGHLIGHTS OF THE CONFERENCE

### OPENING SESSION

Oct. 20, 9:20 ~ 12:40

#### WELCOME ADDRESS

by Mr. Kohei SUZUE,  
Chairman, the Organizing Committee, ICQC '87

#### OPENING ADDRESS

by Dr. Kaoru ISHIKAWA,  
Chairman, the Program Committee, ICQC '87

#### CONGRATULATORY SPEECH

by Representatives from  
IAQ, ASQC, EOQC and JSQC

#### KEYNOTE ADDRESS

by Mr. Shoichiro KOBAYASHI, Chairman,  
The Kansai Electric Power Co., Inc.

#### SPECIAL LECTURE [I]

by Dr. Joseph M. JURAN, Chairman,  
Juran Institute Inc.

#### SPECIAL LECTURE [II]

by Top Management from Abroad  
(under negotiation)

### SPECIAL SESSION

Oct. 20, 14:00 ~ 17:40

#### INTERNATIONAL PANEL DISCUSSION ON MANAGING FOR QUALITY

Dr. Joseph M. JURAN (Leader)

Mr. John J. HUDIBURG

Chairman and Chief Executive Officer,  
Florida Power & Light Co.

USA

Mr. Martin KUILMAN

Vice Chairman, Board of Management,  
N.V. Philips Gloeilampenfabrieken THE NETHERLANDS

Mr. Wolfgang SAUER

President, Volkswagen do Brasil

BRAZIL

Mr. Saburo OHNISHI

President, Nippon Zeon Co., Ltd.

JAPAN

### CLOSING SESSION

Oct. 22, 16:10 ~ 17:10

#### SPECIAL LECTURE [III]

"Total Quality in the Future — A Global Review for the  
Next Decade"

by Dr. Armand V. FEIGENBAUM

President, General Systems Co., Inc.

#### SPECIAL LECTURE [IV]

"Changes Required in Management for Quality"

by Dr. W. Edwards DEMING

Consultant in Statistics

### TECHNICAL SESSION Oct. 21, 22

#### SESSION TITLES

##### STREAM A

1. Development and Design of Quality Control Systems (18)
2. Company-wide Quality Control (12)

##### STREAM B

1. New Product Planning and Development (6)
2. Audit of Quality and Quality Control System (2)
3. Education and Training of Quality Control (8)
4. QC Circle Activities (4)
5. Human Aspects (7)

##### STREAM C

1. Quality and Economy (2)
2. Environmental Quality and Control (2)
3. Quality Assurance (4)
4. Reliability and Maintainability (8)
5. National Implementation (8)
6. Quality Control in Service Industries (5)

##### STREAM D

1. Application of Statistical Methods (24)
2. Quality and Process Analysis (4)

##### STREAM E (Poster Session)

- I. CWQC, QC Circle, Reliability and Others (15)
- II. Process Analysis, National Implementation (15)
- III. QC System and Quality Assurance (19)
- IV. Quality Control Techniques, Education & Training (18)

### PLANT VISITS IN TOKYO AREA

Oct. 23, Friday 08:00 ~ 17:00

- A. NEC CORPORATION
- B. NISSAN MOTOR CO., LTD.
- C. BRIDGESTONE CORPORATION
- D. FUJI XEROX CO., LTD.
- E. KOBAYASHI KOSE CO., LTD.
- F. YOKOGAWA-HEWLETT PACKARD CO., LTD.
- G. ASAHI BREWERIES LTD.
- H. NIHON RADIATOR CO., LTD.
- J. MITSUKOSHI LTD. & YAMAGIWA CORPORATION

### PRE-CONFERENCE ONE DAY SEMINAR

"TQC IN JAPAN"

Oct. 19 9:20 ~ 16:20

### POST-CONFERENCE TOUR

"ANCIENT AND MODERN JAPAN"

Oct. 24 to 31

\* To obtain more detailed information, please write to JUSE for the Final Circular.