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WORKSHOP ON SAFETY IN CHEMICAL PRODUCTION
PACIFICO, YOKOHAMA, JAPAN FROM 31 MAY TO 2 JUNE 1993

XP/INT/92/128

Technical report: Findings and recommendations*

Prepared by
the United Nations Industrial Development Organization

Based on the work of J. A. Kopytowski,
consultant in chemical plant safety

Backstopping Officer: B. Sugavanam, Chemical Industries Branch

* This document has not been edited.

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ABSTRACT

This report summarizes the result of the work carried out the by expert recruited for preparation of the issue paper on "Safe operation of the chemical industry in developing countries" and participation in the **second IUPAC/UNIDO Workshop on Safety in Chemical Industry** held at Yokohama, Japan, from 31 May to 6 June 1993.

The project activities were divided into three stages:

- (1) Pre-workshop period (15 May-30 May);
- (2) Workshop period (30 May-7 June);
- (3) Post workshop period (8 June-16 June).

The transfer of know how and information in the field of safe management of the chemical installations is becoming an urgent priority in the developing countries. By the joint efforts of IUPAC-COCI and UNIDO two workshops on Safety in Chemical Production have been organized. The emerging need for day-to-day assistance and coordination of efforts for safe operation of chemical installations has produced a request to organize the operational programme Global Network on Safety for Chemical Industry (GLONESA). The results of the 2nd Workshop indicated that numerous actions, on information, legislation, guidelines and training are necessary to provide to the chemical industries of developing countries assistance in the field of safe operation chemical installations and this must be done on a regular and organized basis. The advances in the industrialized countries in developing legislation and guidelines on safe operation of chemical installations indicate that **safety engineering and management is becoming a new field of research, teaching, and training at education centres and industry.**

Following the information collected during the Workshop, and discussions held with the representatives of IUPAC-COCI, necessary documents have been prepared examining financial sources to undertake the implementation of a piloting scheme of GLONESA in the Asia Pacific Region.

Introduction

In the period of 1989-1991 UNIDO had prepared number of studies related to safety in chemical industry, especially referring to the emergency and contingency planning. Having in mind the large impact of incorrect operation of chemical installations specially on the environment, UNIDO had organized a workshop in Vienna and participated in the Conference on Ecologically Sustainable Industrial Development, held at Copenhagen, Denmark, from 14 to 18 October 1991. Also in 1991 a joint UNDP/UNIDO/APCTT workshop held at Manila, the Philippines, was organized on Environmental Considerations and Waste Recycling in the Chemical, Metallurgical and Engineering Industries, from 9 to 13 December. In 1991 IUPAC and UNIDO have organized joint workshop on Safety in Chemical Production in Basel, Switzerland, where more than 300 participants from industrialized and developing countries discussed the risks of accidents in chemical industry and modalities for their prevention and mitigation. In 1993 the 2nd workshop on Safety in Chemical Industry was organized in Yokohama, Japan. At this Workshop more than 900 participants from industrialized and developing countries have indicated the need for regular programmes on the improvement of managerial capabilities in the safe operation of the chemical industry in developing countries through information dissemination, training and advisory services. The IUPAC-COCI and UNIDO have been indicated as organizations responsible for initiative and actions in this field.

There are numerous initiatives taken which are the improvement of the environmental impact of the chemical industry and for ensuring that the operation of chemical installations is safe for operators and the environment. Recently, ILO has approved Convention N 170 (1990) related to the safety in the chemical industry operation. This convention in a complex way defines the responsibility of entrepreneurs to qualify products and ensure safety in operation of chemical installation and handling of chemical products. This convention will introduce ratification by countries of a document which will become a legislative obligation and bring about actions which have to be implemented. Also ILO introduced a proposal for registration of hazardous substances based on the ILO Harmonised Classification System (HCS Project). Also WHO has organized modalities for publication of lists of hazardous substances and their registration procedure e.g International Register of Potentially Toxic Chemicals - (IRPTC). UNEP through its APELL programme compiled the possible of information useful to prevent environment pollution. However, all these projects and programmes lack two basic elements:

- direct involvement of the industry from developing countries on a regular basis;
- continuous programme for training in good managerial practices and accident prevention and mitigation for managers from the developing countries, especially for those from medium and small scale industry.

The issue of safe production, handling and application of chemical products has become an important international issue as the chemical industry in developing countries has started to develop at a faster rate than the possibility

of organizing managers trained in safe operation. Therefore any programme combining the control of the safety issues from the legislative and guidelines point of view, as well as undertaking regular training of managers, should find support of the international community. There are many funding possibilities for a such programme:

- regular regional programme of UNDP;
- donor countries contribution;
- non-governmental organizations contribution;
- insurance companies contribution;
- Governments' from the region contribution, etc.

I. Expert activities

An expert was recruited to perform the following tasks (Job description Annex I):

- to prepare an issue paper "Safe operation of the chemical industry in developing countries";
- to participate in the workshop and jointly with UNIDO's staff member (Backstopping officer) to moderate the panel VI-9;
- to prepare necessary programme/project documents for further activities in the field of safety information dissemination and provide managerial training.

The issue paper was prepared over the period from 15-30 May 1993, the abstract has been submitted to the organizing committee and has been published in the Workshop programme. The full text of the issue paper, according to the editors request, has been transferred to organizers on the 31 May 1993 with the diskette facilitating editorial work (Annex II). The issue paper will be published in the Workshop Proceedings.

Expert travelled to Yokohama, Japan on 30 May arriving on 31 May and registered his participation. The final programme of the Workshop is attached. (Annex III).

The technical programme of Workshop started on 1 June. The opening ceremony has been attended by Japanese Government representatives as well as the Kanagawa Province Governor, Japanese and International Union of Pure and Applied Chemistry (IUPAC) officials.

Numerous experts participated in the Workshop (over 900) from France, Germany, the Netherlands, Russia, the United Kingdom, the United State of America, Japan and other countries. Developing countries participation have been ensured by support of IUPAC-COCI and UNIDO, or by their own organizations, representing the following countries: Brazil, China, Egypt, Hong Kong, India,

Indonesia, Republic of Korea, Malaysia, Mexico, Nigeria, Pakistan, the Philippines, Saudi Arabia, Singapore, Taiwan Province, Thailand and Turkey. The list of participants from developing countries is attached (Annex IV).

The Workshop was divided into three forms of activities:

- plenary session papers presentation. All 27 papers mentioned in the programme papers have been presented during the four sessions;
- visits to the local chemical industry enterprises. All Participants were divided into 13 groups and visited different enterprises. The expert jointly, with the UNIDO staff member (BSO) visited Showa Denko Co. and were introduced to the safety management of the factory level and shown special programmes developed to increase awareness of operators and staff to the potential dangers of chemical installation operation;
- panel discussions. Participants were divided into ten panels, moderated by one of the leaders. One expert with the BSO, took part as a moderator of the Panel in the session VI-9: Action of Education and Training Center. In the Panel session also the issue paper was presented. In this panel the majority of developing country participants also took part.

At the end of the Workshop at the final plenary meeting the expert was called upon to present the results of Panel discussions and to take part in approving the final recommendations of the Workshop (Annex V).

At the final plenary meeting the expert presented the results of the discussion and recommendations of Panel VI-9.

In the afternoon of 6 June the Workshop closed and the expert returned to Vienna on the 8 June.

During the last part of the assignment, from 8-15 June, expert prepared documents which may serve as further promotion and implementation documents of the GLONESA programme. The following documents have been prepared:

- TSS-1 for piloting scheme of GLONESA in Asia Pacific Region (Annex VI);
- Terms of Reference for operation of the Regional Asia Pacific Regional Centre of GLONESA to be presented at the meeting of IUPAC-COCI in September at their meeting in Lisbon
- Charter of GLONESA with membership declarations to facilitate at a later date collection of admissions of chemical industry enterprises (Annex VII).

II. Workshop Performance

A. Plenary Sessions

During the four plenary sessions 27 papers were presented, of which eight were given by Japanese participants, two by the developing country representatives and one by UNIDO representative. The list of lecturers is attached (Annex VIII). The full content of papers will be given in the Workshop Proceedings.

Session I. Safety management

At this session 6 papers were presented. The general trend of presentation was showed the complex structure of legislation and guidelines developed by advanced companies in Europe, Japan and the United State of America. In fact papers from Saudi Arabia, however, presented at the II Session also belongs to this feature. It can be concluded that safety management is becoming a complex and highly developed field of research requiring engineering and managerial techniques for the implementation and high-level of specialized know-how. This know-how is supposed to be transferred to the developing countries free of charge having in mind their social well being and for environmental protection. There are two dominating kind of measures for safe operation of chemical installations: one refers to the number of hours without accident, and the second indicates the lost workhours per one million hours of operation. The last figures for advanced companies in Japan are in range from 0.14 to 0.27. It was mentioned several times that OSHA's rule 1910 and ISO 9000 are basic legislative standards to which every effort of improving safety of operation is referred. The company standards are divided into several chapters related to the process design safety, design procedures, process equipment integrity, process risk management, human factors and training procedures, incident investigation rules, and audits and corrective actions. More then 40 different guidelines, standards and procedures are in continuous implementation, development and improvement. It has been mentioned by several speakers that improvement of the safety of the chemical installations operation may have substantial impact on the investment costs as well as operation costs. Only well organized companies producing with substantial margin of profit may allow introduction of complex and expensive safety measures preventing accidents.

Session II. Education and Training

At this session 9 papers were presented. The concept of education in undergraduate courses given by Technical Universities differs from country to country and these are not yet established in uniform standards. At European Universities, the trend is to organize the safety management course around modular concepts, each module covering specific element of safety management problems. However, interest of students is at a low level and courses not have enough coverage.

In several cases it was indicated that safety management is covered in very short courses which cannot give adequate knowledge especially for inexperienced in-plant operation students. The situation is very similar to the early fifties

when chemical engineering was introduced as a separate course and could not keep its competitiveness to chemistry courses. The typical syllabus is composed of legislation, product safety, hazards of operation, risk analysis, environmental impacts assessment, inspection rules, toxicity fire and explosion danger, as well as the maintenance safety and its impact on plant operations.

Plant education and training in large companies is far more advanced than the level of education at Universities. In the United State of America, Center for Chemical Process Safety at AIChE has published "Plant guidelines for the technical management of chemical process safety" and is preparing more over 20 guidelines and operation standards to be introduced by the year 1996. In management training it was stressed that from operation and supervision of the control instrumentation now managers must acquire knowledge of operation, facility inspection and safety control and training. The several stages of development of awareness, acquiring knowledge, training in simulated actions, and creating permanent habits of reaction and reflection have been introduced to American and Japanese companies as concepts improving the safety of operation. The UNIDO paper has shown the critical situation of developing countries in the field of know how of safe operation as well as the need for continuous action in transferring of safety management know-how in terms of safety, health and environment (SHE) concept. It was been proposed to organize Global Network on Safety for Chemical Industry on a permanent basis, instead of organization of casual seminars and workshops.

The session was concluded by informative, interesting and simple simulation experiments of fire and explosions caused by different sources of energy.

Session III. Evaluation of Hazards

Five papers were presented at the session. Contrary to the first Workshop in Basel where this issue was dominated the workshop programme, papers at second workshop on Hazard Assessment were very limited. The new legislative basis approved recently in the USA were presented and obviously the impact on safety improvement of this legislation could not yet be assessed. Also Japanese and European companies experience in hazard evaluation of new products were presented. The multi-step analytical approach seems to be efficient, however it requires highly skilled personnel and a team composed of diversified professions and experienced members. It was stated that evaluation of hazards of average chemical process would require a team of 8-10 members working from four to six weeks. Training of professionals in preparation for hazard assessment takes usually three to four weeks. In the case of a new process the hazard assessment may cost as much as 1% of plant investment cost.

The most interesting issue discussed at this session was establishment by NBS of USA of a new standard on Material Safety Data Sheet (MSDS). The standard was initiated and proposed by Chemical Manufacturers Association and developed by its Health Programme. The function of MSDS is multilateral and is related to the application, handling and assessment of hazards for user and producer. The intention behind the standard introduction was to establish equal conditions for sale of chemical products for all companies which should be obliged to render publicly all information concerning the saleable product. The MSDS format

contains 6-25 pages for each product. Information is given in the following chapters:

- Material (name, producer, composition, basic hazards);
- Hazardous situations (first aid, fire fighting, mitigation of release accident);
- Prevention of a hazardous situation (handling and storage, personnel protection, physical, chemical properties, stabilization);
- Other (toxicological, ecological, disposal considerations, transport, liability etc.)

It seems that worldwide application of standard MSDS could highly improve the safety situation in chemicals processing, handling and storage.

Interesting methodology was presented in evaluation of energy hazards on chemical reaction out of control at several levels of hazards through application of the heat balances method.

Session IV. Engineering

Seven papers were presented at the session in which different aspects of engineering on plant operation were given. The main aspects of process automation and control methods on hazards reduction and implementation of expert systems were discussed. At this session also inspection problems were presented. The pragmatic way of inspecting plants in the United Kingdom and the United State of America were presented, as well as use of on-line computers in safety assessment. Inspection techniques were described, questionnaires discussed at different stages of inspection. The United Kingdom has introduced Structural Auditing Techniques for the Assessment of Management Systems. In case of failure the 3-dimensional matrix is analyzed, indicating results of failure, reasons of failure and measures taken for efficiency.

B. Plant Visits

Session V. Plant visits

Showa Denko Company presented at Kawasaki Works the KYT and PKY safety campaign. KYT is a Japanese abbreviation of Danger Prediction Training and PKY is a Japanese abbreviation of Process Danger Prediction. These safety training methods have been developed in 1974 by the Wakayama Ironworks of Sumitomo Metal Industries, Ltd. and adopted to the chemical industry by Showa Denko in 1978. The teams of workers of one shift through discussions in groups found out latent factors that can cause accident.

From all the factors they select critical ones and work out measures to cope with such critical factors.

This discussion took place every morning before the start of the work. The results are recorded in a special diary and management of plant is obliged to

take measures prescribed through discussion of all teams serving the installation. There are at Kawasaki Works about 700 meetings every year in each section.

The Process Danger Prediction meetings take place once a month in groups of workers on subjects of phenomenons leading to abnormal situations. Workers discuss what caused the abnormal situation, what should be done to correct the situation and how the situation may develop if corrective measures are not taken properly (kind of emergency planning). In all sections of the Kawasaki Works 990 meetings took place in 1992.

During the visit of participants two group of workers demonstrated the KYK and PKY sessions on particular problems in the factory (at KYK session the situation of switching from gas fuel to naphtha in the reforming section of ammonia plant, at PKY session the possible hazard of vaccumization of a large volume tank of styrene).

The Group visited Kawasaki Works ammonia plant which has a 500t/day capacity based on naphtha as raw material.

C. Panel discussions

Session VI-9. Action of Education and Training Centre

Moderators:

Backstopping Officer of the project.

J.A. Kopytowski - Consultant (UNIDO)

Readings: Global Network for Safety in Chemical

Production

Safety of chemical industry in developing countries

Discussion target: Improvement of industrial safety in chemical industry in developing countries through establishment of the Global (Regional) Network on the Industrial Safety in Chemical Industry and modalities of its operation.

Immediate tasks of GLONESA:

- (1) To disseminate safety information considering the hazardous materials, their treatment, handling and application. This information must reach directly producers and entrepreneurs as well as the Governments and other local agencies.
- (2) Methodological assistance to ensure transfer of inherently safe technology, through HAZOP studies and registration procedures. Content of HAZOP study and necessary qualifications to prepare it.

- (3) To organize workshops and exchange of information to transfer know-how in safety management, accidents prevention and contingency planning at the operation of chemical installation.
- (4) How to establish national system of rescue and accident management.
- (5) To advise Governments on adequate regulations concerning the safety in production and logistics of chemical products.
- (6) To produce and disseminate newsletters discussing each new accident indicating preventive course of action.

Organization and operation modalities:

Center, focal points, advisory services, workshops etc. Preliminary organization chart and staffing.

Necessary financial resources and sources:

Cost assessment and options for financing:

- seed money;
- industry contribution by membership fee;
- consulting services.

Potential donors and contributors

Responsibility of licensors

Time schedule of implementation:

Time table of actions and responsible bodies.

Final conclusions and recommendations:

GLONESA or other modalities of safety improvement in chemical industry in developing countries.

Result: Panel position paper.

During the session the issue paper was presented and discussion tasks established. In the session, 32 participants took part. Of them, 9 participants mainly from developing countries (two Japanese participants contributed to the discussion) stressed the urgent need for everyday activities in the field of safety improvement in developing countries. The following comments were made on the tasks of the GLONESA:

INFORMATION - well structured system of information distribution through different means towards recipient with continuous feedback.

TRAINING - from top management to the trainers of operators.

ADVISORY SERVICES - priority on guidelines and formats internationally accepted.

Need for dissemination atleast to one of the dominating region (country) and language was stressed.

The organization chart of GLONESA with UNIDO as coordinating Task Force, Regional Centres and National Focal Points as operating bodies was discussed and found satisfactory.

FINANCIAL SOURCE - to set up a system whereby donor countries, non-governmental institutions and local Governments should be involved. GLONESA should establish membership of network and members should pay a fee. It has been stressed that when need for revamping of chemical installation will arise to improve the safety conditions and environment protection, then local Governments should subsidize the investment credits for small and medium size industries.

Finally the Panel approved the following recommendation:

"There is a need for coordinated efforts of the international community to promote practical steps in transferring awareness and know-how in the field of safety management of chemical industry operations down to the factory level. Integrated efforts of GLONESA may serve this purpose, through organization of Regional Centres and National Focal Points (at already established institutions), reaching as many as possible member companies especially of small-and medium-size. Therefore, support from Governments and industrial associations/companies is necessary and relevant action of IUPAC-COCI/UNIDO is expected.

D. Closing Session

Overview and Recommendations

During the session all Panels reported their conclusions and recommendations. Dr. Kopytowski presented the results of work of Panel VI-9. At the end of the session Dr. Fishli (COCI President) presented the final workshop Recommendations.

(Annex V).

E. Evaluation of Workshop by Participants.

Special evaluation format has been distributed before the Workshop and participants supported by UNIDO were requested to fill in the questionnaire. Eight forms out of ten have returned and are kept in the project file.

Below summary is given of technical evaluation:

Views on:

1) Overall Programme	Relevant	Not relevant		
	8	-		
2) Topics discussed in field of participant	All	Some	None	
	5	3	-	
3) Most important topic for participant's company:				

Role of Governments on safety management
 Safety Management guidelines
 Safety Education
 Evaluation of hazards
 Process safety

4) Quality of presentation	Good	Average	Poor
Lectures	7	1	-
Demcnstration	6	2	1
Field trips	7	1	-
Discussions	5	3	-

One participant complained about the poor quality of abstracts.

5) Expected company involvement in GLONESA activities:

National level	Regional level	Global level
8	3	2

General evaluation of the Workshop was positive and participants found it informative, however, they delay in the publication of proceedings may substantially diminish positive effects, because participants were left only with their notes from various sessions, not having taken to their countries the full text papers.

RECOMMENDATIONS

- 1) It is necessary for UNIDO to define its role in the implementation of safety measures in chemical industry in developing countries. The concept of GLONESA is economically efficient, technically reliable and has the support of industrialized countries companies and their associations.
- 2) It is necessary to take part in the IUPAC COCI meeting in Lisbon in September 1993 to present the previously disseminated Terms of Reference for GLONESA and discuss optional financial sources to which both organizations have to make address for support.
- 3) It would be advisable to organize a small seminar in Vienna for Permanent Mission representatives from developing countries giving them insight into know-

how transfer in the field of safe operation of chemical industry. The recommendations from this seminar should be transferred to the PBC and later to donor organizations and countries.

JOB DESCRIPTION

XP/INT/92/128/11-51

- Title: Chemical Plant Safety (Operational)
- Duration: 1 m/m over a period of 8 months
- Duty Station: Vienna (7 days) March 1993 (Dates to be confirmed)
Home based (15 days) flexible
Yokohama - 8 days (May 31 to June 5, 1993)
- Purpose of the Project: To promote safety in chemical production in relation to industries in developing countries.
- Duties: The consultant in collaboration with the backstopping officer is expected to analyze the factors involved in chemical production in developing countries and will prepare an issue paper for risk assessment/ reduction and management in chemical industries and how developing countries could collaborate under a global networking exchanging information on safety issues related to operational, occupational and environmental aspects. He is expected to use some of UNIDO's reports already available in this area.
- The issue paper will be presented on behalf of UNIDO at the forthcoming workshop on Safety in Chemical Production at Yokohama, Japan in May 1993.
- He should also assist during the workshop discussions with UNIDO participants regarding their reaction to the workshop and how they would like to collaborate on a global networking. He is expected to submit a joint report on the meeting giving his findings and recommendations and also prepare a project proposal for follow-up phase.

Qualifications:

Chemist/ chemical engineer or safety engineer with extensive experience in chemical industries, plant safety, risk management and should be familiar with good manufacturing practices. Experience in integrated approach to chemical industry development and experience in developing countries with great potential for chemical industry development would be an advantage.

Language:

English

Background information:

Recent upsurge in the production and use of chemicals in developing countries especially in Asia, Latin America and Arab regions there is a great concern over safety in its production and also the environmental consequences during production, consumption and post consumption. The recent UNCED meeting held in Rio has set the tone for global action and has given the go ahead to consolidate those areas in which various organizations have competence in dealing with problems. UNIDO has been active in promoting safety in chemical production. In this it collaborated with IUPAC in their first workshop on Safety in Chemical production held in 1990 at Basel and now will take an active role in their 2nd workshop to be held in Yokohama, Japan during May-June 1993.

UNIDO will use the workshop as a spring board to start its programme to set up a Global Network on Safety (GLONESA) in chemical production.

SAFE OPERATION OF CHEMICAL INDUSTRY IN DEVELOPING COUNTRIES

J.A.Kopytowski

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Chemical products are important components of all manufacturing industries and they also occupy a priority position in consumption patterns of any society. However, operation of this industry is hazardous and requires special measures to prevent and mitigate accidents.

The overall world picture is not encouraging. Over 600,000 workers injured per year, absent from work nearly 2 million working days has obviously negative economic impact on industry operation. The social costs of industrial accidents in chemical industry alone may be estimated to achieve several hundreds million of dollars per year. However, the humanitarian aspects are much worse. Unsafe working environment negatively influence labour relations and lowers the work efficiency and satisfaction.

The structure of chemical industry in developing countries differs substantially from that of industrialized countries. It can be seen that average production capacity of chemical enterprise is 5-6 times lower in developing countries and production efficiency per employee is 10-15 times higher in developed countries. Obviously this means that many operations are not mechanized and automated and potential possibility of accident is much higher.

The rules and regulations issued by industrialized countries are currently more and more precise and requiring lot of managerial continuous efforts:

- at the design and construction stages;
- at the normal operation stage;
- at the casualty and accident.

The review of selected accidents is given in paper. This review indicates that through managerial actions, especially education and training over 90% of accidents could be avoided. With very limited financial resources:

- it is possible to disseminate safety information considering the hazardous materials their treatment, handling and application.

- it is possible to ensure transfer of inherently safe technology, through HAZOP studies and registration procedures.

- it is possible to disseminate newsletters discussing each new accident indicating preventive course of action.

- it is possible through workshops and exchange of information to transfer know-how in safety management and contingency planning.

- it is possible through advisory services of experts to advise Governments on adequate regulations concerning the safety in production and logistics of chemical products.

These functions could be exercised by the Global Network on Safety in Chemical Industry (GLONESA).

*/ The full content of the paper will be published in 2-nd IUPAC Workshop Proceedings. For reference see the backstopping officer.

PROGRAM

6/1 (TUE)

OPENING SESSION

9:00—9:40 Opening Ceremony

SESSION I. SAFETY MANAGEMENT

Chairperson: Koichi Nishikawa (Japan Chem. Ind. Assoc)
Hans Künzi (Hoffman-La Roche)

- 9:40—10:10 I—1 **Safety Management at Chemical Plants in Europe**
SWITZERLAND H. Künzi (Roche)
- 10:10—10:40 I—2 **Achieving Excellence in Process Safety Management**
USA D. G. Wika (Du Pont)
- 11:10—11:40 I—3 **The Role of Government for Safety Management
in Japan**
JAPAN I. Hori (Kanagawa Prefectural Gov't)
- 11:40—12:10 I—4 **Safety Management at Chemical Plants in Japan**
JAPAN Y. Sakami (Sumitomo Chem.)
- 12:10—12:40 I—5 **Safety Management at Universities and Labora-
tories in Europe**
SWITZERLAND P. Rüedi (Univ. Zurich)
- 12:10—12:40 I—6 **Safety Management at Universities and Labora-
tories in Japan**
JAPAN K. Tamaru (Tokyo Univ of Sci.)

SESSION II. EDUCATION AND TRAINING

Chairperson: Sanford Schreiber (Am. Inst. Chem. Eng.)
Toshisuke Hirano (Univ. of Tokyo)

- 14:00—14:20 II—1 **Safety Education in Universities in Europe**
UK S. J. Cox (Loughborough Univ. Tech.)
- 14:20—14:40 II—2 **Safety Education at Universities in Mexico**
MEXICO J. Garfias (Inst. Nat'l De Ecologia)
- 14:40—15:00 II—3 **Safety Education and Training for Plant Operation
in Korea**
KOREA Young Soon Lee (Seoul Nat'l Polytechnic Univ.)

- 15:00—15:20 II—4 **Safety & Petrochemical Plants in Saudi Arabia: Industrial Strategy, Manpower Development & Case Study**
SAUDI ARABIA Ahmed M. Al-Nekhlan (Eastern Petrochem.)
- 15:50—16:10 II—5 **Safety Education and Training for Plant Operations in USA**
USA S. Schreiber (Am. Inst. Chem. Eng.)
- 16:10—16:30 II—6 **Safety Education and Training for Plant Operation in Europe**
NETHERLANDS D. G. Mooney (Shell)
- 16:30—16:50 II—7 **Safety Education and Training at Japanese Chemical Companies**
JAPAN Y. Funakoshi (Asahi Chem. Ind.)
- 16:50—17:10 II—8 **Global Network for Safety in Chemical Production (GLONESA)**
B. Sugavanam (UNIDO)
- 17:10—18:10 II—9 **—DEMONSTRATION EXPERIMENT—
Explosion of Flammable Gas, Liquid, and Solid**
JAPAN A. Sawa (Toray Ind.)

6/2 (WED)

SESSION III. EVALUATION OF HAZARDS

**Chairperson: Masamitsu Tamura (Univ. of Tokyo)
Volker Pilz (Bayer AG)**

- 9:00— 9:30 III—1 **Evaluation of Energy Hazards for Reactive Chemicals**
SWITZERLAND F. Stoessel (Ciba-Geigy)
- 9:30—10:00 III—2 **Material Safety Data Base in USA**
USA S. C. Wills (Chem. Manuf. Assoc.)
- 10:00—10:30 III—3 **Hazardous Evaluation for New Chemicals and Their Safety Management**
JAPAN T. Hirota (Mitsubishi Kasei)
- 11:00—11:30 III—4 **Evaluation of Hazards for Chemical Processes in the USA**
USA D. C. Clagett (GE Plastics)
- 11:30—12:00 III—5 **Identification Hazard**
GERMANY V. Pilz (Bayer)

SESSION IV. ENGINEERING

**Chairperson: Yoshito Sakami (Sumitomo Chem. Co., Ltd.)
Ir. C. M. Pietersen
(TNO-Environ. & Energy Res.)**

- 14:00—14:30 IV—1 **Risk Reduction Practices in a Chemical Plant**
HONG KONG H. Sawada (Dow Chem. Pacific)
- 14:30—15:00 IV—2 **Risk Analysis and Knowledge Based Expert Systems (State of the Art)**
NETHERLANDS Ir. C. M. Pietersen (TNO)
- 15:00—15:30 IV—3 **Fuzzy Control System for Chemical Plants**
JAPAN S. Yamamoto (Yokogawa Electric)
- 16:00—16:30 IV—4 **Process automation in Chemical Industry**
GERMANY M. Polke (RWTH-Aachen)
- 16:30—17:00 IV—5 **Inspection Standards for Chemical Plants**
UK T. J. Britton (Health & Safety Executive)
- 17:00—17:30 IV—6 **The Safety Assessment of On-line Computer Systems**
UK J. Pearson (Health & Safety Executive)
- 17:30—18:00 IV—7 **Inspection Standard for Chemical Plant-U.S.A.**
USA B. Hatler (Exxon)

6/3 (THU)

SESSION V. FACTORY VISITS AND CASE STUDIES (Parallel)

- V-1 Nippon Petrochemicals Co., Ltd.: Risk evaluation
- V-2 Tonen Chemical Corp.: Maintenance & inspection system
- V-3 SHOWA DENKO K.K.: Practice of PKY* & KY*
- V-4 Asahi Chemical Industry Co., Ltd.: Safety education
- V-5 Tokyo Gas Co., Ltd.: Antiseismic countermeasure
- V-6 Ishikawajima Harima Heavy Industries Co., Ltd.: Experiment of facility against earthquake
- V-7 Ajinomoto Co., Inc.: Food production
- V-8 Toyo Sanso Co., Ltd.: Safety on semi-conductor gases
- V-9 Kirin Brewery Co., Ltd.: Safety management of bio-industry
- V-10 Mitsubishi Kasei Corp.: Safety for research & development
- V-11 Nissan Motors Co., Ltd.: Safety management at automobile plant
- V-12 NKK Corp.: Safety management at steel plant
- V-13 Fire Research Institute, Fire Defence Agency: Experiment of tank fire and measurement of upper flash point

*KY is an acronym for Prediction of Danger. Kiken=danger. Yochi=prediction.

The English term is Hazard prediction. It means that an effective means is taken to cope with the potential danger, by perceiving dangers or hazards in working in advance.

*PKY is an acronym for Prediction of Danger in Processing.

The English term is Hazard prediction for Process Operation.

6/4 (FRI)

9:30—12:30 **SESSION VI. GROUP AND PANEL DISCUSSION**
(Parallel)

VI—1 Hazard Evaluation of Chemical Reaction

JAPAN Y. Iizuka (Mitsubishi Kasei)

JAPAN M. Wakakura (Ind. Res. Inst., Kanagawa Prefecture)

VI—2 Thermal Analysis

JAPAN M. Tamura (Univ. Tokyo)

JAPAN N. Tanaka (Sumitomo Chem.)

VI—3 Bio-Safety

JAPAN H. Uchida (Teikyo Univ.)

JAPAN S. Hino (Tottori Univ.)

VI—4 Dust Explosion

JAPAN H. Enomoto (Tohoku Univ.)

JAPAN T. Matsuda (Res. Inst. Ind. Safety)

VI—5 Electrostatics Hazards

JAPAN K. Asano (Yamagata Univ.)

USA T. B. Jones (U. Rochester)

JAPAN Y. Matsubara (Fire Res. Inst.)

VI—6 Modification of Safety Operation Manual

JAPAN M. Kobayashi (Nippon Petrochem.)

JAPAN T. Ohta (SHOWA DENKO)

JAPAN Y. Takahashi (Ube Ind.)

VI—7 Safety Education in Universities

JAPAN T. Hirano (Univ. Tokyo)

UK S. Cox (Loughborough Univ. Tech.)

VI—8 Safety Education in Industries

JAPAN I. Shiozaki (Tonen Chem.)

JAPAN M. Tazaki (Mitsui Toatsu Chem.)

JAPAN H. Wada (Mitsubishi Petrochem.)

VI—9 Action of Education and Training Center

B. Sugavanam (UNIDO)

J. Kopytowski (UNIDO)

VI-10 Future Work of IUPAC COCI

SWITZERLAND A. E. Fischli (Roche)

14:00—17:00 **OVERVIEW AND RECOMMENDATION**

Chairperson: Yoichi Uehara (Yokohama Nat'l Univ)

16:00—16:20 **Problems of Chemical Safety in Russia: Past, Present, and Future**

RUSSIA V. G. Zhiboedov (Min. Ecol. & Natural Resources)

16:20—16:40 **Matter Concerning Loss Prevention in Singapore's Oil, Chemical and Process Industries**

SINGAPORE C. B. Ching (Singapore Univ.)

17:00— **CLOSING CEREMONY**

Annex IV

List of participants from developing countries.

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4.

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**2nd IUPAC-COCI Workshop on Safety in Chemical Production
Yokohama, Japan, May 31 to June 4, 1993**

"Recommendations"

1. RATIONALE:

The goal of the organizing committee was to offer an opportunity for leaders from academia, government and industry to:

- a) critically examine current practices;
- b) exchange ideas and experiences; and
- c) discuss important issues with respect to safety and environmental protection.

The committee also recognized the importance of hands-on experience and extended these discussions outside the formal meeting into neighboring plants.

Chemistry is the fundamental basis for all life. Chemistry and chemical technology are not only essential for the maintenance and improvement of every day life, but they are also vital for the continuation of technological advancement based upon progress in fundamental research. Risks associated with the production of chemicals have to be maintained at the lowest tolerable level in order to protect mankind, the global environment and to ensure sustainable development.

Adequate safety management of the whole product life cycle including research and development, production, transport, storage, consumption and final disposal is urgently required. Such management and stewardship is the common responsibility of academia, government, industry and consumers in both developed and developing countries.

The following recommendations have been put forward by the organizing committee of the 2nd IUPAC Workshop and ratified by the conference. It is expected that they will be transmitted by the participants to influential opinion makers world wide. They will also be distributed within the IUPAC network.

2. MEASURES FOR CHEMICAL SAFETY AND ENVIRONMENTAL PROTECTION IN PRODUCTION AND RESEARCH:

Appropriate measures for chemical safety in production and research may be described by a structure interconnecting the five following elements: chemicals, facilities, procedures, human factors and management.

2.1 CHEMICALS:

Any person using chemicals in industrial and academic research organizations should foresee, and assess all possible hazards including those which endanger mankind, the environment, and the production facilities. Appropriate measures should be taken to control all hazardous situations.

2.2 FACILITIES:

All the facilities and apparatus for research, production, storage, loading/unloading, transportation, treatment, use and disposal should be designed and engineered to reduce the risks of chemicals and processes. They should be manufactured, constructed, operated, maintained and inspected with special attention.

2.3 PROCEDURES:

The effective control of hazardous materials requires an ongoing commitment to the principles of process safety management. This is defined by the conference as the application of systems and controls (including programs, procedures, audits and evaluations) to a manufacturing or chemical process in a way that incidents arising from process hazards are prevented.

2.4 HUMAN FACTORS:

The personnel should be educated and trained to recognize potential hazards, to follow related operating manuals and to understand emergency procedures. The individuals must take responsibility for their own action towards corporate goals. They should be motivated to propose "bottom up" activities and to show voluntary commitment towards furthering safety and environmental protection.

2.5 MANAGEMENT:

Managers at all levels are responsible for the administration of chemicals and facilities. They should recognize the hazards of

chemicals, facilities as well as characteristics of human behavior. They should be committed to the active implementation of integrated safety, and environmental management. They should pay attention to the philosophy that safety and environmental protection should be given top priority.

3. COOPERATION FOR LOSS PREVENTION AND ENVIRONMENTAL PROTECTION:

3.1 COOPERATION BETWEEN ACADEMIA AND INDUSTRIES:

Academia has a vital role to play in partnership with industry. Course design, delivery and evaluation should best meet the needs of industry and embrace the existence of academic expertise in safety and environmental protection. Academia should also adopt appropriate safety and environmental protective measures within the own research domain.

3.2 COOPERATION AMONG INDUSTRIES:

Industries should exchange data pertinent to safety and environmental protection. This information should include details (inter alia) of safety management policy, new safety technology and hazardous events. They should also cooperate to promote their principals of "Responsible Care" towards their products over the whole life cycle. Such cooperation requires industries to provide appropriate information in an internationally accepted format.

3.3 COOPERATION BETWEEN INDUSTRIES AND GOVERNMENT:

Government and industry should make concerted efforts to maintain a close relationship. This will enable all governments to produce appropriate legislative instruments for safety and environmental protection and to further ensure the exchange of information.

3.4 INTERNATIONAL COOPERATION:

Developed and developing countries should cooperate to promote the exchange of information concerning safety management and environmental protection including details of hazardous events. International measures should be taken to promote appropriate training, e.g. by establishment of international training centres.

Annex VI */
UNITED NATIONS DEVELOPMENT PROGRAMME

PROPOSAL FOR TSS-1 FINANCING

Country: Asia-Pacific Region

Title: Regional piloting scheme of Global Network on Safety in Chemical Industry (GLONESA).

Agency: United Nations Industrial Development Organization (UNIDO)

I. BACKGROUND

1.1 Context

Chemical products are important components of all manufacturing industries. They also occupy a priority position in consumption patterns of any society. The Chemical Abstracts in 1992 registered the millionth chemical substance identified, of which more than 100,000 are produced on an industrial scale with a total output of over one trillion United States \$ per year, which is about 11.5% of all manufactured products worldwide.

The following socio-economic features of human wellbeing depend on chemical products:

Feature	Functional chemical products
Health and sanitation	Pharmaceuticals, medicines
Hygiene	Soaps, surfactants, cosmetics
Housing	Plastics, fibres, paints
Clothing	Fibres, dyes, surfactants
Food production	Fertilizers, pesticides
Food processing	Preservatives, dyes, surfactants
Transportation	Plastics, paints, oils
Communication	Plastics, dyes, basic chemicals

Review of input-output tables shows a certain consumption/trade/production pattern of the chemical industry, which has an universal character and depends basically on the national income value and specific structure of chemical raw materials. Chemicals are produced in countries with GDP/capita below US \$200 as well as in countries with GDP/capita over US \$15,000 even with a total lack of natural chemical raw materials.

In principle there are two types of chemical industries operating in developing countries:

- Those developed by large international companies. In this case operation is based on internal company regulations and in general is safe. Obviously there are also cases of inadequate technology transfer leading to catastrophic results.

*/ The full content of the TSS-1 is filed separately. For reference contact the backstopping officer.

Annex VII

DRAFT

THE CHARTER
OF THE GLOBAL NETWORK ON SAFETY IN CHEMICAL INDUSTRY

This Document defines the operating structure, principles of activity, administration and financing scheme of the Global Network on Safety in Chemical Industry (GLONESA).

General Introduction

1. Whereas the developing countries economies are still in touch with serious environmental and economical problems, then considering the importance of the safe for people and environment operation of their chemical installations, and acknowledging the leading role of the managerial measures in this aspect, the GLONESA, programme supporting transfer of know how in safety engineering and management for chemical industry, has been established.
2. The name of the Programme is the Global Network of Safety in Chemical Industry (GLONESA).
3. The GLONESA has been founded by joint effort of the Governments of developing countries, IUPAC and its COCI Committee, UNDP, and UNIDO, the signatories of this Charter.
4. The GLONESA co-ordinating task force is affiliated to the United Nations Industrial Development Organization, and located in Vienna, Austria.
5. The GLONESA will be notified by United Nations.

The status, main goal of the Centre, and its tasks

1. The GLONESA is a non-profit, non-commercial, international programme. This status has been given to the GLONESA by organizing bodies.
2. The basic goal of the GLONESA is to provide support and promote transfer of the managerial know how for operational implementation of safe chemical technologies in developing countries.
3. The GLONESA will achieve this goal by implementation of the following tasks:
 - collection and dissemination of information on safe management of chemical technologies as well as ways and means of its continuous improvement;

- provision of the training in good managerial practices for the safe operation of chemical installation;
- participation in elaboration of legal and system solutions that may influence operational and environmental safety in the chemical industry;
- provision of advisory services in practical implementation of instruments of safe technologies implementation and operation (e.g HAZOP studies, EIA studies, implementation of MSD's, etc.).

Membership

1. Membership of the GLONESA is accessible for all chemical enterprises in developing countries.
2. Membership is acknowledged by signature of membership certificate.
3. The member of the Centre has the following rights:
 - to receive know how in the safe technology operation;
 - to receive information collected in the data bank relevant to his technology;
 - to receive the support in training its managerial forces; - to establish direct communication with other members of GLONESA;
 - to propose organization of any event enhancing the activity of the GLONESA;
 - to receive consultation and advisory services on revamping of its technology to safer status of operation.
4. The member of the GLONESA has the following obligations:
 - to supply the information on the operated technology, according to the distributed questionnaire;
 - to report any event in operation of technology which may have impact on safer operation of chemical installations at other members of GLONESA;
 - to provide any guidelines and legislative measure adopted in its country/enterprise fostering the safe operation of chemical installations;
 - to provide names of experts ready to visit other members for the purpose of advisory services in the technology revamping to more safe status of operation;
 - to provide the list of technologies which can be accessible on the commercial basis;
 - to provide experts for lecturing purposes on the good managerial practices workshops.
5. The member of the GLONESA pays yearly membership contribution in amount of US \$50 -1000 depending on the enterprise annual turnover.

Activities of the GLONESA

1. GLONESA is a clearing house for all activities programmed for the purpose of implementation of the safe technologies.

2. The GLONESA will collect and disseminate information regarding the legislation, guidelines and managerial practices of safe operation of the chemical installations and when necessary will establish technological data bases on technologies requiring revamping as well as on the offers of the inherently safe technological improvements.

3. The GLONESA will be responsible for organization of workshops/seminars on the good managerial practices for the safe operation of chemical installations.

4. The GLONESA will provide advisory services to its members and Governments in the field of establishment necessary legislation and prepare guidelines and measures fostering safer operation of chemical installations.

5. The GLONESA will operate in a project-wise modality, registering each case of request as well as the resulting commercial contracts.

Administration of the GLONESA, Board of Trustees and Officers

1. GLONESA is organized by United Nations Industrial Development Organization in Vienna, Austria on behalf of supporting and donors organizations and Governments of the developing countries.

2. UNIDO will ensure the necessary management staff of the GLONESA.

3. The GLONESA's Board of Trustees will be set up from delegated of project contributors (IUPAC-COCI, UNDP, UNIDO, UNEP and other supporting and donor organizations).

4. The election, tenure, number of members of the Board, and rules of voting will be determined by the Meeting of Representatives of GLONESA contributors and members after establishment of the programme.

5. The Board of Trustees of the GLONESA will be responsible for the following matters:

- approval of the yearly programme of the GLONESA activities;
- evaluation of the yearly reports of the GLONESA;
- extension of the GLONESA activities in the framework of the approved budget;
- initiation of the changes and improvements of the statutory role of the GLONESA;
- initiate actions and organize funding of GLONESA activities.

6. UNIDO project manager will run the day-to-day affairs of the GLONESA. He will be responsible for the implementation of the programme approved by the Board and other obligations resulting from the Charter.

Organization of the GLONESA

1. Management of the GLONESA will be provided by UNIDO which establish small Task Force under leadership of the programme manager. Salaries of the Task Force staff are covered from UNIDO budget and salaries of recruited professionals are covered from the programme budget.
2. Direct operation of GLONESA will be organized and controlled by regional centres: in Asia Pacific region, Latin and Central America and Africa.
3. Regional centres will be organized voluntary by the contributing Government from the Region at the existing R&D institutes or existing organizations responsible for the environment protection and safe operation of the industry. In the Regional Centre small task force will be organized to carry out day-today activities. The Task Force will be financed from the local Government contribution and will be supported by the GLONESA budget.
4. Focal points will be organized in all countries of Region from which members have been registred. Focal points will be organized in existing R&D institutes or existing organizations responsible for environment protection and safe operation of the industry. In each Focal Point small task force will be organized to carry out GLONESA day-to-day activities. The Task Force will be financed from the local Government contribution and will be supported by GLONESA from the mebership fees.

GLONESA Financing

1. For the first three years, the GLONESA operation is financed from the voluntary contributions of the donors from industry and Governments and non-governmental organizations accordingly to the attached budget of piloting scheme in Asia Pacific region.
2. The GLONESA is authorized to collect membership fees. The mebership fees will support activities of the Regional GLONESA Centre and national focal points.
3. After three years of the pilot scheme of GLONESA operation and considering the number of projects implemented, the Board of Trustees will propose continuation of the donor country programme for expansion of GLONESA activities to pther regions, or will announce self-financed c o n t i n u a t i o n o f t h e o p e r a t i o n .
4. The self-financing mode of operation would not change any of the GLONESA obligations and modalities of operation.

Annex IX

List of plenary speakers

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*/ speakers that could be usefull for GLONESA activities

UNIDO Comments

The report of the consultant gives a summary of the proceedings of the International Workshop on Safety in Chemical Production organized by the International Union of Pure and Applied Chemistry at Yokohama, Japan in which UNIDO actively participated and contributed to the workshop. The report further provides measures in detail as to how this important and essential field of chemical safety could be strengthened with the cooperation of both developed and developing countries. In developing countries chemical safety should be approached in an integrated manner in that plant, human and environment safety are given equal importance to reduce risk and increase benefits of using the chemicals.

The expert has given a detailed proposal to set up a pilot scale project for the establishment of Global Network for Safety in Chemical Production (GLONESA in CP). If such a pilot network is set up with the collaboration of selected focal points in countries where chemical production is high, it would vastly improve safety aspects related to chemical production.