EUROPÄISCHE FÖDERATION FÜR CHEMIE-INGENIEUR-WESEN
EUROPEAN FEDERATION OF CHEMICAL ENGINEERING
FÉDÉRATION EUROPÉENNE DU GÉNIE CHIMIQUE

5th International Symposium "Loss Prevention and Safety Promotion in the Process Industries"

Volume I: Lectures (1 to 44)

Working Party
"Loss Prevention"

Société de Chimie Industrielle
28, rue Saint-Dominique
F 75007 Paris

AVANT-PROPOS

The growing success of the Symposia of NEWCASTLE (1971), DELFT (1974), HEIDELBERG (1977)) BASEL (1980), HARROGATE (1983) shows that the LOSS PREVENTION AND SAFETY PROMOTION IN THE PROCESS INDUSTRIES are of increasing importance in a world where technology, and particularly chemical industry, enlarges its contribution.

Large and small incidents occurring in the world show the need to be permanently on our guard and it is why that, in spite of the excellent results which have been made in this field, the process industries including chemistry, metallurgy, manufacture of nuclear fuels, petroleum, pharmacy, etc... continue to be deeply involved in safety.

The events organized regularly on these subjects, under the auspices of the European Federation of Chemical Engineering, aims to be the places where those who are concerned can meet, discuss and be informed of the latest and more important developments.

The CANNES International Symposium is going to follow this tradition but, in addition to the usual themes, a special emphasis will be put **on the role of human factor.**

More than 180 papers have been submitted to the Scientific Committee of the Congress which are of high quality and diversity.

Due to the need of avoiding too many parallel sessions, it has been decided to present approximately 70 papers either in sessions or plenary lectures and, for the first occasion, to present posters (at least 20).

An exhibition devoted to the themes of the Symposium will be organized together with technical visits.

As in previous symposia in the series, considerable emphasis will be given to the promotion of discussion periods. To ensure informed comment, preprints of papers will be sent prior to the Symposium to all delegates whose registration papers have been received by 20th july 1986.

5th INTERNATIONAL SYMPOSIUM LOSS PREVENTION

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AUSPICES

This event is under the auspices of the **french Ministère de l'Environnement.**

LECTURES

HUMAN FACTORS

1. The human factor in safety, a review
   Prof. BURKHARDT (F.R.G.)

2. Human factor and systems safety. Ergonomic control room design
   J. Cl. WANNER (France)

3. Human reliability
   A. CARNINO (France)

4. Improvement of operating instructions for nuclear power plants
   R. MARCILLE (France)

5. A new methodology of operating procedures to increase, through self participation, the safety and reliability level of crude oil refining units.
   D. LOUBET (France)

6. Incorporating human reliability into probabilistic risk assessment
   L. BELLAMY, B. KIRWAN, R.A. COX (United Kingdom)

REVIEW PAPERS

7. Electrostatics, a hazard under control ?
   Dr. N. GIBSON (United Kingdom)

8. Explosion
   H.J. PASMAN (Netherlands), H. WAGNER (F.R.G.)

9. Destructive explosion effects
   J. DANGREAUX (France)

HAZARD AND RISK ANALYSIS

10. Process safety assessment of new and existing plants
    M.J. PIKAAR, J.M. BRAITHWAITE, A.P. COX (Netherlands)

11. A design review approach to safety analysis
    J.R. TAYLOR, R.S. SELIG, H. NIELSEN, C.G.PETERSEN, A. ANDERSEN (Denmark)

.../...

12. Evaluation of the coverage and validity of hazard and operability study
    J. SUOKAS (Finland)

13. Chemical plant safety analysis using fault trees
    U. HAUPTMANNS (F.R.G.)

14. Appraisal of the utility of risk analysis in the process industry
    R. A. COX (United Kingdom)

15. Natural gas transmission by pipeline. A re-assessment of the hazards and risks, and their influence on UK legislative safety procedures
    D.A. JONES, G.D. FEARNEHOUGH (United Kingdom)

16. Some views on the management of safe operations
    R.C. MILL (U.S.A.)

17. A practical approach to reviewing the design of chemical plants for process safety
    H. DUCHSCHERER, M. MOLZAHN (F.R.G.)

18. A practical risk analysis tool use in the case of hydrogen production unit
    V. ROCHINA (France)

19. Safety audits as a means of ensuring safety performance in a transnational company
    Dr. W. VOGLER (Switzerland)

CASE HISTORIES

20. Accident reports and missing recommendations
    T.A. KLETZ (United Kingdom)

21. Analysis of the LPG disaster in Mexico City
    C.M. PIETERSEN (Netherlands)

22. Hazards and protection of pressure storage of liquefied petroleum gases.
    J.A. DAVENPORT (U.S.A.)

23. Analysis of causes of accidents at factories dealing with hazardous materials
    Y. UEHARA, H. HASEGAWA (Japan)

24. Human factors and systems failure : case study of the fire and explosion at Chemstar
    B.M. HANCOCK (United Kingdom)

25. Experiences on supporting plant design and commissioning by hazard and risk analysis
E. OLKKOLA, R. SALO, T. VALANTO, S. RIIHIMÄKI, J. FIEANDT (Finland)

26. Industrial safety and factories dimension. A sample investigation on 18 small companies : results and work perspective
R. PASTORINO, D.M. DE FAVERI, C. ZONATO, L. MAGA, G. FERRAIOLO (Italy)

SPILL AND DISPERSION

27. The dispersion of accidentally released gases in a built up area
W. BÄCHLIN, E.J. PLATE (F.R.G.)

28. Wind tunnel simulation of chlorine spills
M.L. RIETHMULLER (Belgium)

29. Water model simulation of hazardous gas diffusion in the atmosphere
M. MILHE (France)

30. Methods for describing heavy gas dispersion in the environment of industrial sites
Y. RIOU (France)

31. Some implications of gas dispersion and wind flows on equipment siting on offshore process installations
Dr. D.M. DEAVES (United Kingdom)

32. Mathematical modeling of heavy gas dispersion - An overview
J.A. HAVENS (U.S.A.)

VAPOUR CLOUD/DISPERSION

33. Vapourization rates of liquids and liquified gases
U. LEBUSER, H.G. SCHECKER (F.R.G.)

34. Gas dispersion modelling and its application in ICI. The disp2 model.
L.W. FIELDING, M.L. PRESTON, P.A. SINCLAIR (United Kingdom)

35. Experiments on the ignition of dense flammable gas clouds
A. EVANS, J.S. PUTTOCK (United Kingdom)

36. Experimental study to assess the characteristics of vapor explosion
C. OGISO, A. FUJITA, Y. UEHARA (Japan)

37. Vapour cloud explosion experiments for use in hazard assessment
C.J.M. VAN WINGERDEN, J.P. ZEEUWEN (Netherlands)

38. Vapour cloud explosions - The effect of obstacles and jet ignition on the combustion of gas clouds
A.J. HARRISON, J.A. EYRE (Grande-Bretagne)

39. The blast effects of explosions
N.F. SCILLY, W.G. HIGH (United Kingdom)

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40. Early detection of hazardous states in chemical reactors with model-based measuring techniques
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41. Use of the DIERS bench-scale apparatus for restabilization and venting runaway reactions
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42. Sizing of emergency vents for vessels on the basis of laboratory scale experiments
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43. Boiling and dissolution delay in two phase systems during vessel top venting
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44. Pressure relief of foaming or highly viscous mixtures
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K. BILLINGE, K. MOODIE, H. BECKETT (United Kingdom)

48. How to handle disasters. An experienced preplanning, training and test procedure for fire fighting in the French Petroleum industry
G. MARLIER, R. ROURE (France)

49. Safe operation of a pneumatic conveying (flash) dryer
H. SCHACKE, K.O. FALKE (F.R.G.)

50. The safe packaging of dangerous goods
A.A. SCHILPEROORD (Netherlands)

51. Acoustic emission testing of process industry vessels and piping
T.J. FOWLER (U.S.A.)

52. Hazard zone sizes within buildings
J.C. MECKLENBURGH (United Kingdom)

53. Safety aspects of computer controlled chemical plants
W. BUCHER, R. FRETZ (Switzerland)

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R. HILL, D. KOHAN (U.S.A.)

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56. Breathing of storage tanks for flammable liquids under atmospheric influence and relevant safety requirements for venting devices and inertgas systems
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57. Investigation on the formation of explosive heavy fuel oil vapour/air mixtures
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68. Experimental test on large hydrocarbon fires . Results and comparison with existing fire models
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69. Development of a device to diminish the risks of torches at LPG-refuelling stations
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70. Safer design of inflammable gas vents
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P2. Safety valves . French regulation and standards.
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Volume III : Proceedings

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OPENING ADDRESS

by Mr. Georges ROQUES,
Chairman of the SOCIETE DE CHIMIE INDUSTRIELLE

Ladies and Gentlemen,

I should first like to wish you all, a warm welcome to Cannes, on the occasion of this symposium, which the SOCIETE DE CHIMIE INDUSTRIELLE has the honor to organize, as member of the European Federation of Chemical Engineering.

In playing this role, the SOCIETE DE CHIMIE INDUSTRIELLE is true to its vocation, which is centered on the industrial applications of technologies, and on all problems related to the implementation of such applications and processes.

The extensive development of the chemical industries over recent decades, while-contributing to economic growth and prosperity in our respective countries has also created new responsibilities. It is true to say that today chemistry is always the key to industrial but also today, no factory or industrial complex, can afford to ignore the constraints and requirements, now widely imposed by legislation in the area of safety, risk and hazard in the workplace, as well as pollution affecting local communities.

As we all know, this demand cannot be met without appreciable investment and cost. However, no one would disagree, that there is a price to pay for the safeguard of people at work, as well as in their environment.

Consequently, in our response to this challenge, we must seek effectiveness as well as efficiency, and one of the major ways to achieve this goal, is through international exchange between experts. One aspect of the vocation of the SOCIETE DE CHIMIE INDUSTRIELLE, is to promote such international coordination, and recent events, in India and Russia, have demonstrated this need at the highest level.

This is the purpose of the Fifth International Symposium on Loss Prevention, and the Promotion of Safety, in the process industries, and the presence of so many participants here today, illustrate the importance of the theme, and the great diversity of the problem existing in this area.

It will be the task of Dr. JOSCHEK, chairman of the working party on "Loss Prevention and Safety" in the European Federation of Chemical Engineering, and also of the Scientific Committee of this symposium, to comment the program you will follow over the next three days.

Finally, I have referred briefly to the legislation which exists on these issues, in our respective countries. In France, the Government agency regulating and overseeing this area, is the"Ministère de l'Environnement", and I am pleased to welcome and pass the floor to Mr. CHAMBOLLE who, as director of the Pollution and Prevention Department, in this sector of the French Administration, has, I am sure, a message of great interest to us all.

I thank you for your attention.

Je peux vous dire qu'il s'agit là de préoccupations majeures de M. CARIGNON puisqu'il a engagé des réflexions et un large débat sur ces thèmes :

- dans le département de l'Isère
- au sein d'un groupe de travail consacré aux moyens à mettre en oeuvre pour limiter l'urbanisation autour des usines dangereuses.

Il a décidé de prendre de nouvelles initiatives en vue d'une meilleure information du public.

Mais puisque la promotion de la sécurité est votre principale préoccupation dans ce Congrès, je ne peux manquer d'évoquer le problème posé par la défaillance humaine mise en cause en particulier dans un accident industriel récent. Comment provoquer l'adhésion de l'ensemble des acteurs de l'entreprise à ces impératifs de la sécurité : participation des travailleurs à la réalisation des études de dangers, présentation des conclusions aux comités d'hygièen et de sécurité, formation continue, participation aux exercices internes ou externes. L'effort technologique et la formation des personnels vers plus de sécurité doivent évidemment être menés de pair.

Avant de conclure, je voudrais dire que je mesure toute l'étendue de la responsabilité qui pèse sur les épaules des dirigeants et des cadres d'entreprise dans ce domaine alors qu'ils ont aussi celle de ne pas faire de pertes financières ; qu'ils ne nous en veuillent pas si nous nous donnons pour tâche de vérifier, comme la loi le prescrit, qu'ils assument cette responsabilité pleinement et rationnellement.

Je suis tout-à-fait conscient que l'élaboration des études des dangers représente un effort très important, qui fait appel à de nombreux spécialistes, dont beaucoup sont présents dans cette salle. Plusieurs mois de travail d'ingénieurs regroupés dans des équipes pluri-disciplinaires sont en général nécessaires pour faire une bonne étude des dangers. Les allers-retours avec l'inspecteur des installations classées sont parfois nombreux et exigent de celui-ci une formation, une disponibilité,et une compétence toujours accrues. Un certain nombre d'entre eux sont également dans cette salle.

Il est satisfaisant de voir qu'en Europe, cet effort est mené de concert entre tous les Etats-membres. C'est une condition indispensable pour éviter les distorsions de concurrence et nous souhaitons que la Commission y veille. Votre Congrès est également indispensable dans cette perspective.

Je vous souhaite donc à tous, trois jours de travail fructueux et agréables.