



EUROPEAN FEDERATION OF CHEMICAL ENGINEERING  
454<sup>th</sup> EVENT

**7<sup>th</sup> INTERNATIONAL SYMPOSIUM  
ON LOSS PREVENTION AND  
SAFETY PROMOTION  
IN THE PROCESS INDUSTRIES**

TAORMINA, ITALY 4-8 MAY 1992

Promoted by the **Working Party**  
**on Loss Prevention and Safety Promotion in the Process Industries**  
and organized by the Italian Delegation of the Working Party appointed  
by AIDIC, Italian Association of Chemical Engineering and  
by SCI, Italian Chemical Society - Lombardy Section.

**VOLUME 1**

**Plenary Lectures - Papers from 1 to 48**

The Symposium is held under the auspices of

**FEDERCHIMICA**

Italian Federation of Chemical Industry

**CIEU**

Interuniversity Centre of Human Ecology,  
Universities of Genova, Pavia and Piacenza

With the official support of

**Ministry of Environment**

**Ministry of Internal Affairs**

**Government of Sicilian Region**

**National Council for Research**

**University of Catania**

**University of Genova**

**University of Messina**

**University of Palermo**

Promoted with the agreement of

**AIDIC**

Italian Association of Chemical Engineering

**SCI**

Italian Chemical Society (Lombardy Section)

**CISAP**

Italian Safety and Environment Committee for the Process Industry

**CSIA**

National Committee on Atmospheric Pollution Study (Italian Member of IUAPPA)

**CCPS**

Centre for Chemical Process Safety, USA

# OFFICIAL COMMITTEES

## EXECUTIVE COMMITTEE

### **R. Alessandrello**

(President, AIDIC, Italian Association of Chemical Engineering)

### **G. Biardi**

(Vice-President, AIDIC)

### **S. Cambi**

(Director of Human Resources and Organization, ENI, Ente Nazionale Idrocarburi)

### **C. Cogliati**

(Managing Director, AUSIMONT)

### **G. Ferraiolo**

(CIEU, Universities of Genova, Pavia and Piacenza and President of CISAP, Italian Safety and Environment Committee for the Process Industry)

### **A. Guccione**

(Vice-President, SARAS, Raffinerie Sarde)

### **A. Piglia**

(Vice-President, ESSO Italiana)

### **G. Porta**

(President, Federchimica, Italian Federation of Chemical Industry)

### **F. Pregaglia**

(President, SCI, Italian Chemical Society, Lombardy Section)

### **G. Zerbo**

(President, CIPA, Industrial Consortium for Environmental Protection)

## ORGANIZING COMMITTEE

**M. Aguggia** - AUSIMONT

**G. F. Cutolo** - ESSO Italiana

**G. Ferraiolo** - University of Genova

**M. Ghezzi** - AIDIC

**G. Massini** - SRP Partners

**F. Milella** - FEDERCHIMICA

**D. Mizzi** - SARAS - Sardinian Refineries

**G. B. Petella** - SRP Partners

**E. Profili** - ENI

**M. Rovatti** - CSIA/ATI

**E. Roviglioni** - ENI

**L. Zanderighi** - SCI Italian Chemical Society

**G. Zerbo** - University of Catania

## SCIENTIFIC COMMITTEE

Prof. Ir. **J. Mewis** Belgium

Prof. Ir. **J. Clerinx** Belgium

Prof. Ir. **A. Germain** Belgium

Ing. **J. Skarka** Czechoslovakia

Mr. **N. Hjorth** Denmark

Dr. **V. Pilz** Fed. Rep. of Germany

Prof. Dr. **H.G. Schecker** Fed. Rep. of Germany

Dr. **C. Bartels** Fed. Rep. of Germany

Mr. **P. Hypponen** Finland

Ms. **L. Laakso** Finland

Mr. **R. Grollier Baron** France

Prof. **R. Papp** France

Mr. **G. Vuillard** France

Dr. **G.F. Cutolo** Italy

Prof. Ing. **G. Ferraiolo** Italy

Dr. Ir. **H.J. Pasman** Netherlands

Ir. **M. Vis van Heemst** Netherlands

Mr. **E.N. Bjordal** Norway

Mr. **J.A. Firing** Norway

Prof. **J. Blasco** Spain

Prof. **J. Cisterò** Spain

Dr. **H. Frostling** Sweden

Mr. **A. Jacobsson** Sweden

Dr. **G. Suter** Switzerland

Mr. **H.A. Duxbury** United Kingdom

Dr. **S.J. Skinner** United Kingdom

Mr. **R.C. Mill** USA

Mr. **G.A. Page** USA

Dr. **M. Peruncic** Yugoslavia



# CONTENTS

## *General note*

*The volumes are not continuously numbered. Only papers are individually numbered.*

## PLENARY LECTURES

F. P. FORABOSCHI

**AREA RISK AND TERRITORY MANAGEMENT**

*(It is to be published in the proceedings)*

T.A. KLETZ

**INHERENTLY SAFER DESIGN - A REVIEW**

P.D. STOREY

**STATE OF EUROPEAN RESEARCH ON MAJOR INDUSTRIAL HAZARDS**

R. GROLLIER-BARON

**INDUSTRIAL HAZARD AND EXTERNAL COMMUNICATION**

F.P. LEES

**REGULATIONS FOR THE CONTROL OF MAJOR HAZARDS WITH SPECIAL REFERENCE TO PIPER ALPHA**

G. J. DYKES

**FLEXIBLE REGULATION OF THE CHEMICAL INDUSTRY**

L. WEISAETH

**TECHNOLOGICAL DISASTERS: PSYCHOLOGICAL AND PSYCHIATRIC ASPECTS**

## PAPERS

*The Papers are listed according to the numbers given them in the Preliminary Program. The missing numbers correspond to withdrawals.*

- 1 EMBLEM, KORTNER, HAUGEN, BEHRENS  
**INTEGRATED ANALYSIS: PROCESS SAFETY, ENVIRONMENTAL POLLUTION, WORKING ENVIRONMENT.**
- 3 ROUHIAINEN  
**IDENTIFICATION AND ASSESSMENT OF ENVIRONMENTAL RISKS**
- 4 SCHREURS, VERBRUGGEN, DE WEL, DENTENEER  
**QUALITY ASSURANCE OF SAFETY AND ENVIRONMENTAL IMPACT STUDIES**
- 5 PICCIOLO, METZGER  
**ENVIRONMENTAL IMPACT ASSESSMENT FOR A MAJOR PETROCHEMICAL PLANT IN ITALY - POLICY CONSIDERATION**
- 6 COLOMBARI, CAZZOLA, SALVATORE, FUREGATO, SCOPESI  
**INDUSTRIAL PIPELINES AND ENVIRONMENTAL PROTECTION: A METHODOLOGY FOR ENVIRONMENTAL EVALUATION**

- 7 CLARKE, NICHOLSON  
ENVIRONMENTAL AND SAFETY RISK ASSESSMENT OF MAJOR GAS DEVELOPMENTS  
IN THE USSR
- 8 ROGERS  
THE USE OF PROBLEM ANALYSIS IN THE INVESTIGATION OF INCIDENTS
- 9 TAYLOR  
A COMPARATIVE EVALUATION OF SAFETY FEATURES BASED ON RISK ANALYSIS  
FOR 25 PLANTS
- 10 KARVONEN, HEINO, WENNERSTEN, ANDERSEN, PETTERSEN  
EXPERIENCES FROM INTELLIGENT ACQUISITION AND USE OF SAFETY INFORMATION
- 11 WEHMEIER, FRIEDEL, SCHMIDT  
MODELLING OF TRANSIENT REACTOR AND CATCHTANK VESSEL PRESSURE  
AND OR MASS DISCHARGE DURING EMERGENCY VENTING
- 12 MASCHIO, BELLO, ZANELLI  
ANALYSIS OF RUNAWAY PHENOMENA IN POLYMERIZATION REACTORS
- 13 DITALI, ROVATI, RUBINO  
EXPERIMENTAL MODEL TO ASSESS THERMAL RADIATION FROM HYDROCARBON  
POOL FIRES
- 14 OGAWA, MIYAKE, MATSUO  
EXPLOSION CHARACTERISTICS OF ETHYLENE OXIDE MIXED WITH NITROGEN  
OR/AND PROPYLENE OXIDE
- 15 BROECKMANN, SCHECKER  
«BOIL OVER» EFFECTS IN BURNING OIL TANKS
- 16 MIKESELL, PAGE  
EVAPORATION OF UNCONTAINED SPILLS OF MULTICOMPONENT NONIDEAL  
SOLUTIONS
- 17 NIKMO, KUKKONEN  
HEAVY GAS CLOUD TRANSPORT IN COMPLEX TERRAIN
- 18 HOWARD  
PRECAUTIONS IN SELECTION, INSTALLATION AND USE OF FLAME ARRESTERS
- 19 RUBACH, SCHECKER, ONKEN  
INVESTIGATIONS FOR THE INCREASE OF THE MAXIMUM GAS FLOW RATE THROUGH  
A WATER TRAP FLAME ARRESTER
- 20 MEMEDLYAEV, GLIKIN, TYULPINOV  
EFFICIENCY AND EXPLOSION SAFETY OF OXIDATION PROCESSES IN FLUIDIZED  
CATALYST BED
- 21 KUKKONEN, SAVOLAINEN, VALKAMA, JUNTTO, VESALA  
CONSEQUENCES OF A MAJOR CHEMICAL ACCIDENT IN IONAVA, LITHUANIA
- 22 ANDERSSON  
STORAGE TANK FIRE AT NESTYE PORVOO REFINERY 23. -24.3.1989



- 23 BERGROTH  
EXPLOSION IN A SULPHONATION-PROCESS
- 24 CHERNOPLEKOV, DOBROCHEEV, KULESHOV, STEPANOV  
MODELLING OF PHENOMENA OF PIPELINE ACCIDENT ON 03/06/89 NEAR UFA  
(BASHKIRIA, USSR) LARGE SCALE LPG CLOUD EXPLOSION
- 25 HANCOCK  
LEARNING FROM ACCIDENT EXPERIENCE - ARE THE OLD LESSONS REALLY BEING  
APPLIED?
- 26 PARET  
PROCESS DEVELOPMENT FOR PLANT WITH HIGH HAZARD POTENTIAL
- 27 PASTORINO, PAGELLA, DE FAVERI  
OCCUPATIONAL ACCIDENTS TREND IN ITALY (1885 - 1980) AND SOME CORRELATIONS  
WITH INDUSTRIAL PRODUCTION TREND
- 28 JEZLER  
THERMAL TANK EXPLOSION: THE WAY FROM EVENT TO MEASURES
- 29 VOLPICELLI, GODONO, MIGLIACCIO, LANCIA  
UNCONFINED VAPOUR CLOUD EXPLOSION: A CASE HISTORY
- 30 LIVINGSTON, GREEN  
EVALUATION OF INCIDENT INVESTIGATION TECHNIQUES AND ASSOCIATED  
ORGANIZATIONAL ISSUES
- 31 KORTNER  
UNCERTAINTIES IN QUANTITATIVE RISK ANALYSES
- 32 WIEDEMANN GTSV (STEAM CRACKER SAFETY WORKING PARTY)  
AN EFFECTIVE TOOL FOR FEEDBACK FROM PAST EXPERIENCE WITH STEAM  
CRACKERS
- 33 AMENDOLA, ZIOMAS  
PROCEDURES AND UNCERTAINTIES IN CHEMICAL RISK ASSESSMENT. RESULTS  
OF A EUROPEAN BENCHMARK EXERCISE
- 34 MALAGOLI, ZAPPELLINI, FONTANA, PISCIOTTA  
A NEW HAZARD IDENTIFICATION PROCEDURE IN THE PROCESS PLANT ANALYSIS
- 35 MERCX, VISSER  
FULL-SCALE EXPERIMENTAL INVESTIGATION INTO VAPOUR CLOUD EXPLOSIONS
- 36 STOCK, WIRKNER-BOTT  
VAPOUR CLOUD EXPLOSION AFTER TWO PHASE JET RELEASE
- 37 CADEDDU, FAORO, VAN DEN BERG, VAN LEEUWEN, GIUSEPPETTI, MAZZÀ  
BLAST PREVENTION INSIDE UNDERGROUND HYDRO-ELECTRIC POWER PLANTS
- 38 TAMANINI, CHAFFEE  
COMBINED TURBULENCE AND FLAME INSTABILITY EFFECTS IN VENTED GAS  
EXPLOSIONS

- 39 ROSEN, FROHLICH  
INHERENT SAFETY - THE QUALITY WAY
- 40 CHUDLEIGH, CATMUR  
IMPLICATIONS OF NEW STANDARDS FOR SAFETY-CRITICAL SOFTWARE  
ON COMPUTER CONTROL OF PROCESS PLANTS
- 41 BARTH, SCHNATZ, KAUFMANN  
RISK MINIMIZING STRATEGY FOR HEAVY GAS PRODUCTION, STORAGE  
AND TRANSPORT, EXEMPLIFIED FOR THE CHLORINE CYCLE IN GERMANY
- 42 RUPPERT, MUSCHELKNAUTZ, KLUG  
DESIGN OF LIQUID SEPARATION DURING TWO PHASE VENTING
- 43 RODHOLM, DAVIES  
COST-BENEFIT THROUGH PROBABILISTIC DECISION MAKING
- 44 SCHREIBER  
MEASURING PERFORMANCE AND EFFECTIVENESS OF TECHNICAL MANAGEMENT  
OF CHEMICAL PROCESS SAFETY
- 45 ARNOLD, MAAREN, REDFEARN  
SAFETY-A-CATALYST TO IMPROVED ORGANIZATIONAL PERFORMANCE
- 46 FROHLICH, ROSEN  
SAFETY & RISK MANAGEMENT SYSTEMS IN THE PROCESS INDUSTRY
- 48 BÜRGE, SCOTT  
ASSESSMENT OF LOW PROBABILITY/HIGH CONSEQUENCE RISKS WITH EMPHASIS  
ON MANAGEMENT SYSTEMS



EUROPEAN FEDERATION OF CHEMICAL ENGINEERING  
454<sup>th</sup> EVENT

**7th INTERNATIONAL SYMPOSIUM  
ON LOSS PREVENTION AND  
SAFETY PROMOTION  
IN THE PROCESS INDUSTRIES**

TAORMINA, ITALY 4-8 MAY 1992

Promoted by the **Working Party**  
**on Loss Prevention and Safety Promotion in the Process Industries**  
and organized by the Italian Delegation of the Working Party appointed  
by AIDIC, Italian Association of Chemical Engineering and  
by SCI, Italian Chemical Society - Lombardy Section.

**VOLUME 2**

**Papers from 49 to 72 - Posters from 73 to 101**



The Symposium is held under the auspices of

**FEDERCHIMICA**

Italian Federation of Chemical Industry

**CIEU**

Interuniversity Centre of Human Ecology,  
Universities of Genova, Pavia and Piacenza

With the official support of

**Ministry of Environment**

**Ministry of Internal Affairs**

**Government of Sicilian Region**

**National Council for Research**

**University of Catania**

**University of Genova**

**University of Messina**

**University of Palermo**

Promoted with the agreement of

**AIDIC**

Italian Association of Chemical Engineering

**SCI**

Italian Chemical Society (Lombardy Section)

**CISAP**

Italian Safety and Environment Committee for the Process Industry

**CSIA**

National Committee on Atmospheric Pollution Study (Italian Member of IUAPPA)

**CCPS**

Centre for Chemical Process Safety, USA

# OFFICIAL COMMITTEES

## EXECUTIVE COMMITTEE

### **R. Alessandrello**

(President, AIDIC, Italian Association of Chemical Engineering)

### **G. Biardi**

(Vice-President, AIDIC)

### **S. Cambi**

(Director of Human Resources and Organization, ENI, Ente Nazionale Idrocarburi)

### **C. Cogliati**

(Managing Director, AUSIMONT)

### **G. Ferraiolo**

(CIEU, Universities of Genova, Pavia and Piacenza and President of CISAP, Italian Safety and Environment Committee for the Process Industry)

### **A. Guccione**

(Vice-President, SARAS, Raffinerie Sarde)

### **A. Piglia**

(Vice-President, ESSO Italiana)

### **G. Porta**

(President, Federchimica, Italian Federation of Chemical Industry)

### **F. Pregaglia**

(President, SCI, Italian Chemical Society, Lombardy Section)

### **G. Zerbo**

(President, CIPA, Industrial Consortium for Environmental Protection)

## SCIENTIFIC COMMITTEE

Prof. Ir. **J. Mewis** Belgium

Prof. Ir. **J. Clerinx** Belgium

Prof. Ir. **A. Germain** Belgium

Ing. **J. Skarka** Czechoslovakia

Mr. **N. Hjorth** Denmark

Dr. **V. Pilz** Fed. Rep. of Germany

Prof. Dr. **H.G. Schecker** Fed. Rep of Germany

Dr. **C. Bartels** Fed. Rep. of Germany

Mr. **P. Hypponen** Finland

Ms. **L. Laakso** Finland

Mr. **R. Grollier Baron** France

Prof. **R. Papp** France

Mr. **G. Vuillard** France

Dr. **G.F. Cutolo** Italy

Prof. Ing. **G. Ferraiolo** Italy

Dr. Ir. **H.J. Pasman** Netherlands

Ir. **M. Vis van Heemst** Netherlands

Mr. **E.N. Bjordal** Norway

Mr. **J.A. Firing** Norway

Prof. **J. Blasco** Spain

Prof. **J. Cisterò** Spain

Dr. **H. Frostling** Sweden

Mr. **A. Jacobsson** Sweden

Dr. **G. Suter** Switzerland

Mr. **H.A. Duxbury** United Kingdom

Dr. **S.J. Skinner** United Kingdom

Mr. **R.C. Mill** USA

Mr. **G.A. Page** USA

Dr. **M. Peruncic** Yugoslavia

## ORGANIZING COMMITTEE

**M. Aguggia** - AUSIMONT

**G. F. Cutolo** - ESSO Italiana

**G. Ferraiolo** - University of Genova

**M. Ghezzi** - AIDIC

**G. Massini** - SRP Partners

**F. Milella** - FEDERCHIMICA

**D. Mizzi** - SARAS - Sardinian Refineries

**G. B. Petella** - SRP Partners

**E. Profili** - ENI

**M. Rovatti** - CSIA/ATI

**E. Roviglioni** - ENI

**L. Zanderighi** - SCI Italian Chemical Society

**G. Zerbo** - University of Catania

- 62 SPATZ, DREES, SCHOFT  
DIRECT CONDENSATION OF RELEASED VAPOR IN BLOWDOWN SYSTEMS DURING VENTING
- 63 GROLLIER - BARON  
HAZARDS CAUSED BY TRACE SUBSTANCES
- 64 KRZYSZTOFORSKI, MACIEJCZYK, WOJCIK, GASIOROWSKI  
CYCLOHEXANE OXIDATION USING OXYGEN ENRICHED AIR
- 65 ST. GEORGES, BUCHLIN, RIETHMULLER, LOPEZ, LIETO, GRIOLET  
FUNDAMENTAL MULTIDISCIPLINARY STUDY OF LIQUID SPRAYS FOR ABSORPTION OF POLLUTANT OR TOXIC CLOUDS
- 66 AAREBROT, SVENES  
INCREASED LEVEL OF SAFETY BY USE OF HIGH INTEGRITY PRESSURE PROTECTION SYSTEMS IN PROCESS PLANTS (HIPPS)
- 67 HOWELLS, TAM  
GAS-FREEING CRUDE OIL TANKS
- 68 SCHÖNBUCHER, GÖCK, FIALA  
PREDICTION OF THE HEAT RADIATION AND SAFETY DISTANCES FOR LARGE FIRES WITH THE MODEL OSRAMO
- 69 WIEDEMANN  
SAFETY PROGRAMME «GASAFE»
- 70 RUGGIERO, MACCHI, MORICI  
OFF-SITE EMERGENCY PLANNING AND PUBLIC STRUCTURE FOR INTERVENTION IN ITALY
- 71 CASSELLI, FORABOSCHI, MASONI  
A METHODOLOGY FOR EVALUATING THE SEISMIC SAFETY MARGIN OF A CHEMICAL PLANT
- 72 PIETERSEN, STOLK  
OFF-SITE EMERGENCY MANAGEMENT FOR INDUSTRIAL AREAS

## POSTERS

*The Posters are listed according to the numbers given them in the Preliminary Program. The missing numbers correspond to withdrawals.*

- 73 BOTHE, BRANDES  
TESTING THE COMBUSTIBILITY OF WATER REDUCED LIQUIDS
- 74 SCHULZ, BRAUN  
FATIGUE CRACK LEAKAGE PREVENTION BY OPERATIONAL VIBRATION SIMULATION TESTS OF PIPING
- 75 DROSTE, WIESER  
FULL-SCALE VERSUS SMALL-SCALE FIRE TESTING OF FIRE PROTECTION MATERIAL FOR LPG STORAGE VESSELS FOR PRESSURISED INFLAMMABLE GASES



- 76 IIZUKA FUJITA  
THE THERMAL STABILITY OF THE VILSMEIER COMPLEX
- 77 GIESBRECHT, BECHTEL, GILBERT, SCHLIEPHAKE  
IGNITION OF UNCONFINED VAPOUR CLOUDS BY HOT PIPES
- 78 GLOR, SIWEK  
MINIMUM ENERGY NECESSARY TO INITIATE DECOMPOSITION OF ETHYLENE OXIDE VAPOUR
- 79 GREWER, HENTSCHEL, REDEKER, CONRAD  
DEVELOPMENT OF A STANDARD METHOD FOR FLAMMABILITY LIMITS OF VAPOR-AIR MIXTURES
- 80 HASEGAWA, NABA  
HAZARDOUS PROPERTIES OF OXIMES
- 81 HEEMSKERK, LONT  
SAFETY MARGINS IN CASE OF CONTAINER TRANSPORT
- 82 LECLERC-BATTIN, MARQUAIRE, COME, BARONNET, GUSTIN  
AUTOIGNITIONS OF GAS-PHASE MIXTURES OF 1,4 DIOXANE AND CHLORINE
- 83 MANGIALAVORI, RUBINO  
EXPERIMENTAL TESTS ON LARGE HYDROCARBON POOL FIRES
- 84 MICHOT, BIGOURD, PINEAU  
INERIS ACTION IN THE FIELD OF HAZARDOUS SUBSTANCES
- 85 MIYAKE, OGAWA  
NON-IDEAL DETONATION PROPERTIES OF PRILLED AMMONIUM NITRATE
- 86 SCHLIEPHAKE, GIESBRECHT, LOFFLER  
FORMATION AND SELF IGNITION OF POLYGLYCOLS IN INSULATION MATERIALS:  
A SOURCE OF DANGER FOR ETHYLENE OXIDE PLANTS
- 87 SUTER, ANGLY, KUPR  
REACTION CALORIMETRY AT MINUS 80 C
- 88 TOGNOTTI, PETARCA  
SAFETY PROBLEMS IN THE PRODUCTION OF ORGANIC HYDROPEROXIDES
- 89 GELFAND, MEDVEDEV, POLENOV, TSYGANOV  
SHOCK WAVES BY SUDDEN EXPANSION OF HOT LIQUID
- 90 UEHARA, SEINO  
EXPERIMENTAL STUDY ON CHANGE OF CRITICAL IGNITION TEMPERATURE  
OF MATERIAL IN VARYING AMBIENT TEMPERATURE
- 91 HEEMSKERK, SCHUURMAN  
TEST STRATEGIES IN PROCESS SAFETY ANALYSIS
- 92 ALAVES  
A STUDY OF THE INFLUENCE OF OBSTACLES ON THE DISPERSION OF HEAVY GAS  
CLOUDS IN THE ATMOSPHERE THROUGH SIMULATIONS PERFORMED WITH THE  
MERCURE GL, THREE DIMENSIONAL MODEL

- 93 ANTONELLO, BUZZI  
THE RELEASE OF HEAVY GASES - HYDROGEN FLUORIDE CASE
- 94 SPADONI, PASQUALI, MACCHI, RICCHIUTI  
«SOURCE TERM» MODELS TO EVALUATE THE DISPERSION OF HEAVY GASES
- 95 THEURER, BAECHLIN, PLATE  
A MODEL FOR CALCULATION OF IMMISSIONS CAUSED BY ACCIDENTALLY RELEASED  
GAS-PLUMES WITHIN BUILT-UP AREAS
- 96 BARTH  
STEAM CURTAINS - MITIGATION OF HEAVY GAS CLOUDS ON INDUSTRIAL TERRAINS
- 97 HAASTRUP, STYHR PETERSEN  
HAZARDOUS MATERIALS: A COMPARISON OF ACCIDENTS FROM FIXED INSTALLATION  
AND TRANSPORT
- 98 HERMANN, SCHECKER, SCHOFT  
DIRECT CONTACT CONDENSATION OF RELEASED VAPOR-GAS-MIXTURES IN A JET  
CONDENSER
- 99 HOWELLS, YULE  
FLAMMABILITY OF HIGH FLASH POINT MISTS
- 100 MAVROTHALASSITIS, MICHAELIS, PINEAU  
CONTRIBUTION TO BOIL OVER AND FROTH OVER QUANTIFICATION
- 101 SCHNATZ, WORSDORFER  
ESSENTIAL CHARACTERISTIC OF AN ONLINE DISPERSION MODEL FOR  
CATASTROPHIC ACCIDENTS



EUROPEAN FEDERATION OF CHEMICAL ENGINEERING  
454<sup>th</sup> EVENT

**7<sup>th</sup> INTERNATIONAL SYMPOSIUM  
ON LOSS PREVENTION AND  
SAFETY PROMOTION  
IN THE PROCESS INDUSTRIES**

TAORMINA, ITALY 4-8 MAY 1992

Promoted by the **Working Party**  
**on Loss Prevention and Safety Promotion in the Process Industries**  
and organized by the Italian Delegation of the Working Party appointed  
by AIDIC, Italian Association of Chemical Engineering and  
by SCI, Italian Chemical Society - Lombardy Section.

**VOLUME 3**  
**Posters from 102 to 171**



The Symposium is held under the auspices of

**FEDERCHIMICA**

Italian Federation of Chemical Industry

**CIEU**

Interuniversity Centre of Human Ecology,  
Universities of Genova, Pavia and Piacenza

With the official support of

**Ministry of Environment**

**Ministry of Internal Affairs**

**Government of Sicilian Region**

**National Council for Research**

**University of Catania**

**University of Genova**

**University of Messina**

**University of Palermo**

Promoted with the agreement of

**AIDIC**

Italian Association of Chemical Engineering

**SCI**

Italian Chemical Society (Lombardy Section)

**CISAP**

Italian Safety and Environment Committee for the Process Industry

**CSIA**

National Committee on Atmospheric Pollution Study (Italian Member of IUAPPA)

**CCPS**

Centre for Chemical Process Safety, USA

# OFFICIAL COMMITTEES

## EXECUTIVE COMMITTEE

### **R. Alessandrello**

(President, AIDIC, Italian Association of Chemical Engineering)

### **G. Biardi**

(Vice-President, AIDIC)

### **S. Cambi**

(Director of Human Resources and Organization, ENI, Ente Nazionale Idrocarburi)

### **C. Cogliati**

(Managing Director, AUSIMONT)

### **G. Ferraiolo**

(CIEU, Universities of Genova, Pavia and Piacenza and President of CISAP, Italian Safety and Environment Committee for the Process Industry)

### **A. Guccione**

(Vice-President, SARAS, Raffinerie Sarde)

### **A. Piglia**

(Vice-President, ESSO Italiana)

### **G. Porta**

(President, Federchimica, Italian Federation of Chemical Industry)

### **F. Pregaglia**

(President, SCI, Italian Chemical Society, Lombardy Section)

### **G. Zerbo**

(President, CIPA, Industrial Consortium for Environmental Protection)

## ORGANIZING COMMITTEE

**M. Aguggia** - AUSIMONT

**G. F. Cutolo** - ESSO Italiana

**G. Ferraiolo** - University of Genova

**M. Ghezzi** - AIDIC

**G. Massini** - SRP Partners

**F. Milella** - FEDERCHIMICA

**D. Mizzi** - SARAS - Sardinian Refineries

**G. B. Petella** - SRP Partners

**E. Profili** - ENI

**M. Rovatti** - CSIA/ATI

**E. Roviglioni** - ENI

**L. Zanderighi** - SCI Italian Chemical Society

**G. Zerbo** - University of Catania

## SCIENTIFIC COMMITTEE

Prof. Ir. **J. Mewis** Belgium

Prof. Ir. **J. Clerinx** Belgium

Prof. Ir. **A. Germain** Belgium

Ing. **J. Skarka** Czechoslovakia

Mr. **N. Hjorth** Denmark

Dr. **V. Pilz** Fed. Rep. of Germany

Prof. Dr. **H.G. Schecker** Fed. Rep. of Germany

Dr. **C. Bartels** Fed. Rep. of Germany

Mr. **P. Hypponen** Finland

Ms. **L. Laakso** Finland

Mr. **R. Grollier Baron** France

Prof. **R. Papp** France

Mr. **G. Vuillard** France

Dr. **G.F. Cutolo** Italy

Prof. Ing. **G. Ferraiolo** Italy

Dr. Ir. **H.J. Pasma** Netherlands

Ir. **M. Vis van Heemst** Netherlands

Mr. **E.N. Bjordal** Norway

Mr. **J.A. Firing** Norway

Prof. **J. Blasco** Spain

Prof. **J. Cisterò** Spain

Dr. **H. Frostling** Sweden

Mr. **A. Jacobsson** Sweden

Dr. **G. Suter** Switzerland

Mr. **H.A. Duxbury** United Kingdom

Dr. **S.J. Skinner** United Kingdom

Mr. **R.C. Mill** USA

Mr. **G.A. Page** USA

Dr. **M. Peruncic** Yugoslavia

# CONTENTS

## *General note*

*The volumes are not continuously numbered. Only papers are individually numbered.*

## POSTERS

*The Posters are listed according to the numbers given them in the Preliminary Program. The missing numbers correspond to withdrawals.*

- 102 STRAMIGIOLI, SPADONI  
VAPORIZATION FROM MULTICOMPONENT LIQUID SPILLS:  
A COMPREHENSIVE MATHEMATICAL MODEL TO PREDICT THE RATES OF BOIL-  
OFF OR EVAPORATION FROM A CONFINED OR UNCONFINED POOL
- 103 WIGHUS  
A TEST METHOD FOR JET FIRE EXPOSURE
- 104 KUKKONEN, VESALA  
MODELLING AEROSOL RELEASES OF HAZARDOUS MATERIALS
- 105 ALTORFER  
EXPLOSION PROTECTION OF WASTE GAS COMBUSTION
- 106 BAILLOU, LISBET, DUPRE, PAILLARD, GUSTIN  
GAS PHASE EXPLOSION OF NITROGEN TRICHLORIDE: APPLICATION TO THE SAFETY  
OF CHLORINE PLANTS AND CHLORINATION PROCESS
- 107 CHATRATHI  
DEFLAGRATION PROTECTION OF PIPES
- 108 COOPER, MOORE  
ACTIVE DETONATION ARRESTERS FOR SOLVENT AND WASTE GAS RECOVERY  
PROCESSES
- 109 HASEGAWA  
AN EXPERIMENTAL STUDY ON THE FILM DETONATIONS OF HIGHER HYDROCARBONS
- 110 PEGG, AMYOTTE, CHIPPETT  
CONFINED AND VENTED DEFLAGRATIONS OF PROPANE/AIR MIXTURES AT INITIALLY  
ELEVATED PRESSURES
- 111 SCHENDLER, CONRAD, DIETLER  
PREVENTING EXPLOSION HAZARDS OF DECOMPOSABLE GASES
- 112 VAN DER WEL, NEERVOORT, LEMKOWITZ, VAN WINGERDEN, SCARLETT  
CONSTRUCTION DEVELOPMENT AND USE OF A NEW EXPLOSION CELL FOR HIGH  
PRESSURE, HIGH TEMPERATURE DUST EXPLOSION TESTING
- 113 ARNAUD, ZAREA, AUDEBERT, BERTRAND, LELIEVRE, DESBORDES, GUERRAUD,  
LEYER, RUTTUN  
THE OVERPRESSURE GENERATED WHEN IGNITING A LARGE SCALE FREE NATURAL GAS JET



- 114      GUIBERT, NOEL, LANGUY, LEYER, DESBORDES  
PREDICTION OF PRESSURE LOAD GENERATED ON OBSTACLES BY VAPOUR CLOUD  
DEFLAGRATION
- 115      VENART, RUTLEDGE, SUMATHIPALA, SOLLOWS  
THE ANATOMY OF A BOILING LIQUID EXPANDING VAPOUR EXPLOSION
- 116      FINES, TSURUDA, HIRANO  
MODELING OF PRESSURE WAVE INDUCED TURBULENCE
- 117      HAAVERSTAD  
DEVELOPMENT AND DESIGN OF BLAST RELIEF PANELS
- 118      ROTA, CANU, CARRÀ, MORBIDELLI  
DIAGRAMS FOR VENT PANELS DESIGN
- 119      TUFANO  
ON THE DESIGN OF INERTING SYSTEMS AGAINST CHEMICAL EXPLOSIONS
- 120      VORATH, REDEKER, BRANDES  
PROTECTIVE MEASURES AGAINST EXPLOSIONS IN SMOKING DEVICES
- 122      ANDREOZZI, AQUILA, INSOLA, CAPRIO  
RUNAWAY REACTIONS IN NITRATION OF AMIDIC COMPOUNDS
- 123      FROBESE, FORSTER  
PROPAGATION OF DETONATIONS THROUGH JUNCTIONS OF PIPEWORK
- 124      GUSTIN, VIDAL  
THE HAZARD OF PROCESSING NITRIC SOLUTIONS OF ORGANIC DIACIDS.  
EXPERIMENTAL INVESTIGATION OF THE SLOW REACTION-DEFLAGRATION-D
- 125      MOLTER  
REINTRODUCTION OF LIQUID PHASE INTO THE REACTOR AFTER SEPARATION FROM  
A TWO-PHASE FLOW DURING PRESSURE RELIEF
- 126      NIEMITZ  
THEORY AND EXPERIMENT OF A CATALYST CONTROLLED SEMI BATCH PROCESS -  
AN ALTERNATIVE APPROACH
- 127      SINGH, BOEY  
MODELLING OF MASS TRANSFER CONTROLLED EXOTHERMIC REACTIONS USING  
ADIABATIC CALORIMETRY
- 128      GUSTIN, VANDERMARLIERE  
THE RUNAWAY BULK POLYMERIZATION OF VINYL ACETATE INITIATED BY A  
PEROXIDE - CASE STUDY: VENTING VS. PRESSURE CONTAINMENT
- 129      ANGELIN, DELLA VALLE, MONTE, LOVATO, RIENZI  
SAFETY SIMULATION AND CONTROL FOR A REACTOR IN PRESENCE OF A HIGHLY  
EXOTHERMIC REACTION
- 130      ZÍKA, MATYÁS  
MODERN TECHNOLOGIES AND EFFICIENT LOSS PREVENTION SYSTEMS IN  
CZECHOSLOVAK CHEMICAL INDUSTRY ARE INEVITABLE

- 131 UHLMANN  
TWELVE YEARS OF EXPERIENCE WITH THE HAZOP METHOD IN TRAINING AND PRACTICE
- 133 DIAZ CORREA  
MAXIMUM CREDIBLE ACCIDENT ANALYSIS OF A GAS COMPRESSION PLANT
- 134 JÄGER, HAFERKAMP  
A CHECKLIST FOR THE SYSTEMATIC EXAMINATION OF STORAGE AND PRODUCTION FACILITIES WITH HIGH RISK POTENTIAL
- 135 KARYDAS  
A PROBABILISTIC METHODOLOGY FOR THE FIRE SMOKE HAZARD ANALYSIS OF ELECTRONIC EQUIPMENT
- 136 RINALDI, STANGHELLINI, SANTUCCI, MALAGOLI, VESTRUCCI, CORTICELLI, COMMISSARI, BARBIERI  
COMPARE: A COMPUTER AIDED RISK EVALUATION PACKAGE
- 137 NAGY  
THE FAULT SEARCHING, SAFETY EVALUATING AND SAFETY INCREASING - ZERO METHOD
- 138 PIETERSEN, VAN HET VELD  
THE RISKS OF TRANSPORTING HAZARDOUS MATERIALS
- 139 WELLS, PHANG  
A MODIFIED FORM OF HAZOP WITH EMPHASIS ON OPERABILITY
- 140 KOIVISTO , DOHNAL, KVAPILIK, PROKES, VYSTRCI, DVORAK  
RISK REASONING AND REVITALIZATION OF INFORMATION POOR KNOWLEDGE
- 141 PHELPS, JUREIDINI  
THE COMPUTER MODELLING OF TANK SPILLS AND CONTAINMENT OVERFLOWS
- 142 PONTIGGIA  
HAZARD ANALYSIS TECHNIQUES ADOPTED BY "TECNIMONT" IN THE DEVELOPMENT OF PROCESS PLANTS PROJECTS
- 143 HURST, WILLIAMS, HANKIN, WILKINSON, NUSSEY  
FAILURE RATE AND INCIDENT DATABASES FOR MAJOR HAZARDS
- 144 MAKSTENEK, LELAKIN, CHERNOPOLEKOV, CHERNYSHEV  
THE EXPERIENCE OF REALIZATION OF ACCIDENT DATA BASE WITH FLEXIBLE STRUTURE
- 145 SASS, ECKERMANN  
CHEMSAFE-A USER FRIENDLY INFORMATION SYSTEM OF SAFETY VALUES
- 146 RIZZO, BAGNARA, MANCINI  
HUMAN ERROR AND WORK ENVIRONMENT
- 147 ABRAMOVICI, SPITZNER  
TRANSIENT HEAT TRANSFER MODEL IN PRESSURE VESSELS SUBMITTED TO EXTERNAL HEAT SOURCES



- 148 CALZADA BAU, ESPASA, BARRERA  
EXPERT SYSTMS IN SAFETY PROMOTION
- 149 FIUMI, ZANNELLI  
AN INTELLIGENT SYSTEM TO CONTROL QUALITY
- 150 GOERING  
AZEXPERT - AN EXPERT SYSTEM FOR SUPPORTING HAZARD IDENTIFICATION FOR  
PROCESS PLANTS
- 151 HEIKKILA, HEINO  
INTELLIGENT TOOL FOR SCREENING AND PRELIMINARY ANALYSIS OF PROCESS  
HAZARDS
- 152 SANTON  
AN EXPERT SYSTEM FOR THE DESIGN OF DUST EXPLOSION RELIEF VENTS
- 153 CORTI, SANSONE  
SAFETY IN DRILLING OPERATIONS: REAL TIME EXPERT SYSTEMS HELP OPERATORS  
IN PREVENTING ACCIDENTS
- 154 PALAZZI  
SAFETY PROBLEMS IN OPERATIONS CONCERNING THE MANIPULATION AND  
STORAGE OF CHEMICALLY UNSTABLE MIXTURES OF WASTES.
- 155 GRIEDER  
EXPERIENCE WITH EXPERT SYSTEMS (ES) FOR CLASSIFICATION OF HAZARDOUS  
CHEMICALS FOR TRANSPORTATION AND WAREHOUSING
- 156 ROOTSAERT, HARRINGTON  
A KNOWLEDGE BASED COMPUTER PROGRAM «COMHAZOP» AS AID FOR HAZARD  
AND OPERATIBILITY STUDIES IN PROCESS PLANTS
- 157 VON HAEFEN  
DUSTEXPERT AN EXPERT SYSTEM FOR THE ASSESSMENT OF DUST EXPLOSION  
HAZARDS
- 158 BELTRAME, BELLANI, CANNALIRE  
SAFETY PROVISIONS FOR UNDERGROUND AND MOUNDED LPG STORAGES
- 159 CONCEICAO, BORREGO  
REAL TIME SIMULATION OF HAZARDOUS ACCIDENTAL RELEASES
- 160 BROCKHOFF  
A METHOD FOR ASSESSMENT OF RISK OF TRANSPORT OF DANGEROUS GOODS.  
A MICRO APPROACH TO MACRO ANALYSIS
- 161 LONDICHE, GUILLEMET  
ASSESSMENT OF THERMAL INSULATING LAYER EFFICIENCY FOR THE PREVENTION OF LPG
- 162 VAN WEES, MERCX  
UNCERTAINTIES OF EXPLOSION DAMAGE CRITERIA
- 163 PURDY, BAGSTER, PITBLADO  
TANK FIRES ESCALATION - MODELLING AND MITIGATION



- 165 VAN GAALEN  
SAFE STORAGE OF P.O., A NEW APPROACH
- 166 NEJEDLY, SKARKA, TOPINKA  
RISK EVALUATION OF A MOLTEN WHITE PHOSPHORUS STORAGE TANK FARM
- 167 BREURE, COENEN  
CONTROL STRATEGY FOR EMISSION OF VOLATILE ORGANIC COMPOUNDS: THE CASE  
OF DIFFUSE EMISSIONS
- 168 MARSILI, VOLLONO, ZAPPONI  
RISK COMMUNICATION IN PREVENTING AND MITIGATING CONSEQUENCES OF MAJOR  
CHEMICAL INDUSTRIAL HAZARDS
- 169 KOIVISTO, SUOKAS  
PROCESS SAFETY IN MULTICRITERIA DECISION MAKING
- 171 BRADLEY, KAMMAL  
THE APPLICATION OF RISK MANAGEMENT AND ENGINEERING LOSS PREVENTION  
METHODS TO THE INSURANCE MARKET



EUROPEAN FEDERATION OF CHEMICAL ENGINEERING  
454<sup>th</sup> EVENT

**7th INTERNATIONAL SYMPOSIUM  
ON LOSS PREVENTION AND  
SAFETY PROMOTION  
IN THE PROCESS INDUSTRIES**

TAORMINA, ITALY 4-8 MAY 1992

Promoted by the **Working Party**  
**on Loss Prevention and Safety Promotion in the Process Industries**  
and organized by the Italian Delegation of the Working Party appointed  
by AIDIC, Italian Association of Chemical Engineering and  
by SCI, Italian Chemical Society - Lombardy Section.

**VOLUME 4**  
**Proceedings**

The Symposium is held under the auspices of

**FEDERCHIMICA**

Italian Federation of Chemical Industry

**CIEU**

Interuniversity Centre of Human Ecology,  
Universities of Genova, Pavia and Piacenza

With the official support of

**Ministry of Environment**

**Ministry of Internal Affairs**

**Government of Sicilian Region**

**National Council for Research**

**University of Catania**

**University of Genova**

**University of Messina**

**University of Palermo**

Promoted with the agreement of

**AIDIC**

Italian Association of Chemical Engineering

**SCI**

Italian Chemical Society (Lombardy Section)

**CISAP**

Italian Safety and Environment Committee for the Process Industry

**CSIA**

National Committee on Atmospheric Pollution Study (Italian Member of IUAPPA)

**CCPS**

Centre for Chemical Process Safety, USA



# OFFICIAL COMMITTEES

## EXECUTIVE COMMITTEE

**R. Alessandrello**

(President, AIDIC, Italian Association of Chemical Engineering)

**G. Biardi**

(Vice-President, AIDIC)

**S. Cambi**

(Director of Human Resources and Organization, ENI, Ente Nazionale Idrocarburi)

**C. Cogliati**

(Managing Director, AUSIMONT)

**G. Ferraiolo**

(CIEU, Universities of Genova, Pavia and Piacenza and President of CISAP, Italian Safety and Environment Committee for the Process Industry)

**A. Guccione**

(Vice-President, SARAS, Raffinerie Sarde)

**A. Piglia**

(Vice-President, ESSO Italiana)

**G. Porta**

(President, Federchimica, Italian Federation of Chemical Industry)

**F. Pregaglia**

(President, SCI, Italian Chemical Society, Lombardy Section)

**G. Zerbo**

(President, CIPA, Industrial Consortium for Environmental Protection)

## SCIENTIFIC COMMITTEE

Prof. Ir. J. Mewis Belgium

Prof. Ir. J. Clerinx Belgium

Prof. Ir. A. Germain Belgium

Ing. J. Skarka Czechoslovakia

Mr. N. Hjorth Denmark

Dr. V. Pilz Fed. Rep. of Germany

Prof. Dr. H.G. Schecker Fed. Rep. of Germany

Dr. C. Bartels Fed. Rep. of Germany

Mr. P. Hypponen Finland

Ms. L. Laakso Finland

Mr. R. Grollier Baron France

Prof. R. Papp France

Mr. A. Perroy France

Dr. G.F. Cutolo Italy

Prof. Ing. G. Ferraiolo Italy

Dr. Ir. H.J. Pasman Netherlands

Ir. M. Vis van Heemst Netherlands

Mr. E.N. Bjordal Norway

Mr. J.A. Firing Norway

Prof. J. Blasco Spain

Prof. J. Cisterò Spain

Dr. H. Frostling Sweden

Mr. A. Jacobsson Sweden

Dr. G. Suter Switzerland

Mr. H.A. Duxbury United Kingdom

Dr. S.J. Skinner United Kingdom

Mr. R.C. Mill USA

Mr. G.A. Page USA

Dr. M. Peruncic Yugoslavia

## ORGANIZING COMMITTEE

**M. Aguggia** - AUSIMONT

**G. F. Cutolo** - ESSO Italiana

**G. Ferraiolo** - University of Genova

**M. Ghezzi** - AIDIC

**G. Massini** - SRP Partners

**F. Milella** - FEDERCHIMICA

**D. Mizzi** - SARAS - Sardinian Refineries

**G. B. Petella** - SRP Partners

**E. Profili** - ENI

**M. Rovatti** - CSIA/ATI

**E. Roviglioni** - ENI

**L. Zanderighi** - SCI Italian Chemical Society

**G. Zerbo** - University of Catania

# CONTENTS

## *General note*

*The volume is not continuously numbered. Discussion, Round Table and late papers are individually numbered.*

## OPENING ADDRESSES

by Prof. Giuseppe Ferraiolo,  
Chairman of the Executive Committee

by Dr. Hans J. Pasman,  
Chairman of the EFCE Working Party on Loss Prevention

by Prof. Kurt Kirchner,  
Chairman of the EFCE Working Party on Environment

by Prof. Alfredo Squarzoni,  
Headmaster of the Engineering Faculty of Genova University

by Dr. Franco Milella,  
Accountable of the Technical-Scientific Office of the Federchimica, Italian Federation  
of Chemical Industry

by Prof. Giuseppe Biardi,  
Vice President of the AIDIC, Italian Association of Chemical Engineering

by Dr. V. Pianese  
Vice Director, Augusta Refinery, ESSO Italiana

## COMMENTS

## LIST OF PARTICIPANTS

## LIST OF EXHIBITORS

## DISCUSSIONS

## ROUND TABLE

## **LATE PAPERS AND CORRECTIONS**

### **Plenary Lectures**

**F. P. FORABOSCHI**  
**AREA RISK AND TERRITORY MANAGEMENT**

### **Papers**

- 1** EMBLEM, KORTNER  
**INTEGRATED ANALYSIS: PROCESS SAFETY, ENVIRONMENTAL POLLUTION,  
WORKING ENVIRONMENT**
- 8** ROGERS  
**THE USE OF PROBLEM ANALYSIS IN THE INVESTIGATION OF INCIDENTS**
- 13** DITALI, ROVATI, RUBINO  
**EXPERIMENTAL MODEL TO ASSESS THERMAL RADIATION FROM  
HYDROCARBON POOL FIRES**  
(corrigenda)
- 22** ANDERSSON  
**STORAGE TANK FIRE AT NESTYE PORVOO REFINERY 23 -24.3.1989**  
(manuscript not available)
- 24** CHERNOPLEKOV, DOBROCHEEV, KULESHOV, STEPANOV  
**MODELLING OF PHENOMENA OF PIPELINE ACCIDENT ON 03.06.89 NEAR UFA  
(BASHKIRIA, USSR) LARGE SCALE LPG CLOUD EXPLOSION**  
(manuscript not available)
- 28** JEZLER  
**THERMAL TANK EXPLOSION. THE WAY FROM EVENT TO MEASURES**
- 29** VOLPICELLI, GODONO, MIGLIACCIO, LANCIA  
**UNCONFINED VAPOUR CLOUD EXPLOSION: A CASE HISTORY**  
(withdrawn)
- 35** MERCX  
**LARGE-SCALE EXPERIMENTAL INVESTIGATION INTO VAPOUR CLOUD  
EXPLOSIONS, COMPARISON WITH THE SMALL SCALE DISCOE-TRIALS**
- 36** STOCK, SCHUMANN, WIRKNER-BOTT  
**VAPOUR CLOUD EXPLOSION AFTER TWO PHASE JET RELEASE**
- 43** RODHOLM,  
**COST-BENEFIT THROUGH PROBABILISTIC DECISION MAKING**
- 44** SCHREIBER  
**MEASURING PERFORMANCE AND EFFECTIVENESS OF CHEMICAL  
PROCESS SAFETY**
- 47** DE STROBEL, BERTELLE  
**POLLUTION RISK CONNECTED WITH TECHNOLOGICAL EVOLUTION**



- 58 WIRKNER-BOTT, SCHUMANN, STOCK  
DUST EXPLOSION VENTING: INVESTIGATION OF THE SECONDARY EXPLOSION
- 59 MULLER, SCHACKE, SIWEK  
GAS EXPLOSION VENTING OF A STRUCTURE
- 66 AAREBROT, SVENES  
INCREASED LEVEL OF SAFETY BY APPLICATION OF HIGH INTEGRITY  
PRESSURE PROTECTION SYSTEMS
- 67 HOWELLS, TAM  
GAS-FREEING CRUDE OIL TANKS  
(withdrawn)
- 68 SCHONBUCHER AND OTHER  
PREDICTION OF THE HEAT RADIATION AND SAFETY DISTANCES FOR LARGE  
FIRES WITH THE MODEL OSRAMO  
(corrigenda)
- 69 WIEDEMANN, G.E.I.E. PROGRAMME GASAFE  
GASAFE PROGRAMME - A SAFETY RESEARCH PROGRAMME ON POSSIBLE  
PASSIVE PROTECTION AGAINST FIRE FOR LIQUEFIED GAS TANK
- 70 RUGGIERO, MACCHI, MORICI  
OFF-SITE EMERGENCY PLANNING AND PUBLIC STRUCTURE FOR  
INTERVENTION IN ITALY  
(corrigenda and addendum)
- 72 PIETERSEN, STOLK  
OFF-SITE EMERGENCY MANAGEMENT FOR INDUSTRIAL AREAS

#### Posters

- 75 WIESER, DROSTE  
FULL-SCALE VERSUS SMALL-SCALE FIRE TESTING OF FIRE PROTECTION  
MATERIALS FOR LPG STORAGE VESSELS
- 80 HASEGAWA, NABA  
HAZARDOUS PROPERTIES OF OXIMES
- 81 HEEMSKERK, LONT  
SAFETY MARGINS IN CASE OF CONTAINER TRANSPORT
- 91 HEEMSKERK, SCHUURMAN  
TEST STRATEGIES IN PROCESS SAFETY ANALYSIS
- 92 ALAVES  
A STUDY OF THE INFLUENCE OF OBSTACLES ON THE DISPERSION OF HEAVY  
GAS CLOUDS IN THE ATMOSPHERE THROUGH SIMULATIONS PERFORMED  
(withdrawn)
- 95 THEURER, BAECHLIN, PLATE  
A MODEL FOR THE CALCULATION OF IMMISSIONS BY ACCIDENTALLY  
RELEASED GAS-PLUMES WITHIN BUILT-UP AREAS

- 99        HOWELLS, YULE  
          FLAMMABILITY OF HIGH FLASH POINT MISTS  
          (withdrawn)
- 101       SCHNATZ, WORSDORFER  
          ESSENTIAL CHARACTERISTIC OF AN ONLINE DISPERSION MODEL FOR  
          CATASTROPHIC ACCIDENTS  
          (withdrawn)
- 103       WIGHUS, SHIRVILL  
          A TEST METHOD FOR JET FIRE EXPOSURE
- 108       COOPER, MOORE  
          ACTIVE DETONATION ARRESTERS FOR SOLVENT AND WASTE GAS  
          RECOVERY PROCESSES
- 110       PEGG, AMYOTTE, CHIPPETT  
          CONFINED AND VENTED DEFLAGRATIONS OF PROPANE/AIR MIXTURES AT  
          INITIALLY ELEVATED PRESSURES
- 112       VAN DER WEL, NEERVOORT, LEMKOWITZ, SCARLETT  
          CONSTRUCTION DEVELOPMENT AND USE OF A NEW EXPLOSION CELL FOR  
          HIGH PRESSURE, HIGH TEMPERATURE DUST EXPLOSION TESTING
- 115       VENART, RUTLEDGE, SUMATHIPALA, SOLLOWS  
          TO BLEVE OR NOT TO BLEVE: ANATOMY OF A BOILING LIQUID EXPANDING  
          VAPOUR EXPLOSION
- 116       FINES, TSURUDA, HIRANO  
          MODELLING OF PRESSURE WAVE INDUCED TURBULENCE
- 120       BRANDES, REDEKER, VORATH  
          PROTECTIVE MEASUREMENTS AGAINST EXPLOSIONS IN SMOKING DEVICES  
          FOR FOODSTUFF
- 123       FROBESE, FORSTER  
          PROPAGATION OF DETONATIONS THROUGH PIPEWORK JUNCTIONS
- 125       MOLTER  
          REINTRODUCTION OF LIQUID PHASE INTO THE REACTOR AFTER  
          SEPARATION FROM A TWO PHASE FLOW DURING PRESSURE RELIEF
- 126       NIEMITZ  
          THEORY AND EXPERIMENT OF A CATALYST CONTROLLED SEMICONTINUOUS  
          PROCESS - AN ALTERNATIVE APPROACH
- 131       UHLMANN  
          TWELVE YEARS OF EXPERIENCE WITH THE PAAG (HAZOP) METHOD IN  
          TRAINING AND IN ACTUAL PRACTICES
- 135       KARYDAS  
          A PROBABILISTIC METHODOLOGY FOR THE FIRE SMOKE HAZARD ANALYSIS  
          OF ELECTRONIC EQUIPMENT



- 137 NAGY  
THE FAULT SEARCHING, SAFETY EVALUATING AND SAFETY  
INCREASING - ZERO METHOD  
(withdrawn)
- 138 PIETERSEN, VAN HET VELD  
THE RISKS OF TRANSPORTING HAZARDOUS MATERIALS  
(withdrawn)
- 146 RIZZO, BAGNARA, MANCINI  
HUMAN ERROR AND WORK ENVIRONMENT  
(withdrawn)
- 155 GRIEDER  
EXPERIENCE WITH EXPERT SYSTEMS (ES) FOR CLASSIFICATION OF  
HAZARDOUS CHEMICALS FOR TRANSPORTATION AND WAREHOUSING  
(manuscript not available)
- 159 BORREGO, CONCEICAO  
REAL TIME SIMULATION OF ACCIDENTAL HAZARDOUS RELEASES
- 161 LONDICHE, GUILLEMET  
ASSESSMENT OF THERMAL INSULATING LAYER EFFICIENCY FOR THE  
PREVENTION OF LPG  
(withdrawn)
- 165 OVERDULVE  
SAFE STORAGE OF PROPYLENE-OXIDE, A NEW APPROACH
- 169 KOIVISTO, SUOKAS  
PROCESS SAFETY IN MULTICRITERIA DECISION MAKING
- 171 BRADLEY, KAMMAL  
THE APPLICATION OF RISK MANAGEMENT AND ENGINEERING LOSS  
PREVENTION METHODS TO THE INSURANCE MARKET  
(withdrawn)