



# European Safety and Reliability Association

# Newsletter

<http://www.esrahomepage.org>

July 2004

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## ESRA NEWS

### Letter from the Chairman



*Carlos Guedes Soares*  
*IST – Portugal*

### ESRA Technical Committees

The Technical Committees continue to be one of the important assets of ESRA as they bring together the specialists in various areas of competence. The networking that this direct contact allows, as well as the initiatives that these Committees have, is very useful to many ESRA members.

Until recently, the ESRA Technical Committees have had various kinds of initiatives in their specialist domain. Some have promoted workshops isolated or integrated in the ESREL Conferences; some have produced reports or have promoted courses, and others have even cooperated with other associations in the organization of specialised conferences.

Following an evaluation of their overall activity, a decision was made in the last year to refocus the scope of these Committees. In view of the central role that the ESREL Conferences have in ESRA and the fact that they are annual initiatives, there is in general little space left for the organization of independent

workshops by the Technical Committees. This is even more the case for the Technical Committees that have organised specialised sessions of papers in their area and even workshops integrated in previous ESREL Conference.

Therefore the decision was made to give the Technical Committees the primary mission of contributing to the organisation of the technical programme of the ESREL Conferences in their specific area of activity, although not depriving them of the possibility of other initiatives as they see fit.

The consequence of this policy was that a significant expansion of the number of the Technical Committees was required in order to make sure that the main areas of interest of the ESREL Conferences would be covered.

Several new Committees have been created, as indicated in the last page of this Newsletter and they were organised by industrial or technological sectors and by methodologies.

I would like to welcome the new Committee Chairmen to their new responsibilities, wishing them success in their efforts to mobilise other colleagues in participating in the ESRA activities in general and in the ESREL Conferences in particular.

Although the Committees have been created and the Chairmen identified they are by no means complete and fully operational. They are presently recruiting members and thus I would invite interested persons to contact the respective Committee Chairman if they wish to participate.

Furthermore, the list of Committees is not yet complete as the subject areas normally included in the ESREL Conferences are not all covered. Therefore, suggestions of new Committees are still welcome.

## ESREL 2004-PSAM 7: A Successful Joint Effort



*Enrico Zio*  
*Politecnico di Milano – Italy*

The annual ESRA Conference, ESREL 2004, took place in Berlin on June 14-18, jointly with the PSAM7 Conference. It was organized by ESRA and the International Association of Probabilistic Safety Assessment and Management (IAPSAM). As such, this joint conference represented the major international event in 2004 concerning the presentation and discussion of innovative methodologies as well as practical applications of probabilistic safety assessment and risk-informed approaches to safety management.

More than 700 attendees from universities, research laboratories, government agencies, industries and consultancy firms, shared five days of intense technical and social activities, creating a stimulating and pleasant atmosphere. The participation covered more than 45 countries, with an active contingent of young students and professionals.

A large number of papers were presented in eleven parallel sessions properly organized in thematic blocks by the technical Conference organizers.

The programme of the Conference included specialists' presentations and discussions of innovative and traditional methods and applications for improving the design and operation of products, processes, equipment and installations from a safety point of view, while taking into account also the realistic constraints on the available physical and economical resources. Although much emphasis was given to the safety and performance requirements, including life cycle processes and cost analysis, of modern engineering systems subject to natural and man-made hazards, significant consideration was given also to the non-negligible societal factors influencing the use of risk assessment and risk management methods. Integral demonstrations of the use of risk analysis and safety assessment were provided in many practical applications concerning major technological systems, ranging from chemical and nuclear ones, to aviation and aerospace ones, to road and railway transport ones, to civil and structural ones, and more. Traditional keynote lectures, workshops, panels and roundtable discussions on Safety and Reliability in "hot" technologies successfully provided forums for open exchanges of ideas.

Overall, we feel very satisfied with the outcome of the Conference and the collaborative effort done by ESRA and IAPSAM. We would like to take this

opportunity to thank all those who have contributed to the organisation of this Conference, in particular the Senior Advisory Board, the Conference Organising Committee, the Application Area and Technical Discipline Coordinators as well as the Members of the Technical Programme Committee. Eventually, the merits of the Conference success are to be found in the enthusiastic participation of all the authors and attendees who have been of prime importance to the success of the Conference.

Thanks and see you soon in Poland at ESREL 2005 and in New Orleans, at PSAM8.

*(Enrico Zio & Cornelia Spitzer)*



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## FEATURES

### The Criteria for Compatibility between Industrial Plants and land Use in Italy



*Giovanni Ugucioni*  
*D'Appolonia S.p.A.*

#### Introduction

Major hazard installation in Italy are ruled by Law 334 of 1999 that enforce the EU 'Seveso II' Directives. The Law Require Plant Owners to issue a Safety Report analysing the accidents that can occur in the installation, their frequency of occurrence and the extent of the associated consequences.

On this basis the competent authorities will assess if the plant can be authorised, with recommendations for further improvement of safety, if necessary.

The criteria for this assessment are given in a Decree from the Ministry of Public Works (DM 9/5/2001) that defines the criteria that the Local Authorities have to follow to assess the compatibility between major hazards installations and surrounding territory. The purpose of this note is to present the main concepts of this Decree and to briefly illustrate its application aspects.

## **The main aspects of the Decree on the Compatibility of Major Hazard Installations with the Territory**

The full title of the decree is “Minimum safety requirements related to land use planning for the areas interested by major hazard plants” (ref. 1; in the following, all English translation of Decree sections are by the Author).

It applies to all installations covered by the “Seveso” Directive, i.e. with exclusion of Military Installations, Mining, Transportation, Nuclear hazards etc.

The decree requires the Local Authorities to issue a ‘Technical Report on Major Accidents Risk’ (“Elaborato Tecnico Rischi di Incidenti Rilevanti”). The “Technical Report”, whose contents are given in an Annex to the Law, will identify the areas that shall be subjected to specific constraints as far as the land use planning is concerned. The criteria for the identification the areas at risk, and the assessment of their compatibility are given in the Annex to the Decree.

The purpose of this note is to illustrate the technical contents of this Annex, without entering into specific discussion on the planning aspects that are also covered by the Law.

The Annex indicates a *three-steps procedure*:

- identification of the territorial and environmental vulnerable elements;
- identification of the damage areas associated to the major hazard installation;
- assessment of the compatibility.

The compatibility assessment does not use the measures of Individual and Societal risk familiar to other countries; it adopts a threshold approach that implicitly refer to the risk, by adopting criteria related to the number of people exposed, the probability of presence etc., without addressing explicitly the calculation of risk measures.

It is interesting to quote, for the Decree Annex, a section that motivates the rationale behind it (translation by the Author).

“This Annex has been formulated considering the two different approaches adopted internationally:

- deterministic, where on the basis of typical and generic damage distances, separation distances between plants and residential areas are given;
- based on Risk evaluation, where the compatibility is based on the risk associated to the accidental scenarios specific for the plant under analysis.

The simplification of the deterministic approach and its stiffness of application suggest the use of an approach based on risk. It is not however considered advisable to follow the extreme way of the explicit and direct use of quantitative probabilistic evaluation (QRA), expressed as individual and societal risk, considering the inherent uncertainties and the application difficulties, that would make their use heavy and aleatory. It is preferred, within an approach based on the evaluation of the risk, to adopt a method that, even if simplified and parametrical, gives a

sufficiently precise and repeatable representation of the risk level of a specific plant-territory reality, with a reasonable effort.”

In the following, the application of this simplified approach is briefly described.

### **Classification of the Territorial Vulnerable Elements in the Area**

The territory is divided into six classes (A to F) according to the type and characteristics of the land use. The definition of the areas makes use of the ‘edification index’ that is defined in the Local Land Use planning, and on other characteristics that can be easily collected.

*Table 1* summarises the criteria for the association of a given area to one of the six classes.

With reference to these criteria, the local planners draw maps where the area is subdivided into these six territorial classes.

### **Identification of damage areas associated to the accidents identified in the Safety Report**

The decree defines threshold levels of damage related to heat radiation, overpressure, toxic concentration, with reference to ‘level of damages’ for people defined as ‘High Lethality’, ‘Beginning of Lethality’, ‘Irreversible Damages’, ‘Reversible Damages’, plus a fifth class related to ‘Structural Damages/Domino Effects’.

*Table 2* (taken from the Decree) gives the physical effect values corresponding to each damage level.

In a dedicated Annex of the Safety Report, the accidental scenarios identified are listed and the distance to each damage level is given, together with the frequency of occurrence of the scenario.

### **Assessment of the compatibility of the Industrial Plant with the Territory**

The compatibility of a given land use (A to F) with an installation that causes a certain level of damage on that specific area is done with reference to a compatibility table (Table 3) where the probability of occurrence of the accident is explicitly considered.

At any given distance from the plant, where the effects of an accidental scenario can be experienced, the Land Use classes allowed are those defined in Table 3 corresponding to the damage level and the Probability class of the scenario. The practical application of the Law makes reference to the frequency of occurrence of events (events/year), as commonly given in Safety Reports. In the following therefore, the frequency of occurrence will be used with reference to the values of Table 3.

It is important to note that with this table it is the first time that a quantitative criteria based on accident frequency of occurrence enter into the Italian Law.

This criterion, in its simplicity, nonetheless implicitly introduces many elements that enter into the definition of risk, namely the vulnerability (included in the ‘Level of Damage’), the frequency of occurrence, the probability of presence of people and the possibility to escape the effects of accidents (included in the Land Use Categories).

## TABLES

Criteria for definition	Territorial classes					
	A	B	C	D	E	F
Residential area. (criteria: Building index in m <sup>3</sup> /m <sup>2</sup> )	>4.5	1.5 – 4.5	1 – 1.5	0.5 - 1	< 0.5	-
Places where concentration of people with limited mobility, e.g. Hospitals, houses for elderly people, Nurseries, elementary schools	> 25 beds > 100 people	< 25 beds < 100 people	-	-	-	-
Places where significant outdoor concentration of people can occur, e.g. marketplaces or other commercial places	> 500 people	< 500 people	-	-	-	-
Places where significant indoor concentration of people can occur, e.g. commercial centres, office buildings, hotels, high schools, universities etc.	-	> 500 people	< 500 people	-	-	-
Places where significant concentration of people can occur, with limited period of presence e.g. theatres, churches, stadiums etc.	-	> 100 people, outdoor > 1000 people, indoor	< 100 people, outdoor < 1000 people, indoor - any number, with max weekly attendance	Any number, with max monthly attendance	-	-
Railway stations and transportation network nodes	-	> 1000 people/day	< 1000 people/day	-	-	-
Industrial, farming	-	-	-	-	Any dimension	-
Within plant fences; Area nearby plant fences, within which are not present structures where the presence of people is normally foreseeable	-	-	-	-	-	X

**Table 1 - Criteria for the Land use Classification**

Accidental scenario	High Lethality	Beginning of Lethality	Irreversible damages	Reversible damages	Structural Damage / Domino effects
Stationary heat radiation	12,5 kW/m <sup>2</sup>	7 kW/m <sup>2</sup>	5 kW/m <sup>2</sup>	3 kW/m <sup>2</sup>	12,5 kW/m <sup>2</sup>
BLEVE/Fireball (variable heat radiation)	Fireball radius	350 kJ/m <sup>2</sup>	200 kJ/m <sup>2</sup>	125 kJ/m <sup>2</sup>	200-800 m (*)
Flash-fire (instantaneous heat radiation)	LFL	½ LFL	-	-	-
VCE (peak overpressure)	0,3 bar (0,6 open spaces)	0,14 bar	0,07 bar	0,03 bar	0,3 bar
Toxic release (absorbed dose)	LC50 (30min,hmn)	-	IDLH	-	-

(\*) depending on the Storage Tank type

**Table 2- Definition of Damage Threshold Levels (ref. 1)**

Probability class of events	Effect Category			
	High Lethality	Beginning of Lethality	Irreversible damages	Reversible damages
< 10 <sup>-6</sup>	DEF	CDEF	BCDEF	ABCDEF
10 <sup>-4</sup> – 10 <sup>-6</sup>	EF	DEF	CDEF	BCDEF
10 <sup>-3</sup> – 10 <sup>-4</sup>	F	EF	DEF	CDEF
> 10 <sup>-3</sup>	F	F	EF	DEF

**Table 3 - Land Use Categories compatible with the Industrial Plants (ref. 1)**

### Application and discussion

The assessment of the compatibility of a new or an existing plant with the territory is based on the Safety Report, where the Owner has the duty to include a dedicated annex where, for all accident scenarios identified, the distance to the level of damage defined by Law shall be given, and the corresponding frequency of occurrence defined. On the basis of these data a map with the 'envelope' of the damage areas is drawn. Each damage area is centred on the location of the corresponding accident source; on the basis of this map the local authorities, by application

of the Compatibility Table, will assess the compatibility of the plant and, if necessary, will give recommendations to ensure the compatibility. As an example, consider a scenario giving a flammable gas dispersion with a distance to LFL/2 (corresponding to the 'beginning of lethality' damage level) of 150 m and an associated frequency of occurrence of 2\*10<sup>-4</sup> events/year; this scenario (see Table 3) is compatible with classes E and F, that is only if within 150 m from the scenario origin only other industrial or agricultural activities are present. Should the

frequency of the same scenario be of (say)  $8 \cdot 10^{-7}$  events/year, the compatibility is ensured also if within 150 m the Land Use is of class C (e.g. light residential areas, small commercial centres, see Table 1).

It has to be noted that the Compatibility Table given by the Decree includes all values higher than  $10^{-6}$  (events/year) but does not set a lower limit for the credibility of scenarios to be considered (the last row of the table defines values “lower than  $10^{-6}$ ” per year). Making reference to table 3, the Owner shall therefore consider all accidents with frequency of occurrence higher than  $10^{-6}$  events/year (and this implies that ‘credibility thresholds’ set at values higher than this limit should no more be allowed), but on the other side is not bound to a clear lower limit for the frequency to be considered.

In principle, any scenario with extremely low probability of occurrence and possibly very high damage distances should be considered, and the last line of the compatibility table applied. This would mean to give the same importance to events with very different level of risk and not to recognise the beneficial effect of introducing measures able to reduce the accident probability.

In practice, most of the safety reports are issued considering a credible limit set at  $10^{-7}$  events/year, below which the event is considered not credible and not deserving further analysis.

The decree has already been applied in some case. There is however a certain debate on the practicability of its application; in particular the authorities of one of the most industrialised Regions of Italy, Lombardia, have challenged the criteria given by the law on the ground that the probability concepts still surviving in the Law give rise to excessive uncertainties and applicative problems, causing serious problems in areas where concentration of major hazard industries and population exist. The Lombardia authorities are therefore studying the adoption of a criteria that should substitute the probability classes given in the Compatibility Table with ‘Quality Classes’ based on an index calculated on the basis of factors related to the Safety Management System of the plant, technical characteristics of the safety systems etc.

### Conclusion

The acceptability of risk is a theme that has been long debated in Italy as in many other European Countries. The solution that has been adopted in the Italian Law is based on an approach that is based not on full risk calculation nor on purely deterministic spacing criteria, with the intention to overcome the difficulties on both the deterministic and the fully risk-based approach.

It is maybe too early to assess how this will work in practice, even if certain objections to this approach have already been raised, aiming to remove the residual probability concepts of the Decree; it is however a type of approach that deserves to be considered within the research and comparative analyses on risk based land use planning.

### References

1. Ministry of Public Works Decree May 9, 2001 “Minimum safety requirements regarding land use planning for areas around major hazard installations” (in Italian), issued on ‘Supplemento Ordinario n. 151’ to the “Gazzetta Ufficiale Italiana n. 138” June 16, 2001.

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## SAFETY AND RELIABILITY EVENTS

### 26<sup>th</sup> ESReDA Seminar on Lifetime Management of Industrial Systems

11<sup>th</sup>-12<sup>th</sup> of May 2004  
Tampere, Finland



*Kaisa Simola*

*VTT Industrial Systems - Finland*

The European Safety, Reliability and Data Association, ESReDA, arranges twice a year a seminar with a changing topic. In connection with the event, working group meetings are also held. Typically ESReDA seminars are cosy events with a very nice atmosphere, providing a good complement to the major conferences. The number of papers presented during these two-day seminars is usually 20-30.

The 26th ESReDA seminar was held in Tampere, Finland, at VTT Industrial Systems on 11-12<sup>th</sup> of May. The topic of the seminar was *Lifetime Management of Industrial Systems*. Fifty-five participants from totally 14 countries attended the seminar, and it was a special pleasure to have many participants from East European countries and Russia. As the organiser of the seminar, I had some slight concerns about our chances to attract enough good quality papers for this event: First, the topic of the previous seminar – lifetime management of structures – was rather close to this one. Second, the closeness of the “big event” of the year, combined PSAM and ESREL conferences in June, could have swallowed up everybody’s efforts in writing contributions. Luckily, I was wrong! Finally we had to reject some good abstracts and ask to combine some papers with at least one common author.

After some last minute cancellations the seminar offered 24 papers that were divided into 10 sessions.

The topics were:

- Expert Judgement
- Structural Reliability
- Risk Based Inspection and Maintenance
- Lifetime Management Programmes
- Management Support Tools
- Understanding and Evaluation of Materials Ageing (2 sessions)
- Condition Monitoring
- Life Cycle Management

The seminar was opened by the seminar chairman Dr. Jouko Suokas, the executive director of VTT Industrial Systems, and ESReDA's chairman Henrik Kortner. After the opening speeches the scene was given to the presentations, and I am not the only one who was pleased to note how interesting and well prepared they were.

After the first day's presentations the city of Tampere offered us a city tour. I believe that nobody will forget the beautiful view from Pyynikki ridge over glittering lakes and green endless forests...

I want to thank again all speakers for their excellent presentations, the audience for their exceptional activity, and the local VTT staff for making practical things work!

## Fifth SAFERELNET General Meeting

10-12<sup>th</sup> of May 2004

Paris, France



Ângelo Teixeira  
IST - Portugal

The Fifth SAFERELNET General Meeting of the Thematic Network took place on 10th and 11th May 2004, in Paris at the TOTAL COUPOLE TOWER.

During this meeting, a Workshop on Standardization and Codes organised by Philip Smedley was held.

The workshop included a plenary session where contributions in the following topics were presented:

- Risk Analysis in European Codes, Vladimir Trbojevic, ABS Consulting, UK;
- Risk Analysis Template for Energy Systems, Ricardo Bolado-Lavin, JRC, Italy;
- ISO/TC8 Ships and Marine Technology, Andrzej Szemro, CTO, Poland;
- Risk Acceptance and LQI, Philip Smedley, PAFA, UK (for Rüdiger Rackwitz, RCP, Germany).

A fundamental part of this Workshop was the constitution of discussion groups on techniques of risk and reliability, acceptability and applications. Following the breakout sessions, their findings were

feedback in an open discussion lead by Ton Vrouwenvelder.

A case study was presented on the Design Code Application – Car Park Example. Presentations included 'Problem & Finding', by Milan Holický, 'Updated Problem & Findings', by Ton Vrouwenvelder.

The conclusions drawn from the Workshop on Standardisation and Codes can be broken down into three categories, namely:

### *More Guidelines needed?*

- Good minimum practice rather than proscriptive requirements –to be understandable by regulators, legislators, industry users and public interest groups;
- "Recommended practice" favoured over "standard" or "guidelines" – suggests best approach but flexibility for improvement;
- Should prevent significant errors in application;
- Need for common terminology – CEN standard possibly, within SAFERELNET definitely;
- Needs to look beyond EU – ideally also get worldwide agreement.

### *Standardisation/Harmonisation*

- Wide support for ideal of improved consistency in techniques and risk levels across European Industry;
- Common approaches, techniques; but do not prevent innovation to improved techniques;
- Sharing knowledge, e.g. accident data. Who would act as the holder of this information? Confidentiality?
- Training v. important, not just documents.

### *Risk Acceptability*

- Support for move towards designer led risk optimisation on cost-benefit method for hazardous situations–simpler requirements for smaller problems;
- Must be supported by regulators, industry and public, Transparency, i.e. should not be a black-box or only understandable by specialists;
- Broad risk tolerability limits –try to cover all individual risks. Maybe different required for different industries –not yet in agreement;
- Public may be subjected to less maximum risk as they gain less benefit (salary).

Following the fifth SAFERELNET general meeting in Paris there was the opportunity to attend a one day course on Production Availability Modelling. The course given by Jean-Pierre Signoret (Total) and Yves Dutuit (Université Bordeaux) was attended by 22 persons.

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# CALENDAR OF SAFETY AND RELIABILITY EVENTS

## Summer School on Sensitivity Analysis

(Sensitivity Analysis in Practice: A Guide  
to Assessing Scientific Models)

13<sup>th</sup> - 17<sup>th</sup> of September 2004

Venice, Italy

Conference Website:

<http://www.jrc.cec.eu.int/uasa/evt-SAMO2004.asp>

## 23<sup>rd</sup> International Conference on Computer Safety, Reliability and Security – SAFECOMP 2004

21<sup>st</sup>-24<sup>th</sup> of September 2004

Potsdam, Germany

Conference Website:

<http://hukla.prakinf.tu-ilmenau.de/safecomp/index.html>

## 27<sup>th</sup> ESReDA SEMINAR on Assembling Evidence of Reliability: The Reliability Case as a Decision Support Tool

15<sup>th</sup>-16<sup>th</sup> of November 2004

The Corinthian, Glasgow, Scotland

Conference Website

<http://www.managementscience.org/esreda.html>

## International Symposium on Stochastic Models in Reliability, Safety, Security and Logistics

15<sup>th</sup>-17<sup>th</sup> of February 2005

Beer Sheva, Israel

Conference Website:

[www.nace.ac.il/extra/SMRSSL05](http://www.nace.ac.il/extra/SMRSSL05)

## QUALITA 2005 - Quality and Dependability (RAMS)

5<sup>th</sup> Multidisciplinary International  
Conference

16<sup>th</sup> – 18<sup>th</sup> of March 2005 - Bordeaux,  
France

Conference Website:

[www.lap.u-bordeaux1.fr/qualita2005](http://www.lap.u-bordeaux1.fr/qualita2005)

## Advances in Reliability Technology Symposium - 16<sup>th</sup> ARTS

12<sup>th</sup>-14<sup>th</sup> of April 2005

Loughborough University, UK

Conference Website

<http://www.lboro.ac.uk/arts>

## The 24<sup>th</sup> International Conference on Offshore Mechanics and Arctic Engineering - OMAE 2005

(Safety and Reliability Symposium)

12<sup>nd</sup> – 17<sup>th</sup> of June 2005

Porto Caras, Halkidiki, Greece

Conference Website:

[www.asmeconference.org/omae05/](http://www.asmeconference.org/omae05/)

## 28<sup>th</sup> ESReDA SEMINAR

On The Geographical Component of  
Safety Management: Combining Risk,  
Planning and Stakeholder Perspectives

14<sup>th</sup> -15<sup>th</sup> of June 2005 - Karlstad, Sweden

Conference Website:

[www.kau.se/esreda](http://www.kau.se/esreda)

## International Conference on Structural Safety and Reliability ICOSSAR 2005

19<sup>th</sup>-22<sup>th</sup> of June 2005 - Rome, Italy

Conference Website:

[www.icossar2005.com](http://www.icossar2005.com)

## ESREL 2005 – The European Safety and Reliability Conference

27<sup>th</sup> – 30<sup>th</sup> of June 2005 – Tri City, Poland

Conference Website:

<http://esrel2005.am.gdynia.pl>

## International Conference "Nuclear Energy for New Europe 2005"

5<sup>th</sup>-8<sup>th</sup> of September 2005 - Bled, Slovenia

Conference Website:

[www.drustvo-js.si/bled2005/](http://www.drustvo-js.si/bled2005/)

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# ESRA INFORMATION

## 1 Membership

### 1.1 National Chapters

- French Chapter
- German Chapter
- Italian Chapter
- Polish Chapter
- Portuguese Chapter
- Spanish Chapter
- UK Chapter

### 1.2 Professional Associations

- The Safety and Reliability Society, UK
- The Danish Society of Risk Assessment, Denmark
- ESReDA
- French Institute for Mastering Risk, France (IMdR-SdF)
- ESRA Germany
- The Norwegian Risk and Reliability Association (ESRA Norway)
- SRE Scandinavia
- The Netherlands Society for Risk Analysis and Reliability (NVRB)
- Polish Safety & Reliability Association, Poland
- Asociación Española para la Calidad, Spain

### 1.3 Companies

- TAMROCK Voest Alpine, Austria
- ARC Seibersdorf Research GmbH, Austria
- VTT Manufacturing Technology, Finland
- Bureau Veritas, France
- INRS, France
- Total, France
- Commissariat à l'Energie Atomique, France
- GRS, Germany
- VEIKI Institute for Electric Power Research Co., Hungary
- Autostrade, S.p.A, Italy
- D'Appolonia, S.p.A, Italy
- IB Informatica, Italy
- TECSA, SpA, Italy
- SINTEF Industrial Management, Norway
- Central Mining Institute, Poland
- Transgás - Gás Natural, Portugal
- Companhia Portuguesa de Produção Electrica, Portugal
- Caminhos de Ferro Portugueses, Portugal
- IDEKO Technology Centre, Spain
- TNO Defence Research, The Netherlands
- HSE - Health & Safety Executive, UK
- Railway Safety, UK
- W.S. Atkins, UK

### 1.4 Educational and Research Institutions:

- University of Innsbruck, Austria
- Université Libre de Bruxelles, Belgium
- University of Mining and Geology, Bulgaria
- École de Mines de Nantes, France
- Université de Bordeaux, France
- Université de Technologie de Troyes, France
- Technische Universität Muenchen, Germany
- Technische Universität Wuppertal, Germany

- National Centre for Scientific Research 'Demokritos', Greece
- Politecnico di Milano, Italy
- University of Rome "La Sapienza", Italy
- Università Degli Studi di Pavia, Italy
- Università Degli Studi di Pisa, Italy
- Technical University of Delft, The Netherlands
- NTNU, Norway
- Gdansk University, Poland
- Gdynia Maritime Academy, Poland
- Institute of Fundamental Technological Research, Poland
- Technical University of Wroclaw, Poland
- Instituto Superior Técnico, Portugal
- Universidade de Coimbra, Portugal
- Universidade Nova de Lisboa, Portugal
- Universidade de Minho, Portugal
- University Politechnica of Bucharest, Romania
- University of Strathclyde, Scotland
- Institute "Jozef Stefan", Slovenia
- Universidad D. Carlos III de Madrid, Spain
- Universidad de Cantabria, Spain
- Universidad de Las Palmas de Gran Canaria, Spain
- Universidad Politecnica de Madrid, Spain
- Universidad Politecnica de Valencia, Spain
- Consejo Superior de Investigaciones Científicas, IMAFF, Spain
- Lulea University, Sweden
- City University London, UK
- University of Bradford, UK
- University of Portsmouth, UK

### 1.5 Associate Members

- Nuclear Consultants International, South Africa
- Fulminese Federal University, Brazil

## 2 ESRA Officials

### Chairman

Carlos Guedes Soares (guedess@alfa.ist.utl.pt)  
IST, Technical University of Lisbon, Portugal

### Vice-Chairman

Enrico Zio ([enrico.zio@polimi.it](mailto:enrico.zio@polimi.it))  
Dept. of Nuclear Eng. Polytechnic of Milan, Italy

### General Secretary & Treasurer

Pieter van Gelder ([P.van.Gelder@ct.tudelft.nl](mailto:P.van.Gelder@ct.tudelft.nl))  
Delft University of Technology, The Netherlands

## 3 Management Board

The Management Board is composed of the ESRA Officers plus one member from each country, elected by the direct members that constitute the National Chapters.

### 3.1 Conference Standing Committee

This committee aims at establishing the general policy and format for the ESREL Conferences, building on the experience of past conferences, and to support the preparation of ongoing conferences. The members are one leading organiser in each of the ESREL Conferences.

### 3.2 Publications Standing Committee

This committee has the responsibility of interfacing with Publishers for the publication of Conference and Workshop proceedings, of interfacing with Reliability

Engineering and System Safety, the ESRA Technical Journal, and of producing the ESRA Newsletter.

## 4 Technical Committees

### 4.1 Technological Sectors

#### 4.1.1 Offshore Safety

Chairman: B. Leira, NTNU, Norway  
E-mail: [Bernt.Leira@marin.ntnu.no](mailto:Bernt.Leira@marin.ntnu.no)

#### 4.1.2 Safety of Maritime Transportation

Chairman: C. Guedes Soares, IST, Portugal  
E-mail: [guedess@alfa.ist.utl.pt](mailto:guedess@alfa.ist.utl.pt)

#### 4.1.3 Safety of Land Transportation

Chairman: Gigliola Spadoni, Univ. of Bologna, Italy  
E-mail: [gigliola.padoni@mail.ing.unibo.it](mailto:gigliola.padoni@mail.ing.unibo.it)

#### 4.1.4 Safety in Civil Engineering

Chairman: Ton Vrouwenvelder, TNO Bouw, The Netherlands  
Email: [A.Vrouwenvelder@bouw.tno.nl](mailto:A.Vrouwenvelder@bouw.tno.nl)

#### 4.1.5 Safety in the Chemical Industry

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