



European Safety and Reliability Association

Newsletter

<http://www.esrahomepage.org>

November 2004

ESRA NEWS

Letter from the Chairman



Carlos Guedes Soares
IST – Portugal

The membership of ESRA is its main asset. It is made up of institutions that are interested in the field of Safety and Reliability and it comprises National Professional Associations, Companies, Higher Education and Research Institutions. Presently with a number of institutional members around 80, ESRA reaches several thousand individuals interested in Safety and Reliability, as some of the National organizations have hundreds of members and most institutions will have tens of employees working in this field.

Since its start several years ago ESRA has had a continued growth in its membership and every year it is a pleasure to welcome several new institutions to its list of members. This year the membership was increased by 10 new members from 8 different countries.

Although ESRA is by nature an European Organization, it is by no means restricted to this boundary, as its statutes allow for Associate members from outside Europe. It is interesting to note that ESRA has presently two Associate Members, one from Brazil and another one from South Africa.

Although ESRA has not been aggressively looking for members outside Europe, it is probably time to make it explicit that indeed, members outside Europe are welcome and in fact this would be in line with what has happened with the ESREL Conferences, which every year attract a good number of participants from outside Europe.

ESRA will continue to be open to new members both from Europe and outside and will strive to provide them with benefits of lower registration rates at the annual ESREL Conferences, of participation in the Technical Committees and of the access to this Newsletter, which we aim at increasing in frequency and improving in content, thanks to the contribution of the members.

New ESRA Members in 2004

ESRA is happy to welcome the following new members that have joined during 2004:

- Technical University of Ostrava, Czech Republic
- Tallin Technical University, Estonia
- Université de Marne-la-Vallée, France
- Siemens S.A. Power, Portugal
- Inst. of Construction and Architecture of the Slovak Academy of Sciences (USTARCH), Slovakia
- ESM-Research Institute into Safety and Human Factors, Spain
- Universidad de Cantabria, Spain
- Luleå University of Technology, Sweden
- Liverpool John Moores University, UK
- University of Salford, UK

FEATURES

Risk criteria for permanent changes in a nuclear power plant



Marko Cepin
"Jozef Stefan" Institute – Slovenia

1. Introduction

Quantitative risk criteria is a term, which raised many discussions in the nuclear community, which tried to determine what are the most representative measures of safety and how safe is safe enough. Probabilistic safety assessment (PSA) with its models, analyses, results and applications plays the key role in those discussions [1], [2], [3], [4].

In the USA and in Spain, an increase of risk due to a selected modification (permanent change in the plant) can be allowed [5], [6], [7], [8]. In Finland, an increase of risk is not allowed due to the modification [9], [10].

The purpose of the present study is to develop the quantitative risk criteria for permanent changes in a nuclear power plant (NPP) in Slovenia.

2. Definition of risk criteria for permanent changes of the plant

Quantitative criteria present only one of the inputs for decision-making about the changes in the plant in addition to qualitative risk analysis and in addition to four issues: the change is in accordance with the legislation, the change is consistent with defence in depth, the change maintains sufficient safety margins, and the change allows performance measurement strategies to monitor the changes. Risk-informed decision-making is based on a spectrum of analyses, which are being expanded with quantitative risk analyses.

Permanent changes in the plant are sorted in four cases according to risk measures: core damage frequency (CDF) and large early release frequency (LERF) and their changes due to implementation of the proposed change [4], [5]. While decreases or small increases of risk measures should not prevent the acceptability of proposed changes, larger increases of any of both risk measures can be acceptable only under other strong arguments otherwise they cannot be acceptable.

3. Case I

A permanent change in a NPP is considered by the regulatory authority, if:

- The change of the core damage frequency (dCDF) due to the proposed permanent change is lower than 0 (CDF after the change is lower than CDF before the change).

A proposed change, which corresponds to case I, would have the highest chances to be considered as acceptable by the regulatory authority.

3. Case II

A permanent change in a NPP is considered by the regulatory authority, if all of the following statements are true:

- CDF, which is calculated with independently verified and validated complete model of PSA, which represent the real and updated current state of the plant before the change and which is based on consideration of standard on PSA [1], does not exceed significantly the value of $1E-4/ry$.
- dCDF due to the proposed change does not exceed 1% of the CDF and the value of $1E-6/ry$.
- An assessment of the permanent change can be performed realistically in PSA and is done in an appropriate way (if a realistic assessment of the permanent change from a risk viewpoint is not possible with PSA, the change has to be evaluated in a different manner; in such case, the quantitative criteria written in this paper are not applicable).
- The cumulative risk contribution of previous permanent changes is not too high (recommendation: the sum of changes of core damage frequency due to previous permanent changes does not exceed 5% of CDF calculated before the proposed permanent change).

A proposed change, which corresponds to case II, would have high chances to be considered as acceptable by the regulatory authority.

4. Case III

A permanent change in a NPP can be considered by the regulatory authority, if all of the following statements are true:

- CDF, which is calculated with independently verified and validated complete model of PSA, which represent the real and updated current state of the plant before the change and which is based on consideration of standard on PSA [1], does not exceed the value of $1E-4/ry$.
- dCDF due to the proposed change does not exceed 10% of CDF and the value of $1E-5/ry$ (the larger the risk contribution, the more seriously the change is investigated).
- An assessment of the permanent change can be performed realistically in PSA and is done in an appropriate way (if a realistic assessment of the permanent change from a risk viewpoint is not possible with PSA, the change has to be evaluated in a different manner; in such case, the quantitative criteria written in this paper are not applicable).

- The cumulative risk contribution of previous permanent changes is not too high (recommendation: the sum of changes of core damage frequency due to previous permanent changes does not exceed 10% of CDF calculated before the proposed permanent change).

A proposed change, which corresponds to case III, may have chances to be considered as acceptable by the regulatory authority.

5. Case IV

A permanent change in a NPP cannot be considered by the regulatory authority, if the following is true:

- dCDF due to the proposed permanent change exceeds 10% of the CDF or exceeds the value of $1E-5/ry$; or if CDF exceeds the value of $1E-4/ry$ with dCDF exceeding $1E-6/ry$; or if CDF significantly exceeds the value of $1E-4/ry$.

A permanent change in the plant cannot be considered by the regulatory authority if it cannot be classified into one of cases I, II or III.

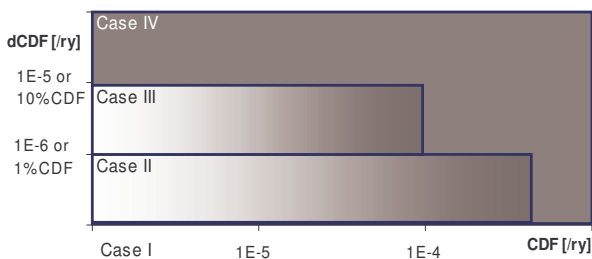


Figure 1: Acceptance Guidelines Considering Core Damage Frequency

Figure 1 shows acceptance guidelines considering CDF, where all four mentioned cases are indicated. Similarly, the cases about risk criteria considering LERF and dLERF are determined. Four cases are classified similarly, with numerical values for LERF and dLERF, which are for one order of magnitude lower than numerical values of the respective criteria for CDF and dCDF. The rule of applying the stricter of both pairs of risk measures applies (pair of risk measures: CDF and dCDF; and pair of risk measures LERF and dLERF are considered). This means that the permanent change in the plant can be classified into a specific case, if both pairs of risk criteria are satisfied:

- criteria considering CDF and dCDF and
- criteria considering LERF and dLERF.

6. Conclusions

The concept of quantitative risk criteria for permanent changes in a nuclear power plant, that was developed, enables a small increase of risk measures if other benefits are more important than the small risk increase.

The risk criteria are developed similarly to risk criteria in USA, as in RG 1.174, with couple of exceptions:

- The relative value of dCDF versus CDF also limits the extent of risk increase, which is not the case in RG 1.174. Such a relative limitation of risk increase prevents situations where plants with very small CDF (and very small LERF) could make changes that would increase CDF very much, relatively.
- The largest cumulative impact of the proposed change and previous changes in periodic safety review period is recommended. The cumulative impact is limited by a 5% increase of initial CDF for less than 1% increase of dCDF and less than $1E-6/ry$ increase of dCDF. This means that at most 5 changes of nearly 1% increase of CDF are allowed in the time interval of periodic safety review. The cumulative impact is limited by a 10% increase of initial CDF for less than 10% increase of dCDF and less than $1E-5/ry$ increase of dCDF. This means that at most 1 change of nearly 10% increase of CDF is allowed in the time interval of periodic safety review.

Similarly, it is with risk criteria considering large early release frequency (LERF) and change of large early release frequency (dLERF).

7. Acknowledgments

The ministry of Education, Science and Sport, Republic of Slovenia supported this research (partly research program P2-0026, partly research project J2-6556 supported together with SNSA).

8. References

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SAFETY AND RELIABILITY EVENTS

The Netherlands Society for Risk Analysis and Reliability (NVBR)



*Theo Logtenberg
The Netherlands Society for
Risk Analysis and Reliability
(NVBR)*

Our society for Risk Analysis and Reliability has 25 individual members and about 200 company members. Last year the NVRB organised 7 evening meetings and cooperated in the organisation of a congress.

The evening meetings were visited by 20 to 40 members and the congress attracted about 125 visitors.

The topics of the meetings were:

1. The risk of flooding
2. A sober look on risks
3. Reliability risks in practice
4. Calamity planning and exercises
5. Safety in the process industry
6. Risk Communication (congress)
7. Results of the working group "decision models".
8. Politics and risk analysis

The meeting "politics and risk analysis" was part of what is called the "university-day", because it is held at one of the universities in the Netherlands and during that day also awards are presented for innovation in risk/reliability methodologies. Prior to

that, a major discussion item is brought forward to the members. This time leading persons from the political arena were invited to give their view on the controllability of risks by the authorities, taking into account the growing interdependencies of networks in the world (i.e.: business activities via the internet).

The presentation of awards is a yearly activity of our society together with the Society for Risk Management. The awards are presented in the categories: oeuvre, company, and study. The oeuvre award is presented to a person who has brought with studies and/or projects our profession to a higher level.



*Aarnout Brombacher
Technical University of Eindhoven,
The Netherlands*

Prof. Dr. Aarnout Brombacher of the Technical University of Eindhoven was the winner of the oeuvre award this year.

The company award is for a company that has incorporated new ideas with respect to risks or reliability in their production process. Unfortunately this year the award committee decided that none of the nominated companies distinguished itself enough to be presented with an award.

The study award is presented to a student who according to the award committee has an outstanding thesis. Three pre-selected students have to defend their work for the participants of the university-day. A jury decides who will be the winner. This year the student award was for Ruben Jongejan of the University of Delft for his project "The observation method in the geo-technique".

More information about the presentations (unfortunately only in Dutch) can be found on our website: www.nvr.nl.

The Danish Association for Risk Assessment



*Palle Christensen,
The Danish Association for Risk
Assessment
Denmark*

The Danish Association for Risk Assessment is a professional society within the Society of Danish Engineers, and a member of ESRA. There is no

formal ESRA chapter in Denmark. With a population of 5 million, a membership of the Risk Society of some 600 may be called surprisingly high. The Society covers, however, much more than what, for example, ESRA would define as belonging to it. Denmark is a country with few companies being covered by the Seveso directive. The membership comprises risk analysts, engineers from companies with risky productions, people from the fire brigade, police, hospitals, and forensic medicine.

The aims of the association are to further the understanding for and the application of risk analysis and risk management, as well as to demonstrate the industry and societal usefulness of applying such methods. This aim is mainly brought into action by the organising of professional meetings for the membership and other interested parties. In this way, an open forum for both people with theoretical interests and people with practical tasks in the field is created. Thus, the meetings reflect this by topics of both types. Board members of the Risk association always conduct the meetings.

A board of 9 members elected on an annual basis administers the Association. To illustrate the activities of the Association, a short resume of its meetings in the second half of 2004 is given below.

On the 16 September, some 40 members paid a visit to the County Alarm Centre for the Greater Copenhagen area belonging to the rescue company Falck, which traditionally works in close collaboration with the public authorities. There are no vehicles at this location. It centrally handles 80.000 ambulance turnouts, 110.000 patient transportations and 10.000 turnouts for rescue tasks. Modern equipment and highly trained staff facilitates a very efficient management of all these tasks in a quiet atmosphere. The company is a competitor to the public fire brigades through public invitations to submit tenders at certain intervals.

The October theme was safety for hospital patients treated in a meeting at the Rigshospitalet, the Copenhagen University Hospital. It was stated that the old culture, where doctors were the masters of life and death, is undergoing a change. Doctors traditionally have not been very open about faults, thus ignoring the possibilities of systematic learning from faults like in, for example, the airline and nuclear industries. In the past, realised faults were reported to the police for further investigation. Patient safety is a relatively new issue in Denmark. Law has introduced a fault reporting system in 2004; this law secures that doctors will not be prosecuted because of input to this new reporting system. Faults will be collected and analysed and distributed further on to all hospitals for the purpose of improvements. A great interest was expressed in seeing after some years, if the system has had any effect. It was stated that it would very much depend on the willingness of doctors to be sufficiently humble on account of themselves.

On the 3 November, the people engaged in that issue presented some recent work on societal vulnerability

analysis in the Nordic countries. Within the last few years, an increased focus on safety for the citizens has developed. This has induced a political will to systematise the different issues in order to be prepared for any hazards. All Nordic countries have produced "National Vulnerability Elucidation Reports". Special methods and forms of reporting have been developed for this topic, and fairly large efforts have been put into the work. The follow-up on all these issues is another case, and it will be necessary to prioritise.

The use of Bayesian Networks as a basis for decision-making under uncertainty was treated at a meeting on 4 November. Professor F.V. Jensen presented the general theory of Bayesian Networks, and its application possibilities in decision support, especially those cases where new evidence appears during the decision process. Many interesting and some amusing examples were presented.

On 17 November and 25 November, representatives of Danish Emergency Management Agency and Vejle Fire Brigade gave presentations about risk-based dimensioning of preparedness. Vejle is a city with a number of Seveso companies. In 2002, a national agreement was signed with the aim of introducing risk-based dimensioning of the local fire brigade resources. This will ideally be based on local community risk assessments, which takes into account the presence of dangerous activities and the size of the population. Special analysis tools have been developed, and they have for the first time been used in Vejle.

Rescue helicopters with doctors on board are a new feature in Denmark. This topic was treated in a speech by the Director of the rescue company, Falck, Ole Quist, at a meeting at Odense University Hospital on 23 November. As Denmark is a small country with fast road access to all places, except to the smaller islands, helicopter services for patients have not hitherto been a great need, except for these islands. But hospitals become larger and fewer, and road traffic is increasing, so a few county-based helicopters have actually just started their activities. Local politics were represented at the meeting, where also a scientific report about optimisation of the transport of patients was presented.

The Association's traditional Christmas meeting had a historical flavour. Denmark is a nation of seafarers, and the sailors, both merchant and navy, had their own church in Copenhagen. They had only their skill and the help of God, and before the reformation, their patron saint, Sct. Nicolai, to rely on. This topic was vividly presented during a guided tour to Holmens Kirke in Copenhagen, which was erected by Christian IV around 1650, with special dedication to the Danish Navy.

As will be understood, the Danish Association for Risk Assessment is at present an organisation with a fairly broad engagement in the spectrum of societal issues.

Presentation of the New VDI Directive VDI 4003 Reliability Management

15th of October 2004

Munich-Ottobrunn , Germany



*Alejandro Lopez Hernandez –
Siemens AG
Transportation Systems, Germany*

The German Engineer Association, Section “Association for System Development and Project Formation”, Committee “Technical Reliability” (VDI-GSP), organized an event that consisted in a detailed presentation of the new directive as well as a workshop about its contents. Through this event the organizers wanted to verify that the participants find an application in this new directive. At the same time for the organizers was very important to know the results and conclusions of the workshop because of the possible necessity to improve the directive. The participants of this event belong to many areas of the industry such as Power Generation Industry, Aviation Industry, Railway Industry, Submarine Industry etc. and their activities are related with reliability.

The event was divided in two parts.

The first part consisted in a plenary session where the contents of the directive and contributions were presented:

- *Convenience and Main Applications of the Reliability Work*, Prof. Dr. Bern Bertsche, Universität Stuttgart;
- *The Safety and Reliability Process in the Aviation Industry*, Dr. Roger Knepper, Airbus Industries, Toulouse;
- *Reliability Management*, Prof. Dr. Bern Bertsche, Universität Stuttgart;
- *Management Actions and Reliability Program*, Dipl. Ing. Bernd Siegler, HDW, Kiel;
- *Reliability Plan and Reliability Actions*, Dr. Friedrich Bohla, Troisdorf, Köln;
- *Overview about Selected Methods*, Dr. Peter Kafka, Garching;
- *Acquire and Handling of Reliability Data*, Dipl. Ing. Hans-Peter Balfanz, TÜV Nord, Hamburg.

The event was opened by Dipl. Ing. Erich Brand, Eurocopter, Ottobrunn, who received the participants cordially and explained briefly the goals of the event and the points to cover in the presentation.

The presenters talked about the reliability, boundary conditions in the industry and the importance of

reliability today. Source of errors and their impact was mentioned. The example of the aviation industry related to reliability process provided a good overview and allowed a better understanding of the new directive.

Important points of the directive were underlined such as “The Responsibility of the Leadership for the Reliability Management and the Reliability Process” , “Definition of Strategic Goals and their derivation to Reliability Goals” or “the Importance to Clear the Competences and Responsibilities in the Life Cycle Process of a Product” etc.

The second part consisted in the workshop. A fundamental part of this workshop was the constitution of work groups who discussed about the next topics:

- Group 1: Management Actions and Reliability Program;
- Group 2: Reliability Plan and Reliability Actions;
- Group 3: Reliability Methods;
- Group 4: Reliability Data.

Finally the results and feedback of the workshop were presented in the plenary session.

After this Mr. Waldemar Krug, Vice-Chairman of VDI-GSP, concluded with a summary of the activities and prospects. He finalized the event with a narration about an incident in an airplane that lost a turbine engine cover during the flight. With it he remembered how important the reliability is and that the human error cannot be scheduled!

A synthesis of the results and conclusions of the workshop in form of sentences follows:

- *Group 1*: It is important to analyze and learn the directive VDI 4003 before it is adopted. Quality saves money. Reliability must be quantified. Reliability management is an interdisciplinary function. The directive assists the management actions.
- *Group 2*: How many criteria are there in order to find priorities? How many critical functions are there? How do we define these? The development reliability level must be defined for each system and device and depends of the architecture layout and the function criticality. The criticality has to be define through a matrix (criticality determination matrix)
- *Group 3*: The FMEA – Method is used generally, but if the object to analyse has a big number of components it is difficult to use. The FTA – Method is important to determine the failure rate of systems and increases its application. The Part Count Method is used to determine failure rate of components. The Markov Model is used occasionally. Human reliability can be quantified and contributes to complete a FTA-Analysis. There is a tendency to mix reliability and safety. The reliability method to use depends on the system or component.

- *Group 4:* Reliability depends strongly on the consumer response. Depending on the application fields there is a bigger influence through interactions between Human and Machines. It is necessary additional instruments for systems to data capture and preventive diagnostic. For systems without access it is possible to complete them with electronic data transmission for remote diagnosis. Internet is discovered as a source of reliability data.

The atmosphere of the event was very nice, nevertheless the participants were very concentrated in the presentation and they worked hard during the workshop. I would say that the goals of the event were met and for the participants were satisfactory to see, that the new directive could be used in their application fields.

Seminar on Emergency & Risk Zoning around Nuclear Power Plants

26-27 April 2005

JRC, Petten, The Netherlands



*Christian Kirchsteiger
European Commission
DG JRC - IE
The Netherlands*

Co-organized by:

- European Commission,
DG Joint Research Centre, Institute for Energy
- Nuclear Energy Agency of the Organization for Economical Cooperation and Development (OECD-NEA)

Scope & Objectives of Seminar

Plant-specific Probabilistic Safety / Risk Assessment (PSA / PRA) can provide together with other, more deterministic information sources relevant information for strategic planning purposes in the area of emergency zoning (risk zones) around a Nuclear Power Plant (NPP), as well as information to the public on the geographical component of plant risk.

Not least due to the close relation of this issue to security and civil protection, there is currently discussion within the nuclear safety community whether or not PSA technology in its current state (Levels 2 & 3) is mature enough to be used to address the issues of levels of plant emergency classification,

concept of risk and emergency zones, relevant risk acceptance criteria, information to the public in the event of a radiological emergency, and public evacuation and sheltering.

The purpose of the seminar is to provide a forum for presentation and discussion of status of emergency planning and risk assessment approaches, safety policies as well as current and possible future requirements for emergency and risk zoning, and consider needs for international harmonization.

The aim is to help relevant stakeholders on both national and international levels to decide on the relevance of this issue and on related research and development needs. Relevant stakeholders would be representatives from regulatory authorities, utilities, civil protection institutions as well as PSA users and developers from all over the world.

The seminar will provide an opportunity for sharing of experiences in the field on both good practice and identification of problem areas, incl. comparison to other major-hazardous industries, such as the chemical process industries.

The following objectives are envisaged:

- To get an overall view of current probabilistic / deterministic information sources used to define risk and emergency zones around NPPs in various countries.
- To share experience in the current applications and interface between PSA for NPP operation and emergency planning (EP).
- To identify current regulations and practices for using outcomes of PSA Levels 2 & 3 for EP.
- To identify requirements for possible future use of PSA in EP.

Seminar Themes

The seminar sessions will be organized along the following thematic lines:

- Approaches to NPP risk/emergency zoning.
- Corresponding regulatory requirements.
- Comparison to other industries (e.g. chemical).
- Current harmonization efforts (PSA standards, acceptance criteria, risk zones).
- Examples of current research in the area.

Suggested Paper Topics

Seminar contributions are expected from all relevant stakeholders, i.e. regulators, civil protection institutions, utilities, PSA users and developers, R&D organizations, engineering contractors and consultants. Major topics are:

- Current approaches to deal with definition of NPP risk and emergency zoning.
- National codes and regulations, including risk informed support to emergency planning.
- Maturity of current PSAs to support plant emergency classification and risk / emergency zones.
- Specific requirements for PSA Levels 2 & 3 to make plant-specific PSAs applicable in EP.

- Technical basis for the radii for the risk / emergency zones and evacuation time criteria for these zones.
- Concrete examples of risk informed support for defining risk zones and relevant information to the public, e.g. by using NPP operational experience and plant-specific PSA.
- Alternatives: more deterministic approaches, engineering judgment, medical judgment, etc.
- Towards international harmonization of risk / emergency zoning.
- Towards international harmonization of how to present the geographical component of plant risk to different stakeholders, incl. the general public.
- EP and risk zoning in the light of increased security concerns.
- Comparison to other major-hazardous industries.

Submission of Contribution

Authors who wish to present a paper are requested to submit an extended abstract (2-3 pages) by e-mail to: christian.kirchsteiger@jrc.nl

Further information is available under:
<http://www.energyrisks.jrc.nl/newspopuphtml.htm>

Seminar Deadlines

- Submission of Abstracts 21 February, 2005
- Acceptance of Extended Abstracts 7 March, 2005
- Full Papers/Presentations Submission 4 April, 2005
- Submission of Paper in camera-ready final version by 6 June 2005 (guidelines will follow)
- Seminar 26-27 April 2005

CALL FOR CONTRIBUTIONS TO THE NEWSLETTER

The ESRA Newsletter is aimed at promoting the information exchange among ESRA members.

Therefore, contributions are sought from ESRA members both on short feature articles and on news of events related with safety and reliability.

In particular, the members of ESRA Technical Committees are specially invited to contribute on their specialist area.

CALENDAR OF SAFETY AND RELIABILITY EVENTS

Advances in Reliability Technology Symposium - 16th ARTS

12th-14th of April 2005

Loughborough University, UK

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

International Conference on Structural Safety and Reliability ICOSSAR'05

19th-22nd of June 2005

Rome, Italy

Conference Website
<http://www.icossar2005.com>

ESREL 2005 – The European Safety and Reliability Conference

27th – 30th of June 2005 – Tri City, Poland

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

International Conference "Nuclear Energy for New Europe 2005"

5th-8th of September 2005 - Bled, Slovenia

Conference Website:
www.drustvo-js.si/bled2005/

The 24th International Conference on Offshore Mechanics and Arctic Engineering - OMAE 2005

(Safety and Reliability Symposium)

12nd – 17th of June 2005

Porto Caras, Halkidiki, Greece

Conference Website:
www.asmeconference.org/omae05/

ESREL 2006 – The European Safety and Reliability Conference

18th – 22th of September 2006 – Estoril, Portugal

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 Industrial Systems, 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
- Siemens SA Power, Portugal
- Caminhos de Ferro Portugueses, Portugal
- ESM Research Institute Safety & Human Factors, Spain
- 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
- Technical University of Ostrava, Czech Republic
- Tallin Technical University, Estonia
- École de Mines de Nantes, France
- Université de Bordeaux, France
- Université de Technologie de Troyes, France

- Université de Marne-la-Vallée, 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 of Construction and Architecture of the Slovak Academy of Sciences, Slovakia
- 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 Sup. de Investigaciones Científicas, Spain
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Dept. of Nuclear Eng. Polytechnic of Milan, Italy

General Secretary & Treasurer

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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.

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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.

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E-mail: Bernt.Leira@marin.ntnu.no

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E-mail: guedess@alfa.ist.utl.pt

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E-mail: gigliola.padoni@mail.ing.unibo.it

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E-mail: G.I.Schueller@uibk.ac.at

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Email: enrico.zio@polimi.it

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Email: a.r.hale@tbm.tudelft.no

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E-mail: ymt@risk_support.co.uk



ESRA is a non-profit international organization for the advance and application of safety and reliability technology in all areas of human endeavour. It is an "umbrella" organization with a membership consisting of national societies, industrial organizations and higher education institutions. The common interest is safety and reliability.

For more information about ESRA, visit our web page at <http://www.esrahomepage.org>.

For application for membership of ESRA, please contact the general secretary **Pieter van Gelder**, E-mail: P.van.Gelder@ct.tudelft.nl.

Please submit information to the ESRA Newsletter to any member of the Editorial Board:

Andreas Behr – andreas.ab.behr@siemens.com
Siemens AG, Germany

Lars Bodsberg – Lars.Bodsberg@sintef.no
SINTEF Industrial Management, Norway

Radim Bris – radim.bris@vsb.cz
Technical University of Ostrava, Czech Republic

Marko Cepin – marko.cepin@ijs.si
Jozef Stefan Institute, Slovenia

Palle Christensen – palle.christensen@risoe.dk
Danish Society of Risk Assessment, Denmark

Theo Logtenberg – theo.logtenberg@mep.tno.nl
The Netherlands Society for Risk Analysis and Reliability

Virgile La Lumia – virgile.lalumia@technicatome.com
Technicatome, France

Sebastián Martorell – smartore@plcione.cc.upv.es
Universidad Politécnica de Valencia, Spain

Beata Milczek – beata@am.gdynia.pl
Gdynia Maritime University, Poland

Zoe Nivolianitou – zoe@ipta.demokritos.gr
Demokritos Institute, Greece

Zoltan Sadovsky – usarzsad@savba.sk
USTARCH, SAV, Slovakia

Kaisa Simola – Kaisa.Simola@vtt.fi
VTT Industrial Systems, Finland

Ângelo Teixeira – teixeira@mar.ist.utl.pt
Instituto Superior Técnico, Portugal

Giovanni Uguccione – giovanni.uguccioni@dappolonia.it
D'Appolonia S.p.A., Italy

Paul Ulmeanu – paul@cce.fiab.pub.ro
Univ. Politehnica of Bucharest, Romania

Leslie Walls – lesley.walls@strath.ac.uk
University of Strathclyde, UK