European Safety and Reliability Association

Newsletter

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EDITORIAL

C. Guedes Soares
ESRA Newsletter Editor
Instituto Superior Técnico, Lisbon, Portugal

The Newsletter is slowly picking up again a more frequent schedule, having two issues published in 2009. The contributors came from both the National Chapters with feature articles and with review of activities of the Chapter as well as from Technical Committees. We also have information on Doctorate degrees concluded and this is some type of information of interest which can be increased in the future. We do not include book reviews in this issue although this is encouraged for books within the scope of the Newsletter.

The distribution of the Newsletter is done electronically and the past issues can be found on the ESRA web site. Normally the ESRA member contact persons are informed of the publishing of the Newsletter hoping that they will disseminate the information within their company. We have now started a different practice of informing a wider group of persons hoping that in this way a wider audience will become aware of the Newsletter. We hope that Newsletter readers will become contributors to the Newsletter at a later stage.

CONTRIBUTIONS FROM ESRA TECHNICAL COMMITTEES

Risk-Based Ship Design: Methods, Tools and Applications

Dr. Rolf Skjong, Det Norske Veritas As
DNV Chief Scientist, Risk & Reliability
IACS Chairman FSA,
ESRA Chairman Safety in Maritime Transportation

The EU integrated project SAFEDOR finished its activities in April 2009. It commenced its work February 2005 as the first large scale project developing the concept and elements of a risk-based design and a corresponding risk based regulatory framework for the maritime industry. A major part of the work was the integration of corresponding design tools to facilitate first principle approaches to safety, addressing the complexity of a fully comprehensive system. Strategic research objectives of the project, meeting the envisaged goals, were:

- Develop a risk-based and internationally accepted regulatory framework to facilitate first principles approaches to safety.
- Develop design methods and tools to assess operational, extreme, accidental and catastrophic scenarios, accounting for the human element, and integrate these into a design environment.
- Produce prototype designs for European safety-critical vessels to validate the proposed methodology and document its practicability.

- Transfer systematically knowledge to the wider maritime community and add a stimulus to the development of a safety culture.
- Improve training at universities and aptitudes of maritime industry staff in new technological, methodological and regulatory developments in order to attain more acceptances of these principles.

Whilst the designs developed are confidential, there is a lot of information from the project in the public domain, see www.safedor.org. These comprise the approval processes for ships and ship systems, risk evaluation and acceptance criteria at ship and functional level and requirements for documentation and qualification. In addition, six formal safety assessment (FSA) studies were conducted; five of them already being submitted to IMO with a review starting in May 2009 during the meeting of the Maritime Safety Committee (MSC 86), and expected completion for submission to MSC 87 (May 2010). Thus, work performed in SAFEDOR towards a modern and risk-based regulatory framework will eventually affect the way risk is managed within rule making process also at IMO level. Much of the work is also published in the book on risk based design http://www.springer.com/engineering/mechanical+eng/book/978-3-540-89041-6

FEATURE ARTICLES

Impact of offsite power system reliability on nuclear power plant safety

Andrija Volkanovski,
Research Assistant
Jožef Stefan Institute, Slovenia

Introduction

The nuclear power plant safety and the power system reliability are mutually interdependent parameters. The safe operation of the nuclear power plant results in delivering a large amount of electrical energy to the power system and contributes to its stable operation. On the other side, the power system delivers the electrical energy to the house load of the nuclear power plant, which is especially important during the shutdown and the start up of the plant. The loss of offsite power initiating event occurs when all electrical power to the plant from external sources is lost. The results of the probabilistic safety assessment (US NRC 2005) show that the contribution of the scenarios connected with the loss of offsite power are the major contributors to the overall risk of the nuclear power plants.

The current methodologies used for the estimation of the loss of offsite power initiating event frequency are performed generally, not considering the actual state and the specifics of the power system.

Method

A new method for the estimation of the loss of offsite power initiating event frequency is developed (Volkanovski 2008). The method combines the linear network flow method with the fault tree analysis features (Volkanovski et al. 2009) as shown on **Figure 1**. A computer program supporting this method has been written. The developed method considers distribution of generators and loads in the power system, power flows through interconnections, configurations of the switching substations and their corresponding voltages and the local weather conditions. The viable pathways of power delivery to the house load of the nuclear power plant are identified and the consequent fault tree is built. The consequent fault trees are built for other loads in the system. New importance measures of the components and groups of the components of the power system identifying the most important elements of the power system from the aspect of nuclear safety and power system reliability are introduced.

With the quantitative and qualitative analysis of the constructed fault trees the unreliability of the power delivery to the house load of the nuclear power plant is assessed. The loss of offsite power initiating event frequency is assessed from the obtained unreliability. The most important elements of the power system from the aspect of nuclear safety are identified. The power system elements which are candidates for redundancy or improved maintenance are identified. The impact of changes in the power system to the safety of the nuclear power plant is evaluated. The analysis included the disconnection or introduction of new power lines and change of the generation and load by their size and reposition. The obtained results include the overall power system reliability and network importance measures for the components of the power system. The verification of the developed method was performed on a standard reliability test system and model of the real power system.

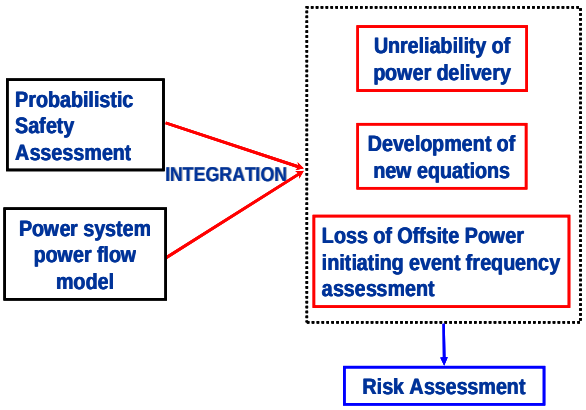

Figure 1: Method flow path

Results and Conclusions

The developed method overcomes the deficiencies in current methodologies for estimation of the loss of offsite power initiating event frequency, considering the actual state of the power system where the nuclear power plant is situated. The obtained results show that power system state has direct impact on the performance and risk of the nuclear power plants. The obtained results show that introduction of new interconnections or installation of new power plants in the power system results in decrease of the risk of the corresponding nuclear power plants. In analysed power system models obtained risk decrease is comparable to the decrease obtained with the installation of the additional emergency diesel generator.

The developed method, with the specific modifications, is applicable for the estimation of the reliability of other networks and critical infrastructures, such as: computer, transport, energy and various goods distribution systems.

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Reliability of safety instrumented systems in the process industry: A perspective on the research challenges

Mary Ann Lundteigen
Department of Production & Quality Engineering,
Norwegian University of Science and Technology

Introduction

Safety instrumented systems (SIS) are widely used in the process industry to respond to hazardous events such as high pressures, gas leakages, and fires. Failing to perform such functions may cause damage to humans, the environments, and material assets, and the reliability of SIS is therefore of great concern to the companies, the public, and the authorities. To make realistic predictions about the system reliability, it is necessary to have adequate models, methods, and data.

Reliability analyses have evolved over several decades, but there are many areas where improvements are needed. This may be due to lack of attention in the past or that new technologies and operational philosophies have introduced new needs. This article gives my perspective on important research challenges, deduced from a rather thorough review of literature in a recent PhD project [1].

Key requirements

Two standards that have gained wide acceptance within the process industry are IEC 61508 [2] and IEC 61511 [3]. Both standards give specific requirements and guidance to safety and reliability assessments of SIS. IEC 61508 is a generic standard and is used to qualify new technology for use in safety applications. IEC 61511 is based on IEC 61508, but is related to the use of proven and IEC 61508 compliant technology in the design of SIS for the process sector. The standards are sometimes supported by national guidelines such as [4] and [5].

Research challenges

Safety and reliability assessment of SIS require knowledge within several areas. A literature review [1] and a careful study of IEC 61508 and IEC 61511 have identified eight areas in Figure 1 as the most important knowledge areas. The dashed circle in Figure 1 indicates the best possible level of knowledge, and the shaded area represents my subjective judgment about the actual current level of knowledge, given as a percentage of the best possible level. The gap between the actual level and the best possible level indicates the needs for research in each area.

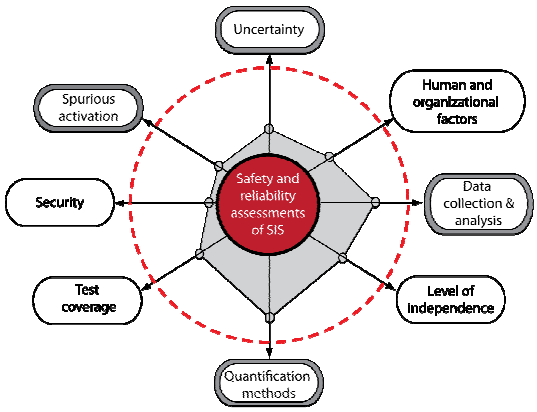

Figure 1 - snapshot of research challenges

The eight areas of knowledge are further elaborated below. It is important to realize that the best possible knowledge is a moving "target". As the technology and applications of SIS change, the required knowledge will also change. The areas are interlinked in the sense that new research in one area may influence both the status and the optimal level of another area. Data collection is, for example, closely linked to calculation methods.

Quantification methods

The process sector often uses reliability block diagrams and fault trees as basis for quantifying reliability [6, 7]. However, all reliability models share a common deficiency: They do not capture all failures that may have an effect on the reliability. Reliability models are often based on failure rate functions, e.g., for random hardware failures. Software failures and systematic failures are more difficult to model and are therefore often excluded from the quantification. When practice indicates that software failures and systematic failures are the most important contributors to unreliability, we may question the value of many reliability estimates, particularly since more and more safety functions are performed by software rather than hardware.

Theory has been developed for how to determine (quantitatively) the failure rate of software, but the approaches are not widely accepted nor found practical for reliability calculations. Currently, IEC 61508 and IEC 61511 do not recommend the inclusion of software failures in the quantification. However, a relevant question to ask is if this is an acceptable approach to follow since it will be easier and easier to meet the acceptance criteria with the contribution from only hardware failures. Finding ways to quantify the contributions from all relevant failures are therefore essential for the completeness of quantification methods.

Level of independence

Most reliability methods reflect the traditional design principle, where the SIS is physically separated from other systems to avoid that failure of another system can prevent the SIS from performing its required functions. This principle is to an increasing degree replaced by functional independence, to increase flexibility, e.g., by allowing easy exchange of signals and information, and to reduce costs, e.g., by sharing hardware and software.

The current reliability methods should therefore be improved to reflect dependencies that may exist between different systems. A starting point may be to analyze experience from other sectors where physical independence is replaced by fault tolerance and functional independence, such as for automotive and aerospace systems.

Data collection and analysis:

An important objective of data collection and analysis is to estimate reliability parameters, such as failure rates. It is often pointless to select a model which requires data that is not available. So, access to adequate data may increase the freedom in selecting reliability models.

Extensive theory is available on how to estimate reliability parameters from large samples in historical data bases or from small samples at a particular plant or application area. Several data collection projects like the Offshore Reliability Data (OREDA), Process Equipment Reliability Data (PERD), and international common-cause data exchange (ICDE) have published data on the performance of equipment in various industry sectors. With the exception of the ICDE project, there is little attention given to the collection of common cause failures.

Overall challenges with data collection projects are the time it takes from data are collected to the data are published and the considerable effort that is needed to review and classify the failures. More efficient methods and tools for online collection and classification of data are therefore needed. Some SIS supplies provide automatic registration of failures, but the industry lacks efficient ways to make use of the collected data in the follow-up of SIS. Existing data collection should also be expanded with other failure categories than hardware failures, for example software failures.

Human and organizational factors

Modeling of human and organizational factors in risk analysis is an area where extensive research has been performed. Still, the relationship between human/ organizational factors and the failure of SISs has been given little attention. A research challenge is therefore to link the contributions from human and organizational factors to reliability parameters, such as systematic failures. It is also important to focus on how humans and organizations cope with the increased complexity of SISs, to avoid introducing failures during design, operation, maintenance, and modifications.

Uncertainty

Reliability analysis is an important decision basis for system designers, manufacturers, and plant owners.

Unfortunately, reliability estimates are constrained by the reliability analysts' competence, the resources made available for the analysis, the ability to capture important system properties, and the access to relevant data. Some industry sectors have uncertainty analysis as an inevitable part of the reliability analysis, like the nuclear industry and the aerospace industry, whereas uncertainty is barely mentioned in standards and guidelines for SIS in the process industry. A research challenge is therefore to find practical ways to account for uncertainty in various stages of the life cycle and to make uncertainty analysis an integral part of reliability analysis and decision making.

Spurious activation

Traditionally, spurious activations of SIS have been seen as a non-safety issue in the process industry, and that the main consequences of such activations are production losses. For this reason, the spurious activations are not given much attention in IEC 61508 and IEC 61511.
In other industry sectors, the need to balance spurious activation and safety is more evident and reflected in regulations and guidelines, such as for railway signaling systems and flight control systems. Also in the process industry, the awareness to the unwanted effects of spurious activations are increasing as some systems, e.g., water cooling systems, water ballasting systems, and well intervention systems may not even have a well defined safe state. A more holistic approach that accounts for spurious activations in reliability analysis may therefore be an important area of further research.

Security
New operational philosophies, like integrated operations in the oil and gas industry, require remote access to control and safety systems. The SIS is therefore becoming more vulnerable to internal and external security threats, but security is seldom a part of safety and reliability assessments. Integrating security into safety and reliability assessments may therefore be an important area for further research. Some first initiatives have been taken, e.g., by SINTEF [8], and may serve as basis for further research.

Test coverage
Most SIS in the process industry operate on demand rather than continuously, and regular testing is therefore required to reveal dormant failures. To what extent the failures are revealed by a test, depends on the quality of the test procedures, the competence of the personnel performing the tests, and how the test conditions relates to the (real) demand conditions. In reliability calculations it is often assumed perfect testing and too little effort is made to evaluate if the assumption is valid. Areas of further research are therefore to find better ways to determine the (actual) test coverage, and to improve the treatment of test coverage in reliability analysis.

Conclusions
Trying to capture all relevant areas of further research is an impossible task. However, based on the discussions above, it is suggested to highlight the following areas as very important for the future:

- *Quantification methods:* New methods need to better address the system complexity that is due to dependency between functions and systems, extensive use of software, human interaction, and security challenges.
- *Uncertainty:* The process industry has very limited focus on uncertainty, and the topic is hardly mentioned in IEC 61508 and IEC 61511. Further research is needed to adapt uncertainty assessment to current reliability methods.
- *Data collection and analysis:* New methods for data collection and analysis need to include common cause failures, human and organizational related failures, and software failures. Effort should also be made to reduce the time from data are collected and to the time where data are reflected in reliability parameters.
- *Spurious activation:* It is more and more recognized that spurious activation may have a negative effect on safety. Further research may therefore assess the relationship between spurious activation and safety and suggest ways to balance safety with the protection against spurious activations.

I hope that my reflections may be basis for further discussions among researchers, reliability analysts, and practitioners that work with SISs. By sharing our perspectives, we may influence the future development and also guide research councils in their prioritization of new research projects.
For more information about the research related to SISs, please visit www.ntnu.no/ross/rams.

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PHD DEGREES COMPLETED

Aspects of improving punctuality: From data to decision in railway maintenance

Birre Nyström
Division of Operation and Maintenance Engineering
Luleå University of Technology, Luleå, Sweden

Main Supervisor: Pro.f Uday Kumar, Luleå Univ. of Technology, Sweden

Main Examiner/Faculty Opponent: Prof. Rommert Dekker, Erasmus University, The Netherlands

The purpose of the research presented in this thesis is to explore and describe information and requirements related to railway punctuality in order to support systematic improvements. The focus is on delay causes related to infrastructure maintenance. To fulfil the stated purpose, **punctuality requirements, availability** concepts, **failure and delay data**, as well as maintenance decisions, have been studied via theoretical and empirical approaches. Data was collected through interviews, document studies, archival analysis, observations and experiments.

It is found that punctuality requirements and performance are currently expressed in many, hardly commensurable, ways. Hence, it is difficult to compare punctuality data from different railways. This is further complicated by the fact that delay attribution is inconsistently performed. It is also found that there is a lack of data on train traffic and infrastructure, for example, causes of delays. Although the consistency regarding ranking of decision-making criteria is rather high, the consistency of maintenance decisions is rather low.

In addition, there are many interacting causes affecting punctuality, including infrastructure, timetable, rolling stock, weather and personnel. It is also found that even though unpunctuality might be explained by unavailability of some parts of the railway system, the concept of availability is not well-established and agreed upon within the railway sector.

Based on the research findings, it is proposed that punctuality should be treated as the extent to which an event takes place when agreed, for example, the agreement between a passenger and a train operating company concerning the arrival of a train at a certain time. A number of availability measures for railway are also proposed, partly based on analogies to the power industry. Furthermore, the developed and applied methodologies, based on vignettes and the Analytic Hierarchy Process (AHP), are proposed to support punctuality improvements.

Based on the results of this research, it is possible to improve data collection and recording, select suitable indicators and increase the awareness of the grounds on which decisions are made, all of which contribute to improved punctuality.

The increasing demand for transportation and sustainability makes railways attractive. The ongoing deregulation of state-owned railways means that many new organisations are entering the railway sector. Hence, reducing railway delays is increasingly important to many stakeholders, including passengers, freight customers, train operating companies, railway infrastructure managers and society in general. The research presented in the thesis will help various stakeholders of railways in improving punctuality.

The thesis can be downloaded from the following site: http://epubl.ltu.se/1402-1544/2008/11/index.html

Dr. Nyström is working as Reliability analyst with Norwegian State Railway (NSB) in Oslo.

Production assurance: concept, implementation and improvement

Phd Thesis
Luleå University of Technology, Sweden

The purpose of this research is to study, analyze and evaluate the application and implementation of Production Assurance Programs (PAP) in production plants, and find some importance measures that show the criticality of the components or subsystems. To fulfil the stated purpose, an explorative literature study combined with a case study of a process plant has been performed. Various examples and data from the oil and gas industry are also used to support the thesis.

In this study, firstly the concept of production assurance is discussed and Overall Production Assurance Effectiveness (OPaE) is suggested as a developed metrics for measuring the performance of a production plant which is considered internal effectiveness of production plant as well as external effectiveness as it considered customer requirement and demand. This thesis present and discusses a methodology that facilitates implementation of PAPs in a production plant. Such a methodology would support production engineers and managers in reducing or eliminating uncertainties and risks in their day to day operation and maintenance decisions.

In this research study, some availability importance measures are defined. Thereafter, it a methodology is suggested to improve the production assurance effectiveness through improvement of reliability, maintainability, and availability of production plant. In the methodology, the concept of importance measures is used to prioritize the components or subsystems. This analysis of importance measures has helped to identify the critical and sensitive subsystems or components that need more attention for improvement.

The research study shows that in order to measure the performance of a production plant, the PA provides a more comprehensive measure of a production plant's real performance com-pared to system availability performance as the production assurance provides information about the production plant's delivery capacity, production rate and ability to deliver according to design or customer demands. The study also indicates that availability importance measures can serve as a guideline for developing a strategy for improvement of production assurance.

SAFETY AND RELIABILITY EVENTS

Martijn Flinterman
The Netherlands Society for Risk Analysis and Reliability (NVRB), The Netherlands

Last year's activities (2008)

Below I give an overview of the activities of our Society for Risk Analysis and Reliability in order to inform the ESRA members what our topics were the past year. We organised four evening meetings and a congress. The meetings were each attended by some 20 to 40 members of in total 260 society members. The Risk Management Congress, which was organised in cooperation with the International Project Management Association, Netherlands and the RISNET Risk Management Knowledge Network, is one of the main meetings each year and was attended by approximately 200 people.

The topics of the meetings were:
1. Reliability Analysis and Asset Management in the Energy Sector;
2. Safety management in the Light-Rail Sector;
3. Misunderstandings about certain dangers resulting from the naive application of the concept of risk;
4. The underpinnings of the current Quantitative Risk Assessment instrument regarding hazardous materials and its maintainability;
5. Risk Management Congress: '"Risk? What risk?", Risk Acceptance and –Denial in daily practice':

- Risk Management and good leadership in a NATO training mission in Iraq;
- The ISO 31000 Risk Management standard;
- Rethinking theoretical risk models, due to the current economic recession;
- Systematic risk management in infrastructure projects;
- The distribution of risk between clients and contractors;
- Information security: risk management using ISO 27001 or CobiT versus a best-practices approach;
- Operational risk management in the banking sector;
- Costs and benefits of risk management in healthcare;
- Risk management: a structured farce?
- Managing risks in construction: from being consciously incompetent to seizing opportunities;
- Consciously dealing with risks. A look behind the scenes of the process industry;
- Safety culture in aviation.

Send an e-mail to publicrelations@nvrb.nl for more information about the presentations or any other question related to our society.

ESREL 2009 Conference

Radim Bris
Chairman of ESREL 2009
Technical University of Ostrava
Czech Republic

The 20th European Safety and Reliability Conference, ESREL 2009, was held in Prague, Czech Republic, between 7 and 10 September 2009. From participants' responses, the conference was very successful. The participants took part in an extensive program with excellent keynote speakers and presentations in six parallel sessions.

Prague, the capital city of the Czech Republic, lies in the heart of Europe and ranks amongst the most impressive historical cities in the world. The participants could admire a lot of historical buildings in the city even during the Conference Gala Dinner which was held on Tuesday September 8 in Zofin Palace. The Zofin Palace is a wonderful neo-renaissance palace located on the most beautiful

island in Prague "Slovanský ostrov". On top of that, the weather was beautiful during all conference days.

Gala Dinner in Zofin Palace

The host institution of the conference was the VŠB Technical University of Ostrava. This is not surprising because the University ranks among top technical universities in the Czech Republic and it develops traditional branches of industry as mining, metallurgy, material engineering, mechanical, electrical, civil and safety engineering, economics, computer science, automation, environmental engineering and transportation. The Conference was held under the auspices of rector of the University professor Tomas Čermák, who gave a Keynote Address at the beginning of the Conference.

The Conference has become well established in the international community, attracting a good mix of academics and industry participants that present and discuss subjects of interest and application across various industries. This year the theme of the Conference was "Reliability, Risk and Safety: Theory and Applications". The Conference covers a number of topics within reliability, risk and safety, including risk and reliability analysis methods, maintenance optimisation, human factors, risk management, etc.

The application areas range from nuclear engineering, oil and gas industry, electrical and civil engineering to information technology and communication, security, transportation or health and medicine. The Conference provides a forum for presentation and discussion of scientific papers covering theory, methods and applications to a wide range of sectors and problem areas. Significant consideration was given also to the societal factors influencing the use of reliability and risk assessment methods. Integral demonstrations of the use of risk analysis and safety assessment were provided in many practical applications concerning major technological systems and structures.

The conference Programme resulted from the enthusiasm and participation of the many researchers who have contributed with their papers and session plans.

The Technical Programme Committee had a very important role of peer-reviewing the full length papers and suggesting improvements in the quality of the original submissions. A subset of this Committee, the Technical Area Coordinators, mostly active Chairmen of Technical Committees of ESRA organized the papers in sessions. Consequently all presentations were good and very relevant to current academic and industrial trends. These presentations have been published as a three volume set (including CD-ROM) of Conference Proceedings: *Reliability, Risk and Safety: Theory and Applications – Bris et al. (eds) © 2010 Taylor & Francis Group, London, ISBN 978-0-415-55509-8.*

All these initiatives and efforts are gratefully acknowledged.

During the Conference days two technical visits were organized for participants: in Nuclear Research Institute Rez (on Thursday, September 10), and in Nuclear Power Plant Temelin (all-day visit on Friday, September 11). These visits were accepted by participants with high interest.

The Conference was attended by 345 participants, from 36 countries. The country distribution is shown in the figure below.

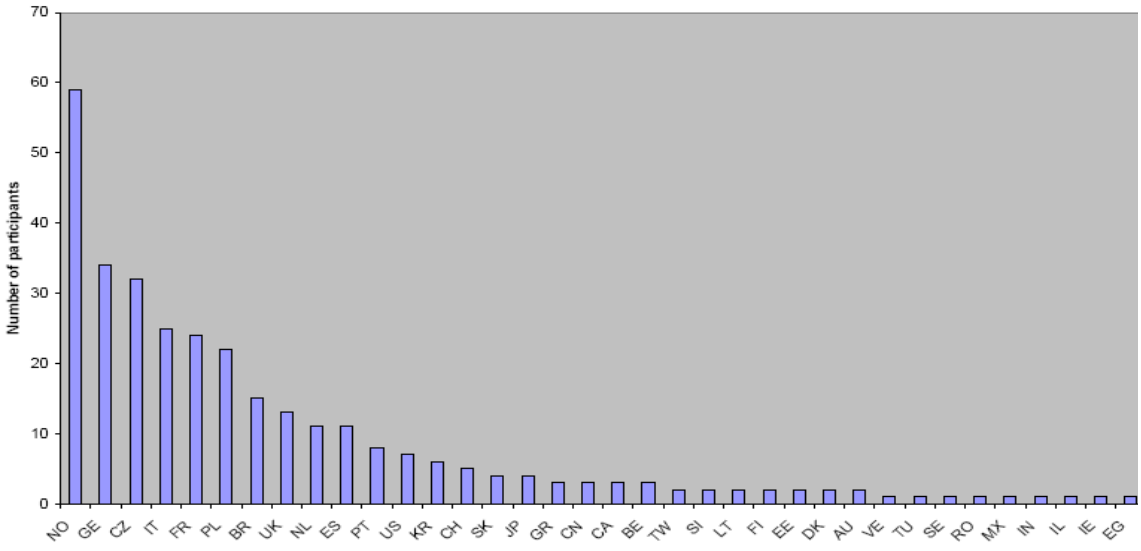
Norway, on the first position was represented by 59 participants, Germany 34, Czech Republic 32, I never expected such a high participation from Brazil (15). All five continents were represented. ESREL 2009 has become a true international event. About 24% of the participants were students, which shows, that there is a new generation of researchers coming up. About 550 abstracts were received. After the review by the Technical Programme Committee of the full papers, 334 were accepted and included in the Conference Proceedings. The work and effort of the peers involved in the Technical Program Committee in helping the authors to improve their papers are greatly appreciated.

The keynote speakers presented interesting overviews and reflections on various topics within risk and reliability. All of them are internationally recognized researchers:

- Professor Pierre-Etienne Labeau, Université Libre de Bruxelles, Service de Métrologie Nucléaire, *Concepts and Potential Uses of a Stimulus-driven, Dynamic Approach to Reliability Issues*

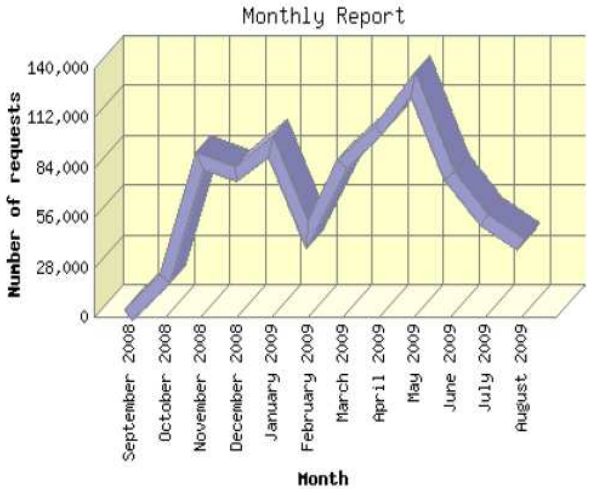
- Professor Josef Šikula, Czech Noise Research Laboratory, Brno University of Technology, *Reliability of Electronic Devices: Failure Mechanisms and Testing*

- Professor William Q. Meeker, Department of Statistics, Center for Nondestructive Evaluation, Iowa State University, *Using Accelerated Life Tests Results to Predict Product Field Reliability.*



Countries represented at ESREL 2009

The review process was conducted electronically through the Conference webpage and I acknowledge the use of the system developed for the ESREL 2006 conference in Estoril, Portugal. I would like to thank Alexandre Janeiro at the Instituto Superior Técnico, for his continuous support during the paper submission and reviewing process. Number of successful server requests on the web address http://www.esrel2009.org/ from October 2008 till August 2009 is demonstrated in the figure bellow (total number was 826,648):



The Conference Esrel 2009 was sponsored by the host Technical University of Ostrava and by the RWE Transgas Net. The support is greatly appreciated particularly in the wake of the financial crisis.

I would also like to acknowledge the local organizing committee, and in particular the team of young people, mostly Ph.D students from the host University. Special thanks go to co-chairmen of the Conference: professors Carlos Guedes Soares, Sebastian Martorell and Zdenek Vintr. All of them significantly contributed to the paper review process. Many thanks also to my young colleague and researcher Pavel Praks for his technical and administrative help during the Conference as well as in the review process.

It was an honour and a great pleasure to have the opportunity to cooperate with you all during the ESREL 2009 conference, both at the planning stage and during the Conference in September 2009.

CALENDAR OF SAFETY AND RELIABILITY EVENTS

6th International Conference on Safety and Reliability
Szczecin, 24-28 May 2010

Information about this event can be consulted on the Conference website at:
http://konbin2010.itwl.pl/announcement.pdf

13th International Symposium on Loss Prevention and Safety Promotion in the Process Industries
Brugge, 6-9 June 2010

Information about this event can be consulted on the Conference website at:
www.lossprevention2010.com

Tenth Conference on Probabilistic Safety Assessment and Management (PSAM 10)
Washington (Seattle), 7-11 June 2010

This meeting will focus on the improvement of performance and safety of complex technological systems, economics, and environment - emphasizing

the breadth of PSA applications including methodologies, technologies, and industries.

Conference website at: http://www.psam10.org.

Important Dates:
Full Paper Submission: 15 Feb 2010
Pre-Conference Workshop: 05-06 Jun 2010

ESREL 2010
European Safety and Reliability Conference,
Rhodes, 5 – 10 September 2010

The ESREL 2010 Conference will be held at the Rodos Ralace Resort Hotel www.rodos-palace.gr.
More information can be obtained at the following address: www.esrel2010.gr.

Important Dates:
Submission of Abstracts: 15 December 2009
Submission of full-length paper: 31 March 2010

8th International Probabilistic Workshop
Szczecin, Poland, 18-19 Nov 2010

Organization: Maritime University of Szczecin, Faculty of Navigation & University of Natural Resources and Applied Life Sciences, Vienna, Department of Civil Engineering and Natural Hazards
Submission: Submission of abstract: May 2010, Submission of final paper: October 2010
Conference location: Maritime University of Szczecin, Poland
Conference Chairman: Prof. Lucjan Gucma
Audience: The conference is intended for civil and structural engineers and other professionals concerned with structures, systems or facilities that require the assessment of safety, risk and reliability.

Further information:
Prof. Lucjan Gucma, Maritime University of Szczecin, Faculty of Navigation, Waly Chrobrego 1-2, 70-500 Szczecin, Poland.
E-mail: l.gucma@am.szczecin.pl
or
PD Dr.-Ing. Dirk Proske, University of Natural Resources and Applied Life Sciences, Vienna, Institute for Mountain Risk Engineering, Peter Jordan-Street 82, 1190 Wien, Austria
E-mail: dirk.proske@boku.ac.at

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

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

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- TNO Defence Research, The Netherlands
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- HSE - Health & Safety Executive, UK
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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.
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