

What is Expected from Safety Engineers, Trainee in the University of Mining&Geology "st. Ivan Rilski", Sofia

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ABSTRACT; Modern trends in engineering expect a great deal towards machine and human safety and towards thus formed working environment. These trends equalize safety standards priorities with quality and environment management. Standards implementation and their proper application require special knowledge in the field of Safety Engineering. This paper presents main ideas and their current realization in 2001 started Master program on Safety Engineering at the University of Mining&Geology, Sofia as well as its compliance with qualification requirement to graduated specialists.

i BACKGROUND

The most featuring process in safety during the last century is its expansion. Engineers are responsible for the safety of constructive, design, technical, technological and management solutions in all phases of life cycle of me products. However, development of science and techniques demand implementation of innovative solutions in extremely dynamic way in order to meet competitiveness of products ensuring better quality of life. In the same time sustainable development of industrial society requires increased indoor and outdoor safety. Following the above stated provisions, international standards (ISO9000, ISO 14000 and ISO 18000) have already acknowledged work environment safety management (ISO 18000), as equal in priority as quality (ISO9000) and environment (ISO 14000) management. As a result of such prioritization, social necessity of professionals with deeper specialization arose in order to meet its creative realization. In Bulgaria such specialists can be safety engineers, upgrading their BSc background in engineering fields at Master level.

In order to meet social needs for safety specialists, the University of Mining&Geology "St. Ivan Rilski" started in 2001 new Masters programme in Engineering Safety. This paper deals with main directions and subject-matter which can help to increase creativity and knowledge of future safety engineers, based on experience of started few years ago Masters program in Bulgaria.

2 WHY STUDY AT MASTEES LEVEL AT MINE FACULTY

Our analysis for engineering study in Bulgaria as well in other countries, utilizing three-level education system (BSc, MSc and PhD) show that engineering study at BSc level ensure good background, which can serve as a basis for deepening and broadening of knowledge in the field of safety. Problems, which one safety engineer can solve are of great responsibility that is why his qualification should be at higher than BSc level. This does mean that at this stage BSc study in safety is not necessary.

Department of Mine ventilation and labor safety, part of Mine-technological faculty of the University of Mining&Geology, Sofia, has more than 40 years experience in safety education of mine students and professionals. This tradition in safety education in one industry with high level of risks, oriented department staff in development and implementation of education in engineering safety at Master level. Thus in this education and science field have highly professional lecturers, ready for the new specialty. Mining is one of the most risky industries. This predefines the orientation of educational process in the University of Mining&Geology towards very high standards in the teaching process of health and safety at work. Such background makes possible extension of educational process to other industrial activities and creation of Master program in Safety Engineering at the Department of Mine Ventilation and Labor Safety. This department provides postgraduate edu-

education in School of Safety in Mining and Geological Survey 25 years already with practicing engineers

3 FUNDAMENTAL OF THE STUDY -
ADMISSION REQUIREMENTS AND MAIN SUBJECTS

Specialized knowledge in physical, chemical and social sciences is mandatory for practicing safety specialists. They should perform not only measurements and analysis as used to be till now, but also to synthesize new solutions for effective risk management. That is why admission procedure claims fundamental knowledge in Maths, Statistics, Physics, Chemistry, basic engineering, and computer skills from candidates.

Table 1 presents the Program syllabus, combined in three semesters. Eight compulsory and three elective courses (chosen from six) are included into program. Two types of study are foreseen - full-time and part-time. Some ideas for development of distance learning exist. Study duration is three semesters with defense of Master thesis at the end. Total number of credits is 129, including 60 in auditorium classes, students' occupation and 69 in self-work on projects and tasks.

Mandatory courses numbered 1, 2, 3, 4, 7, 8, 9 and 10 provide special knowledge to students, and elective courses numbered 4 and 5 supplement the special knowledge.

Mandatory courses "Computer methods in safety" and "Language and information training" augment the remaining courses of the syllabus and provide knowledge and skills that are mandatory for the trainees. These were developed on a module basis with scheduled interaction both between individual modules and other courses.

Module A of "Computer methods" gives additional (as compared to bachelor's degree level) knowledge for working with electronic tables and databases. Practical courses comprise mostly individual work and assignments on other subjects - for instance, assignment on "Industrial ventilation" or analysis and processing of measurements in "Industrial hygiene". Module B of "Computer methods" further improves students' knowledge in Safety statistics focusing on processing of statistical and other data, criteria evaluations and verification of hypotheses. Practice on above mentioned courses include solving of problems for analytical or graphic processing of information obtained during studying of other subjects of the current semester.

Language and information training comprises three modules, as follows:

- Technical translation from foreign language - Module A
- Information retrieval systems - Module B
- Document and report writing and presentation - Module C

Information search, translation, documents prepared and presented, all are generated from other courses of the semester of the master's degree study as a whole.

Table 1 Syllabus of the study

N	Subject	Credits
First semester		
1	Industrial safety (I part)	6,8
2	Industrial Ventilation	5,7
3	Industrial hygiene and professional diseases	5,5
4	Computer methods in safety - Module A (Database management)	2,4
5	Language and information studies - Module A (Translation)	2,2
6	Elective course (1-st, 2-nd or 3-rd elective)	2,2
Second semester		
7	Safety psychology and ergonomics	6,8
8	Industrial safety (II part)	3,4
9	Fire safety and rescue	7,4
10	Management of safety and industrial risks	5,7
4	Computer methods in safety - Module B (Applied statistics)	2,4
5	Language and information studies-Module B	2,4
11	Elective course (among 4-th or 5-th elective)	3,4
Third semester - work on MSc thesis		
5	Language and information studies - Module C	2,4
12	Elective course (among 3-rd, 4-th or 6-th elective)	6,8
	Pre-thesis practice	3,0
	Lectures and seminars on Masters' thesis	15
	Consultations on Masters' thesis	
	Defense of Masters' thesis	
Elective courses		
E1	Microcosmology	2,2
E2	Mine safety	2,2
E3	Applied illumination	2,2
E4	Drilling, exploration, transportation, storage, and usage of oil and gas	5,7
E5	Geotechnical safety	6,8
E6	Ventilation and air conditioning systems' control	6,8

The elective course "Drilling, Exploration, Transportation, Storage, and Usage of Oil and Gas" enhances students' knowledge about widely applied technology in the country and with high degree of risk.

The elective course "Microsociology" provides essential knowledge to be used as basis for personnel management training - a problem which every engineer faces regardless of their chosen field of carrier.

The elective course "Applied Lighting Equipment" supplements the knowledge on labor hygiene and ergonomics and provides essential knowledge on accident reporting.

Elective course "Mine Safety" choose students, who wish to obtain more qualification in this field as well as students with B.Sc. from other than Mining University.

Diploma thesis and pre-diploma internship are related to specific sites whereof risk assessment, safety plans and other documents and analyses of use for the company are developed.

4 WHY WE ARE COMPARED WITH OTHER MASTERS PROGRAM IN THIS FIELD

There is not similar education in Eastern European countries in the field of Safety Engineering. University of Nis at Serbia has safety education based on BsC in safety. It is more targeted towards safety work conditions rather than risk management and minimization. Table 2 presents quantitative analysis of similar Masters programs in Indiana University of Pennsylvania (USA), University of New South Wales (Australia) and University of Nis (Serbia). No similar programs have been found in EU.

Main study parameters have been compared - study duration, credits, main courses and study direction. This comparison shows the followings:

- Study duration is from 1 to 2 academic years for full time study and 1,5 - 2,5 years for part time;
- Number of courses vary from 11 to 15, 8 to 10 of which are compulsory, electives are between 2 and 4, projects included thesis are from 1 to 3;
- Masters studies in Australian and American universities have additional 2-3 specialties in the field of Safety. This can be explained with countries scale and need for more narrow oriented specialists because of various aspects of safety, due to its integration with other activities;
- Courses in MSc. Safety Engineering at University of Mining&Geology, Sofia are generalized, but cover the content of similar courses in other masters programs;
- Some of analyzed Master programs are based on BSc. level in Safety, which predefines the narrowed specialty;

- Departments, started safety education are further expanded to safety science schools; safety faculties; health and safety management institutes. This gives confidence to the staff of department of Mine Ventilation and Labor Safety that the work done till now is in right direction and with good perspectives.

The logics of comparison with similar programs in the filed of safety show that Safety Engineering masters study at the University of Mining&Geology is well balanced to Bulgarian scales and with practice requirements.

5. POSSIBLE STUDENTS REALIZATION

Safety Engineers oversee the manufacturing production process to ensure that every measure is taken to protect workers in the manufacturing environment. They apply principles of science and mathematics to come up with solutions to manufacturing needs and environmental effects. Engineers analyze the impact of products they develop and the systems they design on the environment and people using diem. Engineering knowledge is applied to improving the quality of health care, the safety of food products, and the efficient operation of financial systems.

6. CONCLUSION

Many Safety Engineers should be involved in products testing and in industrial and environment media control. These new engineers should also increase safety training at higher level, utilizing better understanding of behavior, motivation and communication between people and their effective management. In this way they will fulfill the mission of reaching higher standards in culture of safety, which for many countries is the best solution with greatest potential for continuous increase in safety.

Safety engineers will prepare and implement new, more liberal regulation for health and safety at work, which principals require new safety professionals. Entering into creative part of safety, which means that professionals should go beyond official normative requirement, is the great challenge for safety engineers. This mission consist of search and implementation of new technologies, design, constructive and behavioral solutions leading to risks avoidance. Expectations for such creative behavior of safety engineers are crucial in industries with high level of risk. Only in this way they can change the attitude in

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society that the price for better life quality in industrial era should be paid only by people, occupying health and safety risky professions

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Table 2. Comparison of masters program in the field of Safety-

Name of Masters study	Safety Science	Occupational Health and Safety	Science and Technology in Industrial Safety	Safety Science	Labor Safety	Safety Engineering
1 University	University of New South Wales, Australia [2]			Indiana University of Pennsylvania [3]	University of Nis [4]	University of Mining & Geology "St Ivan Rilski", Sofia [1]
2 Study duration	2 years full-time 2.5 year part time	1.5 years full-time 2 years part time	1 years full-time 2 years part time	1.5 years full-time 2 years part time	2 years full time	1.5 years full-time 2 years part time
3 Number of subjects	13	17		8	5	11
- compulsory	4	14	12 credits	4	2 3 special	8
- elective	9	3	48 credits	4		3
- projects	42 credits	2	15 credits	3	2	-
- projects (thesis)	1	1	1	1	1	1
4 Credits	96	72	75	36		93
5 Price	\$11,760/year for Australians and \$18 000/year for foreigners					300 levs/ semester for BG citizens
6 Specialties	Safety Science	Occupational Health and Safety	Science and Technology in Industrial Safety	Safety Management	Labor Safety	Safety Engineering
				Technical safety	Fire Safety	
				Disaster Response		
Structure	School of Safety Science			Safety science department Faculty of Health and Human Services	Faculty of Labor Safety	Department of Mine Ventilation and labor Safety