Methodology for Implementation of Process Safety Management into Experiment Life Cycle

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Abstract: -The presented work deals with experiments in laboratories that solve practical problems. Each experiment is a process that takes place under certain conditions, which significantly influence its results. Results of experiment are further influenced by the quality of: inputs; technical and cyber equipment; control; and the knowledge, experience and skills of personnel. Therefore, experiments supporting the practice must be carried out using a methodology that ensures that the results always are of required quality. Process safety management, which is based on management of risks connected with process, has proven itself in practice. Therefore, we apply its principles into experiment life cycle. Paper shows methodology of process safety managements in experiments and its main part, i.e. prototypal checklist for evaluation of both, the partial risks and the integrated risk of experiment.

Key-Words: - Experiment; limits and conditions; risk; process safety management; methodology for application PSM into experiment life cycle; checklist.

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1 Introduction

The paper is based on the premise that the engineer solves the problems of practice associated with a certain object or facility under certain specific conditions so that the problem solving pans out the required results throughout the lifetime of the object or facility and at the same time does not endanger the object or equipment or its surroundings. In doing so, it uses existing knowledge and experience and ensures that the management of resources, forces and means is economical and promotes the coexistence of the basic systems that humans need for their lives, i.e. environmental, social and technological system. To achieve this goal, it uses knowledge, skills, experience and abilities to create a concept of problem solving and implement it in the given conditions so that the object or other entity is safe, i.e. reliable and functional for its lifetime and under its critical conditions it does not endanger itself or its surroundings.

According to knowledge and experiences summarized in [1], for solving any problem, it is first necessary problem to know and understand it, which can only be done on the basis of: knowledge based on observational and experimental data collection and on the formulation and testing of hypotheses; and applications of correct methods, i.e. methods that are repeatable, transparent, have clearly defined quantities, units and terminology. First of all, it is necessary to summarize the existing knowledge in order to know what is already known and prevent "rediscovery", and consistently apply the principles of logical thinking and qualified methods that are the basis for the creation of quality engineering solutions. Then, it is necessary to carry out:

- investigation of the environment in which the problem is solved, because the real environment is neither homogeneous nor isotropic and influence results of problem solving,
- data collection by observation and monitoring, because the environment is dynamically evolving, which substantially affects its properties, and thus the behaviour of objects that are vital for humans
- and experiments, because they are the cornerstone of an empirical approach to acquiring knowledge about the surrounding world.

The experiments have been used in natural, technical and social sciences are since historical times for two aims: to solve practical problems; and to confirm or refuse results arising from theoretical assumptions. In order to meet these goals, the results of the experiments must be of good quality, i.e.: they must: be correct; have informative power to the problem being solved; and have estimation of random and epistemic uncertainties. It means that quality methods which ensure stable and reliable results and have good discernment must be used to obtain them [1]. According to the document [4], the highest quality factor of an entity (object, system, process, etc.) is the safety, and therefore, the attention is concentrated to it [5,7-9,23-38].

Each experiment is a process. The assessment of many results of experiments performed in university laboratories showed a large dispersion of their results when repeating experiments as for example it is shown by information published in [2,3]. Since practice does not need such results, it is necessary to use a methodology\ of experiment that ensures quality results. Therefore, present article describes how to implement a process safety management (PSM) at experiments in technical fields.

2 Engineering Solutions of Problems

Engineering is a broad discipline that solves problems from their understanding, through the design of solutions to implementation in given conditions. It is the driving force behind human development because it also deals with problems that are difficult to solve precisely. To achieve the goal, it uses the creativity of human individuals and approaches referred to as good practice. At present, it is based on a systemic approach and uses specific disciplines that are characterized in works [5-7] to ensure the current goals, which are a safe enterprise, a safe community, a safe region, etc. According to the works [6,8,9], engineering expertise is understood as an expression of the ability to solve a problems, i.e. to: apply knowledge of mathematics, science and engineering; design and implement experiments; analyse and interpret data; design components or the entire system according to requirements and identify, formulate and solve engineering problems within realistic constraints; communicate effectively; understand the impacts of engineering solutions in a broader context; use state-of-the-art tools and methods in engineering practice; comply with professional responsibilities and ethics; and lead an interdisciplinary team.

It is necessary to perceive that there is the difference between academics and engineers at problem solution. Academics usually look for general solutions or partial solutions depending on the context associated with various definitions of the behaviour of systems and their surroundings. Engineers are interested in solving tasks in the given specific conditions given by: the characteristics of a particular place; legislation, including norms and standards; available resources, namely financial, technical and human (level of qualification of available personnel); the structure of the systems in question, i.e. their elements, links and flows between the elements that make up the assets of the systems that are important in the management of the safety of the systems.

The aim of engineering disciplines is to solve a problem in certain given conditions so that the solution is functional and has the required quality in the given conditions for a set period of time. The primary and absolutely fundamental task that must be solved in order to obtain a qualified solution to a particular problem, is related to the following aspects that must be considered when establishing a concept for solving a particular problem. This is the determination of: the objectives and context of the solution (i.e. to determine whether the problem will be solved as a single-discipline or multidisciplinary or multidisciplinary and cross-cutting one); and at what professional level problem will be solved (i.e. as site-specific, regionally specific or general).

It is reality that the objectives of solving one and the same task may be set differently, e.g.:

- it is considered: a single asset; two or more mutually reinforcing assets; ; and two or more assets, some of which are mutually supportive and some of which are conflicting with each other - e.g.: a good environment promotes human´s quality of life and development; on the contrary, a number of conflicts between the environment and technology, between human and technology are known (see specific areas of study such as human-machine, human-computer, etc.),
- they are considered different critical points of solving tasks.

This is because many practical tasks do not have a general solution due to the fact that the behaviour of systems and their surroundings is variable, variability is not linear, sudden changes occur, etc., which means that there is neither an available analytical solution nor one specific universally valid solution [5,7-9,23,24]. Therefore, the basic steps of problem solving are the following: understanding the problem; knowing the problem; analysis of the causes of the problem; design and implementation of measures to eliminate the causes of the problem with regard to the set goal; test of the effectiveness of the measure; implementation of measures to eliminate the causes of the problem; report on the results of resolving the problem; and identification of future corrective measures and actions in case of large deviations from the required situation. In order to solve the problem for practice, it is necessary to understand it; then it is necessary to determine what and how can be solved and whether the costs incurred (time, wages, preparations, administrative changes) to solve the problem correspond to the possible savings or the level of risk rate; it is important to set the target condition, because it determines criteria or indicators of monitoring the quality of the solution of the problem.

Get to know a problem means assessing a problem from different perspectives. For example, the effects of changes in operating parameters of machines, jigs, the influence of human factor, humidity, temperature, etc. It is ideal to monitor the effects systematically in order to trace the impacts of random and definable causes of process variability. The specificity of engineering methods lies in the fact that it is not possible to separate the characteristics of the phenomena from which the object in question must be protected, the properties of materials, the territory of the structures and equipment that make up the object, the operating conditions and limits, the detection of disturbances of objects when the set limits are exceeded and corrective measures supporting the safety of the object and its surroundings. However, the aim is to ensure a quality solution in the given conditions, and therefore exact results must be combined with the results of good engineering practice, and this primarily means using only proven procedures and verified data.

A process is a sequence of phenomena or activities in space and time in which inputs and outputs can be distinguished. Within each process there are usually numerous parallel but distinct sub-processes. Each sub-process is associated with a specific element of the space or a group of elements in the monitored space. A process model is a depiction of a certain process focused on a specific goal. Because the goals are not the same, in practice there are multiple process models for one process. It is a description of a process at the type level (a graphical representation of business processes or workflows) [39]. In our case the goals of a process model are prescriptive, i.e.: it defines the required processes and how they should/could/might be performed; and it establishes rules, guidelines, and behaviour patterns which, if followed, would lead to the desired process performance.

A process model supported by high-quality IT is a mathematical tool allows you to describe the current state, propose new or optimize existing processes, detect unnecessary processes or inefficient processes, model and evaluate the possible impact of changes before their implementation. Process models are highly sophisticated tools in terms of formalized process analysis. However, it should be noted that a mere graphical presentation may be misleading and may imply an unacceptable simplification of the system under consideration, and therefore models need to be developed for different initial and boundary conditions that reflect differences in initial and ambient states. In practice, there are different process models, e.g. for technology, processes, organization or management [10,39]. At selection of process model, it is necessary to consider that the solution to each problem and its level depend on the conditions in which it is solved.

3 Summary of Knowledge on Process Safety Management

Process Safety Management (PSM) has different versions in the world. It represents complex procedure and requires a multidimensional approach that blends technology and their management [11]. It is connected with safety culture and for its safety assessment, the checklist is often used [12]. In the European Union the process safety management is usually related to the storage and handling of hazardous chemicals [13] to limit risks. In the United Kingdom, the Control of Major Accident Hazards (COMAH) Regulations 2015 cover PSM [14]. It is addressed in specific standards for the general and construction industries.

Process Safety Management is complex and requires a multidimensional approach that interfaces technology and management of problem solutions. Every Process Safety Management program should include 14 basic elements [15-22]. Their brief overview for facility with hazardous substances is:

- Process safety information: Staff should have access to basic information about the hazards of the chemicals and tools they are using on the job.
- Process hazard analysis: This helps organizations evaluate their processes and operations to identify potential hazards. Still, organizations can’t manage safety and hazards until they know what hazards are actually in their facilities.
- Operating procedures: Work should follow consistent, well-established safety protocol.
- Hot work permit: Work with fire or other sources of ignition requires a systematic process for authorization and oversight.
- Emergency preparedness and response: Organizations should have a response plan if something goes wrong.
- Mechanical integrity: Businesses are required to track and evaluate the evolving safety risks of equipment.
- Pre-start-up safety review: Businesses are required to thoroughly assess new or modified facilities before hazardous substances are introduced into the workplace.

- Training management: Employees should be properly trained on all safety procedures and have access to ongoing refresher training.
- Management of change: When processes change, businesses should conduct a systematic review of how the changes will affect risk throughout their facility.
- Incident investigation: When incidents and near-misses occur, businesses need a systematic process to record, track, investigate, report and analyse what happened.
- Contractor safety management: The safety of contractors and subcontractors should be covered by process safety management systems.
- Compliance audits: Organizations should conduct regular internal audits to ensure procedures and processes are compliant.
- Employee involvement: Employees should be able to access, acknowledge and sign-off on policy documents.
- Trade secrets: Employees must be provided thorough documentation of materials and processes, even those that are trade secrets, to ensure health and safety.

It is worth noting that PSM focuses on events that have perhaps occurred very infrequently in the past. Perhaps, they might never have occurred at all. But, if they do occur, they are often catastrophic. While it can be complex and expensive to understand these low-probability events, the outcomes that result when they do occur are orders of magnitude more severe.

4 Safety and Reliability of Results of Experiments in Technical Fields

Each experiment in followed field has a certain aim, e.g. to find: description of behaviour of some object at determined conditions; critical / limit condition at which object change properties; production procedure or technique of manufacturing the real product etc. In further text, we concentrate to last mentioned problem.

Practice requires safe, i.e. reliable and functional outputs. Therefore, at each experiment we need high quality factual data to solve the task. To obtain them by measurement, we need a high-quality method of measuring particulars during the experiment, which are then processed by an appropriate mathematical method. For the data obtained to be credible, the measurement process must be: sufficiently flexible; transparent; repeatable; accurate in the sense that it ensures the same results when repeated; and correct in the sense that both types of uncertainties, the random and the knowledge, are evaluated.

To meet above mentioned requirements, it is necessary to have a safe measuring apparatus, a safe measuring procedure, and to perform the measurement in safely known environment [1]. The measuring apparatus consists of a number of more or less complex elements, components, and systems, which are arranged in certain structure, which must be safe. By the end of the 1980s, there was talk of a quality spiral in the creation of technical systems. Today we use term “safety” [4,11]. The safety of each technical device is determined by many factors. At the design stage, it is about determining the correct specifications, which must respect the characteristics of the place in which the technical equipment is placed. Furthermore, it goes on measures built into the equipment that will facilitate the management of safety in operation under normal, abnormal, and critical conditions of different kinds [23]. In line with current knowledge, it should be ensured:

- application of existing norms and standards, because, without standards and legislation, experts and the professional public would be condemned to repeat the mistakes of the past
- and adding adjustments based on an evaluation of possible risks, which have origin in changes in time and the aging of materials that are the causes of knowledge uncertainties [11,23].

Each experimental device is a unique experimental device. Therefore, it is necessary to prevent faults and defect s by risk management methods. From the point of view of contemporary knowledge, there are used for experimental device design and operation the principles: a risk-based design [23]; and risk-based operation [24].

5 Procedure for Making-up the Methodology for Implementing the PSM into Experiments

In harmony with public interest and human society development, it is required safe experiment execution. It requires safe operating procedures. Procedures must include operating limits and the steps required to correct or avoid deviation from these limits. In harmony with knowledge and experiences summarized in [24], the experimenter must be able to recognize a deviation that affects safety, and know what to do to maintain control under course of experiment. He must know the consequences of deviations, what actions to take, and how to use the appropriate safety equipment. Operating procedures must address safety and health considerations .

Since each experiment is a process, knowledge given above holds for it. In agreement with aims of PSM in case of experiment, it is required an ongoing effort to prevent catastrophic accidents and to obtain safe results. In analogy to procedures described in [15-22], it needs to apply management principles, methods, and practices to prevent and control risks during the experiment preparation, design, course and result evaluation. It requires complete and accurate information on: experiment technology; experiment equipment; physical properties of used materials; external and internal conditions in which the experiment is performed; and hazardous characteristics of phenomena which occur during experiment. Therefore, these factors for safe course of experiment must be reviewed. During audit, they need to be considered: operating limits of apparatuses and their interconnections; the consequences of deviating from these limits; and return measures from deviations. Procedures must address normal, abnormal, and emergency conditions, which can occur during the experiment to prepare response of experimenters to any event that may reasonably occur.

Considering the reality that the conditions under which the experiment is conducted affect the results of the experiment, so in preparation of methodology for practice it is important not only the workflow, but also the definition of the interval of conditions under which the results of experiment have the required quality. Therefore, we need to address the risks associated with the experiment, i.e. with: properties of local environ in which experiment is done; equipment used for experiment; materials used at experiment; preparation and construction of facility for experiment; inspection of facility for experiment; directions for execution of experiment; instructions for health and safety of experimenter during the experiment preparation and execution; response to incidents during the experiment; documentation of particulars at experiment; creation and processing data set from experiment; evaluation and judgement of data from experiment and judgement their acceptability; experiment results documentation; and creation of recommendation for practice (it also means to determine limits and conditions of experiment execution which guarantee required quality of results). Therefore, to obtain high quality results, it must be carried out the risk management for the benefit of safety. In harmony with [23,24], it means to use: principles of risk-based design and risk-based operation; and to have risk management plan, i.e. set of countermeasures for risk mitigation if problems occur.

In analogy to procedures described in [15-24], 14 main elements given above need to be adapted to experiment conditions. These elements should be well-known by safety manager of experiment, and others working in the facility should also be aware of them. The elements are as follows: safety information connected with experiment; audit of external conditions in which experiment is executed; hazard analysis of experiment; operating procedures of experiment; training the experimenter; collaboration of experimenter with co-workers; mechanical integrity of experiment devices; hot works during the experiment execution; management of change of experiment execution if problems occur; incident investigation connected with experiment; compliance audits; participation of other persons at experiment execution; pre-start-up safety review of experiment; and emergency planning and response realized by risk management plan [23,24]. In analogy to [15-24], the check list is the suitable tool for audit of fulfilment of these requirements.

In accordance with the technique [6,26], the following steps shall be followed when compiling checklists: to specify the items that should be monitored; to create an order of items based on their severity for the area being tracked; to identify critical items that are a source of risk; to compile checklist questions; and to determine how the checklist is to be assessed.

6 Methodology for Implementation of PSM into Experiment Life Cycle

Based on above mentioned facts, we propose methodology for implementation of process safety management in experiments by this way:

- to aggregate accessible information connected with experiment,
- to construct process model of experiment,
- to put together: suitable instruments and materials; standards and procedures for designing, manufacturing and operating the experimental instrumentation,
- to create OSHA rules for manufacturing the experiment facility and experiment execution,
- to verify experimenter knowledge, skill and craft in domain of designing, manufacturing and operation,
- to execute construction of experimental equipment,
- to execute safety audit of mechanical integrity of experimental facility, i.e. to consider not only safety of components but also their interconnections (interconnections are very often critical parts of facility [24]),
- to evaluate external hazards in space in which experiment will be executed,

- to evaluate internal hazards connected with experimental facility and phenomena that occur during the experiment execution,
- to create principles of safety culture [24] for experiment execution, which including the risk management plan,
- to start experiment and to realize risk management in profit of safety during the experiment execution
- to document records during experiment,
- after termination of experiment to assemble data and perform experiment data processing.

To make all experiment procedures easily accessible to experimenter they must be converted into checklist.

The example of scheme of environment conditions of room in which experiment is done is shown in Figure 1.

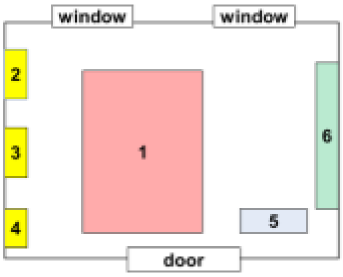

Fig. 1. Layout of the room with experimental equipment. 1- experimental equipment; 2 - gas control station; 3 - water supply; 4 - electric switchboard; 5 - electricity control station for experimental equipment (experiment management, regulation of temperature, humidity and ventilation); 6 - security equipment (fire alarms, fire extinguishing equipment, personal protective equipment, operating regulations, safety data sheets for used technical gases).

The example of process model of experiment is shown in Figure 2.

The prototypal checklist for judgement that process safety management during the experiment has sufficient quality is drawn up in Table 1; it goes on a risk assessment checklist. In real case, all these documents must correspond to real conditions.

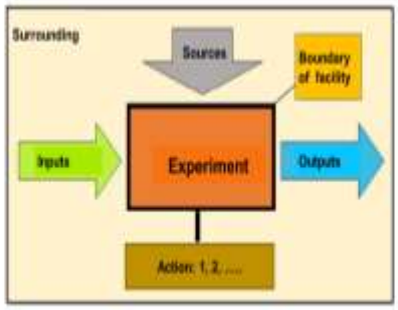

Fig.2. Process model of experiment.

Based on present knowledge and experience, errors in items given in check list and especially their combination influence the result quality of experiment results. To ensure high quality experiment, they must be assessed both, the risks connected with individual items which are given of checklist and integrated risk [5,23,24].

The assessment of partial risks shall be carried out in such a way that the question under assessment is assigned a value of 0 in the event of a negative answer or 1 in the case of a positive answer. Exceptionally, a value between 0 and 1 can also be assigned in the case of partially met conditions [5].

First of all, the number of risk items in a given case should be determined for the assessment of the selected part or all risks, i.e., ***N*** is the total sum of questions, ***n*** is the number of answers NO.

The level of risk in the case under assessment ***r*** is equal to ***n/N*** as a percentage where ***N*** is 100 %. Its assessment is carried out according to the scale used in technical standards since the 1980s, Table 2 [24].

Table 1. Prototypal checklist for judgement of risk of process safety management in experiment; Y - yes, N - no.

Question	Y	N
Preparation of experiment		
Are collected all information connected with experiment?		
Is construct ed the process model for experiment?		
Is the reliable function of air conditioning (temperature, humidity, ventilation) in the room ensured?		
Is the condition of the electricity control cabinet in accordance with standards for safe operation?		
Is the condition of the gas control station in accordance with the standards for safe operation?		
Are the power distribution cables in accordance with the standards for safe operation?		
Is the pipeline for distribution of industrial gases in accordance with standards for safe operation?		
Are the water pipes compliant with safe operating standards?		
Is the fire alarm system in operation?		

Are there functional fire extinguishing systems in the hall (also for case of fire from the wiring)?		
Is the control station compliant with standards for safe operation?		
Does the control system of the control station have an integrated safety management system in accordance with the standards for safe operation?		
Does the safety management system embed in the control station procedures for the safe operation of the measuring equipment not only under normal (design) conditions, but also under abnormal and critical conditions?		
Are evaluated internal hazards connected with experimental facility and phenomena that occur during the experiment execution?		
Is a response plan drawn up for possible internal and external undesirable phenomena?		
Do the room staff have the knowledge and competence to comply with the standards for the safe operation of the control station and the experimental equipment?		
Do the room staff follow the procedures for safe operation in accordance with the operating regulations of the room and the experimental equipment for safe operation?		
Are collected suitable instruments and materials; standards and procedures for designing, manufacturing and operating the experimental instrumentation?		
Are determined principles of safety culture for experiment execution, which including the risk management plan?		
Is processed program of experiment for control station?		
…….*other site and experiment specific items*		
Components of experimental facility (s – number of experimental equipment components)		
Are all components of the experimental device available?		
Is component A1 in accordance with standards for safe operation?		
Is component A2 in accordance with standards for safe operation?		
……		
Is component As in accordance with standards for safe operation?		
Designing and construction procedure and quality verification of measuring equipment (m – number of processes for connecting components)		
Is the appropriate principle of inherent safety used in the design of the measuring device?		
Are passive safety systems used in the design?		
Are active safety systems used in the design?		
Is the B1 interconnection of components in accordance with standards for safe operation?		
Is the B2 interconnection of components in accordance with standards for safe operation?		
…..		
Is the Bm interconnection of components in accordance with standards for safe operation?		
Is the design of the experimental equipment carried out in accordance with standards for safe operation?		
Is the program of experiment inserted into the control station?		
Audit		
Is the correct program of experiment inserted into the control station?		
Are the components and their interconnection carried out according to standards?		
Is performed safety audit of mechanical integrity of experimental facility, i.e. to consider not only safety of components but also their interconnections (interconnections are very often critical parts of facility)?		
Has it been verified that the components and whole construction of the device is robust enough to withstand the supercritical conditions caused by an explosion?		
Has it been verified that the components and whole construction of the device is robust enough to withstand the supercritical conditions caused by a fire?		
Has it been verified that the components and whole construction of the device is robust enough to withstand the supercritical conditions caused by a blow?		
Has it been verified that the components and whole construction of the device is robust enough to withstand the supercritical conditions caused by a high temperature?		
Has it been verified that the components and whole construction of the device is robust enough to withstand the supercritical conditions caused by an electric current?		

Has it been verified that the components and whole construction of the device is robust enough to withstand the supercritical conditions caused by a water?		
…….*other site and experiment specific items*		
Experiment		
Is the control station switched on?		
Are all measuring devices switched on?		
Are all needed sources (electricity, gas, water) switched on?		
Are all OSH protective devices switched on?		
Is the correct sample from the correct sample inserted into the experimental equipment?		
Is monitoring of all-important stages (processes) of the experiment carried out?		
Is the recording equipment operating?		
Is the result sample put out from experimental equipment when experiment is terminated?		
Are used sources turned off after the experiment ends?		
Are the measuring devices turned off after the experiment ends?		
Are all OSH protective devices turned off after the experiment ends?		
Is the control station switched off after the experiment ends?		
Is the room cleaned and locked after the experiment ends?		
Experiment data processing		
Are the particulars obtained from the experiment converted into data in a format that allows further processing?		
Is the accuracy and correctness of the data assessed?		
Is processed a protocol about the experiment and its results?		
Is written a report for the needs of further experiments and practice?		

Table 2. Value scale for determining the level of risk $r = n/N$.

Risk rate	**Values r *in* %**
Extremely high – 5	More than 95 %
Very high – 4	70 - 95 %
High – 3	45 - 70 %
Medium – 2	25 – 45 %
Low – 1	5 – 25 %
Negligible – 0	Low than 5 %

Based to knowledge summarized in [23,24], it holds, if the risk is:

- acceptable, so there is no need to take further measures since the level of safety (experiment quality) is at an acceptable level. If this is confirmed by sufficient number of repeated experiments, methodology of experiment is suitable for practice,
- conditionally acceptable, it is necessary to perform technical measures (parameters of environment, material, technical principle, construction procedure, barriers against the impact of critical phenomena, component backups etc.) when technically and financially possible, and so to reduce the rates of both risks, partial and integral, and, if this is not technically and financially possible, enable the implementation of a response by means of additional technical equipment and organizational measures to enable the performance of the measuring equipment and the acceptable level of safety of the reference after the repair. For needs of practice it is necessary by repeated experiments to find such conditions and limits for experiment execution in which level of risk is acceptable, i.e. level of safety (experiment quality) fits to practice needs. Only, if this is confirmed by sufficient number of repeated experiments, corrected methodology of experiment is suitable for practice (i.e. in practice it must be respected harmony of limits and conditions determined by experiments so required quality of outputs was achieved),
- unacceptable, it is necessary to implement essential technical measures in the field of material, technical principles, construction procedures, barriers against the impact of critical phenomena, component backups) in order to reduce the rates of all risks: partial, integrated risks and integral. For practice the methodology in the presented form is unacceptable and a fundamental change of experiment procedure must be done.

Published papers [41,42] show successful application of this methodology.

7 Conclusion

The present work deals with experiments in laboratories that solve practical problems. Present knowledge and experiences show that results of each experiment are influenced by both, the external and internal conditions under which experiment is executed. Big role plays the quality of: inputs, technical and cyber equipment; control; and the knowledge, experience and skills of personnel. Therefore, experiments must be carried out using a methodology that ensures that the results are of good quality. Process safety management, which is based on management of risks connected with process, has proven itself in practice. Therefore, we show how to apply its principles in experiments, the aim of which is to prepare production procedure for industry.

From technical and economic reasons, industrial practice only needs reliable procedures with high quality, i.e. safe procedures. Paper shows methodology of process safety managements in experiments and its main part, i.e. prototypal checklist for evaluation of both, the partial risks and the integral risk of experiment. For needs of industrial practice, it is necessary by repeated experiments to find such conditions and limits for experiment execution in which level of risk is always acceptable, i.e. level of safety (experiment quality) fits to practice needs.

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