9. Summary

The aim of present work consisted in to achieve a contribution to the knowledge development on the field of safety designing from pipeline plants on the basis of a systematical analysis process. To this was it required to take the present state of knowledge on the field of pipeline engineering and critical to evaluate.
It was shown, that pipelines compared to other procedural plants occupy a special position with regard to their danger potential and possibility of internal and external danger springs and the required method of investigation for the system-specific special characteristic they are to be modified.
Starting point of the investigations was a comprehensive safety analysis to the determination and evaluation of the relevant causes for troubles where a developed endangering model as well as a retrospective method of investigation formed the basics.
An emphasis of work was controlled by the evolution of a particular concept to the risk analysis from pipeline plants. That risk analytical approach allowed it, to register the variable conditions along the location route typical for pipeline plants with respect to the environmental conditions and the relevant performance-influencing factors and to subject to a safety evaluation. The risk determination is carried out by parameters which register the entry probability of a damage event as well as of its effects.
With the concept of risk analysis referring to pipeline route in sections was elaborated a practical instrument to the determination and documentation of objectively available safety deficits. In the result of the risk analysis can carried out on the basis of a corresponding safety-protective-concept a percise ones and pipeline route referring risk reduction.
The further investigations referred to derivation of a system-specific safety-protective structure on the basis of carried out analyses for endangering sources. Starting from the introduced term of the hermetical potentials of a pipeline, three main aims of the planned savety-protective-system for pipeline systems could be derived in this differentiated tasks are to where be assigned to the individual levels in the hierarchy. In this case, all measures appertain to the passive safety level for guarantee of basic safety, the level of the safety exclusion measures prevents an overloading of the pipeline elements acting and damage limit is realized by the protective level.
Within the framework of basic safety, the choice of the safety coefficients as well as the determination of the design pressure are of decisive importance while dimensioning. It could be proved that it is not necessary with it from safety point of view to increase safety coefficients over the measure required in the obligatory system of rules. Within the framework of dimensioning the choice of the design pressure is decisive for the requirement of safety exclusion measures and should be chosen that in this way security measures can be substituted against static over-pressure. Both the basic safety and the level of the safety exclusion measures can be influenced most effective in the planning and building stage of a pipeline so that the greatest potential for the risk reduction consists in this stage.
Since a complete leakage exclusion can not be guaranteed above all on account of the potential possibility of external actions, the aspect of damage limit must be formed considerably more markedly compared to other plant models. The protective level consists of the leakage recognition and location as well as a pipeline route differentiated discharge limit. Further all measures of danger warning are to be assigned to the protective level.
Universal guiding principles for organization of the safety protective system could be derived by the reliability logic connection of the individual levels for pipeline plants. The equivalence of the passive safety and of the level of the safety exclusion measures as well as the special necessity of a differentiated damage limit essentially is included.
The evaluation and arrangement of the individual security measures led to the result, that with the present state of the technical evolution the potential for increase of safety level fewer are

in the field of static (passive) safety but in the case of the dynamic (active) security systems where the furnishings for avoidance of non-permissible pressure impact stress are the with regard to safety relevant systems. The investigation of these safety systems is allowed by the application of reliability methods. Starting from the typical reliability logical structure of the safety systems of pipeline plants, the specific redundancies technical influence could be determined. It was proved, that the effectiveness and the necessity of the redundant organization of local safety systems increases with its number and therefore equivalent for the linear extension of pipeline plants, however it is a redundancy degree more largely as two not required normally with regard to safety.
These simplified model approaches were not sufficient in order to be able to consider the complex influences on the safety system so that the model ideas were had to be extended for the deepening investigations. The developed reliability model includes both the particular system structure and the inspection strategy, the rate of demand and the failure behaviour of the safety system. The valuation basis represents the characteristic Qs. It was found that shortening the testing range is suitable in order to be able to guarantee the reliability of the safety system where boundaries are set by economical limiting conditions of this strategy. For an optimal inspection planning, the rate of demand of the safety system is to be considered in addition to reliability of the individual elements also. The period between two functional tests must be abridged the more unreliable the single elements are and the smaller the rate of demand of the safety system is. Concrete reliability analyses were carried out at the security system for avoidance of non-permissible pressure impact stress. In this way, the possibility was managed to be able to carry out reliability investigations at pipeline plants to concrete safety systems, with the aim, to optimize the technical organization and mode of operation by inclusion of economic limiting conditions.
The supplementary chapter 7 was elaborates from the viewpoint of the practical application the risk- and reliability analyses and includes the conception to the recording and appropriation of the required information and of data where the emphasis is controlled while structuring the data.
Open problems are summarized in a packed manner at the following

1. Computational transfer of the risk and reliability analysis as well as of the data concept for overcoming of information capacity with the destination, conditions changing at short notice to itself react and to be able to carry out the appraisal of their safety relevancy.
2. Inclusion of suitable propagation models of fluid and gaseous medias in grounds for the estimate of the effects of leakage of burial pipelines.
3. Appropriation of sufficiently precise reliability characteristics.

Furthermore, it will be required, to complement the considerations for the dimensioning, the safety organization and mode of operation as well as the models for the reliability evaluation through further economic characteristics.