

KAS

**Commission on
Process Safety**

at the Federal Ministry for the Environment, Nature Conservation
and Nuclear Safety

**KAS recommendations on advancing the
safety culture –**

Lessons learnt from Texas City 2005

Report by the working party on "Texas City"

KAS-7

**Commission on Process Safety
(KAS)**

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adopted by the KAS on 27 October 2008

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The Commission on Process Safety (KAS) was set up by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety pursuant to § 51 a of the Federal Immission Control Act (Bundes-Immissionsschutzgesetz).

Its offices are located at GFI Umwelt - Gesellschaft für Infrastruktur und Umwelt mbH (GFI Umwelt) in Bonn.

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A Preamble

On 23 March 2005, a major accident occurred at the BP Refinery in Texas City, USA, which left 15 people dead, more than 180 people injured, and caused material damages of around US \$ 1.5 billion. This major accident, with its catastrophic effects, prompted a number of comprehensive studies [1, 2, 3], the results of which are now available. The conclusions and recommendations of these reports go beyond the direct causes of this specific event, and have general relevance for improving process safety and preventing major accidents.

The working party on "Texas City" evaluated the Baker Report [1] to ascertain whether the individual findings in the study results and the recommendations derived from it offer us any new, general findings for the advancement of process safety (note: not confined to refineries). The working party on "Texas City" has devised recommendations on individual areas with the aim of ensuring sustained safety management within companies. The representation of individual areas in this report is largely consistent with the approach used by the Baker Report, whereby recommendation no. 10, "Industry Leader", which is aimed specifically at BP, is not relevant for our purposes.

In today's globally interlinked industrial society, safety concerns are of increasingly vital importance. As the global and local integration of industry and society grows, so too does their vulnerability.

Historically speaking, "process safety" began with the development of "safety technology". Operating experiences accumulated over the course of many years and incidents indicate that it is not enough to cite technical failure as the only cause; instead, accidents (such as Seveso, Bhopal, Longford, Texas City, Buncefield) are also attributable to the failure of organizations or individuals ("human factors"). As a result, process safety now focuses increasingly on the organisation ("safety organisation" and "safety management systems") and the "human factor".

Efforts today focus on successfully structuring the complex interactions between technology, organisation and humans in the interests of process safety. In a positive safety culture, humans are viewed not as the ultimate sources of errors, but rather as responsible shapers and users of the targeted interaction between

technology and organization. What is more, humans can also function as a last-resort safety reserve or "*ultima ratio*", which continues to be available even when all other safety devices have failed.

Viewed superficially and in the short term, one could argue that economics and process safety are a contradiction in terms. This view is supported by the fact that while the costs arising in conjunction with process safety measures are known, the monetary benefits of any incident that such measures may have prevented from occurring are difficult to quantify. A company's short-term goals (to produce marketable-quality products cost-effectively, on time and without incident), combined with its longer-term goals, should ensure that process safety is afforded appropriate status in the minds of the company management and employees. More serious incidents and major accidents are rare, but can cause immense damage to the company and threaten its long-term goals or even its very existence. Efforts to maintain and develop awareness of the need for high standards of process safety are therefore worthwhile.

In a positive corporate safety culture, this awareness of the high status afforded to process safety is an integral part of an holistically-minded organisation in which economic success and safe operation of the facility are valued equally.

The KAS views the consistent implementation of the requirements of a safety management system as **one** indication of a positive safety culture, with particular consideration for process safety. The KAS believes that a positive safety culture is pivotal to improving Germany's process safety record, which already ranks highly by international comparison.

Such aspects as process safety, plant safety, product safety etc. should be combined with basic principles of a positive safety culture. In this connection, we can draw on the tried-and-tested provisions and recommendations e.g. of the OECD programmes (Guiding Principles [4]), EU (Reach [5] and GHS [6]) and the initiatives by the chemicals industry (Responsible Care [7], Product Stewardship [8]). In particular, all stages in the lifecycle of hazardous substances fall under the competency of the KAS.

In this report, the KAS highlights ways of achieving the aim of a positive safety culture with a special emphasis on process safety.

B Introduction

High standards of process safety can only be achieved and permanently maintained through the systematically planned interaction between technology, organisation and humans. The KAS believes that companies must practise a positive safety culture which values process safety equally with all other corporate objectives, or in case of doubt, considers it a priority over other corporate objectives, and must maintain this principle in all circumstances.

A clear obligation on the part of the company management for process safety is considered a vital pre-requisite for process safety throughout a facility's entire lifecycle. If the company management is comprised of several individuals, responsibility for process safety should be concentrated on one individual [cf. also § 52 a of the Federal Immission Control Act (BImSchG)]. This "responsible individual" must develop an effective safety organisation by providing the necessary resources. To this end, it is particularly important to ensure the following:

- All corporate processes relevant for safety and environmental protection should be covered by a comprehensive, company-wide management system.
- This includes establishing a structured and systematic "process safety process", and improving this continuously or as and when necessary.
- It is vital to ensure that all internal and external participants (competent authorities, experts etc.) contribute to the achievement and maintenance of process safety throughout a facility's entire service life.

In this regard, it is important to note that the "process safety process" is never complete, but instead requires a constant input of resources and commitment to ensure the on-going improvement of process and plant safety throughout all phases of the facility's lifecycle.

In this process, every individual is part of the whole, and in order to develop a positive safety culture which provides framework for risk-appropriate working, **EVERYONE** must make the issue of process safety their own.

C Safety culture¹

The KAS feels it is necessary to reinforce safety-conscious behaviour in the face of accelerated technological development and increasingly complex systems. The KAS firmly believes in enhancing safety and developing a sustainable safety culture. Studies have established a correlation between the safety performance of individual organisations and the safety culture in identical legal or regulatory situations [9].

The KAS believes that a safety culture can be seen as part of a corporate or organisational culture which reflects the aspect of safety in the standards, values, attitudes and conduct of its employees. According to [10], a safety culture is *"a fundamental attitude of safety-consciousness at all levels of the hierarchy. All members of the company should be aware of their responsibility for safety and should have the ability, resources and competency to accept this responsibility. The safety culture is comprised of two main components:*

- *The first concerns the overarching responsibility of management to formulate and consistently implement a safety-oriented corporate philosophy, to create a suitable organisational structure, and to make available the necessary personnel and technical resources (cf. chapter D.1).*
- *The second component comprises the attitudes and behaviour of personnel at all levels of the hierarchy and the communication between them". (cf. chapters D.2 & 3)*

¹ The comments reproduced here and in Appendix 2 on the topic of "safety culture" are based on an opinion developed on behalf of the working party on "Texas City" by the working party on "Human Factors" at KAS.

Another distinguishing feature of a positive safety culture is that companies exceed compliance with legal requirements and regulations where necessary. Such companies also take into account the findings, evaluations and requirements of external stakeholders. This necessitates frank bi-directional dialogue with the competent authorities, affected neighbours and the general public, and actively addressing their demands with regard to the transmission of information, involvement in decision-making, and safety.

The KAS feels it is essential for companies with a high risk potential to have a well-developed, pervasive safety culture. Under these conditions, the development, maintenance and advancement of an effective safety management system can be optimised, and consistent process safety guaranteed, to optimum effect.

Above and beyond these general remarks, the following stages may help to promote the development of a pervasive safety culture:

- Every company should include guidelines on the safety culture in its corporate policies, elucidating precisely what constitutes acceptable and unacceptable conduct.
- In principle, it is desirable for companies to review their safety culture at regular intervals and identify potential areas for improvement and modifications. First of all, however, it is necessary to develop and distribute appropriate, practical information and criteria enabling the companies to evaluate their own safety culture themselves, and to develop and improve the quality thereof.
- A positive safety culture is also distinguished by the fact that it places certain requirements on the attitudes and conduct of the company's external partners to ensure a high level of process safety. Such external partners include the licensing and supervisory authorities, third-party expert organisations, manufacturers, suppliers and service-providers.
- Within the framework of inspections by the competent authorities pursuant to § 16 of the Major Accidents Ordinance (Störfall-Verordnung), the authorities should take safety culture aspects into account.

- Every company should implement an in-house reporting system for incidents².
- A positive safety culture also includes open communication with the neighbourhood, environmental organisations and the general public.

For further comments on the safety culture, please refer to *Appendix 2*.

D Recommendations on individual areas

D.1 Process safety leadership

Compliance with the legal requirements is an essential, but possibly inadequate, pre-requisite for ensuring high levels of process safety within the context of a positive safety culture. The KAS firmly believes that clear prioritisation of the issue by the company management is a decisive factor in this connection. The perception of such prioritisation by the workforce is pivotal to the implementation of corresponding regulations at an operational level.

The KAS urges company management to demonstrate credible commitment to the high importance of process safety.

Such commitment could be demonstrated, for example, by the following measures:

- A clear commitment by top management (Board/Directors and Supervisory Board) to process safety as a corporate objective which is valued equally with other objectives but which takes priority over other objectives in case of doubt, for example in the corporate policy, annual financial report, reports on environmental protection and safety, sustainability, and corporate social responsibility, where possible using suitable performance indicators (cf. chapter D.5).

² For guidance and tools, please refer to the "Recommendations for internal reporting systems" (KAS-8) developed by the KAS working party on "Human Factors".

- The creation/appointment of a specialist position reporting directly to and advising the company management (e.g. Head of Process Safety, (Group) Major Accidents Officer). In particular, this person shall support the Board of Management and the Supervisory Board in their supervisory role and in the implementation of the requirements listed below.
- Ensuring regular reviews of the effectiveness and performance of the safety management system as genuine management reviews (cf. chapter D.7). Implementation by the Head of Process Safety or by an external organisation (the latter being the preferred option for acceptance reasons).
- Regular, recorded discussion of the results of this review by the company management and Supervisory Board.
- Continuous and visible commitment of the company management, Supervisory Board and senior executives e.g. by specifically addressing process safety issues at public corporate events held by the company management (management meetings, workforce assemblies etc.) and by considering process safety during site visits (particularly in the course of site inspections). Incorporation of process safety elements into the (annual) goal setting procedures.
- Definition of responsibilities and expectations of the individual levels of the organisation. These should be formulated as specifically as possible, and should refer to the existing evaluation systems, contracts etc. For example, key points would include the role model function of management; the high priority afforded to process safety; the fact that deviations will not be tolerated; the allocation of appropriate resources (personnel, funding) depending on requirements; the fact that compliance with legal requirements and the safety management system as defined in Annex III to the Major Accidents Ordinance (Störfall-Verordnung) or comparable in-house regulations is compulsory; and ensuring the on-going improvement of process safety, particularly by means of suitable reviews of effectiveness (performance, e.g. trend-spotting, improving weaknesses).

- Ensuring and participating in open communication within the company on process safety issues (culture of trust). In particular, incidents and near misses are seen as an opportunity for improvement, logged and reported, analysed appropriately, and the lessons learned from them are communicated.
- Specification of individual criteria to evaluate personal achievements relating to process safety, based on the respective task area ("Which factors can be influenced?"). Differentiation of the consequences (financial incentives, in-house comparisons) with regard to task area and hierarchy level.
- Compulsory and comprehensible consideration of process safety in all major decisions e.g. acquisitions (M&A), integration of purchased companies; investments; personnel decisions (in particular, ensuring continuity/know-how/experience).

D.2 Process safety management

In order to achieve a positive safety culture with particular regard for process safety, the KAS believes that company-specific procedures and competencies should be set out in a management system. In establishments falling under the Major Accidents Ordinance (Störfall-Verordnung), this can usually be effectively ensured by means of a safety management system (SMS) as defined in Annex III of this regulation.

The SMS regulates a systematic approach which ensures that process risks are identified and minimised accordingly. The required documentation takes the form of safety discussions, the plant-specific safety concept, and safety reports, for example. The relevant legal regulations and provisions provide the requisite framework. Additionally, we would refer you to the Guidance published by the Major Accidents Commission [11, 12, 13].

Management systems should outline the principal procedures clearly and consistently, but should also be usable in practice.

D.3 Process safety knowledge and expertise

The KAS believes that above-average training standards and up-to-date expert knowledge among the operating staff, specialists and managers regarding the processes and plant, including proper awareness of the potential hazards they are dealing with, are indispensable and fundamental pre-requisites for the effective implementation of internal and external procedures and the embodiment of a positive safety culture.

Extensive educational and vocational training systems exist for this purpose in Germany. They need to be further developed, particularly in the area of process and plant safety.

University training

- The KAS believes that as a result of the widespread introduction of Bachelor's and Master's degrees and the associated shorter study periods, we must not allow the curriculum to be reduced at the expense of "add-on subjects" such as process safety. Otherwise we can expect a weakening in safety technology standards in the medium to long-term, since the necessary expert knowledge will then no longer be available on an adequate scale.
- Consideration must be given to safety technology aspects in the respective processes throughout every phase in the substance lifecycle. The long-term protection and development of the curriculum not only requires appropriate allocation and planning of personnel by the educational establishments, but also corresponding research activities. Furthermore, the vital aspect of practical relevance must not be neglected, with due regard for the basic principles outlined in this document for achieving a positive safety culture.^{3,4}

³ Cf. also the corresponding policy document by DECHEMA [14].

⁴ The KAS Incident Evaluation Committee (AS-ER) is involved in implementation proposals to promote education.

Appointments and changes to positions

- The KAS firmly believes that the duties and responsibilities of employees or positions with regard to process safety must be defined in job descriptions or within the framework of the management system. These requirements should be taken into account when making appointments.
- If positions are altered or reduced, adequate process safety standards must still be ensured.

In-house education and training

- Instruction and training courses in company-specific hazards and emergency measures must constitute part of the induction and on-the-job training of new employees in the facilities.
- The requisite standard of knowledge for employees at all hierarchical levels with regard to environmental protection and safety regulations should be defined and guaranteed by means of training plans/advanced training programmes.
- Depending on the company-specific hazard potential, all training courses should ensure a good balance between occupational health and safety, environmental protection, and process safety issues.
- In the event of changes to positions, measures must be taken to ensure that process safety knowledge and expertise is maintained in the facilities.

Personnel from external companies and contractors⁵

- When using external companies/contractors, the required qualifications and conduct in relation to process safety must be defined and taken into account in the selection process.

⁵ In this regard, the provisions outlined in § 8 of the Occupational Health and Safety Act (Arbeitsschutzgesetz) and § 17 of the Hazardous Substances Ordinance (Gefahrstoffverordnung) should be observed.

- Before commencing work, contractors, external companies and leased labourers must be instructed in the company-specific hazards and regulations.
- Suitable systems must be in place to control compliance with the safety regulations by external companies.

D.4 Support for line management

The KAS firmly believes that as well as having access to adequate time and financial resources, those responsible also need suitable expert support in order to be able to meet their process safety responsibilities (cf. chapter D.1).

The law calls for the appointment of a Major Accidents Officer (§ 58a of the Federal Immission Control Act (BImSchG)). Other supporting roles may include experts in explosion protection, chemical safety technology etc., as well as technical specialists for carrying out and monitoring repairs. For such supporting roles, and where applicable in order to prevent organisational culpability, the following aspects should be taken into account (examples):

- Adequate availability of specialist staff, with due regard for risk potential and complexity, and of resources in the line management ("the leaner the line management, the more important the supporting roles").
- Adequate positioning in the hierarchy
- Professional independence (required by law for Major Accidents Officers).
- If conflicts of interest with a simultaneous operating role cannot be avoided, they should be controlled by means of suitable measures.
- Appropriate involvement in all processes relevant to process safety (e.g. change management).

- Continuous, trust-based contact with expert colleagues at other companies, authorities, professional organisations etc.
- Over-arching coordination of the specialist roles (e.g. by the Head of Process Safety, Group Major Accidents Officer or similar), also to ensure and maintain the required level of specialist expertise (staff selection, personnel planning, advanced training), exchange of experiences (e.g. regular in-house specialist conferences) and quality assurance.

External support is also possible, and in the case of small and medium-sized enterprises (SMEs) this is often a vital solution.

D.5 Measurement and learning

The KAS considers "measurement and learning" to be important steps and tools for safeguarding and improving the high standard of process safety in Germany.

"Measurement" refers to the measurement of process safety, both retrospectively ("lagging indicators") and pro-actively ("leading indicators"). It is particularly important to note that such performance indicators are not confined to technical plant-related aspects, but must also include safety management and the human/machine interface. In order for the indicators to be as meaningful as possible, they should be simply and clearly determined, and should lend themselves to comparison both internally and, where possible, externally.

It would be desirable to obtain a system of indicators similar to that used for occupational health and safety, where international comparability has now been largely achieved. The KAS believes such an holistic approach to be extremely promising. However, it is important to bear in mind that work-related accidents are much easier to define than plant safety incidents.

The KAS advises all companies to prepare and develop such a system of internal process safety performance indicators, taking international developments into account.

"Learning" refers to incorporating the lessons learned (both internally and by others) into one's own company in a suitable manner, and using them to improve process safety.

To this end, the KAS advises every company to introduce an open reporting culture, to systematically record and analyse all relevant in-house incidents, and to maintain a systematic process for implementing the resultant findings. The KAS also recommends that external incidents should also be incorporated into the framework of this systematic process.

External communication of the findings of operational experiences and incidents is indicative of a positive safety culture, and is explicitly supported by the KAS (Incident Evaluation Committee). A wide range of information on recent incidents relating to process safety is available from the Internet. The KAS advises companies to draw on these sources [15] as well as incorporating their own experiences into the systems.

D.6 Process safety auditing

The KAS believes that auditing the safety management system is a fundamentally important aspect of management. It offers verification that an effective safety management system is in place, and is suitable for achieving the objectives specified in the safety policy. The audit provides independent verification of existing deficits and recommendations for their rectification. For this reason, the KAS believes that every company should establish a suitable audit system (cf. Annex III of the Major Accidents Ordinance (Störfall-Verordnung)).

The KAS believes that the effective performance of an audit requires the full backing of top management, and therefore contributes to a positive safety culture within the company (management commitment).

Recommendations derived from the audit should be implemented consistently and within a reasonable period of time. Organisational duties include the definition of responsibilities for initiating audits and implementing the proposed remedial action.

For further remarks on the audit, cf. *Appendix 3*.

D.7 Regular evaluation (Management Review)

The KAS considers the comprehensive, systematic review and evaluation of the effectiveness of the safety management system (management review) by the company management to be a vitally important aspect.

The management review should evaluate the safety management system as a whole with regard to its performance capabilities (structural and procedural organisation), measured against the targets set by the company. In companies with a high risk potential, the KAS considers an evaluation of employees' personal and professional competency at all hierarchical levels to be an additional, important component of the management review.

Evaluation of the management review is an original duty of top management ("Board Monitoring", cf. chapter D.1.).

For further remarks on the Management Review, cf. *Appendix 4*.

D.8 Process safety as a government monitoring task

External influences, e.g. from the neighbourhood, citizens' initiatives, nature and environmental conservation organisations, are important for maintaining awareness of the importance of process safety. Independently of this, a special role is also played by the supervisory authorities.

Administrative control over the operation of industrial facilities is exercised in the form of numerous laws, ordinances and technical rules. Experiences of enforcing the relevant ordinances indicate that the comprehensive observance of such provisions cannot be guaranteed without efficient government monitoring.

Authorities are bound by narrowly defined legal provisions that determine their framework for action. In order to ensure that adequate consideration is given to process safety by the authorities, the following requirements must be met:

- Provision of adequate technical, financial and time resources
- Use of qualified personnel
- Adequate personnel for both licensing and monitoring.
- Structuring of the organisational arrangements (e.g. allocation of responsibilities among federal, regional and local government) in a way that minimises conflicts of interests.
- Maintenance of expert knowledge within the environmental administration (e.g. specialist offices within the relevant authority).

The administrative structures of the Federal *Länder* and local authorities must ensure that these requirements are met. Particular consideration should be given to this aspect when reforming administrative structures, and appropriate reviews should be carried out in case of any recent reforms of administrative structures.

When deploying authority personnel, consideration should be given to the particular requirements of process safety. Staff should have a university degree or equivalent qualification, generally in a technical field or in one of the natural sciences, possibly with an additional qualification such as psychology.

With regard to the experience required, the alternating assignment of personnel to different specialist tasks for short periods is not expedient.

Care must be taken to ensure that monitoring personnel have adequate practical experience, which should be encouraged by frequent on-site assignments wherever possible. Participation in regular advanced training events addressing the key aspects of process safety is essential for ensuring an adequate level of expertise.

Appendix 1: Mandate

At its meeting on 11-12 June 2007, the KAS mandated an ad hoc working party (ad-hoc-AG-TC) on Texas City to draft a working proposal for the KAS's November meeting, examining aspects of the aforementioned reports in greater detail and outlining the required organisational format in the KAS.

The ad-hoc-AG-TC discussed the facts at its meeting on 27 September 2007, and on the basis of the aforementioned reports, recommended the preparation of a KAS policy document on the topics and recommendations cited therein.

The working party to be formed will draft a summary of the recommendations, evaluate them vis-à-vis their relevance for improving process safety and preventing major accidents in Germany, and on this basis, will derive the KAS's recommendations and the policies for the relevant political and social aspects identified, particularly for industry, administration and training.

The aims of this work also include the drafting of recommendations for a KAS policy on the implementation and monitoring of an efficient, comprehensive, practical safety culture. The creation of a working party is recommended, as closed handling of this issue is considered important. As aspects of this topic also intersect with the work of the AK-MF (working party on Human Factors) and AS-ER (Incident Evaluation Committee), close collaboration with these other KAS work units is recommended in the form of personal links.

This recommendation was followed up at the 7th KAS meeting on 5/6 November 2007, and a working party on Texas City (AK-TC) was created.

Appendix 2: Safety culture⁶

The safety culture is based on the following pillars: standards, values and attitudes; safety awareness of all employees; commitment at all levels; and competence.

Standards, values and attitudes

The practised values, attitudes, moral principles and standards of acceptable behaviour constitute a key pillar of any safety culture. These aim to maintain a self-disciplined approach in order to enhance safety beyond legal and regulatory requirements. In particular, this includes the conviction that all accidents are avoidable. The practised standards, values and attitudes inherent in the thoughts and actions of all individuals at all levels of an organisation are particularly relevant here.

Awareness

Sustained safety awareness must be practised at all hierarchical levels of a company with regard to the company-specific, safety-critical technical systems, procedures / applications and management systems.

Commitment

The development, introduction and maintenance of a sustained safety culture necessitates a commitment on the part of top management to identify with and commit to the specified safety-related targets and to make the necessary technical and personnel resources available. This also includes using their powers of persuasion and building trust in relationships with employees at other levels of the hierarchy. Only under these conditions will the entire workforce, at both management and operational level, be able to commit to achieving the company's safety-related targets in their respective areas of responsibility.

Competence

Employees at all hierarchical levels must possess the necessary competence, i.e. qualifications, experience, professional and personal skills (attitudes and conduct), in order to meet duties assigned to them. This also includes recognising their own limitations (not overestimating themselves) and any potential gaps in their qualifications and relevant experience.

⁶ See comments by the AK-MF, loc cit.

Appendix 3: Notes on the audit

The following aspects should be taken into account during the organisation and performance of audits:

- Compilation of the audit team

Appointment of the audit leader and responsibilities

- o The audit leader must have suitable qualifications and experience with regard to the processes being audited.
- o He/she assembles the audit team
- o He/she prepares the audit plan
- o He/she prepares the work documents (check lists, forms for documenting the audit findings and conclusions/recommended remedial action)
- o He/she is responsible for preparing and submitting the audit report
- o He/she shall represent the audit team (reporting rights) to the top management of the company/site or main administration/company management, depending on the corporate structure.

The company being audited shall determine the scope, depth and frequency of audits.

- Audit scope and depth

- o System audit (examines the safety management system, structural and procedural organisation)
- o Compliance audit (review of compliance with licensing notice/conditions, with technical regulations, company standards, documented procedures etc.)
- o Process audit (considers individual processes, e.g. risk analysis, operation monitoring, maintenance and repairs, change management, notification of major accidents and near misses, training and education measures, documentation)

- Audit frequency

The audit frequency is determined by the company management:

- o Together, the audit frequency, scope and depth determine the audit intensity. These parameters should be determined with due regard for the company-specific conditions, in such a way that the overarching audit objectives can also be achieved.

- o Follow-up audits depending on the relevance of the audit findings / recommendations

The results of the audit (recommended remedial action) must be incorporated into the new annual plan.

For further comments on comprehensive plant monitoring, cf. also TAA Guide [16].

Appendix 4: Notes on the management review

Monitoring/control of the safety management system to evaluate compliance with the targets defined in the company's safety policy is the responsibility of top management. Control/monitoring is achieved by the Management Review. The Management Review is performed at regular intervals, once a year, or in the event of an incident necessitating extensive change processes within the company. It is carried out by an independent body within the company on behalf of top management. The Management Review evaluates the safety management system as a whole with regard to its performance capabilities (structural and procedural organisation), measured against the targets set by the company (key performance indicators, KPIs).

Unlike an audit, which determines and evaluates the current status, a management review analyses events retrospectively, with the aim of deriving safety-related improvements for operations and processes. The management review is also used to monitor and control implementation of the recommended solutions derived from the audit findings.

Carrying out an audit, and the audit findings with the recommended remedial action, is just the first step in improving the safety management system and process safety. The subsequent step, i.e. implementing the recommended remedial action based on the audit findings, is crucial. If these actions are not implemented consistently across the company, the continuous improvement process will be interrupted or halted altogether. This will result in falling standards of process safety, which in turn will adversely affect the company image.

In accordance with the corporate safety policy, enforcement of the recommended improvement measures is the responsibility of top management. The necessary responsibilities must be defined (allocation of duties) and the delegation of tasks and transfer of obligations to downstream hierarchical levels (organisational duty) must be regulated according to the company's structure (national or international corporate structures). This also includes the right of mandated employees to report to top management.

Appendix 5: Sources

- [1] THE BP U.S. REFINERIES INDEPENDENT SAFETY REVIEW PANEL
(Baker Panel Report)
http://www.csb.gov/completed_investigations/docs/Baker_panel_report.pdf
- [2] U.S. CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD
INVESTIGATION REPORT REPORT NO. 2005-04-I-TX REFINERY
EXPLOSION AND FIRE (15 Killed, 180 Injured),
http://www.chemsafety.gov/index.cfm?folder=completed_investigations&page=info&INV_ID=52
- [3] FATAL ACCIDENT INVESTIGATION REPORT Isomerization Unit
Explosion
Final Report Texas City, Texas, USA (BP internal report)
- [4] <http://www2.oecd.org/guidingprinciples/>
- [5] http://echa.europa.eu/reach_en.html
- [6] http://ec.europa.eu/enterprise/reach/ghs_more_and_com_proposal_en.htm
- [7] <http://www.responsible-care.de/>
- [8] http://www.ecy.wa.gov/sustainability/Resources/prod_steward.htm
- [9] Fahlbruch, B, Meyer, I. Dubiel, J. (2008). Der Einfluss menschlicher Faktoren auf Unfälle in der verfahrenstechnischen Industrie. Forschungsbericht des UBA
- [10] Eidgenössische Kommission für die Sicherheit von Kernanlagen, KSA
Bericht No. 04-01, January 2004
- [11] SFK-GS-23.1 Leitfaden für die Darlegung eines Konzepts zur Verhinderung von Störfällen gem. § 8 in Verbindung mit Anhang III der Störfall-Verordnung 2000 für Betriebsbereiche, die den Grundpflichten der Störfall-Verordnung 2000 unterliegen, www.kas-bmu.de
- [12] SFK-GS-24.1 Leitfaden für die Darlegung eines Konzepts zur Verhinderung von Störfällen und ein Sicherheitsmanagementsystem gem. § 9 Abs. 1 Nr. 1 i. V. m. Anhang III der Störfall-Verordnung 2000, www.kas-bmu.de

- [13] SFK-GS-31 Leitfaden »Arbeitshilfe zur Integration eines Sicherheitsmanagementsystems nach Anhang III der Störfall-Verordnung 2000 in bestehende Managementsysteme« , www.kas-bmu.de
- [14] DECHEMA Stellungnahme zur Hochschulausbildung
<http://www.dechema.de/Forschungsf%C3%B6rderung-p-61834/Fachgremien/Studien+und+Positionspapiere-p-57334/Kompetenzsicherung+und+weiterentwicklung+in+der+Sicherheitstechnik-p-57340.html>
- [15] ZEMA Portal Ereignisdatenbanken www.umweltbundesamt.de/Zema
- [16] TAA-GS-11 Abschlußbericht des Arbeitskreises »Anlagenüberwachung«
Ganzheitliche Anlagenüberwachung, www.kas-bmu.de

Appendix 6: Members of the Working Party

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