KAS

COMMISSION

ON PROCESS SAFETY

at the

Federal Ministry for the

Environment, Nature Conservation and

Nuclear Safety

Committee report

Experience Reports:

Evaluation of the Reports on
Experiences Made during Safety Checks by Experts according to Article 29a of the Federal Immission Control Act (BImSchG) in 2004 / 2005

Summary

KAS-3.K

The Committee for Experience Reports (Ausschuss Erfahrungsberichte, AS-EB) of the Commission on Process Safety (Kommission für Anlagensicherheit, KAS) has the task of evaluating experience reports on safety checks carried out by experts according to Article 29a of the Federal Immission Control Act (BImSchG).

Moreover, the AS-EB performs an evaluation of activities organised for the exchange of opinions and experiences and records the participation of experts in these activities.

The administrative evaluation of experience reports from the years 2004 and 2005 carried out by the KAS head office basically records whether reports were handed in on time, whether the requirements set out in the TAA-GS-20 guidelines (as of 2001) were met regarding presentation, and whether the data submitted was complete.

The evaluation with regard to the substance of the experience reports was carried out by the members of the AS-EB. It includes in particular the following items:

- Identification of deficits which make it possible to draw general conclusions regarding deficits in plant safety
- Determination of situations which permit the identification of necessary amendments of the relevant technical rules and regulations
- Overview of the main findings / recommendations of the committee.

By the end of 2006 the KAS head office had received annual experience reports for the year 2004 from 195 (72%) and for the year 2005 from 194 (77%) of the appointed experts pursuant to Article 29a BImSchG, 118 (2004) / 100 (2005) of which handed in reports on completed safety checks. A total of 561 safety checks were performed in 2004 and 543 in 2005. In approximately half of these checks, no major deficits were detected.

The AS-EB noted that the majority of reports were suited for the evaluation and that most of them corresponded to the TAA-GS-20 guidelines (old or new version). The most common formal error made related to missing data on the expert carrying out the check, an inadequate format of reports, missing or incorrect data on the check itself, or missing or insufficient descriptions of faults or missing failure codes.

The AS-EB recommends that for the sake of clarity experts should refrain from using abbreviations in the report which might be unclear to third parties (e.g. for plant components).

Results of the evaluation

Besides chemicals installations with a total of 256 checks, the focus was on biogas plants with 115 checks, liquefied gas plants with 78 and ammonia plants with 66 checks.

No major deficits were recorded in about 50% of the safety checks carried out in chemicals installations. A total of 350 major deficits were identified in the remaining 128 checks. The areas most frequently affected were process control engineering devices, safety reports / hazard analysis, fire and explosion damage protection, design of plant components, maintenance and testing, and safety-related reaction engineering and other substance properties.

Specifically, the following shortcomings were recorded several times:

- Defects in stored programme controls (insufficient separation of process control engineering devices and safety-related devices, software problems, conditions imposed by the manufacturer were not respected)
- Lack of classification and testing of process control engineering devices
- Defects in overfill protection and temperature control
- Incomplete safety reports and hazard analyses
- Missing dispersal calculations
- Incorrect classification of safety-relevant plant components
- Insufficient inerting
- Lack of designation of ex zones
- Design of devices not corresponding to designation of ex zones
- Lack of documentation on explosion protection
- Insufficient maintenance and testing
- Problems with insulated pipework
- Insufficient pressure dimensioning of plant components
- Lack of knowledge concerning safety-relevant substance and reaction engineering properties

- Deficits regarding organisation and documentation

Since the chemicals installations evaluated vary considerably, the deficits are difficult to categorise with regard to their nature and relevance for plant safety. In contrast to more homogenous types of installations, such as biogas or liquefied gas plants, chemicals installations are difficult to classify.

Biogas installations can be licensed, inter alia, according to no. 1.2 (installations for electricity production), 1.4 (combustion systems for electricity production), 7.1 (installations for the keeping and rearing of poultry…) or 8.6 (installations for biological treatment of waste) of the Appendix to the 4th Ordinance for the implementation of the Federal Immission Control Act (4. BimSchV). Many biogas installations in Germany are not subject to licensing under the Federal Immission Control Act (BImSchG). Checks on these installations are usually not included in this report.

Significant deficits were detected in about 80% of the biogas installations checked. Most of the deficits were found in the areas of protection against gas explosions and plant component design. Other frequently detected failures related to the design of escape and rescue routes and process-related design.

The following deficits were specifically mentioned:

- Incorrect or undocumented designation of ex zones
- Mistakes in equipping the plant with explosion-proof electrical operating resources and lack of testing
- Flawed design of individual components
- Missing or inadequately positioned emergency flare
- Non-compliance with the required safety distance between gas storage and block-type thermal power station
- No consideration of explosion protection measures in the pre-processing unit
- No high-voltage protection
- Insufficient proof of ventilation
- No fire brigade plans, or lack of coordination with the competent authorities

Major recommendations of the experts were

- Better qualification of manufacturers/builders of block-type thermal power plant modules for biogas installations and
- Review of the section on explosion protection of the “Safety regulations for agricultural biogas plants”.

70% of the 78 liquefied gas plants assessed showed significant deficits. These can be summarised as follows:

- Deficient design
- Insufficient implementation of the provisions of the Major Accidents Ordinance (StörfallV) (concept for the prevention of major accidents, safety report, definition of safety relevant parts of the installation, hazard analysis and major accident scenarios)
- Inadequate performance or documentation of regular tests
- Problems with corrosion protection and defective safety devices due to a lack of repair and maintenance work
- Lack of classification, flawed design or lack of testing of safety relevant process control engineering devices (e.g. overfill protection, emergency shutdown system)
- Defects of the gas detector system
- Non-compliance with the safety distance
- Deficiencies in fire detectors, fire water supply, sprinkler systems and high-voltage protection
- Operating instructions in need of amendments or additions
- Outdated or inadequately implemented contingency plan

The 60 ammonia refrigerating installations assessed (no. 10.25 according to the Appendix to the 4th BimSchV) showed deficits predominantly in the areas of maintenance and testing, process control engineering devices, gas warning devices and contingency plans. Significant shortcomings were found in 70% of the installations assessed and can be summarised as follows:

- Lack of classification, flawed design and lack of testing of safety relevant process control engineering devices

- Deficiencies in gas warning devices, mainly incorrect trigger levels
- Lacking or outdated documentation (diagrams and plans)
- Flawed installation design, especially with regard to pressure protection and safe discharge of NH_3
- Corrosion and insulation problems and failure of individual components due to insufficient maintenance
- Inadequate execution and documentation of regular tests (e.g. of safety relevant devices)
- Outdated or inadequately implemented contingency plan
- No risk assessment according to the Operating Safety Ordinance (Betriebssicherheitsverordnung, BetrSichV)
- Insufficient instruction and training of operating staff

In both years of the evaluation period, about one fourth of the reports contained “fundamental conclusions for the improvement of plant safety”. Mostly, however, these referred to the individual plants checked. In almost all other cases in which “fundamental conclusions for the improvement of plant safety“ were mentioned, these referred to safety deficits which could have been easily avoided by consistently implementing the technical rules and regulations or other appropriate solutions.

Some of the experts’ “fundamental conclusions for the improvement of plant safety” indicate the potential need of further developing the technical rules and regulations. These comments cannot be considered directly due to the format of the experience reports and require further review and specification. They refer to:

- Considerable differences in assessment criteria and requirements laid down in regulations covering explosion protection in methane handling:
  - BGR104 (occupational accident insurance fund regulation) of 12/2002 (Annex F, Section 4.1),
  - “safety regulations for agricultural biogas plants”,
  - GUV17.4 A (statutory occupational accident insurance) “explosion protection measures… at landfill sites”.

Some “fundamental conclusions” refer to improvements in the manufacturing, erection, operation and monitoring of installations:

- Plastic aggregates located outside of buildings must be sufficiently resistant to UV radiation.

  Regular tests, in particular of welds, are necessary.

- In some installations, staff cuts lead to the overburdening of the personnel responsible for plant safety with too many tasks, so that their duties in the area of plant safety cannot be adequately carried out.

In some reports, the area of land use planning in conjunction with Article 50 BImSchG was identified as being problematic. It was pointed out that urban planning does not always sufficiently take account of hazards originating from neighbouring industrial sites:

- The authorities responsible for development planning are largely unfamiliar with the requirements resulting from Article 50 BImSchG; active communication of the problem, e.g. by the Commission on Process Safety via the Federal Ministry and the Länder Ministries for Building through to the municipalities would help to avoid future planning mistakes.

- At the time of evaluation, there were no binding criteria in the Federal Republic of Germany for the assessment of urban planning projects within the meaning of Article 50 BImSchG regarding the compatibility of projects and uses.

  The application of the model developed by the Technical Committee for Plant Safety (TAA) und the Major Accident Commission (SFK), which has now been adopted (see SFK/TAA-GS-1 report), proved helpful since is clearly shows a conflict between planned projects and existing establishments. The result corresponds to comparative assessments according to other models and practical procedures applied in neighbouring countries.

  In order to evaluate spatial planning conflicts in a coordinated way and with long-term legal certainty, uniform and practice-oriented evaluation criteria are urgently required – possibly differentiated for existing and new situations.

Findings/recommendations of the AS-EB

The following findings were derived from the evaluation of the experience reports for the years 2004 and 2005 and will be transmitted to the competent supreme immission control and occupational safety authorities of the Länder and to the German Federation of institutions for statutory accident insurance and prevention (Hauptverband der gewerblichen Berufsgenossenschaften(HVGB), now: German Statutory Accident Insurance (DGUV: Deutsche Gesetzliche Unfallversicherung). It is to be noted that these findings and recommendations are based on different numbers of mentions of the individual problems.

- For biogas plants, there were problems with the implementation of technical rules and regulations, in particular with regard to fire and explosion protection and electrical installations. The knowledge of operators, planners and builders of installations in particular in the field of explosion protection needs to be improved.

- For NH_3 refrigerating installations there were deficits in the implementation of technical rules and regulations (planning, technical arrangements, updated documentation) and the problem of insufficient or lacking acceptance tests and supporting documentation.

- Regulatory requirements regarding storage facilities were not complied with.

- Design:
  - Safety devices/components were not properly designed or were lacking.
  - The requirement of safe discharge from pressure relief devices was not implemented consistently.
  - Pressure relief devices and pressure relief areas were not sufficiently dimensioned, unsuitable or non-existent.

- Maintenance and monitoring:
  - Maintenance was insufficient.
  - The required initial or recurrent checks (also of safety relevant components and measurement and control/process control engineering devices) were not carried out regularly or not documented.

- Safety-relevant process control engineering devices:
  - The classification of or the requirements relating to safety-relevant measurement and control technologies and process control engineering devices were insufficiently observed (cf. VDI/VDE 2180).
  - Equipment with process control engineering devices was insufficient.

- Requirements relating to the development, testing and maintenance of user software for safety related stored programme controls were not complied with (cf. VDI/VDE 2180).
- Gas warning devices were lacking or inadequately designed.

- Systematic assessments:
  - Systematic hazard analyses were insufficient, incorrect or non-existent.
  - Safety relevant characteristics of substances were not determined or evaluated properly.
  - Dangers from reactions of substances were not determined properly or the protective measures taken were inadequate.
  - Storage of refuse-derived fuels, which are classified according to waste legislation, posed considerable problems for substance evaluation, since legislation on hazardous substances and waste legislation are incongruent.

- Fire and explosion protection:
  - Fire protection requirements, e.g. from constructional regulations, were not adequately observed.
  - Necessary organisational and technical measures regarding explosion protection were insufficiently implemented, or not implemented at all. Dust explosion protection is a separate problem area.

- Safety organisation / documentation:
  - Safety management or the corresponding documentation did not fulfil the requirements laid down in the Major Accidents Ordinance.
  - The safety report did not meet the pertinent requirements.
  - Process and operating instructions were incomplete, lacking, or not communicated.
  - Training of the operating personnel and instructions for staff from outside companies were insufficient.
  - Contingency plans did not fulfil the requirements laid down in the Major Accidents Ordinance, were lacking or outdated.
  - Labelling of installations with high safety relevance was missing.
  - Documentation about the installation as a basis for the safety assessment was insufficient.

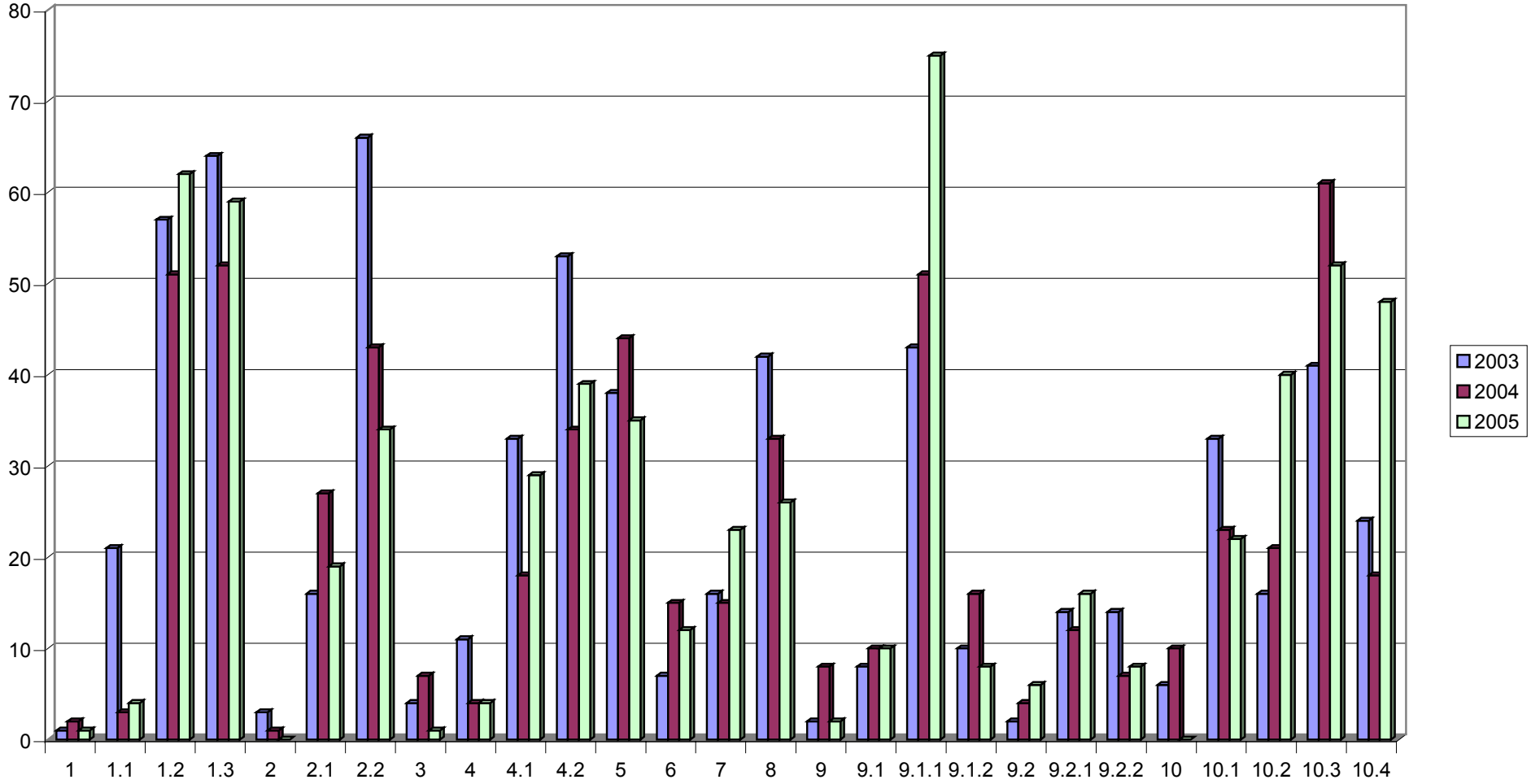
- One special case should be mentioned:
  - In one installation, there were serious divergences with regard to the planned storage facilities, e.g. from the directive on fire-fighting water retention

regarding storage volumes per storage unit, quality of fire protection measures and fire-fighting water retention. The expert concerned noted that the job was not completed *"since the necessary safety measures were not accepted by the applicant because they would have compromised the economic viability of the project".*

In summary, the main areas where shortcomings were detected (see next page) were widely the same as in the experience reports for the years 1999 to 2003, with significant deficits in the areas of explosion protection, (constructional) fire protection, process control engineering, process engineering design and organisation. In the years 2004 and 2005, inadequate testing and deficits in system analysis were further frequently noted problems.

A more detailed presentation of this information is available at www.kas-bmu.de as a PDF file.

Attribution of deficits to failure codes for the years 2003 - 2005



Failure codes pursuant to TAA-GS-20

Code	Topic
1.	**design of plants and plant parts taking into account potential strain during a disruption of normal operation**
1.1	**design and dimensioning of construction components** (earthquake resistant construction, wind loads, other loads)
1.2	**process related design** (process management, plant protection concepts)
1.3	**design of components** (design and dimensioning, materials, strain imposed by pressure, temperature, media)
2.	**quality assurance and servicing of plants, checks**
2.1	**maintenance and repair works**
2.2	**periodic inspections (start-up check and regular checks), conformity**
3.	**supply with energy and operating resources** (electricity, fuel, vapour, water, control air, others)
4.	**process control equipment, electrical engineering**
4.1	**classification according to DIN V 19 250 or VDI/VDE 2180**
4.2	**Operation of Process Control Equipment** construction/make of the safety instrumented systems
5.	**considerations concerning systems analysis** (hazard analysis, safety analysis)
6.	**chemical, physical, human-eco toxicological properties of substances and preparations** (determination and/or assessment of toxicological, chemical, physical and reaction engineering properties of substances and preparations)
7.	**impact of operation failures and incidents, identification (calculation) and assessment** (hazard scenarios)
8.	**fire protection, retention of fire-fighting water** (constructional fire protection, early detection of fire, fire-fighting measures, fire loads, retention of fire-fighting water)
9.	**in-plant explosion protection and protection against impacts from outside explosions**
9.1	**gases/vapours**
9.1.1	preventive explosion protection
9.1.2	constructional explosion protection
9.2	**dusts**
9.2.1	preventive explosion protection
9.2.2	constructional explosion protection
10.	**organisation**
10.1	**alarm and hazard prevention plans**
10.2	**escape and rescue routes**
10.3	**measures relating to the set-up of the plant**
10.4	**safety management**

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