WACKER

Directive A 07-04-04

Safety of Plants and Processes – Design and Changes

Scope

Group

Purpose	To define the group wide procedure for the development, the documentation, the update and the review of plant safety concepts and to define the roles of involved functions.
Interested party	Project coordinator (planner/engineering project manager, advisor or team leader, depending on nature of project), plant teams, safety engineers, safety experts, managers operation / plant managers, reaction safety specialists, developers/process engineers/reaction chemists.
Time frame for implementation	Immediately
Definitions	The **plants/processes** referred to in this directive are chemical or process engineering systems that are used to manufacture, treat and apply substances, including those areas involved in the storing, filling, and transferring of substances, raw materials, intermediates and end products. This also includes the manufacture and distribution of supply media (utilities) as well as facilities for generating energy and all disposal or wastewater treatment plants **Processes**, as referred to in this directive, include ▪ Industrial processes such as flow, conveying and pumping ▪ Heat transfer processes, including vaporization and condensation ▪ Mass transfer systems and thermal process steps such as distillation, rectification, extraction, absorption, desorption and adsorption ▪ Thermodynamic processes such as gas liquefaction and refrigeration ▪ Mechanical processes such as crushing, pulverizing, and sifting/sieving of solid materials Other chemical process steps that deal mostly or only with the conversion and reaction of natural materials or the production of synthetic ones **This directive does not affect:** a) Small systems the size of laboratories and engineering workshops (if there is any doubt whether a particular system is covered by this directive, the laboratory or workshop manager will decide) b) Single package units not coupled to plant interlocks. These include air conditioners and air compressors Machines and equipment (apply local regulations, guidelines and directives)

The contents of this document apply to all gender alike even if gender-specific words (e.g. "he" or "she") are used for simplification.

Approved by:	Issued/Compiled by:	Version:
Auguste Willems, Executive Board	Christian Herbst, WB-S-AN	2022-01 supersedes version: 2017-08

Definitions	**Projects**, as referred to in this directive, are non-recurring development plans associated with new plant construction, for which an engineering project manager is assigned. These consist of activities coordinated within a defined calendar period expressly for the purpose of a new plant construction or implementing plant/process changes. The **design phase** is the time period until a plant starts up or a plant process change is implemented. The **operational phase** is the time period from once a plant has started up or a plant process change has been implemented. **Plant (system) changes are:** ▪ Modifications to equipment (new installation, removal and/or alterations to equipment, machines, facilities, valves, fittings) ▪ Changes in substances / processed chemicals (chemical, physical, safety data, blends/mixtures), change of GHS-classifications ▪ Process engineering/technology changes that affect parameters or specification data such as pressure, temperature, mass and volume flows, concentrations, etc.) ▪ Operational changes (step sequence, time frame, individual monitoring and control methods, supervision, dual verification, formulations) Direct, one-to-one replacement of plant parts (“Replacement by kind”) does not constitute a modification/change as defined in this directive. **Plant management team:** The Plant Management Team is defined by this directive to include the production/operations/plant manager, the process engineering manager, the I & C plant engineering manager and the reaction chemist. Overall organizational responsibility lies with the operation manager (delegated employer duties).

Search Keys: Safety concept, Safety review, Plausibility check, Wacker-Analysis, Management of change (MOC), Risk graph

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1 Principles

This directive defines the group wide procedure for the development, the documentation, the update and the review of plant safety concepts as well as the roles of involved functions. In conjunction with directive A07-04-03 Assurance of Chemical Safety and A07-04-01 Avoidance of Explosion Hazards, A07-04-04 forms a group-wide basic framework for ensuring process safety in all plants.

2 Procedural description and important points

2.1 Always comply with national, regional and/or local laws; Group regulations represent the minimum standard

- All local legislation and regulations (e.g. the German Hazardous Incident Ordinance, valid Chinese or US laws and regulations, etc.) must be fully complied with at all times. When local law or regulation is more stringent than this Group directive, the local requirements are to be observed.

  Should this Group directive surpass the requirements defined by local law, it defines the minimum standard of compliance and has to be applied.

2.2 Every chemical reaction must be assessed for safety

This section describes only the most important requirements. For further details see directive A 07-04-03 “Assurance of Chemical Safety”.

2.2.1 Reaction chemist

- The business division/corporate department/business unit/supply chain ensures that a reaction safety specialist is named for each plant as expert for chemical safety. The reaction chemist is responsible for evaluating chemical reactions and integrates the group function chemical safety in accordance with A07-04-03.

2.2.2 The engineering project manager (in the design phase)

- collects the chemical safety data by analysis or a literature search, e.g.
  - Reaction data (e.g. heat of reaction, rate of temperature increase, etc.)
  - Thermal stability of the material (e.g. onset temperature for self-decomposition, etc.)
  - Plant data (e.g. rate of heat removal from cooling system, max. temperature, etc.)
  - Cross reactivity matrix (which is prepared by the reaction chemist).

2.2.3 Corporate Chemical Safety

- assesses chemical safety by investigating the potential for:
  - Explosions (e.g. run-away reaction etc.)
  - Thermal hazards
  - Pressure hazards

2.3 Systematic safety assessment for every plant

2.3.1 The engineering project manager (in the design phase) and the plant management team (operational phase) ensure that

- A systematic safety assessment is carried out at all plants and for all processes that fall within their area of responsibility and must be kept up to date.
- The following tools are to be used to ensure the systematic safety assessment requirements are satisfied:
  - Plausibility check
  - WACKER analysis
  - Risk graph
  - Explosion protection document (➔ for details see A-07-04-01 “Avoidance of Explosion Hazards” and
    A 07-04-01 WGER).

For a guideline for preparation of systematic safety assessments and example documents see GLOBE (Link):

https://globe.wacker.com/sites/wl-bgh-site-management-burghausen/safety-burghausen/servicecatalog/25628/plant and process safety

Should any projects or changes affect the operations of neighboring plants from other support areas, joint meetings are to be held with representatives from these areas to ensure that any potential impacts are addressed.

WACKER Analysis

- The plant management team or engineering project manager will conduct a WACKER analysis if
  a) safety-relevant system components (SRC) exist according to the criteria listed in Supplement A 07-04-04 Suppl.1
     - Threshold amount of hazardous substances as outlined in Supplement A 07-04-04 Suppl.2 is exceeded
     - Exothermic potential exists
     - Large mass with high temperature exists
     - Pressurized gases exist
     - Special safety-relevant equipment such as scrubbers, flares etc. exist
  b) unresolved issues have been identified during the plausibility check (i.e. “safety concepts not plausible” ➔ see plausibility check).
- If an SRC is identified via criteria in Supplement A 07-04-04 Suppl.1, then the WACKER analysis must at least cover the following:
  - SRC
  - All equipment, heat exchangers, piping, pumps, valves, fans, tanks, instrumentation, apparatus etc.
    - x which is connected to the SRC under normal operation / process conditions
    - x belonging to the same pressure system as SRC
    - x sharing the same pressure-relief system such as safety valves, rupture disks or other pressure-relief safeguarding system.
- Use the outline provided in form WF AS1065B for the WACKER analysis (see Normmaster or Docunize).
- The Safety department at each site informs the Group safety coordinator if local regulations additionally require performing a detailed process risk analysis for lower chemical threshold amounts than listed in Supplement A 07-04-04 Suppl.2.

Plausibility check

- The plausibility check is suitable for those plants and processes that:
  - Are in the early design phase (e.g. pre-basic engineering), in order to evaluate safety strategies at an early stage of the project.
  - Pose little danger. The risk of danger can be considered little when none of the criteria listed in Supplement A 07-04-04 Suppl.1 apply.
- The analysis team (see section 4.4) can decide if the plausibility check may be skipped and replaced by a direct WACKER analysis.
- Use form WF AS1460 for the plausibility check (see Normmaster or Docunize).
- In special cases, for a plant without discernible risk, the plant management team or engineering project manager in coordination with the safety engineer can decide whether no systematic safety assessment is required. The decision has to be documented and justified in writing

Risk graph

- If hazards with significant impact (fire, explosion, substance release, injury) are identified during a WACKER-Analysis, as a general rule they may not be mitigated by organizational measures alone.

- If I & C equipment is to be installed for controlling identified safety hazards*, it should be classified according to its safety integrity level (SIL) using the risk graph form WF AS1075 (see Normmaster or Docunize), and designed and maintained accordingly. The contents of Wacker standard WN 08-26-01 for design, operation and testing have to be observed.

* safety instrumented systems as per IEC 61511-3 "Functional safety - Safety instrumented systems for the process industry sector – Part 3: Guidance for the determination of the required safety integrity levels"

2.3.2 The plant management team sees to it that:

- The WACKER analysis for SRCs and the related documents (e.g. AS1075) , irrespective of the ongoing changes of the MOC process, is revalidated every 5 years to ensure they are current and accurate. If local regulations require more frequent review, local regulations should be followed.
- The insights gained from incidents, plant internal, at Wacker (provided by safety engineers) or in the chemical industry (provided by safety engineers) as well as new safety-related findings are considered in the analysis.
- If someone new joins the plant management team, the main points of the current systematic safety assessment are explained to the new employee as part of the training plan.

2.4 Qualified analysis team for carrying out the systematic safety assessment

The analysis team is comprised of at least the following:

- Manager production / plant manager (if the plant is in operation or as soon as he/she is named for the future operation in the design phase) or designee*
- Reaction chemist as needed
- Process engineering manager and / or Process engineer* (and/or project engineer and / or project manager during the design phase)
- I&C engineering manager and / or I&C engineer* (and/or I&C project engineer and / or I&C project manager in the design phase)
- Safety expert / safety engineer
- If necessary, other functions like area manager, environmental experts or manufacturer can be included

*only if the function is not available within the organisation

The role of each team member

- Design phase: the engineering project manager
  - initiates the systematic safety assessment meetings
  - ensures that all necessary experts from safety, engineering and reaction chemistry (when appropriate) join the discussions
  - provides professional input and questions
  - ensures that the systematic safety assessments are documented
- Operational phase: The plant management team
  - initiates the systematic safety assessment meetings
  - ensures that all necessary experts from safety, engineering and reaction chemistry join the discussions
  - ensures that the systematic safety assessments are documented
- The manager production / plant manager
  - provides professional input and guidance
- The reaction chemist
  - roles are outlined in detail in Group Directive “Assurance of Chemical Safety” A07-04-03
    - Process engineer* and / or process engineering manager (and/or project engineer and / or project manager during the design phase)
      - provides professional input and questions
      - provides complete and up-to-date information and documents for the safety analysis such as Process and Instrumentation Diagrams (P&IDs), list of equipment, information about

instrumentation and process control systems, and (if applicable) explosion-protection documents

- Safety expert/safety engineer responsible for the plant:
  a) Completeness: ensures that all relevant questions and risks have been considered and documented in the Safety Master (P&ID)
  b) Objectivity: considers and questions the process risks and proposed protection measures from a neutral perspective
  c) Equivalence: informs and raises concerns if the proposed protection measures would mean
     - a remaining unacceptable risk
     - a substandard level compared to comparable/equivalent plants and processes at WACKER
     - If the detail of documentation, comprehensibility and reproducibility is not sufficient.
- The evaluation and all decisions (e.g. protective measures) are gathered and documented by the analysis team.
- Finally, each team member signs the completed documents (e.g. WACKER Analysis, plausibility check, risk graph) and hence confirms his/her agreement to the result and the protective measures taken.

2.4.1 Ensuring competency in plant and process safety worldwide

The Group Coordinator Safety ensures a comparable level of expertise regarding systematic safety assessments by the following measures:

- Regular trainings done by regional safety functions or by Group Competence Center Safety if requested
- On demand, the Group Competence Center Safety can provide, depending to availability, process safety experts to support projects. The decision is made by the Group Coordinator Safety.

2.5 Evaluating safety measures for their effectiveness

After implementation of a measure determined during a systematic safety assessment, the engineering project engineer and/or project manager (construction and installation phase) or plant management team (operational phase) confirms the correct setup or mode of operation.

2.6 Archiving of systematic safety assessment documents

- The engineering project manager (design phase) or a member of the plant management team (operational phase) shall maintain the original copy of the printed out and signed master documents for the following:
  - Plausibility check
  - WACKER analysis with related Safety Master P&ID
  - Risk graph

  such that they are readily available at any time for inspection by the safety engineer

  The engineering project manager is responsible for handover of the safety documents mentioned above to the relevant member of the plant management team.
- Copies are distributed in paper or electronic form to all who participated in the systematic safety assessment.
- Explosion protection: See requirements as per Directive A 07-04-01.
- Details for archiving see R08 Supl.5.

2.7 Avoid risks caused by plant changes – Management of Change (MOC)

- Every production site must have a detailed procedure specifying the MOC process regarding plant and process safety at the site, including the responsibilities of the various functions involved.

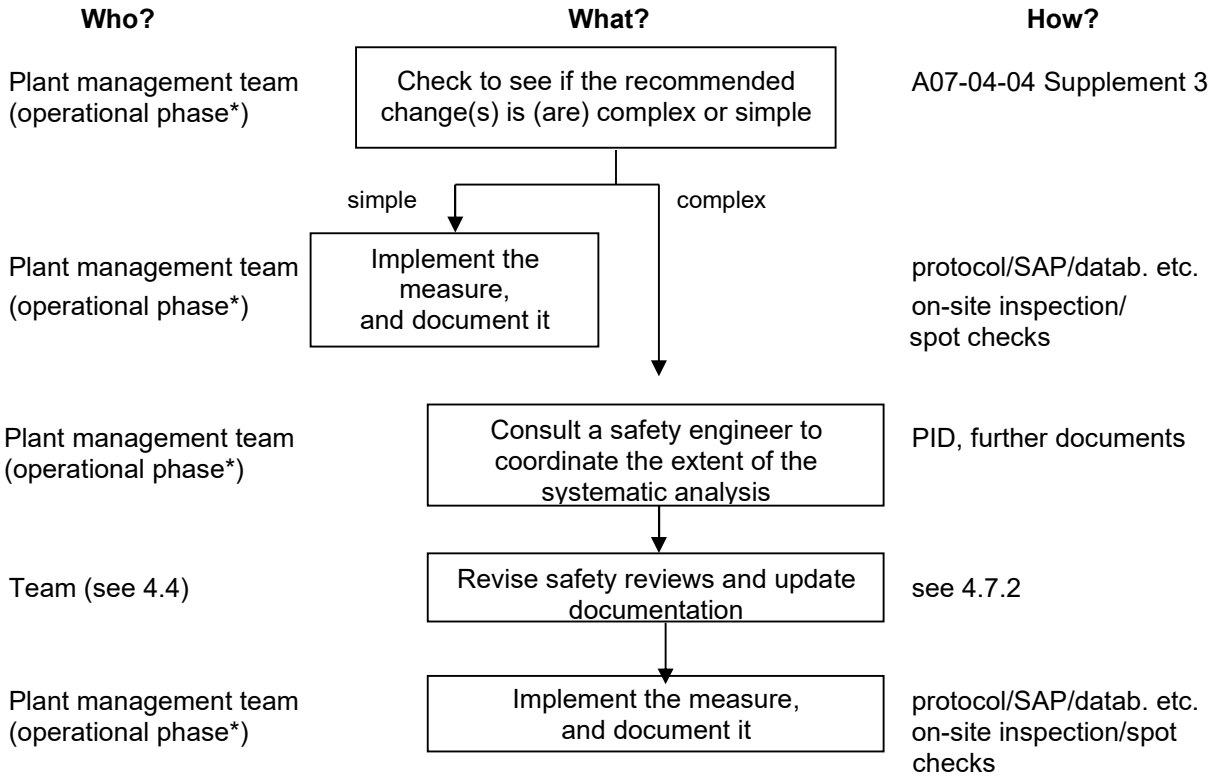
2.7.1 Execution of MOC

- Changes must be assessed to determine whether they have safety-relevant effects or otherwise affect existing safety plans and protective measures. Possible impacts to previous changes have to be considered as well.

  At a minimum, these effects are to be investigated with respect to:
  - Operating and design parameters such as pressure, temperature, mass flows, etc.
  - Energy supply and dissipation
  - Material/loads (chemical, mechanical)
  - Explosion protection
  - Fire prevention (fire loads), air conditioning, ventilation, exhaust systems
  - I&C monitoring/protection systems
  - Structural stability (construction, machines, vessels)
  - Changes in ambient conditions
  - Neighboring plants/facilities

- Comment and recommendation
  - The flowchart below shows the steps to be taken when changes and their effects on plant and process safety are evaluated.
  - Every site must consider other areas (e.g. environmental, quality, etc.) in addition to plant and process safety when carrying out these steps. This should be handled via the site's MOC procedures.

MOC for plant and process safety



*During design phase the engineering project manager is responsible for carrying out these tasks.

2.7.2 Update of the safety documents

Ascertain which of the following documents need to be modified as a result of the change:

- Plausibility check

- WACKER Analysis
- Risk graph
- Explosion protection document
- Cross reactivity matrix
- Classification of the chemical reaction/danger posed by reaction
- Documentation and test documents for pressure equipment
- Other

2.7.3 Minimum requirements for the MOC-Documentation

- The plant management team (operational phase) or the engineering project manager (in design phase) defines the respective documentation for MOCs ensuring compliance with national, regional and/or local regulation.
- The plant management team ensures that all completed, MOCs, including attachments (e.g. evaluations and opinions of other departments) are kept on file for at least five years. For details regarding archiving, see R08, Suppl. 5.

3 References

A 07-03-02 WGER	Safety of Machinery – Design, Changes, Operation
A 07-04-01	Avoidance of Explosion Hazards
A 07-04-03	Assurance of Chemical Safety
DIN EN 61511-3	Functional safety – Safety instrumented systems for the process industry sector – Guidance for the determination of the required safety integrity levels
WF AS1065BE	WACKER Analysis report
WF AS1075E	Safety Instrumented System Classification Analysis
WF AS1460E	Plausibility-Check, basic safety concept
G-WN 08-26-01 WGER	Safety Instrumented Systems including Process Control Monitoring Systems and Process Control Damage Limitation Systems
R 08 Suppl. 5	Compliance – Archiving and Storage
GLOBE	Guideline, example documents https://globe.wacker.com/sites/wb-bgh-site-mgmt-burghausen/safety-burghausen/servicecatalog/25589/systematische-gefahrenanalysen

4 Changes

- Chapter 2.4:Use of a Safety Master as a help for documentation
- Chapter 2.4.1: Adapted to the measures of "Shape the Future"
- Chapter 2.6: Responsibility of the project manager concerning handover of documents to the plant management
- Chapter 2.7.2: Transferred from Supplement 3 into the directive
- In total editorial changes and linguistic clarification

5 Specific Supplements

A 07-04-04 BBL1	Identification of Safety-Relevant System Components (SRC)
A 07-04-04 BBL2	Safety-Relevant System Components (SRC) subject to threshold limits for hazardous substances
A 07-04-04 BBL3	List of Criteria

Transition Period

Applying of threshold quantities for SRC (Supplement 2):

As part of this revision, no new thresholds quantities to determine safety-relevant system components have been added. The transition period granted in 08/2017 revision for the application of the threshold quantities in existing plants outside Europe ends latest in 08/2022.