Capability Statement

Safety Engineering

ILF CONSULTING ENGINEERS

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1 COMPANY PROFILE, CORPORATE PRINCIPLES & HSE

Company Profile

ILF Consulting Engineers (ILF) was founded by Adolf Feizlmayr and Pius Lässer in Innsbruck.

The company looks back on more than **45 years** of successful experience in engineering of major industrial and infrastructure projects.

With more than **6,000 projects** successfully executed, ILF companies rank among the world's leading engineering firms in their fields of core expertise.

ILF has **more than 40 offices worldwide**. A permanent staff of approximately **2,000** is employed to develop and execute project solutions for international customers.

The turnover of the ILF Group is appoximately **200 million EUR** per year.

ILF is active in the following main business areas:

- Oil & Gas
- Energy & Climate Protection
- Water & Environment
- Transport & Structures

Corporate Principles

ILF's presence in the market is dictated by its strong and independent position with **no affiliation to construction firms, suppliers or financial institutions**.

Of the projects ILF has been entrusted with, priority is given to innovation, cost effectiveness, sustainability and environmental compatibility based on the following principles:

- Health, Safety, Security & Environment
- Customer Satisfaction
- Independence
- Qualitative Market Leadership
- Staff

Health and Safety

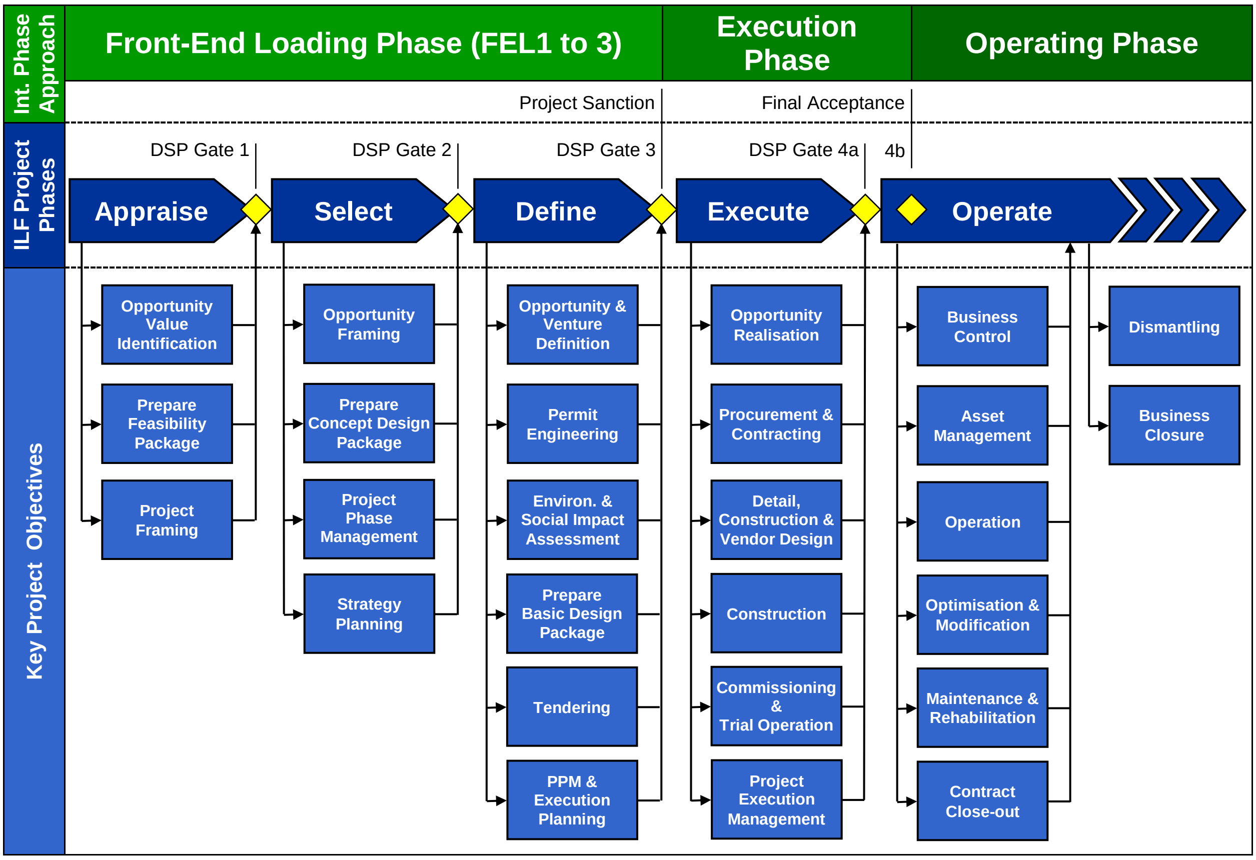
ILF is aiming for the high level of satisfaction of the employee through design of **safe and environmentally compatible installations**.

The aims of ILF in **Occupational Health and Safety (OHS)** of employees and third parties are the prevention of accidents, damages to persons and equipment and the permanent improvement of ILF HSE (Health, Safety and Environment) performance.

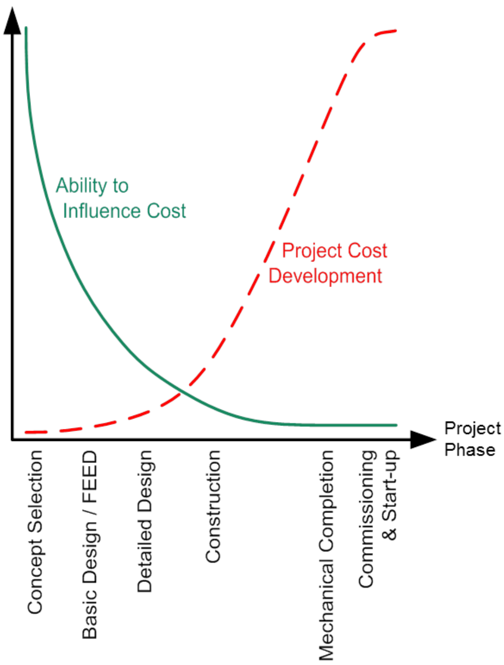
ILF has established an **Integrated Management System (IMS)** which covers the areas of Health, Safety, Environment and Quality Management and follows international standards such as **ISO 9001:2008, ISO 14001:2004, OHSAS 18001:2007 and SCC****.

2 ILF SERVICE APPROACH

Operating Asset Life Cycle



Our project phases are in line with the Project Management Institute (PMI)-definitions in order to provide stage-tailored services.
During all stages ILF may act either on project owner's side or on contractor's side and provide independent and multidisciplinary engineering solutions.
ILF puts particular emphasis on development of cost economic solutions. A particular strength of ILF is the development of sound and economic concepts.



3 SERVICES FOR OUR CLIENTS

Introduction

ILF's Co-Founder Dr. Adolf Feizlmayr says:

"Since performing in-house safety studies we have a better understanding of our projects in terms of safety and risks. We have achieved a more effective and efficient way to include risk mitigation measures in early design stages, and we're also able to make project risks and process safety more visible to our clients."

Safety assurance is a key constraint in ILF's activities and an integral element accompanying ILF's engineering and project management activities. The following services can be provided by ILF as part of activities accompanying related engineering services for new or existing facilities or as standalone consultancy.

Understanding the risks associated with your facilities enhances business performance.

Today's socio-technical systems have become more complex making control of related hazards difficult and costly, but necessary. In response to major disasters in the history of manmade systems, regulatory bodies have identified the need for safety assurance and have developed requirements for which compliance is achieved by developing reasoned arguments which provide evidence of safety assurance through the design, execution and operation of facilities.

Beyond regulatory requirements, ILF is committed to designing and implementing systems which do not compromise the health and safety of personnel and the public, nor endanger the environment and property. Therefore safety assurance is a key constraint in ILF's activities and an integral element accompanying ILF's engineering and project management activities.

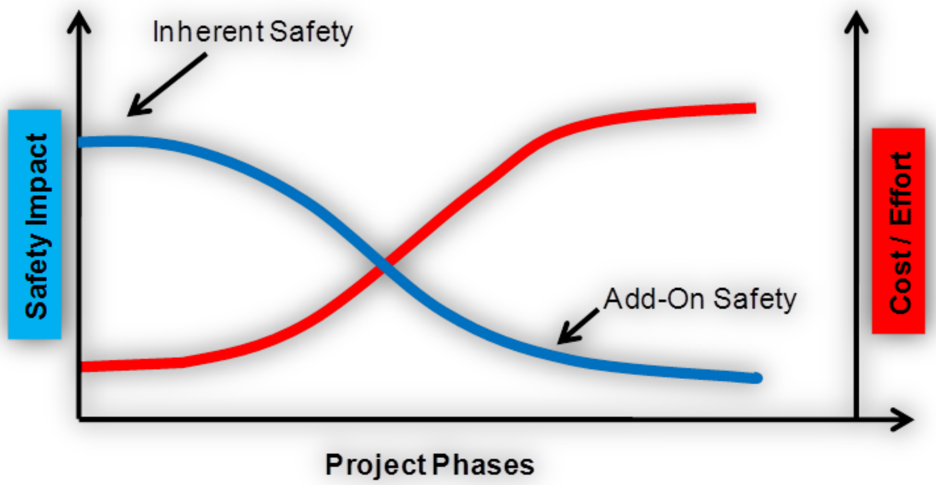


Figure 1 Safety impact and cost of risk reducing measures during a project

Identification of hazardous scenarios is essential for a successful HSE management

Avoiding the occurrence of hazardous events is a major task in order to address the health, safety and environmental aspects related to oil and gas projects. Effective risk management systems have to be applied to all project stages in order to prevent major accidents and to mitigate their consequences. Consequences of accidents may result in fatalities, injuries, pollution and asset damages. The aftermath of this can be extremely costly to the owner / operator and often has a negative impact on the business objectives as well as on the reputation of the organizations involved. Managing the risks of process facilities handling, transporting or storing hazardous materials is a key factor to prevent major accidents.

Early investing in safety pays off.

Identifying, assessing and minimizing the risks in early design stages will save time and money. As shown in Figure 1, risk reducing measures in the beginning of a project is less costly and more effective regarding the safety impact compared to design changes or add-on safety in later design stages.

A not understood or uncontrolled risk is an accident waiting to happen.

Risk can be defined as

"Potential future event that, if it occurs, will impact project objectives (including the protection of human and environment, the schedule, integrity, reputation and cost) either positively (opportunity or upside Risk) or negatively (threat or downside Risk)."

Risks can be managed and controlled. For that, risks associated with the development of new or existing facilities need to be identified and assessed.
One key element of effective HSE management is a systematic approach to the identification of hazards and the assessment of the associated risk in order to provide information to aid decision-making on the need to introduce risk-reduction measures. Hazard identification is therefore the first step for a successful risk assessment. It is based upon consideration of the physical and chemical properties of the handled substance, the arrangement of equipment and installations, operating and maintenance procedures and processing conditions. Further, external hazards need to be considered, e.g. extreme climatic conditions, 3rd party impact, ship collisions, helicopter crash, etc.

Several tools and techniques exist for the identification of hazards. They are selected according to the nature and scale of the installation, the project stage and the experience of the contributing engineers. Different approaches should be applied at different project stages, while a combination of techniques is often better.

ILF supports projects and operators

ILF offers technical safety studies as a standalone service for your oil and gas projects. ILF supports you in organizing and facilitating relevant studies and review sessions including preparation, reporting and action tracking. Technical safety in the design is prepared and conducted according to your needs based on international standards and best practice.

Services

- **Risk Assessment**
  - Hazard Identification (HAZID)
  - Environmental Hazard Identification (ENVID)
  - Quantitative Risk Assessment (QRA)
  - Fire and Explosion Hazards Analysis (FEHA)
  - Identification of Safety Critical Elements (SCE)
  - Hazards and Operability Study (HAZOP)
  - Safety Integrity Level Assessment (SIL)
  - Layer of Protection Analysis (LOPA)
  - Evacuation, Escape and Rescue Analysis (EERA)
  - Emergency Systems Survivability Analysis (ESSA)
  - Emergency Response Analysis and Plans (ERP)
- **Risk Management**
  - Hazards And Effects Register
  - ALARP Reports
  - Control of Major Accident Hazards (COMAH)
- **Reliability Engineering**
  - Failure Mode and Effects (Criticality) Analysis (FMECA)
  - Reliability, Availability and Maintainability Studies (RAM)
  - Deliverability Studies
- **Safety Management Systems**
  - Development and improvement of Safety Management Systems
  - Independent audits
  - Certification preparation
- **Project Assurance**
  - Asset Integrity Management (System) Review (AIMS)
  - Project HSE Review (PHSER)
- **Compliance Assurance**
  - Safety Cases
  - Health, Safety and Environmental Impact Assessment (HSEIA)

Methodology Fire and Explosions Hazards Analysis (FEHA)

Event Tree Approach

Following a given hazardous scenario releasing flammable and / or toxic substances, a logical chain of subsequent consequences is modelled in a consequence evaluation. This starts from the event of release from a given installation and ends up in describing the consequences on adjacent population, environment or assets. However, depending on the material properties, process conditions, leak size, ignition sources, weather conditions and presence of population and vulnerable objects, different consequences may occur. These can be jet fires, pool fires, flash fires, fire balls, BLEVEs (boiling liquid expanding vapour explosions), vapour cloud explosions, toxic exposures, asphyxiation effects or pollutions. For example a flammable but non-toxic gaseous substance (e.g. natural gas) released continuously into the atmosphere results in a jet fire or a flash fire in case of ignition, while released and ignited in a confined or congested area leads to an explosion. The vulnerable effects are therefore due to heat radiation or overpressures, respectively.

The pathway from the release incident to the end events can be simply visualized using the event tree approach. An event tree is an inductive analytical diagram in which an event is analyzed using Boolean logic to examine a chronological series of subsequent events or consequences. Figure 2 presents exemplarily the event tree for a continuous release of pressurized natural gas.

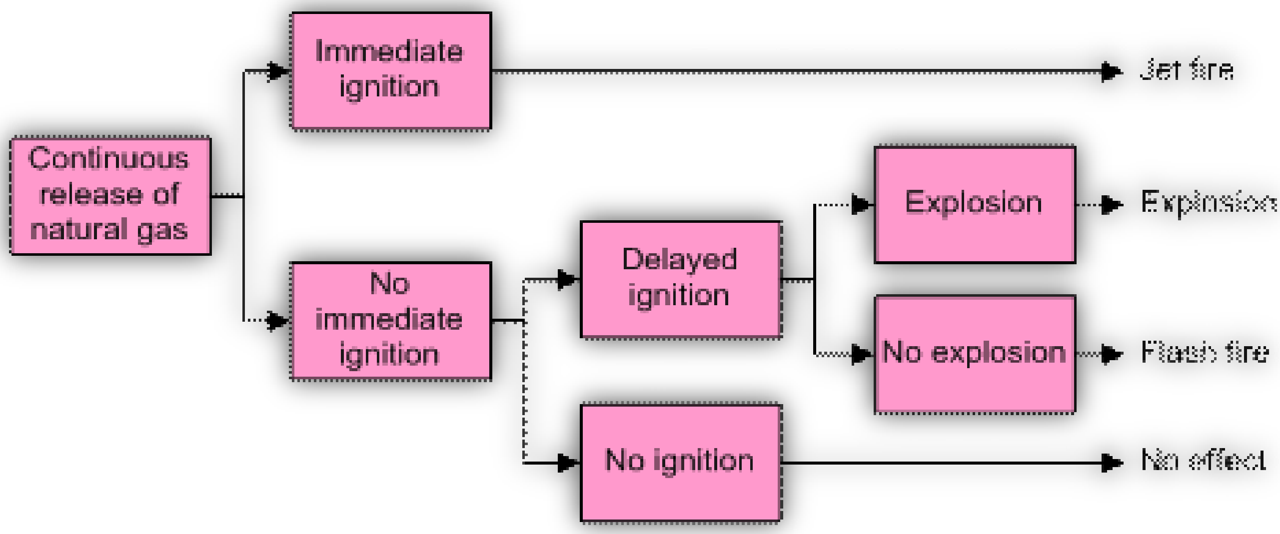


Figure 2 Event tree for a continuous release of pressurized natural gas

Discharge and Dispersion Modelling

Quantifying the consequences of hazardous releases requires precise modelling of the discharge and dispersion behaviour of the released substance. For this purpose sufficient input data has to be collected regarding material and operational properties, leak sizes and release conditions as well as weather conditions and information about the surroundings, e.g. surface roughness, topographical conditions, confinement and congestions, etc.

After defining the relevant properties of a release scenario, the calculation of the discharge and dispersion behaviour of the released substance is performed. The discharge calculations determine the conditions of the material instantaneously after the occurrence of a loss of containment (LOC). It describes the discharge flow rate, the phase conditions, the release direction and duration.

As shown in Figure 3, the material can be released in gaseous or in liquid form or both as a vapour release with rainout. While gases with a density lower than air propagate upwards in the atmosphere mixing with entraining air, denser gases may propagate to or stay at ground level. However, the weather and wind conditions play an important role for the determination of the dispersion behaviour. Liquid rainout will form a pool on the ground which may create flammable or toxic vapour due to pool vaporization. For the consequence calculations ILF uses commercial specialist software based on validated models.

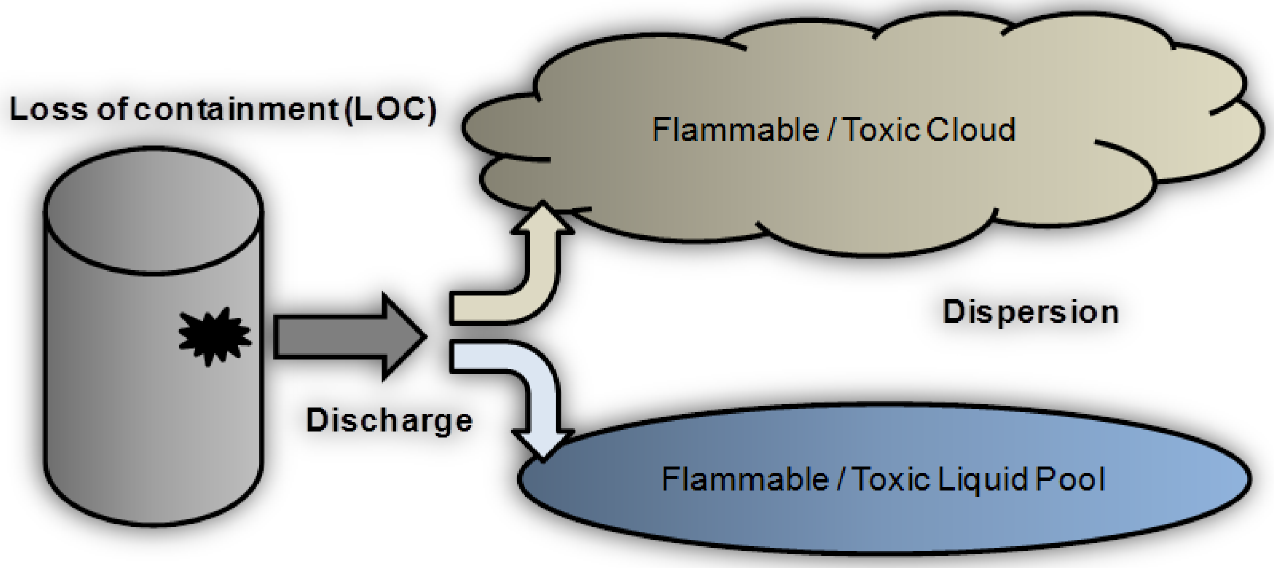


Figure 3 Discharge and dispersion following a loss of containment (LOC)

Heat Radiation, Explosions and Toxic Exposure

Following the discharge and dispersion of a given hazardous material, different vulnerable end events may occur. For toxic releases the hazard related to population results from the toxic dose due to exposure from a cloud of released toxic material. The vulnerability depends on the toxicity and concentration of the substance and the exposure duration. It can be calculated using probit functions and adequate models.

The hazard of fire events is related to the exposure of people and vulnerable objects to heat radiation which is able to cause injuries, fatalities, environmental damages and damages to assets. In a larger establishment heat radiation often leads to escalation scenarios by damaging adjacent installations, vessels or critical structure. A fire event requires the presence of a flammable fuel-air mixture cloud and an ignition source.

Released non-toxic gases in congested areas (e.g. nitrogen) may create an atmosphere with low oxygen concentrations leading to asphyxiation effects. Cryogenic substances (e.g. LNG) may cause embrittlement and damage to steel due to their cold temperatures.

A precise determination of the possible consequences following a hazardous release supports decision-making processes in the design stage. It is required for adequate design of active and passive firefighting utilities as well as for providing inherent safety measures, e.g. sufficient distances, sterile areas, etc.

A detailed evaluation of consequences prevents and mitigates the vulnerable effects of hazardous scenarios and thus enhances the operability, integrity and safety of industrial facilities.

Methodology HAZID

HAZID is applied in early design stages by an interdisciplinary team guided by an experienced HAZID facilitator. A HAZID is performed using a structured list of guidewords taking benefit from the experience of the team members (see ISO 17776). On the basis of the guidewords a brainstorming exercise is carried out, in order to identify all potential hazards, their causes, consequences and safeguards relevant to the investigated facilities. The guidewords can be structured in the following three main sections.

- External Hazards including
- Facility Hazards including
- Health Hazards

Potential causes and consequences of each identified hazardous scenario are documented in report worksheets, with existing safeguards identified or the planned design / operational features that will mitigate / reduce the risk associated with the specific scenario. Recommendations are listed where the HAZID team identifies or assesses that additional safeguards need to be implemented. A HAZID should be conducted systematically and rigorous. Its results and recommendations have to be applied in a tracking system in order to ensure the close-out of all required actions (e.g. design changes, add-on safety, etc.).

Methodology ENVID

The key objective of an Environmental Issues Identification (ENVID) is to identify potential environmental issues resulting from a proposed development and agree practicable measures to ensure that throughout the life span of the development it results in minimal harm to the environment. The process, broadly, weights the relevant factors based on expert judgement and relying on multidisciplinary team strengths, particularly with regard to understanding both demonstrated and perceived potential environmental sensitivities using significance criteria. A crucial aspect of the ENVID process is to ensure that key issues are fully understood and owned by the project team. There are several methods for presenting the results on an ENVID, the most commonly used being matrices or tables.

Methodology PHSER

The purpose of a Project Health, Safety, and Environmental Review (PHSER) workshop is to provide assurance to the end user that HSE hazards have been identified and assessed. The PHSER process consists of formal reviews scheduled near the conclusion of each Project phase and at major Project milestones in the Construction and commissioning Phase.

These reviews are conducted by a team of specialists whose objectives are to verify that the Project has identified and full addressed all aspects of Health, Safety, Environment, relevant to the respective Project and stage.

Methodology HAZOP

HAZOP is a systematic approach to identify hazards and operability problems occurring due to deviations from the intended range of process conditions. A HAZOP is usually conducted at a design stage when sufficient information is available (e.g. PFDs, P&IDs, Layout Plans, etc.). During a HAZOP an experienced team leader guides an interdisciplinary team systematically through the plant design, using a fixed set of guidewords related to specific process parameters (see IEC 61882). Identified hazards and operability problems will be evaluated during a HAZOP regarding their consequences, existing safeguards and recommendations.

The HAZOP review technique is based upon the following fundamental principles:

- Definition of the normal function of a unit and identification of possible deviations of the normal behaviour of the plant by means of guidewords.
- Evaluation of the possible causes and consequences of the deviations and existing safeguards.
- Elaboration of measures to prevent or mitigate the evaluated consequences.

The HAZOP team reviews the system that is designed to operate normally and then considers all types of deviations to the normal conditions using a very structured approach. The HAZOP covers both safety and operation. The related installations are subdivided in nodes which allow for a clear identification and definition of individual process steps which normally are linked to a vessel, machine etc. and a limited number of lines connected to it.

A HAZOP should be conducted systematically and rigorous. It has to be prepared properly and its results and recommendations have to be applied in a tracking system in order to ensure the close-out of all required actions (e.g. design changes, add-on safety, etc.).

Process parameters, such as FLOW, PRESSURE, TEMPERATURE, and LEVEL describe the process intention of vessels, piping or other equipment in specific terms. Parameters can be considered as of two types. Specific parameters, such as those mentioned above, describe the physical aspects of the process. General parameters, such as MAINTENANCE, START-UP / SHUTDOWN and others, describe operations more so than physical aspects of the process.

Deviations are departures from the design intention, which are reviewed systematically by applying the guideword / parameter combinations to study the process. Guidewords are words or phrases that, when considered together with a parameter, form a hypothetical deviation for the team to consider. The basic guide words are: NO, MORE, LESS, AS WELL AS, PART OF, REVERSE and OTHER THAN. E.g. a credible deviation can be MORE FLOW.

Figure 4 shows the routine of a typical HAZOP study:

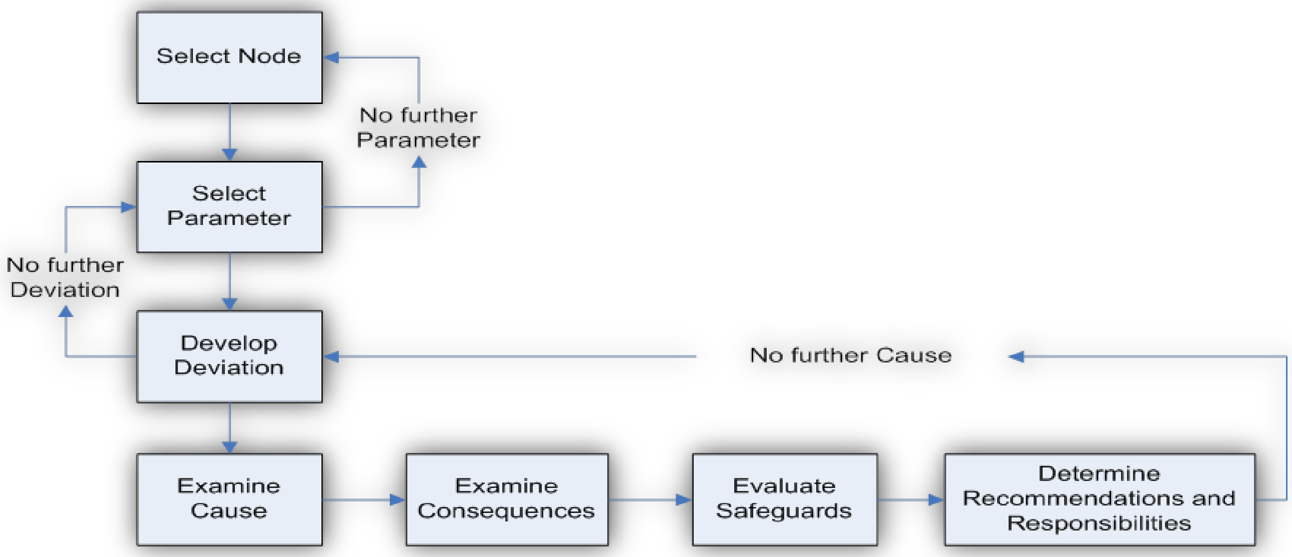


Figure 4 HAZOP study routine

Methodology QRA

General QRA Approach

The general goal of a QRA is to quantify the risks related to a given facility and assess them against risk criteria in order to satisfy regulatory requirements (see CPR 18E). In order to ensure that the overall risk is acceptable or tolerable, risk mitigating measures are applied by following the ALARP principle (as low as reasonably practicable). Since risk is the product of likelihood and consequences of an undesirable event, it can be quantified by knowing the outcome of the event and its frequency of occurrence per year. Summing up the risk numbers of all hazardous events related to the investigated facility leads to the overall risk values. Risk may affect population, environment and / or assets.

QRA Stages

In its elemental form a typical QRA is comprised in the phases presented in Figure 2. The consequence analysis and the frequency analysis can be performed in parallel.

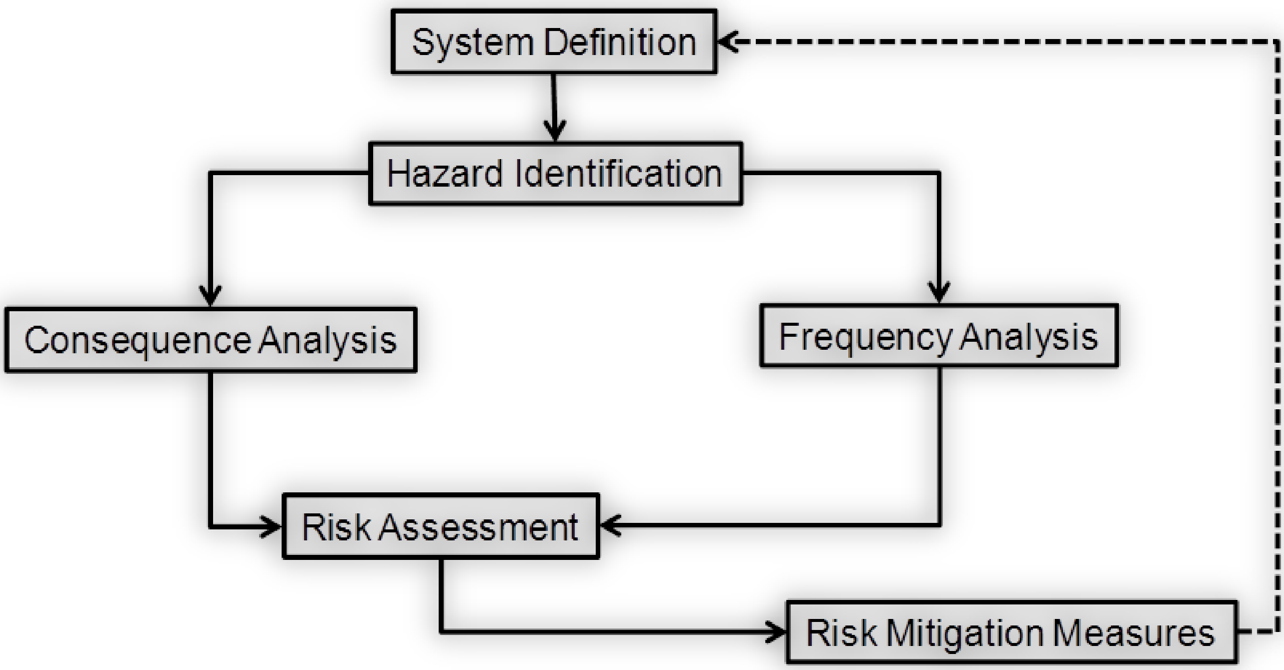


Figure 5 QRA workflow

System Definition

During the system definition phase, the goals and objectives are clarified and the boundaries of the investigated system are defined, considering the physical and operating limits. Additionally, a complete site specific data collection is performed during the system definition phase including information on weather, material properties, population, pipeline operation, potential ignition sources and on existing risk mitigation measures.

Hazard Identification

The hazard identification process has to be performed rigorous, thoroughly and detailed. The goal is to identify all system related hazardous scenarios. For this purpose several techniques like a Hazard and Operability Study (HAZOP), a Failure Mode and Effects Analysis (FMEA), checklist approaches or a Fault-Tree Analysis (FTA) are available.

Consequence Analysis

For each identified hazardous scenario, a chain of subsequent consequences is modelled in the consequence analysis stage. This starts from the release of hazardous material and ending up in the determination of quantified values describing the hazardous effects on population, environment and assets. The logical path to the possible end events can be considered based on an event-tree analysis. The results depend on the amount and the physical properties of the material, on its toxicity and flammability, on the leak size and the release conditions (rate, duration and direction) as well as on the weather and wind conditions. After defining the relevant properties of a Loss of Containment (LoC) scenario, the calculation of the discharge and dispersion behaviour of the released substance is performed. For the consequence calculations ILF uses validated specialist software.

Frequency Analysis

A frequency and probability analysis is performed in order to quantify the likelihood of the identified hazardous scenarios. This includes the frequency of occurrence of all identified hazardous scenarios, the probabilities of different weather scenarios, the immediate and delayed ignition probabilities and the probability of presence of population located indoor and outdoor at the affected area. The frequency and probability numbers are based on empirical data which is collected in in-house data or can be found in the literature.

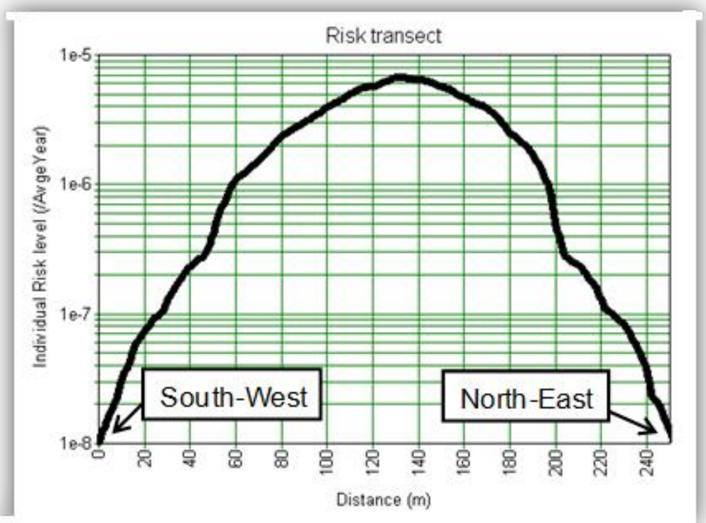


Figure 6 Individual risk results, left: risk contour plot, right: risk transect

Risk assessment and risk mitigation

Combining the results of the consequence analysis with the frequency and probability data leads to the risk results for all investigated hazardous scenarios of a given system. Regarding the risk on the population, a QRA provides individual and societal risk results. For both the individual and the societal risk, risk criteria exist in order to assess their acceptability and tolerability. Following the “As Low As Reasonable Practicable” (ALARP) principle, appropriate risk mitigation measures may be applied in early project stages to ensure a safe operation. The quantified individual risk results are generated out of a risk summation approach by summing up the probabilities of fatality due to all identified hazardous events to a location-specific probability of fatality.

Performing these calculations for a complete area results in the individual risk contours and transects as presented in Figure 6.

The societal risk results measure the risk to a number of people located in the effect zones of the incidents. It generally shows the frequency distribution of multiple fatality events. The most common way of presenting societal risk is generating FN-curves. An FN-curve shows the cumulative frequency F of all events leading to N or more fatalities related to an investigated process facility. Figure 7 shows a typical FN-curve for a given establishment and the appropriate societal risk criteria in the UK and the Netherlands according to CCPS 2009.

Figure 7 indicates that the assessment of societal risk against given risk criteria can be easily performed using the FN-curve approach. Depending on the regulative requirements the societal risk can be ‘acceptable’, ‘intolerable’ or ‘tolerable but not acceptable’. In the latter case, risk mitigation has to be performed according to the ALARP principle, i.e. the risk is only tolerable if risk reduction is impracticable or its costs are in disproportion to the gained improvement. Some risk criteria may not include an ALARP zone. For the risk summation and risk assessment processes, ILF uses validated specialist software. Similar approaches exist for the quantification and assessment of risk regarding the environment or assets. Regarding the process industry the risk to population is considered as the dominant risk. However, thoroughly managing and controlling the risks of an establishment in early design stages is good for a company’s business and reputation.

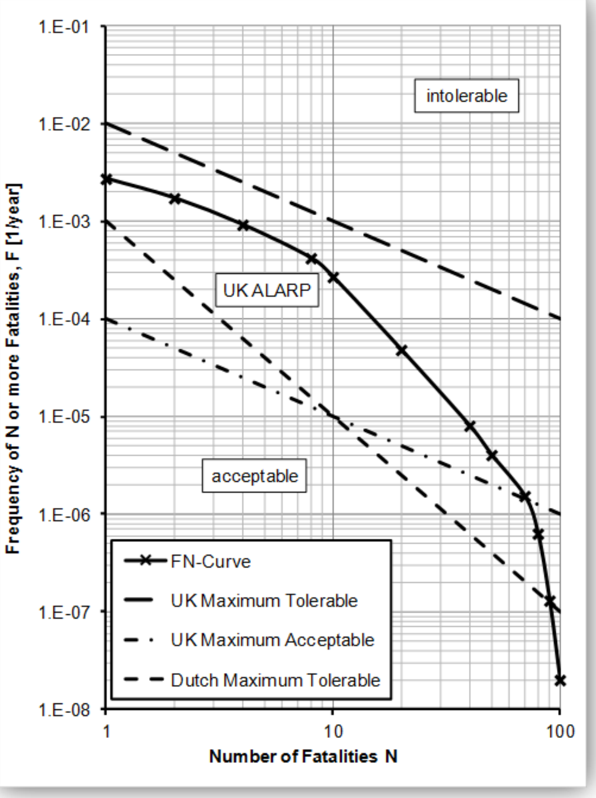


Figure 7 Typical FN-curve

4 CONTACT AND REFERENCES

Point of Contact

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mailto: Stefan.Seidl@ilf.com

Selected References

Please find attached a selection of reference projects.

- **Pipeline Systems**

  - FEED & PMC for Installation of a Single Point Mooring (SPM) – Bangladesh.

    Eastern Refinery Limited (ERL), a subsidiary company of Bangladesh Petroleum Corporation (BPC) intends to install a pipeline and a Single Point Mooring System. The SPM system involves the construction of a floating bouy where tankers can moor to deliver crude or HSD, to the ERL refinery. HAZOP, Availability Study

  - Taif - Al Baha Water Transmission System, HAZOP

  - Gazelle Gas Pipeline

    New pipeline route from Olbernhau to Waidhaus for import of Russian natural Gas via Nordstream Pipeline, partly by upgrading of existing pipeline, partly by new construction with the purpose to shorten relevant route by some 50 km. The volumes of Russian Gas imported via Ukraine and Slovakia by existing south route shall be reduced by this considerably. HAZOP

  - China Central Asia Gas Pipeline (Line C), Basic Design

    Third Line (Line C)of the China - Central Asia Gaspipeline. Gas Pipeline from Uzbekistan trough Kazakhstan to China. HAZOP, HAZID, SIL

  - IP-Gas Pipeline Project -Pakistan- FEED

    Bankable Feasibility Study, ESIA and FEED for 780 km gas pipeline in Pakistan, Diameter 42" for transportation of Iranian gas to Pakistan. HAZOP, HAZID, QRA, ENVID

  - WAG CS BMG C1 & C2 Replacement

    WAG Compressor Station Baumgarten. Replacement of existing gas turbine compressor units C1 and C2 by electrically driven compressor units. HAZOP, HAZID, QRA, RAM

  - WAG plus 200, including Rainbach Compressor Station

    Capacity increase of the West Austrian Gas Pipeline by installation of a new compressor station. RAM

  - WAG Plus 600

    Performance of engineering and management services comprising the following main scope of work: basic and detailed engineering, procurement, project implementation, installation and construction supervision, quality management,commissioning and training. HAZOP, QRA, RAM

  - Kazakhstan-China Gas Pipeline - Project Management Consultant

    The Kazakhstan-China Gas Pipeline (KCGP) Project is part of the Trans Asia Gas Pipeline (TAGP) Project, which is a designated natural gas transportation system for the transportation of natural gas from production facilities in Turkmenistan via Uzbekistan and Kazakhstan to the Republic of China. HAZOP

  - PVS Gas Pipeline

    Expansion of the Primary Distribution System (PVS) owned by the OMV Gas GmbH to meet the rising need for gas transport capacity in the Austrian gas control zone East. HAZOP

- Compressor station Söhlingen

  Implementation of a new gas compressor station to transfer gas production from low-pressure fields into the existing high-pressure transport system. HAZOP

- Baku-Tbilisi-Ceyhan (BTC) Crude Oil Pipeline - Turkish Section

  Transport of crude oil from the Sangachal Terminal in Baku, Azerbaijan to the Ceyhan terminal in Turkey, located at the Mediterranean Sea. HAZOP, QRA

- Baku-Tbilisi - Ceyhan (BTC) Crude Oil Pipeline - Azeri Section

  Transport of crude oil from the Sangachal Terminal in Baku, Azerbaijan to the Ceyhan terminal in Turkey, located at the Mediterranean Sea. HAZOP, ALARP report.

- Burgas - Alexandroupolis Crude Oil Pipeline, FEED

  The purpose of the Burgas - Alexandroupolis Oil Pipeline Project is to carry crude oil produced in Russia, Kazakhstan and Azerbaijan to destinations in Europe, North America and to other international markets. HAZOP, HAZID, QRA, Availability Study, ENVID

- Compressor Station Holtum

  Increase of transport capacity of Netra-Pipeline (Emden - Berlin area). HAZOP, RAM

- VC-Pipeline Burgkirchen-Burghausen: Preliminary Planing, Consultancy Approval Procedure

  Rededication of an existing gas pipeline in a VC-Pipeline. HAZOP

- Nabucco Gas Pipeline, Austrian Section – FEED, HAZID

- Nabucco West 48" Gas Pipeline, FEED & EPCM

  Re-FEED" of the project including System Hydraulics, re-issue of design base memorandum, change of specifications from 56" to 48", re-design and issue of crossing details and alignment sheets, preparation of documents for the application of changing the environmental permit and the preparation of documents for applying for construction permit. QRA

- Nabucco Gas Pipeline - Feeder Lines

  The Nabucco natural gas pipeline constitutes a dedicated gas transit and transportation pipeline from Turkey to Austria via Bulgaria, Romania and Hungary. The aim is to create a pipeline system for natural gas transmission from different sources in the Caspian Sea Region and the Middle East to Central Europe. ILF scope of work is to perform the FEED works for the complete system in eastern Turkey (Georgian border to Ankara) including the national environmental impact assessment(EIA) and the environmental and social impact assessment(ESIA) according to International Financial Institution standards (IFC, EBRD EIB) and best international practice. EIA

- Oron Pipeline, Septa Energy Nigeria Ltd, DED & Procurement Services

  DED for 18" NPS x 37.4km long gas pipeline between Uquo Gas Plant & the Nigerian Integrated Power Plant near Oron. QRA, Technical Safety and Loss Prevention Design

- Natural gas pipeline Manegg

  Diversion of high pressure gas pipeline with 2 motorway crossings in HDD all project phases. QRA

- PVS G00-122 Gas Pipeline Schwechat Mannswörth

  20” gas pipeline with scraper stations, valve station, gas transfer metering stations serving as replacement and expansion of an existing 6" gas pipeline. QRA

- Trans Adriatic Pipeline - Engineering Services Basic Design/ FEED

  The Trans Adriatic Pipeline is a natural gas pipeline running from Thessaloniki in Greece via Albania and the Adriatic Sea to Brindisi in Italy. HAZID, QRA

- Trans Adriatic Pipeline Extended Studies

  Analysis of different throughput case scenarios from Greece to Italy. HAZID

- Ocean

  Transport of crude oil from Eastern Siberia to China. QRA

- Re-allocation EHDL Thurkorrektion

  Re-allocation of a high pressure pipeline 6", length 1.5 km in the vicinity of the river korrection Thur. QRA

- Risk analysis B-NET

  Preparing a risk analysis to find the limit of indemnity for the project: B-Net Pipeline Connection BTV-BTN. QRA

- OGG Baumgarten Compressor Station – EPCM

  The OGG Baumgarten compressor station represents an expansion of the existing primary distribution system and creates additional transport, compressor and metering capacities. QRA (Managed by ILF)

- Natural Gas Pipeline Cawthorne Channel – Bonny

  Provision of a natural gas transmission system from the Cawthorne Channel Flow Stations 1 & 2 to the Bonny Terminal. HAZOP

- Melita - Tripoli Gas Pipeline

  Installation of new Gas Pipelines from Melita to Tripoli and from El Khoms to Tripoli with Compressor Stations. QRA, FEHA

- Taweelah - Qidfa Gas Pipeline

  Feasibility Study and FEED for a gas pipeline from Taweelah to Qidfa. HAZOP, HAZID.

- Compressor Station Egtved

  Natural Gas Compressor Station with electrical driven Turbocompressors (MAM-MOPICO - High Speed, Magnetic bearings, intergrasted motor); 4 Units. Basic and Detail Engineering, procurement, project implementation, installation and construction supervision, quality managemnt, commissioning and training. RAM, HAZID, QRA

- Trans Anatolian Natural Gas Pipeline Project (TANAP), Turkey, PMC

  The TANAP pipeline will be an approximately 1,900 km natural gas pipeline system including a section for sea crossing and all associated facilities, i.e. compressor stations, metering stations, block valves and the SCADA and control, to be constructed in Turkey for the transport of 31bcm of natural gas. QRA, Availability Study, PHSER

- Replacement of 8 inch Test Line, Qatar, FEED

  The main objective of this project is to provide a safe, reliable and uninterrupted means for the Testing Wells at Diyab and wells between Diyab & Jaleha in Dukhan Fields for at least the next 30 years, taking into consideration present and future production levels. Technical Safety and Loss Prevention Design, QRA (Managed by ILF)

- Replacement of 12inch NGL Pipeline, Qatar

  FEED for the replacement of an existing 12 inch Raw NGL Pipeline from Dukhan to NGL-1 plant inside Mesaieed Industrial City.The new pipeline shall follow the exitsting route. On commissioning of the new pipeline, existing pipeline shall be decommissioned and removed. Technical Safety and Loss Prevention Design, QRA (Managed by ILF)

- Radomiro Tomic (RT) Water Supply System

  EPC for a water transmission system from the Coast to the Radomiro Tomic (RT) Mine Site in Chile. RAM

- Integrated Open Season (IOS) Deutschland

  This project includes several planning services for compressor stations as well as pressure reduction and metering stations within the extension of its gas transport network in northern Germany. The services of ILF comprise Basic Design, Detail Design, Permit engineering, Cost Estimation as well as support for procurement, construction, commissioning and final documentation. HAZOP, HAZID, FERA, RAM, ENVID

- ADCOP Availability Study

  Availability Study for ADCOP (Abu Dhabi Crude Oil Pipeline Project) RAM

- Gas Metering Station Type 2

  Turnkey delivery (EPC) of 33 Gas Metering Stations for OMV Petrom in Romania. HAZOP, HAZID

- Habshan - Fujairah Crude Oil Pipeline (ADCOP)

  PMC for the Abu Dhabi Crude Oil Pipeline (ADCOP) Project. A pipeline running from Habshan to Fujairah in the UAE. HAZOP, HAZID, QRA

- Technical and Project Managment Consultancy Services for AzSCP

  Extension of the South Caucasus Pipeline to transport additional gas quantities from SD2 development through Georgia and Azerbaijan. Technical Safety and Loss Prevention Design

- Gas Pipeline Bunde-Etzel, Detailed Design & Construction Supervision

  Detailed engineering, tendering, PMC, construction supervision and commissioning including all coordinations with authorities and land owners. ENVID

- Gas Pipeline Bunde-Etzel LLI Procurement & other services

  Main line pipe, bends and valves specification and procurement acc. to EU standards. HAZOP, HAZID, PHSER

- Oil product pipeline Komsomolsk - De Kastri

  Process part of Basic design design for the Oil product pipeline Komsomolsk - De Kastri, including a 330 km 21" pipeline, pump station(s), metering systems, two tank farms and a tanker loading point. Availability Study

- Kharyaga Development Phase II - Crude oil

  Development of TotalFinaElf oil field in Kharyaga and tie-in in the crude oil export pipeline Kharyaga-Usinsk. Injection of sour gas to maintain well pressure. ENVID

- Trans Austria Gas Pipeline (Loop II)

  Increase of transport capacity for Russian gas from Baumgarten at the Slovak/Austrian border to the Austrian/Italian border. ENVID

- Compressor Station Poggio Renatico

  Transport capacity increase for Russian natural gas to Italy. ENVID

- Renewal of operating permit for TAL Trans Alpine Oil Pipeline - Ingolstadt-Karlsruhe

  Consultancy services to extend the operation permit. ENVID

- Trans Austria Gas Pipeline TAG Expansion 04

  Increase of capacity of Trans Austria Gas Pipeline by approx. 35% by installation of 2 new compressor stations and upgrade of existing compressor and metering stations. ENVID

- Bolshoi Chagan-Atyrau Pipeline

  Transport of crude oil from Karachaganak Field through Bolshoi Chagan to Atyrau. HAZOP

- Brega Compressor Station.

  Capacity increase for natural gas transport from Brega to Tripoli and Benghazi. HAZOP

- Asia Gas Pipeline (AGP) - Uzbek Section – PMC

  Project Management Services for the Uzbek Section of the Asia Gas Pipeline. HAZOP

- Brody-Plock - Crude Oil Pipeline

  Feasibility Study and report on environmental impact of construction of the [Brody-Plotzk] oil pipeline, connecting the Polish and Ukrainian oil transportation system

- WAG Expansion 3

  Increase of transport capacity of the WAG system by 300,000 Nm³/hr in both directions of transport. HAZOP, HAZID, QRA

Tankfarms and terminals

- Krk LNG Terminal

  E.ON Ruhrgas intends to construct LNG Terminals in Krk including gasification plants. QRA

- HAZOP Crude Oil Tankfarm Albotest

  HAZID/HAZOP studies for crude oil tankfarm in Albotest, Romania. HAZOP, HAZID

- Tanker Loading Facilities at Leixoes Marine Terminal – Revamp

  Revamping includes installation of 19 new loading arms, ancillary systems, new piping and ESD systems at 3 berths that can accommodate ocean-going vessels of up to 115,000 DWT. Common facilities, such as nitrogen production and distribution, cleaning solvent distribution, vapour recovery network and treatment as well as new electrical support and a new DCS System for the facilities. HAZID

- New Construction and Revamp of Storage Depots

  Construction of 10 storage depots, revamp of 3 storage depots. HAZOP, HAZID.

- Terminal and Pipeline Operation Masterplan, Study

  Prepare a techno-econonic study to develop a master plan for the Main Oil Pipelines and Jebel Dhanna Terminal considering the operational requirements of the next 30 years. PHA

Thermal Power Plants

- GK Cogeneration Großenkneten, Basic & Detailed Engineering

  Basic-Engineering(FEED)and Engineering, Procurement, and Construction Management (EPCM) for Combined Heat and Power Plant in Großenkneten. HAZOP

Gas storage facilities

- Crystal Gas Storage Etzel

  CRYSTAL gas storage facility at Etzel (Germany) for gas trading purposes. HAZOP, HAZID, SIL, QRA (Managed by ILF)

- LNG Terminal in Ukraine

  Pre-project, exploration works and adjustments of feasibility study for construction of LNG terminal in Ukraine. QRA

- ENECO Gasspeicher Epe

  Pipeline connection to the Dutch gas grid for cavern gas withdrawal and injection, connection to the German grid for cavern withdrawal only. Plant is located near the TRIANEL plant and it is planned for a fully automated operation. RAM

- Nuon Gas Storage Epe

  Preliminary availability and reliability estimate for Gas Storage. RAM

- Gas Storage Facilities Epe

  Provision of gas storage capacity with interconnection to the Dutch gas pipeline system. RAM

- FEED for Stublach Gas Storage Facility

  FEED for a) brine and water infrastructure and b) gas infrastructure of the Gas Storage Facility at Stublach, NE – England. HAZID

- Storage Tanks Jebel Dhanna, Conceptual Design

  Extension of Jebel Dhanna Port Facilities for 2.1 Billion barrel tanks. Studies for opportunities for storage of oil in saltcaverns and overall concept of plant. HAZID.

- Storage Tanks Jebel Dhanna, FEED

  Front End Engineering Design. HAZID, QRA.

Process plants

- NOxER Project for Baumgarten and Ruden Compressor Stations

  Installation of two new DLE gas turbines (approx. 20-25 MW each) as dry low NOx emission machines one in the Baumgarten compressor station and one in the Ruden compressor station. In the course of the conceptual design phase, an analysis was performed to determine the economic efficiency of waste heat utilization. HAZOP, HAZID, QRA, PHSER

- Safety Calculations for LNG Bushy Park

  Thermal Radiation Calculation Study for Bushy Park LNG Peak Shaver. FEHA

Production facilities

- Rospan Novy Urengoy Fields Engineering Support

  Engineering support for the full development of gas-condensate fields in Urengoy region. HAZOP, HAZID, PHSER

- Compressor Station Hespenbusch

  Field gas compressor station using turbo compressors to exploit sour gas from fields with declining pressures. RAM

- Compressor Station Walsrode

  Implementation of a new gas compressor station to transfer gas production from low-pressure fields into the existing high-pressure transport system. RAM

- BAB Gas Compression Project, FEED

  FEED phase for gas compression project; Up to 10 Compressors of 10 MW each. HAZOP, HAZID, QRA, FEHA.

- SIL Assessment Kharyaga Project, Total, Russia

  SIL assessment for EP2 Well Pad for Kharyaga Phase 3 Project, Total E&P Russie. SIL Verification and Test/ Overhaul Schedule. SIL

- **Off-shore Production facilities**
  - Offshore Trunk Line in Lam & Zhdanov Fields, FEED

    Concept FEED and EPIC Tender Package' for New Trunk Pipeline in Lam & Zhdanov Fields. HAZOP, HAZID, QRA, Technical Safety and Loss Prevention Design
  - Platforms LAM C, ZHD A and Submarine Pipelines – PMC

    PMC services (supervision, monitoring, design review and approval) of EPC contractors work for the wellhead platform LAM C, wellhead cum drilling platform ZHD A and submarine pipelines. HAZOP, QRA (Managed by ILF)