UNIT V

RISK MANAGEMENT

Risk management is the identification, evaluation, and prioritization of risks (defined in ISO 31000 as *the effect of uncertainty on objectives*) followed by coordinated and economical application of resources to minimize, monitor, and control the probability or impact of unfortunate events[1] or to maximize the realization of opportunities. Risk management's objective is to assure uncertaintydoes not deflect the endeavor from the business goals.

Risks can come from various sources including uncertainty in financial markets, threats from project failures (at any phase in design, development, production, or sustainment life-cycles), legal liabilities, credit risk, accidents, natural causes and disasters, deliberate attack from an adversary, or events of uncertain or unpredictable root-cause. There are two types of events i.e. negative events can be classified as risks while positive events are classified as opportunities. Several risk management standards have been developed including the Project Management Institute, the National Institute of Standards and Technology, actuarial societies, and ISO standards.[3][4] Methods, definitions and goals vary widely according to whether the risk management method is in the context of project management, security, engineering, industrial processes, financial portfolios, actuarial assessments, or public health and safety.

Strategies to manage threats (uncertainties with negative consequences) typically include avoiding the threat, reducing the negative effect or probability of the threat, transferring all or part of the threat to another party, and even retaining some or all of the potential or actual consequences of a particular threat, and the opposites for opportunities (uncertain future states with benefits).

Certain aspects of many of the risk management standards have come under criticism for having no measurable improvement on risk; whereas the confidence in estimates and decisions seem to increase.[1] For example, one study found that one in six IT projects were "black swans" with gigantic overruns (cost overruns averaged 200%, and schedule overruns 70%)

INTRODUCTION

In ideal risk management, a prioritization process is followed whereby the risks with the greatest loss (or impact) and the greatest probability of occurring are handled first, and risks with lower probability of occurrence and lower loss are handled in descending order. In practice the process of assessing overall risk can be difficult, and balancing resources used to mitigate between risks with a high probability of occurrence but lower loss versus a risk with high loss but lower probability of occurrence can often be mishandled.

Intangible risk management identifies a new type of a risk that has a 100% probability of occurring but is ignored by the organization due to a lack of identification ability. For example, when deficient knowledge is applied to a situation, a knowledgerisk materializes. Relationship risk appears when ineffective collaboration occurs. Process-engagement risk may be an issue when ineffective operational procedures are applied. These risks directly reduce the productivity of knowledge workers, decrease cost-effectiveness, profitability, service, quality, reputation, brand value, and earnings quality. Intangible risk management allows risk management to create immediate value from the identification and reduction of risks that reduce productivity.

Risk management also faces difficulties in allocating resources. This is the idea of opportunity cost. Resources spent on risk management could have been spent on more profitable activities. Again, ideal risk management minimizes spending (or manpower or other resources) and also minimizes the negative effects of risks.

According to the definition to the risk, the risk is the possibility that an event will occur and adversely affect the achievement of an objective. Therefore, risk itself has the uncertainty. Risk management such as COSO ERM, can help managers have a good control for their risk. Each company may have different internal control components, which leads to different outcomes. For example, the framework for ERM components includes Internal Environment, Objective Setting, Event Identification, Risk Assessment, Risk Response, Control Activities, Information and Communication, and Monitoring.

METHOD

For the most part, these methods consist of the following elements, performed, more or less, in the following order.

1. identify, characterize threats
2. assess the vulnerability of critical assets to specific threats
3. determine the risk (i.e. the expected likelihood and consequences of specific types of attacks on specific assets)
4. identify ways to reduce those risks
5. prioritize risk reduction measures

PRINCIPLES

The International Organization for Standardization (ISO) identifies the following principles of risk management:

Risk management should:

- create value – resources expended to mitigate risk should be less than the consequence of inaction
- be an integral part of organizational processes
- be part of decision making process
- explicitly address uncertainty and assumptions
- be a systematic and structured process
- be based on the best available information
- be tailorable
- take human factors into account
- be transparent and inclusive
- be dynamic, iterative and responsive to change
- be capable of continual improvement and enhancement
- be continually or periodically re-assessed

PROCESS

According to the standard ISO 31000 "Risk management – Principles and guidelines on implementation, the process of risk management consists of several steps as follows:

Establishing the context

This involves:

1. identification of risk in a selected domain of interest
2. planning the remainder of the process
3. mapping out the following:
    - the social scope of risk management
    - the identity and objectives of stakeholders
    - the basis upon which risks will be evaluated, constraints.
4. defining a framework for the activity and an agenda for identification
5. developing an analysis of risks involved in the process
6. mitigation or solution of risks using available technological, human and organizational resources

IDENTIFICATION

After establishing the context, the next step in the process of managing risk is to identify potential risks. Risks are about events that, when triggered, cause problems or benefits. Hence, risk identification can start with the source of our problems and those of our competitors (benefit), or with the problem itself.

- Source analysis– Risk sources may be internal or external to the system that is the target of risk management (use mitigation instead of management since by its own definition risk deals with factors of decision-making that cannot be managed).

Examples of risk sources are: stakeholders of a project, employees of a company or the weather over an airport.

- Problem analysis– Risks are related to identified threats. For example: the threat of losing money, the threat of abuse of confidential information or the threat of human errors, accidents and casualties. The threats may exist with various entities, most important with shareholders, customers and legislative bodies such as the government.

When either source or problem is known, the events that a source may trigger or the events that can lead to a problem can be investigated. For example: stakeholders withdrawing during a project may endanger funding of the project; confidential information may be stolen by employees even within a closed network; lightning striking an aircraft during takeoff may make all people on board immediate casualties.

The chosen method of identifying risks may depend on culture, industry practice and compliance. The identification methods are formed by templates or the development of templates for identifying source, problem or event. Common risk identification methods are:

- Objectives-based risk identification– Organizations and project teams have objectives. Any event that may endanger achieving an objective partly or completely is identified as risk.
- Scenario-based risk identification – In scenario analysis different scenarios are created. The scenarios may be the alternative ways to achieve an objective, or an analysis of the

interaction of forces in, for example, a market or battle. Any event that triggers an undesired scenario alternative is identified as risk – see Futures Studies for methodology used by Futurists.

- Taxonomy-based risk identification – The taxonomy in taxonomy-based risk identification is a breakdown of possible risk sources. Based on the taxonomy and knowledge of best practices, a questionnaire is compiled. The answers to the questions reveal risks.
- Common-risk checking– In several industries, lists with known risks are available. Each risk in the list can be checked for application to a particular situation.
- Risk charting – This method combines the above approaches by listing resources at risk, threats to those resources, modifying factors which may increase or decrease the risk and consequences it is wished to avoid. Creating a matrixunder these headings enables a variety of approaches. One can begin with resources and consider the threats they are exposed to and the consequences of each. Alternatively one can start with the threats and examine which resources they would affect, or one can begin with the consequences and determine which combination of threats and resources would be involved to bring them about.

ASSESSMENT

Once risks have been identified, they must then be assessed as to their potential severity of impact (generally a negative impact, such as damage or loss) and to the probability of occurrence. These quantities can be either simple to measure, in the case of the value of a lost building, or impossible to know for sure in the case of an unlikely event, the probability of occurrence of which is unknown. Therefore, in the assessment process it is critical to make the best educated decisions in order to properly prioritize the implementation of the risk management plan.

Even a short-term positive improvement can have long-term negative impacts. Take the "turnpike" example. A highway is widened to allow more traffic. More traffic capacity leads to greater development in the areas surrounding the improved traffic capacity. Over time, traffic thereby increases to fill available capacity. Turnpikes thereby need to be expanded in a seemingly endless cycles. There are many other engineering examples where expanded capacity (to do any function) is soon filled by increased demand. Since expansion comes at a cost, the resulting growth could become unsustainable without forecasting and management.

The fundamental difficulty in risk assessment is determining the rate of occurrence since statistical information is not available on all kinds of past incidents and is particularly scanty in the case of catastrophic events, simply because of their infrequency. Furthermore, evaluating the severity of the consequences (impact) is often quite difficult for intangible assets. Asset valuation is another question that needs to be addressed. Thus, best educated opinions and available statistics are the primary sources of information. Nevertheless, risk assessment should produce such information for senior executives of the organization that the primary risks are easy to understand and that the risk management decisions may be prioritized within overall company goals. Thus, there have been several theories and attempts to quantify risks. Numerous different risk formulae exist, but perhaps the most widely accepted formula for risk quantification is: "Rate (or probability) of occurrence multiplied by the impact of the event equals risk magnitude."

RISK OPTIONS

Risk mitigation measures are usually formulated according to one or more of the following major risk options, which are:

1. Design a new business process with adequate built-in risk control and containment measures from the start.
2. Periodically re-assess risks that are accepted in ongoing processes as a normal feature of business operations and modify mitigation measures.
3. Transfer risks to an external agency (e.g. an insurance company)
4. Avoid risks altogether (e.g. by closing down a particular high-risk business area)

Later research has shown that the financial benefits of risk management are less dependent on the formula used but are more dependent on the frequency and how risk assessment is performed.

In business it is imperative to be able to present the findings of risk assessments in financial, market, or schedule terms. Robert Courtney Jr. (IBM, 1970) proposed a formula for presenting risks in financial terms. The Courtney formula was accepted as the official risk analysis method for the US governmental agencies. The formula proposes calculation of ALE (annualized loss expectancy) and compares the expected loss value to the security control implementation costs (cost-benefit analysis).

Potential risk treatments

Once risks have been identified and assessed, all techniques to manage the risk fall into one or more of these four major categories:

- Avoidance (eliminate, withdraw from or not become involved)
- Reduction (optimize – mitigate)
- Sharing (transfer – outsource or insure)
- Retention (accept and budget)

Ideal use of these risk control strategies may not be possible. Some of them may involve trade-offs that are not acceptable to the organization or person making the risk management decisions. Another source, from the US Department of Defense (see link), Defense Acquisition University, calls these categories ACAT, for Avoid, Control, Accept, or Transfer. This use of the ACAT acronym is reminiscent of another ACAT (for Acquisition Category) used in US Defense industry procurements, in which Risk Management figures prominently in decision making and planning.

RISK AVOIDANCE

This includes not performing an activity that could carry risk. An example would be not buying a property or business in order to not take on the legal liability that comes with it. Another would be not flying in order not to take the risk that the airplanewere to be hijacked. Avoidance may seem the answer to all risks, but avoiding risks also means losing out on the potential gain that accepting (retaining) the risk may have allowed. Not entering a business to avoid the risk of loss also avoids the possibility of earning profits. Increasing risk regulation in hospitals has led to avoidance of treating higher risk conditions, in favor of patients presenting with lower risk.

Risk reduction

Risk reduction or "optimization" involves reducing the severity of the loss or the likelihood of the loss from occurring. For example, sprinklers are designed to put out a fire to reduce the risk of loss by fire. This method may cause a greater loss by water damage and therefore may not be suitable. Halon fire suppression systems may mitigate that risk, but the cost may be prohibitive as a strategy.

Acknowledging that risks can be positive or negative, optimizing risks means finding a balance between negative risk and the benefit of the operation or activity; and between risk reduction and effort applied. By an offshore drilling contractor effectively applying Health, Safety and Environment (HSE) management in its organization, it can optimize risk to achieve levels of residual risk that are tolerable.

Modern software development methodologies reduce risk by developing and delivering software incrementally. Early methodologies suffered from the fact that they only delivered software in the final phase of development; any problems encountered in earlier phases meant costly rework and often jeopardized the whole project. By developing in iterations, software projects can limit effort wasted to a single iteration.

Outsourcing could be an example of risk reduction if the outsourcer can demonstrate higher capability at managing or reducing risks. For example, a company may outsource only its software development, the manufacturing of hard goods, or customer support needs to another company, while handling the business management itself. This way, the company can concentrate more on business development without having to worry as much about the manufacturing process, managing the development team, or finding a physical location for a call center.

RISK SHARING

Briefly defined as "sharing with another party the burden of loss or the benefit of gain, from a risk, and the measures to reduce a risk."

The term of 'risk transfer' is often used in place of risk sharing in the mistaken belief that you can transfer a risk to a third party through insurance or outsourcing. In practice if the insurance company or contractor go bankrupt or end up in court, the original risk is likely to still revert to the first party. As such in the terminology of practitioners and scholars alike, the purchase of an insurance contract is often described as a "transfer of risk." However, technically speaking, the buyer of the contract generally retains legal responsibility for the losses "transferred", meaning that insurance may be described more accurately as a post-event compensatory mechanism. For example, a personal injuries insurance policy does not transfer the risk of a car accident to the insurance company. The risk still lies with the policy holder namely the person who has been in the accident. The insurance policy simply provides that if an accident (the event) occurs involving the policy holder then some compensation may be payable to the policy holder that is commensurate with the suffering/damage.

Some ways of managing risk fall into multiple categories. Risk retention pools are technically retaining the risk for the group, but spreading it over the whole group involves transfer among individual members of the group. This is different from traditional insurance, in that no premium is exchanged between members of the group up front, but instead losses are assessed to all members of the group.

RISK RETENTION

Involves accepting the loss, or benefit of gain, from a risk when it occurs. True self-insurance falls in this category. Risk retention is a viable strategy for small risks where the cost of insuring against the risk would be greater over time than the total losses sustained. All risks that are not avoided or transferred are retained by default. This includes risks that are so large or catastrophic that either they cannot be insured against or the premiums would be infeasible. War is an example since most property and risks are not insured against war, so the loss attributed by war is retained by the insured. Also any amounts of potential loss (risk) over the amount insured is retained risk. This may also be acceptable if the chance of a very large loss is small or if the cost to insure for greater coverage amounts is so great that it would hinder the goals of the organization too much.

RISK MANAGEMENT PLAN

Select appropriate controls or countermeasures to measure each risk. Risk mitigation needs to be approved by the appropriate level of management. For instance, a risk concerning the image of the organization should have top management decision behind it whereas IT management would have the authority to decide on computer virus risks.

The risk management plan should propose applicable and effective security controls for managing the risks. For example, an observed high risk of computer viruses could be mitigated by acquiring and implementing antivirus software. A good risk management plan should contain a schedule for control implementation and responsible persons for those actions.

According to ISO/IEC 27001, the stage immediately after completion of the risk assessment phase consists of preparing a Risk Treatment Plan, which should document the decisions about how each of the identified risks should be handled. Mitigation of risks often means selection of security controls, which should be documented in a Statement of Applicability, which identifies which particular control objectives and controls from the standard have been selected, and why.

IMPLEMENTATION

Implementation follows all of the planned methods for mitigating the effect of the risks. Purchase insurance policies for the risks that it has been decided to transferred to an insurer, avoid all risks that can be avoided without sacrificing the entity's goals, reduce others, and retain the rest.

REVIEW AND EVALUATION OF THE PLAN

Initial risk management plans will never be perfect. Practice, experience, and actual loss results will necessitate changes in the plan and contribute information to allow possible different decisions to be made in dealing with the risks being faced.

Risk analysis results and management plans should be updated periodically. There are two primary reasons for this:

1. to evaluate whether the previously selected security controls are still applicable and effective
2. to evaluate the possible risk level changes in the business environment. For example, information risks are a good example of rapidly changing business environment.

LIMITATIONS

Prioritizing the *risk management processes* too highly could keep an organization from ever completing a project or even getting started. This is especially true if other work is suspended until the risk management process is considered complete.

It is also important to keep in mind the distinction between risk and uncertainty. Risk can be measured by impacts × probability.

If risks are improperly assessed and prioritized, time can be wasted in dealing with risk of losses that are not likely to occur. Spending too much time assessing and managing unlikely risks can divert resources that could be used more profitably. Unlikely events do occur but if the risk is unlikely enough to occur it may be better to simply retain the risk and deal with the result if the loss does in fact occur. Qualitative risk assessment is subjective and lacks consistency. The primary justification for a formal risk assessment process is legal and bureaucratic.

PROJECT MANAGEMENT

Project risk management must be considered at the different phases of acquisition. In the beginning of a project, the advancement of technical developments, or threats presented by a competitor's projects, may cause a risk or threat assessment and subsequent evaluation of alternatives (see Analysis of Alternatives). Once a decision is made, and the project begun, more familiar project management applications can be used:

An example of the Risk Register for a project that includes 4 steps: Identify, Analyze, Plan Response, Monitor and Control.

- Planning how risk will be managed in the particular project. Plans should include risk management tasks, responsibilities, activities and budget.
- Assigning a risk officer – a team member other than a project manager who is responsible for foreseeing potential project problems. Typical characteristic of risk officer is a healthy skepticism.
- Maintaining live project risk database. Each risk should have the following attributes: opening date, title, short description, probability and importance. Optionally a risk may have an assigned person responsible for its resolution and a date by which the risk must be resolved.
- Creating anonymous risk reporting channel. Each team member should have the possibility to report risks that he/she foresees in the project.
- Preparing mitigation plans for risks that are chosen to be mitigated. The purpose of the mitigation plan is to describe how this particular risk will be handled – what, when, by whom and how will it be done to avoid it or minimize consequences if it becomes a liability.
- Summarizing planned and faced risks, effectiveness of mitigation activities, and effort spent for the risk management.

MEGAPROJECTS (INFRASTRUCTURE)

Megaprojects (sometimes also called "major programs") are large-scale investment projects, typically costing more than $1 billion per project. Megaprojects include major bridges, tunnels, highways, railways, airports, seaports, power plants, dams, wastewater projects, coastal flood protection schemes, oil and natural gas extraction projects, public buildings, information technology systems, aerospace projects, and defense systems. Megaprojects have been shown to be particularly risky in terms of finance, safety, and social and environmental impacts. Risk management is therefore particularly pertinent for megaprojects and special methods and special education have been developed for such risk management.

NATURAL DISASTERS

It is important to assess risk in regard to natural disasters like floods, earthquakes, and so on. Outcomes of natural disaster risk assessment are valuable when considering future repair costs, business interruption losses and other downtime, effects on the environment, insurance costs, and the proposed costs of reducing the risk. There are regular International Disaster and Risk Conferences in Davos to deal with integral risk management.

INFORMATION TECHNOLOGY

IT risk is a risk related to information technology. This is a relatively new term due to an increasing awareness that information security is simply one facet of a multitude of risks that are relevant to IT and the real world processes it supports.

PETROLEUM AND NATURAL GAS

For the offshore oil and gas industry, operational risk management is regulated by the safety case regime in many countries. Hazard identification and risk assessment tools and techniques are described in the international standard ISO 17776:2000, and organisations such as the IADC) publish guidelines for Health, Safety and Environment (HSE) Case development which are based on the ISO standard. Further, diagrammatic representations of hazardous events are often expected by governmental regulators as part of risk management in safety case submissions; these are known as **bow-tie diagrams** (see Network theory in risk assessment). The technique is also used by organisations and regulators in mining, aviation, health, defence, industrial and finance.

PHARMACEUTICAL SECTOR

The principles and tools for quality risk management are increasingly being applied to different aspects of pharmaceutical quality systems. These aspects include development, manufacturing, distribution, inspection, and submission/review processes throughout the lifecycle of drug substances, drug products, biological and biotechnological products (including the use of raw materials, solvents, excipients, packaging and labeling materials in drug products, biological and biotechnological products). Risk management is also applied to the assessment of microbiological contamination in relation to pharmaceutical products and cleanroom manufacturing environments.

RISK COMMUNICATION

Risk communication is a complex cross-disciplinary academic field related to core values of the targeted audiences. Problems for risk communicators involve how to reach the intended audience, how to make the risk comprehensible and relatable to other risks, how to pay appropriate respect to the audience's values related to the risk, how to predict the audience's response to the communication, etc. A main goal of risk communication is to improve collective and individual decision making. Risk communication is somewhat related to crisis communication. Some experts coincide that risk is not only enrooted in the communication process but also it cannot be dissociated from the use of language. Though each culture develops its own fears and risks, these construes apply only by the hosting culture.

ISO 14000

ISO 14000 is a family of standards related to environmental management that exists to help organizations (a) minimize how their operations (processes, etc.) negatively affect the environment (i.e. cause adverse changes to air, water, or land); (b) comply with applicable laws, regulations, and other environmentally oriented requirements; and (c) continually improve in the above.

ISO 14000 is similar to ISO 9000 quality management in that both pertain to the process of how a product is produced, rather than to the product itself. As with ISO 9001, certification is performed by third-party organizations rather than being awarded by ISO directly. The ISO 19011 and ISO 17021 audit standards apply when audits are being performed.

The requirements of ISO 14001 are an integral part of the European Union's Eco-Management and Audit Scheme (EMAS). EMAS's structure and material are more demanding, mainly concerning performance improvement, legal compliance, and reporting duties. The current version of ISO 14001 is ISO 14001:2015, which was published in September 2015.

DEVELOPMENT OF THE ISO 14000 SERIES

The ISO 14000 family includes most notably the ISO 14001 standard, which represents the core set of standards used by organizations for designing and implementing an effective environmental management system (EMS). Other standards in this series include ISO 14004, which gives additional guidelines for a good EMS, and more specialized standards dealing with specific aspects of environmental management. The major objective of the ISO 14000 series of norms is to provide "practical tools for companies and organizations of all kinds looking to manage their environmental responsibilities."

The ISO 14000 series is based on a voluntary approach to environmental regulation. The series includes the ISO 14001 standard, which provides guidelines for the establishment or improvement of an EMS. The standard shares many common traits with its predecessor, ISO 9000, the international standard of quality management, which served as a model for its internal structure, and both can be implemented side by side. As with ISO 9000, ISO 14000 acts both as an internal management tool and as a way of demonstrating a company's environmental commitment to its customers and clients.

ISO 14001 standard

ISO 14001 defines criteria for an EMS. It does not state requirements for environmental performance but rather maps out a framework that a company or organization can follow to set up an effective EMS. It can be used by any organization that wants to improve resource efficiency, reduce waste, and reduce costs. Using ISO 14001 can provide assurance to company management and employees as well as external stakeholders that environmental impact is being measured and improved. ISO 14001 can also be integrated with other management functions and assists companies in meeting their environmental and economic goals.

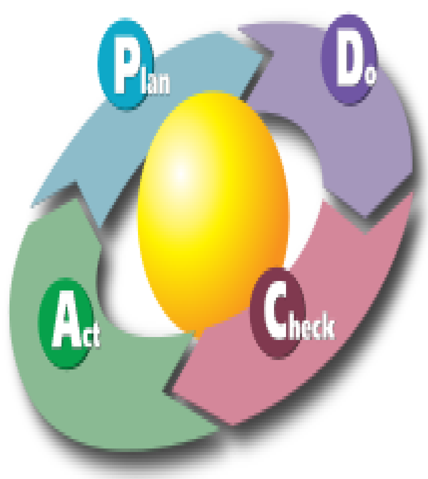
ISO 14001, like other ISO 14000 standards, is voluntary, with its main aim to assist companies in continually improving their environmental performance and complying with any applicable legislation. The organization sets its own targets and performance measures, and the standard highlights what an organization needs to do to meet those goals, and to monitor and measure the situation. The standard does not focus on measures and goals of environmental performance, but of the organization. The standard can be applied to a variety of levels in the business, from the organizational level down to the product and service level.

ISO 14001 is known as a generic management system standard, meaning that it is relevant to any organization seeking to improve and manage resources more effectively. This includes:

- single-site to large multi-national companies
- high-risk companies to low-risk service organizations
- the manufacturing, process, and service industries, including local governments
- all industry sectors, including public and private sectors
- original equipment manufacturers and their suppliers

All standards are periodically reviewed by ISO to ensure they still meet market requirements. The current version is ISO 14001:2015, and certified organizations were given a three-year transition period to adapt their environmental management system to the new edition of the standard. The new version of ISO 14001 focuses on the improvement of environmental performance rather than the improvement of the management system itself.[12] It also includes several new updates all aimed at making environmental management more comprehensive and relevant to the supply chain. One of the main updates asks organizations to consider environmental impact during the entire life cycle, although there is no requirement to actually complete a life cycle analysis. Additionally, the commitments of top management and the methods of evaluating compliance have also been strengthened. Another significant change linked ISO 14001 to the general management system structure, introduced in 2015, called the High Level Structure. Both ISO 9001 and 14001 use this same structure, making implementation and auditing more uniform. The new standard also requires the holder of the certificate to specify risks and opportunities and how to address them.

BASIC PRINCIPLES AND METHODOLOGY



The basic principles of ISO 14001 are based on the well-known Plan-Do-Check-Act(PDCA) cycle.

PLAN: ESTABLISH OBJECTIVES AND PROCESSES REQUIRED

Prior to implementing ISO 14001, an initial review or gap analysis of the organization's processes and products is recommended, to assist in identifying all elements of the current operation and, if possible, future operations, that may interact with the environment, termed "environmental aspects."[13] Environmental aspects can include both direct, such as those used during manufacturing, and indirect, such as raw materials. This review assists the organization in establishing their environmental objectives, goals, and targets (which should ideally be measurable); helps with the development of control and management procedures and processes; and serves to highlight any relevant legal requirement, which can then be built into the policy.

DO: IMPLEMENT THE PROCESSES

During this stage, the organization identifies the resources required and works out those members of the organization responsible for the EMS' implementation and control. This includes establishing procedures and processes, although only one documented procedure is specifically related to operational control. Other procedures are required to foster better management control over elements such as documentation control, emergency preparedness and response, and the education of employees, to ensure that they can competently implement the necessary processes and record results. Communication and participation across all levels of the organization, especially top management, is a vital part of the implementation phase, with the effectiveness of the EMS being dependent on active involvement from all employees.

CHECK: MEASURE AND MONITOR THE PROCESSES AND REPORT RESULTS

During the "check" stage, performance is monitored and periodically measured to ensure that the organization's environmental targets and objectives are being met. In addition, internal audits are conducted at planned intervals to ascertain whether the EMS meets the user's expectations and whether the processes and procedures are being adequately maintained and monitored.

ACT: TAKE ACTION TO IMPROVE PERFORMANCE OF EMS BASED ON RESULTS

After the checking stage, a management review is conducted to ensure that the objectives of the EMS are being met, the extent to which they are being met, and that communications are being appropriately managed. Additionally, the review evaluates changing circumstances, such as legal requirements, in order to make recommendations for further improvement of the system. These recommendations are incorporated through continual improvement: plans are renewed or new plans are made, and the EMS moves forward.

CONTINUAL IMPROVEMENT PROCESS (CI)

ISO 14001 encourages a company to continually improve its environmental performance. Apart from the obvious – the reduction in actual and possible negative environmental impacts – this is achieved in three ways:

- Expansion: Business areas increasingly get covered by the implemented EMS.
- Enrichment: Activities, products, processes, emissions, resources, etc. increasingly get managed by the implemented EMS.
- Upgrading: The structural and organizational framework of the EMS, as well as an accumulation of knowledge in dealing with business-environmental issues, is improved.

Overall, the CI concept expects the organization to gradually move away from merely operational environmental measures towards a more strategic approach on how to deal with environmental challenges.

BENEFITS

ISO 14001 was developed primarily to assist companies with a framework for better management control, which can result in reducing their environmental impacts. In addition to improvements in performance, organizations can reap a number of economic benefits, including higher conformance with legislative and regulatory requirements by adopting the ISO standard. By minimizing the risk of regulatory and environmental liability fines and improving an organization’s efficiency, benefits can include a reduction in waste, consumption of resources, and operating costs. Secondly, as an internationally recognized standard, businesses operating in multiple locations across the globe can leverage their conformance to ISO 14001, eliminating the need for multiple registrations or certifications. Thirdly, there has been a push in the last decade by consumers for companies to adopt better internal controls, making the incorporation of ISO 14001 a smart approach for the long-term viability of businesses. This can provide them with a competitive advantage against companies that do not adopt the standard (Potoki & Prakash, 2005). This in turn can have a positive impact on a company's asset value (Van der Deldt, 1997).

It can lead to improved public perceptions of the business, placing them in a better position to operate in the international marketplace. The use of ISO 14001 can demonstrate an innovative and forward-thinking approach to customers and prospective employees. It can increase a business's access to new customers and business partners. In some markets it can potentially reduce public liability insurance costs. It can also serve to reduce trade barriers between registered businesses.There is growing interest in including certification to ISO 14001 in tenders for public-private partnerships for infrastructure renewal. Evidence of value in terms of environmental quality and benefit to the taxpayer has been shown in highway projects in Canada.

CONFORMITY ASSESSMENT

ISO 14001 can be used in whole or in part to help an organization (for-profit or not-for-profit) better manage its relationship with the environment. If all the elements of ISO 14001 are incorporated into the management process, the organization may opt to prove that it has achieved full alignment or conformity with the international standard, ISO 14001, by using one of four recognized options. These are:

1. make a self-determination and self-declaration, or
2. seek confirmation of its conformance by parties having an interest in the organization, such as customers, or
3. seek confirmation of its self-declaration by a party external to the organization, or
4. seek certification/registration of its EMS by an external organization.

ISO does not control conformity assessment; its mandate is to develop and maintain standards. ISO has a neutral policy on conformity assessment in so much that one option is not better than the next. Each option serves different market needs. The adopting organization decides which option is best for them, in conjunction with their market needs.

Option one is sometimes incorrectly referred to as "self-certify" or "self-certification". This is not an acceptable reference under ISO terms and definitions, for it can lead to confusion in the market.[13] The user is responsible for making their own determination.

Option two is often referred to as a customer or 2nd-party audit, which is an acceptable market term.

Option three is an independent third-party process by an organization that is based on an engagement activity and delivered by specially trained practitioners. This option was based on an accounting procedure branded as the EnviroReady Report, which was created to help small- and medium-sized organizations. Its development was originally based on the Canadian Handbook for Accountants; it is now based on an international accounting standard.

The fourth option, certification, is another independent third-party process, which has been widely implemented by all types of organizations. Certification is also known in some countries as registration. Service providers of certification or registration are accredited by national accreditation services such as UKAS in the UK.

ISO 14001 and EMAS

In 2010, the latest EMAS Regulation (EMAS III) entered into force; the scheme is now globally applicable, and includes key performance indicators and a range of further improvements. As of April 2017, more than 3,900 organizations and approximately 9,200 sites are EMAS registered.

COMPLEMENTARITIES AND DIFFERENCES

ISO 14001's EMS requirements are similar to those of EMAS. Additional requirements for EMAS include:

- stricter requirements on the measurement and evaluation of environmental performance against objectives and targets
- government supervision of the environmental verifiers
- strong employee involvement; EMAS organizations acknowledge that active employee involvement is a driving force and a prerequisite for continuous and successful environmental improvements.
- environmental core indicators creating multi-annual comparability within and between organizations
- mandatory provision of information to the general public
- registration by a public authority

ISO 14001 USE IN SUPPLY CHAINS

There are many reasons that ISO 14001 should be potentially attractive to supply chain managers, including the use of the voluntary standard to guide the development of integrated systems, its requirement for supply chain members in industries such as automotive and aerospace, the potential of pollution prevention leading to reduced costs of production and higher profits, its alignment with the growing importance of corporate social responsibility, and the possibility that an ISO-registered system may provide firms with a unique environmental resource, capabilities, and benefits that lead to competitive advantage.

Research on the supply chain impact of ISO 14001 registration posited that potential positive impacts might include more proactive environmental management, higher levels of communication, higher levels of waste reduction and cost efficiency, better ROI, higher levels of customer relationship management, fewer issues with employee health, and a reduced number of safety incidents. This research concluded that ISO 14001 registration can be leveraged across the supply chain for competitive advantage.

LIST OF ISO 14000 SERIES STANDARDS

- **ISO 14001** Environmental management systems - Requirements with guidance for use
- **ISO 14004** Environmental management systems - General guidelines on implementation
- **ISO 14006** Environmental management systems - Guidelines for incorporating ecodesign
- **ISO 14015** Environmental management - Environmental assessment of sites and organizations (EASO)
- **ISO 14020** to **14025** Environmental labels and declarations
- **ISO/NP 14030** Green bonds -- Environmental performance of nominated projects and assets; discusses post-production environmental assessment
- **ISO 14031** Environmental management - Environmental performance evaluation - Guidelines
- **ISO 14040** to **14049** Environmental management - Life cycle assessment; discusses pre-production planning and environment goal setting

- **ISO 14046** Environmental management - Water footprint - Principles, requirements and guidelines
- **ISO 14050** Environmental management - Vocabulary; terms and definitions
- **ISO/TR 14062** Environmental management - Integrating environmental aspects into product design and development
- **ISO 14063** Environmental management - Environmental communication - Guidelines and examples
- **ISO 14064** Greenhouse gases; measuring, quantifying, and reducing greenhouse gas emissions
- **ISO 19011** Guidelines for auditing management systems; specifies one audit protocol for both 14000 and 9000 series standards together.

FIRST AID

First aid is the assistance given to any person suffering a sudden illness or injury,[1] with care provided to preserve life, prevent the condition from worsening, or to promote recovery. It includes initial intervention in a serious condition prior to professional medical help being available, such as performing CPR while awaiting an ambulance, as well as the complete treatment of minor conditions, such as applying a plaster to a cut. First aid is generally performed by the layperson, with many people trained in providing basic levels of first aid, and others willing to do so from acquired knowledge. Mental health first aid is an extension of the concept of first aid to cover mental health.

There are many situations which may require first aid, and many countries have legislation, regulation, or guidance which specifies a minimum level of first aid provision in certain circumstances. This can include specific training or equipment to be available in the workplace (such as an Automated External Defibrillator), the provision of specialist first aid cover at public gatherings, or mandatory first aid training within schools. First aid, however, does not necessarily require any particular equipment or prior knowledge, and can involve improvisation with materials available at the time, often by untrained persons.

First aid can be performed on all mammals, although this article relates to the care of human patients.

AIMS

- **Preserve life**: The overriding aim of all medical care which includes first aid, is to save lives and minimize the threat of death.
- **Prevent further harm**: Prevent further harm also sometimes called **prevent the condition from worsening**, or **danger of further injury**, this covers both external factors, such as moving a patient away from any cause of harm, and applying first aid techniques to prevent worsening of the condition, such as applying pressure to stop a bleed becoming dangerous.
- **Promote recovery**: First aid also involves trying to start the recovery process from the illness or injury, and in some cases might involve completing a treatment, such as in the case of applying a plaster to a small wound.

TRAINING

Basic principles, such as knowing to use an adhesive bandage or applying direct pressure on a bleed, are often acquired passively through life experiences. However, to provide effective, life-saving first aid interventions requires instruction and practical training. This is especially true where it relates to potentially fatal illnesses and injuries, such as those that require cardiopulmonary resuscitation (CPR); these procedures may be invasive, and carry a risk of further injury to the patient and the provider. As with any training, it is more useful if it occurs *before* an actual emergency, and in many countries, emergency ambulance dispatchers may give basic first aid instructions over the phone while the ambulance is on the way.

Training is generally provided by attending a course, typically leading to certification. Due to regular changes in procedures and protocols, based on updated clinical knowledge, and to maintain skill, attendance at regular refresher courses or re-certification is often necessary. First aid training is often available through community organizations such as the Red Cross and St. John Ambulance, or through commercial providers, who will train people for a fee. This commercial training is most common for training of employees to perform first aid in their workplace. Many community organizations also provide a commercial service, which complements their community programmes.

SPECIFIC DISCIPLINES

There are several types of first aid (and first aider) which require specific additional training. These are usually undertaken to fulfill the demands of the work or activity undertaken.

- **Aquatic/Marine first aid** is usually practiced by professionals such as lifeguards, professional mariners or in diver rescue, and covers the specific problems which may be faced after water-based rescue or delayed MedEvac.
- **Battlefield first aid** takes into account the specific needs of treating wounded combatants and non-combatants during armed conflict.
- **Hyperbaric first aid** may be practiced by SCUBA diving professionals, who need to treat conditions such as the bends.
- **Oxygen first aid** is the providing of oxygen to casualties who suffer from conditions resulting in hypoxia.
- **Wilderness first aid** is the provision of first aid under conditions where the arrival of emergency responders or the evacuation of an injured person may be delayed due to constraints of terrain, weather, and available persons or equipment. It may be necessary to care for an injured person for several hours or days.
- **Mental health first aid** is taught independently of physical first aid. How to support someone experiencing a mental health problem or in a crisis situation. Also how to identify the first signs of someone developing mental ill health and guide people towards appropriate help.

FIRST AID SERVICES

First aider of the British Red Crossaccompanies parade of morris dancers at the Knutsford Royal May Day 2012

Some people undertake specific training in order to provide first aid at public or private events, during filming, or other places where people gather. They may be designated as a **first aider**, or use some other title. This role may be undertaken on a voluntary basis, with organisations such as the Red Cross and St John Ambulance, or as paid employment with a medical contractor.

People performing a first aid role, whether in a professional or voluntary capacity, are often expected to have a high level of first aid training and are often uniformed.

SYMBOLS

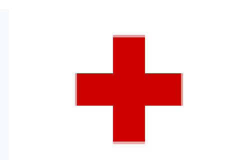
Although commonly associated with first aid, the symbol of a red cross is an official protective symbol of the Red Cross. According to the Geneva Conventions and other international laws, the use of this and similar symbols is reserved for official agencies of the **International Red Cross and Red Crescent**, and as a protective emblem for medical personnel and facilities in combat situations. Use by any other person or organization is illegal, and may lead to prosecution.

The internationally accepted symbol for first aid is the white cross on a green background shown below.

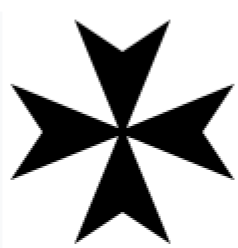
Some organizations may make use of the Star of Life, although this is usually reserved for use by ambulance services, or may use symbols such as the Maltese Cross, like the Order of Malta Ambulance Corps and St John Ambulance. Other symbols may also be used.

ISO First Aid Symbol

St. Andrew's First Aid Badge

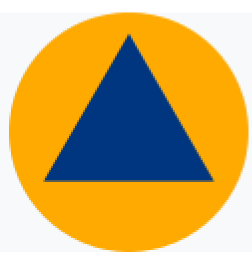


Emblem of the Red Cross



Maltese or Amalfi Cross

Star of life



Civil defence

Conditions that often require first aid

- Altitude sickness, which can begin in susceptible people at altitudes as low as 5,000 feet, can cause potentially fatal swelling of the brain or lungs.
- Anaphylaxis, a life-threatening condition in which the airway can become constricted and the patient may go into shock. The reaction can be caused by a systemic allergic reaction to allergens such as insect bites or peanuts. Anaphylaxis is initially treated with injection of epinephrine.
- Battlefield first aid—This protocol refers to treating shrapnel, gunshot wounds, burns, bone fractures, etc. as seen either in the 'traditional' battlefield setting or in an area subject to damage by large-scale weaponry, such as a bomb blast.
- Bone fracture, a break in a bone initially treated by stabilizing the fracture with a splint.
- Burns, which can result in damage to tissues and loss of body fluids through the burn site.
- Cardiac Arrest, which will lead to death unless CPR preferably combined with an AED is started within minutes. There is often no time to wait for the emergency services to arrive as 92 percent of people suffering a sudden cardiac arrest die before reaching hospital according to the American Heart Association.
- Choking, blockage of the airway which can quickly result in death due to lack of oxygen if the patient's trachea is not cleared, for example by the Heimlich Maneuver.
- Childbirth.
- Cramps in muscles due to lactic acid build up caused either by inadequate oxygenation of muscle or lack of water or salt.
- Diving disorders, drowning or asphyxiation.
- Gender-specific conditions, such as dysmenorrhea and testicular torsion.
- Heart attack, or inadequate blood flow to the blood vessels supplying the heart muscle.
- Heat stroke, also known as sunstroke or hyperthermia, which tends to occur during heavy exercise in high humidity, or with inadequate water, though it may occur spontaneously in some chronically ill persons. Sunstroke, especially when the victim has been unconscious, often causes major damage to body systems such as brain, kidney, liver, gastric tract. Unconsciousness for more than two hours usually leads to permanent disability. Emergency treatment involves rapid cooling of the patient.
- Hair tourniquet a condition where a hair or other thread becomes tied around a toe or finger tightly enough to cut off blood flow.
- Heat syncope, another stage in the same process as heat stroke, occurs under similar conditions as heat stroke and is not distinguished from the latter by some authorities.
- Heavy bleeding, treated by applying pressure (manually and later with a pressure bandage) to the wound site and elevating the limb if possible.
- Hyperglycemia (diabetic coma) and Hypoglycemia (insulin shock).
- Hypothermia, or Exposure, occurs when a person's core body temperature falls below 33.7 °C (92.6 °F). First aid for a mildly hypothermic patient includes rewarming, which can be achieved by wrapping the affected person in a blanket, and providing warm drinks, such as soup, and high energy food, such as chocolate. However, rewarming a severely hypothermic person could result in a fatal arrhythmia, an irregular heart rhythm.
- Insect and animal bites and stings.
- Joint dislocation.

- Poisoning, which can occur by injection, inhalation, absorption, or ingestion.
- Seizures, or a malfunction in the electrical activity in the brain. Three types of seizures include a grand mal (which usually features convulsions as well as temporary respiratory abnormalities, change in skin complexion, etc.) and petit mal (which usually features twitching, rapid blinking, or fidgeting as well as altered consciousness and temporary respiratory abnormalities).
- Muscle strains and Sprains, a temporary dislocation of a joint that immediately reduces automatically but may result in ligament damage.
- Stroke, a temporary loss of blood supply to the brain.
- Toothache, which can result in severe pain and loss of the tooth but is rarely life-threatening, unless over time the infection spreads into the bone of the jaw and starts osteomyelitis.
- Wounds and bleeding, including lacerations, incisions and abrasions, Gastrointestinal bleeding, avulsions and Sucking chest wounds, treated with an occlusive dressing to let air out but not in.

FIRST AID KIT

Many accidents can happen at home, office, schools, laboratories etc. which require immediate attention before the patient is attended by the doctor.

MAKING OF THE FIRST AID KIT

Though professional first aid kits are readily available, one can make a simple kit easily at home. Still, ready made First Aid kits/boxes/pouches/cases are recommended, as they have well organized compartments. To make a First Aid kit, a strong, durable bag or transparent plastic box should be taken and a white cross in a green square placed on the sides and on the top. This will make for easy identification of the box to any user. The kit should be kept such that it is within reach in case of an emergency.

Contents

A First Aid Kit should have the following contents:

- **first-aid manual** different sizes
- **adhesive tape**
- **adhesive bandages** in several sizes
- **elastic bandage**
- **a splint**
- **antiseptic wipes**
- **soap**
- **antibiotic ointment**
- **antiseptic solution** (like hydrogen peroxide or saline)
- **hydrocortisone cream** (1%)
- **acetaminophen and ibuprofen**
- **extra prescription medications** (if traveling)
- **tweezers**
- **sharp scissors**
- **safety pins**

- **disposable instant cold packs**
- **calamine lotion**
- **alcohol wipes or ethyl alcohol**
- **thermometer**
- **tooth preservation kit**
- **plastic non-latex gloves**(at least 2 pairs)
- **flashlight and extra batteries**
- **thermal shock blanket**
- **mouthpiece** for administering CPR (can be obtained from your local Red Cross)
- **blanket (stored nearby)**
- **First Aid Card** containing emergency personal information, phone numbers, medications, manual,
- **pocket defibrillator**

ONSITE AND OFFSITE EMERENCY PLAN

On-site Emergency

If an accident/incident takes place in a factory, its effects are confined to the factory premises, involving only the personss working in the factory and the property inside the factory it is called as On-site Emergency.

Off-site Emergency

If the accident is such that its affects inside the factory are uncontrollable and it may spread outside the factory premises, it is called as Off-site Emergency.

Why Emergency Plan?

The main objectives of an emergency plan are:- a. to control and contain the incident/accident and if possible, eliminate it; and b. to minimize the effects of the incident on persons, property and environment. 6. Each factory or industrial unit should prepare an emergency plan incorporating details of action to be taken in case of any major accident/disaster occurring inside the factory. The plan should cover all types of major accident/occurrences and identify the risk involved in the plant. Mock drills on the plan should be carried out periodically to make the plan foolproof and persons are made fully prepared to fight against any incident in the plant. The plan will vary according to the type of industry and emergency.

On-Site Emergency Plan

After the Bhopal gas tragedy (1984) and Supreme Court direction in case of M/S. Sriram Foods and Fertilizers Vs the Govt. of India has made some important amendments to the Factories Act 1948 in the year 1987 with incorporation of special provisions relating to hazardous process. Under Section 41(B) (4) every occupier is to prepare On-site Emergency Plan and detailed disaster control measures for his factory. Again under provision of Rule 13 of the Manufacture, Storage and Import of Hazardous Chemicals Rules 1989, the occupier shall prepare and keep up to date On-site Emergency plan containing details how major accidents will be dealt with on the site on which the industrial activity is carried on and that plan shall include the name of the persons who is responsible for safety on the site and names of those who are authorized to take action in accordance with the plan in case of emergency. Preparation of On-site Emergency Plan by the occupier is mandatory. The occupier shall ensure a mock drill of the on site emergency plan is conducted at least one in every six months. A detailed report of the mock drill conducted under rule shall be made immediately available to the Inspector and Chief Inspector. Main elements of On-site Emergency plans

. The main elements of on-site emergency plans are:-

o Leadership and Administration.

o Role and Responsibilities of Key Personnel.

o Emergency action. o Light and Power.

o Source of energy control.

o Protective and rescue equipment.

o Communication.

Medical care.

o Mutual Aid.

o Public relation.

o Protection of vital records.

o Training.

o Periodical revision of plan.

Emergency Action Plan for On-Site Emergency Plan.

The Action Plan should consist of the following:- Designated Emergency Control Centre/Room.¬ Key Personnel.¬

Emergency Control Centre . This is the main center from where the operations to handle the emergency are directed and co-ordinated. Facilities to be made available in the emergency control are:- i. Internal and external communication. ii. Computer and other essential records. iii.

Daily attendance of workmen employed in factory. iv. Storage of hazardous material records and manufacturing records. v. Pollution records. vi. Walky-talky. vii. Plan of the plant showing:-

a. Storage area of hazardous materials. b. Storage of safety equipments. c. Fire fighting system and additional source of water. d. Site entrance, roadway and emergency exist. e. Assembly points. f. Truck parking area. g. Surrounding location. viii. Note Book, Pad and Pencil.

II ASSEMBLY POINTS

. A safe place far away from the plant should be pre determined as assembly point where in case of emergency personnel evacuated from the affected areas are to be assembled. The plant workers, contract workers and visitors should assemble in assembly point in case of emergency and the time office clerk should take their attendance so as to assess the missing persons during emergency. II. The Key Personnel for onsite emergency:- 1. Works Main Controller. 2. Works Incident Controller. 3. Other Key Officers a. Communication Officer. b. Security and Fire Officer. c. Telephone Operators. d. Medical Officer. e. Personnel/Administrative Officer. f. Essential work team leaders. 1. Works Main Controller 13. The General Manager of the Plant should act as main controller. His duties are to:- i. Assess the magnitude of the situation and decide whether the evacuation of staff from the plant is needed. ii. Exercise and direct operational control over areas other than those affected. iii. Maintain a continuous review of possible development and assess in consultation with work incident controller and other Key Personsnel. iv. Liaison with Police, Fire Service, Medical Services, Factory Inspectorate and other Govt. Agencies. v. Direct and control rehabilitation of affected area after emergency.

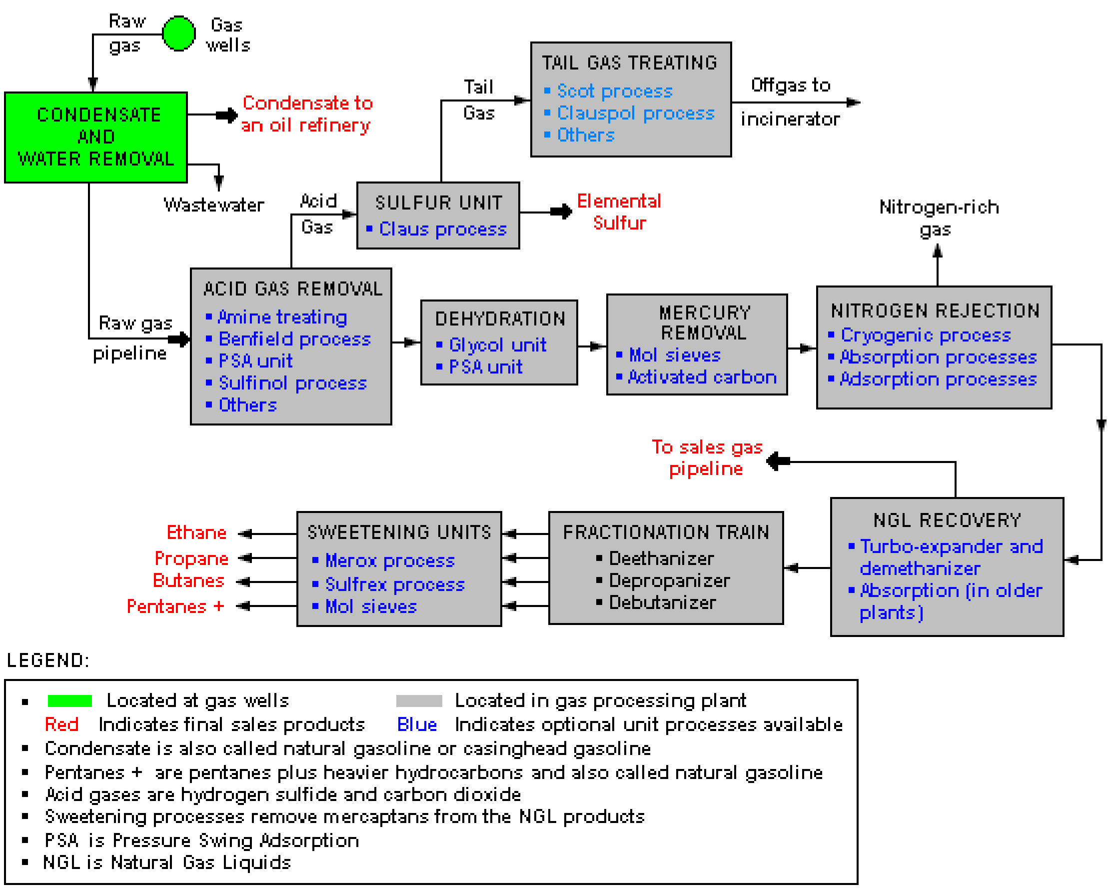
Work Incident Controller (WIC) 15. He is the next responsible officer after the Works Main Controller. Generally the plant manager is designated as Work Incident Controller. In case of emergency he will rush to the place of occurrence and take overall charge and report to the Works Main Controller by personnel communication system like cell phones or walky-talky and inform about the magnitude of emergency. He will assess the situation and considering the magnitude of emergency he will take decision and inform Communication Officer to communicate the news of emergency to different agencies. He will give direction to stop all operations within the affected area. He will take the charge of Main Controller till the Main Controller arrives. He will order for shutdown and evacuation of workers and staffs from affected area. He will inform all Key Personnel and all outside agency for help. He will inform security and fire officers and State Fire Services. He will ensure that all non-essential workers/staff are evacuated to assembly point and areas searched for casualties. He will report all significant development to Communication Officer. Moreover he will advise to preserve evidence of emergency into the cause of emergency. 3. Other Key Personnel and their duties a. Communication Officer. On hearing the emergency siren/alarm he will proceed to the control center and communicate to Work Incident Controller. He will collect information from the emergency affected area and send correct message to work main controller for declaration of emergency. He will maintain a log book of incident. He will contact all essential departments. He will take stock of the meteorological

GAS PROCESSING COMPLEX

Natural-gas processing is a complex industrial process designed to clean raw natural gas by separating impurities and various non-methane hydrocarbons and fluids to produce what is known as *pipeline quality* dry natural gas.

Natural-gas processing begins at the well head. The composition of the raw natural gas extracted from producing wells depends on the type, depth, and location of the underground deposit and the geology of the area. Oil and natural gas are often found together in the same reservoir. The natural gas produced from oil wells is generally classified as *associated-dissolved*, meaning that the natural gas is associated with or dissolved in crude oil. Natural gas production absent any association with crude oil is classified as “non-associated.” In 2009, 89 percent of U.S. wellhead production of natural gas was non-associated.

Natural-gas processing plants purify raw natural gas by removing common contaminants such as water, carbon dioxide (CO_2) and hydrogen sulfide (H_2S). Some of the substances which contaminate natural gas have economic value and are further processed or sold. A fully operational plant delivers pipeline-quality dry natural gas that can be used as fuel by residential, commercial and industrial consumers.



TYPES OF RAW-NATURAL-GAS WELLS

Raw natural gas comes primarily from any one of three types of wells: crude oil wells, gas wells, and condensate wells.

Natural gas that comes from crude oil wells is typically called *associated gas*. This gas can have existed as a gas cap above the crude oil in the underground formation, or could have been dissolved in the crude oil.

Natural gas from gas wells and from condensate wells, in which there is little or no crude oil, is called *non-associated gas*. Gas wells typically produce only raw natural gas, while condensate wells produce raw natural gas along with other low molecular weight hydrocarbons. Those that are liquid at ambient conditions (i.e., pentane and heavier) are called *natural-gas condensate* (sometimes also called *natural gasoline* or simply *condensate*).

Natural gas is called *sweet gas* when relatively free of hydrogen sulfide; gas that does contain hydrogen sulfide is called *sour gas*. Natural gas, or any other gas mixture, containing significant quantities of hydrogen sulfide, carbon dioxide or similar acidic gases, is called *acid gas*.

Raw natural gas can also come from methane deposits in the pores of coal seams, and especially in a more concentrated state of adsorption onto the surface of the coal itself. Such gas is referred to as *coalbed gas* or *coalbed methane* (*coal seam gas* in Australia). Coalbed gas has become an important source of energy in recent decades.

CONTAMINANTS IN RAW NATURAL GAS

Raw natural gas typically consists primarily of methane (CH_4), the shortest and lightest hydrocarbon molecule. It also contains varying amounts of:

- Heavier gaseous hydrocarbons: ethane (C_2H_6), propane (C_3H_8), normal butane (n-C_4H_{10}), isobutane (i-C_4H_{10}), pentanesand even higher molecular weight hydrocarbons. When processed and purified into finished by-products, all of these are collectively referred to as Natural Gas Liquids or **NGL**.
- Acid gases: carbon dioxide (CO_2), hydrogen sulfide (H_2S) and mercaptans such as methanethiol (CH_3SH) and ethanethiol(C_2H_5SH).
- Other gases: nitrogen (N_2) and helium (He).
- Water: water vapor and liquid water. Also dissolved salts and dissolved gases (acids).
- Liquid hydrocarbons: perhaps some natural-gas condensate (also referred to as *casinghead gasoline* or *natural gasoline*) and/or crude oil.
- Mercury: very small amounts of mercury primarily in elemental form, but chlorides and other species are possibly present.[3]
- Naturally occurring radioactive material (NORM): natural gas may contain radon, and the produced water may contain dissolved traces of radium, which can accumulate within piping and processing equipment.[*citation needed*] This can render piping and equipment radioactive over time.

The raw natural gas must be purified to meet the quality standards specified by the major pipeline transmission and distribution companies. Those quality standards vary from pipeline to pipeline and are usually a function of a pipeline system's design and the markets that it serves. In general, the standards specify that the natural gas:

- Be within a specific range of heating value (caloric value). For example, in the United States, it should be about 1035 ± 5% BTU per cubic foot of gas at 1 atmosphere and 60°F (41 MJ ± 5% per cubic metre of gas at 1 atmosphere and 15.6°C).
- Be delivered at or above a specified hydrocarbon dew point temperature (below which some of the hydrocarbons in the gas might condense at pipeline pressure forming liquid slugs that could damage the pipeline).
- Dew-point adjustment serves the reduction of the concentration of water and heavy hydrocarbons in natural gas to such an extent that no condensation occurs during the ensuing transport in the pipelines
- Be free of particulate solids and liquid water to prevent erosion, corrosion or other damage to the pipeline.
- Be dehydrated of water vapor sufficiently to prevent the formation of methane hydrates within the gas processing plant or subsequently within the sales gas transmission pipeline. A typical water content specification in the U.S. is that gas must contain no more than seven pounds of water per million standard cubic feet (MMSCF) of gas.
- Contain no more than trace amounts of components such as hydrogen sulfide, carbon dioxide, mercaptans, and nitrogen. The most common specification for hydrogen sulfide content is 0.25 grain H_2S per 100 cubic feet of gas, or approximately 4 ppm. Specifications for CO_2 typically limit the content to no more than two or three percent.
- Maintain mercury at less than detectable limits (approximately 0.001 ppb by volume) primarily to avoid damaging equipment in the gas processing plant or the pipeline transmission system from mercury amalgamation and embrittlement of aluminum and other metals.

DESCRIPTION OF A NATURAL-GAS PROCESSING PLANT

There are a great many ways in which to configure the various unit processes used in the processing of raw natural gas. The block flow diagram below is a generalized, typical configuration for the processing of raw natural gas from non-associated gas wells. It shows how raw natural gas is processed into sales gas pipelined to the end user markets. It also shows how processing of the raw natural gas yields these byproducts:

- Natural-gas condensate
- Sulfur
- Ethane
- Natural-gas liquids (NGL): propane, butanes and C_5+ (which is the commonly used term for pentanes plus higher molecular weight hydrocarbons)

Raw natural gas is commonly collected from a group of adjacent wells and is first processed at that collection point for removal of free liquid water and natural gas condensate. The condensate is usually then transported to an oil refinery and the water is disposed of as wastewater.

The raw gas is then pipelined to a gas processing plant where the initial purification is usually the removal of acid gases (hydrogen sulfide and carbon dioxide). There are many processes that are available for that purpose as shown in the flow diagram, but amine treating is the process that was historically used. However, due to a range of performance and environmental constraints of the amine process, a newer technology based on the use of polymeric membranes to separate the carbon dioxide and hydrogen sulfide from the natural gas stream has gained increasing acceptance. Membranes are attractive since no reagents are consumed.

The acid gases, if present, are removed by membrane or amine treating can then be routed into a sulfur recovery unit which converts the hydrogen sulfide in the acid gas into either elemental sulfur or sulfuric acid. Of the processes available for these conversions, the Claus process is by far the most well known for recovering elemental sulfur, whereas the conventional Contact process and the WSA (Wet sulfuric acid process) are the most used technologies for recovering sulfuric acid.

The residual gas from the Claus process is commonly called *tail gas* and that gas is then processed in a tail gas treating unit (TGTU) to recover and recycle residual sulfur-containing compounds back into the Claus unit. Again, as shown in the flow diagram, there are a number of processes available for treating the Claus unit tail gas and for that purpose a WSA process is also very suitable since it can work autothermally on tail gases.

The next step in the gas processing plant is to remove water vapor from the gas using either the regenerable absorption in liquid triethylene glycol (TEG), commonly referred to as glycol dehydration, deliquescent chloride desiccants, and or a Pressure Swing Adsorption (PSA) unit which is regenerable adsorption using a solid adsorbent.[17] Other newer processes like membranes may also be considered.

Mercury is then removed by using adsorption processes (as shown in the flow diagram) such as activated carbon or regenerable molecular sieves.

Although not common, nitrogen is sometimes removed and rejected using one of the three processes indicated on the flow diagram:

- Cryogenic process (Nitrogen Rejection Unit),[18] using low temperature distillation. This process can be modified to also recover helium, if desired (see also industrial gas).
- Absorption process, using lean oil or a special solvent as the absorbent.
- Adsorption process, using activated carbon or molecular sieves as the adsorbent. This process may have limited applicability because it is said to incur the loss of butanes and heavier hydrocarbons.

The next step is to recover the natural gas liquids (NGL) for which most large, modern gas processing plants use another cryogenic low temperature distillation process involving expansion of the gas through a turbo-expander followed by distillation in a demethanizing fractionating column. Some gas processing plants use lean oil absorption process[19] rather than the cryogenic turbo-expander process.

The recovered NGL stream is sometimes processed through a fractionation train consisting of three distillation towers in series: a deethanizer, a depropanizer and a debutanizer. The overhead product from the deethanizer is ethane and the bottoms are fed to the depropanizer. The overhead product from the depropanizer is propane and the bottoms are fed to the debutanizer. The overhead product from the debutanizer is a mixture of normal and iso-butane, and the bottoms product is a C_5+ mixture. The recovered streams of propane, butanes and C_5+ may be "sweetened" in a Merox process unit to convert undesirable mercaptans into disulfides and, along with the recovered ethane, are the final NGL by-products from the gas processing plant. Currently, most cryogenic plants do not include fractionation for economic reasons, and the NGL stream is instead transported as a mixed product to standalone fractionation complexes located near refineries or chemical plants that use the components for feedstock. In case laying pipeline is not possible for geographical reason,or the distance between source and consumer exceed 3000 km, natural gas is then transported by ship as LNG (liquefied natural gas) and again converted into its gaseous state in the vicinity of the consumer.

The residue gas from the NGL recovery section is the final, purified sales gas which is pipelined to the end-user markets. Rules and agreements are made between buyer and seller regarding the quality of the gas. These usually specify the maximum allowable concentration of CO_2, H_2S and H_2O as well as requiring the gas to be commercially free from objectionable odours and materials, and dust or other solid or liquid matter, waxes, gums and gum forming constituents, which might damage or adversely affect operation of the buyers equipment. When an upset occurs on the treatment plant buyers can usually refuse to accept the gas, lower the flow rate or re-negotiate the price.

HELIUM RECOVERY

If the gas contains significant helium content, the helium may be recovered by fractional distillation. Natural gas may contain as much as 7% helium, and is the commercial source of the noble gas For instance, the Hugoton Gas Field in Kansas and Oklahoma in the United States contains concentrations of helium from 0.3% to 1.9%, which is separated out as a valuable byproduct

CONSUMPTION

Natural gas consumption patterns, across nations, vary based on access. Countries with large reserves tend to handle the raw-material natural gas more generously, while countries with scarce or lacking resources tend to be more economical. Despite the considerable findings, the predicted availability of the natural-gas reserves has hardly changed.

APPLICATIONS OF NATURAL GAS

- Fuel for industrial heating and desiccation process
- Fuel for the operation of public and industrial power stations
- Household fuel for cooking, heating and providing hot water
- Fuel for environmentally friendly compressed or liquid natural gas vehicles
- Raw material for chemical synthesis
- Raw material for large-scale fuel production using gas-to-liquid (GTL) process (e.g. to produce sulphur-and aromatic-free diesel with low-emission combustion)

REFINARY

A **refinery** is a production facility composed of a group of chemical engineering unit processes and unit operations refiningcertain materials or converting raw material into products of value.

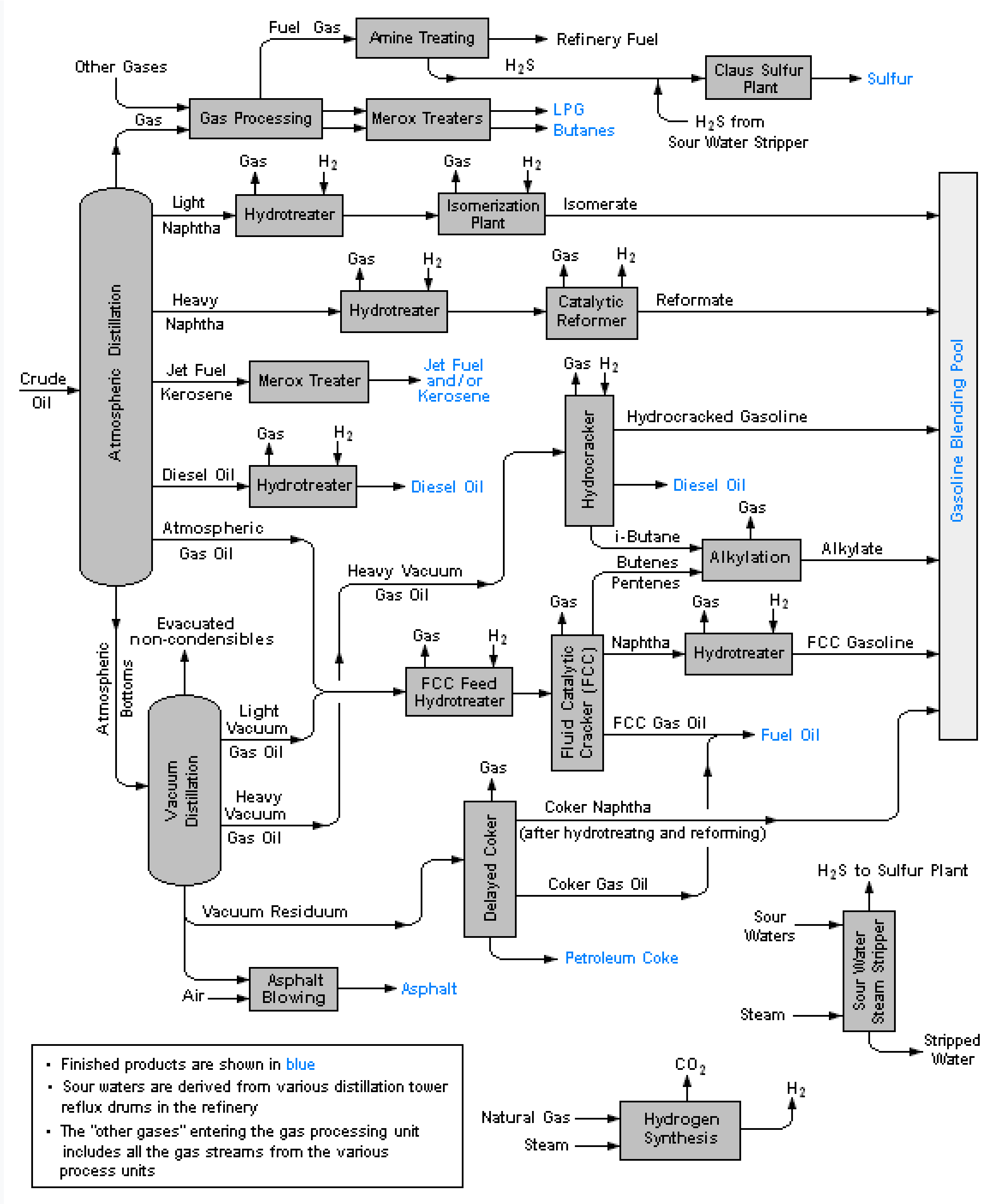
TYPES OF REFINERIES

Different types of refineries are as follows:

- petroleum oil refinery, which converts crude oil into high-octane motor spirit (gasoline/petrol), diesel oil, liquefied petroleum gases (LPG), kerosene, heating fuel oils, hexane, lubricating oils, bitumen and petroleum coke;
- food oil refinery which converts cooking oil into a product that is uniform in taste, smell and appearance, and stability;
- sugar refinery, which converts sugar cane and sugar beets into crystallized sugar and sugar syrups;
- natural gas processing plant, which purifies and converts raw natural gas into residential, commercial and industrial fuel gas, and also recovers natural gas liquids (NGL) such as ethane, propane, butanes and pentanes;
- salt refinery, which cleans common salt (NaCl), produced by the solar evaporation of sea water, followed by washing and re-crystallization;
- metal refineries refining metals such as alumina, copper, gold, lead, nickel, silver, uranium, zinc, magnesium and cob alt;

A typical oil refinery

The image below is a schematic flow diagram of a typical oil refinery depicting various unit processes and the flow of intermediate products between the inlet crude oil feedstock and the final products. The diagram depicts only one of the hundreds of different configurations. It does not include any of the usual facilities providing utilities such as steam, cooling water, and electric power as well as storage tanks for crude oil feedstock and for intermediate products and end products.

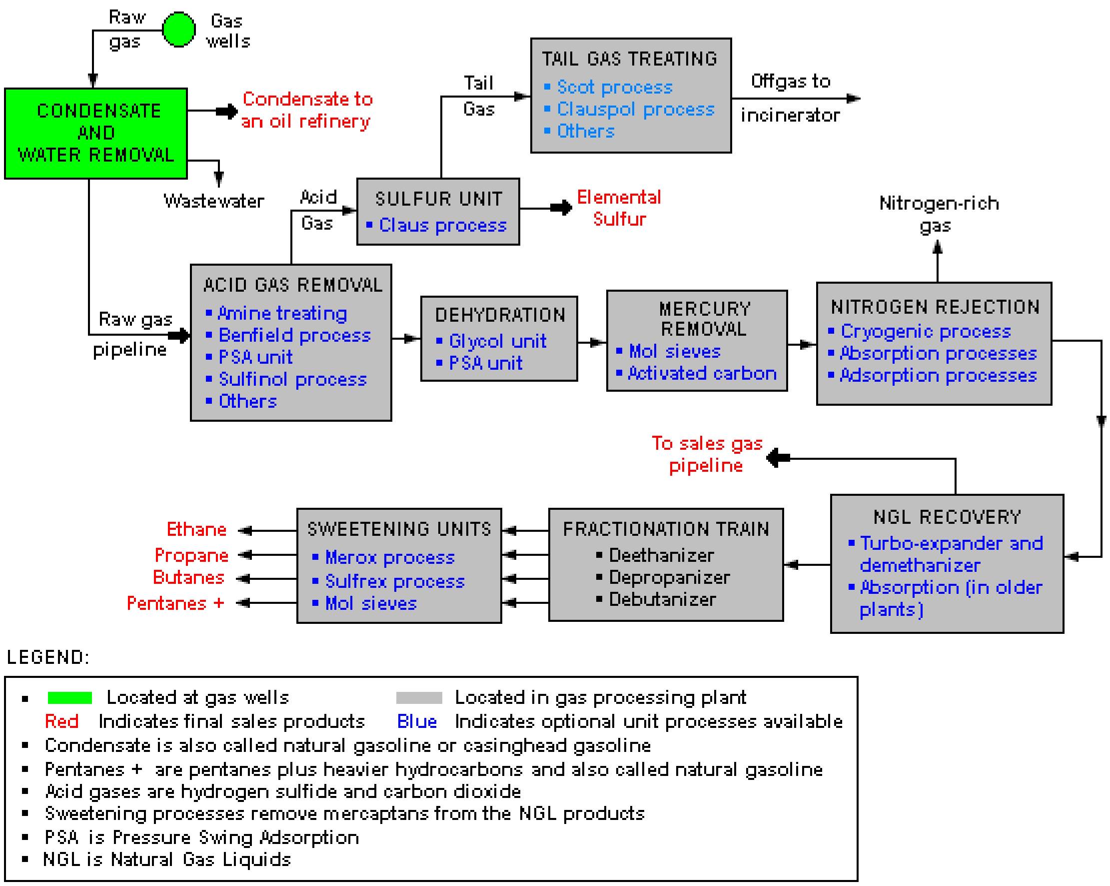


Schematic flow diagram of a typical oil refinery.

A typical natural gas processing plant

The image below is a schematic block flow diagram of a typical natural gas processing plant. It shows various unit processes converting raw natural gas into gas pipelined to end users.

The block flow diagram also shows how processing of the raw natural gas yields byproduct sulfur, byproduct ethane, and natural gas liquids (NGL) propane, butanes and natural gasoline.



Milling

Sugarcane is traditionally refined into sugar in two stages. In the first stage, raw sugar is produced by the milling of freshly harvested sugarcane. In a sugar mill, sugarcane is washed, chopped, and shredded by revolving knives. The shredded cane is mixed with water and crushed. The juices (containing 10-15 percent sucrose) are collected and mixed with lime to adjust pH to 7, prevent decay into glucose and fructose, and precipitate impurities. The lime and other suspended solids are settled out, and the clarified juice is concentrated in a multiple-effect evaporator to make a syrup with about 60 weight percent sucrose. The syrup is further concentrated under vacuum until it becomes supersaturated, and then seeded with crystalline sugar. Upon cooling, sugar crystallizes out of the syrup. Centrifuging then separates the sugar from the remaining liquid (molasses). Raw sugar has a yellow to brown color. Sometimes sugar is consumed locally at this stage, but usually undergoes further purification.[10] Sulfur dioxide is bubbled through the cane juice subsequent to crystallization in a process, known as "sulfitation". This process inhibits color forming reactions and stabilizes the sugar juices to produce “mill white” or “plantation white” sugar.

The fibrous solids, called *bagasse*, remaining after the crushing of the shredded sugarcane, are burned for fuel, which helps a sugar mill to become self-sufficient in energy. Any excess bagasse can be used for animal feed, to produce paper, or burned to generate electricity for the local power grid.

DISASTER MANAGEMENT PLAN

Challenges

The World continues to experience a wide variety of natural and human induced disasters. These are adversely impacting our heritage as well. These disasters include earthquakes, tsunamis, floods, volcanoes, fires, and wildfires.

Approach

Disaster Management involves planning what to do before, during and after a disaster or emergency occurs. Through further understanding these hazards, and assessing a structure's behaviour to them, we can better prepare for disasters.

A risk-informed, performance-based approach exists offering opportunities to better understand objectives, identify credible hazards and develop alternatives that allow stakeholders (owners, government, etc.) to make risk-informed decisions as to how best protect heritage and meet disaster mitigation objectives.

This approach provides tremendous value including:

- Preserving our heritage
- Embrace local heritage, resources, and methodologies
- Limit damage and aesthetic impact
- Cost-effective solutions
- Maintain functionality of sites
- Enhance life safety

Planning for disasters in advance significantly reduces damage to tangible and intangible heritage, including historic sites, structures and their collections.

Services and Deliverables

Services

- Establish Objectives
- Hazard Assessments
- Risk Assessments
- Disaster Prevention Planning
- Disaster Mitigation Planning
- Emergency Access Assessments
- Emergency Egress Assessments
- Emergency Drills
- Emergency Response Equipment Planning
- Disaster Preparedness Planning
- Disaster Response Planning
- Disaster Recovery Planning
- Capacity Building

Deliverables:

- Hazard & Risk Assessments
- Disaster Prevention & Mitigation Plans
- Disaster Preparedness Plans
- Disaster Response Plans
- Disaster Recovery Plans
- Emergency Evacuation Plans
- Emergency Access Plans
- Emergency Management Plans
- Training Programs

EMERENCY PLANNING

The emergency plan includes:

- All possible emergencies, consequences, required actions, written procedures, and the resources available.

- Detailed lists of personnel including their home telephone numbers, their duties and responsibilities.
- Floor plans.
- Large scale maps showing evacuation routes and service conduits (such as gas and water lines).

Since a sizable document will likely result, the plan should provide staff members with written instructions about their particular emergency duties.

The following are examples of the parts of an emergency plan. These elements may not cover every situation in every workplace but serve they are provided as a general guideline when writing a workplace specific plan:

Objective

The objective is a brief summary of the purpose of the plan; that is, to reduce human injury and damage to property and environment in an emergency. It also specifies those staff members who may put the plan into action. The objective identifies clearly who these staff members are since the normal chain of command cannot always be available on short notice. At least one of them must be on the site at all times when the premises are occupied. The extent of authority of these personnel must be clearly indicated.

Organization

One individual should be appointed and trained to act as Emergency Co-ordinator as well as a "back-up" co-ordinator. However, personnel on site during an emergency are key in ensuring that prompt and efficient action is taken to minimize loss. In some cases it may be possible to recall off-duty employees to help, but the critical initial decisions usually must be made immediately.

Specific duties, responsibilities, authority, and resources must be clearly defined. Among the responsibilities that must be assigned are:

- Reporting the emergency.
- Activating the emergency plan.
- Assuming overall command.
- Establishing communication.
- Alerting staff.
- Ordering evacuation.
- Alerting external agencies.
- Confirming evacuation is complete.
- Alerting outside population of possible risk.

- Requesting external aid.
- Coordinating activities of various groups.
- Advising relatives of casualties.
- Providing medical aid.
- Ensuring emergency shut offs are closed.
- Sounding the all-clear.
- Advising media.

This list of responsibilities should be completed using the previously developed summary of countermeasures for each emergency situation. In organizations operating on reduced staff during some shifts, some personnel must assume extra responsibilities during emergencies. Sufficient alternates for each responsible position must be named to ensure that someone with authority is available onsite at all times.

External organizations that may be available to assist (with varying response times) include:

- Fire departments.
- Mobile rescue squads.
- Ambulance services.
- Police departments.
- Telephone companies.
- Hospitals.
- Utility companies.
- Industrial neighbours.
- Government agencies.

These organizations should be contacted in the planning stages to discuss each of their roles during an emergency. Mutual aid with other industrial facilities in the area should be explored.

Pre-planned coordination is necessary to avoid conflicting responsibilities. For example, the police, fire department, ambulance service, rescue squad, company fire brigade, and the first aid team may be on the scene simultaneously. A pre-determined chain of command in such a situation is required to avoid organizational difficulties. Under certain circumstances, an outside agency may assume command.

Possible problems in communication have been mentioned in several contexts. Efforts should be made to seek alternate means of communication during an emergency, especially between key personnel such as overall commander, on-scene commander, engineering, fire brigade, medical, rescue, and outside agencies. Depending on the size of the organization and physical layout of the premises, it may be advisable to plan for an emergency control centre with alternate communication facilities. All personnel with alerting or reporting responsibilities must be provided with a current list of telephone numbers and addresses of those people they may have to contact.

Procedures

Many factors determine what procedures are needed in an emergency, such as:

- Nature of emergency.
- Degree of emergency.
- Size of organization.
- Capabilities of the organization in an emergency situation.
- Immediacy of outside aid.
- Physical layout of the premises.

Common elements to be considered in all emergencies include pre-emergency preparation and provisions for alerting and evacuating staff, handling casualties, and for containing the danger.

Natural hazards, such as floods or severe storms, often provide prior warning. The plan should take advantage of such warnings with, for example, instructions on sand bagging, removal of equipment to needed locations, providing alternate sources of power, light or water, extra equipment, and relocation of personnel with special skills. Phased states of alert allow such measures to be initiated in an orderly manner.

The evacuation order is of greatest importance in alerting staff. To avoid confusion, only one type of signal should be used for the evacuation order. Commonly used for this purpose are sirens, fire bells, whistles, flashing lights, paging system announcements, or word-of-mouth in noisy environments. The all-clear signal is less important since time is not such an urgent concern.

The following are "musts":

- Identify evacuation routes, alternate means of escape, make these known to all staff; keep the routes unobstructed.
- Specify safe locations for staff to gather for head counts to ensure that everyone has left the danger zone. Assign individuals to assist employees with disabilities.
- Carry out treatment of the injured and search for the missing simultaneously with efforts to contain the emergency.
- Provide alternate sources of medical aid when normal facilities may be in the danger zone.
- Ensure the safety of all staff (and/or the general public) first, then deal with the fire or other situation.

Testing and Revision

Completing a comprehensive plan for handling emergencies is a major step toward preventing disasters. However, it is difficult to predict all of the problems that may happen unless the plan is tested. Exercises and drills may be conducted to practice all or critical portions (such as evacuation) of the plan. A thorough and immediate review after each exercise, drill, or after an actual emergency will point out areas that require improvement. Knowledge of individual responsibilities can be evaluated through paper tests or interviews.

The plan should be revised when shortcomings have become known, and should be reviewed at least annually. Changes in plant infrastructure, processes, materials used, and key personnel are occasions for updating the plan.

It should be stressed that provision must be made for the training of both individuals and teams, if they are expected to perform adequately in an emergency. An annual full-scale exercise will help in maintaining a high level of proficiency.

POPULATION DATA

THE DATA SHEET'S MIDCENTURY POPULATION PROJECTIONS INDICATE THAT:

The combined population of the world's least developed countries in the world will double by 2050 to 1.9 billion. There are 48 least developed countries, based on United Nations criteria, most of which are in Africa.
The population in 29 countries will more than double**.** Nearly all of these countries are in Africa.

Forty-two countries will register population declines. These countries are scattered throughout Asia, Latin America, and Europe. Some European countries will post significant declines, such as Romania, which is projected to have a population of 14 million in 2050, down from 20 million today.

The population of the United States will be 398 million, up 23 percent from 324 million today.

According to the Data Sheet's estimates of current population**:**

Over 25 percent of the world's population is less than 15 years old. The figure is 41 percent in least developed countries and 16 percent in more developed countries.

Japan has the oldest population profile**,** with over a quarter of its citizens older than 65. Qatar and the United Arab Emirates are at the other end of the spectrum, with each having only 1 percent over 65.

The top 10 fertility rates in the world are in sub-Saharan African countries, with nearly all above six children per woman, and one topping seven. In Europe, the average is 1.6.

The fertility rate in the United States is 1.8 children per woman, down from 1.9 in 2014. "Replacement" fertility in the United States—that is, the rate at which the population exactly replaces itself from one generation to the next, excluding the effects of migration—is 2.1 children per woman.

Thirty-three countries in Europe and Asia already have more people over age 65 than under 15.

Human Needs, Sustainable Resources

As part of this year's Data Sheet theme, "Human Needs and Sustainable Resources," PRB compiled statistics that speak to the environmental and resource aspects of human development. The Data Sheet included measures of carbon emissions (related to climate change), access to electricity, power from renewable energy resources, how much land countries have set aside for protection, and population per square kilometer of arable land. A few key figures include:

Globally, there was a 60 percent increase in annual carbon emissions between 1992 and 2013, to 9.8 billion metric tons. China posted the largest increase by volume over this period, from 735 million metric tons to 2.8 billion metric tons—which was also the largest amount of any country in 2013.

Forty-three countries reduced their carbon emissions over the same period. The largest reduction by volume was in Ukraine, where carbon emissions declined by 98 million metric tons to 74 million tons.

Eighteen percent of the world's energy comes from renewable sources,which include hydroelectric power.

There is an average of 526 people per square kilometer of arable land. The number is 238 in more developed countries and 697 in less developed countries.