Simultaneous Operations (SIMOPS)

A 5-Day In-house Training Course for

TechnipFMC

12 - 16 January 2019
Alexandria, Egypt
Presented by: Mr. Sasa Kocic

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Simultaneous Operations

SIMOPS

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Senior Consultant
# Table of Contents

Why choose this training course? .................................................. 4
What are the goals? ........................................................................ 4
How will this Training Course be Presented? ............................... 5
Organisational Impact .................................................................. 5
Personal Impact ........................................................................... 5
Daily Agenda .................................................................................. 6
Instructor Profile ........................................................................... 7

**Day One SIMOPS Introduction** ........................................... 9
  - SIMOPS process ......................................................................... 9
  - Area classification in Refineries ............................................... 12
  - Oil refinery Risks and Hazards .................................................. 15
  - Safety by design ........................................................................ 17
  - SIMOPS in refinery operations: Fires and Explosion Protection .... 20
  - Workshop: Case Studies & Worked Examples ............................ 21

**Day Two SIMOPS Risk Management** .................................. 22
  - Risk Management methodologies ............................................... 22
  - Risk Matrix and the construction of risk matrix .......................... 24
  - Job Hazard Analysis .................................................................. 27
  - SIMOPS Checklist ..................................................................... 29
  - Permit to Work (PTW) system and issuing process .................... 29
  - Workshop: Case Studies & Worked Examples ............................ 30

**Day Three SIMOPS in Specific Cases** ................................. 31
  - Common Process Hazards ......................................................... 31
  - SIMOPS in construction ............................................................... 31
  - SIMOPS in maintenance .............................................................. 34
  - Workshop: Case Studies & Worked Examples ............................ 37
Day Four PTW Procedure and SIMOPS..........................38
PTW system.........................................................................38
SIMOPS assessment review.........................................................40
SIMOPS interface document.........................................................40
SIMOPS flowchart ..................................................................41
SIMOPS Toolbox Talk ..............................................................41
Workshop: Case Studies & Worked Examples.................................42

Day Five Refinery Specific Risks and SIMOPS.....................43
Risk Management.....................................................................43
Management of change ..............................................................44
Integrated SIMOPS tool ..............................................................48
Ensuring contractor alignment with safety culture..................49
Human factor and ergonomics, behavioral based safety ...........50
Workshop: Case Studies & Worked Examples.................................51
Why choose this training course?

Any industry works with concurrent or simultaneous operations. The hazards associated with the simultaneous operations or SIMOPS as they call increase as the companies or contractors working on them do not have the same goals, operational or health and safety procedures.

Simultaneous operations are usually defined as independent operations in which the personnel, assets, execution and incidents in any operation may impact the safety of personnel, equipment, and environment of another operation.

Before SIMOPS start, company is required to analyze the potential risks by conducting two or more critical operations at the same time. SIMOPS was most common in the oil and gas industry, but also other industries are now realizing that SIMOPS are a part of their operations and dedicate more and more attention to simultaneous and concurrent operations.

Participants on the SIMOPS training course will become versatile in:

- Identifying most common simultaneous operations in refineries
- Understanding the principles of SIMOPS
- Dealing with health and safety related issues in oil refineries
- Effective communication necessary for making SIMPOS efficient and safe
- Identification of risk mitigation measures in case of SIMOPS activities
- Preparing the SIMOPS plan
- Creating the SIMOPS matrix
- Conducting a Job Hazard Analysis and organizing the operation handover

What are the goals?

By the end of this training course, participants will learn to:

- Apply techniques to handle effectively the simultaneous operations (SIMOPS)
- Ability to analyze both concurrent/simultaneous operations in plant operation
- Recognize and catalogue hazards and risks involved in SIMOPS
- Recognize the roles and responsibilities of all parties involved
- Prepare the SIMOPS plan and SIMOPS matrix
- Use the SIMOPS checklist and conduct a SIMOPS toolbox talk
How will this Training Course be Presented?

Participants to this training course will receive a thorough training on the subjects covered by the seminar outline with the Tutor utilizing a variety of proven adult learning teaching and facilitation techniques. The Simultaneous Operations System training course is based on real life examples and adult learning techniques. The emphasis in the training course will be on the preparation of SIMOPS documentation based on the industrial practice regarding the risk assessment of simultaneous operations and related activities in oil and gas industry. The training material also has the worked examples of SIMOPS plan and SIMOPS matrix.

Organisational Impact

The organizations are almost daily involved in SIMOPS operations and cannot rely on luck alone to prevent incidents from happening, individual and separate risk assessments are not sufficient in the environment where multiple operations are conducted simultaneously.

This course is designed to help organizations adequately train their people to identify the risk in the simultaneous operations and prepare adequate risk mitigation or risk removal measures for the complex operations in plant industries.

Personal Impact

The participants will acquire the knowledge needed to conduct risk assessments, prepare SIMOPS plans and develop SIMOPS matrix.
Daily Agenda

Day One SIMOPS Introduction

- SIMOPS process
- Area classification in refineries
- Oil refinery risks and hazards
- Safety by design
- SIMOPS in refinery operations: Fires and Explosion Protection
- Workshop: Case Studies & Worked Examples

Day Two SIMOPS Risk Management

- Risk Management methodologies
- Risk Matrix and the construction of risk matrix
- Job Hazard Analysis
- SIMOPS Checklist
- Permit to Work (PTW) system and issuing process
- Workshop: Case Studies & Worked Examples

Day Three SIMOPS in Specific Cases

- Common Process Hazards
- SIMOPS in construction
  - Tie-in
  - Additional equipment installation
- SIMOPS in maintenance
  - Shutdown and isolation
  - Pressure testing
  - Inspection
- Workshop: Case Studies & Worked Examples

Day Four PTW Procedure and SIMOPS

- PTW system
- SIMOPS assessment review
- SIMOPS interface document
- SIMOPS flowchart
- SIMOPS Toolbox Talk
- Workshop: Case Studies & Worked Examples

Day Five Refinery Specific Risks and SIMOPS

- Risk Management
- Management of change
- Integrated SIMOPS tool
- Ensuring contractor alignment with safety culture
- Human factor and ergonomics, behavioral based safety
- Workshop: Case Studies & Worked Examples
Mr. Sasa Kocic

Nationality: Serbian
Languages Spoken: English, Russian, Serbian, Croatian, Bulgarian
Total Years of Practical/Training/Consultancy/ in the same field: 13 yrs

Instructor Profile

Sasa Kocic is a Senior Consultant with PetroKnowledge specializing in Data Analysis, Energy Economics, Project Management, Optimization, Simulation, Trading and Economics Model development.

Senior Consultant with 18 years’ experience in working with the government, public and private institutions and companies, and 13 years' experience in training and consultancy. Extensive experience in training and teaching delegates. Actively trained professionals in oil and gas industry, civil engineering industry, maritime and shipping industry, as well as military and police, and has also worked as a lecturer at a college of applied sciences.

Participated in negotiation for implementation of a new legal requirements with representatives of syndicates and non-governmental institutions. Lead negotiations with companies and vendors as Contract Holder and successfully implemented Change Management through the contract duration. Participated in FEED projects for oil and gas fields, with special emphasis on developing upstream petroleum cost models and forecasts.

Teaching students in the oil and gas field on the importance of data analysis, using statistics in oil and gas industry, reservoir modelling, as well as economics and human behavior.

Consultancy and training for multinational, international and national oil companies in: machine and deep learning techniques, Data mining, Enhancing data collection procedures, Processing, cleansing, and verifying the integrity of data used for analysis, doing analysis and presenting results in a clear manner, statistical testing, regression analysis and time series analysis.

Also building different models for data analysis in Excel, R, Visual Basic, Python, SQL, etc.

Highly valued and recommended by the delegates, as well as peers and supervisors.

Prepared models for bond valuation, price forecasting, risk management and valuation for different companies and institutions using Excel and R.
SUBJECT MATTER EXPERT IN:

• Root Cause Analysis
• Risk Management
• Investigation
• Contract management
• Big Data Analytics, Machine Learning and Deep Learning
• Geostatistics, Well Data Analysis, Reserves Modelling
• Data Analysis and Statistics
• Trading, Forecasting, Financial Model Development
• Infographics and design
• R, Phyton, SPSS, SAS software
• Contract Negotiation
• Logistics and Supply Chain

EDUCATION AND QUALIFICATIONS

• PhD candidate focusing on applying machine learning to predict human behavior, University of Nish,
• MSc in Engineering, Logistics and Supply Chain, University of Belgrade
• Certified Tripod Beta Trainer, Energy Institute UK
• Certified BowTie risk analysis trainer, CGE risk management solutions, Holland

PROFESSIONAL AFFILIATIONS

• Energy Institute UK-Certified Trainer
• Institute of Transportation Engineers USA-International Member
• Chartered Institute of Logistics and Transport UK-Chartered Member
• American Production and Inventory Control Society-International Member
• Professional Engineer (Chartered Engineer as per UK nomenclature) in Serbian Chamber of Engineers
Day One SIMOPS Introduction

SIMOPS process

Obviously, on any site there will be many different tasks to be done, often at the same time. The distinction here relates to major work events, such as having two different well heads in close proximity. They could be at any stage of production, one might be abandoned, and one might be being freshly spudded.

To a lesser degree, some might refer to any important events on the same rig as SIMOPS, even if there is only one well bore. A rig crew needs to focus on each job at hand, be that deploying the drill string, casing or cement. Any other major task in the background that might counteract, distract, or impact in any way could be described as a SIMOP situation. An expert in this area will see the bigger picture, with data points from both operations. From a higher view point, risk and performance can be properly assessed and contingencies can be prepared.

A SIMOP describes two or more well bore operations that are close enough to interfere with each other, and transfer risk or performance implications.

This is a HSE and well integrity concept that's mostly used in the well completions stage of the drilling process. Both well bores might be drilled concurrently, but it’s more likely that one has been in production for a period of time.

Here are some examples of SIMOP situations:

- A well is being hydraulically fractured, and the reservoir is shared with other nearby leases that are being conventionally drilled. (Or vice versa).
- On an offshore rig, a drilling, slickline and coiled tubing unit might be working at the same time.
- On a multi platform land rig, separate wells will affect the reservoir pressure, and hydrocarbon flow.
- A crane lift positioned close to another work area.

The considerations for a SIMOPS expert to factor in are numerous, and there will be those that might not immediately come to mind. For a safe and efficient well operation, there are many things to consider, when there are simultaneous operations, this number multiplies.

Someone planning or overseeing a SIMOP will consider the more obvious things such as:

- Well integrity factors
- Environmental factors
- Reservoir pressure
- National rules and regulations
- International rules and regulations
- Operator rules and regulations
Also, there will be extra considerations, that are different to those of individual operations:

- Clashes between decision makers at the same hierarchy, on each operation
- Cultural differences if the different operations are done by different companies
- Schedule clashes
- Physical clashes between equipment or third party interfaces
- Issues with maintenance access.
- Contractual implications, on all affected contracts.

It’s important that a SIMOP is identified as early as possible in the planning stage, and then bought into the well plan. The priority is to avoid accidents, and down time. In some situations, a potential clash or safety concern might be so serious as to render one or more operation non-viable. That’s something that you’d want to discover at the very earliest opportunity.

The SIMOP should be planned as if it were a separate drilling operation. A workshop must be organized where all of the important data can be examined. The workshop will include managers, geologists, engineers, safety specialists, construction teams, fluid specialists, and anyone else who would be involved in a DWOP or similar process. Representatives from all companies and organizations with vested interests need to be present so that everyone ends up on the same page.

During the workshop, brainstorming with a list of previous findings and incidents can help identify potential issues. preemptive risk assessments, and the collective knowledge and experience of everyone in the room can ensure that every potential hazard is covered. This process focuses on hazard identification (HAZID) as its main priority. (Another common term in this area is HIRA which means hazard identification and risk assessment).

The result of the workshop will be a planning blueprint with a full risk assessment and action points. After the initial plan, ongoing meetings and interaction need to take place for successful progress monitoring and interaction.

There will be a list of action points including a MOPO (Matrix of Permitted Operations) that can be done at any time. Risks that can be eliminated or mitigated will be, others will be monitored.

Typical action steps might include:

- The substitution of fluid, equipment or personnel for more compatible solutions.
- The physical location of the operations can be moved away from each other.
- Permits, contracts, schedules and procedures can be adjusted to avoid a simop altogether.
- Additional equipment, controls or safety measures can be implemented.

The creation of a list of operations that CAN be done simultaneously, and a list that CAN'T. SIMOPS represent additional risks and challenges, so experienced managers and consultants need to be deployed. Any drilling operation holds dangers and these must never be underestimated. Operators and contractors have experiences based on previous SIMOP issues, and have developed procedures and programs. On an individual level, professional
teams on each operation that will be conducted simultaneously will cognizant of the need for full respect, communication and disclosure\(^1\).

Simultaneous operations (SIMOPs) are situations where two or more operations or activities occur at the same time and place in a facility.

They may interfere or clash with each other and may involve risks that are not identified when each activity is considered by itself. Thus, they can increase the risks of the activities or create new risks. A number of major process industry accidents have involved simultaneous operations.

In the wake of Hurricane Harvey, the Chemical Safety Board (CSB) issued a Safety Alert on precautions needed during restart of processes that were shut down. The CSB noted that startup requires a higher level of attention and care than normal processing because numerous activities occur simultaneously. This is one example of when simultaneous operations occur. Other examples include construction activities near active equipment and maintenance activities near process operations.

Usually, the situations involved in simultaneous operations are not considered during process hazards analysis (PHA) studies which focus attention on individual process operation. Moreover, PHA teams may not recognize the importance of examining how simultaneous operations may interfere with each other. Furthermore, it is difficult to do so within the constraints of a regular PHA study. Consequently, a SIMOP review should be performed prior to conducting simultaneous operations, for example, before restarting a process after shutdown.

Simultaneous operations (SIMOPs) are situations in processes where two or more operations or activities occur at the same time and place. They may interfere or clash with each other and may involve risks that are not identified when each activity is considered by itself. Thus, they can increase the risks of the activities or create new risks.

Simultaneous operations often involve work in the same area by multiple contractors and subcontractors or multi-disciplinary workers whose work may overlap and/or interact. For example, construction activities near active equipment such as crane lifts over a storage tank containing a toxic material may result in a release from dropped objects. Similarly, a maintenance activity near another process operation such as hot work in the vicinity of a tank truck unloading a flammable material may result in a fire.

A number of major process industry accidents have involved simultaneous operations.

The situations addressed by SIMOP studies usually are not considered during process hazards analysis (PHA) studies which focus attention on individual process operation. Furthermore, PHA teams may not recognize the importance of examining how simultaneous operations may interfere with each other. Moreover, it is difficult to do so within the constraints of a regular PHA study.

\(^1\) https://drillers.com/simops-simple-definition-explanation/
A SIMOP review identifies possible interactions between activities that may adversely impact people, property, or the environment. SIMOP reviews are an important adjunct to the performance of PHA studies such as hazard and operability (HAZOP) studies\(^2\).

**Area classification in Refineries**

Refineries and chemical plants are then divided into areas of risk of release of gas, vapor or dust known as divisions or zones. The process of determining the type and size of these hazardous areas is called area classification\(^3\).

Area classification may be carried out by direct analogy with typical installations described in established codes, or by more quantitative methods that require a more detailed knowledge of the plant. The starting point is to identify sources of release of flammable gas or vapor. These may arise from constant activities; from time to time in normal operation; or as the result of some unplanned event. In addition, inside process equipment may be a hazardous area, if both gas/vapor and air are present, though there is no actual release.

Catastrophic failures, such as vessel or line rupture are not considered by an area classification study. A hazard identification process such as a Preliminary Hazard Analysis (PHA) or a Hazard and Operability Study (HAZOP) should consider these abnormal events.

The most commonly used standard in the UK for determining area extent and classification is BS EN 60079 part 10, which has broad applicability. The current version makes clear the direct link between the amounts of flammable vapor that may be released, the ventilation at that location, and the zone number. It contains a simplistic calculation relating the size of zone to a rate of release of gas or vapor, but it is not helpful for liquid releases, where the rate of vaporization controls the size of the hazardous area.

Other sources of advice, which describe more sophisticated approaches, are the Institute of Petroleum Model Code of Practice (Area Classification Code for Petroleum Installations, 2002), and the Institution of Gas Engineers Safety Recommendations SR25, (2001). The IP code is for use by refinery and petrochemical type operations. The IGE code addresses specifically transmission, distribution and storage facilities for natural gas, rather than gas utilization plant, but some of the information will be relevant to larger scale users\(^4\).

Hazardous areas are defined in DSEAR as "any place in which an explosive atmosphere may occur in quantities such as to require special precautions to protect the safety of workers". In this context, 'special precautions' is best taken as relating to the construction, installation and use of apparatus, as given in BS EN 60079 -101.

Area classification is a method of analysing and classifying the environment where explosive gas atmospheres may occur. The main purpose is to facilitate the proper selection and installation of apparatus to be used safely in that environment, taking into account the properties of the flammable materials that will be present. DSEAR specifically extends the original scope of this analysis, to take into account non-electrical sources of ignition, and mobile equipment that creates an ignition risk.

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\(^3\) [https://en.wikipedia.org/wiki/Electrical_equipment_in_hazardous_areas](https://en.wikipedia.org/wiki/Electrical_equipment_in_hazardous_areas)

\(^4\) [http://www.hse.gov.uk/comah/sragtech/techmeasareaclas.htm](http://www.hse.gov.uk/comah/sragtech/techmeasareaclas.htm)
Hazardous areas are classified into zones based on an assessment of the frequency of the occurrence and duration of an explosive gas atmosphere, as follows:

- **Zone 0**: An area in which an explosive gas atmosphere is present continuously or for long periods;
- **Zone 1**: An area in which an explosive gas atmosphere is likely to occur in normal operation;
- **Zone 2**: An area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it occurs, will only exist for a short time.

Various sources have tried to place time limits on these zones, but none have been officially adopted. The most common values used are:

- **Zone 0**: Explosive atmosphere for more than 1000h/yr
- **Zone 1**: Explosive atmosphere for more than 10, but less than 1000 h/yr
- **Zone 2**: Explosive atmosphere for less than 10h/yr, but still sufficiently likely as to require controls over ignition sources.

Where people wish to quantify the zone definitions, these values are the most appropriate, but for the majority of situations a purely qualitative approach is adequate.

When the hazardous areas of a plant have been classified, the remainder will be defined as non-hazardous, sometimes referred to as 'safe areas'.

The zone definitions take no account of the consequences of a release. If this aspect is important, it may be addressed by upgrading the specification of equipment or controls over activities allowed within the zone. The alternative of specifying the extent of zones more conservatively is not generally recommended, as it leads to more difficulties with equipment selection, and illogicalities in respect of control over health effects from vapors assumed to be present. Where occupiers choose to define extensive areas as Zone 1, the practical consequences could usefully be discussed during site inspection\(^5\).

A hazardous area extent and classification study involves due consideration and documentation of the following:

- The flammable materials that may be present;
- The physical properties and characteristics of each of the flammable materials;
- The source of potential releases and how they can form explosive atmospheres;
- Prevailing operating temperatures and pressures;
- Presence, degree and availability of ventilation (forced and natural);
- Dispersion of released vapors to below flammable limits;
- The probability of each release scenario.

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\(^5\) [http://www.hse.gov.uk/comah/sragtech/techmeasareclas.htm](http://www.hse.gov.uk/comah/sragtech/techmeasareclas.htm)
Ignition sources may be:

- Flames;
- Direct fired space and process heating;
- Use of cigarettes/matches etc;
- Cutting and welding flames;
- Hot surfaces;
- Heated process vessels such as dryers and furnaces;
- Hot process vessels;
- Space heating equipment;
- Mechanical machinery;
- Electrical equipment and lights;
- Spontaneous heating;
- Friction heating or sparks;
- Impact sparks;
- Sparks from electrical equipment;
- Stray currents from electrical equipment;
- Electrostatic discharge sparks;
- Lightning strikes;
- Electromagnetic radiation of different wavelengths;
- Vehicles, unless specially designed or modified are likely to contain a range of potential ignition sources.

Sources of ignition should be effectively controlled in all hazardous areas by a combination of design measures, and systems of work:

- Using electrical equipment and instrumentation classified for the zone in which it is located. New mechanical equipment will need to be selected in the same way. (See above);
- Earthing of all plant/equipment (see Technical Measures Document on Earthing);
- Elimination of surfaces above auto-ignition temperatures of flammable materials being handled/stored (see above);
- Provision of lightning protection;
- Correct selection of vehicles/internal combustion engines that have to work in the zoned areas (see Technical Measures Document on Permit to Work Systems);
- Correct selection of equipment to avoid high intensity electromagnetic radiation sources, e.g. limitations on the power input to fibre optic systems, avoidance of high intensity lasers or sources of infrared radiation;
- Prohibition of smoking/use of matches/lighters;
- Controls over the use of normal vehicles;
- Controls over activities that create intermittent hazardous areas, e.g. tanker loading/unloading;
- Control of maintenance activities that may cause sparks/hot surfaces/naked flames through a Permit to Work System.
Precautions to control the risk from pyrophoric scale, usually associated with formation of ferrous sulphide inside process equipment.

Area classification methods provide a succinct description of the hazardous material that may be present, and the probability that it is present, so that the appropriate equipment may be selected and safe installation practices may be followed. It is intended that each room, section, or area of a facility shall be considered individually in determining its classification. Actually determining the classification of a specific location requires a thorough understanding of the particular site. An exhaustive study of the site must be undertaken before a decision can be made as to what Class, Zone, and Group is to be assigned. It is beyond the scope of this paper to engage in a detailed discussion of how a location is actually classified. The local inspection authority has the responsibility for defining a Class, Zone, and Group classification for specific areas.

Zone Definitions:

Under the Zone system, equipment is tested and marked in accordance with the type of protection used by the equipment and not the area in which it can be used, such as the Class/Division system. It is the responsibility of the user or designer to select and apply the proper protection for each Zone. However, under the new approach, directive 94/9/EC requires that additional markings to specify exactly which categories and Zones the product may be used in.

For all protection methods, the rule applies that parts to which the potentially explosive atmosphere has unhindered access must not attain unacceptable temperatures. The temperatures must fall within the temperature class that applies to the particular potentially explosive atmosphere.

**Oil refinery Risks and Hazards**

The plant and equipment of refineries are generally modern, and the processes are largely automatic and totally enclosed. Routine operations of the refining processes generally present a low risk of exposure when adequate maintenance is carried out and proper industry standards for design, construction, and operation have been followed. The potential for hazardous exposures always exists, however. Because of the wide variety of hydrocarbon hazards and their complexity, it is impossible to identify all of the hazards here – and impossible for construction crews to know everything they may need for protection when performing maintenance, repair, or installation work in an oil refinery.
In a refinery, hazardous chemicals can come from many sources and in many forms. In crude oil, there are not only the components sought for processing, but impurities such as sulphur, vanadium, and arsenic compounds. The oil is split into many component streams that are further altered and refined to produce the final product range. Most, if not all, of these component stream chemicals are inherently hazardous to humans, as are the other chemicals added during processing.

Hazards include fire, explosion, toxicity, corrosiveness, and asphyxiation. Information on hazardous materials manufactured or stored in a refinery should be supplied by the client's representative when a work permit is issued.

The principal hazards at refineries are fire and explosion.

Refineries process a multitude of products with low flash points. Although systems and operating practices are designed to prevent such catastrophes, they can occur.

Constant monitoring is therefore required. Safeguards include warning systems, emergency procedures, and permit systems for any kind of hot or other potentially dangerous work. These requirements must be understood and followed by all workers.

Care should be exercised at all times to avoid inhaling solvent vapors, toxic gases, and other respiratory contaminants.

The principal exposures to hazardous substances occur during shutdown or maintenance work, since these are a deviation from routine operations. Plant turnarounds require careful planning, scheduling, and step-by-step procedures to make sure that unanticipated exposures do not occur. Any plant shutdown requires a complete plan in writing to cover all activities, the impact on other operations, and emergency planning. Plans are normally formulated by plant personnel in conjunction with contractors.

Hydrogen sulphide is a potential problem in the transport and storage of crude oil. The cleaning of storage tanks presents a high hazard potential. Many of the other classic confined-space entry problems can occur here, including oxygen deficiency resulting from previous inerting procedures, rusting, and oxidation of organic coatings. Carbon monoxide can be present in the inerting gas. In addition to H2S, depending on the characteristics of the product previously stored in the tanks, other chemicals that may be encountered include metal carbonyls, arsenic, and tetraethyl lead.

The lightest fraction from the crude unit is first processed in the gas plant. Some of the liquid hydrocarbons from the wet gas are run straight to the gasoline blending plant, but others go through the alkylation process. These light parts are put together using hydrofluoric acid or sulphuric acid as catalysts.

The main hazards in this process come from possible exposure to the catalysts, hydrofluoric acid or sulphuric acid, and their dusts, byproducts, and residues as well as hydrogen sulphide, carbon monoxide, heat, and noise.

Other processes utilize acid catalysts and caustic "washes." These can lead to hazardous situations, especially in shut downs where a contractor's personnel may be exposed to residues or other contaminants.
Information is required from refinery personnel and specialized training is required in the necessary.

**Safety by design**

Prevention through design (PtD), also called safety by design usually in Europe, is the concept of applying methods to minimize occupational hazards early in the design process, with an emphasis on optimizing employee health and safety throughout the life cycle of materials and processes.

Prevention through design represents a shift in approach for on-the-job safety. It involves evaluating potential risks associated with processes, structures, equipment, and tools. It takes into consideration the construction, maintenance, decommissioning, and disposal or recycling of waste material.

The idea of redesigning job tasks and work environments has begun to gain momentum in business and government as a cost-effective means to enhance occupational safety and health. Many U.S. companies openly support PtD concepts and have developed management practices to implement them. Other countries are actively promoting PtD concepts as well. The United Kingdom began requiring construction companies, project owners, and architects to address safety and health during the design phase of projects in 1994. Australia developed the Australian National OHS Strategy 2002–2012, which set "eliminating hazards at the design stage" as one of five national priorities. As a result, the Australian Safety and Compensation Council (ASCC) developed the Safe Design National Strategy and Action Plans for Australia encompassing a wide range of design areas.

The intent of Safety by Design is to:

- Address life-cycle health, safety and environmental risks and environmental aspects including management of the use of natural resources in development projects.
- Systematically and comprehensively identify and assess hazards and environmental challenges, and their associated risk to people, environment, asset and production loss, and company reputation.

Examine whether actual and potential negative impacts can be entirely avoided, or their magnitude reduced by design. If this is not possible then appropriate and preferably engineered controls (i.e., by isolating people from the hazard by use of enclosures) shall be put in place to manage the residual risks and environmental impacts.

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7 [https://en.wikipedia.org/wiki/Prevention_through_design](https://en.wikipedia.org/wiki/Prevention_through_design)
Safety by design is a five-step process:

1. Define safety goals

Goals will help maintain focus throughout the Safety by Design process. Goals should reflect regulatory requirements, legislation and project-specific tolerability of risk criteria and sustainability strategies, as well as project-specific safety and environmental goals.

2. Understand hazards & aspects

If hazards to health and safety or the relevant environmental aspects that require management are not known, they cannot be controlled. The purpose of this step is to identify and understand project specific health and safety hazards as well as environmental impacts.

3. Implement Inherent Safer Design principles

The intent of Inherently Safer Design is to eliminate a hazard or the use of materials or energy completely or reduce the magnitude of use sufficiently to eliminate the need for elaborate safety or environmental management systems. This process of elimination or reduction is accomplished by means that are inherent to the production process and thus permanent and inseparable from it and therefore highly reliable.

The implementation of Inherently Safer Design is achieved by adopting a strategy based on the following principles:

- Eliminate - remove hazardous materials, processes and activities.
- Minimise - use smaller quantities of hazardous substances and materials generally; minimise the number of activities especially hazardous ones.
- Substitute - replace a hazardous, expensive or rare material or activity with one that is less so.
- Moderate – minimise the potential impact of a release of substances, materials or energy, eg by changing layout configuration, adopting less hazardous operating conditions, or by minimising the number of people exposed.
- Simplify – design facilities and plan executions to reduce or eliminate complexity and minimise the possibility of human error.

4. Manage residual risk

If ‘inherent control’ cannot be fully achieved or is perceived to be inadequate, residual hazards, risks and environmental impacts will remain and their associated risks and effects will need to be reviewed, and where reasonably possible, mitigated. Mitigation may require the implementation of additional engineered or procedural controls.

Controls or safeguards are generally more effective if they prevent a hazardous event or unnecessary use of materials or energy from occurring by passive means, rather than reactive means, ie acting on the consequences of events rather than preventing the events. Engineered controls are generally preferred to administrative controls, as these require no, or less, human intervention to be effective.

The preferred hierarchy of controls is reflected in Safety by Design process, and subprocesses that address health & safety and environmental protection & sustainability issues.
Various studies can be conducted as part of the residual risk management process, either in-house or with external support. These studies could include the review of:

- Operability and safety of processes involving hazardous materials.
- Effectiveness of safety instrumented systems as a safeguard.
- Analysis of the possible failure of equipment and the potential impact of this failure on people and the environment.
- Effects and likelihood of releases of hazardous materials.
- Effects and likelihood of fires, explosions and nuclear radiation, and mechanical impacts such as dropped objects and collisions.
- The minimisation of the use of resources (eg water) and energy (eg electricity diesel fuel).
- Human-machine interface and human-friendly design.
- Effects and likelihood of potential human errors.
- Escape, evacuation and rescue process.
- Evaluation of risks to people and the environment, asset-production loss, effects on community, habitat and natural heritage.

5. Consolidate and communicate

Once the Safety by Design process has been completed as intended, and the goals that were identified at the outset of the project have been met, the process can be closed. The findings of the Safety by Design process can be consolidated and communicated to internal and external stakeholders. Depending on legislative and client requirements, a dedicated compliance report such as a Case for Safety or an Environmental Impact Statement is produced⁸.

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SIMOPS in refinery operations: Fires and Explosion Protection

No work takes place in a refinery without a safe work permit.

A safe work permit is a document issued by an authorized representative of the client permitting specific work for a specific time in a specific area. Work permits should indicate the date and time of issue, the time of expiry, a description of the work to be done, and the name of the company performing the work. Permits also specify any hazards and controlled products under WHMIS and any protective equipment needed for the job. The permit will advise you of any steps required to make the area or equipment safe for work, tell you the results of any gas tests, advise you of any electrical lockouts that have been done, and tell you of any Identify its location.

Safe work permits are valid only for a limited time and must be renewed following expiry or normally after any one-hour stoppage, after an emergency warning on the site, or for other safety reasons. After such an event, any required gas testing or other testing must be repeated to ensure a safe return to the work.

The hazards of the petrochemical industry are closely related to those of oil refining, particularly in the raw material stages.

Atmospheric contamination hazards in the petrochemical industry can be complex, particularly when substances or processes combine. These combined effects are often much more toxic and dangerous than individual effects.

As they do in oil refineries, construction crews in petrochemical plants must comply with regulations as well as in-plant procedures. Cooperation between contractor and client is essential for safe work, from the bidding stage until the contract is completed.

Throughout the life of any project, and more importantly during times of vessel traffic (operations, drilling, construction, survey, etc....), a study of the schedule should be made regularly and at every revision to identify any possible SIMOPS along with dates, types of
vessels, vessel names, vessel duties and vessel durations for all vessels planned to be in the field and/or work area\(^9\).

**Typical Refinery Processing Scheme**

**Workshop: Case Studies & Worked Examples**
Planning and Communicating for Conducting Safe SIMOPS-example case will be worked on through the presentation.

Risk Management methodologies

To understand what a risk assessment is and how it can be conducted, it is important to first distinguish the terms ‘risk’ and ‘hazard’. Risks and hazards often get confused as the same thing, however, they are not the same. Risk is the likelihood of harm in defined circumstances while a hazard is an activity with the potential to cause harm.

Hazardous activities are often part of normal business and therefore organizations are exposed to certain risks. Activities such as flying planes or producing kerosene are typical hazards. A hazard by itself is not harmful but if there is a loss of control over the hazard (or hazardous activity) it can become harmful.

To make sure an organization is in control of their hazardous activities and the damage they can cause, a risk assessment should be conducted. A risk assessment is a procedure where different risks are reviewed, qualified and clarified in a way that makes it possible to determine an adequate action or state to prevent or lower the risk. In turn, this makes it possible to make educated decisions when it comes to risk and risk management.

When evaluating risk by conducting a risk assessment, all influential factors need to be considered. By doing so, certain questions need to be asked. Some examples are:

- Who could get harmed?
- How might this person get harmed?
- What is the inherent risk for this to happen? (the risk without any implemented controls or barriers)
- What control measures (also called barriers) are in place or can be put in place to prevent an event from happening?
- What is the residual risk after the control measures? (the risk with implemented controls or barriers).

Over time, the need for better visualization of risk scenarios increased. Organizations wanted more control and oversight which led to the development of the bowtie method as we know it today. A bowtie often tells the complete story that a more traditional risk register cannot. In a bowtie diagram all possible scenarios are individually shown, with all relevant control measures in the right context. This makes it not only possible to intuitively understand the risks, but also to level with everyone who is reading it, regardless of the reader’s level of expertise. By nature, the human mind can more easily understand a picture than a comprehensive spreadsheet10.

Risk management, entails a continuous process of applying a series of mitigating actions—assessing risk through the evaluation of threats, vulnerabilities, and consequences; responding to risks with appropriate countermeasures; and monitoring risks using quality information

10 https://www.cgerisk.com/knowledgebase/Risk_assessment
Elements of Risk Management

- Assess risks: Conduct risk assessments to identify threats, vulnerabilities, and consequences of undesirable events.
- Monitor risks: Monitor how risks are changing using quality information.
- Respond to risks: Make decisions about where and how to invest resources to protect facilities within the organization.

Source: GAO | GAO-18-72
Risk Matrix and the construction of risk matrix

A risk matrix is a matrix that is used during risk assessment to define the level of risk by considering the category of probability or likelihood against the category of consequence severity. This is a simple mechanism to increase visibility of risks and assist management decision making.

Risk is the lack of certainty about the outcome of making a particular choice. Statistically, the level of downside risk can be calculated as the product of the probability that harm occurs (e.g., that an accident happens) multiplied by the severity of that harm (i.e., the average amount of harm or more conservatively the maximum credible amount of harm). In practice, the risk matrix is a useful approach where either the probability or the harm severity cannot be estimated with accuracy and precision.

Although standard risk matrices exist in certain contexts (e.g. US DoD, NASA, ISO), individual projects and organizations may need to create their own or tailor an existing risk matrix. For example, the harm severity can be categorized as:

- Catastrophic – multiple deaths
- Critical – one death or multiple severe injuries
- Marginal – one severe injury or multiple minor injuries
- Negligible – one minor injury

The probability of harm occurring might be categorized as:

- 'certain',
- 'likely',
- 'possible',
- 'unlikely' and
- 'rare'.

However it must be considered that very low probabilities may not be very reliable\(^\text{11}\).

Risk matrices are probably one of the most widespread tools for risk evaluation. They are mainly used to determine the size of a risk and whether or not the risk is sufficiently controlled. There is still confusion about how they are supposed to be used. This article will explain their use in the context of the bowtie diagram.

There are two dimensions to a risk matrix. It looks at how severe and likely an unwanted event is. These two dimensions create a matrix. The combination of probability and severity will give any event a place on a risk matrix.

Most risk matrices have at least three areas.

The low probability, low severity area (usually green) that indicates the risk of an event is not high enough, or that it is sufficiently controlled. No action is usually taken with this. If we talk about risk matrices in a bowtie however, usually bowties are done for major hazards, so most events are high risk and don’t fall into this category.

The high probability, high severity (ususally red) which indicates an event needs a lot or more control measures to bring the probability or severity down. Bowties will have a lot of events that fall into this category.

The medium category (usually yellow) is in between these two areas. Any event that falls in this area is usually judged to be an area that needs to be monitored, but is controlled as low as reasonably practicable (or ALARP, a concept that is beyond the scope of this article, but you can go here and read about it). Essentially it means if we keep the risk at that level, we accept it.

It’s important to understand that a risk matrix by itself makes for a poor decision-making tool. It is best suited for ranking events. There is not enough granularity in a risk matrix to use it for anything other than saying that some events are really bad, and others are less so. Decisions need to be based on an underlying analysis (like a bowtie diagram) that will tell you what will cause the unwanted event and what an organization is already doing to control it. This information will make an informed decision possible.
Another misconception is that a risk matrix is a quantitative tool. In theory, it can be, but in practice, it is not. The risk matrix is made up of two ordinal rating scales, with mostly qualitative descriptions along its axes. This makes it very difficult to assign any real numbers to a matrix and thus to do calculations with it. It can only give a qualitative score that indicates in which category an event falls. It won't allow for any sophisticated calculations.

There are different ways of looking at severity. Something can be very severe from the perspective of human life, or from the perspective of damage to a facility. Usually four perspectives are used (although more or less is also possible) that form the acronym PEAR. This stands for People, Environment, Assets and Reputation. Any event can be judged against these four categories. For instance: a car crash will have an impact on people, but also on assets. An oil spill might have an impact on the environment and reputation, and also some asset and people impact.

These different perspectives do make it very difficult to compare two events with each other. If we have two events, one that scores high on people, and another that scores high on environment, which one is more severe? This is why aggregating risk matrix scores is difficult, if not impossible to do. The best way to compare the severity of events is to make a qualitative judgement.

Up until now, only probability has been discussed. But there are different possibilities. If we drive to work, and there’s a probability of 0.05 that we’ll crash, we expect for every car that in 100 workdays, there are 5 crashes. The probability will be the same every time we drive to work.

Instead of focusing on a single event, we can also say: how often can I drive to work before I crash? The frequency of a crash will be 1 in 20. This is essentially the same, just written down differently.

The last category looks at the past and scores higher if the event has occurred more. The main difference is that probability and frequency tell us something about the future, while historical scales will only tell us something about the past. If something has not occurred yet, a historical scale will not allow you to make a prediction about how often it might happen in the future. This is why most risk matrices now use probability or frequency scales.

There is a problem with events that have a very low frequency, but a catastrophic severity. If the risk matrix categories are not set up correctly, these types of events tend to ‘fall off’ the grid and get less attention than they deserve. This is especially a problem with historical frequency scales, where an event will get the lowest possible score just because it has never occurred. A possible solution is to make the worst severity category the highest priority category, regardless of the probability.

Ranking an event on a risk matrix can be done in three ways:

Worst case scenario. This is done by taking the worst that could happen. For instance in the case of a car crash, there will be multiple fatalities and it might be likely to occur. Essentially when looking at the worst case scenario, all Barriers are ignored and only the Hazard, Top event and Consequences are considered. These types of incidents might occur in reality, but they will most likely be the exception, not the rule.
Current situation. The second strategy tries to evaluate the severity and probability of the average event. So the average severity for a car crash might be a single fatality, and it’s unlikely to happen. This strategy takes into account all the barriers that are currently implemented.

Future situation. The last strategy tries to make an estimate of how the risk might go down after improvements to barriers, or implementation of new barriers. It aims to estimate the future average of incidents.

Even though the risk matrix has a lot of drawbacks, it has endured the criticism and is still one of the standard tools used in most risk assessments. If the risk matrix is used in the correct way, it can add some understanding, although probably the greatest challenge today is for people to understand its limitations.  

**Job Hazard Analysis**

A job hazard analysis (JHA), also called a job safety analysis (JSA), is a technique to identify the dangers of specific tasks in order to reduce the risk of injury to workers. Once you know what the hazards are, you can reduce or eliminate them before anyone gets hurt. The JHA can also be used to investigate accidents and to train workers how to do their jobs safely.

It will take a little time to do your JHAs, but it's time well spent. Be sure to involve employees in the process --- they do the work and often know the best ways to work more safely.

**Instructions for Conducting a Job Hazard Analysis**

- Involve employees
  - Discuss what you are going to do and why
  - Explain that you are studying the task, not employee performance
  - Involve the employees in the entire process
- Review your company's accident/injury/illness/near miss history to determine which jobs pose the highest risk to employees.
- Identify the OSHA standards that apply to your jobs. Incorporate their requirements into your JHA.
- Set priorities.
  - You may want to give priority to:
    - Jobs with the highest injury or illness rates;
    - Jobs where there have been "close calls" - where an incident occurred but no one got hurt;
    - Jobs where you have identified violations of OSHA standards;
    - Jobs with the potential to cause serious injuries or illness, even if there is no history of such problems;
    - Jobs in which one simple human mistake could lead to severe injury;
    - Jobs that are new to your operation of have been changed; and

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How to do it?

1. Break the job task into steps.
   - Watch the worker do the job and list each step in order
   - Begin each step with a verb, for example, "Turn on the saw."
   - Do not make it too broad or too detailed
   - You may want to photograph or videotape
   - Review the steps with the worker and other workers who do the same job to make sure you have not left anything out.

2. Identify the hazards of each step. For each hazard, ask:
   - What can go wrong?
   - What are the consequences?
   - How could it happen?
   - What are other contributing factors?
   - How likely is it that the hazard will occur?

3. Review the list of hazards with employees who do the job. Discuss what could eliminate or reduce them.

4. Identify ways to eliminate or reduce the hazards.
   - Safer way to do the job
   - Describe each step
   - Be specific - don't use generalizations like "Be Careful"
   - Changes in equipment
   - Equipment changes, or engineering controls, are the first choice because they can eliminate the hazard
   - E.g. machine guards, improved lighting, better ventilation
   - Changes in work processes
   - Administrative controls, or changes in how the task is done, can be used if engineering controls aren't possible
   - E.g. rotating jobs, changing the steps, training
   - Changes in personal protective equipment
   - When engineering and administrative controls aren't possible or don't adequately protect the workers, use personal protective equipment
   - E.g. gloves, hearing protection

13 [https://www.safetyworksmaine.gov/safe_workplace/safety_management/hazard_analysis.html](https://www.safetyworksmaine.gov/safe_workplace/safety_management/hazard_analysis.html)
SIMOPS Checklist

Permit to Work (PTW) system and issuing process
Permit to Work (PTW) refers to management systems used to ensure that work is done safely and efficiently. These are used in hazardous industries and involve procedures to request, review, authorize, document and most importantly, de-conflict tasks to be carried out by front line workers. Permit to work is an essential part of control of work (COW), the integrated management of business-critical maintenance processes. Control of work is made up of permit to work, hazard identification and risk assessment (RA), and isolation management (IM).

The following aspects should be considered with respect to Permit to Work Systems:

Human factors;
- Management of the work permit systems;
- Poorly skilled work force;
- Unconscious and conscious incompetence;
- Objectives of the work permit system;
- Types of work permits required; and
- Contents of the work permits.

The following issues may contribute towards a major accident or hazard:

- Failing of the site safety management system;
- Failure to recognise a hazard before and during maintenance;
- Failure to comply with the work permit system in hazardous environments; and
- Communication failure during the use of a work permit system.

The Safety Report should address the following points:

- Whether staff have been sufficiently informed, instructed, trained and supervised to minimise a potential human failing during operation of the work permit system;
- Whether the work permit system includes sufficient safety information, maintenance instructions, correct PPE and equipment for use;
- Whether the work permit contains sufficient information about the type of work required (Equipment removal, excavation, hot/cold work, repairing seals, vessel entry, waste disposal, isolation);
- Whether there is sufficient provision available to fulfil the requirements of the work permit system;
- Whether the employees responsible for control of the maintenance work are identified within the work permit system and that the work is properly authorised by a responsible person;
- Whether the work permit system is managed, regularly inspected and reviewed;
- Whether all work permits are kept on file;
- Human factors (stress, fatigue, shift work, attitude);
Major hazards could arise from the following:

- Wrong type of work permit used;
- Wrong information about work required on the work permit;
- Failure to recognise the hazards where work is carried out (e.g. flammable substances);
- Introduction of ignition source in controlled flameproof area (e.g. welding, non spark-proof tools, non-intrinsically safe equipment used in intrinsically safe zones);
- Terms of work permit not adhered to (e.g. failure to isolate plant and/or drain lines of hazardous substances);
- Failure to hand-over plant in safe condition on completion of work/cancelling of work permit;
- Unauthorised staff performing work permit functions;
- Poor management of the work permit system; and
- Insufficient monitoring of the work permit system.

**Workshop: Case Studies & Worked Examples**
Within the practice we will do a exercise of issuing a Permit To Work.

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14 [https://www.hse.gov.uk/comah/sragtech/techmeaspermit.htm](https://www.hse.gov.uk/comah/sragtech/techmeaspermit.htm)
Day Three SIMOPS in Specific Cases

Common Process Hazards
The major hazards with which the chemical industry is concerned are fire, explosion, and toxic release. Of these three, fire is the most common but, as shown later, explosion is particularly significant in terms of fatalities and loss.

SIMOPS in construction

Tie-In

Piping tie-ins are unavoidable in plants where expansion is a current or future factor. Steam, condensate, compressed air, dust collection, vacuum and process lines are just a few types of plant piping likely to be modified by tie-ins to increase capacity. Here are a few ways to minimize costly disruption of plant operation when tie-ins are inevitable.

Plan and schedule New piping design should include allowances for future expansion. This can be accommodated without major expense. Consider the following:

- Increase design pipe sizes to the next larger diameter if velocity limits permit.
- Provide caps or blind flanges at the end of a pipe run where a brief tie-in outage can be tolerated.
- Provide valves with blind flanges when and where a future tie-in outage cannot be tolerated.
- Provide adequate access and maintenance space for future connecting piping.

Existing piping design may provide limited flexibility for future piping tie-in accommodations. However, take advantage of future scheduled outages and add piping flanges and valves where future tie-ins are inevitable. This will enable future construction to proceed without disrupting plant and process operations.\(^{15}\)

The piping and instrumentation diagram (P&ID) is a useful means to define piping tie-ins. The P&ID does not locate the tie-in physically. However, it defines the functional relationship of the tie-in within the piping system, which is the initial step in the design process. Establish a numbering system for tie-ins, i.e., “T-XXX,” which can be used as a reference on design documents until the project is completed. An indication of “new” and “existing” piping also provides clarity.

A tie-in list can also be useful for estimating the cost of construction and for scheduling work well in advance of the actual piping design activity. Often, the list will include details such as the estimated length, material designation, insulation and coating requirements and reference drawings. Some level of complexity can be assigned to the length to account for miscellaneous fittings and related variables in the cost estimate.

Finally, orthographic and isometric piping drawings should indicate the piping, fittings, valves, material, weld and testing requirements that pertain to the tie-in. Often, the tie-in references are deleted from the “as-built drawings” at the close-out phase of the project.

\(^{15}\) https://www.plantservices.com/articles/2006/184/
The plant and process considerations are usually obvious. Immediate or projected increases in utility or process flow rates are the most frequently cited reasons for tie-in piping. Accommodating the need for these increased demands often results in additional capital equipment.

After the process requirements are determined and the tie-in piping sized, consider isolation provisions. It is rarely feasible economically to shut down the plant or process during tie-in piping installation. Alternately, a short-term, scheduled outage may be sufficient to break the line and install a tie-in connection. After the connection is in place, the piping can be fabricated and connected “off-line” conveniently and economically.

During the interim period, a blind flange can be installed and the process resumed. However, this will require another brief outage to remove the blind flange and connect the tie-in piping. This can be avoided by installing a shutoff valve upstream of the blind flange to provide safe, long-term isolation. Subsequently, the blind flange can be removed, the connecting pipe installed, and the valve opened after the tie-in is completed.

Pay particular attention to installing a shutoff valve that is adequate for temporary “end-of-line service” by considering these factors:

- Valve seals must withstand full rated pressure on one side while unpressurized on the other side in the closed position.
- Valves must withstand a pressure and leak test.
- Valves must be bidirectional so they can be installed with either end open to atmosphere.
- Valves must be installed with a lockout device and comply with OSHA Zero Energy requirements.
- The pressure drops across a tie-in valve (in the fully opened position) should not be excessive.
- Provide a “drainable spool piece” downstream of the shutoff valve.

The purpose of the spool piece is two-fold. First, the drain valve provides a means to check for leakage of the shutoff valve seals. Second, the drain valve relieves pressure buildup when the blank is removed in the event the shutoff valve leaks. Provisions can then be made to deal with the faulty valve. This allows the tie-in piping to be connected safely.

A variety of valves are adaptable to end-of-line shutoff service. These include ball, gate, butterfly and plug types. Carefully compare the service conditions with the valve manufacturer’s specifications to determine suitability for both the prolonged shutoff and open positions.

After determining the tie-in configuration, evaluate the optimum routing of the connecting piping from a flexibility standpoint. The shortest distance between two points generally requires the least amount of piping, but this practice may be unwise from a flexibility standpoint. Added flexibility may be necessary to reduce the pipe loads on sensitive equipment such as compressors, fans or pumps. A piping jog, loop or flexible connector may offer a convenient way to reduce stress and deflection at the tie-in point or at the flanges on installed equipment.
Available software facilitates analysis of piping systems that are subject to pressure, temperature and dynamic reaction loads such as those caused by pressure relief valves. Expansion joints, hangers, anchors and guides can also be evaluated to optimize the piping support system.

**Additional equipment installation**

For precautionary reasons, issue a line break permit to address specific details of the procedure prior to construction. The purpose of the permit is to define:

- Location of the line break.
- Applicable design documents.
- Fluid in the line.
- Safety equipment requirements.
- Hazards associated with handling the materials last in the line.
- Special line washing, purging or flushing requirements.
- Valve locking and tagging requirements.
- All personnel involved or affected by the procedure.
- Installation of the connecting piping is simplified if provisions are made in the piping for isolating the tie-in point. Piping installation can then occur without disrupting the process.

When a tie-in point on a line cannot be isolated or the plant or process cannot be shut down to accommodate the line break, a procedure known as “hot tapping” is required. This is frequently used to break lines containing steam, natural gas, water or other utilities, which must flow uninterrupted on a daily basis. This procedure results in the installation of a lockable tie-in valve while the line is pressurized.

Some essential equipment for the procedure includes hot tap fitting, full open and lockable gate valve, hot tap machine (hydraulic or air-driven), cutter and pilot assembly, tapping machine housing, a power unit (hydraulic or air-driven) and hose. Basic hot tapping steps include:

- Weld the hot tap fitting onto the line.
- Install the full open gate valve on the fitting.
- Inspect and pressure test the valve and fitting.
- Install the hot tap machine on the valve.
- Bore the line.
- Retract the boring bar, then close and lock the valve.
- Depressurize the hot tap machine and remove it.
- Clean the work area.

Following the hot tapping procedure, installation of connecting piping valves and fittings can proceed in much the same manner as though existing isolation provisions were already in the line. Once installation is complete, conduct a pressure and leak test of the newly installed
piping with the tie-in valve remaining in the closed and locked position. With satisfactory pressure test completion, the new tie-in piping is now ready to be activated by unlocking and opening the tie-in valve.

SIMOPS in maintenance
Maintenance activities can potentially expose people to all sorts of hazards. There are five commonly encountered issues that merit particular attention.

- Asbestos
- Falls from height
- Isolation and permits to work
- Falls of heavy items
- Selecting a contractor.

Maintenance safety HSE checklist:

- Do our staff always isolate machines before doing maintenance?

If you aren't sure, you need to watch what happens in practice and speak to the staff concerned. For basic advice see isolation and permits to work.

- Have all our maintenance staff got their own isolation padlocks and warning boards?

If you don't know, speak to the staff concerned.

- Do we know if we've got asbestos in the building, and where it is?

Ask to see the relevant plans, drawings or reports. For a step by step guide to managing asbestos in buildings see HSE's Managing my asbestos web pages. Section 5 in particular deals with the inspection of buildings.

- Do we use this asbestos information when we plan building maintenance jobs?

For a step by step guide to managing asbestos in buildings see HSE's Managing my asbestos web pages. Section 6 in particular deals with using the findings to plan maintenance work.

- Are we thinking about what access equipment is right for the job, or just using whatever we have to hand?

Use the Step-by-step guide to find the right kind of access equipment for specific maintenance jobs.

- Are we thinking through proper lifting plans before lifting heavy loads?
- Are any of us competent enough to take charge of non-standard lifting jobs?
- Do we use 'permits to work' properly when we need them?

If you aren't sure, you need to watch what happens in practice and speak to the staff concerned. For basic advice see isolation and permits to work.

- Do we have any confined spaces?

For basic advice see isolation and permits to work.
Do our managers and supervisors stop maintenance work if it isn't being done safely?\textsuperscript{16}

\textbf{Shutdown and isolation}

Oil refineries, oil and gas production installations and chemical processing plants are characterized by long lengths of continuously welded pipework and pipelines connecting process vessels, plant and installations. The contents are often hazardous substances, which may be flammable and/or toxic and are often at high temperatures and/or pressures. Any intrusive activity could allow the escape of hazardous substances. The implementation of adequate isolation practices is critical to avoiding loss of containment. You should minimise isolation requirements, wherever practicable, by planning intrusive maintenance for shutdown periods. When maintenance work has to be carried out on live plant a high standard of management will be required.

Release of hazardous substances due to inadequate process isolation may lead to:

- Local immediate effects to people (death or injury) and to the environment.
- Long-term effects to people and the environment may be equally serious; and/or
- Escalation of the initial release, causing wider damage to plant and other systems (eg damage resulting in further releases of inventory).

Design of new plant should include facilities for positive isolation (including the valved isolation to install the positive isolation) in the following situations:

- For vessel entry, where a requirement for entry cannot be eliminated by equipment design;
- For isolation of toxic fluids; or
- To control segregation of parts of the plant which, in alternative operating modes, might otherwise be exposed to overpressure conditions. This applies where it is not reasonably practicable for the installed safety systems to protect all foreseeable operating configurations, for example the separation of a high-pressure plant from its drainage system.

Pipework layout should minimise trapped inventories and allow easy removal of fluid for isolation purposes. Ensure that pipework:

- Is of sufficient size and design to minimise the possibility of becoming blocked in service; and
- Is robust and able, where appropriate, to cope with the repetitive stresses imposed by vibration, pulsating pressure and temperature cycling.

\textsuperscript{16} \url{https://www.hse.gov.uk/safemaintenance/checklist.htm}
Unless risk assessment indicates otherwise, isolation and bleed points should be as close as possible to the plant item. Concentration of maintenance work in one place aids control of the isolation arrangements and minimises the inventory of fluid to be depressurised/drained. Ensure that bleeds are:

- Arranged so that their discharge cannot harm personnel or plant, and toxic or flammable material can be conveyed to a safe place for disposal; and
- Easily accessible for checking\(^\text{17}\).

**Pressure testing**

Examples of pressure systems and equipment are:

- boilers and steam heating systems;
- pressurised process plant and piping;
- compressed air systems (fixed and portable);
- pressure cookers, autoclaves and retorts;
- heat exchangers and refrigeration plant;
- valves, steam traps and filters;
- pipework and hoses; and
- pressure gauges and level indicators.

Principal causes of incidents are:

- poor equipment and/or system design;
- poor maintenance of equipment;
- an unsafe system of work;
- operator error, poor training/supervision;
- poor installation; and
- inadequate repairs or modifications.

The main hazards are:

- impact from the blast of an explosion or release of compressed liquid or gas;
- impact from parts of equipment that fail or any flying debris;
- contact with released liquid or gas, such as steam; and
- fire resulting from the escape of flammable liquids or gases.

\(^{17}\) [https://www.hse.gov.uk/pUbns/priced/hsg253.pdf](https://www.hse.gov.uk/pUbns/priced/hsg253.pdf)
The level of risk from the failure of pressure systems and equipment depends on a number of factors including:

- the pressure in the system;
- the type of liquid or gas and its properties;
- the suitability of the equipment and pipework that contains it;
- the age and condition of the equipment;
- the complexity and control of its operation;
- the prevailing conditions (e.g., a process carried out at high temperature); and
- the skills and knowledge of the people who design, manufacture, install, maintain, test and operate the pressure equipment and systems\(^\text{18}\).

### Inspection

Workplace inspections help prevent incidents, injuries and illnesses. Through a critical examination of the workplace, inspections help to identify and record hazards for corrective action. Health and safety committees can help plan, conduct, report and monitor inspections. Regular workplace inspections are an important part of the overall occupational health and safety program and management system, if present. Inspections are important as they allow you to:

- listen to the concerns of workers and supervisors
- gain further understanding of jobs and tasks
- identify existing and potential hazards
- determine underlying causes of hazards
- recommend corrective action
- monitor steps taken to eliminate hazards or control the risk (e.g., engineering controls, administrative controls, policies, procedures, personal protective equipment)

Every inspection must examine who, what, where, when and how. Pay particular attention to items that are or are most likely to develop into unsafe or unhealthy conditions because of stress, wear, impact, vibration, heat, corrosion, chemical reaction or misuse. Include areas where no work is done regularly, such as parking lots, rest areas, office storage areas and locker rooms\(^\text{19}\).

### Workshop: Case Studies & Worked Examples

Prepare and conduct SIMOPS for tie-in operation

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\(^\text{18}\) [https://www.hse.gov.uk/pubns/indg261.pdf](https://www.hse.gov.uk/pubns/indg261.pdf)

\(^\text{19}\) [https://www.ccohs.ca/oshanswers/prevention/effectv.html](https://www.ccohs.ca/oshanswers/prevention/effectv.html)
Day Four PTW Procedure and SIMOPS

PTW system

A permit-to-work system is a formal written system used to control certain types of work that are potentially hazardous.

A permit-to-work is a document which specifies the work to be done and the precautions to be taken. Permits-to-work form an essential part of safe systems of work for many maintenance activities. They allow work to start only after safe procedures have been defined and they provide a clear record that all foreseeable hazards have been considered. A permit is needed when maintenance work can only be carried out if normal safeguards are dropped or when new hazards are introduced by the work.

Information

- Is the permit-to-work system fully documented, laying down:
  - how the system works;
  - the jobs it is to be used for;
  - the responsibilities and training of those involved; and
  - how to check its operation?

- Is there clear identification of who may authorise particular jobs (and any limits to their authority)?

- Is there clear identification of who is responsible for specifying the necessary precautions (eg isolation, emergency arrangements, etc)?

- Is the permit form clearly laid out?

- Does it avoid statements or questions which could be ambiguous or misleading?

- Is it designed to allow for use in unusual circumstances?

- Does it cover contractors?

Selection and training:

- Are those who issue permits sufficiently knowledgeable concerning the hazards and precautions associated with the plant and proposed work?

- Do they have the imagination and experience to ask enough ‘what if’ questions to enable them to identify all potential hazards?

- Do staff and contractors fully understand the importance of the permit-to-work system and are they trained in its use?

Description of the work:

- Does the permit clearly identify the work to be done and the associated hazards?

- Can plans and diagrams be used to assist in the description of the work to be done, its location and limitations?

- Is the plant adequately identified, eg by discrete number or tag to assist issuers and users in correctly taking out and following permits?
• Is a detailed work method statement given for more complicated tasks?
• Hazards and precautions
• Does the system require the removal of hazards and, where this is not reasonably practicable, effective control?
• Are the requirements of The Control of Substances Hazardous to Health Regulations (COSHH) and other relevant legislation known and followed by those who issue the permits?
• Does the permit state the precautions that have been taken and those that are needed while work is in progress? For instance, are isolations specified and is it clear what personal protective equipment should be used?
• Do the precautions cover residual hazards and those that might be introduced by the work, eg welding fume and vapour from cleaning solvents?
• Do the Confined Spaces Regulations 1997 apply? If so, has a full risk assessment identified the significant risks and identified alternative methods of working or necessary precautions?

Procedures:
• Does the permit contain clear rules about how the job should be controlled or abandoned in the case of an emergency?
• Does the permit have a hand-back procedure incorporating statements that the maintenance work has finished and that the plant has been returned to production staff in a safe state?
• Are time limitations included and is shift changeover dealt with?
• Are there clear procedures to be followed if work has to be suspended for any reason?
• Is there a system of cross-referencing when two or more jobs subject to permits may affect each other?
• Is the permit displayed at the job?
• Are jobs checked regularly to make sure that the relevant permit-to-work system is still relevant and working properly?

The permit-to-work form must help communication between everyone involved. It should be designed by the company issuing the permit, taking into account individual site conditions and requirements. Separate permit forms may be required for different tasks, such as hot work and entry into confined spaces, so that sufficient emphasis can be given to the particular hazards present and precautions required.

20 https://antarisconsulting.com/docs/guides/unit_igc1/Permit%20to%20work%20systems%20indg98.pdf
SIMOPS assessment review

A meeting of all the parties involved in the SIMOPS should be set up to enable a review to be undertaken of each party’s work-specific dossier in a systematic manner. Appropriate tools should be used to clearly identify all the risks in conducting SIMOPS contained in each party’s dossier and the review meeting should agree the required specific mitigation measures to be implemented to allow SIMOPS to proceed. Methodology/tools which can be used to identify the risks are:

- Hazard identification and risk assessment (HIRA);
- Clash analysis;
- Interdependency analysis.

SIMOPS interface document

It is important that SIMOPS/interface documentation be developed for the SIMOPS activities.

Depending on the scope of the SIMOPS activities, this could comprise one document covering all the work or alternatively could comprise several documents, covering specific, clearly identified SIMOPS activities. Each interface document should:

- Set out the activities covered by the document and should be applicable to all parties’ operations for the specified activity. A SIMOPS matrix, where appropriate, may be developed to identify which activities are permissible when conducted simultaneously
- Be developed on a discrete basis for various phases of work within the SIMOPS to prevent this becoming an unwieldy document
- Contain a validation exercise to be carried out against original SIMOPS assessment review to ensure that all mitigation and controls are in place
- The SIMOPS interface document should cover the following:
  - Purpose and scope
  - Glossary of terms
  - Roles and responsibilities, including organisation and reporting lines/requirements
  - SIMOPS operations – description of scope of work to be covered by the specific document
  - Procedures and controls
  - SIMOPS risk and mitigations
  - Contingency plans
  - Change control – deviation requests
  - Establishment of who has primacy (who is in overall charge of communications, PTW and operations)
SIMOPS flowchart

SIMOPS Flowchart – Life Cycle Model for SIMOPS:

- Identify SIMOPS
- Kick-off meeting identifying scope of work
- Each party prepares work specific dossiers
- SIMOPS assessment review
- Develop SIMOPS interface document
- Identify constraints and hazards associated with all the activities
- Draw up a checklist of the corresponding mitigation measures
- Develop hierarchy of controls
- Purpose
- Identified SIMOPS
- Procedures and controls
- Risk and mitigation
- Reporting lines
- Contingency plans
- Management of change (MOC)
- Privacy
- Authorisation/PTW
- Communications plan

SIMOPS Toolbox Talk

Once a SIMOPS has been identified, a kick-off meeting should be arranged for all parties to the SIMOPS and the client so that the scope of work for the operations can be drawn up. The party in overall charge (for example client, OIM or master of a specific vessel) should be identified.

The kick-off meeting should identify all the SIMOPS activities to be carried out. A risk assessment of all the anticipated operations should be undertaken to:

- Identify constraints and hazards associated with all the activities;
- Draw up a checklist of the corresponding mitigation measures.
Each party to the SIMOPS activities should draw up a dossier which is intended to provide a work-specific summary identified by that party for their part in the SIMOPS activities. In order that each party can draw up their work-specific SIMOPS dossiers, the kick off meeting should:

- define the responsibilities and nominate the responsible person for each party;
- identify the input required from each party; and
- identify the time frame for each part of the SIMOPS work, including timings of pre-operations meetings and the actual SIMOPS activities themselves.

**Workshop: Case Studies & Worked Examples**

Prepare and conduct a SIMOPS toolbox talk
Risk Management

In the petroleum refining industry, considerable effort has been made over the past decades to provide a proactive safety management system, in order to prevent accidents from happening and/or to mitigate accident escalation. Intermittently, lessons have been learnt from major accidents in the petroleum refining industry, recommendations have been provided based on knowledge and lessons learnt from investigation of the past catastrophic accidents by organizations such as the US Chemical Safety and Hazard Investigation Board (US CSB), the UK Health and Safety Executive (UK HSE), the U.S Occupational Safety and Health Administration, EU commission, America Petroleum Institute (API), Centre for Chemical Process Safety (CCPS) and other independent investigation panels that express more opinion on the need to strengthen risk controls in order to prevent the release of hazards that can lead to major accidents. However, significant effort has been made by the aforementioned organizations to develop and publish a comprehensive guidance and regulations for refiners in the petroleum industry, in order to manage process units risk and prevent unintentional loss of hazardous materials (OGP, 2011). Various regulations and guidelines in relation to environmental health and safety, to prevent foreseeable future accidents in the petroleum refining industry.

Due to the complexity and sizes of most refineries, it is nearly impossible for operators to eliminate all the risks associated with the operations of such facilities. In such circumstances, it is obvious that every refinery is required to have a reliable and consistent risk management process that can be implemented to deal with events and other latent condition that can create a potential pathway to accidents. Various reports on major accidents in the petroleum refining industry emphasized the failure in risk management, leading to systematic causes of accidents. Based on the summary from various cases of accidents, the following risk management failures are identified:

Inadequate attention or awareness of management to significance of a hazard that can trigger an accident.

- Failure in hazard/risk identification and risk assessment of major hazard resulting in poor assessment of hazards and associated risks
- Failure to conduct adequate risk analysis prior to management of change process (i.e. Failure of operator to conduct risk assessment prior to any change event or lack of recognition for need to carry out risk assessment before any change)
- Failure to conduct adequate risk analysis for planning inspections (i.e. lack of appropriate risk assessment to identify latent degradation threat to process equipment and control systems in refinery process units)
- Other issues relating to uncertainty of risk management information in terms of its application in risk assessment and decision making process
- Lack of interest or negligence in acquisition of new knowledge and technology to tackle emerging risks from high degree of complexity of refinery process operations.
- Application of risk analysis method with limited ability to provide valuable safety information to support complex decision making
• Lack of dynamic update on vital changes in safety parameters or technical conditions which are utilised on a continuous basis for risk management of operations
• Tacit knowledge and experience gain by operators from operating a refinery process unit is not explicitly utilized in risk management process, rather, such knowledge and experience is overshadowed by company procedures and governing documentation for handling major accident risks (Andersen and Mostue, 2012)\(^\text{21}\).

**Management of change**

Management of Change (MOC) is a best practice used to ensure that safety, health, and environmental risks and hazards are properly controlled when an organization makes changes to their facilities, operations, or personnel. Having a properly implemented MOC policy in place when implementing changes can help ensure that new hazards aren’t introduced and the risk levels of existing hazards aren’t being increased. Inadequate MOC on the other hand has the potential to increase risks to the health and safety of employees and the environment.

Effective MOC involves review of all significant changes to ensure that an acceptable level of safety will be maintained after the change has been implemented. From this evaluation, the proposed change can either be set for implementation, amended to make it more safe, or rejected entirely. Should the change be implemented, personnel should be informed about the change and how to maintain a safe workspace in this new environment.

Under the Occupational Safety and Health Administration’s (OSHA’s) Process Safety Management (PSM) standard, performing MOC is required when making changes that could affect the safety of a facility. This can include changes in process chemicals, technology, equipment, procedures, and the number of employees involved in a process.

While MOC is generally used to examine the effects of a proposed permanent change to a facility, temporary changes should not be overlooked. A number of catastrophic events have occurred over the years due to temporary changes in operating conditions, staffing, etc. For this reason, an effective MOC program should address all changes that could affect the safety of a facility or personnel, regardless of whether or not it is permanent\(^\text{22}\).

Long-term structural transformation has four characteristics: scale (the change affects all or most of the organization), magnitude (it involves significant alterations of the status quo), duration (it lasts for months, if not years), and strategic importance. Yet companies will reap the rewards only when change occurs at the level of the individual employee.

Many senior executives know this and worry about it. When asked what keeps them up at night, CEOs involved in transformation often say they are concerned about how the work force will react, how they can get their team to work together, and how they will be able to lead their people. They also worry about retaining their company’s unique values and sense of identity and about creating a culture of commitment and performance. Leadership teams

\(^{21}\) [http://researchonline.ljmu.ac.uk/id/eprint/7984/1/2017Isholaphd.pdf](http://researchonline.ljmu.ac.uk/id/eprint/7984/1/2017Isholaphd.pdf)
\(^{22}\) [https://inspectioneering.com/tag/management+of+change](https://inspectioneering.com/tag/management+of+change)
that fail to plan for the human side of change often find themselves wondering why their best-laid plans have gone awry.

1. Address the “human side” systematically. Any significant transformation creates “people issues.” New leaders will be asked to step up, jobs will be changed, new skills and capabilities must be developed, and employees will be uncertain and resistant. Dealing with these issues on a reactive, case-by-case basis puts speed, morale, and results at risk. A formal approach for managing change — beginning with the leadership team and then engaging key stakeholders and leaders — should be developed early, and adapted often as change moves through the organization. This demands as much data collection and analysis, planning, and implementation discipline as does a redesign of strategy, systems, or processes. The change-management approach should be fully integrated into program design and decision making, both informing and enabling strategic direction. It should be based on a realistic assessment of the organization’s history, readiness, and capacity to change.

2. Start at the top. Because change is inherently unsettling for people at all levels of an organization, when it is on the horizon, all eyes will turn to the CEO and the leadership team for strength, support, and direction. The leaders themselves must embrace the new approaches first, both to challenge and to motivate the rest of the institution. They must speak with one voice and model the desired behaviors. The executive team also needs to understand that, although its public face may be one of unity, it, too, is composed of individuals who are going through stressful times and need to be supported.

Executive teams that work well together are best positioned for success. They are aligned and committed to the direction of change, understand the culture and behaviors the changes intend to introduce, and can model those changes themselves. At one large transportation company, the senior team rolled out an initiative to improve the efficiency and performance of its corporate and field staff before addressing change issues at the officer level. The initiative realized initial cost savings but stalled as employees began to question the leadership team’s vision and commitment. Only after the leadership team went through the process of aligning and committing to the change initiative was the workforce able to deliver downstream results.

3. Involve every layer. As transformation programs progress from defining strategy and setting targets to design and implementation, they affect different levels of the organization. Change efforts must include plans for identifying leaders throughout the company and pushing responsibility for design and implementation down, so that change “cascades” through the organization. At each layer of the organization, the leaders who are identified and trained must be aligned to the company’s vision, equipped to execute their specific mission, and motivated to make change happen.

A major multiline insurer with consistently flat earnings decided to change performance and behavior in preparation for going public. The company followed this “cascading leadership” methodology, training and supporting teams at each stage. First, 10 officers set the strategy, vision, and targets. Next, more than 60 senior executives and managers designed the core of the change initiative. Then 500 leaders from the field drove implementation. The structure remained in place throughout the change program, which doubled the company’s earnings far ahead of schedule. This approach is also a superb way for a company to identify its next generation of leadership.
4. Make the formal case. Individuals are inherently rational and will question to what extent change is needed, whether the company is headed in the right direction, and whether they want to commit personally to making change happen. They will look to the leadership for answers. The articulation of a formal case for change and the creation of a written vision statement are invaluable opportunities to create or compel leadership-team alignment.

Three steps should be followed in developing the case: First, confront reality and articulate a convincing need for change. Second, demonstrate faith that the company has a viable future and the leadership to get there. Finally, provide a road map to guide behavior and decision making. Leaders must then customize this message for various internal audiences, describing the pending change in terms that matter to the individuals.

A consumer packaged-goods company experiencing years of steadily declining earnings determined that it needed to significantly restructure its operations — instituting, among other things, a 30 percent workforce reduction — to remain competitive. In a series of offsite meetings, the executive team built a brutally honest business case that downsizing was the only way to keep the business viable, and drew on the company’s proud heritage to craft a compelling vision to lead the company forward. By confronting reality and helping employees understand the necessity for change, leaders were able to motivate the organization to follow the new direction in the midst of the largest downsizing in the company’s history. Instead of being shell-shocked and demoralized, those who stayed felt a renewed resolve to help the enterprise advance.

5. Create ownership. Leaders of large change programs must overperform during the transformation and be the zealots who create a critical mass among the workforce in favor of change. This requires more than mere buy-in or passive agreement that the direction of change is acceptable. It demands ownership by leaders willing to accept responsibility for making change happen in all of the areas they influence or control. Ownership is often best created by involving people in identifying problems and crafting solutions. It is reinforced by incentives and rewards. These can be tangible (for example, financial compensation) or psychological (for example, camaraderie and a sense of shared destiny).

At a large health-care organization that was moving to a shared-services model for administrative support, the first department to create detailed designs for the new organization was human resources. Its personnel worked with advisors in cross-functional teams for more than six months. But as the designs were being finalized, top departmental executives began to resist the move to implementation. While agreeing that the work was top-notch, the executives realized they hadn’t invested enough individual time in the design process to feel the ownership required to begin implementation. On the basis of their feedback, the process was modified to include a “deep dive.” The departmental executives worked with the design teams to learn more, and get further exposure to changes that would occur. This was the turning point; the transition then happened quickly. It also created a forum for top executives to work as a team, creating a sense of alignment and unity that the group hadn’t felt before.

6. Communicate the message. Too often, change leaders make the mistake of believing that others understand the issues, feel the need to change, and see the new direction as clearly as they do. The best change programs reinforce core messages through regular, timely advice that is both inspirational and practicable. Communications flow in from the
bottom and out from the top, and are targeted to provide employees the right information at the right time and to solicit their input and feedback. Often this will require overcommunication through multiple, redundant channels.

In the late 1990s, the commissioner of the Internal Revenue Service, Charles O. Rossotti, had a vision: The IRS could treat taxpayers as customers and turn a feared bureaucracy into a world-class service organization. Getting more than 100,000 employees to think and act differently required more than just systems redesign and process change. IRS leadership designed and executed an ambitious communications program including daily voice mails from the commissioner and his top staff, training sessions, videotapes, newsletters, and town hall meetings that continued through the transformation. Timely, constant, practical communication was at the heart of the program, which brought the IRS’s customer ratings from the lowest in various surveys to its current ranking above the likes of McDonald’s and most airlines.

7. Assess the cultural landscape. Successful change programs pick up speed and intensity as they cascade down, making it critically important that leaders understand and account for culture and behaviors at each level of the organization. Companies often make the mistake of assessing culture either too late or not at all. Thorough cultural diagnostics can assess organizational readiness to change, bring major problems to the surface, identify conflicts, and define factors that can recognize and influence sources of leadership and resistance. These diagnostics identify the core values, beliefs, behaviors, and perceptions that must be taken into account for successful change to occur. They serve as the common baseline for designing essential change elements, such as the new corporate vision, and building the infrastructure and programs needed to drive change.

8. Address culture explicitly. Once the culture is understood, it should be addressed as thoroughly as any other area in a change program. Leaders should be explicit about the culture and underlying behaviors that will best support the new way of doing business, and find opportunities to model and reward those behaviors. This requires developing a baseline, defining an explicit end-state or desired culture, and devising detailed plans to make the transition.

Company culture is an amalgam of shared history, explicit values and beliefs, and common attitudes and behaviors. Change programs can involve creating a culture (in new companies or those built through multiple acquisitions), combining cultures (in mergers or acquisitions of large companies), or reinforcing cultures (in, say, long-established consumer goods or manufacturing companies). Understanding that all companies have a cultural center — the locus of thought, activity, influence, or personal identification — is often an effective way to jump-start culture change.

A consumer goods company with a suite of premium brands determined that business realities demanded a greater focus on profitability and bottom-line accountability. In addition to redesigning metrics and incentives, it developed a plan to systematically change the company’s culture, beginning with marketing, the company’s historical center. It brought the marketing staff into the process early to create enthusiasts for the new philosophy who adapted marketing campaigns, spending plans, and incentive programs to be more accountable. Seeing these culture leaders grab onto the new program, the rest of the company quickly fell in line.
9. Prepare for the unexpected. No change program goes completely according to plan. People react in unexpected ways; areas of anticipated resistance fall away; and the external environment shifts. Effectively managing change requires continual reassessment of its impact and the organization’s willingness and ability to adopt the next wave of transformation. Fed by real data from the field and supported by information and solid decision-making processes, change leaders can then make the adjustments necessary to maintain momentum and drive results.

A leading U.S. health-care company was facing competitive and financial pressures from its inability to react to changes in the marketplace. A diagnosis revealed shortcomings in its organizational structure and governance, and the company decided to implement a new operating model. In the midst of detailed design, a new CEO and leadership team took over. The new team was initially skeptical, but was ultimately convinced that a solid case for change, grounded in facts and supported by the organization at large, existed. Some adjustments were made to the speed and sequence of implementation, but the fundamentals of the new operating model remained unchanged.

10. Speak to the individual. Change is both an institutional journey and a very personal one. People spend many hours each week at work; many think of their colleagues as a second family. Individuals (or teams of individuals) need to know how their work will change, what is expected of them during and after the change program, how they will be measured, and what success or failure will mean for them and those around them. Team leaders should be as honest and explicit as possible. People will react to what they see and hear around them, and need to be involved in the change process. Highly visible rewards, such as promotion, recognition, and bonuses, should be provided as dramatic reinforcement for embracing change. Sanction or removal of people standing in the way of change will reinforce the institution’s commitment.

Most leaders contemplating change know that people matter. It is all too tempting, however, to dwell on the plans and processes, which don’t talk back and don’t respond emotionally, rather than face up to the more difficult and more critical human issues. But mastering the “soft” side of change management needn’t be a mystery23.

Integrated SIMOPS tool

The use of a visual reference for each activity taking place improved the team’s understanding of potential risks and hazards. It also provided a clear identification of the limits of each work scope within the work area, as well as detailed information by clicking on the activity (colour coded by function).

BP and partners are currently investing at significant levels in the ETAP life extension project (ELXP) to secure the future of the field until 2030 and beyond. The safe and effective management of simultaneous operations (SIMOPS) between the ELXP project and the ETAP asset was a critical part of project delivery. To assist with this, the team introduced a new software system called ‘Blue-Beam™’ which allowed the project to introduce multi-layer PDFs showing work activities by function. They also utilised ‘Return to Scene’ (R2S) technology – a virtual ‘Google-style street view’ survey of the plant – which allowed functions to survey and tag sections of the asset that were planned to be addressed during the

23 https://www.strategy-business.com/article/rr00006?gko=dab72
intervention, whilst also enabling participants at SIMOPS sessions to visualise the worksite in 3D\(^2\).

**Ensuring contractor alignment with safety culture**

The condition where appropriate project participants are working within acceptable tolerances to develop and meet a uniformly defined and understood set of project objectives. Conducive cultures can be the most effective tool in achieving safety results. High-performance organizations realize alignment of safety cultures is becoming the core responsibility of not just the contractor, but those engaging them as well.

In this time of strategic outsourcing, many companies utilize contractors to support various business operations. Whether short- or long-term, in several companies these contractors are a business necessity. As these organizations bring groups together representing different cultures around safety, new risks emerge. How well the cultural risks are identified and mitigated, and desired beliefs and behaviors improved, will be the new competitive advantage in safety performance.

Organizational culture can be either a powerful tool or a hindrance to the results organizations need from their contractors. A contractor's culture not only influences the beliefs and behaviors of their employees, but the client's employees as well. When the behavior of contractor personnel is observed by client employees, over time, this has an impact on the beliefs, decisions and behaviors of client employees and the stories they tell one another. With recent unfortunate media-worthy events, it is hard to argue with the fact that contractor and client cultures affect one another.

\[2\] https://oilandgasuk.co.uk/bp-integrated-simops-tool-improves-understanding-of-risks/
Organizations leveraging contractors require a culture-conversation framework that initiates dialogue with both short- and long-term contractors, creating clarity around what safety excellence looks like in knowledge, beliefs and behaviors, not just results. Safety roles, responsibilities and results need to be collaboratively developed and a positive and proactive accountability system established to influence and achieve excellence in outcomes. 

**Human factor and ergonomics, behavioral based safety**

Various approaches have had reasonable success in reducing unsafe behaviours in the workplace.

Some involve penalties; others involve surveillance; others involve guidance, codes and procedures to follow; others still are supportive and training-oriented.

Some initiatives come from the employer, from the social partner organisations, from state regulatory bodies, and some worthwhile initiatives come from individual employees’ own insights, ideas, training and development activities around health and safety.

Most employers and employees in the area of safety will agree that the ultimate aim of a safety initiative is a “total safety culture”; however, this concept is rarely defined. A total safety culture is a culture in which:

- individuals hold safety as a ‘value’ and not just a priority;
- individuals take responsibility for the safety of their co-workers in addition to themselves; and
- all level of employee are willing and able to act on their sense of responsibility – they can go ‘beyond the call of duty’ (Perdue, 2000)

A BBS approach is one which:

- Is based on solid principles about engaging, motivating, assisting, reinforcing, and sustaining safe behaviours
- Takes a systematic approach, examining the motivation underlying behaviours, in order to increase safe behaviour
- Is an ongoing effort; not ‘once-off’ provisions, but a new way of working that the safety leader must continually promote for sustainable, positive results
- Takes time to achieve; however, results can be observed immediately due to the nature of measurement involved
- Emphasises increasing safe behaviours rather than focusing on length of time without injury. BBS programmes do not depend solely on ‘lagging indicators’ (after the fact), and instead shift the focus to ‘leading indicators (preventative)
- Is not a substitute for an already existing comprehensive health and safety programme; it is a supplementary tool that will enhance the effect of already existing practices, and will allow for an objective measurement system.

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• Aims to understand causes of incidents and near misses and correct them through the behaviour of relevant people. For example, reducing hazards often requires behavior change of managers and frontline workers, and equipment redesign involves behavior change of engineers\textsuperscript{26}.

**Workshop: Case Studies & Worked Examples**  
Plan for BBS, where behaviour is explained in terms of the ABC model (Antecedent, Behaviour, Consequence).

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\textsuperscript{26} [https://www.hsa.ie/eng/Publications_and_Forms/Publications/Safety_and_Health_Management/behaviour_based_safety_guide.pdf](https://www.hsa.ie/eng/Publications_and_Forms/Publications/Safety_and_Health_Management/behaviour_based_safety_guide.pdf)
Simultaneous Operations (SIMOPS)

Simultaneous Operations
SIMOPS

12 - 16 January 2020
Alexandria, Egypt
Middle East Oil Refinery (Midor)

Presented by:
Sasa Kocic MSc.
Senior Consultant

Administrative Points

• PetroKnowledge Welcomes you
• Fire Alarms & Emergency Exits
• Please put mobile phones to silent
• Complete the course registration form – this is for your certificate
• Any questions before we start?
Simultaneous Operations (SIMOPS)

Course Outline

Day One
SIMOPS Introduction
- SIMOPS process
- Area classification in refineries
- Oil refinery risks and hazards
- Safety by design
- SIMOPS in refinery operations: Fires and Explosion Protection
- Workshop: Case Studies & Worked Examples

Day Two
SIMOPS Risk Management
- Risk Management methodologies
- Risk Matrix and the construction of risk matrix
- Job Hazard Analysis
- SIMOPS Checklist
- Permit to Work (PTW) system and issuing process
- Workshop: Case Studies & Worked Examples

Day Three
SIMOPS in Specific Cases
- Common Process Hazards
- SIMOPS in construction
  - Tie-in
  - Additional equipment installation
- SIMOPS in maintenance
  - Shutdown and isolation
  - Pressure testing
  - Inspection
- Workshop: Case Studies & Worked Examples

Day Four
PTW Procedure and SIMOPS
- PTW system
- SIMOPS assessment review
- SIMOPS interface document
- SIMOPS flowchart
- SIMOPS Toolbox Talk
- Workshop: Case Studies & Worked Examples
Simultaneous Operations (SIMOPS)

Course Outline

Day One
Refinery Specific Risks and SIMOPS
- Risk Management
- Management of change
- Integrated SIMOPS tool
- Ensuring contractor alignment with safety culture
- Human factor and ergonomics, behavioral based safety
- Workshop: Case Studies & Worked Examples

Section One
SIMOPS Introduction
Simultaneous Operations (SIMOPS)

SIMOPS is an abbreviation of ‘simultaneous operations’
Simultaneous Operations (SIMOPS)

Definition

SIMOPS is the performance of potentially conflicting operations at the same time, in the same location.

Both jobs may be done safely, but without coordination, one act could have a dangerous consequence to other.

Example:

- Commissioning work in Construction areas
- Production activities in Commissioning areas
- Construction work in drilling areas
- Hot work going on during break of containment in process area.

Identify Operations to be executed as SIMOPS

Can SIMOPS be avoided?

Check for pre-requested items and conditions implementation

Execute operations separately at different times

Are all risks taken into account?

Assess SIMOPS for joint hazards/risks

All of the following should be in place:
- PTW issued
- Personnel adequately rested
- PPE use
- Procedure for each operation
- Adequate number of people
- Backup plan available
- Roles and responsibilities understood
- Communication plan checked
- Risk Assessment for each operation conducted

Issue and revise SIMOPS plan

Simultaneous Operations
9 SIMOPS

10 SIMOPS
Simultaneous Operations (SIMOPS)

To avoid incident during SIMOPS you need:

- Adequate Provision
- Strict safety procedures and supervision

SIMOPS safety systems specific tests and monitoring:

- A general actual test of the installation Safety systems such as Fire water system and Gas detection system has to be done prior to start of Simultaneous operations.
- Isolation Systems: Isolation system such as isolation valves and shutdown system to be installed and identified to operate in case of any leakage
- Specific provisions for SIMOPS
Simultaneous Operations (SIMOPS)

**SIMOPS requirements:**

- Training to be conducted for all personnel involved in SIMOPS.
- Safety equipment such as Gas tester, Radios, etc. to be checked for operability.
- Personnel Access Control: Access between areas will be controlled by badges, manned security, the permit to work system.
- All personnel should be familiar and trained with alarm tone.
- Escape ways and Muster Points to be clearly marked and access free.
- Fire-fighting facilities to be ready.
- Clinic, Ambulance and Search and Rescue team to be ready and on-call.
- Security personnel to be trained in order to cooperate with HSE personnel in case of emergency and control the access to restricted areas.

**SIMOPS Safety—General operating philosophy**

- No Hot Permit to Work is allowed in the vicinity of operations inducing hazard of hydrocarbon release such as: Welding, Spray painting, etc.
- Only Authorized personnel to be allowed to enter SIMOPS area that will be restricted by fence and Tag System.
- Keeping as low as reasonably practical the number of persons on site during activities, Numbers must be controlled and monitor by Tag system.
- Full compliance of the activity with the permit to work.
- Pre-check of Plant and Equipment such as Vehicles, Electrical and power tools, IS communication devices, Anti spark equipment.
- Personal protective equipment and escape equipment must be suitable for use within a sour (H2S) service environment.
- Adequate Signs to be installed according to the nature of the job.
- Continuous safety surveillance of the SIMOPS Area to check any anomaly.
Area classification in refineries

A hazardous area can be defined as any location where there is risk of an explosion.

But every hazardous area is different and each has specific requirements depending on the nature of the atmosphere and the elements that are present.
An industrial area is considered a hazardous area when it contains three fundamental components:

- A flammable substance (which can be a gas, liquid, or solid),
- an oxidizer, and
- a source of ignition.
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Oil refinery risks and hazards

National Fire Protection Association System for Classification of Hazards
Because of their inherent hazards, especially from:

- explosion,
- fire, and
- chemicals,

oil refineries are tightly regulated places in which to work.

Hazards include also:

- toxicity,
- corrosiveness, and
- asphyxiation.

The principal hazards at refineries are fire and explosion.

- Refineries process a multitude of products with low flash points.
- Although systems and operating practices are designed to prevent such catastrophes, they can occur.
- Constant monitoring is therefore required.
- Safeguards include
  - warning systems,
  - emergency procedures, and
  - permit systems for any kind of hot or other potentially dangerous work.

These requirements must be understood and followed by all workers.
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Major potential air contaminants

Safety by design
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ANSI/AIHA Z-10 Standard Elements

- Safety and health needs are addressed in the design and redesign processes.
- Hazards are identified and analyzed, and risks are assessed and prioritized.
- A prescribed hierarchy of controls is used to reduce risks to an acceptable level.
- A management-of-change procedure is implemented so that hazards and risks are properly considered when changes are made.
- Safety and health specifications are included in purchasing documents and contracts to avoid bringing hazards and risks into the workplace.

Why Focus on Safety through Design?

The design stage offers the greatest opportunity and most cost-effective time to anticipate, analyze, eliminate, and control hazards.
What is Safety through Design?

Safety through design is defined as the integration of hazard analysis and risks assessment methods early in the design and engineering stages and the taking of the actions necessary so that the risks of injury or damage are at an acceptable level.

Design Diagram

Moving Safety Upstream in the Design Process

- Business Concepts
- Design
- Build
- Operation Maintenance
- Decommission
- Recycle

Safety Through Design

Retrofit

Moving safety from an afterthought to a forethought in process, product, and facility design.
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**Design Diagram**

*Safety Through Design: A Pre-Thought, Not an Afterthought*

- **Design**:
  - Project Conception
  - Design

- **Retrofit**:
  - Build
  - Operate, Produce, Maintain

- **Retire**:
  - Eliminate, Recycle, Review

---

Figure 1-1. The model for safety through design.

**Benefits of Safety through Design**

- Significant reductions in injuries and illnesses, damage to the environment and costs
- Productivity increase
- Reduced operating costs
- Retrofitting costs avoided

---

Simultaneous Operations
SIMOPS
SIMOPS in refinery operations: Fires and Explosion

Workshop: Case Studies & Worked Examples
Section Two

SIMOPS Risk Management

Risk Management methodologies
### What is risk management?

**Risk Analysis**
- Source Identification
- Risk Estimation

**Risk Treatment**
- Avoidance
- Optimization
- Transfer
- Retention

**Risk Acceptance**

**Risk Communication**

---

### Definition of Hazard and Risk

**Hazard:**

- the property of a substance or situation with the potential for creating damage

**Risk:**

- the likelihood of a specific effect within a specified period
- complex function of probability, consequences and vulnerability
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Risk Management Process

ISO 31000

- Establish The Context
- Identify Risks
- Analyze Risks
- Evaluate Risks
- Threat Risks

ISO 17776:2000(E)

- Step 1: Identify Hazards
- Screening Criteria
- Step 2: Evaluate Risk
- Identify Risk reduction Measures
- Step 3: Set Functional Requirements

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37

Risk Management Process

Uncertainty
Less focus
Reduced trust
Reduced loyalty

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38
Risk assessment and risk analysis of technical systems can be defined as a set of systematic methods to:

- Identify hazards
- Quantify risks
- Determine components, safety measures and/or human interventions important for plant safety
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Risk Analysis – Main Steps

- Hazard Identification
- Hazard & Scenario Analysis
- Likelihood
- Consequences
- Risk

- "What if"
- Checklists
- HAZOP
- Task analysis

- Fault tree analysis
- Event tree analysis
- Bowties
- Barrier diagrams

Risk management

Risk management must have its Return On Investment.

If the value of investment overcomes the value of the risk, management will usually not invest the money in Risk Management.

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Risk acceptance

For society’s acceptance the following factors play a role:

- Risk aversion
- “Cost/benefit” and ALARA principle
- The source of the risk: fatality risk in apartments is a factor 150 less acceptable than in traffic (Swedish study)

Existing risk criteria are founded on comparison with general fatality risk (ca. $10^{-4}$ per year for young people) and the costs, society is willing to pay for saving a human life.
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Risk Matrix and the construction of risk matrix
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### Risk matrix

<table>
<thead>
<tr>
<th>Consequences</th>
<th>Minor</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likely</td>
<td>?</td>
<td>✗</td>
</tr>
<tr>
<td>Unlikely</td>
<td>OK</td>
<td>??</td>
</tr>
</tbody>
</table>

**Code**

- **OK** = acceptable risk
- **?** = doubtful
  - CONSIDER THE OPTIONS
- **✗** = unacceptable risk
  - DON’T DO IT!

### Risk control Hierarchy of options:

- Elimination
- Substitution
- Isolation
- Engineering
- Administration
- Personal protective equipment
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Multi-level scale of consequences

- **Level 1**: first aid treatment (Minor)
- **Level 2**: treatment by a doctor (Moderate)
- **Level 3**: immediate hospitalization or death (Severe)

Multi-level scale of likelihood

- **Level 1**: known to commonly occur; not unexpected
- **Level 2**: uncommon, rare, but sufficiently frequent to have been witnessed by self or a known person
- **Level 3**: very rare; have heard of it happening; may possibly have been witnessed by self or a known person
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**Risk matrix**

<table>
<thead>
<tr>
<th>Consequences</th>
<th>Minor</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likely</td>
<td>OK</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Unlikely</td>
<td>OK</td>
<td>?</td>
<td>X</td>
</tr>
<tr>
<td>Very unlikely</td>
<td>OK</td>
<td>OK</td>
<td>??</td>
</tr>
</tbody>
</table>

**Code**
- **OK** = acceptable risk (low risk)
- **?** = doubtful
  - CONSIDER OTHER OPTIONS
- **??** = very doubtful
  - Either DON’T DO IT or PROCEED WITH GREAT CARE
- **X** = unacceptable risk
  - DON’T DO IT!

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**Figure 1 – A typical Risk Assessment Matrix**

**Severity Rating**
- 0: Zero injury
- 1: Slight injury
- 2: Minor injury
- 3: Major injury
- 4: Single fatality
- 5: Multiple fatalities

**Consequence**
- People
- Assets
- Environment
- Reputation

**Increasing probability**
- A: Has occurred in industry
- B: Has occurred several times a year in operating company
- C: Occurred several times a year in location
- D: Manage for continued improvement

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**SIMOPS**

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Job Hazard Analysis

Hazard identification is part of the process used to evaluate if any particular situation, item, thing, etc. may have the potential to cause harm.

The term often used to describe the full process is risk assessment:

- Identify hazards and risk factors that have the potential to cause harm (hazard identification).
- Analyze and evaluate the risk associated with that hazard (risk analysis, and risk evaluation).
- Determine appropriate ways to eliminate the hazard, or control the risk when the hazard cannot be eliminated (risk control).

Overall, the goal of hazard identification is to find and record possible hazards that may be present in your workplace. It may help to work as a team and include both people familiar with the work area, as well as people who are not – this way you have both the experienced and fresh eye to conduct the inspection.
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Hazard identification can be done:

- During design and implementation
- Designing a new process or procedure
- Purchasing and installing new machinery
- Before tasks are done
- Checking equipment or following processes
- Reviewing surroundings before each shift
- While tasks are being done
- Be aware of changes, abnormal conditions, or sudden emissions
- During inspections
  - Formal, informal, supervisor, health and safety committee

After incidents

- Near misses or minor events
- Injuries

What is Job Hazard Analysis (JHA)?

It is a method for systematically identifying and evaluating hazards associated with a particular job or task.

It is also called “job safety analysis (JSA)”.

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Why conduct a job hazard analysis?

A job hazard analysis can prevent work-related death, injuries or illnesses by eliminating or controlling identified hazards.

It is a means to ensure that workers have the training, equipment and supplies to do their jobs safely.

It will help you in developing your accident prevention program (APP), an L & I safety requirement for all employers.

Note: The general method can be used in other loss prevention efforts such as environmental pollution prevention or fire protection.

Hazard Awareness

Accepting a risk or hazard is not the same as eliminating or controlling it.

When conducting a job hazard analysis, you may need to take a fresh look at the way things are done at your workplace.

Even though you may hear “we’ve been doing it that way for 20 years and nothing happened”, it doesn’t mean a hazard doesn’t exist.

You should take a comprehensive look at all possible hazards with an open mind.
### How to conduct a JHA?

- Identify the job or task to be analyzed.
- Break the job or task into key components.
- Identify the hazards found in each key component.
- Identify ways to eliminate or control these hazards.
- Eliminate the hazard or install controls.
- Keep a record of the hazards identified and steps taken to eliminate or control them.
- Periodically assess controls to ensure they are working correctly.

### Identifying the job for analysis

Any job or task that meets any of the following conditions should have a JHA conducted for it:

- Jobs or tasks with a history of injuries or near misses.
- Jobs with catastrophic potential – fire, explosion, large chemical releases, massive equipment failure.
- Tasks in which one simple human error could lead to serious injury.
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Identifying the job for analysis

Any job or task that meets any of the following conditions should also have a JHA conducted for it:

- New people doing the task,
- Tasks that have changed,
- Rarely performed jobs,
- Any job done under a "safety permit" - confined space permit, hot work permit, etc.

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Identifying jobs for a JHA

Look at jobs where workers have been injured using existing information from:

- Your accident or incident reports
- Your worker compensation claims
- Industry or trade association data

Conduct a preliminary worksite walk-around to observe or identify hazardous jobs or tasks.

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Walk-around Observations

Watch workers doing their jobs to identify potential hazards that may lead to an injury, paying attention to the amount of time the worker is exposed to the hazard.

Talk with workers to find out what they think is the most hazardous part of their job.

Ask them if what you observe them doing is typical.

Once you have identified jobs needing a JHA, then it is time to start conducting the JHA

- Involving employees and/or foreman or supervisors in the JHA process allows them to bring their insights about the jobs to the process.
- They can help identify hazards and they will have ownership of the JHA and will often more readily accept the findings and the hazard controls selected.
Once a job is identified, you will need to break it into key components or sub-tasks and list all the hazards associated with each sub-task.

Too much detail makes the JHA cumbersome, but too little detail may omit hazards.

The correct amount of detail breaks the job into components that make sense in terms of the overall job.

Generally, limit the number of components to 10 or less.

---

**Break job down into key components**

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**Breaking job into key components - example**

**Changing a light bulb**

<table>
<thead>
<tr>
<th>Too Much Detail</th>
<th>Too Little Detail</th>
<th>Right Amount of Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Get ladder from storage.</td>
<td>Get a ladder and new light bulb.</td>
<td>Get ladder from storage.</td>
</tr>
<tr>
<td>Get new light bulb from storage.</td>
<td>Change bulb.</td>
<td>Carry ladder and light bulb from storage.</td>
</tr>
<tr>
<td>Carry ladder and light bulb to light needing changing.</td>
<td>Put ladder away and throw out old light bulb.</td>
<td>Place ladder under light to be changed.</td>
</tr>
<tr>
<td>Place ladder under light to be changed.</td>
<td>Turn light switch off.</td>
<td>Using ladder, change bulb.</td>
</tr>
<tr>
<td>Ensure light switch is in the off position.</td>
<td>Place ladder under light to be changed.</td>
<td>Using ladder, change bulb.</td>
</tr>
<tr>
<td>Climb ladder.</td>
<td>Put ladder back in storage.</td>
<td></td>
</tr>
<tr>
<td>Remove light cover.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twist light bulb in a counter clock-wise direction until it is free of the socket.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove old light bulb.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insert new light bulb into socket.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn in a clock-wise direction until tightened.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace light cover.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Descend ladder.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carry ladder back to storage.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Simultaneous Operations (SIMOPS)

**Job Hazard Analysis**

**Example form**

Date of analysis: __________________________

People who participated:

________________________________________

________________________________________

Job or task where injuries occur, or can occur

<table>
<thead>
<tr>
<th>How people get hurt</th>
<th>What causes them to get hurt?</th>
<th>What safe practices or PPE are needed?</th>
</tr>
</thead>
</table>
| Ladders tipping over | • Ladder was not on a level surface  
• Ladder was on soft ground and the leg sunk in  
• The person reached out too far to reach up safely – the person stood up near the top of it  
• Ladder broken or damaged | • Set ladder feet on solid level surfaces.  
• When reaching out, keep belt buckle between the side rails of the ladder.  
• Do not stand on the top of a step ladder or on the first step down from the top.  
• Replace or repair ladder |
| Lifting heavy objects | • Trying to lift too heavy objects  
• Bending over at the waist when lifting  
• Turning (twisting) back while lifting | • Use proper lifting practices (bend knees, don't twist)  
• For very heavy objects, use mechanical devices or get another person to help |
| Slipping on the floor | • Spilled liquids not cleaned up  
• Small objects are dropped on the floor and left there  
• People wear the wrong type of shoes for conditions | • Wipe up all spilled, and pick up dropped items, immediately.  
• Wear sturdy shoes with slip-resistant soles |
| Using the bench grinder | • Flying particles get in eyes  
• If grinder wheel breaks, large chunks fly off at high speed  
• High noise level can injure hearing | • Wear safety glasses and earplugs when using grinder.  
• Keep tongue guards adjusted properly (see sticker on grinder for spacing) |

Small Business Job Hazard Analysis

(General Example)

Date of analysis: __________________________

People who participated:

________________________________________

________________________________________
Simultaneous Operations (SIMOPS)

Ranking Hazardous Tasks

Once you have identified jobs or tasks that have the potential to or are in fact injuring workers, you will need to rank these tasks and start addressing the most serious first.

One method for ranking tasks considers the probability that the hazard will cause an injury and an estimate of the severity of that injury.

These are not precise predictions of when or how severe an injury may be, they are only estimates.

The method can help you decide which is more important – an infrequent job that has the potential to kill a worker, or frequent job that causes less severe injuries.

### Severity Table

<table>
<thead>
<tr>
<th>Score</th>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Catastrophic</td>
<td>May cause death</td>
</tr>
<tr>
<td>3</td>
<td>Critical</td>
<td>May cause severe injury or illness</td>
</tr>
<tr>
<td>2</td>
<td>Marginal</td>
<td>May cause minor injury or illness</td>
</tr>
<tr>
<td>1</td>
<td>Minor</td>
<td>Will not cause injury or illness</td>
</tr>
</tbody>
</table>

### Probability Table

<table>
<thead>
<tr>
<th>Score</th>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>frequent</td>
<td>Very likely to occur frequently</td>
</tr>
<tr>
<td>4</td>
<td>probable</td>
<td>Probably will occur at some time</td>
</tr>
<tr>
<td>3</td>
<td>Occasional</td>
<td>May occur infrequently</td>
</tr>
<tr>
<td>2</td>
<td>Remote</td>
<td>Unlikely, but possible</td>
</tr>
<tr>
<td>1</td>
<td>Improbable</td>
<td>So unlikely, it is assumed it will not occur</td>
</tr>
</tbody>
</table>

Consider the severity of the injury of something may go wrong while doing the task in the severity table.

Next, think about how often the worker is exposed to the hazard in the probability table.

Multiply the severity rank by the probability rank.

Address the highest scored tasks first.
After you have identified the jobs and evaluated its sub-tasks and hazards, you will need to identify ways to eliminate or control these hazards.

- The best method is eliminate the hazard at the source.
- If elimination is not possible, control the hazard at its source with engineering controls or limit worker exposure using administrative controls.
- If those two methods are not enough to remove or reduce the worker exposure to acceptable levels, then personal protective equipment must be used.
- Personal protective equipment can also be used temporarily while engineering controls are installed.

Periodically reviewing your job hazard analysis ensures that it remains current and continues to help reduce workplace accidents and injuries. Even if the job has not changed, it is possible that during the review process you will identify hazards that were not identified in the initial analysis.

It is especially important to review your job hazard analysis if an illness or injury occurs on a specific job. Based on the circumstances, you may determine that you need to change the job procedures or provide additional controls to prevent similar incidents in the future. This is also true in a close call, or near miss situation where an injury was barely avoided.

Any time you revise a job hazard analysis, it is important to train all employees affected by the changes in the job methods, procedures, or protective measures adopted.
The checklist is provided to use as a tool to ensure ongoing compliance with the SimOps plan.

It is to be completed by the SimOps Controller.
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A manual of permitted operations (MOPO), also referred to as a matrix of permitted operations, is a visually coded manual used to define whether a work activity can be conducted safely within a given condition.

A particularly common area of concern that is addressed by MOPOs is whether two activities can be conducted safely at the same (referred to as simultaneous operations, or SIMOPs).
Simultaneous Operations (SIMOPS)

Permit to Work (PTW) system and issuing process

The Objective of the Permit To Work (PTW) system is “To provide a system which ensures that work activities can be carried out in a safe manner”.

The PTW System Corporate Custodian is the Production Function Permit to Work System Manager who is responsible for providing steering / direction to ensure that the PTW System meets the needs of the company.

The PTW Training Custodian is employee who is responsible for the content and suitability of PTW training.

Asset Directors are responsible for the implementation of the PTW System, and for appointing Focal Points for the PTW System in each Area.
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A Permit is required

For any work carried out
- Inside a process or hydrocarbon area
- On an electrical installation
- When entering a Confined Space
- When other Supplementary Certificates are required to carry out the work i.e. Isolation (Mech. or Elect.) and Gas Testing
- Work within emergency planning zone of a critical sour area

A Permit is also required when
- The work is not familiar to the Work Force
- The work is not carried out by competent staff
- An approved procedure is not in force for the work

Work with a valid work permit when required

Class A
- Red Edged Permits - Class A Permits are required for high risk work. This is work that could lead to major consequences such as fire, explosion, or loss of life. 
  Example: Hot work in a Process Area

Class B
- Blue Edged Permits - Class B Permits are required for medium risk work. 
  Example: Hot Work in a Hydrocarbon area

No Permit Job
- Jobs that have been determined as no Permit Jobs need to be discussed, agreed and authorised as such. These still need to be risk assessed. 
  Example: Entry into Well Cellars or Cosasco pits by Area Authority to carry out Operational Tasks to an approved procedure
All work undertaken using the PTW system requires to be Hazard Assessed and controls put in place to enable the work to be done safely.

Hazard Assessment is accomplished using the **Job HSE Plan**.

In addition to the Job HSE Plan, the PTW Holder shall conduct a TRIC. The TRIC is not a repeat of the Job HSE Plan but a location specific Risk Assessment, which will focus on the hazards at the worksite at the time the work is to be carried out.

The TRIC shall be carried out at the Worksite immediately prior to the activity start.

**Tips for supervisors**

- Pose Question to your group
- Allow 5 minutes for discussion on each Question
- Summarize what you have heard before moving to the next Question
- Split big groups up into smaller discussion teams
- Take your time
- Encourage everyone to take part
- Look for real examples from your own workplace
- Find and use real examples of incidents related to this rule from your site
- Link the discussion to real work on site involving the people in the tool box talk
Simultaneous Operations (SIMOPS)

Workshop: Case Studies & Worked Examples

Section Three
SIMOPS in Specific Cases
Common Process Hazards

A common way to classify hazards is by category:

- biological – bacteria, viruses, insects, plants, birds, animals, and humans, etc.,
- chemical – depends on the physical, chemical and toxic properties of the chemical,
- ergonomic – repetitive movements, improper set up of workstation, etc.,
- physical – radiation, magnetic fields, temperature extremes, pressure extremes (high pressure or vacuum), noise, etc.,
- psychosocial – stress, violence, etc.,
- safety – slipping/tripping hazards, inappropriate machine guarding, equipment malfunctions or breakdowns.
Process safety hazards are issues that could result in equipment failure or large scale accidental damage to equipment or personnel.

Process safety accidents happen less frequently than personal accidents, but have a far greater impact.

Process safety hazards typically include dust, gas or vapor contamination in processing plants, potential detonation of energetic materials and runaway exothermic chemical processes.

Process Safety Hazards: Hazards associated with the loss of primary containment of a hazardous substance.

Process Hazards include:

- fire,
- explosion, and
- toxic release.

These hazards are associated with incidents which occur at low frequencies, but can have catastrophic consequences.
The major hazards with which the chemical industry is concerned are fire, explosion, and toxic release.

Of these three, fire is the most common but, explosion is particularly significant in terms of fatalities and loss.

Factors that determine the scale of the hazard are as follows:

- **The Inventory**
  - The most fundamental factor that determines the scale of the hazard is the inventory of the hazardous material.
  - The larger the inventory of material, the greater the potential loss.

- **The Energy Factor**
  - For an inventory of hazardous material to explode inside the plant or to disperse in the form of a flammable or toxic vapor cloud, there must be energy.
  - In most cases, this energy is stored in the material itself.

- **The Time Factor**
  - Another fundamental factor is the development of the hazard in time.
  - The time factor affects both the rate of release and the warning time.

- **The Intensity/Distance Relationship**
  - An important characteristic of the hazard is the distance over which it may cause injury and/or damage.
  - In general, fire has the shortest potential range, then explosion, and then toxic release.
Factors that determine the scale of the hazard are as follows:

- **The Exposure Factor**
  - A factor that can greatly mitigate the potential effects of an incident is the reduction of exposure of the people who are in the affected area.
  - This reduction of exposure may be due to features that apply before the hazard develops or to emergency measures that are taken after the hazard is recognized.

- **The Intensity/Damage and Intensity/Injury Relationships**
  - The range of the hazard depends also on the relationships between the intensity of the physical effect and the proportion of people who suffer injury at that level of the effect.
  - The annular zone within which injury occurs is determined by the spread of the injury distribution.
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Representation of overpressure contours and flame spread in a refinery explosion (image courtesy of Gexcon AS)

3-D representation of the impact of a carbon monoxide release in a refinery (image courtesy of Gexcon AS)
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‘Onion’ representation of LOPA

Summary of hazardous substances, consequences and impacts with barriers as controls
SIMOPS in construction
  o Tie-in
  o Additional equipment installation

During each SIMOPS workshop the below steps were undertaken under the guidance of the SIMOPS facilitator:

- Identification of the SIMOPS scenarios, means identification of the concurrent activities to be carried out during tie-in;
- Identification of the related hazards;
- Evaluation of the risk of simultaneous execution of the activities;
- Identification of control measures and/or operating procedures already planned and consequent assignment of the responsibility for their implementation;
- Evaluation of the residual risk with risk control measures already in place;
- Identification of additional risk control measures, if required;
- Assignment of responsible person for the implementation of identified countermeasure;
- Updated schedule of construction, pre-commissioning, commissioning and start-up activities;
- Process Flow Diagrams (PFD) and Piping & Instrumentation Diagrams (PID);
- Plant layouts and equipment layouts;
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**Tie-in Preliminary works**
- Notification from Company
- Nondestructive evaluation (NDE)
- Pre-fabrication of Tie-in spool
- Hydrotest for Tie-in spool
- Testing for existing Tie-in line
- Excavation for foundation (if required)
- Foundation installation (if required)
- Scaffolding installation
- Structure, Platform, Support installation

**Tie-In execution works**
- Positive Isolation from Company
- Blinding (Gas free line)
- Cold cutting
- Installation of tie-in spool
- Welding
- NDT (Non Destructive Testing)
- Hydrotest
- Line Blowing and Drying
- De-Blinding and client handover
Simultaneous Operations (SIMOPS)
Simultaneous Operations (SIMOPS)
For precautionary reasons, issue a line break permit to address specific details of the procedure prior to construction.

The purpose of the permit is to define:

- Location of the line break.
- Applicable design documents.
- Fluid in the line.
- Safety equipment requirements.
- Hazards associated with handling the materials last in the line.
- Special line washing, purging or flushing requirements.
- Valve locking and tagging requirements.
- All personnel involved or affected by the procedure.
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Basic hot tapping steps include:

• Weld the hot tap fitting onto the line.
• Install the full open gate valve on the fitting.
• Inspect and pressure test the valve and fitting.
• Install the hot tap machine on the valve.
• Bore the line.
• Retract the boring bar, then close and lock the valve.
• Depressurize the hot tap machine and remove it.
• Clean the work area.

Installing new equipment, whether in a brand-new production line or an existing line, can be challenging.
1. First, be sure to talk to your supplier’s project manager before starting preparation for the installation. He may have information that will affect your preparation. He also will be your main contact for questions regarding delivery of the project, and will give you an idea of what you need to have on hand and what you need to accomplish before equipment is delivered.

2. Ask your supplier about electrical requirements and other necessities that need to be on-site for proper installation.

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Perform engineering study
Prepare area reservation plan
Prepare lift plan (if needed)
Prepare SIMOPS plan
Simultaneous Operations (SIMOPS)

**SIMOPS in maintenance**
- Shutdown and isolation
- Pressure testing
- Inspection

Before any plant is inspected, maintained, cleaned or repaired, where practicable, it must be shut down and its energy sources locked out and tagged as part of an isolation procedure (often called Lockout Tagout) to ensure the safety of those doing the work.

The aim of an isolation procedure is to:

- isolate all forms of potentially hazardous energy to ensure that an accidental release of hazardous energy does not occur
- control all other hazards to those doing the work
- ensure that entry to a restricted area is tightly controlled.
Simultaneous Operations (SIMOPS)

The risks associated with any plant or equipment undergoing inspection, maintenance, cleaning, repair or construction should be assessed and appropriate control measures put in place.

Before work commences the plant should be stopped, appropriately isolated/locked and danger tagged, and any stored energy should be dissipated.

Separate controls away from the plant operator or immediate work area must also be isolated or locked and danger tagged.

The following lock-out process is the most effective isolation procedure:

- shut down the machinery and equipment
- identify all energy sources and other hazards
- identify all isolation points
- isolate all energy sources. In the case of electrical equipment ‘whole current isolation’, such as the main isolator, should be used instead of ‘control isolation’ by way of the stop button on a control panel
- control or de-energise all stored energy
- lock-out all isolation points, using padlocks, multi-padlock hasps and danger tags
- danger Tag machinery controls, energy sources and other hazards.
Pressure tests are performed to ensure the safety, reliability, and leak tightness of pressure systems.

A pressure test is required for a new pressure system before use or an existing pressure system after repair or alteration.

There are two methods for pressure tests:

- hydrostatic and
- pneumatic.

A hydrostatic test is performed by using water as the test medium, whereas a pneumatic test uses air, nitrogen, or any non-flammable and nontoxic gas.

Pressure Test is performed or conducted when there are new or old operating equipment like Boilers, Heat Exchangers, Pipe Connections and other pressure vessels installed.

- All pressure vessels must go through the pressure test before they are permitted to operate.
The steps below are typical procedures while other may have added requirements:

- 1 Bolts together the 2 pipes.
- 2 Connect the elbow casting simplifies the end of the pipelines. The fitting of the elbow casting simplifies the process of filling the pipeline with water.
- 3 Bolt a flange fitted with a shut off valve to the other end of the pipe.
- 4 Close the shut off valve and fill the pipeline with water until the water start to flow through the elbow.
- 5 Bolt a flange with a pressure gauge connection to the elbow casting
- 6 Connect the test pump to the shut off valve

- 7 Open the shut off valve and operate the test pump until water overflows from the pressure gauge connection (BLEEDING PROCESS).
- 8 Fit the pressure gauge.
- 9 Operate the test pump until the pressure gauge indicates the specified test pressure.
- 10 Inspect for leaks in the pipeline at the flange joint, as well as the pipe system in general.
- 11 Release the pressure from the pipeline through the test pump discharge valve.
- 12 Disconnect the test pump and drain the pipeline through the shut off valve.
- 13 Remove the blank flanges and dismantle the pipe joints.
Pipeline inspection is a part of the pipeline integrity management for keeping the pipeline in good condition.

The rules governing inspection are the pipeline safety regulations.

In most cases the pipeline is inspected regularly.

The pipeline safety regulations require that the operator shall insure that a pipeline is maintained in an efficient state, in efficient working order and in good repair.

The pipeline inspection includes external inspection and internal inspection.

Workshop: Case Studies & Worked Examples
Section Four
PTW Procedure and SIMOPS

PTW system
Permit To Work refers to management systems used to ensure that work is done safely and efficiently.

These are used in hazardous industries and involve procedures to request, review, authorize, document and most importantly, de-conflict tasks to be carried out by front line workers.

A permit-to-work system is a formal written system used to control certain types of work that are potentially hazardous.

A permit-to-work is a document which specifies the work to be done and the precautions to be taken.

Permits-to-work form an essential part of safe systems of work for many maintenance activities.

Permit-to-work systems form an essential part of the task risk assessment process.

When a task is identified an appraisal should be carried out to identify the nature of the task and its associated hazards.

Next, the risks associated with the task should be identified together with the necessary controls and precautions to mitigate the risks.

The extent of the controls required will depend on the level of risk associated with the task and may include the need for a permit-to-work.
A permit-to-work is not simply permission to carry out a dangerous job.

It is an essential part of a system which determines how that job can be carried out safely, and helps communicate this to those doing the job.

It should not be regarded as an easy way to eliminate hazard or reduce risk.

The issue of a permit does not, by itself, make a job safe - that can only be achieved by those preparing for the work, those supervising the work and those carrying it out.

Essential features of permit-to-work systems are:

- clear identification of who may authorise particular jobs (and any limits to their authority) and who is responsible for specifying the necessary precautions;
- training and instruction in the issue, use and closure of permits;
- monitoring and auditing to ensure that the system works as intended;
- clear identification of the types of work considered hazardous;
- clear and standardised identification of tasks, risk assessments, permitted task duration and supplemental or simultaneous activity and control measures.
Simultaneous Operations (SIMOPS)

Note the use and control of the system is enhanced by the colour coding of the permits!

Permit to work must be obtained
SIMOPS assessment review
Purpose of the Assessment Review

- A meeting of all the parties involved in the SIMOPS should be set up to enable a review to be undertaken of each party's work-specific dossier in a systematic manner.
- Appropriate tools should be used to clearly identify all the risks in conducting SIMOPS contained in each party's dossier and the review meeting should agree the required specific mitigation measures to be implemented to allow SIMOPS to proceed.

Methodology/tools which can be used to identify the risks are:

- Hazard identification and risk assessment (HIRA);
- Clash analysis;
- Interdependency analysis.
During the SIMOPS assessment review, the roles and responsibilities of each of the parties within the SIMOPS are identified and a hierarchy of control established for each work-specific SIMOPS activity.

The roles and responsibilities for all parties and individuals who have authority within the SIMOPS should be established. This should cover reporting lines in normal and emergency modes and hierarchy of controls for the different phases of operations. Management hierarchy should identify authorisations required for work to proceed. An authorisation control system should be established which also clearly identifies controls that would stop the SIMOPS, e.g.:

- weather limits,
- change in another party’s SIMOPS activities,
- vessel loss of position,
- vessel loss of anchor,
- loss of communications,
- incident or near-miss stopping an operation.
Simultaneous Operations (SIMOPS)

SIMOPS interface document

It is important that SIMOPS/interface documentation be developed for the SIMOPS activities. Depending on the scope of the SIMOPS activities, this could comprise one document covering all the work or alternatively could comprise several documents, covering specific, clearly identified SIMOPS activities.
Each SIMOPS interface document should:

- Set out the activities covered by the document and should be applicable to all parties’ operations for the specified activity.
- A SIMOPS matrix, where appropriate, may be developed to identify which activities are permissible when conducted simultaneously;
- Be developed on a discrete basis for various phases of work within the SIMOPS to prevent this becoming an unwieldy document;
- Contain a validation exercise to be carried out against original SIMOPS assessment review to ensure that all mitigation and controls are in place.

The SIMOPS interface document should cover the following:

- Purpose and scope;
- Glossary of terms;
- Roles and responsibilities, including organisation and reporting lines/requirements;
- SIMOPS operations – description of scope of work to be covered by the specific document;
- Procedures and controls;
- SIMOPS risk and mitigations;
- Contingency plans;
- Change control – deviation requests;
- Establishment of who has primacy (who is in overall charge of communications, PTW and operations);
- Authorizations to proceed process (PTW);
- Communication plan
Simultaneous Operations (SIMOPS)

WORK
• Custom streamlined workflow based on your procedures
• Perform planned and emergency maintenance activities
• Assess, assign and control work
• Track progress and completion details

RISK ASSESSMENT (JSA/IHA/TRA/ora)
• Ensures correct risk assessments are being carried out
• Total visibility into hazards and controls
• Configurable field-specific phrase library
• At risk areas show other issues in adjacent locations

PERMIT TO WORK
• Custom streamlined workflow based on your procedures
• Checks for conflicts and SIMOPS
• Skill checks and lessons learned for real-time awareness
• Strict processes and certificate control ensure compliance

ISOLATIONS / LOTO
• Dynamic isolations built through a variety of methods
• Turn standard P&IDs into interactive tools
• Full key safe and lock box management
• Isolation tags and barcodes configured to your design

SANCTION TO TEST
• Sanction to Test certificate controls release of isolations
• Isolation points can be selected for removal
• Validations between permits and Sanction to Test
• Seamlessly integrates with other documents in Q4

MANAGEMENT OF CHANGE (MoC)
• Clear overview of change requests
• Configurable workflow and approval cycle
• Real-time implementation tracking
• Includes commercial and technical authorisation

AUDITS
• Perform audits on safety documents
• Configurable workflow and questions
• Set and review assessment scoring for pass or fail
• Dashboard KPI for performance and deviations

OPERATIONAL RISK ASSESSMENT (ORA)
• Ensures correct risk assessments are being carried out
• Total visibility into hazards and controls
• Configurable field-specific phrase library
• At risk areas show other issues in adjacent locations
Simultaneous Operations (SIMOPS)

SIMOPS flowchart

- Identify SIMOPS
- Kick-off meeting identifying the scope of work
- Each party prepares work specific dossiers
- SIMOPS assessment review
  - Review risks: identify specific mitigation measures
  - Develop hierarchy of controls

- Purpose
- Identified SIMOPS
- Procedures and controls
- Risk and mitigation
- Reporting lines
- Contingency plans
- Management of change
- Primacy
- Authorization/PTW
- Communications plan

- Is there a need for Change/Deviation?
- Carry out SIMOPS
- Preparation for SIMOPS
  - Meetings
  - Communications
  - Authorization/PTW
  - Change control
- Close out
  - Roles and responsibilities
  - Validate communications

Lessons learned
Simultaneous Operations (SIMOPS)

- SIMOPS assessment review
- Develop SIMOPS interface document
  - Purpose
  - Identified SIMOPS
  - Procedures and controls
  - Risk and mitigation
  - Reporting lines
  - Contingency plans
  - Management of change
  - Primacy
  - Authorization/PTW
  - Communications plan

Preparation for SIMOPS
- Roles and responsibilities
- Validate communications

Carry out SIMOPS
- Meetings
- Communications
- Authorization/PTW
- Change control

Is there a need for Change/Deviation

Close out
- Lessons learned

Lessons learned
Simultaneous Operations (SIMOPS)

It is important that SIMOPS are identified at an early stage before the work commences.

SIMOPS may come about as the result of the following issues:

- Schedule clashes, e.g. activities in same area at same time;
- Physical clashes, e.g. anchor patterns, loss of position;
- Failure impacts, e.g. explosions, leakage, gas etc.;
- Interference between platform operations and vessel operations;
- Contracts and third party interfaces, e.g. liabilities, risk/insurance;
- Environmental impacts, e.g. currents, icebergs, weather limitations;
- Territorial clashes, e.g. 500m zone, existing infrastructure;
- Any other combined/simultaneous activity in the area of operation which could compromise project success criteria.

SIMOPS Toolbox Talk
A meeting of all the parties involved in the SIMOPS should be set up to enable a review to be undertaken of each party’s work-specific dossier in a systematic manner.

- Appropriate tools should be used to clearly identify all the risks in conducting SIMOPS contained in each party’s dossier and the review meeting should agree the required specific mitigation measures to be implemented to allow SIMOPS to proceed.

Methodology/tools which can be used to identify the risks are:

- Hazard identification and risk assessment (HIRA);
- Clash analysis;
- Interdependency analysis.

What is Toolbox Talk (TBT)?

Short talks that focus on a specific job/topic carried out by the supervisor or the senior person.

- e.g. High pressure testing, manual handling, lifting ...

- TBT is a two way communication responsibility.
- Help inform inexperienced workers and provide reminders to experienced workers of correct control measures.
Why TBT is important?

• Determine the responsibilities of employees & supervisors.
• Allow supervisor and workers to explore the risks of specific HSEQ issues and think about ways to deal with them.
• Encourage worker engagement.

How to deliver a TBT Top Tips?

• Know your material.
• Do not get side tracked by other topics.
• Make eye-contact.
• Make sure your voice carries to the back of the room.
• Involve staff using open questions.
• Summarise key points.
• Do not speak too quickly or too slowly.
• Keep an eye on your timings.
Simultaneous Operations (SIMOPS)

Workshop: Case Studies & Worked Examples

Section Four
Refinery Specific Risks and SIMOPS
Risk Management

What is the Risk Management process?

• The Risk Management Process consists of a series of steps that, when undertaken in sequence, enable continual improvement in decision-making.
Step 1. Communicate and consult

- Communication and consultation aims to identify who should be involved in assessment of risk (including identification, analysis, and evaluation) and it should engage those who will be involved in the treatment, monitoring, and review of risk.
Step 2. Establish the context

- Establish the context
- Identify the risks
- Analyse the risks
- Evaluate the risks
- Treat the risks

Provide a five-step process to assist with establishing the context within which risk will be identified:

1. Establish the internal context
2. Establish the external context
3. Establish the risk management context
4. Develop risk criteria
5. Define the structure for risk analysis

Step 3. Identify the risks

Risk cannot be managed unless it is first identified.

Once the context of the business has been defined, the next step is to utilize the information to identify as many risks as possible.
Step 4. Analyze the risks

During the risk identification step, a business owner may have identified many risks and it is often not possible to try to address all those identified.

The risk analysis step will assist in determining which risks have a greater consequence or impact than others.

Step 5. Evaluate the risks

Risk evaluation involves comparing the level of risk found during the analysis process with previously established risk criteria, and deciding whether these risks require treatment.

The result of a risk evaluation is a prioritized list of risks that require further action.

This step is about deciding whether risks are acceptable or need treatment.
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**Step 6. Treat the risks**

Risk treatment is about considering options for treating risks that were not considered acceptable or tolerable at Step 5.

Risk treatment involves identifying options for treating or controlling risk, in order to either reduce or eliminate negative consequences, or to reduce the likelihood of an adverse occurrence.

Risk treatment should also aim to enhance positive outcomes.

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**Step 7. Monitor and review**

Monitor and review is an essential and integral step in the risk management process.

A business owner must monitor risks and review the effectiveness of the treatment plan, strategies and management system that have been set up to effectively manage risk.
Simultaneous Operations (SIMOPS)

Summary of risk management steps

- Establish the context
  - The external context
  - The internal context
  - The risk management context
  - Develop risk evaluation criteria
  - Define the structure for risk analysis

- Identify the risks
  - What can happen
  - When, where and how

- Analyze the risks
  - Determine existing controls
  - Determine probability
  - Determine consequence
  - Estimate level of risk

- Evaluate the risks
  - Compare with criteria
  - Set priorities

- Treat the risks
  - Identify options
  - Assess options
  - Prepare treatment plans

Management of change
Management of change

• During normal operations hazards are contained and the operation is usually within the safe margin

Changes Either:

• Shift the bounds of “Normal Operation” or
• Put the facility into an “Abnormal Situation”

Definition: Change - Any addition, process modification, or substitute item (e.g., person or thing) that is not a replacement-in-kind
There are many types of changes, such as:

- Equipment changes
- Procedural changes
- Chemical changes
- Process changes
- Control / limit changes
- ITM changes
- Personnel changes
- Infrastructure changes

All must be managed!

To manage change successfully and safely, you must have:

- A robust management-of-change program in place
- Clear ownership of the program and its constituent parts
**Simultaneous Operations (SIMOPS)**

**Essential elements of a robust MOC program:**

- Agree on the technical justification for the change at the appropriate management level
- Risk-assess the proposed change.
- Using a multi-disciplined team of competent people
- Including specialists and vendors when needed

**Definition: Temporary change**

- A change that is implemented for a short, predetermined, finite period

**Definition: Emergency change**

- A change needed in a situation where the time required for following the normal MOC procedure could result in an unacceptable safety hazard, a significant environmental or security incident, or an extreme economic loss.
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**START**
Anyone proposes a change

**RIK?**
- No
  - Originator fills out a RFC form
- Yes
  - MOC not required
  - Required level of risk review decided
  - Perform risk review
  - Complete tasks identified by review

**RFC** = “Request for Change”
- Describe what is to be changed
- Identify the type of change
- Document the technical basis
- Specify a time limit if any
- What-If. HAZOP, Safety Review, etc.
- Use required participants per MOC procedure
- Answer questions raised
- Implement risk-control measures

From previous slide

**Authorize change**

- Execute change
- Update PSI, procedures, etc.
- Train/inform personnel

**Check operational readiness (PSSR)**

**Start up or re-start**

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171 SIMOPS

Simultaneous Operations
172 SIMOPS

86
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**Change Management Strategy**

1. **IMPROVE**
   - Existing Product, process, service
   - Gap in performance
   - Focus on fixing gap through targeted recommendations

2. **DESIGN**
   - Current product, process, service (AI)
   - Short of needs or
   - No existing product, process or service
   - Focus on creating vs. fixing ("Clean State")

3. **MANAGE**
   - Operation and documentation of product, process, service
   - Balanced measures and ongoing monitoring (includes "Voice of Customer")
   - Portfolio management & Corrective Actions

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173 SIMOPS

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Simultaneous Operations
174 SIMOPS

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Continuous Improvement

Evaluate → Assess

People → Tools → Change

Manage Change → Implement

Change → Process → Design

Implement

Integrated SIMOPS tool

SIMOPS inherently require a centralized management and coordination system to integrate and visualize distributed data points and to enable communication and collaboration between disparate teams, departments, and even companies to optimize multiple operations.
Simultaneous Operations (SIMOPS)

SIMOPS operations management system.

- 1. Centralized system with real-time data feeds
- 2. Visualization linking space and time
- 3. Infrastructure to communicate and collaborate, both onshore and offshore
- 4. Post mission playback and analysis for future improvement.
Simultaneous Operations (SIMOPS)

Ensuring contractor alignment with safety culture

The contractor ratio within the oil and gas extraction industry has increased significantly over the past two decades.

With this rise in the number of contractors, the frequency of injury has also increased.
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HSE culture ladder

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SIMOPS

181

182
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Human factor and ergonomics, behavioral based safety
Simultaneous Operations (SIMOPS)

**What is Behaviour Based Safety?**

Behaviour based safety (BBS) creates a safety culture that helps to identify safe behaviour.

For BBS to work, all levels of the company must work together.

BBS looks at how three things interact to improve safety:
- Person
- Work Environment
- Behaviour

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**The Safety Triad**

Three elements of the safety triad:
- Environment
- Persons
- Behaviour
Simultaneous Operations (SIMOPS)

Principles of BBS

- Behaviour causes accidents
  - Observe – measure – manage
  - Feedback is essential to improvement
- Consequences motivate behaviour
- Communication is the key
- Participation creates ownership
- Continuous improvement happens when we work together
- Be proactive rather than reactive

Behaviour VS Attitude

**Behaviour:**
- what you do

**Attitude:** what you think, feel, or believe
- A bad attitude may result in committing an unsafe act or failing to prevent an incident
Barriers to safe behavior:

• Untrained or unskilled workers
• Complacency
• Personal choice
• Culture
• Ineffective management systems

Why At-Risk Behaviors?

Jobs get done faster
Perception that risk is low
“Nothing is going to happen to me” attitude
At-risk behavior is reinforced
Lack of awareness that behavior is risky
One way to look at how changing your behavior can improve safety is the ABC Model:

A = Activator: triggers behavior

B = Behavior: what we do

C = Consequence: reinforcement or punishment

Your attitude (the activator) affects how you behave.

Your behaviour has consequences:

- Consequences can either reinforce or deter a behavior
- Positive reinforcement enforces safe behavior
- Negative reinforcement deters unsafe behavior
BBS training attempts to reduce work-related injuries by creating a culture of safe behavior through

- Observation
- Feedback
- Positive intervention

Four Key Components to BBS Programs

- Correct behavior
  - Determine the safe way to do the job
- Observation card
  - Observe and record unsafe behaviors
- Feedback process
  - Deliver feedback immediately following an observation
- Measurement tool
  - BBS is an ongoing process
Simultaneous Operations (SIMOPS)

Observation Process

**Observe**
- Observe the job to make sure you understand what the worker is doing and provide necessary feedback

**Understand**
- Communicate effectively; make sure the workers understand why their behavior is unsafe

**Identify alternate behavior**
- Coach the worker in the correct, safe behavior and allow change for safer way of getting the job done

**Clarify commitment**
- Make it clear that workers are committed to doing the job safely through feedback and positive intervention

**Obtain agreement**
- Workers must agree to change unsafe behavior to an alternate safe behavior

**Observe to follow-up**
- Observe workers at a later date to make sure they are using the safe behavior; reinforce the safe behavior with positive feedback
Feedback Process

Deliver feedback immediately following an observation:

- Safe behavior observed
  - Feedback should acknowledge and reinforce it
- Unsafe behavior observed
  - Identify cause of unsafe behavior
  - Explain why the behavior was unsafe
  - Offer an alternative safe behaviour

Measurement Tool

BBS must be an ongoing process

For BBS to work, everyone needs to be involved

Companies that see results from BBS

- Keep up data entry
- Use performance charts
- Use observation reports
- Set specific safety goals
Simultaneous Operations (SIMOPS)

Motivation or “buy in”

Motivation built on a solid culture (buy in from leadership to workers)

Key motivational points include:

- providing employees with the sense of “value”
- recognizing employees for good work
- fostering a sense of community

Positive Reinforcement

Getting what you want

Acknowledgement, recognition, better work assignments

Maintains or increases desired behavior

Gives discretionary effort (more than asked)

Behaviour occurs more frequently
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