Non Operated Joint Venture's HSE Management Guidelines (Aiming to ensure occupational health and safety of JVs and prevent environmental accidents)

HSE Committee, HSE Management Subcommittee
The Japanese Association for Petroleum Technology

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1. Introduction

1.1. Background and objectives

On-site operations in E&P projects involve significant risks of accidents, human injuries (occupational and health hazards), property damage, and adverse impacts on society and the natural environment. These HSE risks need to be minimized not only by the operator but also by the joint venture (JV) as a whole. In general, it is difficult for non-operators to be deeply involved in HSE management, and it is difficult for them to gather information about the business and reflect their opinions to the operator. On the other hand, non-operators have legal and social responsibilities in the event of an emergency. The purpose of the guidelines is to recognize these issues and to organize what non-operators can do to help prevent accidents involving JVs. Non-operators need to share the same understanding of the risks of the project with the operator, and confirm that the operator is taking ALARP mitigation measures against such risks.

The Japanese Association for Petroleum Technology (JAPT) HSE Committee and the HSE Management Subcommittee have developed a set of guidelines to help non-operators understand the HSE risks associated with all stages of E&P operations, including exploration, development, production, and abandonment, and to make recommendations to operators for improvement. The HSE Management Subcommittee will introduce guidelines that pick up points considered necessary for the management of existing projects, based on the actual status of these management activities within each company and a survey of domestic and international literature. Specifically, Chapter 2 describes the requirements for operating an HSE Management System (HSE-MS), Chapter 3 describes specific measures for monitoring and review to ensure occupational health and safety and to prevent environmental accidents, and Chapter 4 describes the points to keep in mind when assessing the integrity of an E&P project at each stage of its life cycle and the systematic risk management methods that should be implemented prior to the start of operations. It is hoped that the guidelines will be useful to non-operators in establishing a method of involvement in HSE management for non-operator projects to prevent accidents in JVs, as well as to recognize the gap between what an operator's HSE-MS should be and what it currently does. In addition, "Case Studies" and "Columns" on HSE management by HSE Management Subcommittee members are also included in the guidelines for reference by non-operators.

The HSE screening criteria for public institutions and commercial banks that provide financing to private sector projects are based on the Performance Standards (PS) of the

International Finance Corporation (IFC). [1] [2] PS1 (Environmental and Social Assessment and Management System) describes the standards required for all projects and then refers to the appropriate section for each project. According to this, if an operator's HSE management can be comprehensively verified to meet the standards of this PS, the project can be assessed as having adequate HSE considerations. However, it is important to note that the PS criteria are focused on the screening private companies that invest in or guarantee the debt of "new businesses. In other words, please note that the guidelines place emphasis not only on "newly-entered businesses" but also on "continuous implementation" of measures through PDCA throughout the life cycle of the E&P business.

1.2. Level of involvement in non-operator business management

The HSE Committee recognizes that the level of involvement of non-operators in the JV's HSE management can be classified as Table 1-1. The HSE Management Subcommittee hopes that the guidelines will help to achieve a level of involvement over "Influence" that is both consistent with the above objectives.

Table 1-1 Levels of non-operator involvement

level of Involvement	Example
Control	Involvement at the same level as operator projects (e.g., cooperative operations, etc.)
Influence	Actively participate in HSE management of the JV regardless of the occurrence of accidents or non-conformities by reviewing HSE plans, dispatching secondees, etc.
Monitor	Involvement in understanding accident KPIs/incidents, participating in HSE audits, raising concerns, etc.

1.3. Decision-making body for JVs (JV management)

E&P projects are often operated by a JV consisting of two or more companies that enter into an agreement to share the costs, risks, benefits, and responsibilities of the project. While there are various types of JVs, "incorporated JVs"[1] and "unincorporated

[1] Corporate JV: A method in which the parties participating in a JV establish a new joint venture company, such as a stock company or special purpose company (SPC), and become shareholders or investors.

JVs"[2] are representative. The guideline covers both types of JVs.

In the case of an "incorporated JV," the HSE-MS is usually governed by a "JV Board"[3] composed of representatives of the major shareholders of the joint venture. In the case of an "unincorporated JV," the operator's HSE-MS is usually used as the governance framework, and reporting is done throuth an "Operating Committee (OpCom)" consisting of representatives of each of the JVs. The JV decision making body in this guideline is the JV Board in the case of an "incorporated JV" and the OpCom in the case of an "unincorporated-type JV".

[2] Unincorporated JV: A JV in which no joint venture company is formed and the companies participating in the JV conduct the business by concluding a contract that sets forth the terms and conditions of the JV.
[3] JV Board: For the purposes of the guideline, the JV Board means the Board of Directors (in the case of an incorporated JV), the Project Committee or Management Committee (in the case of an unincorporated JV), or the governing body of the JV.

2. HSE-MS requirements

This chapter describes the items that should be included in an E&P project's HSE policy, as well as the basic ideas and requirements regarding governance, leadership and competencies. It would be referenced when participating in E&P as a non-operator and when reviewing the adequacy of the operator's HSE-MS.

2.1. HSE policy

JVs in E&P projects should develop an HSE policy, obtain approval from JV management, and publicize it internally and externally. The HSE policy should include the following contents. [3] [4]

- ✓ Protect the environment, safety, community and human rights in the ares of operation
- ✓ Compliance with all relevant laws and regulations
- ✓ Follow the standards and best practices of the region and industry in which the project is implemented
- ✓ Making maximize efforts to achieve sustainable development
- ✓ Systematic organizational efforts to
  - (1) Manage significant[4] risks
  - (2) Comply with relevant laws and regulations
  - (3) Continuously improve performance
- ✓ Performance monitoring, evaluation and reporting
- ✓ Investigation of critical incidents and near misses
- ✓ Encourage all parties, including contractors, subcontractors, and suppliers, to comply with this policy

2.2. Governance

The governance of the HSE should be carried out through the following activities. [4]

- ✓ Operator's management of HSE-MS, regular updates, performance tracking, and reporting to JV management
- ✓ Clarification of responsibilities by JV management
- ✓ Demonstration of HSE-MS by JV management, HSE-MS engagement by all parties
- ✓ Explain HSE risks and mitigation measures to stakeholders in advance - Engage respectfully, respectfully, and proactively at the begining of the project and

[4] Significant: The level that the JV considers serious in terms of "probability of occurrence" and "magnitude of impact (to people, assets, environment, reputation). Criteria must be clearly defined and approved by JV management.

continue to do so

- ✓ Periodic HSE-MS review and approval by JV management

2.3. Leadership

This section describes the leadership requirements for shaping a safety culture and the specific measures that leaders[5] should take. [5] The concept of leader-led safety measures is illustrated in Figure 2-1.

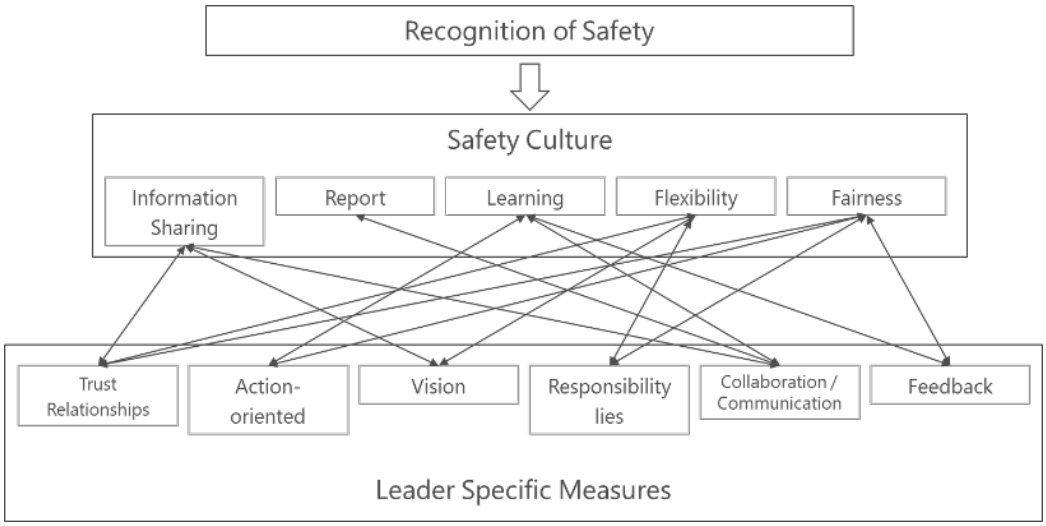

Figure 2-1 Conceptual diagram of leader-led safety measures

2.3.1. Recognition of safety

It is said that approximately 80% of accidents are caused by human error. A closer look reveals that the majority of accidents are caused by the following organizational factors.

- ✓ Problematic tasks
- ✓ Unclear work process
- ✓ Troubled equipment
- ✓ Excessive workload, inadequate resources
- ✓ Lack of education and training

It is the leader who has the authority to make these improvements. In addition, it is noted that "work as imaged" and "work as done" are often different, and it is important for leaders to recognize the difference. In other words, if something is found to be different from the initial image, the leader needs to take the initiative to improve it.

[5] Leaders include organization-wide leaders, senior leaders, mid-level managers, field supervisors, safety leaders, etc.

Leaders also need to properly assess the balance between "work efficiency" and "safety" and make decisions accordingly.

Case Study

An HSE manager investigated the causes of the last 350 incidents and found that 90% of them were caused by the organization's systems. The HSE manager reported to JV management and proposed the formation of a task force to improve the system, which was approved.

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Column

- ✓ At a regular technical meeting for an existing project, each partner takes it in turn to present an HSE moment at the beginning of the meeting, which is a good opportunity to raise HSE awareness among non-operators and to request accurate reporting of HSE-related information to non-operators.
- ✓ In addition, by researching, introducing and suggesting the latest HSE management methods, non-operators could contribute to accident prevention.
- ✓ A domestic oil exploration and production company, enlisted the help of a drone service provider to implement a proposal to use drones to safely manage high altitudes and hazardous areas.
- ✓ The operator made the following comments
  - ➢ Drone could be used in our field for security measures and power line inspections.
  - ➢ A few years ago, we ordered a drone for utilizing purpose from outside of the country, but for some reason it was stopped at customs and could not be imported. We don't know exactly what happened after that, but it was eventually canceled. If we get a chance, we will consider it again. Thanks.

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2.3.2. Creating a safety culture through leadership

Safe operations require the development of a safety culture in the organization. The elements necessary to form a safety culture are shown in Table 2-1. [6]

Table 2-1 Elements necessary to form a safety culture

Element	Description.
Informed culture	Companies collect and analyze safety-related information and share the results with all employees.
Reporting culture	Employees report accidents and near misses to the company. The company is not concerned or blamed for the report.
Learning culture	Organizations change unsafe situations by learning from their mistakes and making improvements.
Flexible culture	In the event of an unexpected accident or emergency, the company is allowed to take flexible non-prescribed action.
Fair Culture	People understand the boundaries between acceptable and unacceptable behavior. Unacceptable behavior will be judged fairly.

A company's culture is formed through a very complex process due to a variety of factors, but it is said that strong leadership can change this. [7] A company's culture can be changed by a variety of factors. Therefore, it is important to create an environment where leaders can discuss issues and motivations in an open and transparent manner at leadership meetings with a sense of responsibility.

2.3.3. Specific measures to be taken by leaders

After having a proper awareness of safety and forming a safety culture in the organization, specific actions should be implemented by leaders. Table 2-2 shows the specific actions that leaders should implement after having a proper awareness of safety and forming a safety culture in the organization.

Table 2-2 Items leaders should implement to create a safety culture

Items	Description.
Building trust relationships (Credibility)	Leaders should be trusted through close communication with staff
Action orientation	Action guidelines and field manuals should be realistic and in line with actual operations
Vision	Specific visions such as "zero disaster"

Accountability	Clarify the division of roles and responsibilities
Collaboration and communication	Communicate with other employees through voice communication, toolbox talks[6] , etc.
Feedback	Create an environment where the voices of the field are heard by leaders.

2.4. Competency[7]

Employee competency management is necessary to meet performance standards, and the following four controls are recommended. [8]

Identification of required competencies	For each work, identify the competencies required to perform the work. This applies to both direct employees and contractors.
Provide necessary training	Provide pre-work trainings, periodic in-service trainings, on-the-job trainings, etc.
Certification of competencies	Certify the necessary competencies through both written and oral means. Periodic competency reviews should be conducted for particularly advanced technologies. The organization is required to continuously manage the professional competence of each technician through databases and/or other means.
Refresh	Work assignments should also be updated periodically

[6] Toolbox talk: A group discussion of safety issues before work begins, held daily at the beginning of each shift change. The purpose is not only to ensure the health and safety of employees, but also to create and maintain a safety culture in the organization.

[7] Competency: The ability to perform one's assigned tasks accurately and reliably. Competency includes the skills and knowledge required to do the job, as well as the ability to recognize the limits of human ability and to obtain the advice and cooperation of others when necessary.

3. Monitoring and review

This chapter describes specific measures for monitoring and review to ensure occupational health and safety and prevent environmental accidents. It should be used as a reference when participating in E&P projects as a non-operator position, checking whether the operator's PDCA cycle HSE-MS is adequate and taking initiatives to further improve the operator's HSE management, as the non-operator involvement level is above Influence.

3.1. Monitoring by Key Performance Indicators (KPIs)

3.1.1. Purpose of KPIs

Improper management of safety processes not only poses a risk of harm to people, but can also affect the environment, property, reputation, and financial stability. In general, inadequate management of safety process causes serious damage, companies will closely investigate the causes and take measures to improve their management systems and prevent similar incidents from recurring. However, these are retrospective actions and these measures may not directly lead to the prevention of serious incidents. KPIs approach generates a set of data that can be analyzed to improve preventive measures such as management system revisions, procedure changes, training opportunities or facility engineering aimed at eliminating or minimizing the likelihood of serious incidents.

3.1.2. Stages of KPIs and the evaluation criteria

The IOGP report classifies safety management KPIs into four tiers, as shown in Figure 3-1 Pyramid conceptual diagram of safety process management [9] Tiers 1 and 2 are lagging indicators, corresponding to LOPC (Loss of Primary Containment)[8] occurrences. Tiers 3 and 4 are leading indicators and these are intended to be more specific to a company's own management system, individual activities, assets, facilities, plants, etc.

[8] LOPC: An unplanned or uncontrolled release of material (including non-toxic and non-flammable materials (e.g., steam, hot water, nitrogen, compressed CO_2 or compressed air)) from a major containment.

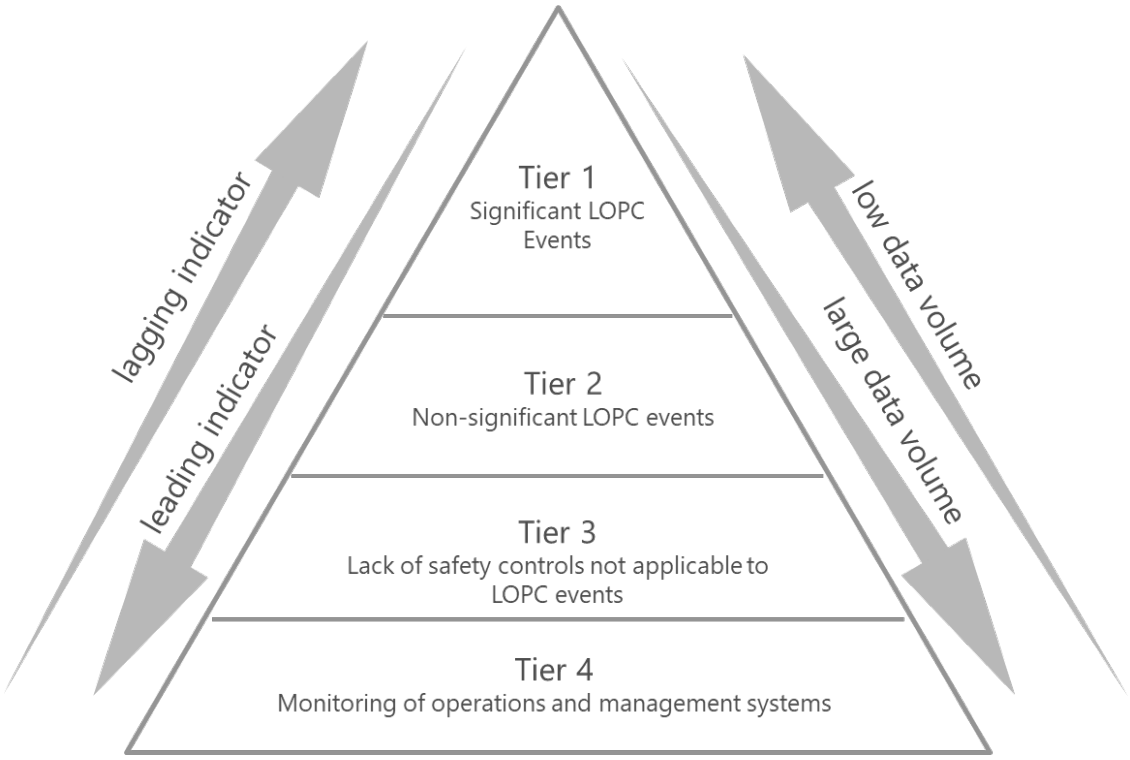

Figure 3-1 Pyramid conceptual diagram of safety process management

If a substance is released under unscheduled or uncontrolled conditions, the Tier is classified based on the type and amount of the substance and the location of the release. Table 3-1 Examples of LOPC Tier 1/2 criteria values shows an example of Tier 1 and 2 thresholds for typical substances.

Table 3-1 Examples of LOPC Tier 1/2 criteria values

Nonpoisonous substance (Example.)	Tier 1		Tier 2	
	Outdoor	Indoor	Outdoor	Indoor
Flammable gas (natural gas, mercaptan)	> 500 kg	> 50 kg	> 50 kg	> 25 kg
Flammable liquids boiling point < 35 C & flash point < 23 C (LPG, LNG)	> 500 kg	> 50 kg	> 50 kg	> 25 kg
Flammable liquid flash point > 23 C & < 60 C (diesel)	> 1,000 kg / > 7 bbl	> 100 kg or > 0.7 bbl	> 100 kg or > 0.7 bbl	> 50 kg or > 0.3 bbl
Liquid flash point > 60 C (asphalt, lubricating oil)	> 2,000 kg or > 14 bbl	> 200 kg or > 1.4 bbl	> 200 kg or > 1.4 bbl	> 100 kg or > 0.7 bbl

Toxic (poisonous) substance (example)	Tier 1		Tier 2	
	outdoors	indoor	outdoors	indoor
Toxic inhalation hazard zone A (acrolein, bromine)	> 5 kg	> 0.5 kg	> 0.5 kg	> 0.25 kg
Toxic inhalation hazard zone B (hydrogen sulfide, chlorine)	> 25 kg	> 2.5 kg	> 2.5 kg	> 1.25 kg
Toxic inhalation hazard zone C (sulfur dioxide, hydrochloric acid)	> 100 kg	> 10 kg	> 10 kg	> 5 kg
Toxic inhalation hazard zone D (ammonia, carbon monoxide)	> 200 kg	> 20 kg	> 20 kg	> 10 kg

In addition, examples of Tier 1 and Tier 2 events other than the above substance releases are shown in Table 3-2　Tier 1 and 2 events other than substance release.

Table 3-2 Tier 1 and 2 events other than substance release

Tier	Event
Tier 1	✓ Employee, contractor, or subcontractor becomes "days away from work" or dies ✓ Hospitalization or death of a third party ✓ Community officially declares its intention to evacuate or shelter in place ✓ Fire or explosion resulting in damage in excess of $100,000.
Tier 2	✓ Recordable injury to employees, contractors, and subcontractors ✓ Fire or explosion with damage value of over $2,500 and under $100,000

A conceptual flowchart of the Tier 1 and 2 and other classifications is shown in Figure 3-2 Classification chart of safety process KPIs Tier 1 and 2.

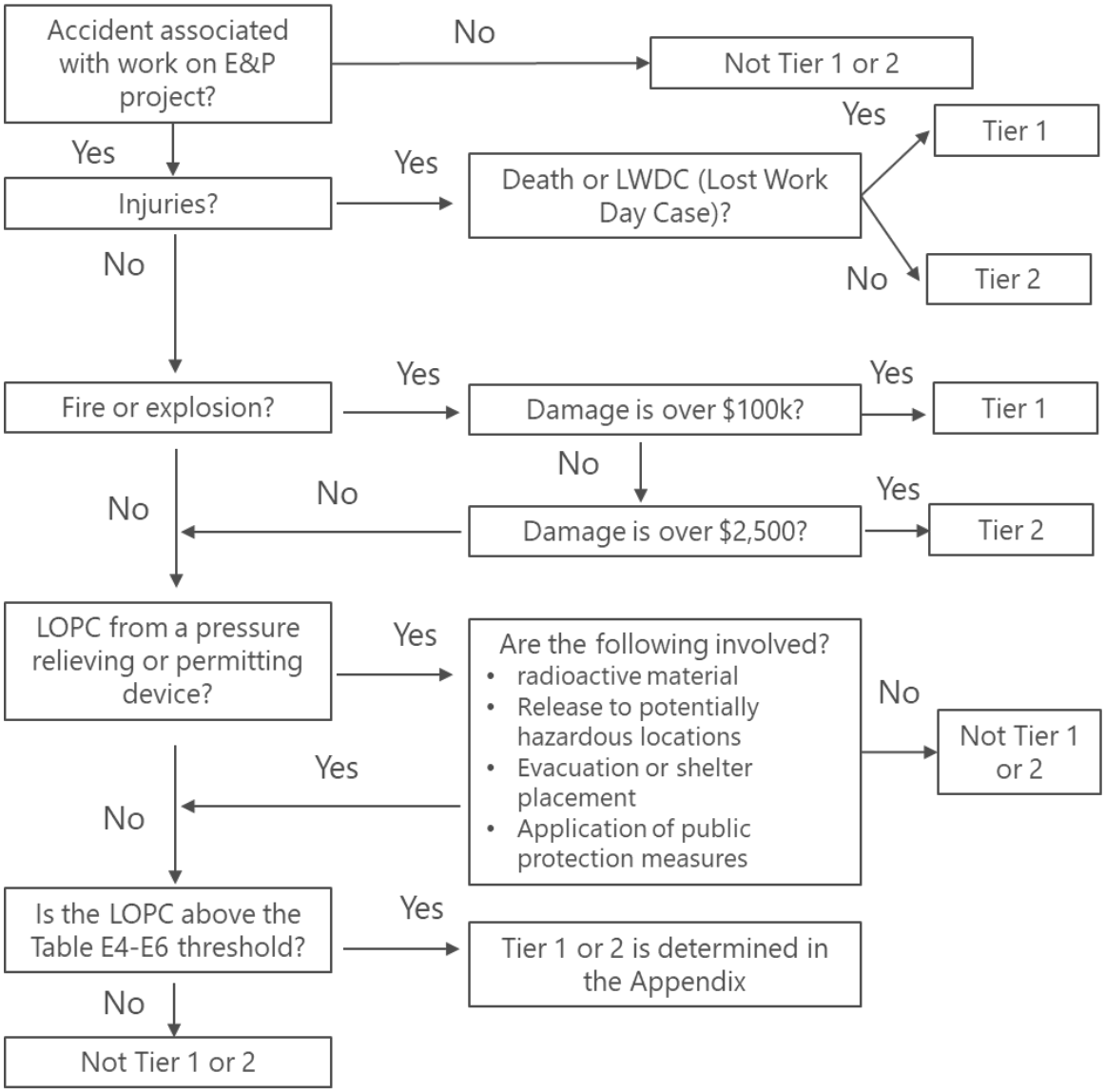

Figure 3-2 Classification chart of safety process KPIs Tier 1 and 2

Tier 3 is used to monitor the performance of barriers that prevent LOPCs in Tier 1 and 2; Tier 3 applies when the LOPC falls below the Tier 2 threshold or when it does not result in a LOPC but one or more key barriers or support systems are not performed as expected. Tier 4 is used to monitor the implementation and effectiveness of management system elements that support the performance of key barriers; Tier 4 uses data from the process safety KPIs to verify the effectiveness of the barriers in the next section.

Case Studies

- ✓ An oil development project involving Japanese company A as a non-operator is considering the development of a new oil reservoir containing hydrogen sulfide (H_2S).
- ✓ The operator has experience in developing and producing oil containing H_2S and is not overly concerned about the safety. However, in order to understand that the operator's H_2S measures are reasonable enough and to explain them to the company's managements, the person in charge of the company A investigated H_2S measures through literature research, etc., and held a briefing session within the company. In addition, the managements approved to organize a seminar by an external specialist to learn more details, such as equipment configuration for acid gas treatment, design requirements, material selection, prepared a checklist of H_2S countermeasures, etc.
- ✓ Company A then held a series of technical dialogues with the operator on H_2S measures and risk management involvement to understand their effectiveness, explained them internally, and agreed to move to development.

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3.2. Evaluation of barrier effectiveness

3.2.1. Functions of barriers

The definition of a barrier in the IOGP is "to prevent the occurrence of an unintended event or to prevent an event from leading to disaster." [8] . While one barrier that works universally for all hazards would be ideal, in reality this is not the case, and a combination of barriers is required. One way to understand barriers conceptually is the Swiss cheese model, in which barriers are linked to slices of "Swiss cheese" and stacked side by side. Each barrier is represented as a single slice of cheese, and the holes in the slices represent weaknesses in some of the barriers. Incidents occur when one or more holes in each slice line up. Therefore it is important to create a barrier system that prevents this by providing multiple independent slices, as shown in Figure 3. 3-3.

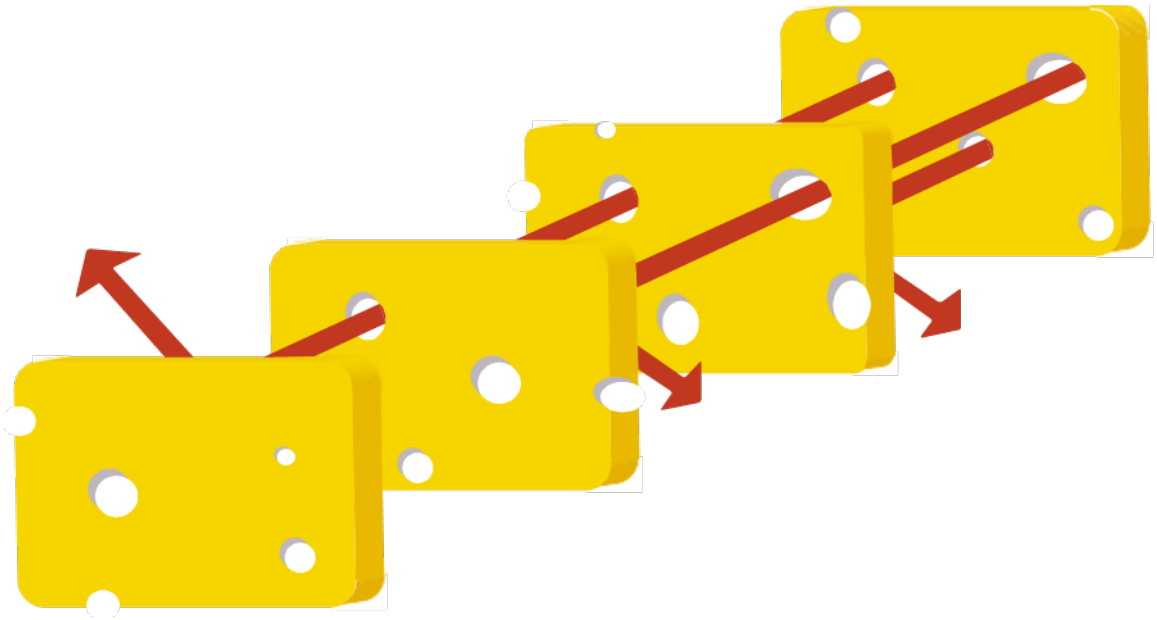


Figure 3. 3-3　Schematic diagram of the Swiss cheese model of barrier concept

3.2.2. Types and functions of barriers and planning

Barriers are broadly categorized as "hard barriers" or "human barriers. Typical "hard barriers" are safety devices that require periodic inspection and maintenance by human operators to ensure proper functioning. Human barriers are human-enabled activities that require systematic operational discipline. Both barriers require management through HSE-MS.

The "Swiss cheese" model described in the previous section assumes that holes will always exist, even temporarily, and the goal of barrier management is to identify holes (e.g., equipment degradation, temporary safety bypass, operational changes, maintenance failures, individual and team skills), recognize that holes are constantly changing and to make the hole as small as possible and to minimize its duration of existence as much as possible. This will reduce the likelihood that all the holes will line up and the worst case scenario will occur.

Planning of specific barriers should be identified by visualizing the needs. For example, a bow tie analysis is a method of systematically evaluating threats, top events, and consequences in the form of a bow tie that identifies the barriers needed for each facility. For more information on risk management techniques, see Section 4.3.

The number of barriers for individual equipment should be no more than 20 that can realistically be managed (even then, the total number of critical equipment may be more than a thousand), and systematic management is required.

3.2.3. Barrier performance standards

Performance criteria for barriers are usually described in terms of functionality, availability, reliability and viability. Performance criteria therefore determine the design specifications of the equipment and also set the requirements for the maintenance and testing of the asset throughout its entire life cycle.

It is important to consider the range of possible performance criteria for each component and to optimize the overall barrier to achieve cost-effective risk reduction. Such barrier optimization requires input from designers, operations, and often risk management experts to ensure that all relevant factors are considered.

3.3. Audit

3.3.1. Functions

One of the key methods in the PDCA of the HSE-MS is auditing. Trained audits promote continuous improvement of occupational health and safety management and help prevent serious accidents, worker injuries, and illnesses. Audits should focus not only on identifying nonconformities, but also on making improvements with the auditor's advice. When nonconformities are identified, effective concrete measures for improvement should be discussed. Items that are not nonconformities but should be improved should also be pointed out.

3.3.2. Creation of checklist items

The content of an audit checklist is an essential part of the effectiveness of an internal audit. The following are some key points for creating an effective checklist.

- ✓ Are HSE management policies and objectives in place, and are specific measures being implemented to achieve them?
- ✓ Are HSE management policies and objectives realistic and in line with current organizational realities?
- ✓ Are the HSE management policies and objectives, and specific measures to achieve them, communicated to all employees?

Table 3-3 Checklist for HSE management in nonoperator jurisdictions shows an

example of a checklist for HSE management in non-operator position. While it is desirable to be able to confirm through audits that all non-operator projects are in compliance with the items on this list, since the list also includes recommendations as well as requirements, it should also be used for the purpose of checking for excess or deficiency of the audit check items.

Table 3-3 Checklist for HSE management in nonoperator jurisdictions

Note: "Organization" in this checklist refers to "organization to be audited.

Items	No.	Requirements and recommendations
0. Management system	0.1	The organization has established, implemented, and maintains an HSE management system that complies with the HSE-MS for non-operator.
1. Policy	1.1	The organization has taken into account the risks and legal requirements associated with the non-operator, and the organization's HSE policy provides a policy (including a management framework) for HSE in the non-operator.
2. Roles and authority	2.1	The organization designates a person responsible for (or in charge of) HSE.
	2.2	The roles, responsibilities, authority, and necessary qualifications of the above responsible person (or persons in charge) satisfy the legal requirements (e.g., legal requirements for full-time HSE personnel, notification of appointment, etc.).
	2.3	The organization has defined, documented, and explained the roles, responsibilities, and authorities for operational management, evaluation, and decision making.
3. Risks and opportunities	3.1	The organization has access and actually obtains the results of the operator's risk assessment and risk register, reviews and evaluates their contents, and takes action as necessary.
	3.2	The organization identifies risks for each non-operator business and for non-operator business in general. Management risks are also considered in the identification of risks.
4. Environmental impact	4.1	The organization obtains and reviews the results of environmental and social impact assessments of the operator’s projects.
	4.2	The organization confirms that the operator's environmental management plan reflects legal requirements and any additional requirements derived from the results of the above assessment (e.g., setting voluntary emission standards that exceed legal requirements, adding voluntary monitoring items, etc.).

5. Legal and other requirements	5.1	The organization organizes, documents, and maintains legal and other requirements, including those imposed as a non-operator.
	5.2	The organization identifies, implements, and maintains how the above requirements are applied in the management system (e.g., permits, notifications, reporting, reflection in operational management standards and targets, and other activities that need to be addressed).
6. Target	6.1	The organization sets HSE targets for non-operator as necessary, taking into account the risks and opportunities of the non-operator, legal requirements, and the results of environmental and social impact assessments of the non-operator.
7. Plan for initiatives	7.1	The organization has developed a plan to address HSE, including with respect to non-operator. Note: When developing the plan, it is advisable to consider risks, opportunities (including those related to management), legal requirements, results of environmental and social impact assessments, and set targets.
8. Competency, education	8.1	The organization has identified the competence requirements for personnel (2.3) needed to properly implement HSE management for the non-operator, and has actually recruited and deployed personnel who satisfy these requirements.
	8.2	The organization develops, implements, and maintains, as necessary, training and development plans to maintain and improve the capabilities of the above personnel.
	8.3	The organization provides education, committee meetings, and other opportunities to ensure that all personnel understand the basics of HSE and encourages participation in HSE activities.
9. Document management	9.1	Documents (including records) required by legal and other requirements and as a non-operator, documents are identified and properly retained and maintained to enable the company to demonstrate that it is properly managing its operator.

	9.2	The organization records and retains records of any communications the organization has with the operator regarding HSE, including responses to nonconformities, and the results of actions taken. Note: In determining the retention period, it is helpful to consider the length of time necessary to provide evidence of involvement in HSE management to the operator.
10. KPI	10.1	The organization considers risks, opportunities, legal requirements, and the results of environmental and social impact assessments, and sets HSE related KPIs for the non-operator (Lost Time Injury Frequency (LTIF), Total Recordable Incident Ratio (TRIR), environmental impact related data, failure time etc.).
11. Operational management	11.1	The organization incorporates the necessary processes related to HSE into its operational processes, such as operational management and decision making processes for the non-operator .
	11.2	The organization includes criteria related to HSE in its investment decisions and other project decision-making criteria.
12. Emergency response and preparedness	12.1	The organization has established standards for dealing with emergencies that occur in non-operator operations and explains these standards to all concerned.
	12.2	The organization obtains and reviews the operator's emergency response standards.
	12.3	The company designates multiple contact personnel to be notified by the operator in the event of an emergency, clearly defines the order of priority of these personnel, and communicates their names and contact information to the operator.
	12.4	The organization has multiple contacts on the operator side in addition to the primary contact, who are known to the organization's personnel and can be referenced when and where needed.

	12.5	The organization has clearly identified the contact person, name of the person in charge, etc., with whom the organization needs to communicate externally, so that personnel are aware of this information and can refer to it when and where it is needed.
	12.6	The communication system in the event of an emergency situation is made easy to understand using charts, etc.
	12.7	The organization has established, implemented, and maintains the processes, roles and responsibilities necessary to update and maintain the contact list, including the operator and external contacts listed above.
	12.8	The organization conducts periodic drills (including call-in drills) to respond to emergencies involving the non-operator.
13. Evaluation	13.1	Information related to the KPIs of the on-operating business as determined by the organization is available from the operator.
	13.2	The organization regularly monitors, measures, and evaluates the KPIs.
	13.3	The organization regularly evaluates the progress of HSE goals, including those related to non-operator projects.
	13.4	The organization regularly monitors and evaluates the progress of its action plans, including those related to non-operator projects.
	13.5	The organization defines the responsibilities for monitoring the above KPIs, targets, and plans, as well as the responsible persons, management criteria, and reporting criteria.
	13.6	If necessary, the organization establishes trigger levels that require action within the KPI management criteria.
	13.7	The organization has established, implemented, and maintains a process for taking action when targets are not met, plans are delayed, or there is a possibility that they will be missed.
	13.8	The organization conducts HSE audits of the operator on a regular basis and/or with criteria (e.g., when a major incident occurs, KPI trigger levels, etc.).

	13.9	The organization participates in or receives information from reviews of HSE conducted by the operator.
	13.10	The organization uses internal audits and self-assessment sheets to evaluate the compliance of the organization's HSE management, including the non-operator, with laws and regulations, the requirements of the non-operator and others, and to the organization's own standards.
14. Response to nonconformity	14.1	Reporting criteria from operator in the event of incidents and non-compliance are clear. Information is available that does not interfere with the non-operator's "accident and disaster reporting standards" or with the monitoring of the organization's targets and KPIs.
	14.2	The above reporting standards ensure that the necessary information is reported at the required time, including preliminary, interim and final reports.
	14.3	The organization has established, implemented, and maintains a process to evaluate the adequacy of corrective actions taken in response to operational incidents and for violations of laws and regulations.
	14.4	Arrangements are in place to communicate with the operator if there are any questions or comments regarding the report.
	14.5	The organization organizes and maintains information on incidents of the non-operator business, violations of laws and regulations, etc.
15. Management review	15.1	The organization conducts management reviews at predetermined intervals to evaluate the effectiveness of the management system, including with respect to HSE management of non-operator, and takes action as necessary.

Also, please note that "check items" and "questions" are different. In other words, "check items" are designed to confirm whether or not the requirements are met, while "questions" are not questions that can be answered with a yes/no answer, but should be designed to elicit objective facts so that the auditor can confirm whether or not the check items are met. In addition, the question "Please show me" is often effective. Table 3-4 Examples of audit checks and questions shows examples of "check items" and "questions" in an audit.

Table 3-4 Examples of audit checks and questions

Checklist	Question
Have you reviewed the operator's investigation into the cause of the serious incident and the measures taken to prevent recurrence?	✓ How many serious incidents have occurred in the past year? ✓ What are the results of the review of each case?
Have you evaluated the effectiveness of your emergency response procedures?	✓ Show me the "Emergency Test Evaluation Sheet."

3.3.3. Audit review

Nonconformity is treated as "not in compliance" through the audit. In general, nonconformities are classified as shown in Table 3-5.

Table 3-5 Degree of audit nonconformity and how it was addressed

Degree of nonconformity	How to deal with it
Critical nonconformity	Likely to have a significant impact on HSE, and the management system is deficient. Corrective actions should be taken and followed up.
Minor non-conformity	Nonconformities that do not have a significant HSE impact. It may be acceptable to address the issue by confirming that it is corrected at the next audit.
Observations	The system is improved by pointing out the nonconformities that are not nonconforming but not so good, or that are not currently nonconforming but may become so in the future.
Recommendations (opportunities for improvement)	Something that can be better and more realistically improved if action is taken.

It is important that corrective actions are taken to prevent recurrence. In other words, simply correcting a nonconformity does not mean that the corrective action is complete. A specific example is shown in Table 3-6.

Table 3-6 Examples of corrective actions for nonconformities

Example of non-compliance ✓ Failure to confirm the contents of the HSE annual report received from the operator.
Example of inadequate preventive measures not leading to corrective actions ✓ The company in charge of the project will properly check the contents from the next time.
Example of corrective actions taken to prevent recurrence ✓ Include a schedule for review of operator HSE report in the HSE annual plan and review progress monthly; check with operators if HSE reports have not been received. ✓ The results of the HSE report review should be reported to the operator. If there are any unclear areas, review them until they are fully understood. ✓ Include the results of the HSE report review and confirmation to the operator in the monthly report to JV management. Include the contents in the HSE report published externally.

Figure 3. 3-4 shows a general flow of an internal audit.

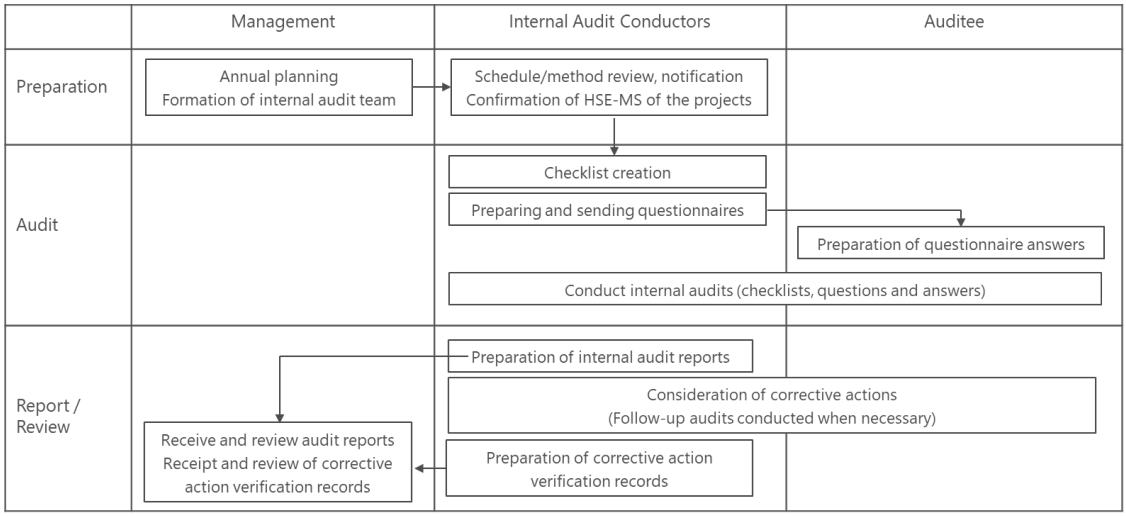


Figure 3. 3-4 General flow of an internal audit

Case Study

- ✓ Internal audits were conducted on the HSE management of existing non-operating projects. The audit attended a related training in advance, prepared checklists and questionnaires for each existing project, and conducted interviews. Some of the results are presented below.
- ✓ The checklist questions are as follows
  - ➢ Please list some of the HSE incidents that are anticipated for this project that you believe pose the highest risk due to their frequency of occurrence and the severity of their impact on the company.
  - ➢ What are your plans as a non-operating company in the event of such an incident? Also, please share any suggestions you have for improving the current HSE system, particularly with regard to risk analysis.
- ✓ The answer to A project is as follows.
  - ➢ Due to the remote onshore location of the field, the impact of an oil leak or accident at the facility on the surrounding area is limited. On the other hand, several fatal accidents have occurred due to errors and mistakes in work procedures, and similar events in the future would pose a high risk to the project.
  - ➢ Basically, as a non-operator, we should work with the operator to raise HSE awareness through HSE committees and on-site HSE audits.
- ✓ Responses to B project are as follows.
  - ➢ Security measures against local demonstrations and terrorism. Although oil spills are expected to occur in the future, the risk of a serious environmental impact is considered low, given the circumstances of the incidents and the measures taken to date. On the other hand, demonstrations and terrorist attacks have the potential to escalate into direct attacks, so security measures by the government and military remain important.
  - ➢ At present, it is difficult to say that countermeasures against serious terrorist incidents are sufficiently established. In particular, there is a need for training in countermeasures and information dissemination in the event of casualties hostage-taking, and other incidents. We would like to continue discussions on effective countermeasures.

Company providing information: Private

3.4. Rules for accidents and emergencies response

This section describes the rules for responding to emergency accidents.

3.4.1. Definition of accidents and emergencies

Operators and non-operators need to clarify the definition of "accidents and emergencies. In general, an incident is defined as a situation in which the operation of an E&P project in which the company is involved results in human casualties, social or environmental impacts, or other conditions that affect or disrupt project operations.

3.4.2. Accident record management

In addition to the method of determining the severity level of accidents and emergencies using the criteria described in the KPIs section, the severity level is often based on the level of injury or treatment.

(1) Injury level

This method determines the level of an accident by focusing on the level of injuries, and allows objective classification of levels. There are two main types of monitoring methods that focus on actual injuries (Hurt Based) and potential injuries (Potential Hurt Based), and the latter is preferred from the viewpoint of establishing priorities for measures to prevent recurrence. The determination of severity level based on the typical level of injury is shown in Table 3-7.

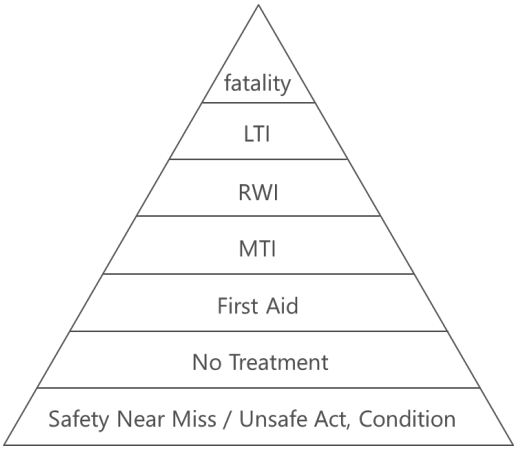
Table 3-7 Severity level classification by typical injury level

Severity level	Treatment period	Examples of injuries
5 (Fatalities)	-	Multiple deaths
4 (Fatality)	-	1 person died
3 (Severe hurt)	More than 1 month or sequelae	Long-term or lifelong sequelae
2 (Moderate hurt)	1 week to 1 month	Fractures, etc.
1 (Minor hurt)	Few days	Incisions and other injuries
0 (No hurt)	No	No injuries

(2) Treatment Level

Treatment level is a method of classifying injuries by focusing not on the injury itself, but on the type of treatment received as a result of the injury and the extent to which it affected operations. It is widely recognized in various industries, including E&P, and can

also be used for reporting by governments and various agencies. Figure 3. 3-5 shows how the severity level is determined based on typical injury levels.

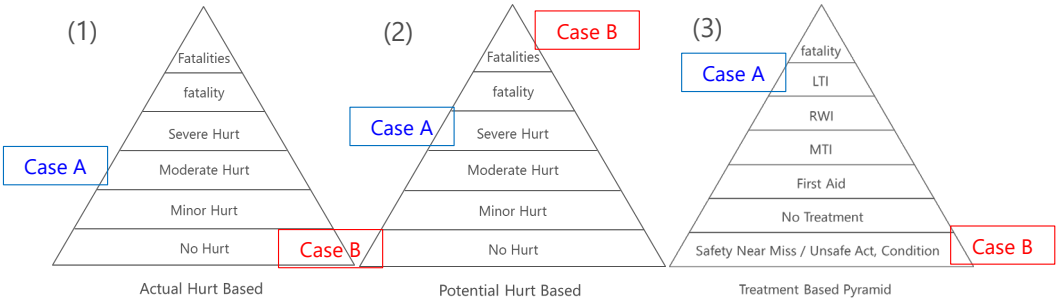


LTI	Lost Time Injury	At least 1 day of absence is required
RWI	Restricted Work Injury	Return to work in less than 1 day, but subject to restrictions
MTI	Medical Treatment Injury	Return to normal operations in less than 1 day
First Aid		Received first aid and returned to normal operations

Figure 3. 3-5 Severity level determination by typical injury level

Case Studies

- ✓ About the following two HSE incidents that occurred in an E&P project, the severity levels were classified by (1) injury level, (2) potential injury level, (3) treatment level.
- ✓ Case A: During ***'s work, he cut his thigh, was treated at a hospital, and was off work for several days. If the wound had been a few centimeters deeper, the injury could have reached the aorta.
- ✓ Case B: Several workers discovered unexploded ordnance while digging up soil. After all workers were safely evacuated, the unexploded ordnance was safely removed.



- ✓ As a result, there was no significant difference in the severity of Case A at levels (1), (2), and (3), and the operator treated it as a HIPO. On the other hand, Case B was treated as minor at levels (1) and (3), but at level (2), it was judged to be of the highest severity, and was given the highest priority over other HSE cases for consideration of countermeasures. In this way, it is considered that the severity of HSE cases should be considered at multiple levels.

Information provided by: ITOCHU Oil Exploration Co.

Column

- ✓ A Non-operator's internal HSE Committee set the following goals at the beginning of the year
  - ➢ For each existing project, consider and implement what can be done as a non-operator to reduce HSE incidents.
- ✓ At the end of the fiscal year, each project leader reported on the results as follows

Existing project	Case studies of efforts to reduce HSE incidents by non-operators
Case 1	Requested operators to share post investigation reports including lessons learned for HSE cases. This has improved the previously unclear sharing of reports and all reports will be shared from this fiscal year.
Case 2	To confirm that the incident report has been finalized by all the shareholders, the HSE Committee monitors each case until appropriate measures are taken to prevent recurrence.
Case 3	Efforts have been made to reduce the number of HSE incidents through HSE awareness presentations at partner meetings.

Information provided by: ITOCHU Oil Exploration Co.

3.4.3. Accident and emergency preparedness

A reporting system based on the severity level of the accident/emergency must be established in advance, and implemented and operated to ensure that information is communicated without delay. Non-operators are required to know the operator's primary and secondary contact information for the operator in the event of an accident or emergency, to disseminate this information throughout the company, and to maintain the most up-to-date version of this information at all times. In the event of a serious accident, there is also an obligation to report the incident not only to all employees and stakeholders, but also to external parties.

3.5. Disclosure of information to outside

3.5.1. Importance of corporate disclosure

Beyond the accidents and emergencies described in the previous section, people and organizations around the world want to understand the business of E&P and talk to companies about the impacts, risks, opportunities, and trade-offs of their activities. And companies are required to respond to these demands through corporate reporting, including sustainability reporting. Specifically, suppliers in the supply chain need to confirm the transparency of the companies they do business with, financial institutions need to confirm the financial soundness of the companies, etc., and authorities need to confirm that the companies are complying with laws and regulations.

In addition, reporting on sustainability strategy and performance has become increasingly importance to the investment community in recent years, with a clear focus on assessing ESG issues. In particular, climate change has led to demands from customers and other stakeholders (including regulators) to demonstrate climate-related impacts, and companies are required to make detailed ESG disclosures in sustainability reports and other documents. Conversely, these disclosures are expected to increase corporate value, raise awareness of issues, improve operational efficiency, build stakeholders relationships, enhance trust, and increase asset transparency, among other benefits.

3.5.2. Matters to be disclosed

While the scope and depth of a company's disclosure will vary depending on the nature and size of the company and the composition of its shareholders, in general, the items that should be included in a sustainability report are listed in Table 3-8. [10]

Table 3-8 Contents to be included in the sustainability report

Items	Specific items to be reported
Message from the president	✓ Company vision and long-term goals ✓ Transparency and reporting commitments ✓ Strategies for sustainability ✓ Performance, issues, and progress in the reporting year ✓ New investments and initiatives
Corporate activities	✓ Key activities, geographic location, organization, products and services, size and composition of workforce, sustainability risks and opportunities, etc.

Sustainability	✓ Understanding of sustainability, corporate responsibility, and corporate citizenship ✓ Environmental and social impacts and opportunities from oil and gas operations ✓ Elements and issues necessary for long-term project implementation ✓ Contribution to the community and environment
Vision	✓ Future energy supply and challenges ✓ Labor availability, product quality, safety and reliability, environmental and community considerations, stakeholder engagement, innovation, etc.
Strategy	✓ How the company's sustainability priorities integrates with its overall vision and business strategy ✓ How value is created for stakeholders and shareholders
Governance and management	✓ The role of the board of directors and officers ✓ That issues identified as material receive sufficient attention and that management decisions are based on appropriate information
Climate change and energy transition	✓ Company position, strategies and actions, resilience to climate change risks, GHG emissions and other relevant performance indicators ✓ Risks and opportunities from climate change ✓ Important of scenario analysis and transition to low-carbon energy
Critical incident risk management	✓ Specific management practices for safety and other risks ✓ Serious incidents, if any during the reporting year, the nature of the incident and remedial measures
Impact on the community	✓ Respect for human rights of local people, transparency of payments to governments, local environmental impacts (e.g., protection of freshwater and biodiversity)

Case Study

- ✓ In an oil development project in which Japanese company A participates as a non-operator, the operator is to be changed from a major oil company, B to a government-owned company C.
- ✓ The person in charge of Company A reviewed the sustainability report posted on Company C's website and confirmed that the report covered almost all of the contents to be included in the sustainability report in this guideline, and that it also included specific measures for "poverty alleviation," "digitalization," "employee rights and career development," and others. The person in charge at Company A reported to the internal HSE peer review meeting that "We have not found any major deficiencies in Company C's HSE management, but will continue to monitor it closely,", which was accepted by management.
- ✓ Company A's representative then took the opportunity to meet with Company C's management to request that sufficient manpower and time be devoted to the handover of HSE to prevent accidents due to lack of communication, etc. Company C's management responded, "I understand Company A's concerns. I will instruct again to ensure thorough HSE management through adequate communication.

✓HSE strategy and high-level discussion

– Risks led by the operator transition
  - In general, major change of management and organization may make potential risk relatively higher due to communication and orders confusion.
  - Careful transition with sufficient resource would be needed.
– Strategy and organization of new operator
  - It is important to check the strategy and organization of new operator, if there is any difference from the current operator.
– Proposal of KPI sharing scheme / importance of monthly report
  - Sharing KPI to partners through regular reporting system, such as monthly report, would contribute project's HSE performance.

Company providing information: Private

4. HSE management throughout E&P lifecycle

4.1. From exploration to decommissioning

This section describes HSE management issues to be considered at each stage of E&P operations, from exploration to development, production, and decommissioning.

4.1.1. Exploration

- ✓ During an exploration stage, attention should be paid to the health and safety of workers (public safety, work environment, disasters, epidemics, experience, etc.), the environment (air pollution, water pollution, soil contamination, biodiversity, etc.), and society (local residents, cultural heritage, etc.).
- ✓ In addition to the above, fuel spills, noise, vibrations, topographic variations, etc. should be considered when collecting geological and geophysical exploration data.
- ✓ During the drilling of exploration or appraisal wells, spills of chemicals, mud, and produced fluids, wastes such as drainage and cuttings, and odors should also be added to the list of considerations.

4.1.2. Development: conceptual design

- ✓ At the time of conceptual design, a balance between useful life and cost that maintains the health of the asset is considered. The leader determines the best combination of the two.
- ✓ Identify key hazards in the asset and consider their barriers.
- ✓ Consider whether there are any external events, such as production shipment and processing facilities, that could have a significant impact on the health of the company's assets.
- ✓ Examine standard barrier performance, inspection and maintenance methods.
- ✓ Examine whether there are any serious problems with the decommissioning operation.

4.1.3. Development: detailed design

- ✓ Full spec documentation is required to explain asset design, operation, maintenance policies and major hazard management policies.
- ✓ Establish maintenance, inspection, and testing routines for all barriers.
- ✓ Risk management should demonstrate that hazards and risks are adequately controlled through equipment specifications (plant), procedures, delegated responsibilities (process), and personnel with the necessary skills.
- ✓ Operational review and familiarization by maintenance and operations personnel

should begin at this stage and continue through the construction phase.

4.1.4. Development: construction & commissioning

- ✓ If design changes occur during the construction phase, it is important that the changes necessary to maintain asset integrity standards are properly managed and approved.
- ✓ Prior to commissioning, finalize all necessary operation, maintenance, testing procedures, recruit and train personnel with the necessary skills.
- ✓ Commissioning tests may be required to verify functional performance elements of barriers such as blowdown systems and isolation valves.

4.1.5. Operation: production operation

- ✓ Asset integrity barriers defined in the initial phase need to be implemented, monitored and maintained.
- ✓ Subsequent changes to the asset design, operating limitations, or maintenance frequency should be subject to change control and review by an authorized technical authority.
- ✓ As operating conditions change over time, the original design assumptions may no longer be valid. Such changes may affect operating limitations and should be covered by a management of change process.
- ✓ Codes and standards may also change during the life cycle of a facility. The original design should be reviewed against such changes to determine if the changes are required by regulation or justified to reduce new or newly understood risks.

4.1.6. Decommissioning

- ✓ When a facility is shut down and dismantled, barriers and evacuation routes may not operate normally, and great care must be taken to ensure that the integrity of the facility is maintained at the same level as when it was in operation.
- ✓ Ensuring the removal of process materials and hazardous substances can be a major concern for regulators or decommissioning personnel and requires detailed procedures to be identified and approved in advance by the decommissioning program.
- ✓ Social and environmental impacts should be disclosed in advance by conducting the study and obtaining public acceptance.

Case Study

- ✓ Japanese company A participated as a non-operator in an offshore exploration project. A rig to be used for an exploration drilling was selected and contracted to a drilling contractor that proposed the highest score in the technical and commercial evaluation prepared in advance by the operator.
- ✓ Prior to drilling the exploration well, a workshop was held with personnel from the operator and the drilling contractor, including Company A's drilling personnel. Through risk assessment, he confirmed that there were no unacceptable risks.
- ✓ In addition, the operator conducted an inspection of a rig undergoing maintenance work, which was attended by several people from Company A. The rig crew was asked HSE-related questions by several personnel, all of which were answered appropriately in accordance with ALARP and the observers confirmed that there were no major safety issues with the equipment.
- ✓ The rig was equipped with the latest dynamic positioning system, and the rig's strong weather resistance was confirmed. However, it was also confirmed that the logistics should be carefully planned due to problems with the operation of the supply vessel.
- ✓ In addition, Company A's technicians boarded the rig after drilling began and confirmed that the drilling operations were being conducted with safety as the top priority.
- ✓ Although the actual drilling operation was delayed from the original plan due to technical challenges, Company A requested that the operator continue to operate in a safety-first manner.

Company providing information: Private

4.2. New entry

- ✓ When considering an acquisition of an E&P asset interest, at any stage of its life cycle, it is needed to obtain information about the integrity of the asset and validate as part of the due diligence process.
- ✓ It is also needed to review the operator's HSE-MS, environmental and social impact information for major operations, operating structure of major operations, and accident statistics.

- ✓ After obtaining HSE information on production and waste disposal/emergency response plans, etc. in advance, measure the competency of the operators and recognize the apparent and potential HSE risks. In addition, identify compliance requirements such as legal regulations in the country or region of the participating project (it is desirable to obtain such information at the time of participation in the project, when it is relatively easy to obtain information).

Column

The Japan Organization for Metals and Energy Security (JOGMEC) has an HSE policy that requires lenders and guarantors to reduce HSE risks associated with their projects and operations, prevent environmental pollution and human injury, and have emergency response plans in place. In addition, when receiving financial assistance such as loans or trade insurance from the Japan Bank for International Cooperation (JBIC), Nippon Export and Investment Insurance (NEXI), private banks, etc., appropriate environmental and social considerations must be made to avoid or minimize any unacceptable impacts of the project on the environment and local communities. Appropriate environmental and social considerations must be made to avoid or minimize unacceptable impacts on the environment and local communities.

When receiving support from JOGMEC, JBIC, NEXI, etc., the project sponsor is required to demonstrate that the project has appropriate HSE (or environmental and social) considerations based on the review criteria or guidelines of the respective organization. Among the criteria of these organizations, the following items are directly related to HSE risk management, such as safety and accident prevention.

- JOGMEC/HSE audit criteria
  - Petroleum and other combustible natural gas: https://www.jogmec.go.jp/content/300062173.pdf

  Section II-4 Safety
  - ✓ 4.3 Risk analysis
  - ✓ 4.4 Safety design
  - ✓ 4.5 Operation control and equipment maintenance
  - ✓ 4.6 Emergency response
- JBIC/NEXI Environmental and Social Guidelines/Checklist for Oil and Gas Development
  - JBIC: https://www.jbic.go.jp/ja/business-areas/environment/confirm.html
  - NEXI: https://www.nexi.go.jp/environment/index.html

  Section 5 Other (2) Accident Prevention Measures
  - ✓ (1) Analysis of accident risk and design considerations
  - ✓ (2) Accident prevention management system, education, etc.
  - ✓ (3) Emergency response plan

Information provided by: Japan Oil Engineering Co.

4.3. Risk management

4.3.1. Risk management to prevent serious accident events

This section describes risk management to prevent Major Accident Events (MAEs) in E&P operations. Specifically, it provides an overview of the process safety risk management to be carried out at the FEED and EPC stages, as well as the key risk assessment items, as shown in Figure 4-1 of an overview of the process safety risk management[9]. It also describes the practices to be implemented by non-operators according to their level of involvement ("Control", "Influence", "Monitor").

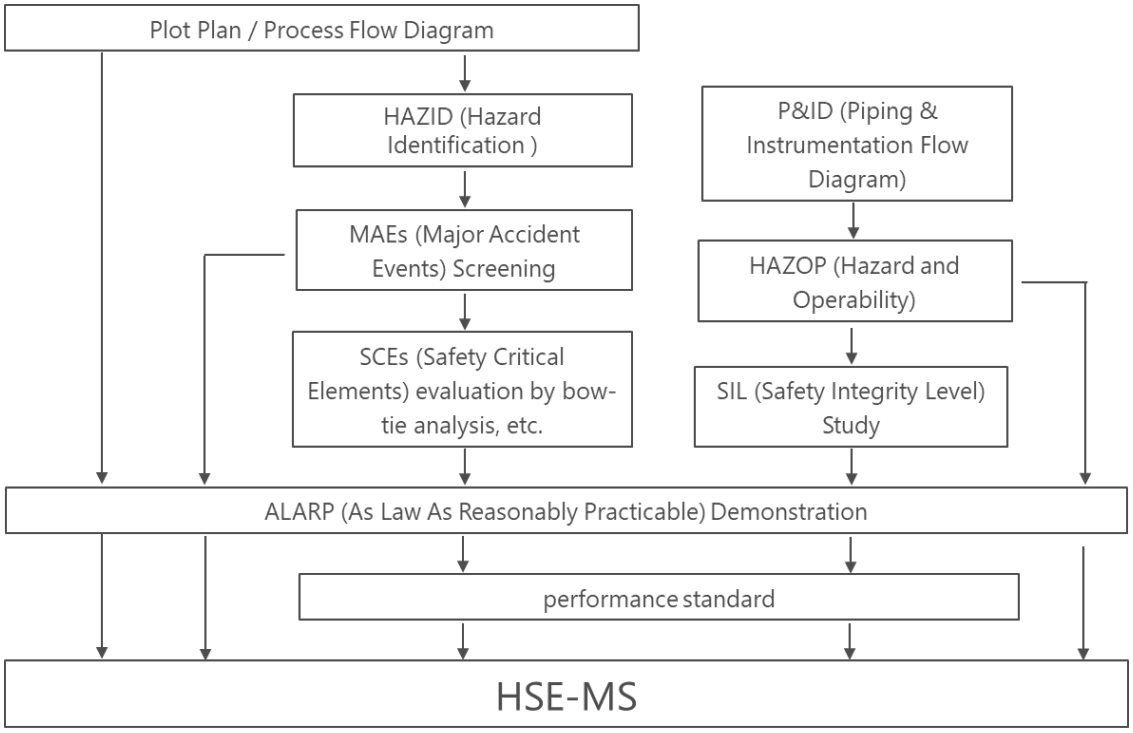


Figure 4-1 Example of risk management flow

4.3.2. HAZID

HAZID is an important assessment to identify critical hazards at an early stage of a project, such as conceptual design or FEED. By studying hazards before decision is made to invest in development, it is possible to avoid cost increases due to major design changes later on. Specifically, a workshop-style study by a multi-discipline team of

[9] Process Safety Risk Management: This is the management of facility design and integrity, ensuring that facilities are designed and constructed (or selected) to be suitable for their purpose and function. It also ensures that the facility is operated, inspected, and maintained to maintain its integrity and performance throughout its life cycle. Process safety risk management overlaps in part with HSE-MS risk management.

experts using Plot Plans and Process Flow Diagrams will list hundreds of hazards, including environmental, geographic, process, fire and explosion, safety, and health hazards.

Table 4-1 shows the practice that non-operators should implement for HAZID at each level of involvement.

Table 4-1 Example of practices that non-operators should implement for HAZID

Level of involvement	Examples of practices that non-operators should implement
Control	Planning and leading the evaluation of HAZID
Influence	Send experts to HAZID to contribute to its evaluation
Monitor	Obtain HAZID evaluation results from the operator to confirm their validity to ask questions or make comments as necessary

4.3.3. Screening for serious accident events

Hazards listed by HAZID are scored based on their probability of occurrence and magnitude of impact using a risk matrix, as shown in Figure 4-2 Example of risk matrix of a risk matrix example and classified into the following three categories.

(1) MAEs, or Intolerable Risk

(2) ALARP

(3) Tolerable Risk

Consequence					Probability				
					A	B	C	D	E
Magnitude of Impact	human	assets	environment	reputation	Near heard of in industry	Heard of in industry	Incident has occurred in similar operations	Happens several times a year in similar operations	Happens several times a month in similar operations
0	No health effect / illness	No damage	No effect	No impact					
1	Slight health effect / illness	Slight damage	Slight effect	Slight impact		Tolerable	Risk		
2	Minor health effect / illness	Minor damage	Minor effect	Limited impact					
3	Major health effect / illness	Local damage	Local effect	Considerable impact			ALARP		
4	Single fatality	Major damage	Major effect	National impact					
5	Multiple fatalities	Extensive damage	Massive effect	International impact			High: MAE / intolerable		

Figure 4-2 Example of risk matrix

4.3.4. Determination of critical safety design

Safety Critical Elements (SCEs) are physical control measures intended to prevent or limit MAEs, and inadequate SCEs can lead to MAEs. Examples of how to evaluate whether a device is an SCE is shown in Figure 4-3. [11]

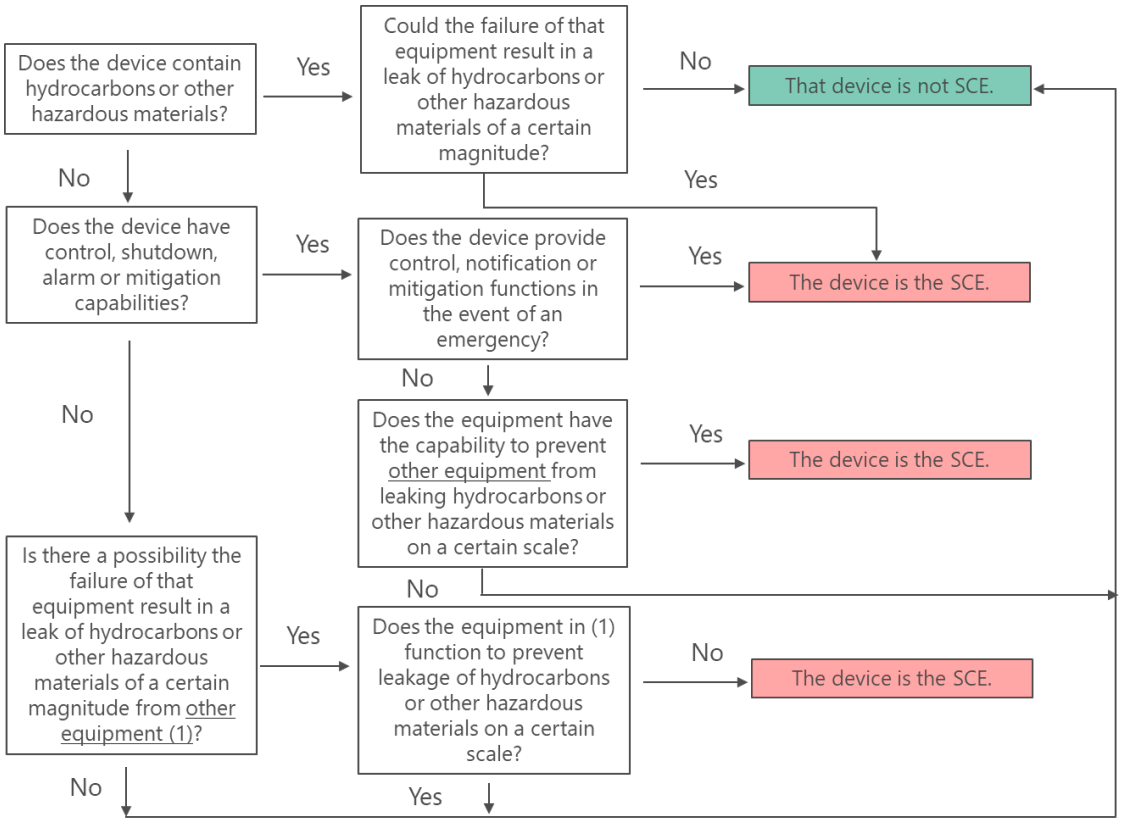


Figure 4-3 Example of critical safety equipment determination

When considering risk mitigation measures, it is appropriate to manage mitigation measures hierarchically. In terms of priorities, the highest priority is to eliminate the hazard at its source, followed by controlling the risk through engineering and organizational means, as follows.

(1) Elimination of hazards at the source
(2) Substitution of materials and processes
(3) Engineering (ventilation/control, isolation, etc.)
(4) Control measures (procedures, work practices, education/training)
(5) Personal protective equipment

4.3.5. Risk assessment of critical safety design (e.g., bow tie analysis)

Hazards identified in the MAEs require risk reduction measures (i.e., accident prevention and impact mitigation measures). Bow tie analysis visually organizes the results of the workshop-style discussions as shown in Figure 4-4. First, the hazard that causes the MAE identified in HAZID is set as "Top Event" and placed in the center. On the left side, the threats that cause the Top Event are written, and in between, barriers that reduce the occurrence of the Top Event are described. On the right side, the worst case outcome and the mitigation measures are written.

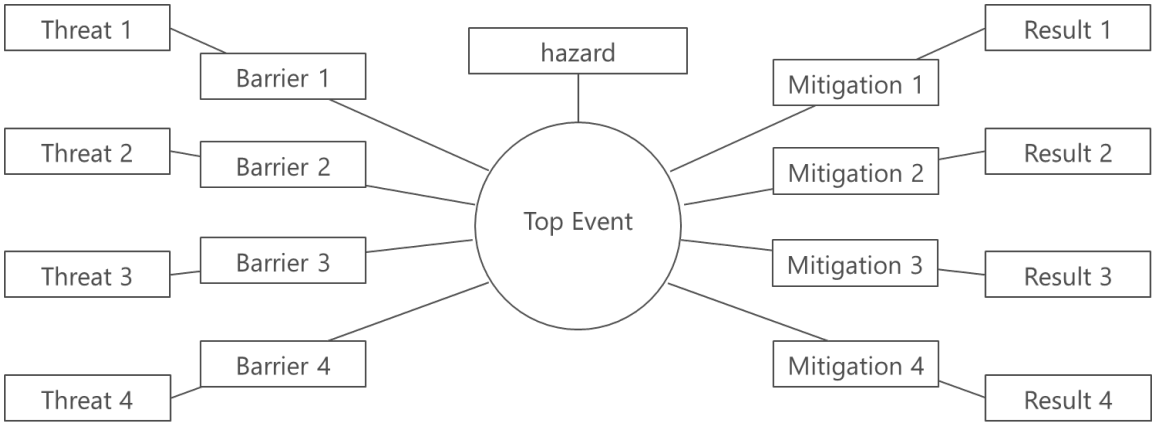


Figure 4-4 Diagram of bow tie analysis

Table 4-2 shows the practice that non-operators should implement for the risk assessment of critical safety equipment at each level of involvement.

Table 4-2 Example of practices that non-operators should implement for risk assessment of critical safety equipment

Level of involvement	Examples of practices that non-operators should implement
Control	Double-check risk assessments by independently conducting assessments equivalent to those conducted by the operator, etc.
Influence	Send experts to risk assessments and contribute to their evaluation
Monitor	Receive risk assessment results from the operator to confirm their validity and ask questions or comments as necessary

4.3.6. HAZOP

During the detailed design phase, a HAZOP (Hazard and Operability) assessment is

performed as an assessment to identify potential anomalies and hazard scenarios in the process system.

The basic concept of HAZOP is that equipment may deviate from its normal condition or design/operational intent due to inadequacies or age-related deterioration, etc. The first step is to assume failures of control equipment or human error that may cause the deviation. As a result, the possible effects on the system are identified. The next step is to determine the adequacy of the current countermeasures and verify whether they are sufficiently equipped to prevent the occurrence of the cause or to detect and mitigate the effects.

Specifically, HAZOP-specific keywords called "guide words" and "process parameters" are combined to systematically assume possible deviations from design intent or operational intent. Table 4-3 shows an example of "guide words, Table 4-4 shows an example of "deviation", and Table 4-5 shows an example of HAZOP assessment.

Table 4-3 Example of HAZOP guide words

No/None	Not happening at all.
More	More than expected
Less	Less than expected
Reverse	The opposite of what is expected.
As Well As	Something superfluous happens.
Part of	Only partially achieved.

Other than	Something totally different happens.
Sooner Than	Faster than expected
Later Than	Later than expected.
Longer Than	Longer than expected
Shorter Than	Shorter than expected

Table 4-4 Example of HAZOP displacement

guide word		process parameter		slippage
No	+	Flow	=	No Flow
More	+	Pressure	=	Higher Pressure

Table 4-5 HAZOP evaluation example

parameter	guide word						
	No	More	Less	Reverse	Other than	As well as	Part of
Flow	No flow rate	Increased flow rate	Flow rate decrease	Counter-current	Flow to different pathways	-	-
Pressure	Vacuum	Pressure increase	Pressure decrease	-	-	-	-
Temperature	-	temperature increase	Temperature decrease	-	-	-	-
Liquid level	Faulty liquid level	Rise in liquid level	Drop in liquid level	-	-	-	-
Composition	-	-	-	-	-	Adulteration	Partial suspension of raw materials
Reaction	Cessation of reaction	Increased reaction time	Reaction velocity decrease	Abreaction	-	-	-

Table 4-6 shows the practice that non-operators should implement for HAZOP at each level of involvement.

Table 4-6 Example of practices that non-operators should implement for HAZOP

Level of involvement	Examples of practices that non-operators should implement
Control	Plan and leading the HAZOP assessment
Influence	Send experts to HAZOP to contribute to the evaluation
Monitor	Receive HAZOP evaluation results from the operator to confirm their validity and ask questions or comments as necessary

4.3.7. Safety level study

After the HAZOP is completed, a Safety Integrity Level (SIL) is assigned based on the risk and whether it is required as a safety instrumented system. Specific SIL assignment methods include risk matrix and Layer Of Protection Analysis (LOPA).

The LOPA objective is to identify available countermeasures for the potential consequences of a particular risk. The system is analyzed starting with a quantification of the likelihood of a particular hazard and using a quantitative approach to identify mitigation measures for the hazard. Measures or "layers of protection" need to be independent to be effective; LOPA can address key questions such as "how safe?", "how many independent layers of protection are needed?", and "how much risk reduction does

each layer provide?". An image of the construction of multiple layers of protection through LOPA is shown in Figure 4-5.

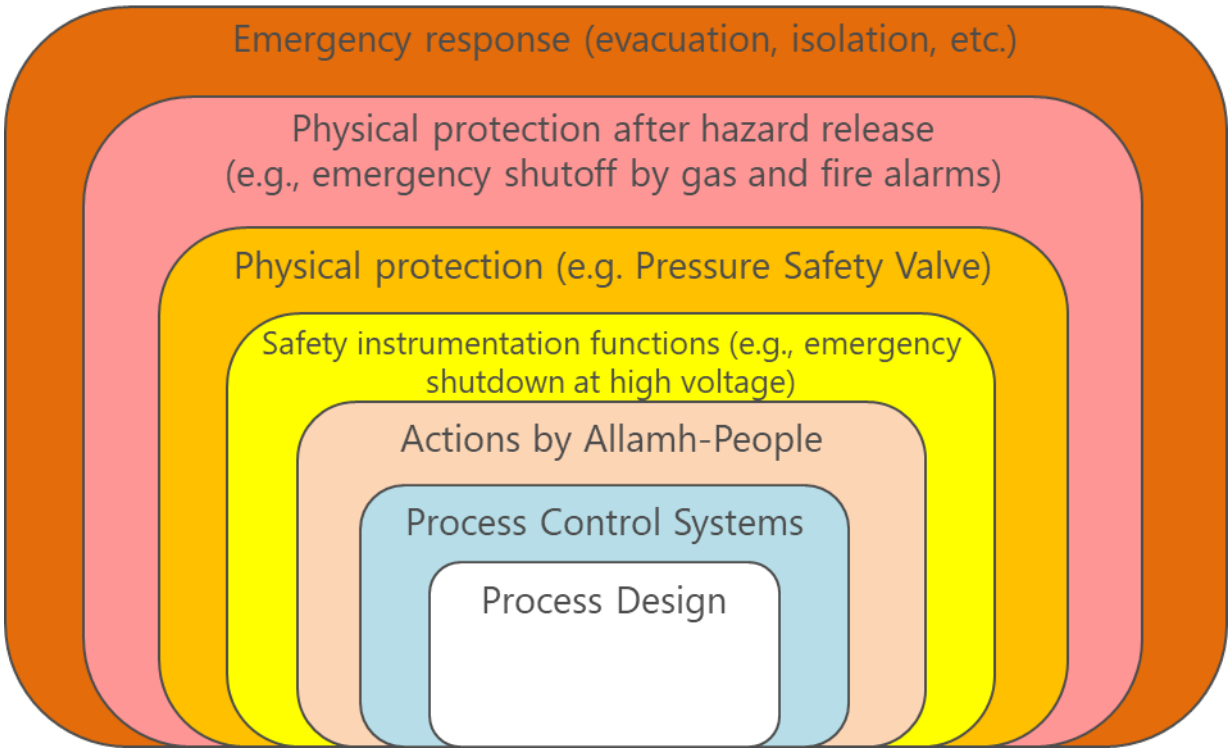


Figure 4-5 Image of Multiple Protection Layer Construction by LOPA

Table 4-7 shows the practice that non-operators should implement for the level of safety study at each level of involvement.

Table 4-7 Example of practices non-operators should implement for the level of safety study

Level of involvement	Examples of practices that non-operators should implement
Control	Double-checking study results by, for example, conducting an independent evaluation equivalent to the study conducted by the operator
Influence	Send experts to the Study to contribute to its evaluation.
Monitor	Receive study results from the operator to confirm their validity and ask questions or make comments as needed

4.3.8. Performance standard

Performance Standards are parameters against which SCEs are evaluated to ensure that they reduce the risk of MAEs to ALARP levels and it provide benchmarks for measuring, monitoring, and testing the effectiveness of SCEs to identify the need for corrective actions based on deviations from these benchmarks or performance trends. Specifically, a document should be prepared that organizes the requirements for SCEs in terms of the following

- ✓ Functionality
- ✓ Reliability / Availability
- ✓ Survivability
- ✓ Dependencies / Interactions with dependent facilities

An example of a typical worksheet to demonstrate that these required performances are met by the design is shown in Figure 4-6.

Subject	Name of SCE	
Objective	SCE Objectives	
	Required Performance and Standards	Specific measures to ensure
Functionality	Functions required as SCE	Items that can be confirmed that the left column is met in the design
Reliability	Specific measures to reduce the occurrence of defects	
Viability	Resistance to fire, explosion, and other emergencies	
Dependent facilities	List of other safety devices on which SCE depends	

Figure 4-6 Example of worksheet entries for performance standards

Table 4-8 hows the practice that non-operators should implement for performance standard at each level of involvement.

Table 4-8 Example of practices non-operators should implement for performance standards

Level of involvement	Example of practices that non-operators should implement
Control	Work with operators to create performance standards

Influence	Review performance standards developed by operators to ensure their validity, asking questions and commenting as needed
Monitor	Receive and validate key performance standards from operators

Case Study

✓ Examples of performance standards for uninterruptible power supplies are shown below.

Equipment	Uninterruptible Power System (UPS)	
Objective	Supply power needed to safely shut down the plant in case existing power equipment fails	
	Necessary Performance Standards	Ensurement
Functionality	Can be supplied for safety related systems when required • 2 x 100% UPS • Supply more than 1 hour to emergency shutdown system and warning system	• Description in specification sheet • Confirmation by drawing • Confirmation of inspection results by equipment maker • Auditing • Field test
Reliability	Dual connections (electronic and control line) between UPS and emergency systems	
Survivability	Equipment is installed in either switch room or safety area surrounded by fire wall	
	Cables are installed where is protected by physical damages	
Dependencies	Emergency shutdown system, Gas/fire detection system, refuge area, warning systems	

Company providing information: Private

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We will continue to update the guidelines based on your comments and suggestions, and our goal is to serve as a knowledge base for non-operator HSE management in the future.

If you are interested in working on updating these guidelines, please contact the HSE Management Subcommittee.

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