

# Shell Brazil Exploration & Production

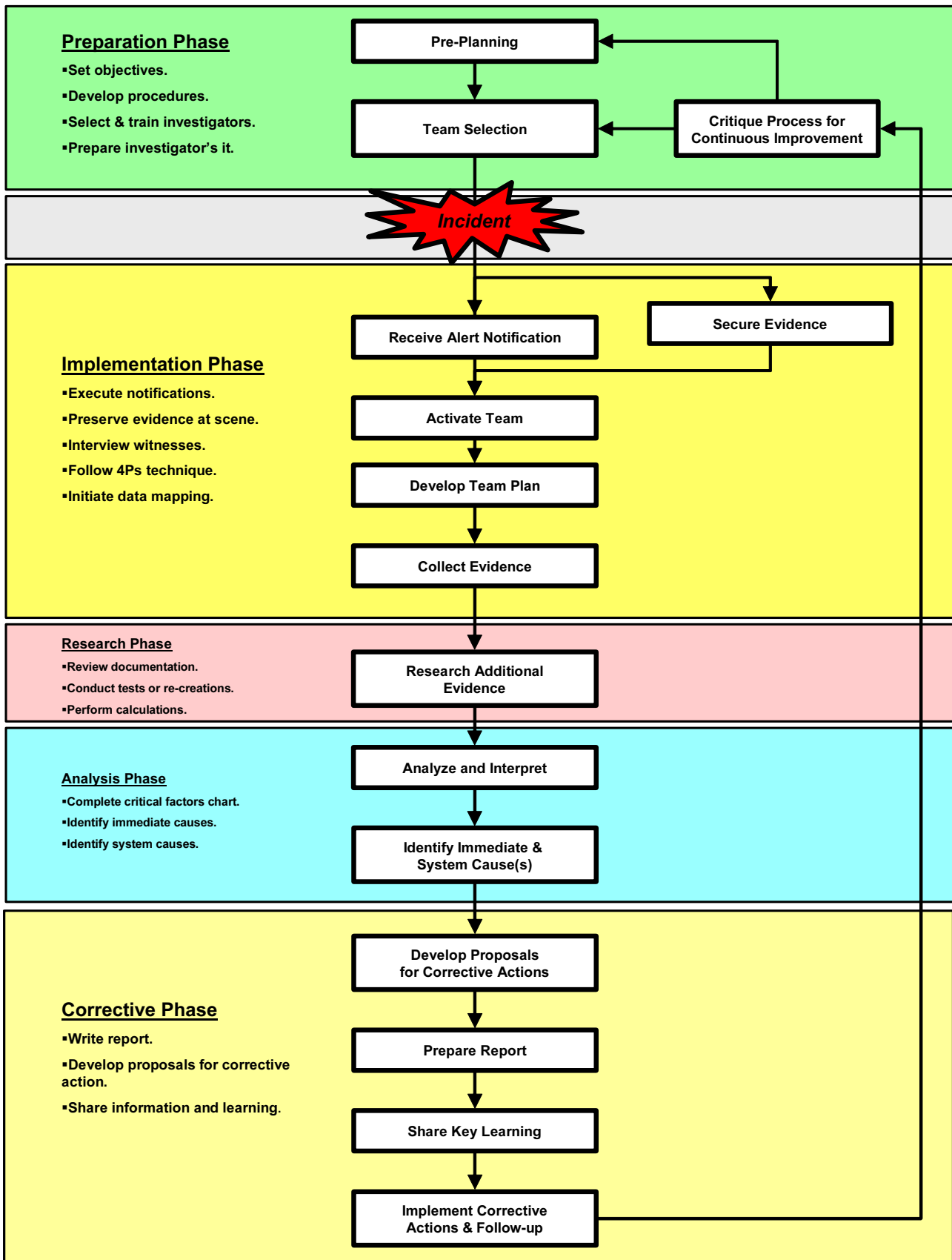
## Comprehensive List of Causes

A Tool for Root Cause Analysis

SBEP HSSE Team



# Incident Investigation Flow Chart



# Glossary

This Glossary is provided to the user of Shell Comprehensive List of Causes chart, as a guide to further define and explain the various causes. Since the causes selected can and will be used for trend analysis, accuracy in selecting the appropriate cause is important. Users are encouraged to use this glossary to ensure proper understanding of each cause category.

In each category, “Other” is listed as the last option, in case none of the above causes fit the circumstances. While appropriate in some cases, the use of “Other” should be minimised, as it adds little value in trend analysis.

## Comprehensive List of Causes A TOOL FOR ROOT CAUSE ANALYSIS

### POSSIBLE IMMEDIATE CAUSES

**Immediate causes are covered in the first two quadrants entitled: Actions and Conditions.**

#### Actions

There are four major categories of actions, with an additional level of detail under each of the major categories.

#### 1. Following Procedures

- 1-1 **Violation (by individual):** one individual fully aware that he was taking a risk but still decided to do the job that way.
- 1-2 **Violation (by group):** people fully aware that they were taking a risk but still decided to do the job that way, e.g., solving a problem knowing that they have to infringe on the rules.
- 1-3 **Violation (by supervisor):** a supervisor or other management person fully aware that he was taking a risk but still decided to do the job that way.
- 1-4 **Operation of equipment without authority:** the person involved operated equipment for which he was not authorised to do so, either because he did not have work permit or, for the person working in his own department, he was told by his supervisor he was not allowed to work on it. This also applies in situations where operating the equipment is not in the person’s job description and, therefore, understood that he is not authorised to operate the equipment, e.g., operating a forklift without training or operating process equipment that is not included in the worker’s job function.
- 1-5 **Improper position or posture for task:** the person did not follow the human kinetic practices. The person was working on an unsafe, unstable or non-standard work floor or was placing body parts in unsafe positions.
- 1-6 **Overexertion of physical capability:** did more than a person is physically able to do, e.g., carrying too much weight, etc.
- 1-7 **Work or motion at improper speed:** the person involved was not working at the proper speed, not taking time to do things safely, e.g., driving too fast, running or adding chemicals too fast or too slow, etc.
- 1-8 **Improper lifting:** material being lifted, either by human or mechanical means, was lifted contrary to proper practices or was over the capacity of the person or the lifting equipment.
- 1-9 **Improper loading:** the equipment was improperly loaded, e.g., a vehicle or centrifuge loaded to one side or overloaded or wrong product in wrong cycle.
- 1-10 **Shortcuts:** the person involved in the work took a shortcut instead of performing the work in accord with the procedure.
- 1-11 **Improper load vehicle capacity:** the vehicle was improperly loaded, e.g. 5 passenger in a car with 4 seat belts
- 1-12 **Improper use of handrail:** violation of the 3 points of contact rule.
- 1-13 **Other:** if none of the above categories apply, this category can be used.

## 2. Use of Tools or Equipment

- 2-1 **Improper use of equipment:** equipment was used for activities for which it was not designed or equipment was misused, e.g., operating equipment beyond the maximum recommended temperature.
- 2-2 **Improper use of tools:** tools were used for activities for which they were not designed or tools were misused, e.g., possibly wrong tool for job, using excessive force on a tool, etc.
- 2-3 **Use of defective equipment (aware):** knowing that the equipment was defective and still going on with the work, e.g., running a forklift with leaking hydraulics.
- 2-4 **Use of defective tools (aware):** knowing that the tools were defective and still using them.
- 2-5 **Improper placement of tools, equipment or materials:** material or equipment placed in potentially hazardous position.
- 2-6 **Operation of equipment at improper speed:** an operating limit was exceeded - the speed of a grinding wheel, the assembly line was speeded up, operating throughput was surpassed, etc.
- 2-7 **Disrespect to the speed limit:** the driver did not observe the speed limits
- 2-8 **Servicing of equipment in operation:** an attempt was made to service equipment without turning it off - trying to clear a jammed machine, rodding out a plugged line, etc.
- 2-9 **Other:** if none of the above categories apply, this category can be used.

## 3. Use of Protective Methods

- 3-1 **Lack of knowledge of hazards present:** knowing that the situation was not normal, the person involved in the incident was not warned about the hazards.
- 3-2 **Personal Protective Equipment not used:** equipment prescribed in the procedures was not used.
- 3-3 **Lack of use of seat belt:** the driver/passenger was not using the seat belts available in the vehicle
- 3-4 **Improper breathing apparatus/wind socks for a H<sub>2</sub>S exposed work environment:** the required breathing apparatus/wind socks was not used or was not used in the proper way, e.g., non-fitting gas mask.
- 3-5 **Improper use of Personal Protective Equipment:** the required Personal Protective Equipment was used, but it was not used in the proper way, e.g., wrong size of safety glasses or incorrect type of respirator, not maintaining or inspecting the equipment correctly.
- 3-6 **Improper use of fall arrestor equipment:** the required fall arrestor was not used or was not used in the proper way, e.g., not proper tie.
- 3-7 **Servicing of energised equipment:** the equipment was not electrically or mechanically safeguarded according to lockout, red tag or line and equipment opening procedures.
- 3-8 **Equipment or materials not secured:** equipment, materials or person was not secured against movement or falling, e.g., ladder not secured, load not rigged properly, no toe boards on scaffolding, etc.
- 3-9 **Disabled guards, warning systems or safety devices:** the proper guards, warning systems or other safety devices were in place, but were disabled or overridden to allow the work to proceed without these protections.
- 3-10 **Removal of guards, warning systems or safety devices:** the proper guards, warning systems or other safety devices had been removed at the some prior time, and not reinstalled or reactivated.
- 3-11 **Personal Protection Equipment not available:** the necessary personal protective equipment was not available at the job site.
- 3-12 **Other:** if none of the above categories apply, this category can be used.

## 4. Inattention/Lack of Awareness

- 4-1 **Improper decision making or lack of judgement:** the situation was wrongly judged and the wrong decision was made.
- 4-2 **Improper decision making of unnecessary confined space entry:** the decision of entering on a confined space was wrongly judged.
- 4-3 **Improper decision making of unnecessary work at heights:** the decision for conduct a work at height was wrongly judged. The work could be performed in another way without involve work at height.

- 4-4 **Distracted by other concerns:** the person involved was distracted and not attentive to the work in progress; therefore, the person was not aware or aware too late that something had gone wrong.
- 4-5 **Inattention for footing and surroundings:** the person was just walking around and did not notice the obstacle or the surface conditions of the ground.
- 4-6 **Distracted by use of mobile phone while driving:** the person was driving with the mobile phone on.
- 4-7 **Horseplay:** person(s) involved in the event were engaged in inappropriate activities, including practical jokes or clowning around.
- 4-8 **Acts of violence:** any type of physical or mental confrontations that can cause bodily injury or mental anguish.
- 4-9 **Failure to warn:** an individual had knowledge of a dangerous condition or activity, but did not warn current or future persons of the exposure, e.g., not tagging a defective tool.
- 4-10 **Use of drugs or alcohol:** person(s) involved in the event were determined to be under the influence of drugs or alcohol.
- 4-11 **Routine activity without thought:** the person involved was performing a routine activity, such as walking, sitting down, stepping, etc., without conscious thought, and was exposed to a hazard as a result.
- 4-12 **Inattention to housekeeping:** employee do not keep the work area clean, tidy and free of obstruction.
- 4-13 **Other:** if none of the above categories apply, this category can be used.

## Conditions

There are four major categories of conditions, with an additional level of detail under each of the major categories.

### 5. Protective Systems

- 5-1 **Inadequate guards or protective devices:** adequate guards and protective devices that were needed to protect the worker were not present.
- 5-2 **Defective guards or protective devices:** guards and protective devices were installed but failed at the time of the incident.
- 5-3 **Inadequate Personal Protective Equipment:** the Personal Protective Equipment used was not adequate for the situation at the time of the incident or the wrong type of Personal Protective Equipment was specified.
- 5-4 **Defective Personal Protective Equipment:** the Personal Protective Equipment was sufficient, but the Personal Protective Equipment used was defective at the time of the incident.
- 5-5 **Inadequate warning systems:** adequate warning systems were present but failed to provide notice at the time of the incident.
- 5-6 **Defective warning systems:** adequate warning systems were present but failed at the time of the incident.
- 5-7 **Inadequate isolation of process or equipment:** the equipment was not properly isolated and the people involved were exposed to chemicals, hot surfaces, electricity, etc.
- 5-8 **Inadequate isolation of lifting area:** the lifting area was not properly isolated and the people involved were exposed to drop objects.
- 5-9 **Inadequate safety devices:** safety devices such as pressure relief valves or turbine over speed trips were present, but did not act quickly enough to prevent the accident.
- 5-10 **Defective safety devices:** safety devices such as pressure relief valves or turbine over speed trips failed to activate.
- 5-11 **Other:** if none of the above categories apply, this category can be used.

## 6. Tools, Equipment & Vehicle

- 6-1 **Defective equipment:** the right equipment was selected but the equipment involved was defective.
- 6-2 **Defective oxygen/gas detector equipment:** the right oxygen/gas detector equipment was selected but the equipment involved was defective.
- 6-3 **Inadequate equipment for work at heights:** the necessary equipment needed to work at height was in some way inadequate or not supplied.
- 6-4 **Inadequate equipment:** the necessary equipment needed to do the job was in some way inadequate or not supplied.
- 6-5 **Improperly prepared equipment:** the equipment was not prepared adequately prior to the job or maintenance work, e.g., a vessel not thoroughly cleaned of process chemicals prior to entry.
- 6-6 **Defective tools:** the right kind of tool was selected but the tool involved was defective.
- 6-7 **Inadequate tools:** the tools were not adequate for this purpose, or the proper tools were not supplied.
- 6-8 **Improperly prepared tools:** the tools were not prepared properly before the job, e.g., not repaired properly or not cleaned of contaminants.
- 6-9 **Defective vehicle:** the right type of vehicle was being used, but the vehicle was defective.
- 6-10 **Inadequate vehicle for the purpose:** the necessary type of vehicle to perform the function was not available, e.g., forklift being used as a crane.
- 6-11 **Improperly prepared vehicle:** the right vehicle was being used, but the vehicle had not been properly repaired or serviced for use.
- 6-12 **Other:** if none of the above categories apply, this category can be used.

## 7. Work Exposure to

- 7-1 **Fire and explosion:** the incident was caused by a fire and/or explosion.
- 7-2 **Noise:** the incident was caused by a short term exposure to extremely high noise levels or by continuous overexposure to noise, e.g., shock effect, process equipment, high noise-producing tools.
- 7-3 **Energised electrical systems:** incident caused by system not fully de-energised.
- 7-4 **Energised systems, other than electrical:** incident was caused by a system not fully isolated from gravitational, pneumatic, hydraulic or chemical energy sources.
- 7-5 **Radiation:** the incident was caused by dangerous radiation, e.g., x-ray, high frequency radiation, laser, etc.
- 7-6 **Temperature extremes:** the incident was caused by an exposure to extreme high or low temperatures.
- 7-7 **Hazardous chemicals:** the incident was caused by extremely hazardous chemicals used in the process, e.g., reactive, toxic or ecologically dangerous chemicals.
- 7-8 **Mechanical hazards:** incident caused by sharp edges, moving equipment, etc.
- 7-9 **Clutter or debris:** housekeeping was inadequate or work location was not clean and orderly.
- 7-10 **Storms or acts of nature:** the incident was a direct or indirect result of a storm, tornado, hurricane, hail storm, etc.
- 7-11 **Slippery floors or walkways:** the incident was caused by a slippery walking or working surface.
- 7-12 **Other:** if none of the above categories apply, this category can be used.

## 8. Work Place Hazards

- 8-1 **Congestion or restricted motion:** layout of the workplace was poor and not enough clearances were available or accessibility to equipment or tools was poor.
- 8-2 **Inadequate or excessive illumination:** the workplace was poorly illuminated or the visibility was poor.
- 8-3 **Inadequate ventilation:** poor ventilation, e.g., the temperature could rise too high, concentrations of chemicals could rise or oxygen levels could decrease, etc.
- 8-4 **Inadequate constant atmospheric test for confined space entry:** atmosphere test was not performed or monitored in a constant basis for confined space entry.

- 8-5 **Inadequate atmospheric test for the H<sub>2</sub>S exposed space:** atmosphere test was not performed or monitored in a constant basis for H<sub>2</sub>S exposed space.
- 8-6 **Unprotected height:** a contributing factor was work at an unprotected height, e.g., scaffold building, in towers, or on roofs, etc.
- 8-7 **Inadequate work place layout:** the controls, labels or displays used to monitor the work were not adequate, e.g., the controls were out of normal reach, labels or displays were out of sight. Can also include misinformation such as mislabelled equipment or chemicals.
- 8-8 **Other:** if none of the above categories apply, this category can be used.

## POSSIBLE SYSTEM CAUSES

**System causes are covered in the final two quadrants entitled: Personal Factors and Job Factors.**

### Personal Factors

There are six categories of personal factors, with an additional level of detail under each of the major categories.

#### 1. Physical Capabilities

- 1-1 **Vision deficiency:** the incident happened because the person involved had a vision deficiency, e.g., could not see over long distance, could not see alarms on the panel, etc.
- 1-2 **Hearing deficiency:** the incident happened because the person involved had a hearing deficiency, e.g., could not hear the alarm.
- 1-3 **Other sensory deficiency:** a deficiency, like reduced feel or smell, contributed to the incident.
- 1-4 **Reduced respiratory capacity:** asthma, silicosis, asbestosis, and other related diseases contributed to the incident or seriousness of the incident.
- 1-5 **Other permanent physical disabilities:** all other physical disabilities not mentioned above, e.g., weak back, ankles, etc.
- 1-6 **Temporary disabilities:** disabilities, which are temporary like, broken bones, muscle pain, migraine headache, etc.
- 1-7 **Inability to sustain body positions:** the incident happened because the person involved did not have the capability to sustain the required body position for a longer time.
- 1-8 **Restricted range of body movement:** a physical condition restricted the person's movement and wasn't planned for in the job activity, e.g., a temporary or permanent physical disability, wearing of Personal Protective Equipment, unusual weight, unusual heights, etc.
- 1-9 **Substance sensitivities or allergies:** the person involved in the incident was medically proven to be allergic or sensitive to the substances involved.
- 1-10 **Inadequate size or strength:** the person assigned to the work did not have the size or strength to complete the task safely, e.g., couldn't reach, couldn't lift.
- 1-11 **Diminished capacity due to medication:** the side effects of medication limited the person's physical capability.
- 1-12 **Other:** if none of the above categories apply, this category can be used.

#### 2. Physical Conditions

- 2-1 **Previous injury or illness:** the incident happened because the person involved was ill (fever or any other kind of illness) or had an existing injury before the incident happened.
- 2-2 **Fatigue:** the person involved in the incident was fatigued due to workload or to lack of rest, e.g., too long working hours without time to relax, working more than 8 hours per shift, working double shifts over a long period of time, or working for a too long period (e.g., no days off over a period of more than seven days).
- 2-3 **Diminished performance:** the surroundings or conditions have lead to less than ordinary performance, e.g., temperature extremes, lack of oxygen due to high elevations, atmospheric pressure changes, such as encountered during diving work.

- 2-4 **Blood sugar insufficiency:** at the time of the incident, the person involved had a too low blood sugar. This should be medically established.
- 2-5 **Impairment due to drug or alcohol use:** at the time of the incident, the person involved was under the influence of alcohol or drugs.
- 2-6 **Other:** if none of the above categories apply, this category can be used.

### 3. Mental State

- 3-1 **Poor judgement:** although the person involved was well trained at the time of the incident, the person did not choose an appropriate course of action.
- 3-2 **Memory failure:** although the person involved was well trained at the time of the incident, the person could not remember how to act or react.
- 3-3 **Poor coordination or reaction time:** although the person involved knew exactly which actions to take, the person was not capable of coordinating all the required actions or the reaction time was too long.
- 3-4 **Emotional disturbance:** the incident happened because the person involved was emotionally disturbed.
- 3-5 **Fears or phobias:** the incident happened because the person involved had a fear or phobia, e.g., someone who is afraid of working on heights, climbing ladders or claustrophobia, etc.
- 3-6 **Low mechanical aptitude:** the person was confused on what actions to take because they did not understand basic elements of how mechanical things work.
- 3-7 **Low learning aptitude:** the person involved had been well trained, but was confused due to limited learning capability.
- 3-8 **Influenced by medication:** the person's mental state was diminished due to side effects of medication (e.g., drowsy, light-headed)
- 3-9 **Other:** if none of the above categories apply, this category can be used.

### 4. Mental Stress

- 4-1 **Preoccupation with problems:** the person involved in the incident was preoccupied with problems and was not fully concentrated on the activities in progress, e.g., problems at work or at home.
- 4-2 **Frustration:** the incident happened because the person involved was frustrated, e.g., no promotion, never received a positive reward from his supervisor, doing his very best and seeing no results, etc.
- 4-3 **Confusing directions/demands:** the person involved in the incident felt the work was not well-defined with proper direction or demands. Can be the result of too many people giving orders.
- 4-4 **Conflicting directions/demands:** conflicting directions or demands led to an incident, e.g., a rush job but still having to follow all the time-consuming safety procedures.
- 4-5 **"Meaningless" or "degrading" activities:** the person involved in the incident felt the work the person was doing was meaningless, e.g., cleaning up and the next day it is filthy again, degrading or too much experience or education for this low classified job.
- 4-6 **Emotional overload:** the person was under high stress from either work or personal issues that affects their emotional state.
- 4-7 **Extreme judgement/decision demands:** the work being done required judgement and decision making that created stress, e.g., time sensitive decisions, high stakes in the outcome, incomplete information in which to base the decision.
- 4-8 **Extreme concentration or perception demands:** the work environment contributed to the incident, as the work required great concentration, e.g., a person is so absorbed in what they are doing, they fail to recognise a hazard.
- 4-9 **Extreme boredom:** the person is adversely affected by monotonous or repetitive work.
- 4-10 **Other:** if none of the above categories apply, this category can be used.

### 5. Behaviour

- 5-1 **Improper performance is rewarded:** although the supervisor knew that the person was not following the safety procedures, guidelines or JSAs, the person was rewarded because the job was completed quickly. The worker may also have felt rewarded by performing improperly, e.g., if by taking shortcuts, an unpleasant job is finished quicker.

- 5-2 **Improper supervisory example:** supervisors not giving the proper example to the people working in their organisations.
- 5-3 **Inadequate identification of critical safe behaviours:** in the organisation, it was not well identified which safe behaviours were critical to preventing incidents.
- 5-4 **Inadequate reinforcement of critical behaviours:** a supervisor seeing someone not following the safety procedures and guidelines and not correcting immediately is an example of inadequate reinforcement of proper behaviour. Similarly, supervisors must note when employees are performing correctly to adequately reinforce the proper performance. Peer pressure can also play a role, if proper performance is criticised.
- 5-5 **Inappropriate aggression:** either the people were aggressive or actions were done and decisions were taken in an aggressive way without really having an overview of the consequences.
- 5-6 **Improper use of production incentives:** the use of incentives for production or timeliness have created an incentive to ignore safety requirements.
- 5-7 **Supervisor implied haste:** the incident was caused by the supervisor's implication that speed in completing the work was more important than safety considerations.
- 5-8 **Employee implied haste:** the incident was caused by the employee's assumption that speed in completing the work was more important than safety considerations.
- 5-9 **Inadequate housekeeping behavior:** lack of attention to the housekeeping procedures after perform a task.
- 5-10 **Other:** if none of the above categories apply, this category can be used.

## 6. Skill Level

- 6-1 **Inadequate assessment of required skills:** the person involved believed they had the proper skills to perform the work, but in fact, lacked required skills.
- 6-2 **Inadequate practice of skill:** the person involved was theoretically experienced but lacked practice in performing the task.
- 6-3 **Infrequent performance of skill:** the person was trained in the job but the activity involved in the incident was done on a very low frequency or the person involved rarely performed the activity.
- 6-4 **Lack of coaching on skill:** the incident happened because the person involved did not have the coaching of a supervisor or experienced co-worker.
- 6-5 **Insufficient review of instruction to establish skill:** the person involved had training, but was not given the opportunity to practice or perform the task as part of training to firmly establish the skill.
- 6-6 **Other:** if none of the above categories apply, this category can be used.

## Job Factors

There are eight categories of job factors, with an additional level of detail.

## 7. Training/Knowledge Transfer

- 7-1 **Inadequate knowledge transfer:** a well developed training effort was in place, but failed to transfer the necessary knowledge. Reasons for this could include the inability of students to comprehend (material beyond their level, language difficulties), inadequate instructor qualifications, inadequate training equipment (lack of props or means to illustrate the topic) or misunderstood directions on the part of the students.
- 7-2 **Inadequate recall of training materials:** a well developed training effort was successful in transferring the necessary knowledge, but students were not able to recall the material when needed. This could be the result of training not being reinforced on the job, or an inadequate retraining frequency.
- 7-3 **Inadequate training for working on a H<sub>2</sub>S designated area:** some training for working on a H<sub>2</sub>S designated area was conducted, but it failed to accomplish the necessary knowledge transfer.
- 7-4 **Inadequate training effort:** some training was conducted, but it failed to accomplish the necessary knowledge transfer. Potential causes include inadequate training program design,

- poorly developed training objectives, inadequate orientation programs, inadequate initial raining efforts or poor means to determine if students have indeed mastered the material being taught.
- 7-5 **No training provided:** there was no effort made to train the particular person in this subject. Reasons for this can include a failure to identify training was necessary, reliance on out of date or inaccurate training records, a change in work methods or a conscious decision to forego training.
- 7-6 **Other:** if none of the above categories apply, this category can be used.

## 8. Management/Supervision/Employee Leadership

- 8-1 **Conflicting roles/responsibilities:** who was to be responsible for what was not clear and well defined. This could include unclear reporting relationships, unclear assignments of responsibilities, improper delegation or conflicting situations where more than one party appears to be responsible for the same issue.
- 8-2 **Inadequate leadership:** the person assigned with the responsibility for aspects of safety had not carried out their responsibility to the degree necessary for safe work. This could include, lax standards of performance being tolerated, inadequate accountability for safety performance, little performance feedback, inadequate knowledge of conditions at the work site or inadequate safety promotion.
- 8-3 **Inadequate risk assessment:** the risks for the job were improperly or insufficiently assessed
- 8-4 **Inadequate correction of worksite/job hazards:** a hazard or incident had previously occurred to draw attention to a deficiency, but there was an inadequate effort to correct that deficiency.
- 8-5 **Inadequate identification of worksite/job hazards:** the incident was caused by the failure to perform or properly respond to a loss exposure study, such as a HAZOP review or Job Safety Analysis.
- 8-6 **Inadequate monitoring of weather conditions:** the weather conditions were not properly monitored for a ground disturbance work
- 8-7 **Inadequate management of change system:** the incident happened because a system or procedure did not exist or was incomplete to ensure that changes which affect the process are adequately assessed, documented and communicated.
- 8-8 **Inadequate incident reporting/investigation system:** the incident reporting and investigation procedures and guidelines were not followed for incidents that happened in the department. Therefore, the learning experiences and recommendations that could have prevented similar incidents were not discovered or lack of tracking system to ensure follow-up was done or not communicating the results of the investigations.
- 8-9 **Inadequate or lack of safety meetings:** safety meetings were not held or did not transfer essential knowledge about safety issues related to the incident.
- 8-10 **Inadequate performance measurement and assessment:** the means to measure and track safety performance were inadequate, leaving the organisation unsure of what needed to be done.
- 8-11 **Other:** if none of the above categories apply, this category can be used.

## 9. Contractor Selection and Oversight

- 9-1 **Lack of contractor pre-qualification:** a contractor firm was hired to perform work without successfully completing a pre-qualification review.
- 9-2 **Inadequate contractor pre-qualifications:** a pre-qualification review was conducted, but it failed to identify deficiencies in the contractor's capabilities.
- 9-3 **Inadequate contractor selection:** the selection of a contractor was made without all relevant data, or without proper consideration of safety capabilities.
- 9-4 **Use of a non-approved contractor:** a contractor firm who did not meet pre-qualification criteria was hired to perform work.
- 9-5 **Lack of job oversight:** a contractor firm's work was not inspected or audited to identify deficiencies in outcomes or methods.
- 9-6 **Inadequate oversight:** a contractor firm's work was inspected or audited, but deficiencies present were not identified.
- 9-7 **Other:** if none of the above categories apply, this category can be used.

## 10. Engineering/Design

- 10-1 **Inadequate technical design:** the incident was caused by a poor technical design, weak materials of construction, valves in the wrong spot, lines in walkways, etc. The reasons for inadequate technical design can be faulty input into the design process (bad information) or faulty design output (a bad design).
- 10-2 **Inadequate standards, specifications and/or design criteria:** although the design criteria and specifications had been followed, the specifications and criteria were not adequate and had to be adapted.
- 10-3 **Inadequate assessment of potential failure:** the incident was caused by the fact that the potential failure was not adequately assessed in the initial design stage.
- 10-4 **Inadequate ergonomic design:** the incident was caused by a poor ergonomic design, meaning that there was not an optimal tuning between the equipment and human working with the equipment.
- 10-5 **Inadequate design of excavation** the incident was caused by a poor design of the excavation site.
- 10-6 **Inadequate monitoring of construction:** although all design specifications and criteria had been followed, inspections during the construction were not done adequately.
- 10-7 **Inadequate assessment of operational readiness:** the incident happened because either the procedure for handover from construction to production was not followed, software changes were not fully tested or operating manuals and training were not completed.
- 10-8 **Inadequate monitoring of initial operation:** the incident happened because there was not enough monitoring and analyses of the initial operation information.
- 10-9 **Inadequate evaluation and/or documentation of change:** the incident happened because unevaluated changes were made and an unsafe situation was introduced. Documentation and communication of the changes was required and could have been overlooked.
- 10-10 **Other:** if none of the above categories apply, this category can be used.

## 11. Work Planning

- 11-1 **Inadequate work planning:** the work being done was not adequately planned in terms of people, equipment, materials, procedures or permits.
- 11-2 **Inadequate journey risk assessment:** route was not clearly defined and mapped.
- 11-3 **Inadequate use of the “buddy system” for a confined space entry:** the worker entered in a confined space without anyone else monitoring the task.
- 11-4 **Lack of awareness regarding wind direction and appropriate escape routes:** improper assessment or JSA during work at H<sub>2</sub>S exposure area.
- 11-5 **Inadequate lifting plan in place:** a lifting operation was performed without a proper lifting plan.
- 11-6 **Inadequate preventive maintenance:** the incident happened because the failing piece of equipment was not included in a preventive maintenance program, was overdue or was wrongly overhauled.
- 11-7 **Inadequate reparative maintenance:** the incident happened because the equipment failed due to wrong or insufficient reparative maintenance.
- 11-8 **Excessive wear and tear:** the incident happened because the equipment that failed showed excessive wear and tear due to corrosion, erosion, misuse, etc.
- 11-9 **Inadequate reference materials or publications:** the person doing the work did not have the proper owner’s manual, vendor information, repair procedures, etc. to have proper knowledge to do the work.
- 11-10 **Inadequate audit/inspection/monitoring:** the incident happened because the equipment failed due to inadequate audit, inspection and monitoring because the required audit/inspection/monitoring was not done adequately or was not done at all.
- 11-11 **Inadequate inspection of lifting equipment and safety devices:** the incident happened because the lifting equipment failed due to inadequate inspection because the required inspection was not done adequately or was not done at all.
- 11-12 **Inadequate emergency plan in place:** the job was performed without a proper emergency plan for the risks assessed .
- 11-13 **Inadequate job placement (wrong person for the job):** the selection process was not successful in choosing a suitable worker for the particular job assignment.
- 11-14 **Other:** if none of the above categories apply, this category can be used.

## 12. Purchasing, Material Handling & Material Control

- 12-1 **Incorrect item received:** the correct item was ordered, but an incorrect item was received. Reasons for this can include incorrect specifications to vendors, inaccurate information on the requisition, inadequate control on who can modify orders, an unauthorised substitution by the vendor, inadequate product acceptance procedures or a failure to verify receipt of proper goods.
- 12-2 **Inadequate research on materials/equipment:** the lack of knowledge led to the wrong item being ordered.
- 12-3 **Inadequate mode or route of shipping:** the hazard was created during shipment of the item - either by lost custody or product degradation.
- 12-4 **Improper handling of materials:** the hazard was created due to improper handling of the material.
- 12-5 **Improper storage of materials or spare parts:** the hazard was created as the item degraded while in storage.
- 12-6 **Inadequate material packaging:** the hazard was created when the item was damaged due to improper packaging.
- 12-7 **Material shelf life exceeded:** the hazard was created when outdated materials were used.
- 12-8 **Improper identification of hazardous materials:** the materials were not properly identified, and appropriate handling procedures were not used.
- 12-9 **Improper salvage or waste disposal:** the hazard was created when an item was improperly de-commissioned and disposed.
- 12-10 **Inadequate use of health and safety data:** the hazard was created when relevant health and safety information was not exchanged or used.
- 12-11 **Other:** if none of the above categories apply, this category can be used.

## 13. Tools and Equipment

- 13-1 **Inadequate assessment of needs and risks:** the wrong tools and equipment were provided, as a result of the faulty assessment of what was needed to properly perform the work.
- 13-2 **Inadequate human factors/ergonomics considerations:** the tools and equipment provided did not reflect the needs of the person performing the work.
- 13-3 **Inadequate standards or specifications:** improper tools and/or equipment was provided, as a result of inadequate standards or specifications covering what should have been provided.
- 13-4 **Inadequate availability:** the needed tools or equipment were not available at the job site.
- 13-5 **Inadequate adjustment/repair/maintenance:** the proper tools and equipment were available, but were not in good repair when used.
- 13-6 **Inadequate salvage and reclamation:** tools and equipment that were removed from service for overhaul were not properly repaired or destroyed, creating a hazard.
- 13-7 **Inadequate removal or replacement of unsuitable items:** items that were no longer serviceable remained on the equipment.
- 13-8 **No equipment record history:** a hazard was created as a result of a failure to maintain proper records on the equipment.
- 13-9 **Inadequate equipment record history:** records were maintained, but failed to properly identify a hazard.
- 13-10 **Other:** if none of the above categories apply, this category can be used.

## 14. Work Rules/Policies/Standards/Procedures (PSP)

- 14-1 **Lack of PSP for the task:** there were no written PSP covering the work being performed at the time of the incident. This could be the result of a failure to assign responsibility for the development of PSP, or the failure to complete an adequate job safety analysis for the task.
- 14-2 **Lack of permit to work system:** the high risk activity was performed without the proper permit to work.
- 14-3 **Inadequate development of PSP:** there were some PSP in place, but the PSP that were developed did not fully meet the needs of the work. This could be the result of inadequate co-ordination with design efforts, having unknowledgeable people developing the PSP, not identifying the proper steps to take in problem situations or a poor format that made the PSP difficult to use.

- 14-4 **Inadequate implementation of PSP, due to deficiencies:** there were PSP in place, but the implementation of the PSP was not complete due to deficiencies in these documents. This could include such things as contradictory requirements, confusing formats, inaccurate sequence of steps, technical errors, incomplete instructions, etc.
- 14-5 **Inadequate enforcement of PSP:** well crafted PSP were in place, but their use was not properly enforced, for reasons such as inadequate monitoring of the work being done, inadequate supervisory knowledge of what was to be done or inadequate reinforcement with labels or signs.
- 14-6 **Inadequate communication of PSP:** there was an appropriate PSP in place, but it had not been properly communicated. This could be the result of incomplete distribution, language difficulties, incomplete integration with training efforts or out of date PSP still in use.
- 14-7 **Inadequate accountability for the “permit to work” system:** the permit to work system was in place for the task, but not clearly defines the single point of accountability
- 14-8 **Other:** if none of the above categories apply, this category can be used.

## 15. Communication

- 15-1 **Inadequate horizontal communication between peers:** incident happened because there was no communication or no adequate communication between peers and colleagues.
- 15-2 **Inadequate vertical communication between supervisor and person:** incident happened because there was no communication or no adequate communication between supervision and workers, top bottom and bottom up in the same organisation.
- 15-3 **Inadequate communication between different organisations:** organisations other than their own were not properly informed.
- 15-4 **Inadequate communication between work groups:** the incident occurred because two or more individuals or groups were working on the same task, but did not properly communicate.
- 15-5 **Inadequate communication between shifts:** the incident occurred due to poor shift handover procedures, e.g., workers not expected to write a detailed account of problems in a log.
- 15-6 **Inadequate communication methods:** the normal means of communicating information were not adequate - phone lines busy, static on radios, writing was illegible, etc.
- 15-7 **Inadequate lines of communication while in a confined space:** the proper lines of communication were not established for the confined space entry.
- 15-8 **No communication method available:** the proper tools (telephone, computer, mail, paging system for emergencies, tapes and recorder, slides and projector boards) were not available.
- 15-9 **Incorrect instructions:** the person involved was given instructions; but the instructions were not understood as meant, and they were unclear or incomplete.
- 15-10 **Inadequate communication due to job turnover:** the person starting a task was not around to finish it, and those assigned to complete the work did not have the necessary information.
- 15-11 **Inadequate communication of safety and health data, regulations or guidelines:** the safety and health data and new regulations were not discussed with the people performing the work.
- 15-12 **Standard terminology not used:** incident happened because either terminologies were different departments or there was confusion, e.g., different pieces of equipment have the same numbers. Standard codes and practices were not followed, e.g., colour coding for lines, electrical, etc.
- 15-13 **Verification/repeat back techniques not used:** a verbal message was misunderstood and went unidentified because there was no verification/repeat back of the message by the recipient.
- 15-14 **Messages too long:** confusion arose due to the length of the message.
- 15-15 **Speech interference:** a verbal message was not properly transmitted due to background noise, static or other distractions.
- 15-16 **Other:** if none of the above categories apply, this category can be used.

