Job Safety Analysis

Global Operations and Technology

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April 2023	1.3	Minor update section 2.6 for clarification
February 2023	1.2	Update as part of the Standards Life Cycle process
May 2020	1.1	Aligned with Safety Risk Matrix Standard
Sept 2008	01	Endorsed by Operational Excellence Leadership Team
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SUMMARY OF CHANGES

Standard revision	Major or Minor change	Paragraph number	Content of change
1.3	Minor	2.2 figure 2.2	Added to summarise the initial and residual risks
1.3	Minor	2.6	Clarified that the Vopak Safety Risk Matrix shall be used to assess the risks associated with the hazards identified in the task steps of the JSA
1.3	Minor	Appendix 3 - D	Added examples of human factors as a contributor to incidents
1.2	Minor	1.2.1	Added Training
1.2	Minor	2.5.1	Added Human factors
1.2	Minor	2.9	Aligned review cycle of JSAs linked to operational routine tasks with the Integrated Management Standard
1.2	Minor	Appendix 3 - B	Changes in Job factors, distinction made between: task-, human- and organisation factors
1.2	Minor	Appendix 3 - D	Added table Identification of Human failures
1.2	Minor	Appendix 4	Revised JSA worksheet example

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1 Introduction

This document is one in a series of standards within the framework of the Vopak Operational Excellence program. Implementation and compliance with these standards is part of the process of achieving Vopak's ambitions for Operational Excellence.

The primary objective of this document is to describe the Vopak minimum requirements for identifying and assessing the risks of each element of the task and to provide the safest means of performing the task.

1.1 What is Job Safety Analysis (JSA)?

Job Safety Analysis (JSA) is the application of the hazards and effects management process at the task level, identifying and assessing the hazards of each element of the task and defining appropriate controls and mitigating measures to eliminate, control or to minimise the hazards to an acceptable level. The methodology is derived from the work study technique known as Task Analysis, and is known variously as Job Hazard Analysis (JHA), Work Safety and Health Analysis, Activity Risk Assessment (ARA).

1.2 Where and When is JSA applied?

A JSA needs to be applied for any task for which a formal assessment of hazards and control measures is required, such as:

- Operational routine tasks.
  Examples: (un)loading trucks, (un)loading vessels, tank transfers.
- Routine tasks having a history of incidents including near misses.
  Examples: hoses handling, pigging, maintenance of equipment etc.
- New tasks or tasks introducing new work methods.
  Examples: Drumming for the first time, or new drum filling equipment.
- Routine tasks being carried out in unusual circumstances.
  Examples: Replacing a fire pump.
- Non-routine or one-off tasks.
  Examples: project construction activity, specific maintenance activity.
- As a verification of the hazard management elements of an established work procedure.

The JSA complements the functions of a Standard Operating Procedure (SOP) and vice versa. The use of both SOPs and JSA provides the safest means of performing the task. SOPs might not provide sufficient detail for the specific task. A procedure cannot consider all possible conditions, such as weather conditions, noise, lighting, whereas a JSA will consider these factors.

A Permit to Work (PtW) and JSA are not interchangeable, the JSA is complementary to the PtW. The JSA brings an extra level of risk awareness and risk reduction.

1.3 Who performs JSA?

JSA is a multidisciplinary team exercise involving three to five people. The person involved in leading the analysis should have a level of operational and/or technical competence relevant to the job to be analysed and be a competent JSA Leader. The composition of the team depends on the individual task

being analysed and front line supervisors and each area of skill should be represented. For simpler tasks, a small team led by the supervisor of the activity should be sufficient. Tasks of greater complexity may involve safety advisers and area supervisors or the asset owner.

Larger teams or JSA exercises covering a number of tasks may benefit from use of a facilitator (someone holding JSA skills).

If the task is to be carried out in a live production facility a representative of the facility supervision should be in the team or should approve the JSA. Contractor work leader or representative should also be a part of the team where a contractor's company is involved in performing the job. They have specific knowledge of the job, which internal staff cannot have.

1.2.1 Training

All persons involved in the JSA process must be trained prior to undertaking their role(s). Also these persons should have relevant work experience, seniority (JSA leader), and familiarity with the terminal for their role(s). The local training program must specify the minimum training frequency. The persons shall receive training in the JSA philosophy and risk identification and assessments. The training shall capture the following:

- JSA process
- The tasks which are required to have a JSA
- Breaking down a task into its component steps
- Assessing the hazards
- Risk control measures
- JSA review and update cycle

The terminal should consider multiple levels of training, tailor-made to the roles in the JSA process (JSA leader and JSA participant) and registered as required training in the training matrix.

2 Application

2.1 Conducting JSA

JSAs may be conducted on an existing task or prior to a task, during the planning stage. Three principal ways of conducting JSAs are discussed below:

- Direct observation
- Group discussion
- Recall and check

2.1.1 Direct observation

In this method the persons doing the analysis actually observes the job being done.
They may observe the process a number of times before they identify the separate steps, estimate the potential accidents and develop controls and recovery measures.
In addition they may observe different employees doing the same job to establish variations in job execution.

The advantages of direct observation are threefold:

- **Recognition**
  Seeing the job being done stimulates recognition of potential hazards / accidents more effectively than relying on memory. It also stimulates better solutions.

- **Experience**
  Employees who do a job regularly are a rich source of information about risks, accidents and near accidents associated with their job; they can be a great help with the JSA. In addition, observing the job gives supervisors an excellent opportunity to exchange safety ideas with operatives.

- **Environment**
  The influence of the environment and interface with other work can be more readily appreciated. A limitation of the observation method is that it cannot be readily applied to new jobs or jobs done frequently.

Key points for using the observation method are presented in **Appendix 1** – Direct Observation.

2.1.2 Group discussion

A group of people familiar with and having experience of performing the job, under the guidance of the supervisor, use their collective experience to identify the job steps, the potential hazards / accidents in each and develop good controls, solutions.
The participants in the discussion should be those with the most knowledge about the job. In either case, the supervisor needs to be competent in JSA group discussion techniques. He should be able to stimulate a group to obtain the maximum contribution from each of its members and guide the discussion down the most productive paths.

This method relies on an open discussion. The discussion creates consensus on what should happen, makes participants more aware of the hazards and creates a common understanding of risk and where the limit for unacceptable risk is set. Studies have shown that JSA group discussions (involvement) improves the knowledge, situational awareness and hazard identification and ownership.

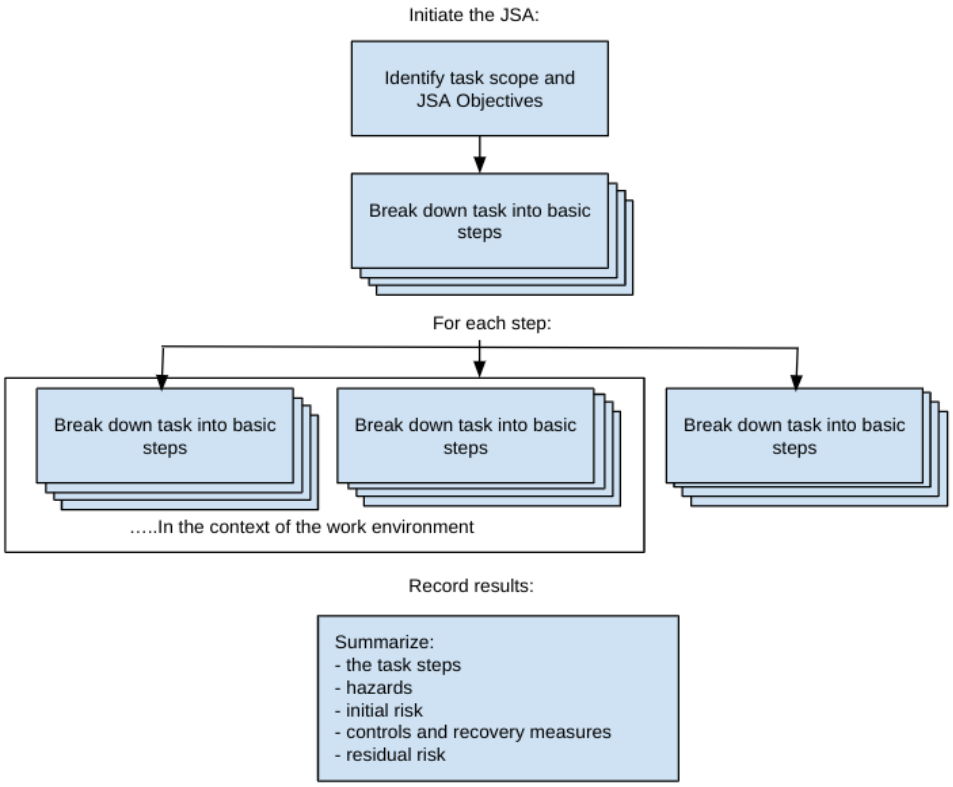
2.1.3 Recall and check

'Recall and check' differs from group discussion in that a JSA leader prepares a JSA for the work operation, which is then reviewed by another person with knowledge of the work. A challenge relating to this method is that the opportunity for input from workers decreases, making them less able to influence their work in comparison to a group discussion. Another disadvantage is that the sense of ownership of the analysis is reduced, and can lead to poorer adherence to the measures.

Recall and check shall only be used in the planning stage e.g. for a green field. Additionally, observations and/or group discussions shall be performed after go-live.

2.2 Outline of JSA Process

Figure 2.2 Outline of JSA Process



2.3 Initiating a JSA

Determine the task to be analysed, establish the scope of work and the objectives of the exercise. Convene and brief the JSA team.

Selection of tasks for JSA can be made on the basis of need as identified in **section 1.2** Where and When is JSA applied?. It is a requirement under the control of work standard that each department have JSAs done for routine operational and maintenance activities and as required under the permit to work requirements.

The scope of work should include the task to be analysed and the range of operating environments to be considered. Permit to Work is required to specify that a JSA is carried out as part of work preparation when it concerns, high risk non-repetitive, complex work for which a standard risk

assessment methodology (hazard tree) is not available. Detailed information is defined in the Permit to Work blueprint (MyDocs document number 61.072987).

2.4 Breaking Down the Task

Break down the task into its basic steps, describing what is to be done, and in what sequence. This information is often available in a work procedure or job method statement (JMS).

In defining the steps a balance must be made between too much and too little detail.

As a general rule, the demarcation between steps will be marked by some change, either in activity or location, that would result in different hazards or exposure. Experience has shown that most tasks that are the subject of JSAs can be broken down into ten steps or less. If more than 15 steps are identified and it is not feasible to merge some steps without losing essential detail, it is recommended that the task itself is split and separate JSAs are conducted for each part.
Each step description should:

- Provide a statement of what is to be done, without reference to how it is to be done or who is to do it.
- Begin with an action verb (install, remove, assemble etc.).
- End with the subject being discussed (pump, valve, hoist etc.).
- Omit reference to hazards.

An example is presented in **Appendix 2** – Breaking Down the Task - Example**.**

2.5 Identifying Hazards and Potential Incidents

Examine each basic step for hazards that could be present as a result of the task itself or of the work environment. At the same time, consider the departures from expected circumstances and emergency conditions that could release or expose the hazard, and the potential incident that could result.

The observation method described in **section 2.1.1** provides a good opportunity to assess hazards in the context of the work environment and discuss them with operators.

The key activity in a JSA is to determine the hazards and potential incidents associated with each particular step. JSAs fail or become inefficient when the focus is on overall solutions to the whole job. Structured questions should be applied to each step to stimulate discussion about the various risk factors. Where temporary piping hookups are installed the JSA may also include a simple HAZOP. **Appendixes 3 A, B and C** – Hazard Identification presents checklists relating to hazards, job factors and incident potential.

2.5.1 Human factors

Human factors are often recognized as being a contributor to incidents. Proactive identification of the key human factors that influence non-desired behaviour of staff, and the potential human failures that may occur should be considered in the assessment of risk. The associated controls implemented shall reduce the potential of incidents resulting from human failure.

Human failures can be distinguished in errors and violations:

- Human error: a human error is an action which was not intended, which involved a deviation from a standard, procedure or work instruction;
- Violation: a violation is a deliberate deviation from a standard, procedure or work instruction.

More details regarding human factors and measures to reduce these errors and/or violations can be found in the HSE Health and Safety Guidance Reducing error and influencing behaviour HSG48

Appendixes 3 – **D Identification of Human Failures** and **B Job Factors** can be used as guidance to identify failures in the execution of task steps and the factors that influence human performance (task factors, person factors, organisation factors). These human factors should be considered when creating suitable controls.

2.6 Assessing Risk

The next step is to assess the risk associated with the task by assessing the severity of the hazard and the likelihood of its occurring.

The risk assessment is used to set the level of control and recovery, and to prioritise actions to be taken.

The assessment is a coarse approximation and should be reached without delayed debate but high risk hazards identified could be the subject of a more detailed assessment later.

A risk matrix shall be used to present risk by plotting the likelihood on one axis and the severity on the other. The Vopak Safety Risk Matrix shall be used to assess the risks associated with the hazards identified in the task steps of the JSA. Reference is made to the Vopak Safety Risk Matrix Standard MyDocs document number (61.071891).

An example of risk assessment is shown in **Appendix 4** – JSA Worksheet.

2.7 Controls and Recovery Measures

Controls and recovery measures should be developed first of all from an overview of the complete task and the risks involved. If the task as described involves a number of high risks, a change in the entire task may present a better solution than controlling each hazard individually.

If no radical solution presents itself, each hazard and potential incident should be examined and control measures identified. A useful hierarchy of solutions to bear in mind is shown below (ranked broadly in order of effectiveness):

1 Eliminating the hazard (eg buying ready sawn timber rather than using a circular saw)
2 Substitution (using a less hazardous material or process)
3 Reducing the frequency of a hazardous task
4 Enclosing the hazard
5 Guarding/segregating people
6 Automated shut off controls / alarm warning when out of range or unsafe condition
7 Additional procedures
8 Additional supervision
9 Additional training
10 Instructions/information (handouts/signs)
11 (Some) personal protective equipment.

In addition to defining controls, recovery measures should also be developed to take into account the possibility of control failure. Recovery measures to consider include:

- Detection and alarm devices
- (some) Personal protective equipment
- Secondary containment

- Escape and rescue equipment
- Emergency procedures

2.8 Recording the JSA

Summary information for each JSA should include:

- The scope of work
- Assumptions made
- Position/qualifications of team members
- Abbreviations used, etc.

Results of the JSA should be tabulated on a form of the type shown in **Appendix 4** – JSA Worksheet. A copy of this summary should be available at the workplace for use as a site reference. Where a program of JSA's has been undertaken, the results should be filed in an appropriate reference manual.

2.9 Review and Update JSA

Implemented JSAs require review to assure that there are sufficient controls in place to execute the task safely. Besides review, frontline staff shall be encouraged to share experience, give comments and feedback and raise questions to enable continuous improvement. This feedback needs to be recorded and systematically managed.
A review cycle must be in place, similar as Vopak has for the Life Cycle Management of standards.

To ensure that the experience and information gained by doing the job remains available to others who may be required to perform the same or similar jobs, the JSA team should, at the completion of each job, review and update the original JSA. A JSA linked to a permit to work (high risk, non-repetitive, complex work), has a validity of three months. In case it is still needed after this period, the JSA needs to be reviewed and re-approved. JSAs linked to operational routine tasks have a validity of 2 years or sooner when there is a change.

When reviewing the JSA on completion of the job, the following should be considered:

- Changes to job circumstances
  Changes in the environment, specifications, or tools and equipment can cause job steps to be added, deleted or changed. Changes in job steps can introduce new hazards requiring new solutions.

- Unforeseen hazards
  Once a job has commenced additional unforeseen hazards may present themselves so that solutions have to be developed on the job. These job developed solutions need to be included on the revised JSA.

- External influences and interfaces
  When doing a JSA it is often difficult to identify all of the possible external factors that impact on the job and the interface with other jobs and people in the immediate vicinity. Feedback of this type can be valuable to people planning similar jobs in the future.

Appendix 1 – Direct Observation

Key points in the observation method of JSA are:

- Select the right employee to observe

  When you have more than one person doing the job you plan to analyse, choose the one who will be able to help you most. He should be experienced and cooperative. It is also a good idea to observe more than one employee.

- Explain what you intend to do

  Make sure the employee fully understands the purpose of your observation. Emphasise that the study is of the job not of him. The best approach is to invite the employee to share the task with you. 'I'll do the writing, and you help me with the ideas'.

- Observe to get the step-by-step breakdown

  Keep in mind that you are observing to identify the basic steps. Don't break down the activity into too many steps. On the other hand, don't make the steps so broad that critical aspects are overlooked. If the job is a lengthy one, develop a preliminary breakdown by recall then check it with the employees. Where there is full agreement, there may be no need to observe that task element. Observation can then concentrate on the task elements where there is uncertainty.

- Check your job step break down with the employee

  When you complete your observation, check your breakdown with the employee observed. Get agreement on what is done and in what order, not on how it is done. Don't discuss hazards or precautions at this stage.

- Record the job step breakdown

  After you have checked the job step breakdown with the employee, record the steps **(see Appendix 2** – Breaking Down the Task - Example**)**. If you have observed one employee, check the breakdown with other experienced employees.
  The direct observation method is suitable for repetitive and frequently carried out jobs.

Appendix 2 – Breaking Down the Task - Example

A step-by-step breakdown for the job of testing a relief valve is:

Step 1	Set up relief valve (RV) on test bench
Step 2	Engage clamp jacks
Step 3	Check lift pressure
Step 4	Reset at correct pressure
Step 5	Fit plug and hose; complete bubble test
Step 6	Remove plug, hose and exhaust valve
Step 7	Release clamps
Step 8	Remove RV from test bench
Step 9	Certify RV

Note the following:

- Each step tells generally what must be done with no reference to how.
- No hazards are mentioned and no safety precautions are prescribed. These come later the job steps are described in their normal order of occurrence.
- The description of each step starts with an action word, position, remove, tighten, etc.
- It usually takes only a few words to describe a job step.
- Two errors to be avoided in this part of the JSA are:
    - **Making the job steps too 'fine'.**
      This results in an unnecessarily large number of job steps. For example, in the following 'expansion' of Step 6, the steps are of similar actions, performed at the same time and having similar hazards:

Step 6	Remove plug
Step 7	Remove hose
Step 8	Remove exhaust valve

    - **Making the job steps too 'broad'.**
      For example:

Step 1	Set up relief valve (RV) on test bench
Step 2	Check lift pressure; complete bubble test
Step 3	Remove RV from test bench

      These steps are too general and omit activities that could contain potential accidents. When this happens the whole JSA is weakened.

Appendix 3 – Hazard Identification

Appendix 3 – A. Hazards, Hazardous Conditions and Hazardous Activities

The following is a memorandum, based on the Hazards and Effects Hierarchy:

Table 3-A. Hazards, Hazardous Conditions and Hazardous Activities

Hazards		Hazardous Conditions	Hazardous Activities
Hydrocarbon liquids/ gases	Extreme temperatures	Vibration	Manual handling
Flammable materials	Open flame	Lighting	Use of machinery
Explosives	Electricity	Extreme ambient temperatures	Driving
Material under pressure	Electromagnetic radiation	Temporary facilities	Climbing /working at heights
Differences in elevation	Radioactives	Non-breathable conditions	Confined spaces
Objects under stress	Noise		Stacking
Moving equipment/ vehicles	Toxic substances/ chemicals		Excavation work
Natural occurrences (weather, tides etc)	Biological conditions		

Appendix 3 – B. Job Factors

Aspects of the work environment, the task step itself and the organisation that should be considered in the context of the task step, such as:

Table 3-B. Job Factors

Task Factors	Person factors	Organization factors
Clarity of signs, signals, instructions and other information	Physical capability and condition	Work pressures e.g. speed versus safety
System/equipment interface (labelling, alarms, error avoidance/ tolerance)	Fatigue (acute from temporary situation or chronic)	Level and nature of supervision / safety leadership
Difficulty / complexity of task	Stress / morale	Communication / language
Routine or unusual	Work overload /underload	Resource levels
Repetitiveness	Knowledge and Competence to execute the task	Peer pressure
Divided attention	Motivation versus other priorities	Clarity of roles and responsibilities
Procedures inadequate or inappropriate		Consequences of failure to follow rules/procedures (Just culture)
Preparation for task (e.g. permits, risk assessments, checklist)		Effectiveness of organisational learning (leaning from experiences)
Time available / required		Organisational or safety culture
Tools appropriate for task		Norms and values
Communication, with colleagues, supervision, contractor, other		Controls
Working environment (noise, heat, space, lighting, ventilation)		
Services and consumables		

Appendix 3 – C. Key points for Identifying Line of Fire Hazards / Potential Line of Fire Risks

Each question is, in principle, put to each job step. In practice the nature of the job step and the surrounding circumstances may eliminate the need to raise some of them:

- Can the employee be **struck by** or **contacted by** anything while doing this job step?
- Can he **strike against** or make **injurious contact** with anything?
- Can he be **caught in, on** or **between** anything?
- Can the employee **strain** or **overexert**?
- Can the employee **slip** or **trip** on anything? Can he/she **fall** in any way?
- Can employees be **exposed** to any **injurious condition** such as gas, heat, fumes, pressure, chemicals, asbestos, etc.?
- Can the employee **injure a fellow employee**?
- Can **damage** to **equipment** occur?
- Can **pollution** of the **environment** occur?

Appendix 3 – D. Identification of Human Failures

Errors that can be as guidance to identify failures in the execution of task steps

Human error		
Type of error	Description	Controls
Action error - Transfer through the wrong pipe line / in wrong MOT or tank	During discharge of product from a vessel to a tank, the product is transferred into an incorrect tank, the order was given by radio.	- Use of written or electronic work orders. - Training - Labeling / identification
Action error - Quantity (un)loaded too little / too much	Operator loaded too little quantity, driver was not included during the pre-weighing, the driver was sitting in his cabin during loading / post weighing Operator transferred product from a shore tank to a vessel. The quantity transferred was done by manual gauging. The operator delivered too much product to the vessel. The product temperature increased during the transfer, however the operator did not re-calculate the level to stop	- Procedures - Training
Action error - Operation too fast / too slow	Vessel discharged product with a too high velocity, flow rate was not agreed during the ship/ shore conference and flow rate wasn't monitored.	- Ship/shore checklist - Procedures - Training
Action error - Action not executed	Operator did not close the end valve prior to disconnection of the railcar	- Training - Checklist
Checking error - Check incomplete	A part of the cargo handling system is partly automated and partly manual operated. Line up check not performed, operator assumed that all valves were automatically aligned	- Training
Checking error - Right check on wrong asset/object	Operator checked the wrong pipeline	- Proper identification of pipelines.
Checking error - Check too early / late	Received quantity through external pipeline exceeded the quantity agreed with the customer due to failure to stop the transfer in time	- Communication agreement - Procedures - Training
Selection error - Wrong selection made	Operator inserts an incorrect gasket between the ship's manifold and the jetty hose. The gasket is not suitable for the product to be transferred When drivers arrive at the loading bay, they issue the work order to the operator or lay the work order on the operator's desk. Operator grabs the incorrect work order to load a road tanker	Required type of gasket specified on the work order Describe in the procedure that the operator must only accept the work order for the road tanker to be loaded
Violations		
Type of violation	Description	Controls
Deliberate actions	Operator must load a road tanker the distance from the loading rack to the tank is not so far. He crossed the pipelines to open the tank valve, the short cut is taken because there is no access / walkway close by	Preventive measure to cross the pipe lines or provide access close by

Appendix 4 – JSA Worksheet

An example of a JSA worksheet, showing analysis with risk assessment, is given in the JSA worksheet

Link to an empty JSA worksheet