

SAFETY GUIDELINES FOR IRON & STEEL SECTOR		
MINISTRY OF STEEL, GOVT. OF INDIA	CREATION OF SAFETY DATABASE AND PROACTIVE DATA COLLECTION	Doc. No: SG/27
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## 1. OBJECTIVE:

This document intends to provide details of the procedures for the database creation and schema of the datasets required. Also, the document details the procedures for conduction of different types of workplace audits and their data collection systems.

## 2. SCOPE:

This guideline of practice is applicable to all Iron and Steel sectors.

## 3. PROCEDURES

### 3.1 Definitions

- (i) A **hazard triangle** comprises of three components: Hazardous element, accident causing mechanism and target/threat. A hazard triangle is designed for each possible accident/incident to understand its propagation.
- (ii) A **hazardous element (HE)** is the source which has the potential to cause harm or loss. In general, the sources are energies, hazardous materials, equipment, software, and humanware.
- (iii) An **accident causing mechanism (ACM)** is the triggering events which alone or in sequence cause HE to actuate into an accident. For example, a high voltage electric wire (HE), uninsulated or worn-out (event-1) when touched (event-2) by a person causes electrocution (the accident) resulting death (threat) of the person (target). Here, events 1 and 2 in sequence cause the HE (high voltage) to actuate into 'electrocution' (the accident).
- (iv) An **accident** is an unplanned event resulting into harmful consequences such as death, injury, illness or loss of property.
- (v) A **risk control system (RCS)** is physical or non-physical barrier applied in workplace to prevent flow of unwanted events or mitigate the effects once incident/accident has occurred.
- (vi) **Preventive Risk Control Systems (P-RCSs)** are physical or non-physical barriers in the workplace to prevent the occurrence of an incident/accident. The number of incidents is inversely proportional to the performance of P-RCS.
- (vii) **Mitigating Risk Control Systems (M-RCSs)** are the physical or non-physical barriers at the workplace that reduce the severity of an incident. The severity of the incident is inversely proportional to the performance of M-RCS.
- (viii) **Target** are the people, property or environment which are exposed to the harm that may be caused if the unsafe events propagate to cause incident/accident.

- (ix) **Threat** is the potential harm or loss that could be caused due to occurrence of incident/accident.
- (x) An **accident path** is described as chain of events, which violate preventive risk control systems. This actuates the hazardous material/element to cause accident/incident. The probability of these accident/incident is inversely proportional to the performance of P\_RCS and the severity of these accident/incident is inversely proportional to the performance of M\_RCS.
- (xi) **Unsafe Act** is something somebody does which may culminate in harm. The word “may” is used because it is not necessary that it should always lead to an injury or other incidents, but we can be sure that if such acts are persisted they will result in avoidable injuries or other losses. Basic Criteria to define Unsafe Act are as follows:
  - a) Person is there,
  - b) Non-compliance of established rules, and
  - c) Can be corrected on the spot without any resource.
- (xii) **Unsafe Condition** may refer to the condition of the floor, of the ladder, of a machine, of a stairway, of a tool, of a conveyor belt, of anything else of physical, environmental, mechanical or other character which could lead to an accident. Basic Criteria to define Unsafe Conditions are as follows:
  - a) It is not Unsafe Act,
  - b) Non-compliance of established or not established rules, and
  - c) Cannot be corrected on the spot without any resource.

### 3.2 Procedure for database creation

- (i) Form a Team involving members from safety, IT, operations and maintenance.
- (ii) The team shall identify different safety programs and ensure collection of safety related data for each of the programs (See **Annexure I**).
- (iii) Understand the goal of different safety programs and identify all types of data to be collected. The desired schema with expected data types for different safety programs is provided in **Annexure II**.
- (iv) The IT professional shall design the database using any relational database management system for the schema specified in Annexure II for each program with the help of database developer and database administrator. As a minimum alternative, excel based data collection and storage system can be designed.
- (v) For relational database, design a front end where the details of each program can be logged and automatically stored in the database. The data collection procedure is provided in SG-26: Guidelines for incident investigation.
- (vi) Collect data through front end interface and download it periodically.
- (vii) Use the downloaded data to perform desired analysis.

### 3.3 Procedure for incident investigation

Please refer **SG-26**: Guidelines for incident investigation.

### 3.4 Procedure for proactive data collection

#### 3.4.1 Hazard recognition report

**3.4.1.1 Purpose:** This report contains the information about all the possible hazards present at the workplace and their possible propagation. The preparation of this report is the responsibility of a team comprising safety professional, unit/section manager or line manager.

#### 3.4.1.2 Conduct of hazard inspection

- (i) Form a team of safety professionals and line manager of the unit chosen for inspection.
- (ii) The team must understand the terminologies related to hazard recognition as mentioned in the guideline before starting the inspection.
- (iii) The team shall visit the workplace with hazard recognition sheet and observe the unsafe acts or conditions present at the workplace. The team shall explicitly observe the followings:
  - (a) The hazard sources and the accident causing mechanisms.
  - (b) The risk control systems which are effectively preventing the propagation of ACMs.
  - (c) The possible accidents which may be caused if the ACMs are not prevented effectively.
  - (d) The targets of the possible accidents and threats they are exposed to.
  - (e) The situations which require RCSs to prevent and mitigate the accidents.

The above details shall be noted in the sheet for each hazardous conditions observed at the workplace.

- (iv) After recording the observations, the details shall be discussed with the line manager and the severity associated with each accident path must be assessed. Also, corrective actions must be suggested by the line manager.
- (v) The details of the observations along with the suggested corrective actions must be recorded in the IT based system by the safety professionals.
- (vi) The line manager must acknowledge the observations and set the target date for implementation of the corrective actions. If the severity of any accident path is very high, then it must be discussed with senior management.
- (vii) The team must visit the site again after the set target date to verify whether the corrective actions are implemented or not. If everything adheres to the safety requirement, then the observation shall be closed and the details of the accident path along with RCSs' detail shall be added

to the list of the existing hazard triangle and accident path. Otherwise, the issue shall be escalated.

### **3.4.2 Informal Observation Report**

**3.4.2.1 Purpose:** This type of reporting is intended to identify and record both safe and unsafe practices that can be observed at the workplaces and should be brought into the notice of the unit manager. The responsibility is on the employee, safety professional, chief of department (CoD), Unit/section manager, and senior management.

#### **3.4.2.2 Conduct of informal observations**

- (i) Plan the safety visit in the specific area of unit/department/division by a team or individual. If the audit is performed by a team, then the team may comprise safety professional or line manager or employee or both.
- (ii) Observe the workplace to identify the hidden hazards. Bring them immediately to the notice of all the workers/employees working at that place. Explain the severity and possible consequences to them.
- (iii) Log the observations in the IT based system with all the details. The visit carried out in a group may be logged by any one employee with reference to other employees in the team.
- (iv) Details of the logged incident is sent to the area owner through mail. He/she must take the preventive or mitigating actions to close the observation at the acceptable severity level. This must be done within the stipulated days.
- (v) In case when the observation has potential of fatality, area owner may request for extending the days after taking the immediate control of the unsafe acts or conditions to bring it within acceptable severity limit.
- (vi) After implementing the corrective actions, the area owner may close the observation with required additional comments.
- (vii) The above information is to be provided to the observers through mail.
- (viii) In case when the area owner fails to take corrective actions for fatality type of observation, then it is to be escalated to the senior management.

### **3.4.3 Hazard and Operability (HAZOP) study**

**3.4.3.1 Purpose:** The HAZOP study is intended to identify the process deviations that can occur during operations of a plant, delineate the causes and consequences of such deviations, and finally recommend the actions needed to prevent such deviations. The process deviation (e.g., more pressure, loss of power, etc.) is the departure from design intension.

#### **3.4.3.2 HAZOP procedure**

HAZOP is a detailed procedure, usually done for safety critical systems of process plant. The team conducting HAZOP should have design knowledge of the process, hazard knowledge, and experience of conducting incident

investigation of process incidents. The process is usually described using piping & instrumentation diagram (P&ID).

The team may follow the steps given below to conduct a HAZOP study:

- (i) Define system scope and boundaries. Understand the design, operation and maintenance of the system.
- (ii) Plan for HAZOP: it includes the goal, analysis procedure, worksheet, schedule, and process. Divide the system under consideration into the smallest manageable sections/segments (e.g., reactor, storage, etc.) for the analysis.
- (iii) List down the study nodes (e.g., line, vessel, pump). Here 'study node' is the location at which the process parameters (e.g., pressure, temperature, etc.) are investigated for deviations. Acquire all necessary data for this purpose.
- (iv) Describe the design intent at each of the nodes chosen. This requires to establish and define all important parameters and all appropriate guidewords. See Annexure d (i) for sample parameters and Annexure d (ii) for guidewords.
- (v) Using appropriate guide words and process parameters for each of the nodes chosen, list down the deviations (e.g., more pressure, no flow, etc.). See Annexure d (iii) for sample list of deviations.
- (vi) Establish HAZOP analysis worksheet, conduct HAZOP meetings, and record the HAZOP analysis results in the HAZOP worksheet (See Annexure d(iv) for a sample HAZOP worksheet).

## Annexure I

### Safety Programs:

#### **a) Hazard recognition**

**Purpose:** This program intends to identify hazards at the workplace through formal inspection of the workplace and to provide correct risk control systems.

This program captures information about the following elements of hazard recognition by observing the workplace for hazardous scenarios and their propagation mechanisms.

- (i) Hazard triangle
- (ii) Hazardous element (HE)
- (iii) Accident causing mechanism (ACM)
- (iv) Accident
- (v) Risk control system (RCS)
- (vi) Preventive Risk Control Systems
- (vii) Mitigating Risk Control
- (viii) Target
- (ix) Threat
- (x) Accident path

#### **b) Behavioural observations**

**Purpose:** The aim of this program is to observe the unsafe practices, i.e., unsafe acts or conditions that exist in the workplace due to behavioural flaws of employee or contractor.

Behavioural observations are carried out separately for employees and contractors under the reporting system informal observation report and contractor audit report, respectively. The details of procedure to carry out each program are provided earlier.

The team intends to observe the unsafe acts and conditions that exist in the workplace, and assess the severity associated with them. Any situation is considered as the unsafe act or condition according to the definitions given in *Section 3.3.1*.

While observing the workplace, the observer shall observe the following and explicitly mention in their audit report

- (i) **The reaction of people:** Sometime people, who are knowingly acting unsafely, correct their behaviour on arrival of the superior. It is important to look out for these reactions on arrival at the work site, to understand what the real work standard is.
- (ii) **The position of people:** How people position themselves to perform work is often a direct or an indirect contributing cause of injuries. Identify if the person could get injured, based on how he/she is positioned versus the job and the environment.

(iii) **Clothing and Personal protective equipment:**

- Observe whether all required PPE for the job is available
- If available, what is the condition of the PPE (as per TSL standards)?
- If available, is the PPE being used?
- Is the PPE being worn correctly?
- If not, why? Find out 'why', through conversation with the employees.

(iv) **Tools and equipment:** Tools and equipment that are used to prepare and perform a task are critical to ensure safety of the employee as well as people in the area.

- Are these being used properly?
- Are these in safe condition?
- Are homemade tools (not properly designed) being used?
- Are these the right tools for the job? Were these designed to prevent all unnecessary risks?

(v) **Rules & Procedures:** The intent of rules & procedures is to describe the best way to perform a (routine) task. Procedures should include quality, efficiency and safety aspects of the job. Ensure only trained people perform a task, and that the people always work according to the procedures.

(vi) **Orderliness:** For housekeeping, it is essential that we set clear minimum standards, and continually reinforces, as this will very easily slip.

- Is workplace neat?
- Are materials and tools kept in safe manner?

**c) Incident Investigation**

Incidents are unplanned events or chains of events that have, or could have, resulted in injury or illness or damage to assets, the environment or company reputation. All the incidents to be duly reported. An incident may lead to

- Fatalities
- Lost time injuries (LTIs)
- First aid cases
- Injuries on duty
- Ex-gratia (out of goodwill)
- Burn
- Property damage
- Near miss observations/ dangerous occurrences

The detail of each type of incident and detailed procedures of incident investigation is provided in SG-26: Guidelines for incident investigation.

**Annexure II:****Schema of tables in safety database****a) Preliminary incident report**

<b>Attribute Name</b>	<b>Description</b>
Date	Date on which incident/accident takes place
Time	Time of incident/accident
Brief description	Text description of events leading to incident/accident
Location	Exact location of the incident
Incident category	Type of incident (e.g., process or behavior)
Impact	Severity of incident/accident
Activity type	Types of activity being done at time of incident
Incident status	Open/close (Close means root causes identified and preventive & mitigative actions are taken)
Hazardous element*	The sources of incident
Accident causing mechanism*	The act or condition which caused the incident
Event	The accident/incident that occurred
PPE	PPE requirement
Behavior	Behavior of the person responsible for the incident
Risk calculation	Risk potential

\*See Section 3.3.1 for definitions

**b) Informal observation report**

<b>Attribute Name</b>	<b>Description</b>
Visit status	Status of visit
Date	Date of visit
Obs. detail	Brief description of the event
Obs. status	Status of the observation
Location	Location in which observation was done
Obs. type	Type of observation (safe or unsafe)
Severity	Severity of observation
Category	Category of the observation
Risk control system*	Absence of which control system
No of person	No of person present during visiting
Action taken	Action taken for preventing further similar incidents
Remarks	Remarks, if any
Hazardous element*	The source of unsafe act or condition
Accident causing mechanism*	The act or condition which may cause the incident
Potential event	The possible accident/incident that may occur
Reaction of the people**	How people reacted



Position of the people**	The safe or unsafe position of people at workplace
Clothing and PPE**	Appropriateness of PPEs
Tools and equipment**	Appropriateness of tools and equipment
Orderliness**	The cleanliness of the workplace
Rules and Procedure**	The adherence to operating procedure and workplace rules

\*See Section 3.3.1 for definitions and \*\*Annexure 3b.

### c) Hazard recognition

Attribute Name	Description
Visit ID	Unique identity number for a visit
Visit date	Visit date for line walk
Location	Location in which observation was done
Division	Division in which observation was done
Department	Department in which observation was done
Unit	Section in which observation was done
Location	Exact location of the line walk
Visit summary	Textural description of the observation
Type of line walk	Type of line walk done
Visited with	Name of team members
Duration	Duration for the line walk
Hazardous element*	The source of unsafe act or condition
Accident causing mechanism*	The act or condition which may cause the incident
Potential accident*	The consequential event if ACM is not prevented
Target*	The people or thing that is exposed to harm from accident
Threat*	The harm that may be caused if accident occurs
Potential event	The possible accident/incident that may occur
PPE	PPE requirement
Effective risk control system*	Presence of which control system
Preventive RCS*	RCS suggested for prevention
Mitigating RCS*	RCS suggested for mitigation

\*See Section 3.3.1 for definitions

### d) HAZOP Report

- (i) Sample parameters for HAZOP study (Note: the list is not exhaustive. The select HAZOP team must prepare the complete list of parameters for the system under study)

Process parameters	
<ul style="list-style-type: none"> <li>• Flow</li> <li>• Pressure</li> <li>• Temperature</li> <li>• Time</li> <li>• Level</li> <li>• Concentration</li> <li>• Phase</li> <li>• Power</li> </ul>	<ul style="list-style-type: none"> <li>• Volume</li> <li>• Composition</li> <li>• Viscosity</li> <li>• Agitation</li> <li>• Reaction</li> <li>• Component</li> <li>• Density</li> <li>• Vibration</li> </ul>

(ii) Sample guidewords for HAZOP study (Note: the list is not exhaustive. The select HAZOP team must prepare the complete list of guidewords for the system under study)

Guide Words	Meaning
• No	• Negation of the Design Intent
• Less/low	• Quantitative Decrease
• More/high	• Quantitative Increase
• Part Of	• Qualitative Decrease
• As Well As	• Qualitative Increase
• Reverse	• Logical Opposite of the Intent
• Other Than	• Complete Substitution
• Too long	• Quantitative Increase (Time)
• Too short	• Quantitative Decrease (Time)

(iii) Sample deviations (deviation = guideword + parameter) for HAZOP study (Note: the list is not exhaustive. The select HAZOP team must prepare the complete list of deviations for the system under study)

Guide word	Parameter	Deviation
NO	FLOW	NO FLOW
REVERSE	FLOW	REVERSE FLOW
MORE	PRESSURE	HIGH PRESSURE
LESS	PRESSURE	LESS PRESSURE
AS WELL AS	ONE PHASE	TWO PHASE

OTHER THAN	OPERATION	MAINTENANCE
FAST	REACTION	FAST REACTION
TOO LONG	TIME	TOO LONG TIME
HIGH	LEVEL	HIGH LEVEL

(iv) Sample HAZOP worksheet (Note: It is an example. The select HAZOP team may prepare a better one to record HAZOP analysis results)

SI No.	Study node	Deviation (guideword + parameter)	Possible causes	Possible consequences	Existing barriers*	Anticipated risk**	Recommended actions	Remarks, if any
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

\*Preventive and mitigative barriers; \*\*Use HSE or other risk matrix

### **Annexure III:**

#### **Benefits of collecting proactive data**

- (i) The hazard recognition reporting aims at identifying all the hazards and their possible accident causing mechanisms and consequences (accident scenarios). This allows in looking at any hazardous situations and conditions as chain of events that may lead to incidents.
- (ii) Understanding the hazard as chain of events allows precise estimation of its risk and identifying appropriate P-RCS and M-RCS.
- (iii) Moreover, hazard recognition through workplace inspection helps in identifying the hazards which are otherwise intrinsic to recognize through work system design study.
- (iv) Workplace observations not only intend to identify unsafe practices that exist in the workplace, but also bring it into the notice of employees at the same time. This helps in driving the attention of employees to the unsafe practices which they adopt unintentionally or negligently.
- (v) Explicitly announcing the unsafe acts and conditions and their possible consequences drives employees towards safety, since it shows the involvement of senior management in ensuring safe workplace and increases the confidence of employees towards safe environment.
- (vi) Workplace observations also captures information about the safe practices which motivates employees to adopt safe practices.

There are different types of analysis that can be carried out with the data stored in database. To name a few are given below.

- Hazard triangle and micro-hazard mapping & management
- Safety barrier analysis (Root cause analysis)
- Frequent accident causation path analysis
- High risk incident prediction
- Future accident/incident prediction
- Safety performance indicator analysis
- Safety rule generation

\*\*\*END\*\*\*