Procedure for Hazard Identification and Risk Assessment in Waste-water Treatment Planting Saudi Arabia

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Abstract *: It is well known that wastewater treatment projects worldwide has become one of the most important, vital projects and linked to civilization. Since potable water and irrigation for agriculture water considered a very low resources in the Kingdom of Saudi Arabia - desert regions - soit is necessary to pay more attention to these projects, which already happened, where billions of Saudi Riyals have been invested in the sewage and industrial water treatment projects.*
Wastewater treatment industryin Saudi Arabiahas expanded to include a lot of units and departments, machines and hundreds of workers and has become a danger to staff and the areas surrounding these stations.
In this research we mention the steps and methods to be used and followed by workers in dealing with the various hazards. We start by identifying the hazards then point out how to analyze these hazards and classified into several degrees according totheir severity.
However it's necessary to specify the responsibilities and roles of employees in dealing with these risks.

I. INTRODUCTION

There are two kinds of wastewater treatment plants in Saudi Arabia,industrial wastewater treatment plant and sanitary wastewater treatment plant. The industrial wastewater treatment plant is designed to treat incoming industrial wastewater from industries like factories and plants. The sanitary wastewater treatment plant is designed to treat incoming sanitary wastewater from community area.
Hazard assessments and controls help build safe and healthy workplaces. They are at the core of every organization's occupationalhealth and safety management system. The hazard assessment and control process provides a consistent approach for employers and workers to identify and control hazards in the workplace. It allowseveryone to focus their efforts in the right areas, andto develop worker training, inspections, emergencyresponse [1].
This research aims to identify the OH&S hazards of (equipment, substances and / or movements) which may cause harms -in order to determine the level of risk associated with the hazard and its controls.
The procedurecan be implemented for:

- Routine and non-routine activities.
- Activities for all personnel having access to the work place
- Activities of contractors and/or subcontractors.
- Facilities at the workplace (Water Treatment Plant, Workshop, Buildings, electrical Substation, warehouses for Spares and Material, labs, etc.…..).

II. Basic Terminology:

- **HSEC**:Health, Safety and Environment Committee.
- **Hazard**:source, situation, or act with a potential for harm in terms of human injury or ill health, or a combination of these.
- **Hazard identification**: process of recognizing that a hazard exists and defining its characteristics.
- **Risk**: combination of the likelihood of an occurrence of a hazardous event or exposure(s) and the severity of injury or ill health that can because by the event or exposure(s).
- **Risk assessment**: process of evaluating the risk(s) arising from a hazard(s), taking into account the adequacy of any existing controls, and deciding whether or not the risk(s) is acceptable.
- **Acceptable risk**: risk that has been reduced to a level that can be tolerated by the organization having regard to its legal obligations and its own OH&S policy

- **Behavior Based Safety (BBS):** workplace behaviors are what one sees when observing people conducting tasks in their workplace.
- **OH&S:** occupational health & safety.
- **HSER:** Health, Safety&environmental Management Representative.
- **IMS Management representative:** A member appointed by the top management to be responsible for certain quality, safety and environmental tasks irrespective of his other responsibilities.

III. THEWASTE WATER TREATMENT PLANT: AN OVERVIEW

Water is one of the most significant sectors in the Kingdom the National Water Company (NWC) established in 2008, as a Saudi joint stock company fully owned by the government (namely the Public Investment Fund), aims to provide water and wastewater treatment services in accordance with the latest international standards. This is achieved by the concerted efforts of national cadres in partnership with carefully selected international operators through foreign PPP.

NWC specializes in providing the highest quality drinking water, ensuring the presence of water and wastewater connections in all households, preserving natural water resources and the environment, using the Treated Sewage Effluent (TSE) with maximum efficiency, and training qualified Saudi employees in accordance with the latest international standards.

Throughout its new phase, NWC is able to implement radical changes in the water sector's performance. This was achieved through raising the company's operational efficiency in line with international standards, establishing a solid infrastructure that can accommodate the evolving demands of a growing KSA population, providing high-quality services to clients and customers, and investing all essential efforts for preserving natural water resources, protecting the environment, and ensuring sustainability.Figure 1.

Figure 1. Wastewater Treatment Plant

3. PROCEDURE

3.1 Hazard Identification

There are many hazards that may cause injury, illness. Hazard Identification is the basis for the risk assessment process. (Table 1) contains questions that will lead to identifying commonly observed hazards [2] and [3].

Table 1: Hazard Identification Checklist

		HAZARD IDENTIFICATION
A		**ENTANGLEMENT**
A1		Can anyone's hair, clothing, gloves, neck-tie, jewellery, cleaning brushes, rags or other materials become entangled with moving parts of the plant, or materials in motion?
B		**CRUSHING**
B1		Can anyone be crushed due to:
	a	Material falling off the plant?
	b	Uncontrolled or unexpected movement of the plant or its load?
	c	Lack of capacity for the plant to be slowed, stopped or immobilized?
	d	The plant tipping or rolling over?
	e	Parts of the plant collapsing
	f	Coming in contact with moving parts of the plant during testing, inspection, operation, maintenance, cleaning or repair?
	g	Being thrown off or under the plant?
	h	Being trapped between the plant and materials or fixed structures?
	i	Other factors not mentioned?
C		**CUTTING, STABBING & PUNCTURING**
C1		Can anyone be cut, stabbed or punctured due to:
	a	Coming in contact with sharp or flying objects?
	b	Coming into contact with moving parts of the plant during testing inspection, operation, maintenance, cleaning or repair of the plant?
	c	The plant, parts of the plant or working pieces disintegrating?
	d	Work pieces being ejected?
	e	The mobility of the plant?
	f	Uncontrolled or unexpected movement of the plant?
	g	Other factors not mentioned?
D.		**SHEARING**
1		Can anyone's body parts be sheared between two parts of the plant, or between two parts of the plant, or between a part of the plant and a work piece or structure?
E		**FRICTION**
E1		Can anyone be burnt due to contact with moving parts or surfaces of the plant?
F		**STRIKING**
F1		Can anyone be struck by moving objects due to:
	a	Uncontrolled or unexpected movement of the plant or material handled by the plant?
	b	The plant, parts of the plant or pieces disintegrating?
	c	Work pieces being ejected?
	d	Mobility of the plant
	e	Other factors not mentioned?
G		**HIGH PRESSURE FLUID**
G1		Can anyone come into contact with fluids under high pressure, due to plant failure or misuse of the plant?
H		**Working at height**

H1	Guardrail systems	
H2	Scaffolding system inspection and maintenance	
H3	All required PPEs are in use (helmet , safety shoes , gloves , etc....)	
H4	Working at height permits	
I	**ELECTRICAL**	
I1	Can anyone be injured by electrical shock or burned due to:	
	a	The plant contacting live electrical conductors?
	b	The plant working in close proximity to electrical conductors?
	c	Overload of electrical circuits?
	d	Damaged or poorly maintained electrical leads & cables?
	e	Damaged electrical switches?
	f	Water near electrical equipment?
	g	Lack of isolation procedures?
	h	Other factors not mentioned?
J	**EXPLOSION**	
J1	Can anyone by injured by explosion of gases, vapours, liquids, dusts or other substances, triggered by the operation of the plant or by material handled by the plant?	
K	**Confined space**	
K1	Confined spaces Work permits	
K2	Confined space safety inspection	
K3	Using suitable PPEs for working at confined spaces (helmets , safety shoes, oxygen cylinders	
L	**SLIPPING, TRIPPING & FALLING**	
L1	Can anyone using the plant, or in the vicinity of the plant, slip, trip or fall due to:	
	a	Uneven or slippery work surfaces?
	b	Poor housekeeping.
	c	Obstacles being placed in the vicinity of the plant?
	d	Other factors not mentioned?
L2	Can anyone fall from a height due to:	
	a	Lack of proper work platform?
	b	Lack of proper stairs or ladders?
	c	Lack of guardrail or other suitable edge protection?
	d	Unprotected holes, penetrations or gaps?
	e	Poor floor or working surfaces, such as the lack of slip resistant surfaces?
	f	Steep walking surfaces?
	g	Collapse of the supporting structure?
	h	Other factors not mentioned?
M	**ERGONOMIC**	
M1	Can anyone be injured due to:	
	a	Poorly designed seating?
	b	Repetitive body movement?

	c	Constrained body posture or the need for excessive effort?
	d	Design deficiency causing mental or psychological stress?
	e	Inadequate or poorly placed lighting?
	f	Lack of consideration given to human error or human behaviour?
	g	Mismatch of the plant with human traits and natural limitations?
	h	Other factors not mentioned?
N	**SUFFOCATION**	
N1	Can anyone be suffocated due to the lack of oxygen, or atmospheric contamination?	
O	**HIGH TEMPERATURE OR FIRE**	
O1	Can anyone come into contact with objects at high temperatures?	
P	**TEMPERATURE (THERMAL COMFORT)**	
P1	Can anyone suffer ill health due to exposure to high or low temperature?	
Q	**OTHER HAZARDS**	
Q1	Can anyone be injured or suffer ill-health from exposure to:	
	a	Chemicals?
	b	Biological?
	c	Toxic gases, vapours or fumes?
	d	Dust?
R	**OTHER HAZARDS (Cont'd)**	
	e	Noise?
	f	Vibration?
	g	Radiation?
	h	Other factors not mentioned?
S	**ENTRAPMENT**	
S1	Can anyone be locked or trapped in an area of space?	

3.2 Risk Assessment Team

A team approach is adopted for the risk assessments where representatives from relevant work places make up the risk assessment team, and are actively involved in the risk assessments. Team members consist of (At least)

- One Safety department representative,
- One area Section Head or supervisor
- One of the HSERs members.

It should be noted that:

- Team members must be trained on this risk assessment method and procedure.
- TheHSEC will lead the team as the risk assessment advisor/moderator.
- Risk assessment team identifies the hazards using hazard identification, Risk assessment and observation record sheet form (HSE-HI/FR01) which reviewed by the process owner manager and approved by HSSE Manager.
- Team members can include others up to six persons if needed.

3.3 Risk Identification and Assessment

When the hazard identification is completed, the following questionsare asked:

- What is the severity or consequences of the hazard (e.g. injury, damage, spillage, business interruption, fire, explosion, etc.)? As a rule, the most severe consequence is considered.
- What is the probability of occurrence? The probability should be estimated from previous experiences or, if possible, with the help of statistics.
- Is the hazard related to any Legal Requirement? Any hazard related to legal requirement and not compiling with it; the severity should be 5.
  Using the severity and probability criteria defined below, the risk can be introduced into a Risk Matrix based on [4] and [5].

RISK = SEVERITY × PROBABILITY

3.4 Acceptable Risks

Acceptable risks of potential and/or existing hazards will be determined per hazard after finalizing the preparing of risk assessment sheet and applying the necessary control, which has to comply with legal obligations, canbe tolerated by the organization & will be updated per risk assessment updating.

3.5 Behavior Based Safety (BBS)

Everybody who works to reduce accidents and improve safe performance is concerned with human behavior. "Behavior and accidents is what it's all about," is a commonly heard phrase[6].

Behavior is defined as "an observable act"; i.e. workplace behaviors are what one sees when observing people conducting tasks in their workplace. The behavior is assessed as dangerous action, dangerous condition or positive point.

The BBS objective is improving the safety at work by privileging constructive dialogs and eliminating hazardous working conditions and acts [7].

Since the risk assessment will include person's behaviors, which isthe base of culture change, the following steps will be followed whenassessing employee's behavior

Announce your visit to the person to be visited and to his Supervisor (at the latest 24 hours before the visit)

- Explain to him the objective of your visit
- Observe the person work (10-15 minutes)
- Identify: The positive points (PP) - The Dangerous Acts (DA) - The Dangerous Conditions (DC).

After the observation, engage the dialog with the visited person, starting with the positive points (PP) that the visitors have observed.

Make him aware of the DC & DA and what are the improvements that could be done right now?

Each Process Owner is responsible for updating the hazard identification; risk assessment & observations register on annual basis.

If a major change in the process takes place the Head of Department is responsible for updating the hazard identification, risk assessment & observations Register and informing the department Health & Safety Coordinator. Changes could be the following and other pertinent information:

- Installation of new Equipment or new material
- Asset Transfers
- After Reported Accidents
- Machine Acceptance of Modified Equipment
- Chemical Approval Requests
- Operational Reviews
- Management Reviews.

Table 2: Criteria for evaluating the severity

Severity of Consequences					
Category/ Descriptive Word	**Personnel Illness/ Injury**	**Equipment Loss ($)**	**Down Time**	**Product Loss ($)**	**Environmental Effects**
5 CATASTROPHIC	Death	>1M	>1 Month	>1M	Long-term (>5yrs) environmental damage or requiring >$1M to correct and/or in penalties
4 CRITICAL	Severe injury or severe occupational illness >2 Week hospitalization	250K to 1M	1 Month to 1 week	250K to 1M	Medium-term (1-5 yrs) environmental damage or requiring $250K - $1M to correct and/or in penalties
3 SIGNIFICANT	Major injury or major occupational illness <2 Week hospitalization	50K to 250K	3 days to 1 week	50K to 250K	Short-term (3 mo-1 yr) environmental damage or requiring $50K - $250K to correct and/or in penalties.
2 MARGINAL	Minor injury or minor occupational illness No hospitalization Day case	1K to 50K	1 day to 3 days	1K to 50K	Brief-term (<3 mo) environmental damage or requiring $1K - $50K to correct and/or in penalties.
1 NEGLIGIBLE	First Aid No injury or illness	<1K	<1 day	<1K	Minor environmental damage, readily repaired and/or requiring <$1K to correct and/or in penalties

Table 3: Criteria for evaluating the probability

PROBABILITY		
Level	**Descriptive word**	**Definition**
5	**FREQUENT**	Expected to occur in all circumstances (Once per week)
4	**PROBABLE**	Expected to occur in most circumstances (Once per month)
3	**OCCASIONAL**	Will probably occur in most circumstances (Once per year)
2	**REMOTE**	Might occur at some time (Once per 10 years)
1	**IMPROBABLE**	Could occur at some time, but less possible (Once per 100 years)

Table 4: Risk Matrix

Probability	**5**	**5**	**10**	**15**	**20**	**25**
	4	**4**	**8**	**12**	**16**	**20**
	3	**3**	**6**	**9**	**12**	**15**
	2	**2**	**4**	**6**	**8**	**10**
	1	**1**	**2**	**3**	**4**	**5**
		1	**2**	**3**	**4**	**5**
		Severity				

Legend		
≥20	E	Extreme risk - immediate action required (Red)
>10&<20	H	High risk - urgent management attention needed (Yellow)
>5 & ≤10	M	Medium risk - management attention as soon as possible (Green)
≤5	L	Low risk – non urgent management attention needed (White)

Table 5: Risk assessment procedure steps.

Step	Action	Explanations
1	Decide to perform a risk assessment	The risk assessment may be the result of: • New equipment being introduced or existing equipment or workplace being modified • Significant changes being introduced to the tasks performed in the workplace; • Safety control systems being modified; • Regulatory requirements • Equipment that is being used for another purpose • New information about the identified hazards being available • An incident investigations revealing new information regarding workplace hazards and/or the level of risk • An accident.
2	Establish a risk assessment team	A team of trained and appropriate people covering all domains of the projected assessment shall conduct the risk assessment. Team to be no more than 6 people.
3	Identify the hazards	Is there a hazard or issue (e.g. electricity, chemicals, thermal stress, moving equipment, human error, external event, etc.)? As an aid for assessors, Appendix A contains questions that will lead to identifying commonly observed hazards.
4	Assess the risk for all the hazards identified in Step 3 above	The Risk Assessment Team • Evaluates what is the likely severity (consequence) of such a hazard • Evaluates what is the probability of the hazard causing injury or loss.
5	Prioritize the risk	The severity and probability are introduced onto the Risk Matrix to prioritise the risks as: E: Extreme risk; immediate action required H: High risk; urgent management attention needed M: Medium risk; management attention as soon as possible L: Low risk; longer term action may be required
6	Develop action plans	Identified risks shall be prioritised for action and control measures. The following hierarchy will apply to reduce the risk as far as practicable: • Elimination; • Substitution; • Engineering controls; • Signage/warnings and/or administrative controls; • Personal protective equipment.
7	Communicate results and arrange training	The outcomes of risk assessments shall be communicated to all concerned people. Existing and new staff working in the assessed workplace must be made aware of the risks and trained on the mitigation and control measures.

3.6 Responsibility

3.6.1. The HSC in each department is responsible for maintainingthe hazard identification; risk assessment & observations register for each area.

3.6.2. OH&S Manager is responsible to review and update this procedure.

3.6.3. OH&S Manager is responsible to coordinate or establishing of hazard identification and risk assessment for subcontractors' activities and setting the need of controls with the concerned departments.

3.6.4. OH&S Manager is responsible for setting the need of controls for visitors as well as safety training & awareness of new employees.

IV. CONCLUSIONS

The employer's hazard assessment and management will determine, in large part which Standards and procedure shall be used in the workplace to provide safe and healthful working conditions. Therefore, it will be incumbent for the employer, and / or all persons involved in the hazard assessment to know which Standards will apply to any given situation.

References

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