# Guide in Developing Sanitation Safety Plan (SSP) for health facilities

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# INTRODUCTION TO SANITATION SAFETY PLAN

SANITATION SAFETY PLANNING (SSP) is a step-by-step risk-based management tool for sanitation systems. It can be applied to the entire sanitation chain to ensure that all systems are managed to meet the required health objectives.

SSP is a guide to facilitate drafting and implementation of health risk assessment and management plans along the sanitation chain to meet the *Sustainable Development Goal 6 (SDG 6)* – to ensure the availability and sustainable management of water and sanitation for all.

SSP will ensure *safely managed* and *safely treated* wastewater. Specifically, it will provide assurance to the authorities and the general public on the safety of effluents for discharge or re-use.

# TARGET USERS AND PURPOSE OF GUIDE

This document is intended to provide guidance and assistance to the sanitation service providers in developing their own Sanitation Safety Plan. This document is based on the *2015 World Health Organization Sanitation Safety Planning Manual*. This guide was also based on the actual steps and procedures done during the development of the ten new pilot SSPs. All the learnings and experiences during the activity were considered in developing this guide.

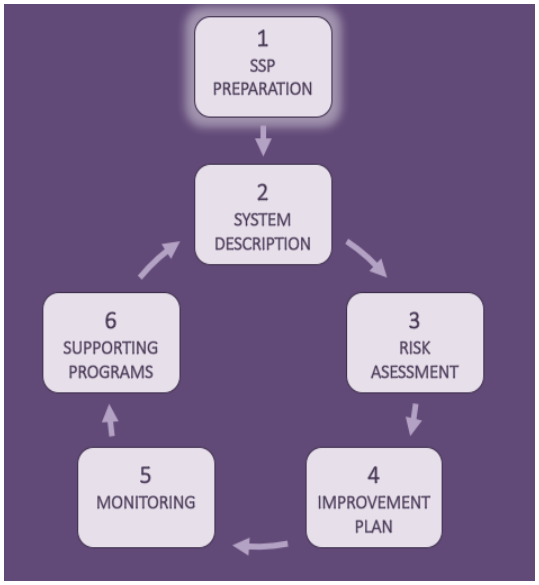
This document is divided into six sections representing the six modules in developing the SSP. The six modules as well as the expected outputs from each module is presented in **Table 1**.

**Table 1: SSP Module and Outputs**

| SSP Module | Output |
|---|---|
| **Module 1:**<br>**Prepare for Sanitation Safety Plan** | • Agreed study area/s, objective, scope, boundaries and leadership for SSP;<br>• SSP Team Composition;<br>• Identified Stakeholders |
| **Module 2:**<br>**Describe the Sanitation System** | • A validated map and description of the system;<br>• Identification and characterization of waste streams;<br>• An understanding of the factors affecting the performance and vulnerability of the system;<br>• A compilation of all other relevant technical, legal and regulatory information |
| **Module 3:**<br>**Identify hazardous events, assess existing control measures and exposure risks** | • Identified exposure groups and exposure routes;<br>• A risk assessment table which includes a comprehensive list of hazards, and summarizes hazardous events, exposure groups and routes, existing control measures and their effectiveness;<br>• A prioritized list of hazardous events to guide system improvements; |
| **Module 4:**<br>**Develop and implement an incremental improvement plan** | • List of options of control measures for prioritized risks;<br>• An improvement plan based on the options identified |
| **Module 5:**<br>**Monitor control measures and verify performance** | • An operational monitoring plan;<br>• A verification monitoring plan;<br>• Auditing of System |
| **Module 6:**<br>**Develop supporting programmes and review plans** | • Supporting programmes and management procedures;<br>• Periodic review and update of SSP |

## MODULE 1

# PREPARATION OF SSP




This process identifies the priority areas, the specific public health objectives of the SSP and the scope and boundaries in the sanitation chain that need to be included to meet the objectives. Also, a multi-disciplinary team will be assembled for the development and implementation of the SSP and stakeholders

**1.1 Establish priority areas or activities**

This action will help to identify the foci of the SSP. This should ensure that the SSP addresses the areas or activities that pose the greatest health risks.

**1.2 Set Objective**

Specific sanitation safety objectives must be developed to clearly define the purpose of the SSP. Overall objective must always be related on promoting improved public health outcomes however, other objectives may be related to wastewater management and its use.

**1.3 Define the system boundary and lead organization**

The SSP boundary may be defined by the specific sanitation safety objectives developed.

The lead organization responsible for each sanitation steps within the boundary may vary depending on the limits and purpose of the plan. The lead organization does not need to be responsible for all the sanitation steps within the boundary.

**1.4 Assemble the team**

The main criterion for identifying the members of the SSP Team is that they should be directly involved with the operation of the system. It is important to carry out a stakeholder analysis.

It is important to divide the responsibilities between members of the group from the start of the process and clearly define and record their roles.

## 1.1. Study Area and Existing Sanitation System

The study area is the specific location where the SSP will be implemented. The existing sanitation system or sanitation activities within the study area must be identified and clearly defined, starting from the point of wastewater generation until the treatment and final disposal of wastewater and other waste products generated by the sanitation system.

A sanitation system map of the study area must be developed and presented in the SSP. This will be used as basis for the SSP Objectives and SSP System Boundary.

## 1.2. Identification of SSP Objectives

The SSP objectives is based on the existing sanitation system within the study area. The overall objective of the SSP must be for the protection of the health of specific groups (e.g. workers, local community, farmers) who are exposed to the sanitation system within the study area. Other objectives may be related to:

- Improvement of wastewater management and its use;
- Promote safe disposal and/or re-use of wastewater and Biosolids;
- Protect the environment from possible pollution caused by disposal of wastewater.

## 1.3. Defining System Boundary and Lead Organization

The system boundary sets the limits or the extent up to which the SSP will be applied to. The system boundary should reflect the specific SSP objectives identified. In defining system boundaries, the following must be considered:

- The scope of operations of a sanitation system;
  - These are the activities and components of the sanitation system within the study area that the lead organization has control.
- Administrative boundaries;
  - This covers the area/s where the lead organization of the SSP has the authority or power to implement the SSP.
- Sanitation catchment area;
  - This is the area/s where the waste products generated by the sanitation system are disposed (e.g. disposal of the treated effluent, disposal of biosolids)
- Area where waste products are used;
  - This refers to the re-use of wastewater and biosolids.
- Protection of specific exposure group.
  - These are specific groups that can be exposed to the sanitation system.

For each sanitation activity or components within the system boundary, a lead organization must be identified. The lead organization is the one responsible in the operation of the specific sanitation activity.

## 1.4. Identifying SSP Team Members

For the development of the SSP and to ensure the implementation of the SSP, a team must be formed. The main criterion for identifying the members of the SSP Team is that they should be

directly involved in the operation of the system. It is important that the members of the SSP team is knowledgeable to the activities of the sanitation system.

A team leader must be assigned to lead the development and implementation of the SSP. The team leader must have the authority, organizational and interpersonal skills to ensure that the SSP can be implemented.

The roles and responsibilities of each members must be divided and clearly defined. It is important to ensure that every sanitation step has an assigned member to monitor. When identifying team members and assigning their responsibilities, the following must be considered:

- Are all steps of the sanitation chain within the system boundary represented?
- Are day-to-day technical operational skills included?
- Does one or more member have an understanding of management systems and emergency procedures?
- Do members have the authority to implement recommendations stemming from the SSP?
- How will the work be organized? Will the activities be regular or periodic?
- Can the team activities be done as part of regular activities?
- How will documentation be organized?
- What external technical support can be brought in to support the team?

The team composition and assigned roles to each must be recorded. A suggested template that can be used is shown in **Table 2**.

The SSP development and implementation require time and some direct costs (e.g. training cost, sampling and testing cost, other costs that will be identified in the implementation plan). Management support will be needed for the SSP process to allocate staff time and any funding needed as the SSP is being conducted. A template for management support is shown in **Appendix A**.

## 1.5. Identifying Stakeholders

Multi-stakeholders should be identified to ensure that all the sanitation steps outside the responsibilities of the lead organization are represented. The stakeholders that can be considered are those who:

- have direct control over some aspects related to wastewater management and use (e.g. regulatory authorities such as LGU, DENR-EMB, DA and DOH);
- have some influence over the practices that affect wastewater use safety (e.g. farmer cooperatives who re-uses wastewater and biosolids for agricultural use);
- provides services needed by the operation of the sanitation system (e.g. desludgers of septic tanks, solid waste collectors)
- are affected by the operation of the sanitation system (e.g. local community, workers);

The roles of the stakeholders in the development and implementation of the SSPs must be identified and recorded using the suggested template below.

**Table 2: Suggested SSP team membership recording form**

| ROLE IN THE SSP TEAM | SPECIFIC RESPONSIBILITIES | NAME | POSITION IN THE ORGANIZATION | ADDRESS AND CONTACT DETAILS |
|---|---|---|---|---|
| | | | | |

**Table 3: Suggested SSP stakeholders recording form**

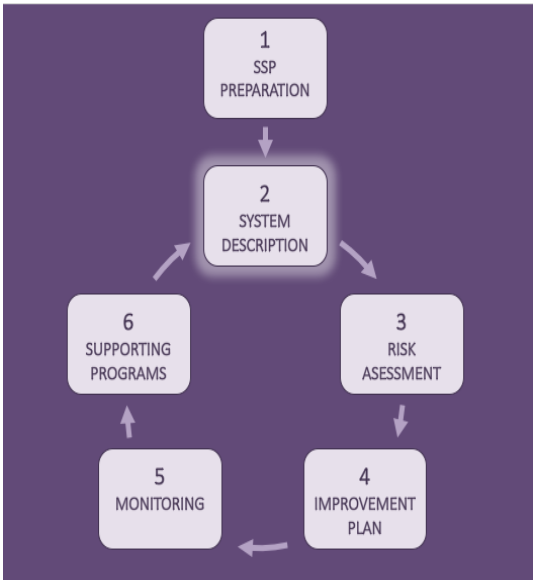
| TITLE/ORGANIZATION | ROLE IN THE SSP |
|---|---|
| | |

MODULE 2

# DESCRIPTION OF SANITATION SYSTEM

The main objective of Module 2 is to generate a complete description of the sanitation system within the boundary identified in Module 1.

A thorough understanding of all parts the sanitation system and its performance requirements supports the subsequent risk assessment process.




**2.1 Map the System**

A complete description of each sanitation step within the system boundaries must be generated. The system map must follow the path of all the fractions of the waste, from the point of generation to its use or disposal. Flow diagram or geographic map may be used to map the system. It is important that the system map is accurate.

**2.2 Characterize the waste fraction**

The waste characterization aims to identify all the composition (physical, chemical and microbiological) of the waste streams in the sanitation system.

**2.3 Identify potential exposure groups**

Group of people that are possibly exposed to the hazards are identified as well as to where and how, within the system, the exposure occurs.

**2.4 Gather compliance and contextual information**

Controlling and managing system risks is closely linked to quality standards, monitoring system management and performance, demographic aspects and land use patterns, as well as climate change and seasonal conditions; therefore, it is very important to collect all available information on these subjects

**2.3 Validate the system description**

System validation should provide evidence of the stated system characteristics and performance. This can be done by conducting a filed investigation such as sanitary inspections and surveillance, focus group discussions, key informant interviews and collection of samples for laboratory.

## 2.1. Map the System

It is important that the SSP presents the complete process of the sanitation system within its system boundary. The components of the sanitation system for this SSP are detailed in this section. The subsequent risks assessment needs to be supported by a thorough understanding of all parts of the sanitation system and its performance requirements. The system map must follow the path of all wastes from the point of generation up to its use or disposal.

In mapping the system, the following can be considered to ensure that all points within the system are included:

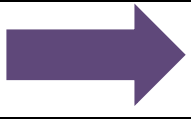
- All sources of wastes-both point and non-point sources;
- All used and disposed parts of the waste stream have been accounted for;
- All significant existing potential barriers;
- Drinking-water sources, if relevant to the system or could be affected by the system

***Important Note*:**

Waste streams within the sanitation system may include:

- Raw wastewater (e.g. black water, greywater);
- Drainage water;
- Pre-treated effluent of septic tanks;
- Septage;
- Fat, oil & grease;
- Treated effluent;
- Excess sludge from treatment process;
- Solid wastes that are contaminated by the wastewater (e.g. solid wastes from bar screens of STP, solid wastes collected in the drainage)

The method chosen for mapping will depend on the scale and complexity of the system. Flow diagram or geographic map may be used to map the system. If flow diagram is used to map the system, symbols are suggested to be used to represent the different sanitation steps (e.g. circle for process, arrow for transportation and rectangle for waste streams). Codes can be also used for each sanitation step for easier reference (e.g. P1, P2, P3… for process and T1, T2, T3… for transportation).

| Legend | Meaning |
|---|---|
|  | Process |
|  | Transport |
|  | Waste streams |

## 2.2. Description of Sanitation Steps

The sanitation steps must be clearly described in detail to help the SSP team in identifying the hazards and hazardous events in the system. At each step, the team should record available quantitative information about the waste streams (e.g., flow rate, design capacity) of each treatment element. It will also be helpful to understand the variability of the system. The team must ensure that all the sanitation activities in the system map are described in this section.

**Table 4** shows some of the relevant information to be gathered to help the team in describing the sanitation steps. Every sanitation system is unique; therefore, the team must only collect data that are applicable or relevant to their system.

***Important Note*:**

Treated effluent can be re-used in:
- Landscaping;
- Flushing of toilets;
- Irrigation of crops

Biosolids can be re-used as:
- Fertilizer;
- Soil Conditioner

**Table 4: Guide on describing sanitation steps**

| Sanitation Step/Component | Information to be gathered |
|---|---|
| Toilet wastewater generation | - Number of toilets |
| Kitchen wastewater generation | - Number of grease traps installed |
| Septic tanks | - Type of septic tank (e.g. watertight, bottomless);<br>- Number of septic tanks;<br>- Location of septic tanks;<br>- Frequency of desludging of septic tanks;<br>- Discharge of pre-treated effluent of septic tank (e.g. to sewer lines, to drainage) |
| Sewer networks | - Number of manholes;<br>- Length of sewer pipes;<br>- Location of lifting stations |
| Wastewater treatment plant | - Treatment capacity;<br>- Daily flow rate;<br>- Treatment process;<br>- Process flow diagram;<br>- Design capacity of tanks |
| Effluent Outfall | - Location of effluent outfall;<br>- Classification of the receiving water body |
| Recycling of wastewater | - Purpose of recycling (e.g. landscaping, flushing of toilets, irrigation of crops);<br>- Volume of recycled wastewater used |
| Re-use of sludge/biosolids as soil conditioner or fertilizer | - Location of farm where the biosolids is re-used;<br>- Treatment of biosolids;<br>- Cooperative who uses the biosolids |
| Disposal of biosolids or excess sludge of treatment process | - Volume of excess sludge or biosolids disposed;<br>- Biosolids management<br>- Location of disposal |

## 2.3. Characterization of Waste Fraction

In the system map, the composition of the waste streams generated by the system are known and the path of these wastes through the sanitation system is established. To completely identify and assess the potential hazards, the composition of these wastes must be known at all key control points.

When characterizing waste streams, the following factors must be considered:

- The source(s) of the waste;
- The main composition of the waste in terms of liquid and solid fractions;
- The potential for accidentally mixed components of the waste that may pose risk;
- The likely concentration of physical and chemical pollutants and pathogenic microorganisms of the waste

Once the waste streams are characterized, potential health hazards of these wastes must be identified by the team. A suggested template for identifying potential health hazards of the identified wastes are shown in the **Table 5**.

## 2.4. Validation of System Description

System validation ensures that the information gathered in describing the sanitation system is complete and accurate. This can be done by conducting a filed investigation such as sanitary inspections and surveillance, focus group discussions, key informant interviews and collection of samples for laboratory.

**Table 5: Initial identification of potential health hazards of the identified waste components**

| WASTE COMPONENTS | BIOLOGICAL HAZARD | CHEMICAL HAZARD | | PHYSICAL HAZARD | | |
|---|---|---|---|---|---|---|
| | Virus, Bacteria, Helminths, Protozoa, Vector Related Diseases | Toxic Chemicals | Heavy Metals | Sharp Objects | Inorganic Material | Malodors |
| **Input** | | | | | | |
| *This includes the type of wastewater generated in the source (e.g. black water, greywater)* | | | | | | |
| **Output** | | | | | | |
| *This includes all the wastes generated by the sanitation system (e.g. effluent, septage, FOG, excess sludge, screenings etc.)* | | | | | | |

## 2.5. Gathering of compliance and contextual information

For the compliance to legal requirements and other relevant information, the following should be considered when gathering information. This will have an impact on the development and implementation of the SSP.

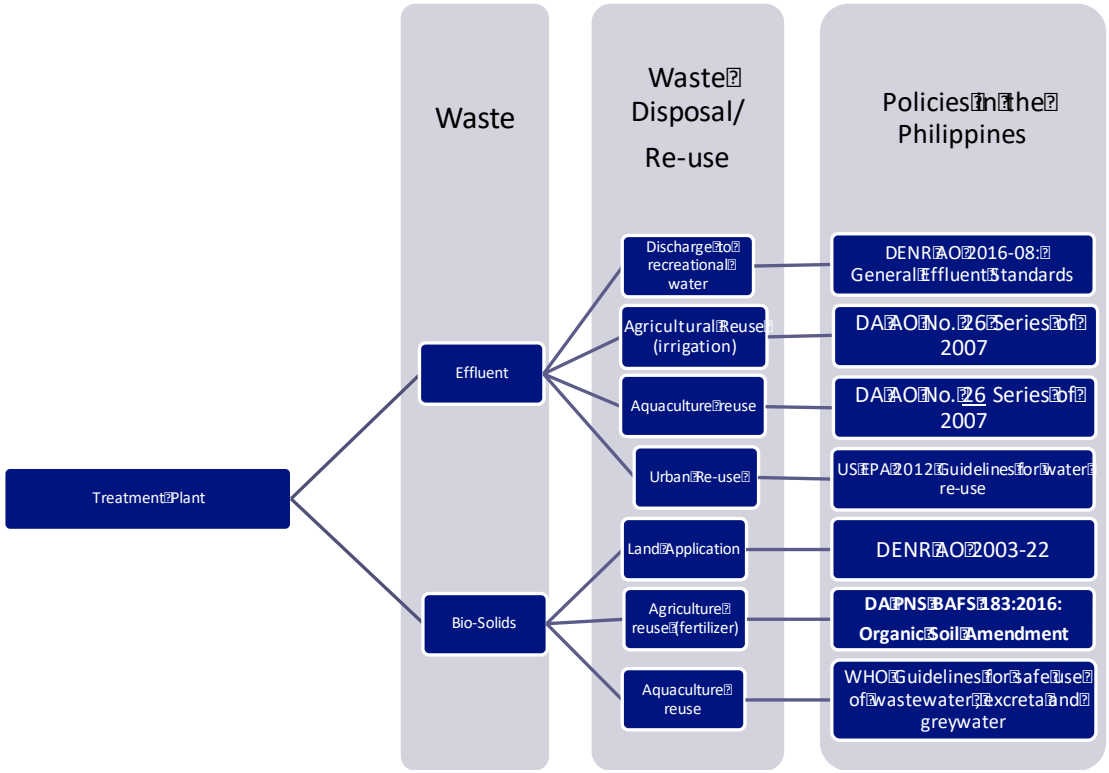
**Table 6: Information to be gathered for contextual and compliance requirements**

| Factors | Information to be gathered |
|---|---|
| Relevant quality standards, certification and auditing requirements | • Relevant laws relating to public health and the environment;<br>• Regulations on effluent disposal and discharges and odor regulations;<br>• Specifications on planning related to spatial planning of urban areas, vulnerable environmental areas and agricultural/pasture land and restrictions;<br>• Specific national regulations related to agricultural products;<br>• Specific national guidelines for preparedness or disaster planning;<br>• Regulations related to quality monitoring, surveillance and system auditing (not financial), and;<br>• Certification requirement related to agricultural end products. |
| Information related to system management and performance | • Data on monitoring and surveillance of the system;<br>• Frequency of documentation;<br>• If faults and/or deviations were followed-up;<br>• Epidemiological data on the groups of people involved, and<br>• Type and amount of products produced. |

| Factors | Information to be gathered |
|---|---|
| Demographics and land use patterns | • Location and population of human settlements, especially informal ones;<br>• Special activities that could have impact on sanitation/wastewater production;<br>• Special equity considerations concerning ethnicity, religion or specific communities/group of user, and;<br>• Other land uses, such as industry, commercial, livestock and recreational activities |
| Known or suspected changes relating to weather or other seasonal conditions | • Mean variability of the load to the treatment plant over the year;<br>• Seasonal variation of use due to type of crops and harvest;<br>• Additional inflow areas during heavy rainfall and implications on the treatment steps, and;<br>• Changes in usage patterns in time of water scarcity |

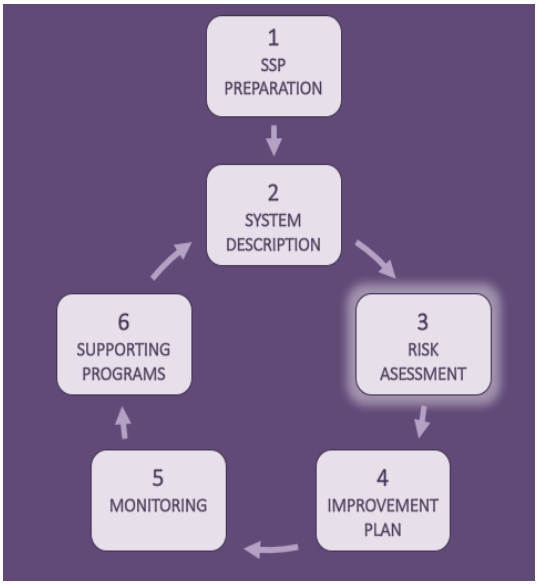
The figure below shows an overview of the existing policies in the Philippines regarding the disposal and re-use of wastewater and biosolids. In the absence of Philippine policy, international standards are suggested to be used as guide.

**Figure 1:Policies overview on disposal and re-use of wastewater and Biosolids in the Philippines**



MODULE 3

# IDENTIFICATION OF HAZARDOUS EVENTS & ASSESSMENT OF EXISTING CONTROL MEASURES AND EXPOSURE RISKS




The main objective of this SSP is to protect the health of the public who are exposed to the hazards of the sanitation system. Specifying each step in the system is essential in determining potential hazards and hazardous exposure events for the exposure groups. Each step within the sanitation system boundary of this SSP was revisited to trace the pathways that may lead to pollution or incidence of disease. Each component of the sanitation system was studied to trace exposure event that may pose hazards to humans.

Furthermore, the existing control measures were identified and assessed whether such control measures, if not completely eliminate, decreases the risks of the hazards. Exposure risks were also assessed and prioritized.

**3.1 Identify hazards and hazardous events**

The team should identify and their associated hazardous events at each sanitation step along the system boundary.

**3.2 Refine exposure groups and exposure routes**

To identify who may be at risk and how the risk occurs during the operation of the sanitation system or when using its products, in relation to the identified hazards and hazardous events.

**3.3 Identify and assess existing control measures**

For each hazardous event identified, control measures that are already in place as well the effectivity of the control measure to reduce the risks are identified. Control measures can be evaluated by considering its potential and actual performance.

**3.4 Assess and prioritize the exposure risk**

The risks can be serious, moderate or potentially insignificant. Therefore, in this stage of the plan the SSP Team should establish the risk associated with each hazard and then prioritize the most serious risks.

## 3.1. Identification of Hazards and Hazardous Events

The team must identify the hazards of each sanitation step and their corresponding hazardous events. Hazard identification is a combination of desktop exercise and field investigation. In order to do this, the team must have a technical understanding on how the various components of the sanitation system work in theory and in practice.

### 3.1.1. Hazards

In Module 2, the possible hazards of the waste streams considered in the SSP are identified. Typical hazard types related to the operation of a sanitation system is shown in **Table 7.**

**Table 7: Typical hazard types in sanitation system**

| Hazard Type | Examples |
|---|---|
| Microbial Pathogens | • Bacteria, parasitic protozoa and viruses in water from faecal sources<br>• Helminths<br>• Vector-borne pathogens |
| Chemicals | • Heavy metals in sludge or Biosolids from industrial sources<br>• Herbicides and pesticides<br>• Chemicals used in the sewage treatment process |
| Physical | • Sharps<br>• Odours<br>• Physical injury<br>• Skin irritants |

### 3.1.2. Hazardous Events

The SSP Team should identify the following hazardous events:

- **Hazardous events associated with the normal operation of the system**

These hazards may include the possibility of defective infrastructure, system overloads, lack of timely maintenance, operator error, involuntary contact by operators with hazardous waste, excessive emanations of gas and smells, excessive accumulation of waste, etc.

- **Hazardous events due to system failure or accident**

It is also highly likely that failures or accidents will occur during the operation of the system, often caused by events not connected with the operation itself, such as electricity blackouts, accidental spillages of hazardous waste, treatment failure, equipment breakdown, etc.

- **Hazardous events related to seasonal or climatic factors**

Hazards can also be due to failures or accidents generated by seasonal and climate changes such as flooding or drought, seasonal changes in the behavior of the system, change in quality of the influent due to heavy rainfall, etc.

- **Indirect hazards or hazardous events**

These are hazards that potentially affect people who are not directly involved in the sanitation chain. These include vermin, vector proliferation, effects of waste discharges into the rivers, irrigation canals and fields and to the downstream communities, etc.

- **Cumulative hazards**

Some hazards are not evident under ordinary circumstances but could have a progressive impact on the health of those involved or on the environment inside and outside the system. For example, soil quality deterioration, soil salinity, eutrophication of water sources, and bio-accumulation of toxic compounds in irrigated products, etc.

## 3.2. Identification of Exposure Groups and Exposure Routes

Identified hazard and hazardous exposure events must be related to its corresponding exposure groups and the routes by which these groups may be affected. Clear and precise identification of the exposure group and exposure routes are significant to address well the possible health hazards and to identify the proper control measures.

### 3.2.1. Exposure Groups

The team must identify all possible group of people that may be exposed to the identified hazardous events. Exposure groups can be categorized as shown in the **Table 8** below.

**Table 8: Exposure group categories**

| Exposure Group Category | Description |
|---|---|
| Workers | • People who are directly involved in the operation, repair, maintenance and cleaning of the sanitation system.<br>• Users of recycled effluent (e.g. for landscaping, vehicle washing) |
| Local Community | This may include people who are living:<br>• near the treatment plant;<br>• near the farm where biosolids are used;<br>• near the body of water where wastewater is discharged;<br>• near the landfill where biosolids are disposed;<br>• tourists (local/international);<br>• users of recycled effluent (e.g. for flushing of toilets) |
| Farmers | • People who uses wastewater to irrigate their crops<br>• People who uses biosolids as soil conditioner or fertilizer. |

| Exposure Group Category | Description |
|---|---|
| Consumers | People who consume or use products (e.g. crops, fish or compost) that are produced using sanitation waste products. |

The exposure groups must be further categorized and defined in detail based on:

- How or what activities they do that exposes them to the identified hazardous events.;
- Number of people that are directly and indirectly exposed;
- Where the exposure may occur within the sanitation system.

Suggested template for exposure group identification as well as sample of further classification of the exposure groups is presented in **Table 9.** Each sub-category of the exposure group has assigned code as reference.

**Table 9: Template for exposure group identification**

| Exposure Group | Reference | Description | No. of exposed individuals |
|---|---|---|---|
| Workers | W1 | Workers that repairs and maintain the sewer system | |
| | W2 | Workers involved in the desludging of septic tanks | |
| | W3 | Workers involved in the operation of the sewage treatment plant | |

### 3.2.2. Exposure and Transmission Routes

The primary health hazards associated with wastewater and biosolids are excreta-related pathogens, some vector-borne disease and certain chemicals. These health hazards can be transmitted to humans thru direct contact exposure (primary) to the contaminated wastewater or through an external exposure (secondary) by consuming products that used contaminated wastewater or by vectors such as mosquito and flies. Transmission can also occur through the air, as with inhalation aerosols and contaminated particles. Common exposure routes of the hazards are shown in **Table 10.**

**Table 10: Common exposure routes of hazards in sanitation**

| Exposure and Transmission Route | Description | Hazards |
|---|---|---|
| Ingestion of pathogens and chemicals after contact with wastewater/excreta | Transfer of excreta (urine and/or faeces) through direct contact to the mouth from the hands or items in contact with the mouth including ingestion of contaminated soil via contact with hands (e.g. farmers or children). | Pathogens, Chemicals |
| Ingestion of contaminated groundwater/surface water | Ingestion of water, drawn from a ground or a surface source, which is contaminated from wastewater or excreta/sludge including unintentional ingestion of recreational waters by swimmers/bathers. | Pathogens, Chemicals |
| Consumption of contaminated produce(vegetables) | Consumption of plants (e.g., lettuce) that have been grown on land irrigated or fertilized with a sanitation product. | Pathogens, Chemicals |
| Dermal contact with excreta and wastewater | Infection where a pathogen (e.g. hookworms) enters through the skin via the feet or other exposed body part following contact with wastewater, excreta, open defecation, contents of leaking sanitation technologies or during operation (e.g., pit emptying). | Pathogens, Chemicals, Skin irritants |
| Contact with vectors (e.g. flies, mosquitoes) | Transmission routes include the mechanical transfer of excreta by flies to a person or food items, and bites from a mosquito or other biting insects, which could be carrying a disease. | Vectors |
| Inhalation of aerosols and particles | The inhalation of micro-droplets of water and particles (which may not be noticeable) emanating or resulting from a sanitation technology, which may carry a pathogen dose. | Pathogens, Chemicals |

## 3.3. Identification and Assessment of Control Measures

For every hazardous event identified, control measures that are already in place to minimize the risk of that hazardous event must be identified. The existing control measure must also be assessed based on its effectivity to reduce the risk of exposure to the hazardous event.

***Important Note*:**

When assessing how effective the control measure is, consider:

- How effective the existing control measure could be (assuming it was working well at all times)?
- How effective the existing control measure is in practice (actual performance)?

## 3.4. Assessment and Prioritization of Risks

The risks of the hazards and hazardous events to the health of the exposed group can be serious, moderate or potentially insignificant. The team must assess all the identified hazardous events based on the risks associated with each. This is to help the team to identify what hazardous events must be prioritized in providing interventions to reduce the risks it may pose.

In identifying the level of risk of each hazardous event, semi-quantitative risk assessment can be used. In semi-quantitative risk assessment, risk matrix is used to arrive at a risk category or score. The formula on how risk is computed is presented below:

**RISK = LIKELIHOOD X SEVERITY (CONSEQUENCES)**

The risk level can be categorized as low, medium, high or very high depending on the likelihood and severity of each hazardous event. The semi-quantitative method requires the SSP team to assign a likelihood and severity to each identified hazardous event to arrive to a risk category or score. The table below shows the risk assessment matrix to be used in determining the risk level of each hazardous event.

**Table 11: Risk Assessment Matrix**

| | | | SEVERITY (S) | | | | |
|---|---|---|---|---|---|---|---|
| | | | Insignificant | Minor | Moderate | Major | Catastrophic |
| | | | 1 | 2 | 4 | 8 | 16 |
| LIKELIHOOD (L) | Very unlikely | 1 | 1 | 2 | 4 | 8 | 16 |
| | Unlikely | 2 | 2 | 4 | 8 | 16 | 32 |
| | Possible | 3 | 3 | 6 | 12 | 24 | 48 |
| | Likely | 4 | 4 | 8 | 16 | 32 | 64 |
| | Almost Certain | 5 | 5 | 10 | 20 | 40 | 80 |
| Risk Score R = (L) x (S) | | | <6 | 7-12 | 13-32 | >32 | |
| RISK LEVEL | | | Low Risk | Medium Risk | High Risk | Very High Risk | |

**Table 12** below shows the suggested scoring and definitions of the likelihood and severity. The SSP team may choose to develop their own definitions of likelihood and severity. Each likelihood and severity have corresponding scores, depending on the probability or frequency of the hazardous event to happen (likelihood) and on the significance of the impact to the health of the exposed group if the hazardous event occurs (severity). In determining for the likelihood, the team must take into account the control measure/s in place and its effectivity.

The SSP team must be familiar with the operations of the sanitation system in order to determine the possible occurrence of the hazardous events and also, must have the knowledge on the effects of the identified hazards to the health of the exposed group to determine the severity.

***Important Note*:**

When assessing the likelihood and severity of each hazardous event, the following questions can be asked:

- How frequently does this hazard occur in the sanitation system?
- How severe are the effects of the hazards to the health of the exposed groups?

**Table 12: Suggested definition of Likelihood and Severity**

| LIKELIHOOD (L) | | |
|---|---|---|
| | **Descriptor** | **Description** |
| **1** | **Very Unlikely** | Has not happened in the past and is highly improbable it will happen in the next 12 months (or another reasonable period) |
| **2** | **Unlikely** | Has not happened in the past but may occur in exceptional circumstances in the next 12 months (or another reasonable period) |
| **3** | **Possible** | May have happened in the past and/or may occur under regular circumstances in the next 12 months (or another reasonable period) |
| **4** | **Likely** | Has been observed in the past and/or is likely to occur in the next 12 months (or another reasonable period) |
| **5** | **Almost Certain** | Has often been observed in the past and/or will almost certainly occur in most circumstances in the next 12 months (or another reasonable period) |

| SEVERITY (S) | | |
|---|---|---|
| | **Descriptor** | **Description** |
| **1** | **Insignificant** | Hazard or hazardous event resulting in no or negligible health effects compared to background levels |
| **2** | **Minor** | Hazard or hazardous event potentially resulting in minor health effects (e.g. temporary symptoms like irritation, nausea, headache) |
| **4** | **Moderate** | Hazard or hazardous event potentially resulting in a self-limiting health effects or minor illness (e.g. acute diarrhea, vomiting, upper respiratory tract infection, minor trauma) |
| **8** | **Major** | Hazard or hazardous event potentially resulting in illness or injury (e.g. malaria, schistosomiasis, food-borne trematodiases, chronic diarrhea, chronic respiratory problems, neurological disorders, bone fracture); and/or may lead to legal complaints and concern; and/or major regulatory non-compliance |
| **16** | **Catastrophic** | Hazard or hazardous event potentially resulting in serious illness or injury, or even loss of life (e.g. severe poisoning, loss of extremities, severe burns, drowning); and/or will lead to major investigation by regulator with prosecution likely |

Once the likelihood and severity are determined, the risk level of the hazardous event can be computed. Definition of the risk levels are shown in **Table 13**. For the SSP, the hazardous events with

risks that are considered to be very high, high and medium will be prioritized in providing control measures.

**Table 13: Definition of risk levels**

| RISK LEVEL | NOTES |
|---|---|
| **Very High and High Risk** | Actions need to be taken to minimize the risk. Possible options (short, medium and long-term options) should be documented (as part of the improvement plan developed in the next Module) and implemented based on priorities and available resources. |
| **Medium Risk** | Currently low or very unlikely impact on exposure groups. The situation can be improved with operational changes or system improvement over the medium to long term. |
| **Low Risk** | Actions may be taken but not a priority, or no action is needed at this time. The risk should be revisited in the future as part of the review process. |
| **Unknown priority** | Further data is needed to categorize the risk. Some action can be taken to reduce risk while more data is gathered. |

**Table 14: Template for risk assessment of hazardous events**

| Sanitation step | Hazard Identification | | | | Existing Control(s) | | RISK ASSESSMENT L=Likelihood; S=Severity; R=Risk level (e.g. High) | | | | Comments justifying risk assessment or effectiveness of the control |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hazardous event | Hazard | Exposure route | Exposure Groups | Description of existing control | Validation of control | L | S | Score (L x S) | R | |
| | | | | | | | | | | | |

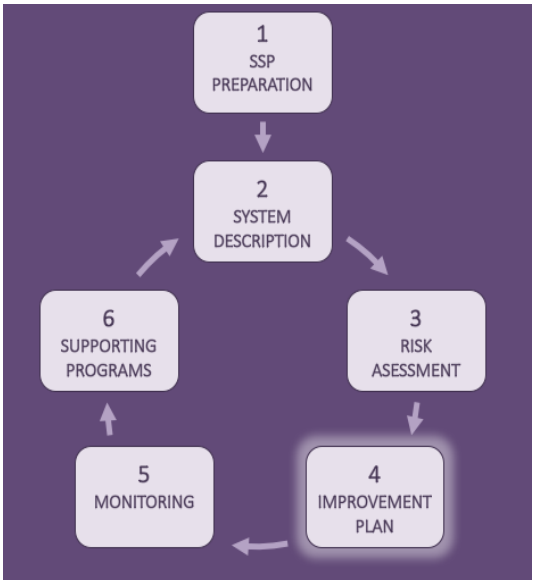
## MODULE 4

# INCREMENTAL IMPROVEMENT PLAN

Considering the hazards identified and the level of risk priority that these entail, new control measures or improved existing control measures must be developed to improve risk management.

Once the appropriate control measures are established, the improvement plan must be developed by the SSP team to decrease or eliminate the risks. Improvement plans can be capital works, operational measures, behavioral measures or a combination of the three.

This process helps to ensure that the funding and effort targets the highest risks with greatest urgency.




**4.1 Consider options to control identified risks**

The SSP team should consider a range of options to control the prioritized hazardous events in order to reduce the risk level. These may include short and long-term plans, treatment and non-treatment and behaviors options, and a range of locations along the sanitation chain.

**4.2 Use selected options to develop an incremental improvement plan**

Once the most appropriate control measures for each risk have been identified, the SSP team must consolidate the options into a clear action plan or the improvement plan.

**4.3 Implement of Improvement Plan**

Improvement plan is implemented with action taken by the organization responsible for the respective improvement action.

The SSP team should monitor and report on the implementation status of the improvement plan to ensure that the action is taken.

## 4.1. Development of list of options of control measures

From identified prioritized hazardous events in Module 3, the SSP team must consider a range of options to reduce the risk. This can be new control measures or improvement of the existing control measures. When considering control options, take in to account the following:

- Potential for improving existing control measures;
- Cost of the control option relative to its likely effectiveness;
- Most appropriate location in the sanitation chain to control the risk;
- Technical effectiveness of the proposed new control measure;
- Acceptability and reliability of the control in relation to local cultural and behavioural habits;
- Responsibility for implementing, managing and monitoring the proposed new controls;
- Training, communication, consultation and reporting needed to implement the proposed control measure

List of control measure developed for each hazardous event must be recorded using the suggested template below.

**Table 15: Template for the control measure options**

| Sanitation Step | Hazardous Event | Priority Risk | Control Measure Options |
|---|---|---|---|
| | | | |

## 4.2. Development of Improvement Plan

From the list of options developed, the team must derive an improvement plan by choosing what control measures will be implemented. Improvement plans can be capital works, operational measures, behavioral measures or a combination of the three.

In order for improvement plan to be implemented and managed, the following must be included in the improvement plan:

- The person or agency responsible;
- Estimated cost for the implementation of the chosen control measure;
- Timeline for the implementation of the chosen control measure.

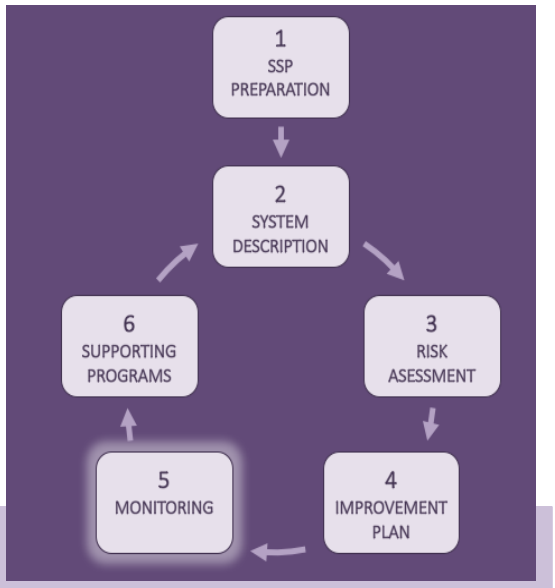
A suggested template to document the improvement plan developed is shown in the **Table 16**.

**Table 16: Improvement Plan Template**

| IMPROVEMENT ACTION (S) (NEW/IMPROVED CONTROL MEASURE) | HAZARDOUS EXPOSURE EVENT TO BE MITIGATED | RESPONSIBLE AGENCY/PERSON | ESTIMATED COST | TIMELINE | STATUS |
|---|---|---|---|---|---|
| | | | | | |

MODULE 5

# MONITORING OF CONTROL MEASURES & VERIFICATION OF PERFORMANCE




The main objective of this Module is to develop a monitoring plan that regularly checks that the system is operating as intended and defines what to do if it's not.

The purpose of verification monitoring is to determine the compliance of the system design parameters and/or whether the system complies with the specified requirements. Verification monitoring must be carried out periodically to show that the system is working as designed.

**5.1 Define and implement operational monitoring**

Operational monitoring is the routine monitoring parameters that can be measured quickly through rapid testing or simple observations and measures. It provides real-time feedback to know whether the system is working properly and if not, to make the relevant corrections as quickly as possible.

**5.2 Verify system performance**

To periodically verify whether the system meets the intended performance outcomes such as quality of effluents or products. Verification monitoring focuses on system end points such as effluent water quality, microbial and chemical testing of products and soils and health status of the exposed groups.

**5.3 Audit the system**

Audit ensures that the SSP continues to contribute to positive health outcomes by checking the quality and effectiveness of SSP implementation.

The SSP team should monitor and report on the implementation status of the improvement plan to ensure that the action is taken.

## 5.1. Development and Implementation of Operational Monitoring Plan

The purpose of developing an operational monitoring plan is to give a simple and rapid feedbacks to know whether the control measures are operating as intended and if not, to make necessary relevant corrections as quickly as possible.

In developing an operational monitoring plan, the team must identify the following for each monitoring points:

- Parameters to be monitored;
- Method of monitoring;
- Frequency of monitoring;
- Who will monitor;
- A critical limit;

The team must also identify the following in case the operation exceeds the critical limit:

- What corrective action to be undertaken;
- Who will take the corrective action;
- When will the corrective action be taken;
- Who needs to be informed of the action taken

***Important Note*:**

Operational monitoring can be done by:

- Simple measures (e.g. flow rate, detention times, temperature);
- Observations (e.g. use of PPEs, on-farm practices)
- Sampling and testing (e.g. BOD, COD, TSS)

Suggested template for the operational monitoring plan is shown in **Table 16.**

## 5.2. Development of Verification Monitoring Plan

The purpose of verification monitoring is to determine the compliance of the system design parameters and/or whether the system complies with the specified requirements. Verification monitoring must be carried out periodically to show that the system is working as designed. This type of monitoring generally requires more complicated forms of analysis than operational monitoring.

Suggested template for verification monitoring plan is shown in **Table 18.**

***Important Note*:**

Verification monitoring focuses on system endpoints such as:

- effluent water quality;
- Biosolids quality; and
- health status of high-risk exposed groups (e.g. workers).

## 5.3. Auditing the system

The purpose of the audit id to ensure that the SSP continues to contribute to positive health outcomes by checking the effectiveness of the implementation of the SSP. It should demonstrate that the sanitation safety plan has been properly designed and is being implemented correctly and effectively.

Auditing can be done internally or by regulatory or independent auditors. The frequency of the audit depends on the level of confidence required by the regulatory authorities.

In conducting audit, the following questions can be considered:

- Have all significant hazards and hazardous events been identified?
- Have appropriate control measures been included?
- Have appropriate operational monitoring procedures been established?
- Have appropriate operational or critical limits been defined?
- Have corrective actions been identified?
- Have appropriate verification monitoring procedures been established?
- Have those hazardous events with the most potential for problems to human health been identified and appropriate action taken?

**Table 17: Template for Operational Monitoring Plan**

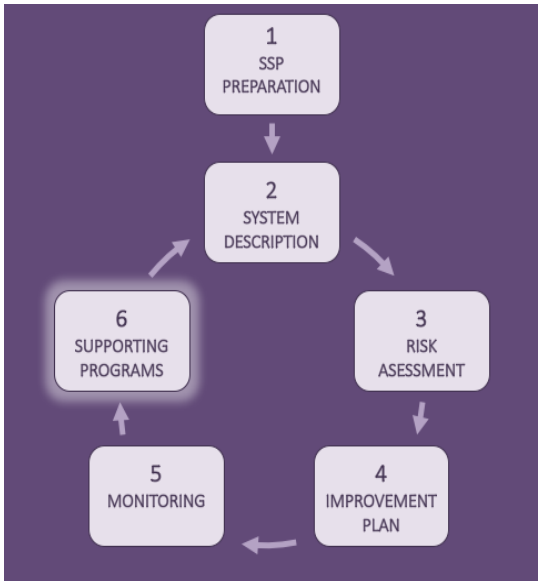
| SANITATION STEP | EXISTING CONTROL MEASURE | OPERATIONAL LIMIT | OPERATIONAL MONITORING | | | | | CORRECTIVE ACTION PLAN | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | What | How | When | Where | Who | How | Who | When | Report to |
| | | | | | | | | | | | |

**Table 18: Template for Verification Monitoring Plan**

| VERIFICATION MONITORING | |
|---|---|
| What | |
| Limit | |
| When | |
| Who | |
| Method of Monitoring | |

MODULE 6

# DEVELOPMENT OF SUPPORTING PROGRAMS & REVIEW OF PLANS




This module supports the development of people's skills and knowledge, and an organization's ability and capacity to meet the SSP commitments.

Supporting programmes and regular reviews will ensure that the SSP is always relevant and responds to the current or anticipated operating conditions

**6.1 Identify and implement supporting programmes and management procedures**

Supporting programmes and management procedures ensure that SSP operation is supported with clear management procedures, programmes of research and training for staff, and communications to key stakeholders especially larger or complex systems.

**6.2 Periodically review and update the SSP outputs**

The SSP outputs must be periodically reviewed as new controls are implemented and to analyze new or emerging hazards and hazardous events.

## 6.1. Identify and Implement Support Programmes and Management Procedures

### 6.1.1. Support Programmes

Support programs are activities that indirectly support the sanitation safety. They are activities that are necessary for proper operation of the control measures. A key aspect of supporting programs is communication of health issues with the stakeholders.

Supporting programs are organization-wide activities that should be in place in support of mitigating the health effects of wastewater and its by-products. These activities do not directly affect the quality of the wastewater and bio-solids but are meant to ensure that no additional source of potential hazards will come from the operating / surrounding environment, the equipment's used and the people themselves, employees and visitors alike.

Sample of supporting programs are:

- Training programs for staff as support in the implementation of the control measures, operational monitoring and implementation of corrective actions;
- Presentation of evidence and results to public and institutional stakeholders;
- Awareness raising and training for key exposure groups to improve compliance for control measures that require behavior change;
- Provision of incentives or penalties linked to compliance;
- Routine maintenance programs;
- Public awareness campaigns;
- Research programs to support key knowledge or evidence gaps;
- Tools for managing the actions of staff such as quality assurance systems;
- Lobbying for an appropriate SSP enabling environment; and,
- Engagement of stakeholders in SSP

### 6.1.2. Management Procedures

Management procedures are written instructions that describe the steps or actions to be taken during (a) normal operating conditions (b) implementation of control measures, (c) monitoring of the operations and for (d) corrective actions when operational monitoring parameters exceeds the identified critical limits. These are often called standard operating procedures or SOPs. Emergency management procedures could also be developed.

All systems require instructions on how to operate the system. Management procedures and manuals should be available for all individual technical components of the system. In addition to the technical information needed to run the system, management procedures should also be developed outlining the tasks to be undertaken in managing all aspects of the sanitation system including during emergency situations. Also, procedures for routine monitoring and inspection activities and their collected results must also be documented as part of management procedures.

***Important Note*:**

Sample of management procedures are:

- Operation and maintenance schedules;
- Procedures for all aspects of the treatment of the system (e.g. screening aeration, filtration, chlorination);
- Operational monitoring procedures;
- Procedures related to managing inputs to the sanitation system;
- Schedules and procedures to monitor wastewater quality and reuse application and statutory requirements

If operational and emergency protocols are already in place but has no formal document to support it, the SSP team should recommend the development of these manuals to the management of the sanitation system. This will be done by documenting existing and best practices within the system.

## 6.2. Periodical Review and Update of SSP

To ensure the SSP covers emerging hazards and issues, the SSP Team shall review it periodically. Frequency of the review depends on the team nut it is suggested to conduct a review annually or semi-annually. The implementation of the SSP framework reduces the number and severity of incidents, emergencies or near misses affecting or potentially affecting the health of the workers, users and community. Reviews should take into account any improvements made, changes in operating conditions and any new evidence on health risks related to the sanitation systems.

***Important Note*:**

In addition to the scheduled periodic review of the SSP, the SSP should also be reviewed in the following situations:

- After an incident, emergency or near miss;
- After major improvements or changes to the system;
- After an audit or evaluation to incorporate findings and recommendations

In addition to the periodic review of the SSP, review of the SSP following every emergency, incident or unforeseen event irrespective of new hazards will be conducted to ensure that the same incident/emergency will less likely recur in the future and to determine whether the response was effective or need to be improved.

The result of a post incident review will identify areas for improvement; whether it is a new hazard, or a revised risk for the risk assessment, a revision for an operating procedure or a training issue. The SSP must be revised to reflect the change and incorporate the lessons learned into the SSP documentation, procedures, and supporting programs.