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# Risk Assessment, Risk Management and Best Practices Guidance



**Plastics**Europe  
Association of Plastics Manufacturers

1	Contents	
2	Introduction .....	2
3	Scope of the guidance document .....	2
4	Definitions and acronyms .....	3
5	Structure of the guidance document.....	3
	SECTION A – RISK ASSESSMENT.....	4
6	Typical activities along the value chain.....	4
7	Risk analysis .....	4
7.1	ASSESSMENT BASED ON THE LIKELIHOOD OF EVENT .....	5
7.1.1	<i>Description of the approach</i> .....	5
7.1.2	<i>Pre-assessment on high-risk areas for integration with the assessment per location</i> .....	6
7.2	ASSESSMENT PER LOCATION.....	6
7.2.1	<i>Flow diagram approach</i> .....	7
7.2.2	<i>Material flow mapping approach</i> .....	7
7.2.3	<i>Description of operation approach</i> .....	8
7.2.4	<i>Assessment per location - Integrated approach for risk mapping</i> .....	8
7.2.5	<i>Critical point identification</i> .....	8
7.3	THE USE OF THE TEMPLATES FOR RISK ASSESSMENT .....	9
7.4	TEMPLATE DESCRIPTION .....	9
	SECTION B – BEST PRACTICES .....	10
8	Introduction .....	10
9	Barriers and procedures .....	11
9.1	PREVENTIVE BARRIERS AND PROCEDURES TO AVOID SPILL .....	11
9.2	MITIGATING BARRIERS AND PROCEDURES TO AVOID LOSS.....	11
9.3	PICTOGRAMS .....	12
10	Accessibility of Barriers and Clean-up Procedures .....	12
11	Incidents and reporting .....	12
12	Checklists and Templates.....	14
12.1	BARRIER CHECKLISTS .....	14
12.2	TEMPLATE FOR REPORTING A PROCEDURE RELATED TO AN OPERATION/EQUIPMENT .....	15
12.3	TEMPLATE FOR INCIDENT REPORTING .....	15
	SECTION C – IMPLEMENTATION OF THE MEASURES.....	17
13	The bow-tie model.....	17
13.1	THE BOW-TIE METHODOLOGY AT CRITICAL POINT LEVEL: PRELIMINARY STEPS .....	17
13.2	THE BOW-TIE METHODOLOGY AT CRITICAL POINT LEVEL: SAMPLING.....	18
13.3	THE BOW-TIE METHODOLOGY AT CRITICAL POINT LEVEL: CALCULATION STEPS – CALCULATING THE SPILL PROBABILITY.....	19
13.4	THE BOW-TIE METHODOLOGY AT CRITICAL POINT LEVEL: CALCULATION STEPS – ESTIMATING THE BARRIER EFFICIENCY .....	19
13.5	THE BOW-TIE METHODOLOGY AT CRITICAL POINT LEVEL: CALCULATION STEPS – CALCULATING THE LOSS PROBABILITY .....	20
13.6	THE BOW-TIE METHODOLOGY AT MACRO AREA LEVEL.....	20
13.7	THE BOW-TIE MODEL FOR RISK REDUCTION PURPOSE.....	21
13.8	THE BOW-TIE MODEL FOR REPORTING PURPOSE .....	21
14	Conclusions .....	22
	ANNEX B1 – Best practice catalogue .....	23
	ANNEX B2 – Examples of procedures .....	31
	FROM SECTION 9.1: PROCEDURES FOR PREVENTIVE BARRIERS .....	31
	FROM SECTION 9.2: PROCEDURES FOR MITIGATING BARRIERS .....	31
	ANNEX B3 – Catalogue of procedures .....	32
	GENERAL PROCEDURES AND GOOD PRACTICES .....	32
	CLEAN-UP PROCEDURES .....	33
	ANNEX B4 – Pictograms .....	38

## 2 Introduction

Unintentional loss of plastic pellets can occur at all stages along the value chain despite the application of the current standard environmental, safety and quality management controls. The Operation Clean Sweep® (OCS) programme was developed by the industry to help companies tackle pellet leakage by providing a series of key recommendations and guidelines. The OCS certification scheme is aimed at controlling and documenting the compliance of companies throughout the entire plastics supply chain with requirements on the prevention of plastic pellets, powders and flakes loss to the environment. Considering that pellet loss can occur at any step of the supply chain, such requirements should apply to producers, compounders, converters but also to any third-party company handling pellets (transport and logistics, waste managers and recyclers).

By signing the European OCS pledge, each pellet-handling company recognises the importance of preventing spillages into the environment and commits to the following six actions:

1. Improve worksite set-up to prevent and address spills;
2. Create and publish internal procedures to achieve zero industrial plastic material loss;
3. Provide employee training and accountability for spill prevention, containment, clean-up and disposal;
4. Audit performance regularly;
5. Comply with all applicable state and local regulations governing industrial plastics containment;
6. Encourage partners (contractors, transporters, distributors, etc.) to pursue the same goals.

## 3 Scope of the guidance document

This guidance document intends to provide a comprehensive guidance to prevent pellet loss in the environment including:

- a risk analysis and risk mapping;
- the monitoring of potential losses;
- a catalogue of preventive and mitigating measures with some examples of barriers and procedures;
- the implementation of preventive and mitigating measures (barriers and procedures);
- the monitoring of the effectiveness of the preventive and mitigating measures (barriers and procedures).

The diversity of operations by nature between the different stakeholders of the polymer value chain suggests a dedicated approach and a standardised methodology for assessing the effectiveness of the preventive and mitigating measures.

Typically, the issues related cover both the environment and the health & safety. The approaches described in this document can be used to guide and target pellet loss prevention and mitigation, according to the development of the plant in mastering environmental management issue.

- The laws and regulations regarding H&S are defined at national level by the member states;
- Environmental management may follow international norms like ISO 14-000;
- Both aspects may be defined by internal policies on top of the requirements of the law;
- H&SE handling may vary along the value chain.

Preventing pellet loss should be an integral part of Good Manufacturing Practices (GMP), but the prevention tools might be different depending on the requirements of the operations along the value chain.

This guidance document should provide support for the actions 1 to 4 to which the companies signing the European OCS pledge are committing, as reported in the previous paragraph. At the same time, the OCS core requirements already define what are the criteria for compliance with the OCS scheme. However, the guidelines here provided should allow achieving the following minimum requirements:

- Identifying the source of pellet spill and pellet loss and addressing the risk;
- Carrying out a complete and comprehensive assessment without data gaps;

- Implementing a risk minimisation plan and constantly monitoring its effectiveness (with the possibility of using the bow-tie risk reduction model described in the present document).

## 4 Definitions and acronyms

Microplastics: ‘microplastic’ means particles containing solid polymer, to which additives or other substances may have been added, and where  $\geq 1\%$  w/w of particles have (i) all dimensions  $\leq 5\text{mm}$ , or (ii) a length of  $\leq 15\text{mm}$  and length to diameter ratio of  $>3$ .<sup>1</sup>

Pellet: the term "pellets" covers either resin pellet, granulate, flake, powder, dust and production scrap.



pellets



flakes



powder/dust

Spill: an unwanted situation/occurrence/event where pellets are released inside the operational boundary of the plant/site.

Loss: an unwanted situation/occurrence/event where pellets are released outside the operational plant/site boundary to the “environment” (e.g. water, soil...).

Incident: an unwanted event occurring occasionally (i.e., without a defined frequency) where pellets are released.

Accident: an unwanted event occurring with a defined frequency where pellets are released.

Critical point: either a physical location or an operation for which pellet spill (and possible loss) occurs.

Macro area: area of the plant where specific operations involving pellets are carried out. A macro area can be split in different critical points to better describe the pellet spill/loss pathway.

Preventive barrier/measure: either a physical barrier or a procedure that prevents a spill to occur. Preventive barriers/measures are applied within the operational boundary of the plant.

Mitigating barrier/measure: either a physical barrier or a procedure that prevents a loss of spilled pellets to occur. Mitigating barriers/measures are applied at the operational boundary of the plant.

SOP : Standard Operating Procedure

## 5 Structure of the guidance document

The present document is mainly divided into 3 different sections:




- Section A – Risk assessment: this section shows some possible approaches for carrying out a meaningful risk analysis;
- Section B – Best practices: this section offers an overview of preventive and mitigating barriers and procedures for containing both pellet spill and pellet loss;
- Section C – Implementation of the measures: this section presents a risk reduction model aimed at obtaining a general overview of the preventive and mitigating measures in place, as well as implementing them by constantly checking the progress.

<sup>1</sup> Opinion of the European Chemicals Agency Risk Assessment and Socio-economic assessment committee on the proposed restriction on intentionally added microplastics, 10, December 2020, p. 6.

## SECTION A – RISK ASSESSMENT

### 6 Typical activities along the value chain

The whole value chain from polymer manufacturing to secondary raw materials involve typical processes. The nature of the process or the number of processes differs from plant to plant. It is possible to identify three main stages in the value chain: raw material production, compounding and converting (shown in the table below). Typical processes involve extruding, mixing, blowing, shredding, regrounding, cutting, drilling, shaping, sorting, washing, foaming, etc

 <b>producer</b>	A producer delivers at goods out, virgin powder or pellet or flakes of (a recycler is a producer of virgin material)
 <b>compounder</b>	A compounder is preparing master batches from them to be used by converter
 <b>converter</b>	A converter is transforming virgin raw and masterbatch to product

For each process, the likelihood of spills may depend on various process layout: closed and continuous processes will reduce the occurrence of spills, while batch process may be required in some productions. Therefore, there is no definite GMP to prevent spillage of microplastics and that is compatible with any manufacturing process. However, despite the process variability, it is possible to identify some preventive and mitigating measures that are commonly used across different plants to contain pellet spill and pellet loss, respectively.

Moreover, it is also important to highlight that the location of the process and the probability of spillage may directly influence the probability of a loss: processes outside buildings and process without confinement are more at risk than fully confined processes. A location-specific assessment might be required in order to implement the necessary measures to prevent spill and loss.

### 7 Risk analysis

The purpose of the risk analysis is to identify the source of pellet loss in the environment to provide an appropriate remedy, with respect to the characteristics of the plant, in its environment.

The source of spill and/or loss are assessed together along potential pathways for loss. There may be spills inside the plant/site but no loss outside the plant/site boundary: in this case the risk analysis should still be carried out to investigate what potential pathways for loss are.

Two complementary approaches may be followed:

1. An assessment based on the likelihood of event like pellet spill or pellet loss, from outside of the plant where the loss is observed to the source of the spill.
2. An assessment per location of the likelihood of spills which may induce a loss in the environment.

A low probability occurrence may also lead to pellet loss, but may require a more thorough analysis based on the likelihood of event. The approach based on location does not allow to consider the versatility of plant activities along the value chain, but it focuses on the measures that are taken specifically either in a defined physical location of the plant or for a specific operation carried out in the plant. Therefore, as already mentioned above, both approaches are complementary: if used together, they achieve maximum effectiveness.

Type of risk analysis	Resources needed	Effectiveness on risk analysis
<b>Likelihood of event</b>	Internal audit	High
<b>Assessment per location</b>	Survey of events	High
<b>Both</b>		Very high

## 7.1 Assessment based on the likelihood of event

The likelihood of event with respect to pellet loss is a risk-based approach. This necessarily covers H&S and Environmental concerns. It differentiates strongly between spills and loss, allowing spill events if they are not related to the loss.

### 7.1.1 Description of the approach

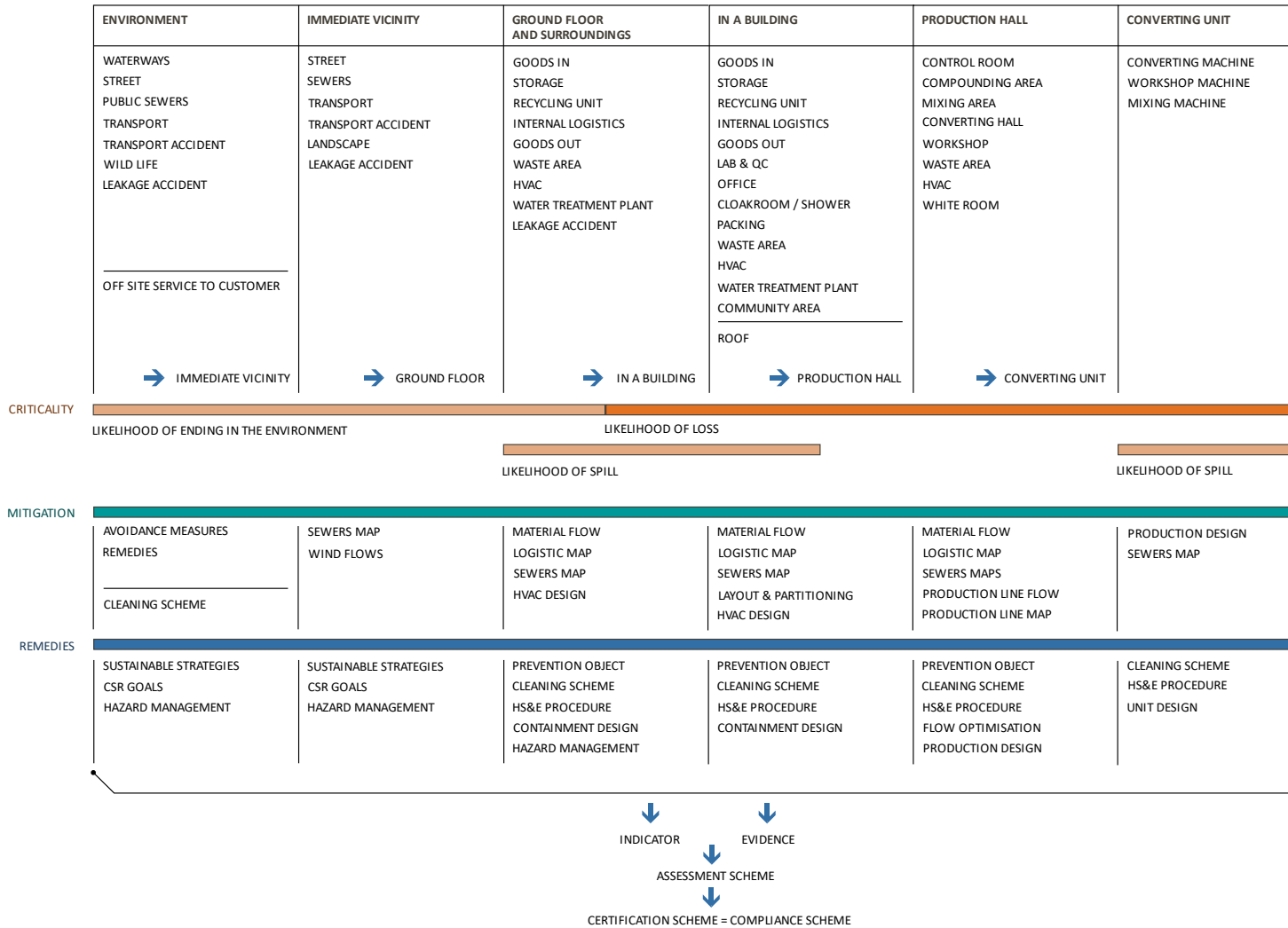
A schematic representation of assessment based on the likelihood of event is reported below. In this approach, the risk analysis starts with a full plant site audit to assess the presence of loss in the closed environment of the plant. Independently of the plant layout, thanks to this approach it should be possible to address the source of spill/loss starting from the pellet loss event. Each step leads the company officer in charge to identify the cause of the loss.

In order to carry out this type of assessment, it is important to focus on different “compartments” where loss might occur:

- Environment: this includes the possible pathways that lead to pellet loss outside the plant boundary, including the pellet transport activities;
- Immediate vicinity: this focuses on the events occurring near the plant boundary, including transport activities as well;
- Ground floor and surroundings: this includes several areas within the plant boundary where the events of spill and loss might occur;
- Building: this focuses specifically on the single building composing the plant;
- Production Hall and Converting unit: these are more specific compartments that deserve special attention because relevant quantities of pellets are handled.

Independently of the measures that are taken, the likelihood of spill is generally addressed to those compartments located within the plant boundary, whereas the likelihood of loss and of pellets ending in the environment is potentially addressed to each compartment, with a higher risk for those compartments located outside the plant boundary.

When it comes to assess the risk of spill, the risk of loss and their criticality, it is fundamental to identify the measures that are taken in order to contain the risk: this might require complete information on material flow, plant layout, sewer map, HVAC design, production flow map, etc. At the same time, the appropriate remedies should be taken in order to contain a spill event and to implement the risk minimisation plan.



### 7.1.2 Pre-assessment on high-risk areas for integration with the assessment per location

The approach based on the likelihood of event explained above is a preliminary step to follow before carrying a meaningful assessment per location, described in the following paragraphs. More specifically, it is fundamental to investigate all possible pathways leading to pellet loss on the high-risk areas located in the plant such as the sewer system, HVAC system, waste area, the roofs of the plant buildings, etc., where pellets could be easily lost in the environment if appropriate actions and remedies are not taken. Once the possible sources of loss are identified in the high-risk areas of the plant, a specific assessment per location can be carried out, focusing on the barriers and procedure in place to contain both spill and loss.

## 7.2 Assessment per Location

The assessment per location is based on a survey approach. It allows to have an accurate description of risk, according to the probability of occurrences. The approach narrows down the occurrence of spills and consequent possible loss, by targeting primarily the highest root causes. There are several levels of efficiency to perform an assessment per location:

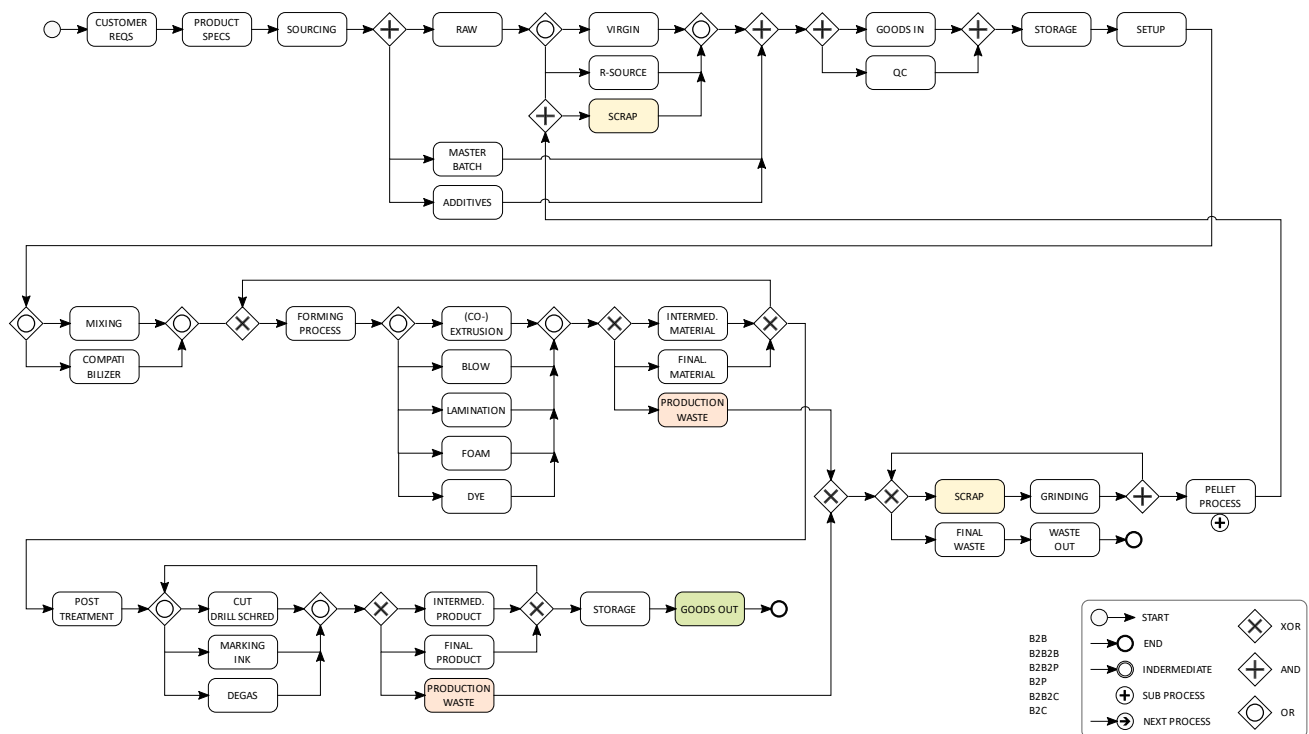
- Flow diagram approach
- Material flow mapping approach
- Description of operations approach

The three approaches can be combined and complemented in order to obtain a complete and more informative risk assessment.

Type of description	Resources needed	Effectiveness on risk analysis
Process Flow Diagram	Average	Good
Material Flow Mapping	Average	Very Good
Description of Operations	High	Excellent

### 7.2.1 Flow diagram approach

The flow diagram describes stages in one or many production schemes in the plant. The description is focusing on the process relevant for pellet loss and spill. This allows to further describe the process with occurrence of spills.



### 7.2.2 Material flow mapping approach

The material flow mapping is focusing on the routes taken by the material from entrance (goods-in) until exit (goods-out) or even for on-site construction. Some operational macro area can be identified:



- Goods In: this operational macro area includes all activities related to raw material delivery and handling;
- Storage: this operational macro area includes all activities carried out in the warehouse related to raw material handling and dispatch of goods;
- Production: this operational macro area includes all activities relating to the product manufacturing process;
- Workshop: this operational macro area includes all activities related to product finishing;
- Goods Out: this operational macro area includes all activities related to the distribution of the semi-finished and finished products;



- Off-Site Activities: this operational macro area (or more than one) includes all activities that are carried out outside the plant/site boundary and that are related to handling and processing of pellets. There might be several off-site activities where the risk of spill and loss might occur.

### 7.2.3 Description of operation approach

If some operations are described, their description should be related to a Process Flow Diagram or a Material Flow Mapping. If all operations are effectively described to assess the occurrence of spills and probability of losses, then the Description of Operations does not require a Process Flow Diagram or a Material Flow Mapping.

### 7.2.4 Assessment per location - Integrated approach for risk mapping

In order to perform a risk mapping, for those macro areas of the plant/site with a higher risk of spill and loss it is necessary to identify the critical points of the plant and/or critical operations carried out in the plant where spill and loss might occur. These points should be clearly indicated in the plant map to identify their physical location. When an operation is carried out, a clear description of tasks performed by the workers should be provided, in order to identify the physical location of the operation.

The material flow mapping should be complemented indicating critical points and/or critical operations. Taking into account the layout diversity of the plants, it might not be always possible to identify all critical points within a plant, but just a selection of them. The most common critical points and operations are reported in the following paragraph.

For each identified critical point/operation, complete information on preventive barriers and/or procedures should be provided. For each macro area/building of the plant, complete information on mitigating barriers and/or procedures should be provided. A full list of barriers and procedures is shown in the section dedicated to best practices and risk minimisation (section B).

At the same time, it is necessary to provide additional information on incidents that can lead to pellet spill (and potentially, to pellet loss), indicating the physical location of the incident, the quantities spilled, the occurrence and the measures taken to contain the incident. A list of common incidents occurring in the plants is provided in a dedicated paragraph below.

Quantitative information on pellet spill should be provided for those critical points/operations for which one or more preventive barriers/procedures are in place. At the same time, the complementary information on the mitigating barriers/procedures in place should be considered in order to rationalise all possible pathways leading from spill to loss.

### 7.2.5 Critical point identification

The table below reports the most common critical points that can be found in the plant macro areas shown in the material flow mapping.

Macro area (material flow mapping)	Critical points/operations
Goods in	Receiving area for sacks
	Receiving area for bulk containers
	Loading point for silo trucks
	Transport equipment
	Connect/Disconnect location/operation
	...
Storage	Handling of sacks
	Handling of bulk containers
	Silo area (to be specified)
	Outgoing warehouse
	Conveying lines and couplings
	Goods dispatch/loading ramp

	...
Production – Resin prod/compounding/Converting process	Feeding points
	Sampling area
	Shredders
	Mixing units
	Internal recovery unit
	...
Workshop	Cutting
	Drilling
Goods out	Handling of sacks
	Handling of bulk containers
	Trucks
Off site	Cutting

### 7.3 The use of the templates for risk assessment

The templates provided in annex A can be used:

- to assess the risk and to guide for the implementation;
- to implement OCS prevention schemes;
- to acquire know how and develop relevant prevention strategies;
- to allow auditing and subsequent certification.

This guidance provides minimum requirements for an accurate risk analysis.

### 7.4 Template description

The templates for risk assessment are reported in a single file containing several sheets. A description of each sheet is provided below:

- Management, M1: this template is designed for the assessment of the management., the resource appointed to pellet loss prevention, the way of reporting spill and loss of pellets, the regulatory framework and the implementation of best practices;
- Monitoring, M2: this template is focused on the monitoring of the raw material flow in the plant, the understanding of the configuration of the site, the assessment of the flow of pellet loss to the sea, the understanding of the building management and the relationship between processes, spill and loss, the monitoring of spills and the monitoring of losses;
- Landscape, A1: this template is designed for characterising the landscape, evaluating if spills might occur outside the plant boundary, understanding if loss can occur when goods are entering and going out, understanding the water flow and checking the measures implemented with respect to the landscape;
- Building, A2: this template is related to the assessment of spills and losses within a defined building of the plant. The template should be filled in for each building where spill and loss might occur and it should include information on the building description, the related activities that are carried out, the roof accessibility and the assessment of spills;
- Operation, O: this template is related to the assessment of spills and losses within a defined operational area of the plant. The template should be filled in for each operational area where spill and loss might occur and it should include a description of the spill and loss events, a description of the possible consequences and the related impact, and a description of preventive and containment measures. For some specific operational area, an additional template might be needed for a more detailed assessment and to start the assessment by using a risk reduction model, described in section C of this document. These specific operational areas are:
  - Goods In;
  - Storage;
  - Process;

- Workshop;
- Goods Out;
- Off-site activities;
- Bow Tie – Critical point template: this template should be filled in for each of the operational areas reported above and it represent a pre-assessment step before applying the risk reduction model. The template should be filled in for each macro area (operational area) considered for the assessment. The information to be reported in this template should be critical point specific and it should include a description of the critical points/critical operations, the preventive measures in place for the critical points listed and the mitigating barriers in place for the macro areas (operational areas) listed above;
- RA checklist – critical point template: this template represents a checklist to get an overview of the assessment. The completeness of the risk assessment should be validated for each operational area (macro area) and each critical point (if applicable to the specific case) by answering some questions (Y/N) and providing further information, if needed;
- RA checklist – plant boundary template: this template represents a checklist to get an overview of the assessment. The completeness of the risk assessment should be validated for each relevant point at the plant boundary (e.g., sewer system, roof, fences) by answering some questions (Y/N) and providing further information, if needed.

## SECTION B – BEST PRACTICES

### 8 Introduction

The Catalogue of procedures to achieve zero pellet loss goal/Best practice was created in order to help companies to prevent and manage pellet losses according to industrial best practices. In the following pages the typical activities of plastics converters are examined, focusing on the events that might cause a pellet/microplastic spill (inside the plant) and loss (into the environment) and how to prevent, contain or remove them.

The catalogue should be used by an entire management of a company and by each employee that is involved in operations connected to the pellets, powders and flakes. In addition, this catalogue should be used together with the OCS risk assessment guidance document.

The guidance provides tools and examples to help companies prevent potential spills and losses of pellets, powders and flakes during the following activities:

- Goods In;
- Storage;
- Process;
- Workshop;
- Goods Out;
- Off-site activities;
- Any other relevant additional activities and operational macro areas.

## 9 Barriers and procedures

A barrier is a system in place, that reduces the probability that an event occurs. A barrier can be either “hardware”, for example filters, cyclones, or “software”, for example training or specific procedures.

There are two different types of barriers:

- Preventive barrier/measure: either a physical barrier or a procedure that prevents a spill from occurring (for example, closed sampling system). Preventive barriers/measures are applied within the operational boundary of the plant;
- Mitigating barrier/measure: either a physical barrier or a procedure that prevents a loss of spilled pellets to the environment (for example, pellet catch filters in drain pits). Mitigating barriers/measures are generally applied at the operational boundary of the plant.

For example, seals on equipment shall be present as a preventive barrier to avoid potential spill of the pellets from the equipment. In the event of a spill where the preventive barrier is bypassed, a mitigating barrier should come into effect to avoid possible loss of these spilled pellets to the environment. This can be a tool like collector drains near the equipment or an immediate cleaning procedure to combat a potential loss into the environment.

### 9.1 Preventive barriers and procedures to avoid spill

As mentioned above, a preventive barrier is either a physical barrier or a procedure that prevents a spill. Preventive barriers are installed in an area depending on the operational nature of the area or the equipment that is used to handle the pellets. For instance, operational areas where forklifts are used such as storage areas shall have a preventive barrier – “outfitting forklifts with clean-up kits”. This can be used by forklift operators in the event of an unforeseen spill during the operations in the storage area.

However, certain preventive barriers are present in multiple macro areas. For example, buckets and retention trays are present in areas such as production plant, storage areas etc.

Procedures that are in place in order to prevent a potential spill can also be categorised under preventive barriers. These procedures are used as a guidance to ensure no pellets are spilled during operations. For example, operating manual to guide a worker to use a particular equipment correctly so that no pellets are spilled during the operations can be classified as a preventive barrier.

Predefined zones for trucks to operate outside where these trucks are not allowed can also be classified as a procedure under preventive barriers. This helps to contain spilled pellets in a confined zone rather than the whole area. This will aid in easing the follow-up actions.

A procedure can be in place for existing physical preventive barriers to ensure maintenance or follow up actions if any. Examples of procedures are shown in Annex B2. These types of procedures are also classified as preventive barriers.

To sum-up, following types of procedures can be classified as preventive barriers:

- Procedures that are designed to prevent or minimise a spill/loss during operations
- Procedures that are a guidance to the workers on how to operate/maintain a physical preventive barrier

### 9.2 Mitigating barriers and procedures to avoid loss

As mentioned above, mitigating barriers are either a physical barrier or a procedure that prevents a loss of spilled pellets. Mitigating barriers are the last resort to prevent any possible loss of the pellets to the environment after the spill of pellets has occurred. Mitigating barriers are less specific compared to the preventive barriers in terms of their physical location within the plant. For instance, drain covers can be present in all the macro areas irrespective of nature of the operation carried out. Some of the examples of mitigating barriers (physical tools/equipment) which were obtained through survey conducted by EuPC which are shown in Annex B2.

Cleaning procedures to prevent the loss of spilled pellets to the environment can also be considered as a mitigating barrier. Procedures can also be in place for certain physical mitigating barriers to ensure correct operation or regular inspections. Some examples are reported in Annex B2.

### 9.3 Pictograms

Pictograms can be placed in the operational areas of the plant. Pictograms convey concise information on preventing a spill or the follow-up actions in the event of a pellet spill. Some examples of pictograms are shown in Annex B4 of this section.

## 10 Accessibility of Barriers and Clean-up Procedures

Barriers should be readily accessible in the event of a spill. In the majority of cases, barriers are placed in the areas classified as high-risk areas where a potential spill is likely to occur (critical points). A strategic placement of the barrier is necessary to ensure the barrier is effective in preventing a loss/spill. In the event of a continuous spill occurring due to breakage of an equipment, the accessibility of a barrier such as cleaning tools becomes a vital factor along with the time gap before an action is taken to prevent the spill. This also conveys the importance of multiple barriers of the same kind (cleaning tools in this case) to be present in the same critical point or macro area.

However, there are certain areas in the plant where a physical barrier cannot be placed and/or the accumulation of pellets is not monitored frequently. These are defined as Peripheric Areas. For example, a roof or cracks in the road where pellets remain accumulated and no physical barriers can be used to prevent spill. However, once pellets are accumulated in these areas, it is important to make sure they are not lost to the environment. Therefore, a clean-up procedure should be initiated.

Considering that the installations of preventive barriers is not foreseen in the peripheric areas, mitigating barriers represent the only way to contain a possible loss.

An overview of general clean-up procedures can be found in Annex B3.

## 11 Incidents and reporting

In order to prevent pellet loss, companies are expected to keep track of pellet loss incidents. This not only helps to understand the actual probability of a loss scenario but also ensures a good practice of reporting and cleaning up.

As a part of workers training programme, workers shall be instructed to report incidents of a pellet spill/loss to the management or the appropriate personnel. The worker shall report the cause of the incident, the area where the incident occurred, the approximate amount of spill and if any follow up actions have been taken or not. A role of responsibility shall be assigned to a person from the management to monitor incidents and follow-up on the cleaning up actions. The amount of spilled pellets shall be documented for reference. If the incident has occurred as a result of bypassing any preventive or mitigating barriers, this shall be reported with the barrier that has been bypassed. The management is obliged to inspect the barrier and come up with corrective measures to ensure the barrier is working properly.

A table depicting the different levels of incident based on the risk level is shown below. As mentioned in the table, Level 1 corresponds to spills that are in minor quantities which is below the threshold level. The threshold level can be set by the company itself. Incidents categorized under level 1 can be easily managed by a worker who has undergone training and need not be reported. Incidents under level 2 which are above the threshold level need to be reported. This should be reported to the person responsible for monitoring the incidents. Workers may clean the spilled pellets and report the quantity and the cause of the spill. At elevated levels above threshold, the risk factor is deemed high. Hence, this needs to be notified to the upper management. The spill should be inspected by the person responsible to understand the root cause, amount spilled and if any barriers have been bypassed. A detailed report should be prepared prompting an action from the management to rectify the situation and to avoid such incidents in the future. A clean-up operation shall be

initiated once the incident is reported to the person responsible for the monitoring of incidents. If the physical barriers have been bypassed or did not perform the intended task properly, this shall be reported as well under 'Level Z'. This should also prompt an action from the management to ensure the barrier is working correctly. The risk factor is very high.

**TABLE 1 LEVEL OF INCIDENTS AND THEIR SPECIFICATIONS**

Incident Level	Level Description	Risk Factor	Reporting Level
<i>Level 1</i>	<ul style="list-style-type: none"> <li>- Minor amount spilled</li> <li>- Can be managed by the worker</li> </ul>	<b>LOW</b>	<ul style="list-style-type: none"> <li>- No need to be reported</li> </ul>
<i>Level 2</i>	<ul style="list-style-type: none"> <li>- Amount spilled above a threshold level</li> <li>- Worker(s) can clean the site</li> <li>- Should be reported and followed up if needed</li> </ul>	<b>MEDIUM</b>	<ul style="list-style-type: none"> <li>- Should be reported to the person responsible for monitoring incidents</li> </ul>
<i>Level 3</i>	<ul style="list-style-type: none"> <li>- Amount spilled well above the threshold level</li> <li>- Should be reported first and then a clean-up operation should be initiated</li> </ul>	<b>HIGH</b>	<ul style="list-style-type: none"> <li>- Should be reported to the person responsible for monitoring incidents</li> <li>- The upper management should be notified</li> </ul>
<i>Level Z</i>	<ul style="list-style-type: none"> <li>- When a preventive/mitigating barrier does not work or has been bypassed</li> <li>- Worker(s) should report and then a clean-up operation should be initiated</li> <li>- The upper management should look into possible measures to rectify the barrier</li> </ul>	<b>VERY HIGH</b>	<ul style="list-style-type: none"> <li>- Should be reported to the person responsible for monitoring incidents</li> <li>- Should be reported to the upper management and the situation should be rectified</li> </ul>

**NOTE: If a loss has occurred instead of spill, the number and volume of incidents resulting in any unrecovered release (loss) of plastic pellets, flakes, powders, or granules, within the physical custody of a company, from containment to ground or water outside member-operated facilities and estimated to be greater than 0.5 litres or 0.5 kilograms per incident. When a loss has occurred, the level of incident is considered to be Level Z. (US OCS Blue definition) should in addition be reported to the responsible trade association**

A template for incident reporting with an example is attached to this document.

## 12 Checklists and Templates

### 12.1 Barrier Checklists

This checklist is to report the barriers present at your facility. The template allows you to report multiple barriers which can be chosen from a drop-down list. In case the barrier is not in the list, the template allows you to overwrite a custom barrier. Each barrier reported has corresponding set of questions in the checklist which are:

- Is this barrier relevant to your plant? – *Mention if the barrier is present in your plant and if it has a significance in preventing/mitigating pellet spill/loss. The question can be answered with a Yes/No with additional comments if needed.*
- List the critical points where this barrier is present – *Mention the critical point(s) where this barrier is present. The template allows you to report up to 4 critical points. Additional points can be added by inserting a row with the same question and appropriately numbering the critical point(s).*
- Have you adapted a SOP for this barrier? – *This means that if this barrier has any specific procedures in place instructing a worker on how to operate/maintain this barrier. This is more relevant in the case of physical barrier which require timely inspections, maintenance etc.*
- Are workers aware/trained on the SOP? – *Mention if the workers are trained with the SOP indicated above or not.*
- Please indicate the SOP for this barrier in short – *Please mention the SOP in brief for the barrier.*
- How often is this barrier inspected? – *Mention the frequency of inspections conducted. For example, how regularly are drain covers checked to monitor if the covers have reached their full capacity.*
- What is the frequency of maintenance? – *Mention first if any maintenance is required and if yes, the frequency of the maintenance*
- What is the consequential action taken if the barrier fails to perform the intended task? – *If the barrier fails to perform at any given point, what will be the alternative or the action taken to combat further spill/loss. For instance, a back-up barrier or an immediate cleaning procedure.*
- Can this barrier function independently without human intervention? – *This is to understand if the barrier is Automatic/Semi-Automatic or Manual. If the barrier is automatic, no human intervention is needed. If the barrier is semi-automatic, some human intervention is needed. If the barrier is a manual barrier like cleaning tools, full human intervention is need.*
- Is the barrier readily accessible? E.g., cleaning tools readily available? – *In case of a spill/loss, is the barrier readily available to prevent/mitigate a spill/loss? If the barrier is not easily available or easily accessible at the time of an incident, this has a direct impact on the spill/loss.*

A separate sheet for preventive barrier(s) and mitigating barrier(s) are foreseen in the file.

## 12.2 Template for reporting a procedure related to an operation/equipment

This is a general template used for reporting a procedure related to an operation, clean-up procedure or a procedure related to an equipment. The template consists of following questions to be filled:

- Diagram/picture: *Insert a diagram of the equipment/operation if available.*
- Identified risks: *Mention the risk which will be eliminated if this procedure is in place.*
- Description of the procedure: *Describe this procedure in detail.*
- Responsible inspector (e.g., QSE manager, production responsible): *Mention the person responsible to supervise this procedure.*
- Responsible to undertake procedure: *Mention the person who will execute this procedure.*
- Training has been received (Yes/No)? *Mention if the workers/personnel have received appropriate training to conduct this procedure or are aware of the procedure or not.*
- Maintenance Frequency: *Mention the maintenance frequency*
- Inspection Frequency: *Mention the frequency of inspection*
- Specifications for implementations: *Mention if any technical specifications are to be followed to implement this procedure.*
- Equipment needed: *Mention the equipment(s) needed in aiding this procedure if any.*

An example on how to use this template is provided within the template excel file.

## 12.3 Template for incident reporting

This template can be used to report a spill/loss incident. The template is developed in correlation with paragraph 11 of this section.

This template has two parts:

a. To be filled by the worker – *This section is for the purpose of preliminary reporting when an incident takes place. The worker on site shall report the incident using this template. This should be followed up by the HSE/person responsible for monitoring the incidents. He/She shall use the second template to prepare a detailed report. The template has the following questions to be filled in:*

- Incident description – *Briefly describe the incident.*
- Area where the incident occurred - Please specify the macro area as well as the critical point – *Mention the macro area and the corresponding critical point where the incident occurred.*
- Cause of the Incident – *Mention the cause and what prompted the incident.*
- Amount of pellets spilled (estimate) in kg – *Mention the approximate amount of pellet spilled/lost in kg.*
- Incident Level – *Choose the level of the incident from the drop-down list. A description of the different levels of incident is provided in Table 1.*  
**NOTE: If a loss has occurred instead of spill, the incident level is considered as Level Z.**
- Clean Operation Initiated (Yes/No)? – *Mention if clean-up operation was initiated after the spill – Yes/No.*
- Clean up Procedure – *Describe the clean-up procedure that was initiated.*



b. To be completed by the responsible for monitoring incidents. – *As mentioned above this template should be used by the HSE/person responsible for monitoring the incidents after the worker has reported the incident using the template explained above. The template has the following questions to be filled in:*

- Incident description – *Briefly describe the incident.*
- Area where the incident occurred - Please specify the macro area as well as the critical point – *Mention the macro area and the corresponding critical point where the incident occurred.*
- Cause of the Incident – *Mention the cause and what prompted the incident.*
- Amount of pellets spilled (estimate) in kg – *Mention the approximate amount of pellet spilled/lost in kg.*
- Reported by (Worker name) – *Mention the name of the worker who reported the incident.*
- Incident Level – *Choose the level of the incident from the drop-down list. A description of the different levels of incident is provided in Table 1.*

**NOTE: If a loss has occurred instead of spill, the incident level is considered as Level Z.**

- Clean Operation Initiated (Yes/No)? – *Mention if clean-up operation was initiated after the spill – Yes/No.*
- Clean up Procedure – *Describe the clean-up procedure that was initiated.*
- Were any physical barriers compromised? If yes, which barrier and where – *Mention if any barrier(s) failed to perform the intended task or malfunctioned which led to this incident.*
- Reported to the management? (In case of Level 3 and Level Z) – *Mention if the incident was reported to the management for further follow-up in case if the incident level was 3 or Z.*

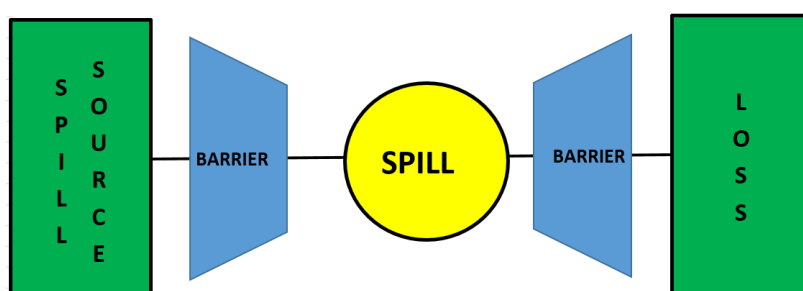
An example on how to use this template is provided within the template excel file.

## SECTION C – IMPLEMENTATION OF THE MEASURES

### 13 The bow-tie model

The bow-tie methodology is very well known and widely used in the industry for both process and personal safety. It starts from a potential pellet loss analysis and reflects the efforts (“barriers”) a company makes to prevent spills and, if necessary, mitigate these spills in order to prevent losses to the environment.

Such a methodology allows to steward progress and allows external auditors to verify whether the barriers installed are working properly: this approach foresees a documented rating of the effectiveness of each barrier. At the same time, this model gives the opportunity to assess the efficiency of the most common barriers and procedures to contain and/or prevent spill and loss.



In order to apply the bow-tie model, it is necessary to use a specific template, that will be described in a specific paragraph at the end of this section.

Before showing the detailed bow-tie methodology, it is worth mentioning that the bow-tie model can be applied at 2 different levels of specificity:

- At critical point/operation level: in this case, the information on barrier efficiency is more accurate, because the preventive barriers are assigned to specific critical points/operations. This approach is described in the next paragraphs;
- At macro area level: in this case, the information on barrier efficiency is less accurate, specifically for the preventive barriers. This is described in paragraph 13.6, but for a full understanding of the approach it is important to get familiar with the methodology developed at critical point/operation level.

For both levels of specificity, an assessment on the mitigating barriers in place is foreseen and such barriers are related to a specific macro area of the plant.

#### 13.1 The bow-tie methodology at critical point level: preliminary steps

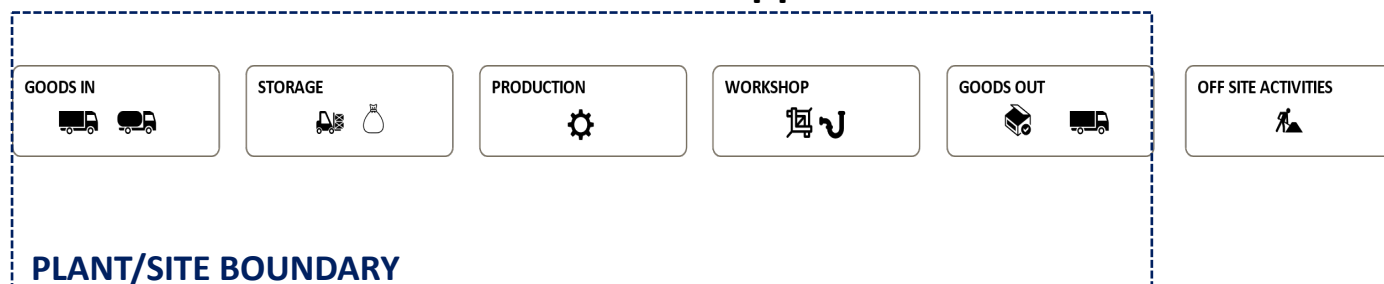
The bow-tie methodology requires a preliminary assessment by location through a material flow approach, already shown in the previous sections of this document.

As a first step, the different macro areas of the plant/site should be identified, distinguishing between those macro areas that are within the plant/site boundary and those macro areas that are outside the plant/site boundary.

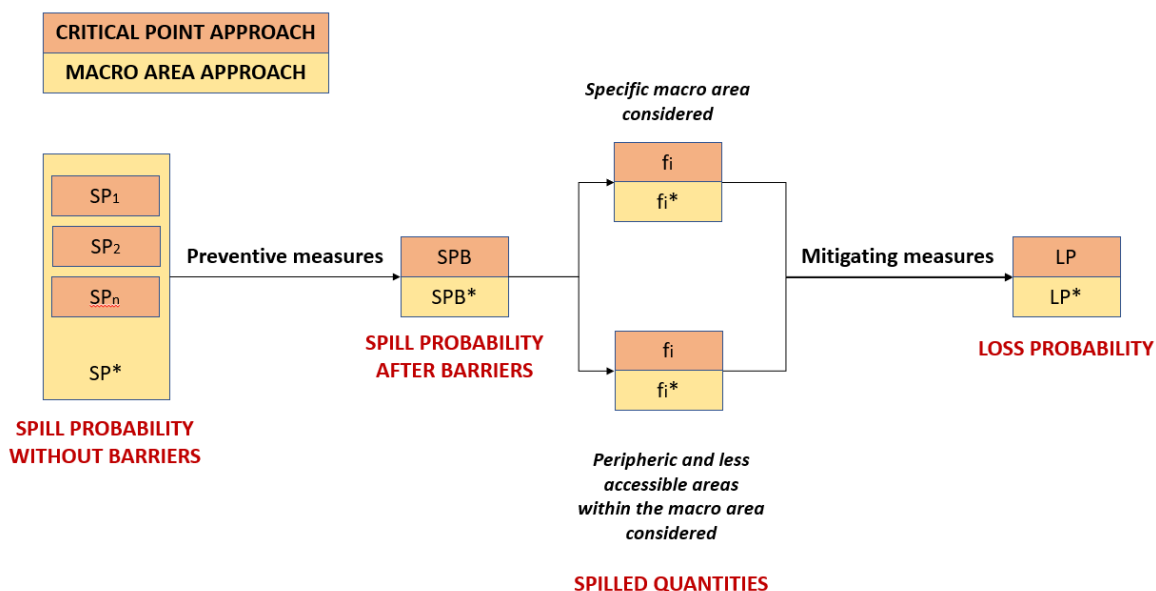
As a second step, specific critical points/operations should be assigned to each identified macro area.

As a third step, both preventive and mitigating barriers should be assigned: more specifically, preventive barriers should be critical point/operation-specific and mitigating barriers should be macro area-specific.

## Material Flow approach



The bow-tie model shown and explained in the next paragraphs has been developed specifically for compounders and converters and it requires the calculation of some key parameters, summarised in the sketch below. Detailed information on each key parameter is provided below, together with the formula needed for their calculation.



### 13.2 The bow-tie methodology at critical point level: sampling

The sampling step is the subsequent step to carry out the risk assessment through the bow-tie model. By following the proposed sample methodology (Annex D), it should be possible to measure the spills for either a specific critical point/operation or a specific macro area of the plant.

Critical point-specific measurements are fundamental for the application of this risk reduction model because it allows carrying out a very detailed assessment per barrier and or procedure in place to contain and/or prevent pellet spill. More specifically, thanks to the calculation of specific figures (that will be presented in the next paragraph), it would be possible to identify those physical locations of the plant/site where the risk of spill is higher. This would enable companies to implement the preventive barriers and measures in order to further reduce pellet spill.

Macro area-specific measurements are relevant for quantifying the potential pellet loss occurring in a macro area of the plant/site and, consequently, for the overall site, after applying specific correction factors.

### 13.3 The bow-tie methodology at critical point level: calculation steps – calculating the spill probability

Considering the different type of operations carried out in a plant, the risk of pellet spill might be different depending on the critical point/operation considered. Therefore, there is the need to define a parameter that represents the magnitude of a spill event without considering the preventive barriers or procedure in place: this parameter is the spill probability without barriers (SP), that can be calculated as follows:

$$SP = \frac{\text{spilled quantity (without barrier) for a specific critical point}}{\text{sum of all spilled quantities (without barrier)}}$$

The spilled quantities without barrier for a specific critical point can be either measured or estimated. The throughput of pellets for a specific critical point is known from the material flow analysis and the spill quantities should be indicated as a yearly figure: in order to do this, it is necessary to scale up the spilled quantities for each critical point considering both the annual throughput and the throughput considered for measuring/estimating the spilled quantities. Depending on the calculations/estimates made, it should be possible to report a minimum spilled quantity and a maximum spilled quantity per critical point. Both values should be considered for the assessment. However, the spill probability should be calculated taking into account the worst-case scenario (maximum spilled quantities) when applying the formula shown above.

Different SPs can be derived for several critical points, indicating that the magnitude of a spill event is not the same in every area of the plant. The SP values are percentage-based, meaning that each critical point has an intrinsic spill probability without the application of specific preventive measures. Critical points with a higher spill probability should have higher priority when it comes to the choice and the application of preventive barriers and procedures.

### 13.4 The bow-tie methodology at critical point level: calculation steps – estimating the barrier efficiency

Another fundamental calculation step is the estimation of the theoretical efficiency of the barriers in place (both preventive and mitigating). Such an efficiency can be estimated considering both dependability and performance capability of the barrier: the dependability is based on reliability and availability of the barriers, whereas the performance capability is based on effectiveness and independency of the barrier, as shown below.

Dependability				
Reliability	> 99%	Low	Mid	High
	98% - 90%	Low	Mid	Mid
	< 89%	Low	Low	Low
		<89%	90% - 98%	> 99%
Availability				

Performance capability				
Effectiveness	>90%	Low	Mid	High
	71% - 90%	Low	Mid	Mid
	< 70%	Low	Low	Low
		1	2	3
Independency				

- The reliability measures the failure rate of a barrier to perform its intended task. This can be classified as the total number of failures divided by the total uptime of the barrier. The reliability is given a score of 1 when below 89%, a score of 2 when comprised between 89 and 99 % and a score of 3 when above 99%.
- The availability measures total uptime of the barrier divided by total downtime to get the percentage of available functional hours [Mean Time to Repair (MTTR) (in hours) + Mean Time Between Repairs (MTBR) (in hours), divided by MTBR]. The availability is given a score of 1 when below 89%, a score of 2 when comprised between 89 and 99 % and a score of 3 when above 99%.
- The effectiveness defines the ability of a barrier to avoid pellets spilled or loss to pass through it. For hardware (i.e., filters) can be defined by the product specification (i.e., filter efficiency). The effectiveness is given a score of 1 when below 70%, a score of 2 when comprised between 70 and 90 % and a score of 3 when above 90%.
- The independency defines the promptness and the certainty of the barrier intervention: 1 – manually activated and executed; 2 – manually activated, automatically executed; 3 – automatically activated and executed.

All these parameters should be taken into account to calculate the efficiency of each barrier and procedure in place. According to its efficiency value, a specific label is assigned to the barrier. Each label is related to an efficiency range: therefore, both the upper and the lower limits of efficiency are introduced in the model.

### 13.5 The bow-tie methodology at critical point level: calculation steps – calculating the loss probability

After calculating the spill probability (SP) and estimating the theoretical efficiency of the whole set of barriers, it is possible to calculate the probability that a loss event occurs (loss probability, LP). Differently from the spill probability, defined per critical point/operation, the loss probability should be related to the macro areas of the plant/site: this is due to the fact that mitigating barriers cannot be always attributed to individual critical points/operations because they normally operate at a wider level, involving several critical points (i.e., filters in the sewage system, filters in the ventilation system).

Assuming that a certain number of critical points are located in a macro area, the spill probability for each of them should be calculated ( $SP_1, SP_2 \dots SP_n$  for  $n$  critical points), as well as the efficiency of all the preventive barriers in place at these critical points ( $PB_{1eff1}, PB_{2eff1}, \dots, PB_{meffn}$  for  $m$  barriers and  $n$  critical points). This allows calculating the spill probability after barriers (SPB), defined as follows (assuming  $n$  critical points and  $m$  barriers for each of them).

$$SPB = SP_1 \times (1 - PB_{1eff1}) \times (1 - PB_{2eff1}) \times \dots \times (1 - PB_{meff1}) + SP_2 \times (1 - PB_{1eff2}) \times (1 - PB_{2eff2}) \times \dots \times (1 - PB_{meff2}) + \dots + SP_n \times (1 - PB_{1effn}) \times (1 - PB_{2effn}) \times \dots \times (1 - PB_{meffn})$$

The spill probability after barriers should be calculated for both upper and lower limit of efficiency of the barriers in place: therefore, a min SPB and a max SPB are calculated, respectively.

Pellets that have by-passed the preventive barriers might still be lost in the environment. It is possible to assume that a certain fraction of pellets is spilled within the same macro area for which mitigating barriers are foreseen, but at the same time another fraction of pellets might be spilled in peripheric or less accessible areas of the plant (collector grate in the sewage system, roof of the building, less accessible floor, etc.) and in this case specific mitigating barriers should be foreseen as well, in order to avoid that such spills become losses.

Before evaluating the efficiency of the mitigating barriers in place, it is necessary to measure/estimate the spilled quantities in the macro area considered and the spilled quantities in the peripheric/less accessible areas of the plant for the specific macro area considered. Consequently, as already done for the preventive barriers, the theoretical efficiency of the mitigating barriers in place for a specific macro area and for the peripheric/less accessible areas should be estimated ( $MB_{1eff}, MB_{2eff}, \dots, MB_{peff}$ , for  $m$  mitigating barriers in series in the macro area considered). At the same time, it is necessary to define how the spilled quantity is divided into the different sets of mitigating barriers placed in both main macro area and peripheric/less accessible areas, by introducing a factor,  $f$ , which is defined between 0 and 1. Finally, the loss probability (LP) in a specific macro area (including both main macro area and peripheric/less accessible areas), can be calculated as follows, considering  $n$  groups of mitigating barriers placed in parallel:

$$LP = SPB \times \sum_{i=1}^n [f_i (1 - MB_{1eff}) \times (1 - MB_{2eff}) \times \dots \times (1 - MB_{meff})]_i$$

### 13.6 The bow-tie methodology at macro area level

Also in this case, the bow-tie methodology requires a preliminary assessment by location through a material flow approach. The different macro areas of the plant/site should be identified, distinguishing between those macro areas that are within the plant/site boundary and those macro areas that are outside the plant/site boundary. At the same time, both preventive and mitigating barriers should be identified and assigned to specific macro areas of the plant/site.

When applying the bow-tie methodology following the macro area approach, the spill probability for a specific macro area,  $SP^*$ , should be calculated:

$$SP^* = \frac{\text{spilled quantity (without barrier) for a specific macro area}}{\text{sum of all spilled quantities (without barrier)}}$$

In a similar way, the barrier efficiencies need to be estimated, considering both preventive and mitigating barriers.

Subsequently, the spill probability after barriers for a specific macro area (SPB\*) should be calculated, considering m preventive barriers placed in series and n groups of preventive barriers placed in parallel, together with the related efficiencies (PB<sub>1eff</sub>, PB<sub>2eff</sub>, ..., PB<sub>meff</sub>):

$$SPB^* = SP^* \sum_{i=1}^n [(1 - PB_{1eff}) \times (1 - PB_{2eff}) \times \dots \times (1 - PB_{meff})]_i$$

Finally, as already shown above for the calculation at critical point level, the theoretical efficiency of the mitigating barriers in place for a specific macro area and for the peripheric/less accessible areas should be estimated (MB<sub>1eff</sub>, MB<sub>2eff</sub>, ..., MB<sub>p-eff</sub>, for m mitigating barriers in series in the macro area considered). At the same time, it is necessary to define how the spilled quantity is divided into the different sets of mitigating barriers placed in both main macro area and peripheric/less accessible areas, by introducing a factor, f, which is defined between 0 and 1. Finally, the loss probability (LP) in a specific macro area (including both main macro area and peripheric/less accessible areas), can be calculated as follows, considering n groups of mitigating barriers placed in parallel:

$$LP = SPB^* \times \sum_{i=1}^n [f_i (1 - MB_{1eff}) \times (1 - MB_{2eff}) \times \dots \times (1 - MB_{m-eff})]_i$$

### 13.7 The bow-tie model for risk reduction purpose


The bow-tie model shown above represent an assessment tool for the implementation of the risk minimisation plan for the reduction of pellet spill and loss. This model gives a clear visual overview of the preventive and mitigating measures in place, allowing their continuous implementation. Moreover, the bow-tie model allows identifying those areas of the plant where the risk of spill and loss is higher and for which the improvement of the preventive and mitigating measures is required. A complete description of the bow-tie model for risk reduction purpose is provided in Annex C1. At the same time, Annex C2 reports the description of an example of bow-tie application for risk reduction purpose.

### 13.8 The bow-tie model for reporting purpose

The bow-tie model can be also used as a tool for reporting pellet loss. Depending on the level of information available, different approaches might be followed:

- Detailed info on barrier efficiency, estimated and/or measured pellets in barriers: following the bow-tie model for risk reduction purpose and the proposed sampling methodology provided in Annex D it should be possible to measure the spills for either a specific critical point/operation or a specific macro area of the plant. These input values, combined with the barrier efficiencies, allow obtaining estimates of spills and losses in a specific compounding and/or converting plant;
- Information on pellets collected at preventive barrier level (CPB): in this case, a simplified version of the bow-tie model can be applied, taking into account the quantity of pellets collected in the preventive barriers and a generic efficiency factor of the most common preventive barriers in place (collection/retention trays, buckets). These input values are the starting point for the application of the model, which will backcalculate spills (rule of 3) and then apply mitigating barriers reduction factors. It keeps the same level of detail in the BowTie section dedicated to the mitigating barriers;
- Information on pellets collected at mitigating barrier level (CPM): in this case, a simplified version of the bow-tie model can be applied, taking into account the quantity of pellets collected in the mitigating barriers and their efficiency factors, which allows a back-calculation of spill and the estimate of loss. Also in this case, the model keeps the same level of detail in the section dedicated to the mitigating barriers;
- Information on pellets sent to recyclers and/or waste management companies: in this case, a simplified version of the bow-tie model can be applied, taking into account the quantity of pellets sent to recyclers and/or waste management companies. The model keeps the same level of detail in the section dedicated to the mitigating barriers, but does not consider the contribution of the preventive barriers and their efficiency. This approach should be preferred for closed processes/operations and when the preventive measures are already integrated in the plant design (e.g., pellets producers).

Independently on the approach followed, the quantitative figures that can be estimated are always indicated as ranges, comprised between a minimum value (obtained considering the highest barrier efficiencies within a defined efficiency range) and a maximum value of spill/loss (obtained considering the lowest barrier efficiencies within a defined efficiency range). These ranges, attributed to a specific plant, need to be compared to those coming from the assessment of other compounding/converting plants, in order to obtain an aggregated relative value, which would allow reporting losses at a sectorial level. Such a comparison is needed to define which data are significantly deviating from the aggregated ranges: in case the relative reported losses are lower or higher than the aggregated values, additional investigation might be needed in order to understand the reliability of the figures obtained by the individual plant assessment.

 Annex C3 reports a set of instruction on how to use the bow-tie model for reporting purpose.

## 14 Conclusions

As already mentioned in the first section of this document, such a guidance provides support for the actions 1 to 4 to which the companies signing the European OCS pledge are committing. As a consequence, this document should be considered as a stand-alone guidance that can be used for the identification of the source of pellet spill and pellet loss, the development of a complete risk assessment and the implementation of the risk minimisation measures.

It is worth highlighting that the diversity of the operations carried out along the polymer value chain cannot easily allow applying a fully standardised and harmonised approach. Therefore, the tools provided in this guidance reflect the complexity of the value chain, allowing a customisation of the risk assessment approach, which is based, however, on a common methodology.

## ANNEX B1 – Best practice catalogue

In order to achieve minimum pellet loss, it is important to employ the use of physical tools other than procedures. Hence, preventive barriers and mitigating barriers were introduced in Section 9 of this document. The definitions of both preventive and mitigating barriers were defined earlier in the section. This annex summarises some of the examples of preventive barriers and mitigating barriers that are commonly installed.

Some of the examples of preventive barriers (physical tools/equipment) are:

- Collection trays
- Pellet/flake/powder disposal cans
- Retention trays (dry or wet)



- Seals (on transfer equipment)





- Buckets



- Tools cleaning (shovel vacuum cleaner, etc)
- Sumo gloves (forklift equip.)



- Procedure for handling octabins (Example in Annex B2)
- Procedure for handling sacks
- General cleaning tools

The general cleaning tools include the broom, shovel, spades, floor squeegees etc. which can be used to clean spills immediately after the spill has occurred.



Mitigating barriers can be classified on according to the potential points of emission into the environment. The three emission points are Soil, Water and Air. Some of the examples of mitigating barriers (physical tools/equipment) which were obtained through the survey conducted by EuPC are:

1. **Air**

a. Dust collection equipment or filters

A dust collector is a system used to enhance the quality of air released from industrial and commercial processes by collecting dust and other impurities from air or gas. Designed to handle high-volume dust loads, a dust collector system consists of a blower, dust filter, a filter-cleaning system, and a dust receptacle or dust removal system. It is distinguished from air purifiers, which use disposable filters to remove dust.



**FIGURE 1 INDUSTRIAL DUST COLLECTION SYSTEM**

Industrial air filters are devices designed to remove solid particulates and molecular contaminants for the purpose of improving air quality in a system or environment. An example is shown below.



FIGURE 2 INDUSTRIAL AIR FILTERS

## 2. Water

### a. Industrial Water Filters (in pipes/drains)



These filters can be fit inside pipes which are a part of the waste water separation system.

### b. Waste water separation system

Wastewater treatment is a process used to remove contaminants from wastewater and convert it into an effluent that can be returned to the water cycle. Once returned to the water cycle, the effluent creates an acceptable impact on the environment or is reused for various purposes (called water reclamation).

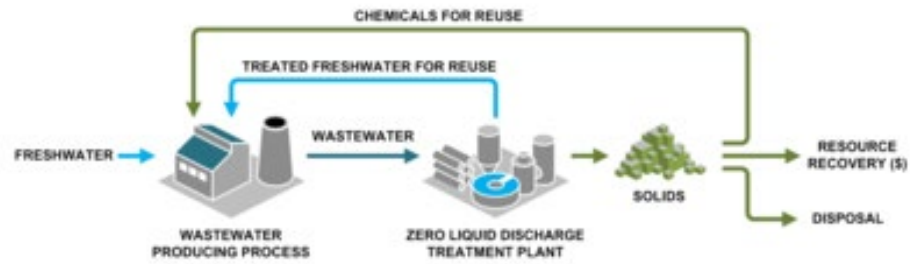


FIGURE 3 INDUSTRIAL WASTEWATER SEPARATION SYSTEM SCHEME

- c. Baffles, skirts and booms in containment ditches/ponds  
Baffles are also referred to as hydraulic baffles (curtains), bio separators, floating baffles, lagoon baffles and water curtains. Regardless of the name, they are commonly used in a large range of wastewater facilities and reservoirs in addition to industrial and municipal water treatment facilities. They can also be attached to walls and floors when used as a tank baffle. If properly designed and installed, pond and tank baffles can significantly contribute to the reduction of Total Suspended Solids (TSS).



FIGURE 4 INSTALLED BAFFLES IN A POND

- d. Surface skimmers  
The surface skimmer provides a permanently clean water surface, reducing oily film residue and therefore contributing to a reduction of microorganisms, better oxygen exchange and greater light penetration. It skims off the film residue and constantly brings new layers of water to the surface.



FIGURE 5 SURFACE SKIMMER

### 3. Soil

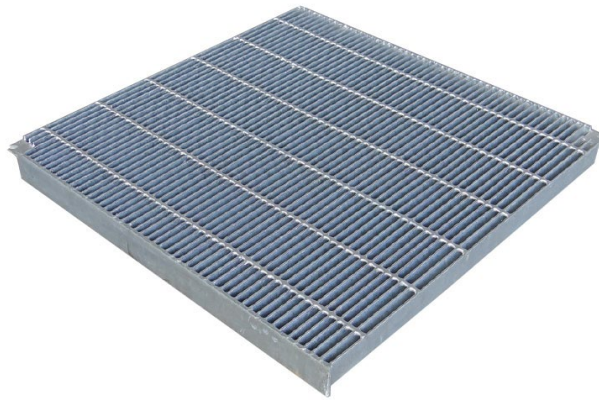
#### a. Vacuum system

The industrial vacuum cleaner is a machine used for the general cleaning in industrial environment, as well as many other more specific applications, not necessarily related to simple cleaning. Hence, they can also be used to collect spilled pellets in clean-up operations.





b. Collector grates



- c. Filtered storm drain system with a screen  
A filter is placed on top of the drain system to prevent pellets entering the drain system.



d. Bunding

Bunding, also called a bund wall, is a constructed retaining wall around storage where potentially polluting substances are handled, processed or stored, for the purposes of containing any unintended escape of material from that area until such time as a remedial action can be taken.



e. Retaining walls

Retaining walls are relatively rigid walls used for supporting soil laterally so that it can be retained at different levels on the two sides. Retaining walls are structures designed to restrain soil to a slope that it would not naturally keep to (typically a steep, near-vertical or vertical slope). This way installed retaining walls around the plants aids in keeping the spilled pellets withing the boundary of the plant. This is useful especially in sloppy terrains.



**FIGURE 6 RETAINING WALL SYSTEMS**

## ANNEX B2 – Examples of procedures

### From Section 9.1: Procedures for preventive barriers

How to handle octabins/big bags?

- During the loading of octabins a sealed tunnel is recommended;
- During the unloading use specific equipment foreseen;
- Make sure to perform visual inspection before unloading in order to prevent accidents;
- The biggest risk is whether the cargo will overturn, therefore ensure that the octabins are stable on the pallet. In addition, the octabins may also crack if exposed to any mechanical stress that has weakened the cardboard (some equipment such as sumo gloves for forklift may help prevent this mechanical stress;
- If a spillage occurs or the octabin overturns, damaged product and pellet must be collected immediately. The area around the spill should be sealed until a clean up has been executed;
- Similar procedures can be applied for big bags. An overview of handling, filling, emptying and disposal and transportation procedures of bags are given in Annex B3. A similar set of procedures can be adapted for octabins as well.



Sealing Loading Cars/Trucks

- Close all outlet caps properly before cars/trucks are moved (and request customers to do the same when returning empties).
- Apply seals on all outlet caps (e.g., 1/8" stranded steel cable or its equivalent is common).
- Design or modify loading systems so that transfer lines can be completely emptied, with any residual resin being discharged into a container after loading is completed.

### From Section 9.2: Procedures for mitigating barriers

- Drain covers:
  - Regularly check drains by collecting samples;
  - Establishment of filters in drains that collect microplastics, where the wastewater is emitted to the environment;
  - Regular inspection of the bank area of nearby surface water.
- Tools for immediate cleaning (shovel, broom, brush, vacuum cleaner):
  - Cleaning equipment is available and there are procedures to ensure that pellets do not remain on the floor over time;
  - Well-marked and fixed places for the tools and for disposing of collected pellets;
  - Work instructions for regular cleaning of areas;
  - Sealed containers for collected dust and pellets;
  - Clean-up methods should follow the hierarchy indicated below:
    - 1) Vacuum cleaner;
    - 2) Brooms and showels;
    - 3) Water (to wash off);
    - 4) Blow pellets away.



## ANNEX B3 – Catalogue of procedures

### GENERAL PROCEDURES AND GOOD PRACTICES

This section showcases examples of procedures and good practices to inculcate in your daily operations to ensure minimum pellet loss. Examples below are specific to an operational area:

#### *a) Raw Material Delivery*

- Transport each product with the most suitable clamping truck.
- Clamping truck must be used when transporting a block.
- Forklift/stacker must be used for palletized products.
- Forklift preferably with custom forks or stacks.
- Procedures and training of truck operator must be performed.
- If a spillage occurs or the octabin overturns, damaged product and pellet must be collected immediately.

#### *b) Production and Storage*

- Good and safe emptying of the plastic bag / internal lining of the octabin reduces waste of pellets on the floor. The emptying station should be reviewed for leaks and higher edges that minimize leaks during the emptying process should be considered.
- Equipment maintenance procedures.
- Avoid any drains near the emptying point.
- Plastic film, internal lining and cardboard are collected.
- Cleaning equipment is readily available and there are procedures to ensure that pellets do not remain on the floor over time. If possible, the pellet should be recycled.
- Work instructions for regular cleaning of this area
- Maintenance procedures to avoid pipe leaks.
- Maintenance procedures for filters and appliances to prevent roof leakage.
- Procedures for checking and cleaning filters.
- Removing external dust on silos and other equipment.
- Procedures for daily collection of wastes
- Good tools such as vacuum cleaner.
- Work instructions for regular cleaning of this area

## CLEAN-UP PROCEDURES

Examples of clean-up procedures are given below specific to an operation nature. The procedures are shown with respect to the template for reporting procedures described earlier in this document.

### *i. INTENDED OPERATION(S) WHERE PROCEDURE IS APPLIED: TRANSPORT AND PACKAGING*

**Objective:** To ensure minimum pellet loss

**Target points where procedures are applied:** Hopper car and hopper truck cleaning, loading, storage and unloading present special resin handling challenges

**a. Cleaning Point:** Cleaning Empty Hopper Cars and Trucks (Residual Pellets)

**Procedure:**

- Use air lance to make total pellet, flake and powder removal easier.
- Ensure hopper car and truck cleaning areas have wastewater collection and pellet, flake and powder filtration systems installed.
- Recover all pellets, flakes and powder from wash water.
- Recycle, resell or dispose of collected pellets, flakes and powder properly.

**Responsible inspector (e.g. QSE manager, production responsible):**

**Responsible to undertake procedure:** Tony Stark

**Training has been received (Yes/No)?:** Yes

**Maintenance and Inspection Frequency:** Cleaned Daily and Inspected Daily

**Specifications for Implementations:**

**Equipment Needed:** Air Lance, Waste water filters, Manual Cleaning tools

**b. Cleaning Point:** Cleaning Empty Hopper Cars and Trucks (Transfer of pellets)

**Procedure:**

- Operate the conveying system properly to avoid clogging and necessitating the opening of lines.
- If a line must be opened to clear blockage, anticipate the potential for pellet, flake and powder loss and always place a catch pan or tarp under the connection.
- Remove any spilled pellets, flakes and powder from the top of the car/truck before leaving the containment area—residual pellets, flakes and powder will fall to the ground as cars are moved outside the plant.

**Responsible inspector (e.g. QSE manager, production responsible):**

**Responsible to undertake procedure:** Tony Stark

**Training has been received (Yes/No)?:** Yes

**Frequency:** Cleaned Daily and Inspected Daily

**Specifications for Implementations:**

**Equipment Needed:** Collection trays, Manual Cleaning tools

**c. Cleaning Point:** Sealing Loading Cars/Trucks

**Procedure:**

- Close all outlet caps properly before cars/trucks are moved (and request customers to do the same when returning empties).
- Apply seals on all outlet caps (e.g., 1/8" stranded steel cable or its equivalent is common).
- Design or modify loading systems so that transfer lines can be completely emptied, with any residual resin being discharged into a container after loading is completed.

**Responsible inspector (e.g. QSE manager, production responsible):**

**Responsible to undertake procedure:** Tony Stark

**Training has been received (Yes/No)?:** Yes

**Maintenance and Inspection Frequency:** Cleaned Daily and Inspected Daily

**Specifications for Implementations:**

**Equipment Needed:** Collection trays, Seals, Disposal cans for pellet collections, Manual Cleaning tools

**d. Cleaning Point:** Unloading Hopper Cars and Trucks

**Procedure:**

*For Valve Opening*

- Contain possible spill during hook-up by placing a catch pan under the unloading valve before opening.
- Purge unloading tubes within containment area.
- Keep area swept up or vacuumed.
- Consider installing connecting hoses equipped with valves that will close automatically when the connection is broken. Clogged hoses, material bridging in outlets, etc., can require unloading lines to be opened, which presents the risk of spillage.
- Anticipate the potential for pellet, flake and powder loss before opening the line.
- Place pellet, flake and powder disposal cans at rail yards for loading and unloading.
- Have a catch pan or tarp ready to catch pellets, flakes and powder.
- Immediately clean up and properly dispose of any spilled pellets.
- Surges in unloading lines can cause pellets, flakes and powder to be vented into the environment. To help prevent this, install a bag house, filter bag assembly or other control device at the unloading system vent.

**Responsible to undertake procedure:** Tony Stark

**Training has been received (Yes/No)?:** Yes

**Maintenance and Inspection Frequency:** Cleaned Daily and Inspected Daily

**Solution specifications:**

**Equipment Needed:** Collection trays, Seals, Disposal cans for pellet collections, Manual Cleaning tools, bag house, filter bag assembly

**e. Cleaning Point:** Completing Unloading

**Procedure:**

- Ensure that the car/truck is thoroughly unloaded.
- Cycle the outlet valve while air is flowing.
- Visually confirm that each compartment is empty.
- Purge the line before disconnecting.

**Responsible to undertake procedure:** Tony Stark

**Training has been received (Yes/No)?:** Yes

**Maintenance and Inspection Frequency:** Cleaned Daily and Inspected Daily

**Specifications for Implementations:**

**Equipment Needed:** Seals, Disposal cans for pellet collections, Manual Cleaning tools, Vacuum

*ii. INTENDED OPERATION(S) WHERE PROCEDURE IS APPLIED: Miscellaneous*

1. **Cleaning Point:** Bags: Emptying and Disposal

**Procedure:**

- Thoroughly empty bags.
- Collect, handle, store and transport the empty bags to avoid/contain the escape of pellets, flakes and powder.
- Recycle plastic resin bags, shrink-wrap and stretch-wrap, whenever possible.
- Dispose of packaging by incineration or in a well-managed landfill.
- Stress the need for “no loss to the environment” procedures.

**Responsible to undertake procedure:** Tony Stark

**Training has been received (Yes/No)?:** Yes

**Maintenance and Inspection Frequency:** Cleaned Daily and Inspected Daily

**Specifications for Implementations:**

**Equipment Needed:** Seals, Disposal cans for pellet collections, Manual Cleaning tools, Hand Vacuum

## 2. **Cleaning Point:** Bags: Filling and Handling

### **Procedure:**

- Inspect all pallets for protruding nails or broken boards.
- Use bags that are not easily punctured.
- Use a heavier weight container/bag if breakage is a recurring problem.
- Move and stack bags immediately after filling to avoid seepage.
- Tape leaks (temporary solution) and replace leaking bags as soon as possible.
- Regularly clean up pellets, flakes and powder spilled during the filling process. Wherever possible, select filling equipment designed to prevent pellet, flake and powder loss.
- Implement warehouse and handling procedures that minimize the chance of pellet, flake and powder spillage.
- Dispose of collected pellets, flakes and powder properly.

**Responsible to undertake procedure:** Tony Stark

**Training has been received (Yes/No)?:** Yes

**Maintenance and Inspection Frequency:** Cleaned Daily and Inspected Daily

**Specifications for Implementations:**

**Equipment Needed:** Seals, Disposal cans for pellet collections, Manual Cleaning tools, Hand Vacuum

## 3. **Cleaning Point:** Ensure pellets, flakes and powder are properly disposed of to avoid contaminating the environment.

### **Procedure:**

- Store waste pellets, flakes and powder in properly labeled containers.
  - Do not permit loose pellets, flakes and powder to accumulate on the ground or floors.
  - Install pellet-specific waste container (e.g., one or more) in each pellet-, flake- and powder-handling area.
  - Routinely check that there is adequate waste storage capacity.
- Use separate containers for recyclable and non-recyclable pellets, flakes and powder.
- Use only covered containers or vehicles without leaks.
- Inspect and confirm proper handling and storage procedures if an outside vendor is used for waste removal.
  - Stress the need for “no loss to the environment” procedures.
- Preferred disposal methods are:
  - Recycle or resell waste pellets, flakes and powder.
  - Approved incineration of waste pellets, flakes and powder in properly licensed and operated incinerators.
  - Deposit in a controlled landfill only after confining pellets, flakes and powder in such a manner that prevents their loss due to rain, wind, flooding, etc.
  - Consider using waste pellets, flakes and powder in a fuel-blending program.
  - Include pellet, flake and powder retention capabilities and practices in criteria for selecting waste disposal companies.

**Responsible to undertake procedure:** Tony Stark

**Training has been received (Yes/No)?:** Yes

**Maintenance and Inspection Frequency:** Cleaned Daily and Inspected Daily

**Specifications for Implementations:**

**Equipment Needed:** Disposal cans for pellet collections, Manual Cleaning tools, Hand Vacuum etc.

4. **Cleaning Point:** Bags and Octabins – Transport

**Procedure:**

- Inspect the bags/octabins properly before its transported
- Check for leaks or damages which could potentially lead to a spill
- While transporting be observant to prevent accidents that could lead to rupture of bags/octabins.
- Once transported, inspect the bags/octabins again and check for any damages or ruptures.
- If a rupture has been noticed at the end of transportation, trace back the path of transportation to check for spills.
- All spills should be cleaned immediately
- Dispose of collected pellets, flakes and powder properly.

**Responsible to undertake procedure:** Tony Stark

**Training has been received (Yes/No)?:** Yes

**Maintenance and Inspection Frequency:** Cleaned Daily and Inspected Daily

**Specifications for Implementations:**

**Equipment Needed:** Disposal cans for pellet collections, Manual Cleaning tools, Hand Vacuum etc.

## ANNEX B4 – Pictograms



Operation Clean Sweep®

Klimaschutz  
Klimaschutz



### Null Granulat Verlust

SOP – Standard Operating Procedure / For internal use only  
No: WEEU-SOP-1097  
Valid from: 2018/11/15  
Version: 1 / Original



Another example of a pictogram representing operational instructions in loading area for trucks is shown below:







## PELLET SPILL RISK



Pay **attention** in this area for a potential **spill** of **pellets**. In case of a spill, please follow the required **procedures** to **clean-up**



## POTENTIAL PELLET LOSS



Pay **attention** here. If pellets end up in this area this means that spilled pellets will eventually end up in the environment. **Act up !**

