Purpose: The purpose of this document is to aid in the implementation of the nanomaterial risk assessment process and safe practices necessary for safe handling and disposal of nanomaterials.

Scope: This Safety Guideline is aimed at those people who, in the course of their duties, handle nanomaterials or those who are responsible for putting in place control measures for activities involving nanomaterials.

Reference documents:
[1] Safety Regulation SR-C, Chemical agents (EDMS No. 940853)
[4] Safety Form SF-C-0-0-2 – Nanomaterial Risk Assessment (EDMS No. 1235859)
[5] Safety Form SF-C-1-0-2 – Chemical Inventory (EDMS No. 1093029)

Further Reading:
- Management of Nanomaterials Safety in Research Environment: EPFL (Ecole Polytechnique Fédérale de Lausanne Switzerland); University of Fribourg, Switzerland; Institut universitaire romand de Santé au Travail, Lausanne, Switzerland; 2010 (Link to Article).
- Analyse de risque sur l’utilisation de nanopoudres d’oxyde d’yttrium (Y₂O₃) – ISOLDE. Détermination du niveau de danger Nano lors de l’utilisation de nanopoudres, méthode EPFL. CERN, Nhât-Tân Vuong, 30 January 2012 (EDMS No. 1184538 Rev. 1).
- Nanomatériaux, Prevention des risques dans les laboratoires, ED 6115, INRS, January 2012.
- Le nanomatiéras, définitions, risques toxicologiques, caractérisation de l’exposition professionnelle et mesures de prévention, ED 6050, INRS, June 2008.
- Risk management of carbon nanotubes. Health and Safety Executive, January 2011 (Link to Article).

TRACIBILITY

Reference No.: Safety Guideline SG-C-0-0-5

EDMS No.: 1113400 ver. 2

Prepared by: J. Gulley HSE/SEE

Date: 18/01/2017

Verified by: C. Laverriere, F. Angerand, U. Tihinen HSE/SEE

Date: 29/05/2017

Approved by: E. Cennini HSE/SEE

Date: 30/05/2017


<table>
<thead>
<tr>
<th>Rev. No.</th>
<th>Date</th>
<th>Description of Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>30/05/2017</td>
<td>Update hyperlink under Reference Documents [6]. Under chapter 6.3, removal of text and Table 1. Renaming of chapter 6.5 and removal of text relating to annual declaration.</td>
</tr>
</tbody>
</table>
1 INTRODUCTION

There is currently no specific regulation governing the use of nanomaterials. CERN’s Safety Regulation for Chemical Agents, SR-C [1], is applicable since nanomaterials fall under the definition of what constitutes a hazardous chemical agent:

- « Any chemical agent which, whilst not meeting the criteria for classification as a dangerous substance or mixture [...], may, because of its physico-chemical, chemical or toxicological properties and the way it is used or is present in the workplace, present a risk to the safety or health of the person [...]. »

As such, the requirements applicable to hazardous chemical agents are also applicable to nanomaterials:

- « For each activity under the responsibility of the organic unit involving a hazardous chemical agent and for each hazardous chemical agent involved, the organic unit concerned shall carry out a risk assessment. »

Given the lack of current knowledge about the toxicity of nanomaterials, it is recommended that all nanomaterials, including waste material, are considered potentially hazardous unless sufficient information to the contrary is obtained.

2 DEFINITIONS

Nanoscale: Size range from approximately 1 nm to 100 nm [2].

Nanomaterials: Material with any external dimension in the nanoscale or having internal or surface structure in the nanoscale [3].

Nanoparticle: Nano-object with all three external dimensions in the nanoscale [2].

Figure 1 below shows the different categories of nanomaterials:

---

1 On 18 October 2011 the Commission adopted the Recommendation on the definition of a nanomaterial. According to this Recommendation a "Nanomaterial" means: "A natural, incidental or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50 % or more of the particles in the number size distribution, one or more external dimensions is in the size range 1 nm - 100 nm."
3 HAZARD IDENTIFICATION

3.1 Nanomaterials inventory

An up-to-date inventory of the identified nanomaterials must be kept by the person responsible for an activity involving nanomaterials, using Safety Form SF-C-1-0-2 – Chemical Inventory [5]. The inventory should be compiled using the Safety Data Sheet (SDS) for the nanomaterial provided by the supplier. The inventory should indicate: the name of the chemical agent; the nanomaterial hazard and any chemical hazards (e.g. flammable, corrosive); the storage location; and the maximum quantity stored.

3.2 Hazard Labelling and warning sign

In the absence of an official defined pictogram for the nano-hazard, the pictograms shown below have been adopted by CERN.

In the absence of an original label on a container indicating the hazard of nanomaterials, or for containers or sealed plastic bags used to recover waste material the pictogram shown to the left (SCFM: 50.55.20.092.0) should be placed on the container/bag.

The warning sign shown to the right (SCFM: 50.55.89.730.0) should be placed on cupboards or on the points of entry to storage areas where nanomaterials are stored or handled.
4 RISK ASSESSMENT

4.1 Methodology

Safety Form SF-C-0-0-2 – Nanomaterial Risk Assessment [4] based on the EPFL risk assessment methodology described in annex 1, has been developed to determine the Nano Risk level based on the input of the user and to provide details of which control measures are required. This form should be completed by those who are involved in activities involving nanomaterials. This method that consists of two main steps, assumes that inhalation and skin contact are the most important routes of exposure:

Step 1 - Determine the Nano Risk level (i.e. Nano 1, 2 or 3) for the activity in the laboratory, using the decision tree in Annex I.

Step 2 - the technical, organizational, personal protective measures and management of cleaning measures for the different laboratory (Nano Risk level) types are presented in the tables in Annex I.

4.2 Control measures

The appropriate control measures will depend on the outcome of the risk assessment. Depending on the Nano Risk level associated with the activity, the preventive and protective measures which should be observed will be provided by the risk assessment tool, Safety Form SF-C-0-0-2 – Nanomaterial Risk Assessment.

5 EXPOSURE MONITORING

5.1 Recommended exposure limits

There are no existing legal exposure limits for nanomaterials in the host states, or at European or International level, with respect to the nano-hazard. Exposure limits have been recommended for some specific nanomaterials by various institutes.

The HSE Unit recommends the respect of the following threshold values recommended by BSI (British Standards) that are based on the physical, chemical or toxicological properties of the nanomaterial concerned [6]:

- **Fibrous** nanomaterials = 0.01 fibres/ml (where a fibre = 3:1 aspect ratio; length greater than 500 nm).
- **CMAR**2 nanomaterials = 0.1 x existing material workplace exposure limit for bulk counterpart (i.e non-nano).
- **Insoluble** nanomaterials = 0.666 x existing material workplace exposure limit for bulk counterpart.
- **Soluble** nanomaterials = 0.5 x existing material workplace exposure limit for bulk counterpart.

Consult the HSE Unit for further details.

In the absence of a defined legal exposure limit, the level of exposure should be reduced to as low a level as reasonably practicable.

---

2 CMAR: Carcinogenic, Mutagenic, Asthmagenic, Reproductive toxin
5.2 Exposure monitoring campaign

The need to perform exposure monitoring for nanomaterials could be justified depending on the results of the risk assessment, on-site tests etc. An exposure monitoring campaign for nanomaterials can be costly to undertake and is a complex decision making process, which should be carried out in every laboratory where nanomaterials are handled [7].

For the exposure monitoring campaign, real-time measurements of the concentration and the number of particles and fibres should be made. For a particular nanomaterial the measuring points would usually be:

- close to the source of release and far from the release point (to take into account the background concentration);
- In the breathing zone of an operator or for fixed sampling points, positioned at the approximate breathing height of an operator.

6 SAFE PRACTICES

6.1 Disposal

Before working with nanomaterials, you should complete an internal transport request in EDH “Transport Request (CERN Site)” in order to obtain a sealed container and suitable plastic bags for the disposal of nanomaterials. You should put ‘b.262’ under ‘From’ for the chemical waste service at building 262 and the identifier for your laboratory under ‘To’.

All waste generated during the handling of nanomaterials (e.g. cleaning solution, waste paper, samples, filters, vacuum cleaner bag, used personal protective equipment, etc...) should be kept separate from normal waste. All loose solid waste should be double bagged in sealed plastic bags and clearly labelled with the nano-hazard pictogram.

Conditionned waste must be disposed of using the internal transport request in EDH, this time putting the identifier of your laboratory under ‘From’ and ‘b. 262’ under ‘To’. The Safety Data Sheet should be attached and relevant information filled-in (type of material, kind of hazard, name of the chemical, etc...).

6.2 Emergency procedure

An emergency procedure, based on the Nano Risk level and the quantity of nanomaterial involved, must be established by the person responsible for the laboratory to deal with spills. The area affected by the spill should be clearly delimited and an evacuation of those people in the vicinity made if necessary. Spill clean-up should involve the use of wet wipes or vacuum cleaners fitted with a HEPA filter. Dry sweeping must be avoided.

Based on the extent of the accident/incident, the Fire Brigade should be contacted (Tel. 74444) for situations that are not covered by the emergency procedure. In addition, people working with nanomaterials must be informed of the appropriate first aid procedures (chapter 4 of the Safety Data Sheet).

6.3 Training and Information

People working with nanomaterials must receive adequate training and be sufficiently informed about the inherent hazards and the control measures in place in their laboratory.
6.4 Authorized personnel

Entry to a laboratory or other area where nanomaterials are handled must be restricted to authorized personnel. The list of authorized personnel, established by the person responsible for the laboratory, must be clearly displayed at the entrance to the laboratory.

6.5 Informing the HSE

Persons responsible for a laboratory at CERN which produces, distributes or imports, from outside France, 100 grams per year or more of a nanomaterial must explicitly inform the HSE Unit in writing.
ANNEX I - EPFL RISK ASSESSMENT METHODOLOGY (DECISION TREE)

Figure 2 – Risk Assessment decision tree