



Template for Performing Generic Radiation Risk Assessments

Introduction

ZIA has developed a radiation risk assessment (RRA) tool for use by zircon processors. This tool allows the identification of risks within operations, guiding manufacturers to ensure they have appropriate procedures in place to operate safely and in compliance with local regulations such as the EU's Basic Safety Standards (BSS) Directive.

With the introduction of BSS, increased focus has been brought to bear on the processing of zircon and zirconia. While these industries are well aware of the associated risks, BSS will require greater formalisation of procedures. The first step in developing management systems for radiation hazards is to produce a radiation risk assessment (RRA). Such RRAs will also be of value in other jurisdictions outside the EU.

The Template

A template RRA was prepared using Excel spread sheets. The template contains five tabs: *Introduction, Questionnaire, Risk Assessment (RA), Risk Matrix* and *RA Criteria*.

The 'Introduction' tab offers a brief summary of the workings of the template.

The 'Questionnaire' tab is the actual template itself and is supported by information from the other tabs. This is the only tab that requires completion by the user.

The 'Risk Assessment' is linked the 'Questionnaire' tab.

The 'Risk Matrix' and 'RA Criteria' tabs are used to generate data in the 'Risk Assessment (RA)' tab as described below.

Questionnaire

This poses a set of questions to the user, each requiring a yes (Y) or no (N) response. This Y/N column is the only one that needs to be completed for the RRA tool to function. A 'yes' answer in this column will result in the population of the five adjacent columns. The numbers that appear in these five columns are the risk scores that are generated from the "RA" tab. Completion of the Yes/No questions will give a fully-populated set of data in the five adjacent columns. These columns and rows are summed to show the radiation risk area with the greatest risks and also those tasks/ scenarios that are the most hazardous from a radiation point-of-view. All high-risk scores will appear in **red**, indicating areas that require attention.



Note that the risks identified by this assessment are unmitigated risks i.e. assuming that no improvements or protection measures have been implemented. Once mitigation has been implemented a new set of data can be generated.

The completed RRA highlights those areas of the operation that have the highest radiation risks, and it will be these that will attract regulatory attention. Before presenting the RRA results to a regulator it is recommended that the operator performs specific radiation dose measurements to establish the actual level of risk and, based on these measurements, the operator implements measures to fully protect personnel and/or members of the public.

RA Criteria

This includes a table that describes two parameters: consequence and likelihood. Consequence is the maximum consequence associated with the risk/hazard being considered, and likelihood describes the possibility of that consequence occurring. There are five levels of likelihood from 'Rare' to 'Almost Certain', and there are five levels of consequence from 'Insignificant' to 'Critical'.

Risk matrix

This is a classic 5 x 5 matrix with the five consequence parameters horizontal at the top and the five likelihood parameters vertical at the side. Each parameter is allocated a numerical score and the intersection of two parameters is represented by multiplying the scores of the consequence and the likelihood.

Risk Assessment (RA)

This contains descriptions of all the broad groups of hazards perceived to be associated with the industry sector and shows hazards for zircon milling, thermal zirconia and chemical zirconia production. The consequence and likelihood allocated to each hazard is somewhat empirical and based on extensive, expert experience.

Comments

While all attempts have been made to make this template as generic as possible there remains some specific questions that are not generic. These can be refined based on detailed input from the user.



Appendix: Template RRA Example

Below is an example of an operator that mills zircon sand. The column (in yellow) and marked “Answer Y or N” has been completed and the adjacent columns were then automatically populated by the model.

The high-risk scores (as determined by the Risk Matrix) are marked in **red**. In this example the high risks are:

- i) Radioactive dust for plant operators and maintainers.
- ii) Gamma radiation and radioactive dust for the dust extraction system maintainers.
- iii) Radioactive dust for people cleaning the plant floors
- iv) Gamma radiation and radioactive dust for people handling scrap.
- v) Exposure to contaminated equipment or scales by maintainers of the plant and dust extraction systems, also the people handling scrap from the plant.

Further, the template shows that the highest risk is from dust, with a score of **393**. It also shows that the highest risk activities are removing scrap from the plant and maintaining the dust extraction system with risk scores of **226**.

The high score given to dust exposure is expected for a milling operation. It also indicates to the operator that control of dust exposures is very important in this example. The next step would be to conduct a dose measurement program where people working in the areas indicated are monitored for radioactive dust exposure.

The example also indicates that exposure to radon and volatile radionuclides is of low risk; similarly, transport of the bagged product is also low risk.

The question on employment of female workers in production was answered ‘No’; however, it will be noticed that if a yes answer is given then some high-risk scores are generated. This is a result of attention being placed on radiation exposure of pregnant females in the BSS and indicates that employers need to manage this issue with some care.

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Example: Template Radiation Risk Assessment (RRA) for zircon milling

		Risk ratings						
		Y / N	Risk Score	Risk Score	Risk Score	Risk Score	Risk Score	Risk Score
Answer questions 4-19 if you mill zircon sand			Gamma	Dust	Radon	Po210/Pb210/Ra226	Scales	Total
4	Do you have plant operators?	Y	33	72	5	5	48	163
5	Do you have plant maintainers?	Y	33	72	5	5	72	187
6	Do you have operators for the fume/dust control system?	N	0	0	0	0	0	0
7	Do you have maintainers for the fume/dust control system?	Y	72	72	5	5	72	226
8	Do you have people cleaning plant floors?	Y	33	72	5	5	33	148
9	Do you have people handling scrap from the plant?	Y	72	72	5	5	72	226
10	Do you have people bagging product?	Y	33	33	5	5	11	87
11	Are there residences down-wind of plant?	N	0	0	0	0	0	0
12	Are there public buildings down-wind of plant?	N	0	0	0	0	0	0
13	Do you allow persons who are not employees onto your site?	N	0	0	0	0	0	0
14	Are the solid wastes >1 Bq/g?	N	0	0	0	0	0	0
15	Is the activity of liquid wastes when evaporated >1 Bq/g?	N	0	0	0	0	0	0
16	Are there emissions of radon gas from the plant stacks?	N	0	0	0	0	0	0
17	Do you employ pregnant female workers in production?	N	0	0	0	0	0	0
18	Do you transport milled zircon to customers in bulk?	N	0	0	0	0	0	0
19	Do you transport milled zircon to customers in bags?	Y	22	22	5	5	22	76
Total risk score			276	393	30	30	308	
Score for highest risk cause			393					
Score for highest risk work type			226					