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# Discovering an Orphan Source of Ionizing Radiation with Respect to Occupational Safety and Health

Miroslav Tomek [1], Jan Strohmandl [1], Pavel Tomášek [1*], Dušan Vičar [1]

[1] Tomas Bata University in Zlín, 760 01 Zlín, Czech Republic.

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**Abstract**

Compliance with the principles of occupational safety and health is one of the preconditions for avoiding emergency events. Without a doubt, this is one of the underlying duties of every employer or operator of waste recycling centers. The risk to health resulting from an orphan source of ionizing radiation in the form of scrap metal is quite high and can affect a significant number of people. As part of the precautions relating to employees, the employer must analyze the risks associated with working with scrap metal and emphasize the possibility of any previous contamination. In practice, various methods and procedures are used to assess the risks at scrap metal collection facilities, which are mostly based on the knowledge and experience of their inspectors. However, this is not usually done by means of appropriate risk analysis methods, which is the main disadvantage. The goal of this article is to point at the risks related to discovering an orphan source of ionizing radiation by using the Ishikawa diagram and the point method. Furthermore, this article also deals with the demarcation of a safety zone with respect to the protection of health and the environment. The specification of risks, the proposal of recommended precautions, and the expeditious demarcation of a safety zone in the case of the intervention of fire brigades in order to protect and/or decontaminate the persons are also included.

*Keywords:* Metal Waste; Protection; Risk; Radiation; Occupational Safety and Health; Scrap Metal.

## 1. Introduction

The Occupational Health and Safety (OHS) risk analysis is one of the most important activities for all employers in the Czech Republic, which arises from the relevant legal norm [1, 2]. Furthermore, this is completely valid for people who may come into contact with contaminated metal waste; in these cases, all principles stipulated by Act No. 263/2016 Coll [3] and REGULATION No. 307/2002 Coll [4], which are in full compliance with the European Union law provided by COUNCIL Directive 96/29/EURATAM [5] or COUNCIL Directive 2003/122/EURATOM [6], must be followed. Isolated radioactive sources or other orphan sources of ionizing radiation (SIR) are collected and handed over to scrapyards as scrap metal. Scrap metal is an important source for the iron and steel industry and is generally intended for recycling and further production.

Above all, the harmful effect of ionizing radiation, the source of which can be an orphan SIR in the form of scrap metal, is the result of energy absorption by body tissues, the so-called radiation dose. Externally, the effect of the SIR is manifested exclusively by the emitted gamma and beta radiation. Alpha radiation is absorbed by the upper layers of the skin and therefore does not affect body tissues. Ionizing radiation can initiate processes in tissues that lead to cell destruction or alteration; it can also cause malignant tumors and alter genetic makeup [7].

* Corresponding author: tomasek@utb.cz

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Ionizing radiation is one in the physical factors of the work environment. Damage to the health caused by irradiation can be divided as follows:

- Somatic consequences (manifested directly in the irradiated individual) and genetic consequences (manifested in future generations).
- Early consequences (manifested over days, weeks, or months) and belated consequences (manifested over years).
- Effects:
  - *Deterministic* (inevitable, non-stochastic, and non-random) that manifest themselves in all irradiated individuals when a certain threshold dose is exceeded. The threshold dose for a given effect decreases individually, depending on the irradiation conditions and the effects on the individual proportional to the dose.
  - *Stochastic* (random, statistical) that have no threshold dose and are of a statistical (probabilistic) nature. A stochastic damage manifests itself only in some persons (individuals) from a significant statistical set, i.e. it has only a certain probability coefficient for individuals. In case of stochastic effects, it is never possible to decide for sure whether or not a particular disease in an individual has occurred as a result of irradiation [7].

In the past, contaminated scrap metal unintentionally disposed of in a scrapyard. People were exposed to radiation and their health was damaged. These events can still occur today. In particular, the persons who have been and may be threatened by the SIR, include employees of scrapyards who buy up scrap metal and persons who use these collection yards. Other groups of vulnerable persons are also drivers who transport metal waste for further processing, road users, workers in the iron and steel industry, and last but not least, the Fire Rescue Service (FRS) of the Czech Republic. The objective of risk analysis is to prevent risks, eliminate them, or minimize those that cannot be completely eliminated. Effective prevention of health damage related to dealing with contaminated metal waste must be based on knowledge of the nature of the risks and their severity [8]. The condition for effective prevention from the perspective of OHS is the fulfilment of all requirements stipulated by law, technical standards, and recommendations of the State Office for Nuclear Safety and the State Office of Labour Inspection, which can further incorporate laws and decrees [9-11]. Other important sources of information are professional publications and articles that focus on the problem [12-14]. There are official obligatory instructions related to SIR in the Czech Republic [15, 16].

The findings of the authors are the following. A very large part of publications is focused on sources coming from the nuclear facilities [17, 18]. Another focus is on the staff of medical institutions [19-21]. However, the situation presented in this article is not yet solved or presented. From the OHS perspective, various methods and procedures are used in practice to assess risks in scrapyards, which are mostly based on the knowledge and experience of their inspectors. In order to evaluate the risks associated with the SIR in the form of scrap metal, the authors used two methods. The first is the Ishikawa diagram, which is used to show the relationship between problems and their possible causes. The said diagram is the first step in solving all problems that can be induced by multiple causes [22, 23]. The second method used to assess the principles of OSH is the semi-quantitative point method [24, 25].

These days, scrap metal is an important starting material for the industrial production of metals. Radioactivity found in the scrap is caused mainly by the orphan SIR, which leads later to the production of contaminated products. Above all, the consequences of such emergencies are economic, and the costs of their removal run into millions of euros. The most well-known events that have already occurred include an incident that took place on December 6 1983, in a scrapyard in Ciudad Juarez, Mexico. The casing of a medical device was torn and disposed of as standard metal scrap. This device contained an SIR with a total activity of almost 17 TBq. Thousands of small pieces of the cobalt radionuclide 60Co were scattered over a wide area, which, together with other scrap, also entered the melting process and subsequently contaminated it with radioactivity. The contamination was only detected 41 days later by accident when a truck carrying radioactive steel passed through the detectors of the Los Alamos National Laboratory, USA, and set off an alarm. In the meantime, several thousands of people were irradiated, hundreds of tables with radioactive metal bases were mounted in restaurants, and dozens of houses with radioactive steel reinforcements in the bearing walls were built [26, 27].

It seems that this event, completely unrelated to the Czech Republic, was a unique combination of chance, ignorance, and negligence, which could not even happen today. However, dozens of emergency events related to the handling of orphan SIR are recorded in the Czech Republic every year, while the captures of vehicles transporting contaminated waste account for more than half of these events. Nevertheless, not all scrapyards have financially demanding portal monitors installed at the entrance, which automatically detect possible radioactivity. The risk of penetration of the orphan SIR into scrap metal, irradiation of employees, and subsequent contamination of the melt is thus significantly increased. Another issue can be the loss of confidence in the quality of the metal products [8, 27].

The objective of the authors was to use the previously mentioned methods to identify the risks that may arise in the event of noncompliance with stipulated safety measures during the capture or finding of the orphan SIR in scrap metal, to minimize risks and propose the prompt creation of a safety zone.

## 2. Materials and Methods

Dangerous orphan SIR, potentially present in scrap metal, can be divided into several groups according to the original purpose of use as follows [11]:

- Industrial measuring devices and their cases,
- Flaw detectors and their components,
- Medical irradiators and sources,
- Sensors of ionization fire detectors,
- Chemicals and radioactive dyes,
- Transport packaging sets and their components,
- Objects used for shielding and handling of ionizing radiation sources.

Between 2017 and 2021, over 180 emergency events related to the handling of SIR were investigated in the Czech Republic by the State Office for Nuclear Safety [28]. These included:

- 54 cases of contaminated scrap metal caught by detectors at the entrances to iron and steel works or scrapyards,
- 87 vehicles with contaminated municipal waste detected at the entrance to municipal waste incinerators,
- 45 cases in other facilities.

Below is a more detailed description of methods used in this work.

The Ishikawa diagram is an analytical method for displaying and analysing causes and effects. The principle of the diagram is based on simple causality–each effect (problem) has its cause or combination of causes. When solving a problem, analytical methods are used to systematically search for the possible causes and these are represented in a diagram in the shape of a fishbone. Largely, the causes can be found in several basic dimensions, which are [22]:

- Man Power – causes produced by people.
- Methods – causes produced by rules, directives or standards.
- Machines – causes produced by equipment such as machines, computers, tools.
- Materials – causes produced by defects or properties of materials.
- Measurements – causes produced by inappropriate or incorrectly selected measurements.
- Mother Nature – causes produced by environment, weather conditions or culture.

The point method, which is used to assess risks at work, consists of five basic evaluation categories and two evaluation criteria. The level of risk is a combination of the probability of occurrence of the risk and the possible severity of the consequence of the risk. Risks are always related to the position of the job and workplace. Human life and health are protected values. This method of risk assessment is one of the most frequently used in the field of occupational safety and health. The criteria are assigned the number of points from 1 to 5, that is, the lower the risk, the smaller the number, and the other way round.

The process of dealing with material in a scrapyard with possible detection of a SIR is depicted in Figure 1.

The probability of the risk factor and the severity of its elementary causes identified in the Ishikawa diagram were used to calculate the resulting level of some risks. This semi-quantitative point method is defined by Equation 1:

$$R = P \times N, \tag{1}$$

where, R is the level of risk, P is the probability of occurrence and N is the severity of the effects.

The protected value is human life and health. The probability of the risk factor was related to its occurrence in percentage, discovered during the field survey. The evaluation of the severity of the effects is based on the evaluation of the severity of the given minimal cut set (Table 1).

**Table 1. Values of parameters of the risk level**

| Probability | Points | Occurrence | Severity of effects | Points |
|---|---|---|---|---|
| Infrequent | 1 | 0-20 % | Negligible impact | 1 |
| Improbable | 2 | 21-40 % | Low severity | 2 |
| Probable | 3 | 41-60 % | Medium severity | 3 |
| Possible | 4 | 61-80 % | High severity | 4 |
| Permanent | 5 | 81-100 % | Critical impact | 5 |

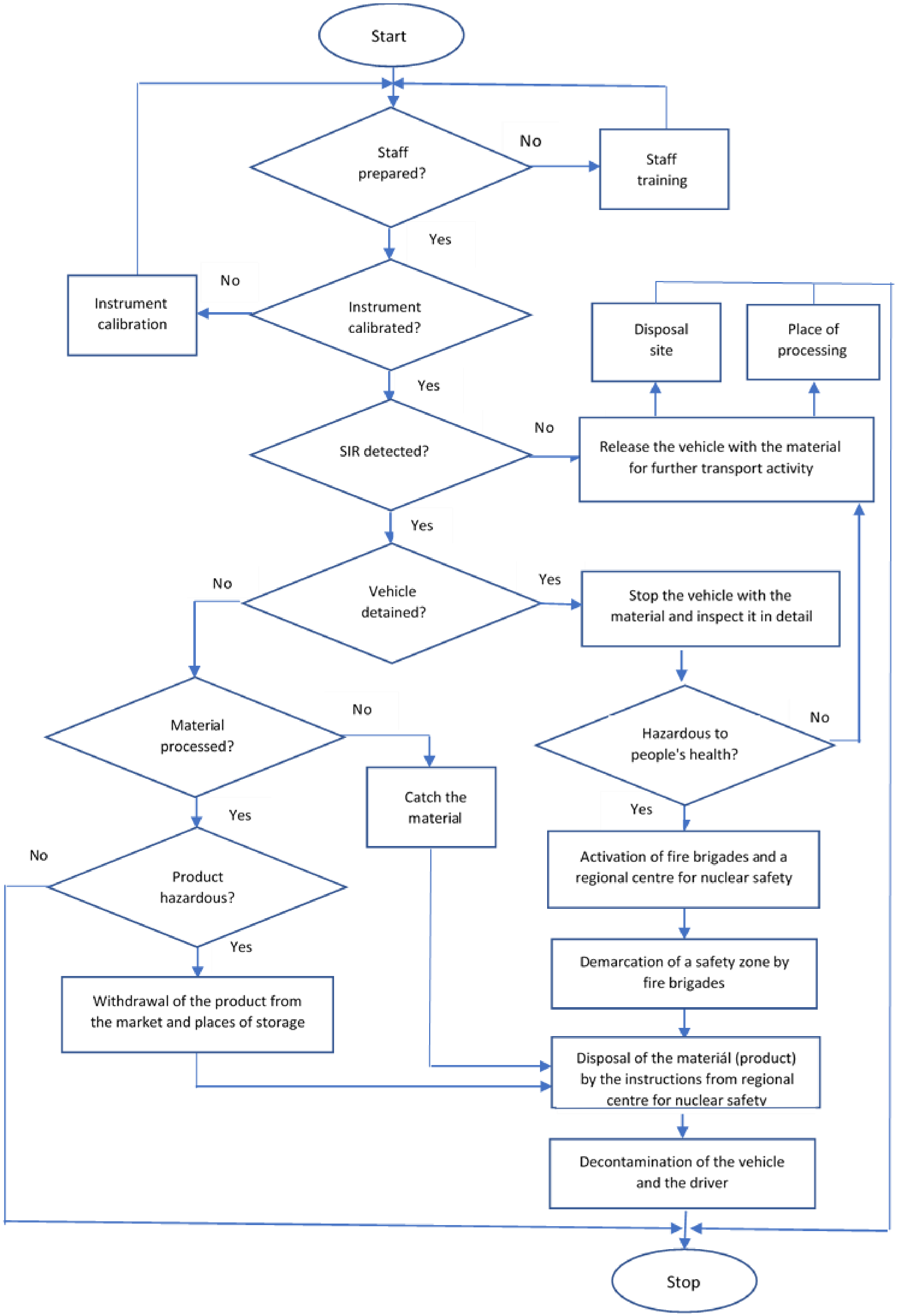


**Figure 1. Flowchart diagram**

According to the calculated score, each risk factor was assigned a level of risk, which implied the requirements for acting appropriately to minimize it:

- 1-3 points = *level I:* acceptable risk, no special measures required,

- 4-6 points = *level II:* low risk, it needs to be monitored and checked,
- 8-12 points = *level III:* undesirable risk, it is necessary to take safety measures and check their observance,
- 15-25 points = *level IV:* unacceptable risk, effective safety measures must be taken immediately, the risk must be reduced to a lower level.

From the perspective of the OHS, intervening firefighters must mark out a safety zone (SZ) if negative effects of ionizing radiation originating from the SIR are detected.

## 3. Results

Based on the evaluation of the overall level of risk using the point method for individual factors (Table 2), it is clear that the lack of technical means is already in the area of unacceptable risk. The safe operation of the scrap metal collection facility is basically impossible without staff being equipped at least with hand-held detectors.

**Table 2. Risk assessment**

| Risk factor | P | N | R | Level |
|---|---|---|---|---|
| Lack of technical means | 4 | 4 | 16 | IV |
| Ignorance of emergency procedures | 4 | 3 | 12 | III |
| Missing documentation in the workplace | 3 | 3 | 9 | III |
| Ignorance of the appearance of potentially dangerous sources | 2 | 4 | 8 | III |
| Delivery containing the SIR | 1 | 5 | 5 | II |

Under the condition that all scrap metal deliveries containing the SIR were captured, the relevant factor represents only a low level of risk with a rare probability of its occurrence; however, the severity of its effects is critical. Therefore, it is desirable to monitor and check the risk.

The results of the implementation of the Ishikawa diagram to the solved problem are shown in Figure 2.

The risk assessment proved that the measures for minimizing the risk of penetration of the orphan source into the facility and subsequent contamination of workers with ionizing radiation should be targeted at early detection of the SIR already at the entrance to the collection facility. This makes it possible to prevent the receipt of the scarp and ensure an immediate and safe distance for people from the SIR. It is essential to equip the collection facilities with manual detectors for checking received material. In addition, it is necessary to train the staff so that they can visually recognize potentially dangerous material during subsequent activities among the scrap already received, which will prevent further contact with the SIR [11]. The documentation for the event of an emergency must be located directly at the workplace and the staff must be familiar with the contingency procedures, which should be incorporated directly into the approved documentation for the operation of the facility.

The safety zone (SZ) is to be marked out in case of an emergency event caused by the SIR. The boundaries of the SZ are defined by the measured values of the equivalent dose or surface activity. It is a space in which special measures must be introduced and the principles of radiation protection must be observed.

In the event of intervention of the FRS when there is a risk of radiation from the SIR or radioactive contamination, the outer zone is marked at least 50 m from the place of intervention where the dose rate values are lower than 0.5 $\mu Gyh^{-1}$, and based on a radiation survey the following spaces are marked out:

- Safety zone for gamma irradiation at the internal boundary of the SZ at the level of the dose rate and for contamination at the level of surface activity,
- The shape and size of individual zones can be significantly increased in particular due to the amount of radioactivity that escaped into the open space or that is present at the accident site, and due to weather conditions, type of the terrain (e.g., woods and soil cover, urban buildings), and measures taken in connection with the intervention. When marking the zones out, it is necessary to take these factors into consideration and, if necessary, adjust the boundaries.

The delimitation of the boundaries of the SZ for external irradiation is carried out by members of the FRS of the Czech Republic within the radiation survey in two steps:

- Finding the boundary of the SZ,
- Delimitation and demarcation of the SZ.

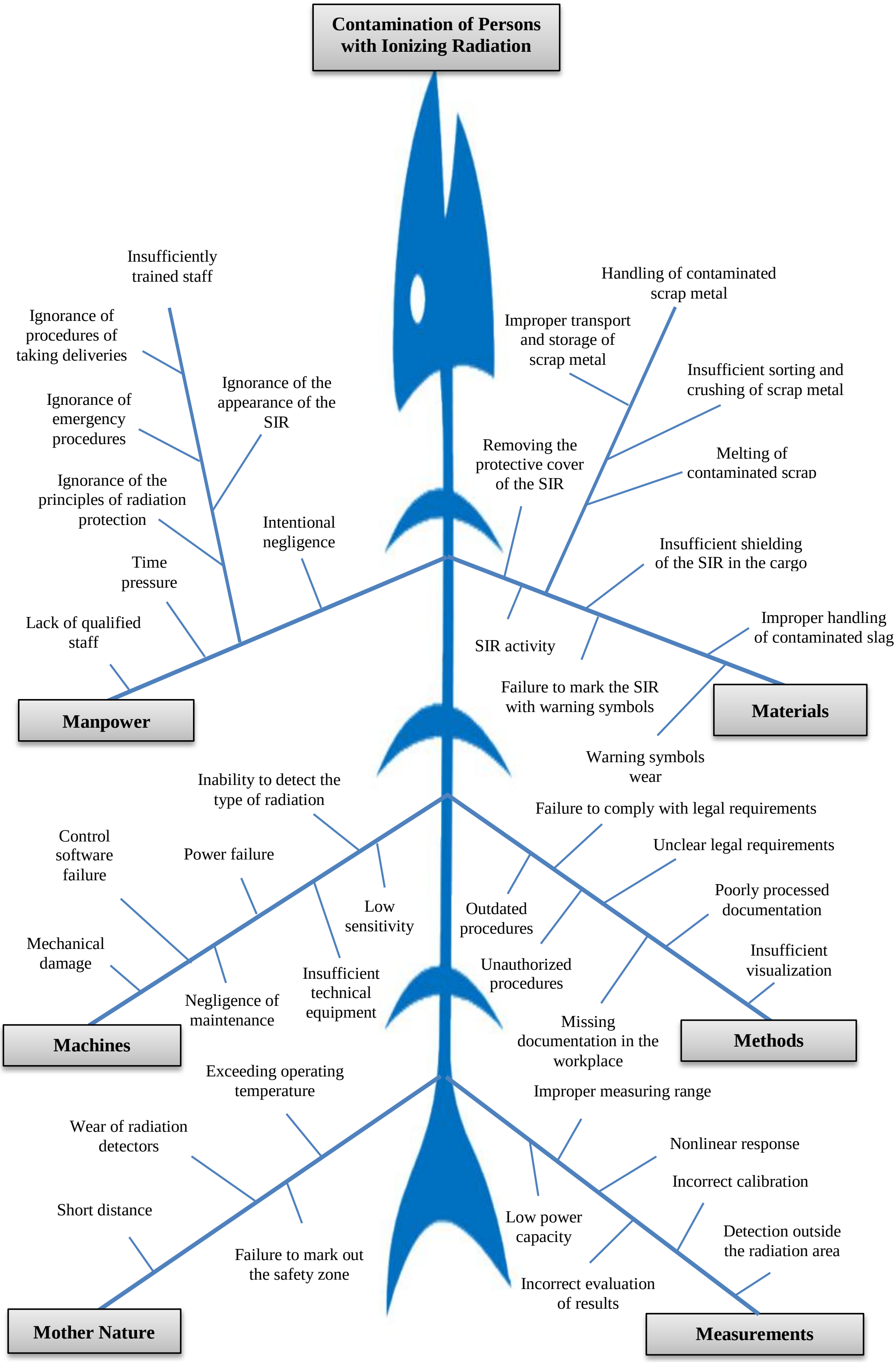


**Figure 2. Ishikawa diagram**

First, the FRS proceeds in the direction of the increase in the dose rate and find a place where P = 10 $\mu Gyh^{-1}$. After that, they proceed systematically from the said place to find other places with the value P = 10 $\mu Gyh^{-1}$ and the SZ is delimited as a closed area. Finally, the SZ is marked out by stakes and tapes. During measurement, the detector is aimed toward the expected place of occurrence of the SIR, and in order to capture the directionally oriented beam of ionizing radiation from the SIR, the detector is regularly placed in four measuring positions (above the head, below the knees, to the left and right of the body) [29].

Ionizing radiation follows rules similar to those for other types of radiation. Its intensity is inversely proportional to the square of the distance from the radiation source (this applies only to the point source). Let us consider the dependence of the dose rate P on the distance d according to Equation 2:

$$P(d) = \frac{X}{d^2} + H \tag{2}$$

where, X is a constant proportional to the activity of the SIR and H is a value of natural radiation (further not taken into consideration).

By means of an interactive experiment called "*Dependence of radioactivity on the distance from the emitter*" [30] (Table 3), it was discovered that the dependence is not exactly $1/\mathrm{d}^2$ and the highest value of dependability is demonstrated by the power trend-line.

**Table 3. Processed measurement data**

| Position (cm) | Average number of source pulses | Average number of background radiation pulses | Average number of pulses (no background) | Standard deviation |
|---|---|---|---|---|
| 5 | 134.2 | 11.4 | 122.8 | 17.3 |
| 7 | 92.8 | 11.6 | 81.2 | 12.9 |
| 9 | 66.2 | 15.4 | 50.8 | 10.8 |
| 11 | 51.2 | 11 | 40.2 | 3.3 |
| 13 | 41 | 11.4 | 29.6 | 4.9 |
| 15 | 32.8 | 12.8 | 20 | 4.4 |
| 17 | 30.4 | 11.6 | 18.8 | 6.5 |
| 19 | 24.2 | 12.8 | 11.4 | 3.0 |
| 21 | 24.6 | 11.6 | 13 | 515.9 |

For this reason, Equation 2 has been adjusted by another variable in the distance exponent:

$$P(d) = \frac{X}{d^Y} \tag{3}$$

From the perspective of occupational health and safety, the scrapyard authors assume that the staff have a hand-held detector at their disposal, with the help of which they are able to measure the dose rate on the surface of the SIR and on the outer surface of the vehicle. The objective of the next procedure is to find a function that determines an approximate distance of the SZ boundary based on these two values (ideally only on the latter).

For instance, in 2015, the values of the equivalent dose of a captured level meter were 280 $\mu Svh^{-1}$ on the surface of the SIR and 41 $\mu Svh^{-1}$ on the surface of the vehicle. These values were used to model the exposure of workers to ionizing radiation [31].

The dependence of the number of pulses on the distance from the source of ionizing radiation can be expressed with high reliability by means of a power function. By applying several types of nonlinear regression to a set of measured data, it was discovered that the highest confidence level was shown by the power trend line [30]. The authors plotted the values on Figure 3, with the first measurement at a distance of 1 cm and the second at a distance of 200 cm from the SIR. The displayed power trend line (Figure 3) represents a function according to Equation 4:

$$f(x) = \frac{a}{x^b} \tag{4}$$

where, in this particular case, a = 280; b = log (280/41)/log 200.

The limit for marking out the SZ is given by the recommended value of the equivalent dose 10 $\mu Svh^{-1}$ [32].

The following variables were specified:

- $A$ as the value of the dose rate measured on the surface of the SIR [$\mu Svh^{-1}$],
- $B$ as the value of the dose rate measured on the surface of the vehicle [$\mu Svh^{-1}$],
- $C$ as the distance of the SIR from the measuring point on the surface of the vehicle [cm].

The calculation (Equation 5) of the approximate distance of the boundary of the SZ d [cm]:

$$d \approx \left(\frac{A}{10}\right)^{\frac{\log C}{\log \frac{A}{B}}} \tag{5}$$

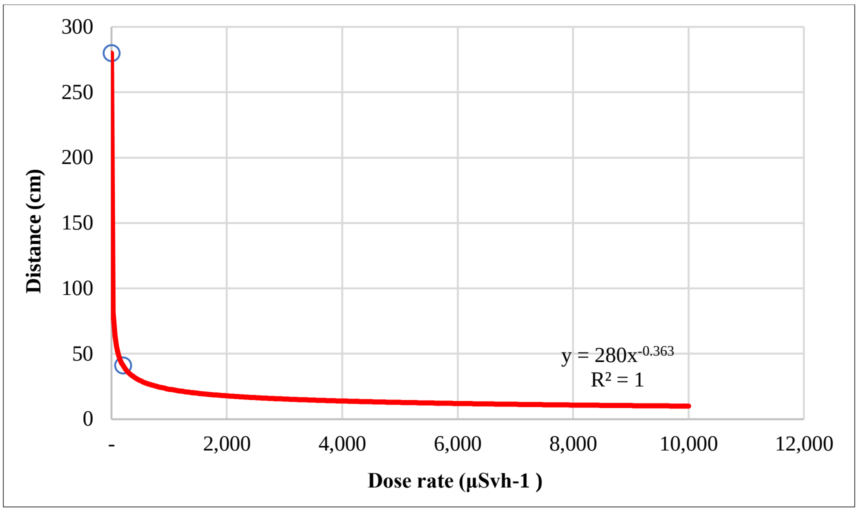


**Figure 3. Dependence of the dose rate on the distance**

Similarly, the approximate border of the SZ can be determined by changing the denominator from 10 to 1000 $\mu Svh^{-1}$; it is only meaningful if a value higher than 1 $\mu Svh^{-1}$ was measured on the surface of the vehicle. However, this is too complex to be used in practice. For further simplification, the authors considered that the vehicle SIR was located in the loading space at a distance of 100-200 cm from the measuring point on the surface of the vehicle (here, the function value varies within the range of ± 12.5 %, Table 4).

**Table 4. Approximate determination of the distance of the SZ boundary**

| C [cm] | B [$\mu Svh^{-1}$] | 2B [m] |
|---|---|---|
| 50 | 67.80 | 135.6 |
| 100 | 52.70 | 105.4 |
| 123 | 48.95 | 97.9 |
| 150 | 45.50 | 91.0 |
| 200 | 41.00 | 82.0 |
| 250 | 37.80 | 75.6 |

Thus, the measured value B [$\mu Svh^{-1}$] can be used for a rough estimate of the distance of the SZ boundary d [m] according to Equation 6:

$$d \approx 2B \tag{6}$$

Defining the exact distance of the SIR from the measuring point on the vehicle surface is then not crucial. Although the difference between the values A and B is affected by many factors, such as radionuclide type, total source activity, its position, shielding by other loaded scrap and driver's cab, etc., the function continues to approach the linear function with increasing distance from the source.

Similarly, it is possible to use this method for the approximate determination of the boundary of the SZ (Figure 4) when any orphan SIR is captured. The source of radiation is bypassed in a circle with a radius of 1-2 m, and according to the measured values of the equivalent dose, the distance of the SZ boundary in the respective direction from the centre of the circle is determined analogously. If necessary, measures are taken to exclude people from the marked-out SZ.

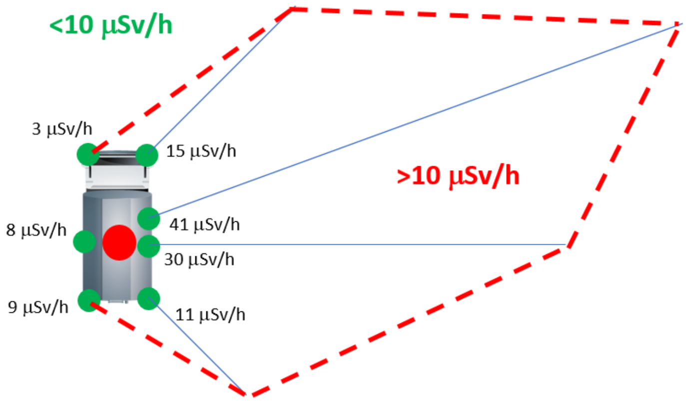


**Figure 4. Demarcation of the safety zone [33]**

In order to verify the proposed method, the calculations should be compared with the real demarcation of the SZ boundary that was made during the finding of the level meter in 2015.

## 4. Results and Discussion

The problem being solved includes health threatened by ionizing radiation emitted by an orphan source. The transfer of ionizing radiation energy from the SIR to a person who is in the area of possible radiation from the undetected SIR can cause the following types of damage to the organism:

- Acute radiation sickness,
- Acute localized damage (radiation dermatitis, hair loss, ulcer formation),
- Damage to the fetus for the pregnant, infertility,
- Irreversible late damage (opacity of the eye lens, chronic radiation dermatitis, shortening of life span),
- Genetic changes.

The most prominent manifestation of the early effect of ionizing radiation originating from an SIR can be acute radiation sickness, which will develop after the body or part of it is irradiated with a higher dose. Depending on the degree of irradiation, symptoms of damage to the hematopoietic organs, the digestive system, and the central nervous system can predominate in the clinical picture. The formation of radionuclides by the action of neutrons on inactive elements contained in soil, water, and objects on the ground will depend on the type of SIR and the surrounding environment in which the SIR is located [7].

The investigated effect is the impact of this radiation on people. In searching for causes of possible exposure to ionizing radiation, the authors of the article used the method of six questions [22]:

- What is/is not the problem?
- Why does the problem occur/not occur?
- How do we know that the problem occurred/did not occur?
- When does the problem occur/not occur?
- Where does the problem occur/not occur?
- Who does contribute to the causes of the problem or suppresses it?

The Ishikawa diagram was used to determine the effects of exposure of persons to ionizing radiation from an orphan source by assessing the following causes: methods, mother nature, measurements, man power, materials and machines. With respect to the methods, the causes resulting from insufficient quality of documentation, its up-to-dateness and lawfulness were incorporated. Within mother nature, the possible exposure of persons due to short distances from the source during manual handling, failure to mark the SZ when the source is found or captured, and environmental effects [34] with a negative impact on detection are the most prevailing causes. In the field of measurements, possible causes of irradiation resulting from incorrect calibration of measuring instruments and incorrect evaluation of measurement results were identified. The safe operation of the scrapyard is basically impossible without the staff being equipped at least with hand-held detectors.

In the dimension of man power, the main causes of irradiation include insufficiently trained personnel at the level of contingency procedures, ignorance of the principles of radiation protection, and ignorance of the appearance of the SIR, including intentional neglect of duties. In the field of materials, other possible causes were identified, which resulted from various activities associated with handling contaminated scrap during the entire recycling process and the failure to label the SIR with radioactivity warning symbols. The dimension of machines includes the causes induced by the failure of detectors and the overall lack of suitable technical means capable of detecting radiation, as well as neglected maintenance.

The standard procedure for marking out the SZ boundaries is quite precise but lengthy. Scrapyard staff must have a simple methodology at their disposal, by means of which they would be able to estimate the approximate boundary of the SZ and implement two basic methods of protection against ionizing radiation: time (shortening the length of exposure) and distance (determining a relatively safe distance from the SIR). Within the SZ, it is necessary to determine the boundary of the entrance and the route of the movement, both downwind, from the windward side, and perpendicular to the direction of the wind. It is also necessary to establish a decontamination site at the exit of the SZ.

During capture of the orphan SIR in the vehicle, it is recommended to define the approximate limits of the SZ in meters prior to the arrival of the Czech Republic if the value measured on the vehicle surface is greater than 10 $\mu Svh^{-1}$. The equivalent dose in $\mu Svh^{-1}$ ($\mu Gyh^{-1}$), measured by the handheld detector in the reverse direction from the centre of the loading surface of the vehicle, is multiplied by two based on several reference points on the vehicle surface. Increased attention must be paid to the maximum measured value, as most flaw detectors and inspection instruments emit ionizing radiation in a directional beam. The vehicle must be parked in such a way that people can be excluded from the estimated SZ.

Serious radiation accidents still occur outside the SIR workplace, and it is not an abuse of the SIR. The cause of the accidents was and is a decrease in the level of SIR security in some organizations. Long-unused stored resources, changes in the owners of these resources or warehouses can be the cause of the loss of control over SIR. Radiation accidents can also include those that occur as a result of human greed (efforts to obtain metal objects with the aim of monetizing them in scrapyards).

## 5. Conclusion

It is necessary to be extremely careful when dealing with a possible orphan SIR occurring in scrap metal. The main cause of accidents has been the decline in the level of SIR in some countries. Stored sources that were unused for a long period of time and changes in ownership of these sources or warehouses were the cause of the loss of control over the SIR. In addition, there are accidents that occurred as a result of greed (attempts to obtain metal in order to monetize it in scrapyards).

In order to comply with the principles of OHS, established preventive measures must be observed. Preferably, the main objective is to capture the orphan SIR immediately upon entering the facility, or discover it during the handling of already collected scrap metal in the facility, or prior to its transport for further processing. Amongst other things, the precondition for prevention is compliance with legal norms and relevant regulations both by the founder of the scrapyard or the employer, as well as by the persons who handle the SIR. The basis for processing specific measures for risk minimization when dealing with the orphan SIR of scrap metal must be its identification by means of the risk analysis. In the article, the authors applied the Ishikawa diagram and the point method to solve the problem. Implementing the mentioned methods of risk analysis can be considered suitable and sufficient in the field of OHS when processing metal waste. Among other things, the results of the risk analysis show that the orphan SIR, which can contaminate metal waste, can be divided into several groups according to their original purpose of use. Undoubtedly, industrial measuring devices and their cases pose the highest risk to health due to their high variability and widespread use. For this reason, employers must pay maximum attention to the training of their employees and control their activities. It was also discovered that more than half of the emergency events related to SIR handling in the past five years were captures of vehicles at the entrance of iron and steel works or scrapyards. The authors suggest that in the event of an emergency related to the capture of contaminated metal waste, the approximate boundaries of the SZ should be marked at the relevant entrances prior to the arrival of the FHS of the CR. Its objective is to limit the negative effects of the SIR so that the threat to the safety and health of staff and other persons is minimized.

## 6. Declarations

### 6.1. Author Contributions

Conceptualization, M.T. and D.V.; methodology, J.S.; software, P.T.; validation, M.T., J.S., P.T. and D.V.; formal analysis, D.V.; investigation, P.T.; resources, J.S.; data curation, D.V.; writing—original draft preparation, M.T. and J.S.; writing—review and editing, P.T.; visualization, P.T.; supervision, M.T., J.S. and P.T.; project administration, J.S.; funding acquisition, J.S. and P.T. All authors have read and agreed to the published version of the manuscript.

### 6.2. Data Availability Statement

Data sharing is not applicable to this article.

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### 6.4. Conflicts of Interest

The authors declare no conflict of interest.

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