HRN

Hazard Rating Number

HRN = SE x NP x PR x FR

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Rev.2

Rua Afonso César de Siqueira 106, Sala 1402-A
São José dos Campos – SP – Brazil – Phone: +55.12.9.9673.1960

site: www.matecengenharia.com.br contact: almeida@matecengenharia.com.br

1. SCOPE

This document presents the methodology for assessing the safety of machines and installations following the concept of HRN – Hazard Rating Number.

2. HRN

The HRN Methodology – Hazard Rating Number – was presented in 1990 by Chris Steel in an article on Risk Estimation, where the probability and frequency of exposure to a hazard, the number of people involved in the exposure and the estimated maximum damage are considered, in a semi-quantitative way. Numerical values are assigned to phrases that describe a particular event, and the exercise consists of selecting the phrases (and their respective values) that best represent the hazard being assessed. Then, the values found are multiplied and the result, called HRN, gives the estimate of the risk of the event under analysis.

Some countries, like Brazil, demands that every piece of machinery/equipment be submitted to a risk appreciation, following the local legislation (Norma Brasileira NBR 12100), evaluating the severity of the event, its consequences, the probability of occurrence and the number of people involved – exactly the parameters that are part of the HRN. Thus, this method is usually used to fulfil this legal demand and the following parameters are evaluated:

• SE ➔ Severity of the possible injury or damage (consider the greatest damage expected for a given hazard).

• NP ➔ Number of people exposed to the hazard.

• PO ➔ Probability of the event occurring based on the exposure.

• FR ➔ Frequency of exposure to the hazard (frequency with which the operator is exposed to a given hazard)

Mathematically, the expression that determines the HRN is:

$$HRN = SE * NP * PR * FR$$

The result obtained for the machine or installation, should be used to prioritize the actions to be taken to eliminate or reduce the hazard. The original values proposed by Chris Steel to evaluate each parameter have been revised through the years, and the majority are still valid today, but this document uses these updated values, as follows:

SE = Severity of possible harm	Value of SE
Fatality	15
Loss of limb, eye or serious illness of permanent nature	8
Loss of limb, eye or serious illness of a temporary nature	4
Break of a major bone or minor illness (permanent)	2
Break of a minor bone or minor illness (temporary)	1
Laceration or mild ill health effect	0,5
Scratch or bruise	0,1

NP = Number of Persons at risk	Value of NP
More than 50 people	12
16 to 50 people	8
8 to 15 people	4
3 to 7 people	2
1 to 2 people	1

PR = Probability of Occurrence	Value of PR
Certain (no doubt)	15
Likely (to be expected)	10
Probable (not surprised)	8
Even chance (could happen)	5
Possible (but unusual)	2
Unlikely (but could occur)	1
Highly unlikely (though conceivable)	0,5
Almost impossible (possible only in extreme circumstances)	0,03

FR = Frequency of Exposure	Value of FR
Constantly	5
Hourly	4
Daily	2,5
Weekly	1,5
Monthly	1
Annually	0,2
Infrequently	0,1

After the multiplication of the individual parameters, the result obtained for the HRN is then evaluated according to the following table:

HRN	Type of risk	Description
0 to 5	VERY LOW	Very low risk for the operational safety/employee. Actions to reduce or minimise the residual risks, if necessary, can be implemented within 1 year.
6 to 25	LOW	Presence of residual risks that demand the implementation of additional safety measures within 6 months.
26 to 50	MODERATE	Presence of important risks that demand reduction or elimination within 3 months.
51 to 100	SIGNIFICANT	Presence of risks that demand the implementation of additional safety measures within 1 month.
101 to 200	HIGH	Presence of risks that demand the implementation of additional safety measures within 1 week.
201 to 500	VERY HIGH	Presence of risks that demand the IMMEDIATE implementation of additional safety measures.
> 500	UNACCEPTABLE	THE ACTIVITY MUST STOP IMMEDIATELY. It is unacceptable to keep the operation of the plant/equipment in the current situation.

The following table brings examples of some hypothetical HRN assessments:

Description of the Risk	Probability of Occurrence (PR)	Frequency of Exposure (FR)	Severity of the Damage (SE)	Number of People exposed (NR)	HRN	Risk Classification
Large wood saw operating without protection, with risk of upper limb amputation or death due to deep cuts in critical parts of the body.	5	4	15	2	750	UNACCEPTABLE
	Could happen	Every hour	Fatality	3-7 people		
Person falls when getting off the bus, causing a fracture in the lower limb (individual analysis)	2	2,5	2	1	10	LOW
	Possible	Daily	Break of a major bone	1-2 people		

NOTE 1: If the HRN analysis is related to machinery, it is recommended that the evaluation report include specific information about the machine/equipment such as type, description, function, year of manufacture, construction material, capacity, etc., along with photos of the item under analysis.

NOTE 2: As with many quantitative risk assessment methodologies, a potential pitfall of this method is making the wrong assumptions when selecting the relevant HRN values. This could lead to an unrealistically low evaluation of the risk level, and so important safety improvements are overlooked. Alternatively, if overly conservative values are selected, then this may overestimate the level of risk, leading to the implementation of unnecessary costly improvements. Therefore, as for all risk assessment methodologies, it is important that the risk assessments are carried out by a competent person or team, who have the right level of knowledge, experience, and skills in this area.

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The Author

***M.A. Almeida**, Chemical Engineer by UNICAMP, Risk Analysis Specialist by ICI Hazard Group – England and current member of the Technical Committee for Chemical Safety of CRQ/SP, is part of the group of professionals of **MATEC Soluções Corporativas Ltda.**, a Brazilian company specialized in projects for industrial installations and the use of best engineering practices, as well as personnel capacitation related to industrial safety.*