

Definition of barrier:

A procedure or material element intended to interrupt or modify an accident scenario in such a way as to reduce either its frequency or its consequences.

The barriers come in two categories, two types and two classes.

The two categories of safety barriers are:

1. The preventive barriers, which lower the probability that an accident takes place
2. The protective barriers, which reduce severity or consequences

Those two categories of safety barriers can be divided in two types:

1. The technical safety barrier (Engineering Controls)
2. The administrative safety barrier (Administrative Controls).

Definitions:

Technical safety barrier: a physical component, safety device or instrumented safety system put in place to oppose the chain of events likely to result in an accident. (INÉRIS, méthodes systématiques de détermination d'ensemble de scénarios et exigences pratiques en terme de barrière de sécurité, 2004.)

Administrative safety barrier: a human activity (operation or procedure) that opposes the chain of events likely to result in an accident or reduces its consequences. (INÉRIS, 2004)

The technical preventive and protective safety barriers can also be divided into two classes: **active barriers** and **passive barriers**.

EXAMPLES OF SAFETY BARRIERS:

PREVENTIVE BARRIERS:	PROTECTIVE BARRIERS:
Regular maintenance program (P, O)	Safety wall (T, P)
Staff training (P, O)	Diked area (T, P)
Internal policies (P, O)	Sprinklers, water curtains (T, A)
Alarmed detection devices (T, A)	Emergency plan (P, O)
Automatic valves (T, A)	
Check valve (T, P)	

A = active, P = passive, O = organizational, T= technical

For further details, you can obtain the 2007 edition of the CRAIM GUIDE or refer to the guide on the Internet at www.CRAIM.ca.

Technical Popularization Pamphlet

3



CRAIM
MAJOR INDUSTRIAL ACCIDENTS
REDUCTION COUNCIL*





Safety Barriers The Bow Tie

Vision and Mission of the CRAIM

Vision

CRAIM aims to be the benchmark in hazardous substance risk management within the scope of sustainable development by applying rigorous, responsible and concerted methodologies.

Mission

To DEVELOP rigorous tools and methods that provide responsible management of risks related to hazardous substances.

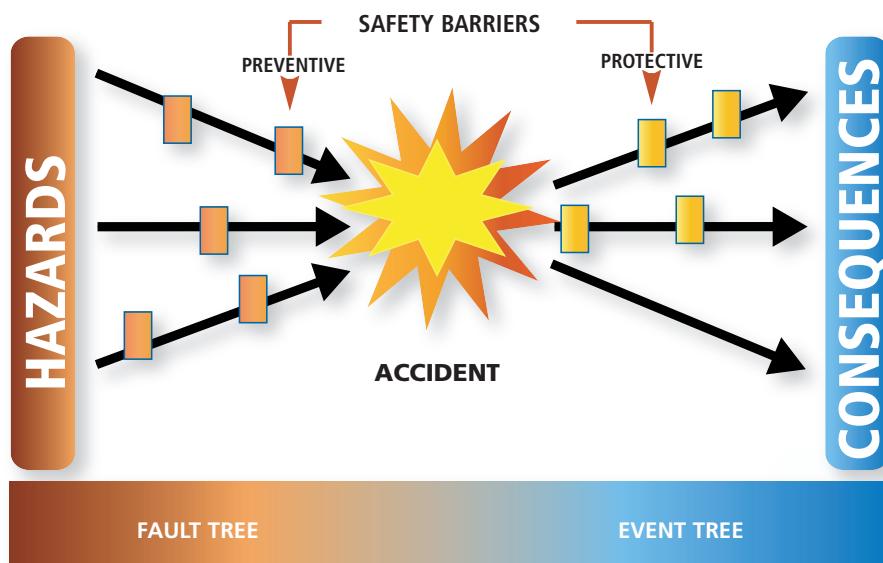
To PROMOTE and support a culture of collaboration between all stakeholders to effectively manage the risks involving hazardous substances.

To FOSTER, with stakeholders, a reduction in the risks of major industrial accidents through the implementation of appropriate prevention, preparedness, response and recovery measures.

This document, based on current available facts, is designed to familiarize the reader with certain basic concepts. The reader must be aware that the information provided in this document is not complete, and therefore, that other complementary sources must be consulted to avoid any unfortunate situations. The reader is entirely responsible for any decisions or actions taken on the basis of this document.

The Bow Tie

The bow tie used in several industrial sectors was developed by Shell. It is based on a tree approach, a characteristic that allows to immediately visualize the possible causes of an accident, its consequences and the barriers that have been installed. The undesired event (accident in centre) may be the result of several possible causes, such as the release of a toxic substance, an explosion, a ruptured pipe, a burst of reactivity, a breach in a reservoir, the decomposition of a substance, etc. This tool allows to illustrate the results of a detailed risk analysis (of FMECA, HAZOP or What If type, for example), a more complex process than a preliminary risk analysis.



The left side of the bow represents the determination of hazards, of possible causes of the accident and of various chains or combinations of events (black arrows) that may cause the undesired event. The barriers, referred to as preventive barriers (orange rectangles), must be installed between these possible causes and the accident.

The right side of the bow represents the possible consequences of the accident. For example, when a pipe is ruptured or a breach appears in a reservoir, the result may be the formation of a pool or a cloud. Protective barriers must be installed between the accident and the receptors to reduce any harmful effects on these receptors (ex.: a sprinkler system).

Thus, the bow tie reflects the scenarios of accidents that may occur, as well as the measures taken to prevent them or reduce their likelihood and consequences. The barriers are referred to as preventive barriers and protective barriers. The protective barriers reduce the level of severity of the consequences, while the preventive barriers reduce their likelihood. Using a matrix (of the type used to conduct a preliminary risk analysis) to establish our acceptability zone, the effect of the barriers is visible and can render tolerable an initially unacceptable situation.

Example of an SO₂ release, excerpt from Propositions pour la révision du Guide de Maîtrise de l'Urbanisation, INÉRIS, September 2002

