Archives of Occupational Health | Volume 7 | Issue 1 | January 2023 | 1375-6.

Editorial

Domino Effects in Process Industries

Fereydoon Laal

Social Determinants of Health Research Center, Department of Occupational Health Engineering, Birjand University of Medical Sciences, Birjand, Iran• Corresponding authors: Fereydoon Laal, Email: fereydoonlaal@gmail.com

A small fire in process industries such as refineries and petrochemicals can cause a domino effect and spread to nearby units. These industries include many processes such as production, storage, and transfer, which are different in nature and have different risks. The domino effect causes the spread of the accident in the adjacent units using escalation vectors. Domino events are mostly of very low frequency with severe consequences. Therefore, special attention should be paid to their prediction and control. The consequences of these accidents are diverse at different levels, and in addition to industrial sites, they affect people, environment, and economy. Therefore, the effects of these accidents are recognized as an important priority issue among risk experts and the safety community, for example, the EU requirements in the Seveso-II directive (1). It is noteworthy point is that most of the process accidents inside the country (Iran), such as the petrochemical accident in the Bouali Sina reservoir, happened in a domino pattern (2).

Therefore, during risk analysis and assessment, it is not only important to deal with one equipment or unit, but the chain effects of the accidents of that equipment or unit on other units should also be considered, and this can be done by examining the domino effects of accidents. A domino system consists of at least two source and target subsystems. The domino effect has several basic components:

1.The initiator of the domino effect, which is the initial event, is often fire and explosion. The possible causes of these events can be a combination of human, process, and organizational management factors. This can be achieved by using Root Cause Analysis (RCA) approaches such as Fault Tree Analysis (FTA), and Fishbone. Natural disasters in industrial environments (Natural Hazards Triggering Technological Disasters: Natech) and terrorist attacks are other possible causes of an initial event. In the study of Taveau (2011), 206 incidents that occurred continuously in floating roof tanks were investigated, of which 145 incidents were fires and 61 incidents were explosions (3). According to the study by Kletz et al., the main causes of accidents in these tanks were lightning (32%), maintenance operations (13%), operational errors (12%), equipment failure (8%), sabotage (8%), cracking and rupture (7%), pipe leakage and rupture (6%), static electricity (5%), open flames (4%), natural disasters (3%) and runaway reaction (2%) (4).

2.Escalation vectors are responsible for the possible spread of the accident. Escalation vectors are physical effects such as thermal radiation, excessive pressure, or fragments thrown by explosions.

Citation: Laal F, Fallah Madvari R. **Domino Effects in Process Industries.** Archives of Occupational Health. 2023; 7(1): 1375-6.
Article History: Received: 26 January 2022; Revised: 25 April 2022; Accepted: 27 April 2022

Copyright: ©2023 The Author(s); Published by Shahid Sadoughi University of Medical Sciences. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

[Downloaded from aoh.ssu.ac.ir on 2026-11-27]

[DOI: 10.18502/aoh.v7i1.14289]

Escalation vectors depend on various factors, such as the type of initial event and the distance between the center of the event and neighboring units.

3.Secondary random events can happen from one to several events.

4.A consequence is much more severe than the consequences of the initial event. The domino effect is a sequence of successive reactions, the result of each reaction can strengthen the result of the previous reaction.

There are several methods for calculating escalation vectors, including analytical models, integral models, and average models, which are a combination of two analytical and integral models (2). To determine which units are affected, the initial vectors applied to the adjacent units as a result of the initial event should be compared with the predetermined threshold values. If the escalation vectors are significantly higher than the corresponding threshold, it indicates that they have enough power to damage the adjacent units, which itself leads to the loss of safety or physical integrity. Therefore, a preliminary screening of the neighboring units is done by doing this comparison, and potential secondary targets are identified. Potential secondary units are those adjacent units that are more likely to participate in the domino effect. The presence of secondary units in the domino effect not only aggravates the accident and the consequences, but also causes the domino effect to be promoted to a higher level by affecting the third unit. The escalation vectors caused by secondary events also lead to the occurrence of other events at the third level. Therefore, more attention in this field will improve the safety culture to prevent these accidents. Students' theses and their practical implementation in industries can be one of these cases.

References

1. Khakzad N, Khan F, Amyotte P, Cozzani V. Domino effect analysis using Bayesian networks. Risk Analysis: An International Journal. 2013;33(2):292-306.
2. Pouyakian M, Laal F, Jafari MJ, Nourai F, Kabir S. Fuzzy Bayesian estimation and consequence modeling of the domino effects of methanol storage tanks. International journal of occupational safety and ergonomics. 2022;28(4):2509-19.
3. Taveau J. Explosion of fixed roof atmospheric storage tanks, Part 1: Background and review of case histories. Process Safety Progress. 2011;30(4):381-92.
4. Kletz T, Amyotte P. What went wrong?: case histories of process plant disasters and how they could have been avoided: Butterworth-Heinemann; 2019.

[Downloaded from aoh.ssu.ac.ir on 2026-11-27]

[DOI: 10.18502/aoh.v7i1.14289]