Improving Barrier Effectiveness using Human Factors Methods

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Abstract

The Process Industry has an established practice of identifying barriers to credit as IPLs (Independent protection layers) through the use of methods such as PHA (Process Hazard Analysis) and LOPA (Layer of Protection Analysis) type studies. However, the validation of IPLs and barriers to ensure their effectiveness especially related to human and organization factors is lagging.

The concept of barriers as discrete onion layers comprised of administrative controls, alarms, instruments, mechanical devices, and post-release mitigation is highly idealized. Even worse it is misleading because it blinds us to the reality that all barriers are human. Further, this human base is often made up of small groups of people, comprised of operations, maintenance, and technical staff, with a management layer. The groups of people that maintain and manage all barriers is the most critical factor to ensuring good performance of those barriers in the threat path of a hazard scenario. The methods of PHA and LOPA as currently practiced are not addressing this issue. There is not even awareness of this issue, because the mantra to “ensure independence between protection layers” creates the illusion that barriers can be made independent.

The two related issues this paper will address are, (1) the human and organization impact on effectiveness of a single barrier, and (2) the human and organization impact on all barriers in the same threat path. The first issue can be addressed with established human factors and human reliability tools such as Task Analysis, coupled with a public domain human reliability model. The second issue is more complex and requires analyzing the groups of people that cross barrier types and can negatively influence multiple barriers.
The methods and concepts will be explained by considering the following barrier types, in a common threat path. The approach described in this paper has been in use for the past two years applied to actual barriers.

- Critical Alarm with Operator Response
- Safety Instrumented System
- Mechanical Pressure Relief Device

Demonstrating barrier effectiveness involves both qualitative and quantitative considerations. Demonstrating qualitative effectiveness is done by performing a Task Analysis to identify the degradation factors (human and organization) and degradation factor controls related to the barrier. Demonstrating quantitative effectiveness of the same requires use of a Human Reliability method. Neither of these approaches has been widely adopted in the Process Industry and so there exists a competency gap related to their use. However the need for these tools is evident by the incidents arising in industry due to human and organization factors.

Finally, documenting the results on a Bow-tie diagram (the left-hand side) will be demonstrated. Identifying leading process safety indicators embedded in the Bow-tie will be discussed.

**Key Words**

Bow-tie, Barrier effectiveness, Task Analysis, Human Factors, Human Reliability