Snares to LOPA Action Items

Glenn Rozmus
Smith & Burgess
glenn.rozmus@smithburgess.com

Dustin J. Smith
Smith & Burgess
dustin.smith@smithburgess.com

Dick A. Baum
Smith & Burgess
dick.baum@smithburgess.com

Abstract

Greater numbers of action items are being generated from the LOPA process as it becomes increasingly utilized as a method for risk evaluation. The quantity and type of action items result from the combination of initiating events, conditional modifiers, and prescribed guidelines. The quality of the inputs determines whether the action items will actually provide any additional safety benefit. This paper is not a procedure for performing a LOPA analysis, but presents issues to be aware of when generating a list of initiating events, evaluation of the initiating event severities, and the influence of conditional modifiers.

1. Introduction

As a process safety consulting company, Smith & Burgess has been asked to review numerous action item lists from LOPA studies. The lists were generated based upon company standards, the guidelines of the company PSM policies, and the expertise of the facilitator. Companies are sometimes surprised at the quantity and intent of the action items. We hope to create awareness of the effects of seemingly innocuous company policies and suggest alternative strategies. Examples are given as to how the guidelines used for the LOPA study can alter the quality and quantity of action items. As a result, facility personnel will be better informed prior to and during the LOPA process and understand the effects of the inputs on the results.

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2. Background

2.1 LOPA

Layer of Protection Analysis (LOPA) is a hazard analysis method used for evaluation of risk. It is more rigorous than the qualitative HAZOP method but not as rigorous as a fully quantitative risk analysis. It is normally used to evaluate select scenarios generated from a HAZOP study which require further analysis to confirm that consequences and safeguards have been properly addressed. LOPA may also be used as a basis for prioritization of action items based upon ranking of the risks.

2.1.1 Methods

There is no uniform method for performing a LOPA analysis. A well-documented procedure is presented by the Center for Chemical Process Safety (CCPS) [1]. There is a variety of software available which are available for LOPA studies. There are also various hybrid methods, created by individual facilitators or dictated by company policy. It is intended that all of the methods are substantially equivalent and achieve the same desired result.

2.1.2 Guidelines

Guidelines for performing a LOPA study are as varied as the methods used. The guidelines used for a particular study are set prior to the study either solely by the host company or from a method agreeable to both the company and the facilitator.

3. OSHA PSM Standard

3.1 Relevant Regulations

LOPA is not specifically mentioned in the OSHA PSM Standards but there are sections that refer specifically to the evaluation of hazards.

3.1.1 29 CFR 1910.119 PSM Standard

OSHA Standard 1910.119 sections (e)(1), (e)(2), and (e)(3) state that the complexity of the process affects the PHA methodology selected, lists methodologies that are appropriate to evaluate the hazards of the process being analyzed (LOPA is not mentioned), and lists the items that the process hazard analysis must address [2].

3.1.2 Enforcement Directives

Also, OSHA enforcement directive guidelines state that the process must be evaluated with an appropriate methodology according to the hazards of the system [3]. The use of LOPA analysis follows as a means to highlight high risk scenarios.

4. LOPA Action Item Snares

4.1 Company Influence

Often a company establishes the overall policies for performing a LOPA study. Since a policy is therefore in place, employees adhere to it whether it is excessively burdensome or excessively remiss. In addition, since the policy is in writing, it must also be strictly followed since OSHA will issue citations for non-compliance to written policies.

4.1.1 Knowledge

Have you read your company PHA/LOPA policy? Even though this probably has been written by a concerted team effort by safety professionals and is well-intended, it must be followed no matter its suitability. When the LOPA analysis is scheduled it is too late to read the policy and suggest an internal review if necessary.

4.1.2 Scope

What risks are covered in your company PHA/LOPA guidelines? Are production/economic risks included? Companies who want to have economic risks identified in LOPA studies are sometimes surprised to find the scope and depth of action items generated as a result.

Are conditional modifiers included as an adjustment for the risk level? Not all companies include these for LOPA studies. Sometimes the conditional modifiers are omitted so that the risk is not minimized. However, if there is a risk of serious employee injury but there are normally no employees inside the plant site and the risk level is not modified for this situation, expect additional action items to be generated to meet the required IPLs (Independent Protection Layers).

4.1.3 No Policy

If your company has no policy concerning LOPA studies, then perhaps a verbal negotiation between the company and the facilitator will determine the guidelines for the LOPA study. This will therefore determine the quantity and quality of the LOPA action items. Without a policy there will be no consistency and without consistency the results of the study will vary.

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A LOPA study can only be successful if a detailed and comprehensive policy is in place. The LOPA methodology is very standard but the company's determinations and agreements for the risk criteria to be used is imperative. The guidance provided from industry publications are tools for establishing the criteria but the company must provide the "hard" numbers. The quantitative portion of LOPA depends on this input. Any gray areas not addressed may lead to lengthy discussion points and result in recommendations that may not be warranted.

EXAMPLE:

Informal company guidelines were used to evaluate the severity of LOPA scenarios generated from process conditions of overpressure. This resulted in generation of a large number of action items involving a large number of additional IPLs. The first step for resolution was to recommend a RAGAGEP-based standard for evaluation of high pressure scenarios. This was found in API RP 581 [6] which lists the percentage of vessel overpressure and correlates it to the vessel and system integrity. This indicated that risks were overemphasized and that there was actually no hazard for this group of action items. The second step was to complete the action items with an alternative solution (in this case no action), based on an OSHA compliance guideline and enforcement procedure.

4.2 Facilitator Influence

Even though the facilitator may be directed by company policies and may even use specialized software, the overall quality of the LOPA study still rests with the facilitator. The ultimate goal for conducting a LOPA study is to have the team comprised of a LOPA-experienced facilitator and LOPA-trained members.

4.2.1 Scenarios

Scenarios for LOPA analyses should be the most serious consequence of all initiating events considered for individual equipment or groups of equipment. Without written guidance, the facilitator may include excessive scenarios without regard to quantity or quality of the output (action items).

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The risk criteria as determined by the company must include the risk matrix trigger points for sending the scenario to LOPA. Different severities for safety, environment, commercial impacts or business interruption must be defined based on the company guidelines.

4.2.2 Frequency Modifiers

Has the initiating event under consideration ever happened in the history of the facility? Guidance for this frequency should be explained in the company policy. Without written guidance, the facilitator will make suggestions which may or may not be uniform from scenario to scenario and which may or may not be consistent with published guidelines for equipment failure.

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The trap! Frequency modifiers are the qualitative portion of LOPA that must be approached with caution yet are vital to an accurate assessment of risk. Occupancy, time at risk, and ignition probability should all be factored where applicable. That's why they were developed. Caution must always been used to ensure they don't become the method to play with the numbers and reduce the risk.

4.2.3 IPLs

Independent Protection Layers (IPLs) can be interpreted with some variety. For example, the number of IPLs counted with different instrumentation interlocks may depend on whether the interlocks are on separate controllers, on separate input cards on the same controller, or on different racks on the same controller. Credit may or may not be taken for these variations.

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A planning meeting with the LOPA facilitator to review IPL criteria has many benefits. As facilitators we have all had the training, read the books and facilitated the studies. Each company is unique and their IPL criteria will not be the same. A review between the facilitator and the company is the place for questions to be answered and resolved. Sometimes as facilitators our experience does get in the way.

4.3 Action Items Aspects

After LOPA action items have been generated, they must be addressed. With a good LOPA study this is straightforward. With a poor LOPA study there are snares that have already been tripped.

4.3.1 Quantity

A large quantity of LOPA action items may have resulted from a variety of causes. Now what? Are the action items based on analysis of totally different scenarios? Are they from the same scenarios with different contributing factors? Do the action items overlap between scenarios? Sorting through the jumble can be daunting.

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Different initiating events can result in the same consequence, but keep in perspective that different IPL's and modifiers may exist. Each scenario has to be evaluated individually.

EXAMPLE:

A large number of LOPA action items were generated from a large number of similar scenarios as a result of company policy and facilitator guidance. Sorting through the similar scenarios and similar action items was overwhelming. The solution was to group the action items based on the root cause scenario and the specific equipment. This enabled the minimum amount of IPLs to be utilized to remedy numerous action items.

4.3.2 Quality

Will the LOPA action items improve the safety of the facility? Prior to the LOPA analysis, were applicable industry standards considered?

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LOPA recommendations must be developed to "close the gap". Unfortunately, too often the thought is to add an IPL and move on. This may create burdensome recommendations that though they solve one problem, they create other issues. The focus should always be to prevent and detect first, working with the left side of the LOPA sheet. Eliminating or reducing the likelihood of the initiating event should always be the first objective.

EXAMPLE:

A LOPA analysis was performed on an equipment burner system without regard to RAGAGEP (Recognized and Generally Accepted Good Engineering Practices) standards. In this case this referred to industry standards for burner systems. Remedy for the numerous recommendations generated involved two steps. The first step was to compare the burner system to a NFPA standard which defines safety systems for burners [4]. After satisfying that all requirements were currently met, the second step was to complete the recommendation with an alternative solution (in this case no action). For this example, resolution of PSM action items is addressed by a PSM Compliance Guideline and Enforcement Procedure.

“OSHA considers an employer to have "resolved" the team's PHA findings and recommendations when the employer either has adopted the recommendations or has justifiably declined to do so. Where a recommendation is rejected, the employer must communicate this to the team and expeditiously resolve any subsequent recommendations of the team. An employer can justifiably decline to adopt a recommendation where the employer can document, in writing and based upon adequate evidence, that one or more of the following conditions are true:

1. The analysis upon which the recommendation is based contains material factual errors;
2. The recommendation is not necessary to protect the health and safety of the employer’s own employees or the employees of contractors;
3. An alternative measure would provide a sufficient level of protection; or
4. The recommendation is infeasible.”[5]

Since the burner system already met a RAGAGEP standard, the action items were not necessary to protect the health and safety of the employer’s own employees or the employees of contractors and the action items could be closed.

EXAMPLE:
A company wished to resolve LOPA action items regarding installation of new pressure relief valves (PRVs). Resolution included re-evaluation of the process system to confirm or refute the hazard, PRV installation recommendations, or alternately installation of safety integrity level (SIL) instrumentation. Guidance was presented to the company for all approaches. The first guidance was to refer to ASME Section VIII [7] which states that there be no credible overpressure scenario in which the pressure exceeds 116% of the MAWP. If the process system meets this requirement then no PSVs are required.

API Standard 521 [8] states that if instrumentation is used to replace relief devices, it must be at least as reliable as a SIL 3 system. A SIL 2 system may be acceptable if some other means are used to bridge the gap to a SIL 3 system. Part of a correct instrumentation solution is a system which contains appropriate documentation.

5. Conclusion

Smith & Burgess can help you plan and prepare for your next LOPA study. You should also refresh yourself with the OSHA PSM requirements and read your company policies. After the LOPA study begins, the path will already be set. The action items will reflect company intentions and/or facilitator preferences. Handling the action items will then either be a meaningful effort for beneficial solutions or a less fruitful effort to justify alternatives.

6. References

[1] Layer of Protection Analysis, Center for Chemical Process Safety, New York, 2001.
[2] Occupational Safety and Health Administration, Occupational Safety and Health Standards, Subpart H, Hazardous Materials, Standard Number 1910.119, Process safety management of highly hazardous chemicals, www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=9763&p_table=STANDARDS (accessed Dec. 27, 2012)

[3] OSHA Enforcement Guidelines, http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9760 (accessed Dec. 27, 2012)
[4] NFPA 87 Recommended Practice for Fluid Heaters, 2011 Edition, NFPA, Quincy, MA.
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[8] Pressure-relieving and Depressuring Systems, ANSI/API Standard 521, 5th edition, January 2007, API, 2008 (accessed Dec. 28, 2012)