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INSIGHT

What You Need to Know About Facility Siting and Revalidation

Facility siting is an assessment of occupied buildings given potential exposure to explosion, fire and toxic hazards. As stated in the Occupational Safety and Health Administration (OSHA) standard 29 CFR Part 1910, it is a requirement for Process Safety Management (PSM) covered processes.

This article was adapted from the paper, "The Facility Siting Cycle (Revalidation)," which was presented at AIChE's 13th Global Congress on Process Safety (GCPS) in San Antonio, Texas.

Sites are always changing and, as a part of the management of change (MOC), the facility siting should be maintained in-line with these changes. At a minimum, the facility siting study should be updated and revalidated at least every 5 years, according to OSHA. While maintaining a current facility siting study can be a challenge, revalidation has many benefits aside from helping to provide a safer working environment.

What is Facility Siting?

Facility siting is a continuous cycle. It is intended to be revised and updated as processes and facilities change, though it is not uncommon for the initial facility siting study to be considered "the end" or the "goal." This ongoing cycle can be broken down into six (6) steps:

1. Corporate Practice
2. Pre-Study/Initial Siting Study
3. Detailed Assessments
4. Remediation Planning
5. Implement Remediation
6. Management of Change

There are a variety of technical approaches to performing facility siting. These approaches vary in their levels of applicability, conservatism and technical difficulty. Both consequence-based and risk-based methods can benefit from these approaches.

For example, vapor cloud explosions (VCE) hazards can be evaluated with widely used screening/traditional methods (Gaussian dispersion and VCE blast curves) or can be modeled using computational fluid dynamics (CFD) methods for both dispersion and explosion.

Fire hazards can be assessed (in order of complexity) using spacing tables, empirical modeling, geometric analysis (using view factor and shading from obstacles) and/or CFD fire modeling. Fire evaluation criteria can

use heat flux values for certain consequences, such as thermal radiation intensity tolerable for evacuating personnel. A more detailed approach would be to perform a thermal dose calculation that integrates thermal radiation intensity exposure over time to predict personnel vulnerability.

Toxic release hazards can be assessed using traditional dispersion models or with CFD. Evaluation criteria can be based on endpoints of concentration levels, such as Immediately Dangerous to Life or Health (IDLH), or on a dose calculation that integrates exposure level over time to predict personnel vulnerability.

Apart from the simplest hazard assessment methods, most facility siting studies utilize a wide variety of software packages (commercial and in-house) to evaluate hazards with varying levels of complexity. As with any software package, technology is upgraded and additional capabilities are implemented. As more advanced software packages are utilized for this type of work, they become more prevalent in industry. This along with hardware improvements can lower the cost of analysis. This improves the cost-benefit for screening level studies and detailed assessments like CFD.

Further resources, guidance and recommended practices for facility siting can be found in several sources, including:

American Petroleum Institute (API)

- API RP 752, Management of Hazards Associated with Location of Process Plant Permanent Buildings; Third Edition, 2009.
- API RP 753, Management of Hazards Associated with Location of Process Plant Portable Buildings; First Edition, 2007.
- API RP 756, Management of Hazards Associated with Location of Process Plant Tents; First Edition, 2014.

Center for Chemical Process Safety (CCPS)

- Guidelines for Facility Siting and Layout; First Edition, 2008.
- Guidelines for Evaluating Process Plant Buildings for External Explosions, Fires, and Toxic Releases; Second Edition, 2012.
- Guidelines-for-Chemical-Process-Quantitative Risk Assessment; Second Edition, 2000.

UK - Chemical Industries Association

- CIA Guidance for the Location and Design of Occupied Buildings on Chemical Manufacturing Sites; Third Edition, 2010.

What is Revalidation?

One of the key required components of the facility siting cycle is revalidation. In its simplest form revalidation is a verification of the hazards assessments and the occupied buildings, accounting for any large site changes, such as new process units. As stated in 29 CFR Part 1910.119 section e.6, revalidation is required every 5 years based on the original study's completion date. In addition to providing a safe working environment, there are several other benefits with revalidation.

Owner/operators may have performed a variety of detailed assessments and/or preliminary hazard assessments for potential process or site changes. Revalidation provides an opportunity to combine these various studies into a single document. This can make it easier for owner/operators to maintain a clear picture of the site's current facility siting status and avoid conflicting or overly burdensome conclusions based on separate documents that lead to unjustified or unnecessary mitigation costs.

Revalidation also provides the ability to take into account risk or hazard mitigation implementations since the previous study was issued. This also minimizes the need to maintain multiple documents to capture the site's current facility siting status. A single consolidated document makes it easier to respond to and explain current site and remediation status to regulatory bodies (e.g., OSHA).

After the screening level study, sites may perform hazard assessments for planned new units or even a variety of preliminary units. These studies are frequently based on general layouts and process information. Even for assessments based on 90% complete models, revalidation provides an excellent opportunity to ensure that assumptions and idealized processes properly match the as-built product.

A specific timeframe for implementation of a mitigation plan is not specified in the API or CCPS guidance documents; although, CCPS points out that such implementations can take "several years" but should be implemented promptly like other PHA findings. So, remediation timelines can extend beyond the

required 5-year revalidation cycle. Revalidation serves as a valuable tool to benchmark the progress of the remediation effort and to determine if the remediation plan needs a course-correction based on changing conditions.

Over time a site's ownership may change. New management may have different policies and standards regarding the performance of facility siting, such as different evaluation criteria or differences in adopted methodology, such as risk-based versus consequence-based. Revalidation should address such changes.

Industry accidents provide lessons learned that may influence or have a direct impact on facility siting. A specific example would be the generation of API 753 for portable buildings after the 2005 BP Texas City incident. Likewise, the 2005 Buncefield accident highlighted the potential for surrounding foliage to support an unexpectedly severe VCE. All of these conditions may be a reason to evaluate and revise the existing hazard criteria.

Another value gained by revalidation is assessing the effectiveness of the MOC system to identify changes to the site that influence facility siting. MOC is a challenge for most sites to effectively keep track of changes to personnel, buildings, and processes. Effective MOC necessitates that personnel be knowledgeable of the site's facility siting criteria and the limitations of the methods employed. Training should be refreshed to ensure current personnel can address MOC issues and/or identify potential issues for further assessment.

Finally, revalidation can also incorporate lessons learned from onsite explosions, fires, toxic releases or near-misses. If an accident has occurred, it is likely that a safety system has been implemented. The safety system should be evaluated to see if it can address other previously identified scenarios. Near-misses can also be evaluated as accidents to quantify their hazard potential if not properly mitigated.

What to Expect During Revalidation

Revalidation should start with a reassessment of the current owner/operator's policies and procedures. This is followed by consideration of historical events in industry as well as onsite recorded incidents and near-misses. MOC events including new process units and new buildings should be evaluated. Any studies based on preliminary or final design should be verified to match the as-built/operating elements. Remaining buildings and onsite congestion will be verified to confirm that changes were not missed by the MOC system. Detailed assessments should verify that they are still applicable, accounting for any site changes that may affect the results, prior to inclusion in the revalidation study. Any implemented migration efforts should also be verified that they are maintained over the life cycle. Scenarios and models can then be re-evaluated to address any software improvements or updated technical approaches. Finally, the results of the revalidated study will either continue with the existing remediation plan or make adjustments to account for new hazards.

Benefits of the Facility Siting Cycle

- When considered as a whole, the benefits from revalidation include:
- Consolidating various preliminary or detailed studies into a single revised facility siting study to generate a coherent picture that can enable the owner to optimize mitigation plans
- Taking credit for operational changes and mitigations implemented
- Benchmarking the progress of the facility siting remediation plan
- Evaluating and revising existing hazard criteria
- Taking advantage of modeling, software and methodology improvements to illustrate reduced hazards
- Assessing the effectiveness of the MOC system to identify changes to the site that influence facility siting

While revalidation can sometimes be treated in a cursory manner, there are many opportunities and advantages available to owners and operators during the facility siting process.

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