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SUPPLEMENTAL EVAC TECHNOLOGY – SO THAT NOBODY GETS LEFT BEHIND



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A SAFETY CULTURE

MARCELO D'AMICO, FIRE PROTECTION ENGINEER/
PRINCIPAL AT ORCUS FIRE PROTECTION LLC, HOUSTON
(TEXAS), WRITES ABOUT THE BENEFITS OF PROJECT
COLLABORATION FOR EMERGENCY RESPONSE PLANNING.

An industrial facility poses some of the most complex challenges to emergency response personnel, such as the composition of raw materials and finished products, high pressure and high temperature processes, congestion of process units and manufacturing area, location of facility, local responder experience, available emergency response resources, and more.

The facility's owner and/or operator's main goal is life safety, but another important factor to consider is asset protection and business continuity. Downtime of an industrial facility or one of its processes could cost upwards of millions of dollars per minute, which could cripple the company's bottom line, as well as have a ripple effect on the marketplace where its products are bought and sold.

During the project phase (new or upgrade) of an industrial facility, it is not uncommon to look at its design from a code-compliance standpoint. Loss prevention and fire protection engineers alike will dissect applicable codes and standards and implement the 'minimum' level of protection based on prescriptive requirements. This philosophy, although not incorrect, proves a disservice to an industrial facility's operational personnel, emergency responders, and its overall level of protection by not focusing on risks and hazards that are often minimised or inadequately addressed.

The collaborative involvement of fire protection engineers, loss prevention professionals, emergency responders, and

operational personnel is the key to a well-protected industrial facility (new project or upgrade).

It is of utmost importance that everyone understands the level of performance that is expected from fire protection and other safety systems at an industrial facility.

The key to a well-protected industrial facility is the ability to be proactive instead of reactive to emergencies both from engineering design and execution standpoints. By being proactive during the engineering phase of a project, fire protection and other safety system components are considered, aiding operators and emergency response personnel instead of hindering their ability to effectively respond to an emergency. This could be something as simple as looking at the types of firewater hose connections for emergency response and mobile equipment.

To determine the level of performance and overall expectations of fire protection and other safety systems, the project team must first determine specific risks and hazards associated with the facility through formal risk assessments such as a Hazard Identification Study (HAZID) and a Quantitative Risk Assessment (QRA), as well as analyse the facility/client's level of risk tolerance as determined via a risk matrix. This approach is a better budgetary tool since it will provide a vision of global risk, allowing adequate budget values in proactive – as opposed to reactive phases – otherwise known as 'pay-some-now versus pay-much-more-later approach'.

Since all hazards and risks are identified during the early phases of a project, the cost of implementing fire protection and other safety systems is incrementally smaller than installing during or after the construction phase of a project.

These formal risk assessments should be scientific in

Figure 1: a typical industrial facility. Key to a well-protected facility is the ability to be proactive instead of reactive to emergencies.





nature; well documented; flexible; consistent; open to review; and they should pose the following questions:

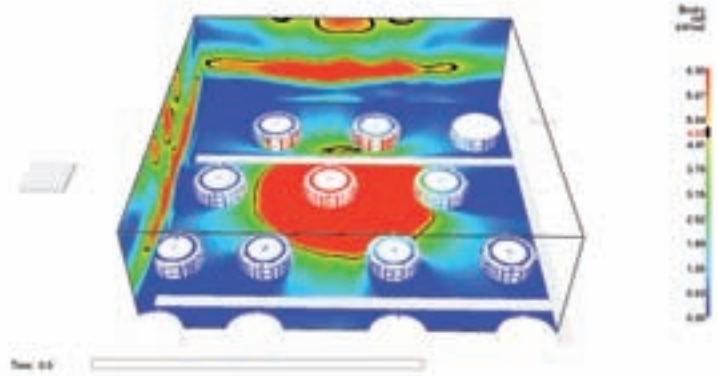
- What can go wrong?
- How likely will happen?
- What are the consequences when it happens?
- What can be done to mitigate the risks?

More often than not these assessments rely only on the expertise of the company executing it as well as available historical data provided by outside industry sources.

A more effective approach is to also involve operations personnel from similar facilities as well as emergency response personnel responsible for such facilities and the hazards they will protect. This will provide the consulting firm executing the assessment with a global view of risks and hazards, likelihood of historical events in similar facilities from a facility level (personal experience of operations personnel), its consequences based on operational input; resulting in an emergency response philosophy based on feedback from local personnel (information specific to geographical areas).

Once the initial risk assessments are complete, a list of recommendations shall be provided, which should be reviewed collaboratively by the facility team comprised of (but not limited to) engineers (various disciplines); designers; safety/health/environmental personnel; operations representatives; and emergency response team. This will ensure that recommendations are innovative, practical, and cost effective.

Recommendations stemming from a risk assessment can come in many forms based on the risk tolerance a facility is willing to accept. The facility may choose to install or not install fire protection and other safety systems, after careful



analysis of its cost and benefit.

One example of a specific type of risk assessment which impacts emergency response personnel is a radiant heat analysis performed using various types of computer model methodologies such as computational fluid dynamics (CFD) and fluid dynamics simulator (FDS). One example of a CFD model output is illustrated in Figure 2.


Without the information provided by the radiant heat analysis, emergency response personnel will include firewater as a resource for effectively cooling adjacent structures (eg buildings, atmospheric storage tanks, pressure vessels, etc.). Cooling water demand is normally calculated utilising a specific design density over an area of protection. Based on a prescriptive approach, emergency response personnel can inadvertently overtax a firewater system, which may allow the fire to rage out of control by improper fire fighting.

Using the results of radiant heat calculations, emergency

Figure 2: radiant heat analysis using computational fluid dynamics (CFD) is one way of assessing risk that may impact upon an emergency response.


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Figure 3: example of a poorly-designed and difficult-to-maintain deluge system installed on a process tower.

response personnel will know exactly what adjacent structures require cooling (measured in Kw/m^2). That is, the radiant heat models will illustrate different levels of radiation and illustrate to emergency responders where staging areas need to be located, where bunker gear needs to be worn, and what needs to be cooled (other benefits do exist). The result is that emergency response plans can be tailor-made to include these calculations and provide valuable information to the emergency response team based on varying environmental conditions.

Once a facility decides that additional layers of protection are required based on the results of formal risk assessments, the project team must decide which fire protection and other safety systems to install.

Although most times overlooked, decisions made during the engineering phase can be extremely beneficial to facility operations, emergency response personnel and the project's overall budget. If specific systems are installed without the input of the project team, its operation can actually be detrimental to emergency response personnel.



Figure 4: a hydrant that has not been properly maintained.

One example is the installation of water spray/deluge systems surrounding atmospheric storage tanks for the purposes of cooling. From a prescriptive point of view such systems are advantageous because they do not require any human interaction during an emergency, and they enable emergency responders to set up for the actual fire at hand.

Conversely, these systems – around atmospheric storage tanks – can prove unreliable due to nozzles being plugged as a result of lack of maintenance and the utilisation of large quantities of water in relation to the portion of the tank that actually requires cooling. They are also costly in comparison to manual or fixed monitor cooling options.

Another example of engineered systems that can prove problematic for emergency responders is the firewater distribution system's discharge outlet sizing (hydrants).

Based on prescriptive code requirements, designers and engineers will space hydrants at a maximum distance from one another and will specify its discharge outlets at $2\frac{1}{2}$ ".

Although some $2\frac{1}{2}$ " to 3" hose will be used for smaller fires, the use of large-diameter hoses (such as 5" and 6") is a less labour intensive option for the large flow requirements that are more commonplace in industrial facilities.

Hydrant outlets should therefore be designed and engineered to have a sufficient quantity of outlets at the specific size that is congruent with the hazards the hydrant is protecting. Moreover, a more effective hydrant spacing strategy should include locations based on the results of risk assessments and modelling, to fully understand where water demands are going to be at their peak.

Once fire protection and other safety systems are installed they must be maintained, inspected and tested – a design aspect that is commonly overlooked by designers and engineers alike.

The project mentality is to execute the project on time and on budget, while the responsibilities for the safety system's upkeep/life cycle are with the operational personnel.

This philosophy creates two major issues:

- (1) fixed systems that – if not maintained – may not operate effectively when called upon, forcing emergency responders to modify their strategy and tactics to provide support to additional areas
- (2) manual equipment that – if not maintained – will not operate as intended, and leave responders vulnerable during

a critical phase of the incident.

One example of this arose during an audit of a top-five-operator refinery facility where a critical piece of mobile equipment (large capacity firewater/foam monitor) which was specified by fire protection engineers – and accounted for in written emergency response plans – was found in poor condition.

The wheeled unit had a flat tire and its foam equipment was not properly installed. After interviewing facility personnel, it was clear that training in the use of the equipment had not been provided, and indeed the equipment had never entered the inspection and testing rotation of the facility's fire brigade and HSE (health safety and environmental) department.

Another example of poorly maintained fire protection systems arose during several visits to a major operator's mid-stream facilities, where firewater pumps were either inoperative or performing below their rated capacity.

Upon interviewing facility personnel, they explained that the firewater pumps didn't have a flow meter device or a test header, which would have enabled performance testing to be accomplished within the time provided in the schedule for this type of work.

Moreover, emergency response plans were found to have incorrect water flow and pressure information, as they assumed that the firewater pumps were operating at optimal performance.

Poorly performing and/or inoperative firewater pumps leave emergency responders in a precarious position during fire fighting operations. It is extremely important that fire protection engineers are conscious of the inspection, maintenance and testing criteria of equipment that is located within an industrial facility.

The collaboration of engineers, operations and emergency response personnel through the life cycle of a new or upgrade project of an industrial facility is imperative for the success of its fixed and mobile fire protection and other safety systems, as well as the success of emergency response. Input from a diverse group of individuals will ensure that each system and/or equipment will provide the desired level of life safety and asset protection. The by-product of this innovative approach for an industrial facility is an unparalleled safety culture that will go beyond the boundaries of a project, and will linger with every action taken related to emergency response where a collaborative group of like-minded individuals will meet for the greater good of the facility and its business continuity.

The end result will be real protection, not perceived protection.



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Figure 5: neglected, out-of-service firewater pump.