Session No. 566

How Do You Provide Fall Protection in a Wind Tunnel, and Other Odd Locations?

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Introduction

When I was asked to lead a team to evaluate a customer's fall protection needs, I was somewhat hesitant. I felt I was fairly competent when it came to fall protection and I knew that the team would include two other very knowledgeable individuals who could make up for any of my shortcomings. But I was worried about this NASA customer. They have an entire staff of safety professionals along with several other contractor safety professionals whom oversee HSE concerns at the center. How could we assist them in the identification and elimination of fall hazards?

What I soon discovered was that this task was more about perspective and focus than about identifying fall hazards. The HSE team at NASA Langley Research Center (LaRC) had identified many of the fall hazards onsite. The issues they were faced with was how best to reduce or eliminate these hazards in a way that was conducive to completing their mission. They needed help making fall prevention and protection at NASA LaRC a systematic program.

Experience Gained at a High Cost

Late one afternoon in 2005 my teammate, Robert Whitfield, received the phone call that every safety professional fears. An employee had fallen while descending a tower and had died at the scene. After the initial shock dissipated, he started the notification process and waited for additional information to filter in. While waiting he started playing 20 questions on what could have happened. Did the employee have on his fall protection equipment? Had he anchored off correctly? Had he followed our safety procedures? Was he familiar with the tower and its

hazards? The answer to these and many others were all yes. Our Corporation had a good fall protection program that met current OSHA guidelines, so what went wrong? Over a year later OSHA agreed, our Fall Protection Program was compliant and not at fault.

As part of our Corporations recovery from this tragic event, an internal Six Sigma based "Green Belt" team consisting of experienced climbers, instructors, and management was formed. During that year while OSHA investigated, we took a hard look at not just our current fall protection program but also the tasks our employees were really being asked to perform. Our Corporation got into the climbing business gradually. First it was some roof top work, then some tasks on antennas, and finally tasks performed on towers. Since it was so gradual, few noticed that our tasks aloft had increased and changes in our program may have been needed. OSHA was at a loss for suggesting improvements but our mandate was clear. We needed to go beyond current OSHA requirements to protect our employees. The generic Fall Protection Program we had built years before no longer had enough detail and depth for the tasks we performed. In response, we adopted a Managed Fall Protection Program based on the new family of ANSI Z359 -2007 standards. These standards are the bedrock that our Fall Protection Program is now built on. And the compass we used to direct NASA to a more comprehensive structured level of fall protection.

Customer Concerns

With a project like this one, you cannot just jump in and hope for the best. The first step and maybe the most vital aspect of this task was communicating with our customer. While my team and I had a vision for this project, we had to be on the same page as our NASA customer. Fortunately for us, the leadership at NASA LaRC was very welcoming to our ideas and plans. However they did have three very critical concerns that they felt needed to be addressed within this task.

1. Are all of our employees adequately protected?
2. Are we OSHA compliant?
3. How do we create a program that will last?

Protecting Employees

Obviously the point of this entire project was to ensure that NASA LaRC employees fall hazard exposure was reduced. But the point that the customer wanted stressed was "are all employees covered and do they understand the risks". To answer this question we had to work with the NASA Safety team to identify not just hazards but who was exposed, when was this exposure and why was there a hazard in the first place. To accomplish this we had to dig deeper and get on the ground with the scientist, technicians and contractors who make things go at NASA LaRC.

OSHA Compliance

NASA Langley Research Center takes OSHA compliance very seriously. They are an OSHA Voluntary Protection Program (VPP) STAR site and have been for a number of years. This designation is of the utmost importance to site leadership and they wanted to use this project as a tool that they could use to demonstrate their commitment to safety and health to the VPP audit team.

Program Development and Maturity

To properly address the first two major concerns, the customer was certain that their fall protection program would have to be updated. What they were not expecting was the depth to the recommended program changes. Truthfully the program would have to be re-created as a managed fall protection program that addressed everything from SOP's to training to management responsibilities. This new program would be an evergreen program that would mature as it was managed and grow as the site's needs changed.

Findings

Once the team was boots on the ground at NASA LaRC we found that the customer had identified over 30 locations onsite that there were known fall protection hazards. At first this seemed like an overwhelming number but we soon found out that many of the hazards were duplicates and we could address them systematically. These hazards are very common and consisted of items such as: ladders that did not meet OSHA specifications, missing guardrails, unsafe elevated work surfaces etc. These are all very common to almost any safety professional evaluating fall hazards.

What we also found out, as a team is that NASA LaRC being a unique research facility and having many buildings that were constructed well before there was a NASA, had many unique fall hazards. There are not many places that have to worry about fall protection in a 16 foot diameter horizontal wind tunnel or when setting up a test in a thermal vacuum chamber were conditions can vary vastly in temperature and pressure. While some of these were surprisingly simple to address others stretched our imaginations.

Table 1 is an example of a compliance matrix that was supplied to NASA about the team's findings. It illustrates that at several locations there were multiple hazards that needed to be addressed and gives a brief example of the recommendations that were made concerning these hazards.

Location	Violation	OSHA Standard	Recommendation
Bldg 1214 BART Wind Tunnel	Working on unguarded elevated surface.	1910 Subpart D Walking Working Surfaces	Install a horizontal lifeline above the tunnel.
Bldg 1236 National Transonic Facility (NTF) 800 ton Liquid Nitrogen Tank	Ladders are used to access pipes and evidence suggests that pipes are used as platforms.	1926.501(b)(1)	Install a permanent elevated work platform. *See diagrams 1 & 2 in App 1*
BLDG 1236 NTF Diesel Room	Valves accessed via ladder. Evidence that pipes are used for platforms.	1926.501(b)(1)	Install a permanent elevated work platform. *See diagram 3 in App 1*

BLDG 1236 NTF LCI	Roof access to LCI, there is no guardrail in work area.	1926.501(b)(1)	Install a permanent ladder or make roof accessible via a man lift, also install a guardrail around work area. Denote a path of travel from roof access to controls.
BLDG 1236 NTF Motor Drive Line	Cable guard rails do not meet OSHA specs.	1926.502(b)	Ensure that cable guardrails comply with OSHA specs for displacement, flagging and mid-rail.
	Guardrails are removed in some areas to allow for maintenance work.	1926.501(b)(1)	Install anchor point(s) in ceiling I-beams with retractable lanyards to allow employees to tie off when working in these areas.
	Employees climbing the drive cover use stiffener plates as handholds and do not have an anchor point.	OSHA General Duty Clause 5(a)(1)	Provide better handholds for climbing the drive cover and flush mount an anchor on the drive for tie off.
BLDG 1236 NTF Wind Tunnel	When climbing in the interior of the tunnel, handholds are not adequate to allow for safe climbing.	OSHA General Duty Clause 5(a)(1)	Provide more handholds that are staggered to allow for a more natural climb.
	Secondary level, where work is performed is not level and there is a 6-7 foot fall. No rails.	1926.501(b)(1)	Install D-ring style anchors in the pre-existing holes in the seams of the tunnel.

Table 1.

Fall Protection Applications

As we worked our way through the audit, the team made a conscience effort to provide solutions that went beyond a harness and lanyard. A number of questions/considerations also had to be addressed:

- What tasks are actually performed in each area?
- How often must this area be serviced?

- Is this a confined space?
- Has rescue considerations for an injured worker been addressed?
- What training (fall protection, hazard identification, etc.) have the users received?
- Are additional hazards present (temperature, wind, high voltage, moving equipment, etc.) that could hamper or alter our fall protection solutions?
- Has management of change been addressed?

Our goal was to either eliminate the hazard when possible or to integrate solutions that would flow seamlessly with the mission or task. This isn't to say that we never recommended using a personal fall arrest system or administrative controls. However we did try to limit these as a response. It is our belief that PFAS's can be effective when used under the correct conditions but too often they are used as a "catch all" in fall protection without proper risk assessment and analysis.

Below is an example of one of the findings that we presented to NASA along with recommendations and diagrams. In this example you will see how four separate hazards were identified and recommendations were made based on eliminating or controlling the hazard and the task associated with the area were the hazard is present. You will also see an example of the diagrams that were supplied to NASA for recommendations that would require more in-depth engineering.

Bldg. 1265 8 ft High Temperature Tunnel

This tunnel presents some very unique hazards due to the interchangeable nozzles that are used to change wind velocity. These large nozzles must be free to move so they can be changed when tests call for a new wind velocity. Below is a list of hazards that have been identified in the Bldg. 1265 8 ft High Temperature Tunnel

- Elevated valves must be accessed to complete nozzle changes and to perform tests. Currently these valves are accessed by climbing structural support members (See photo X).
- An elevated cable tray is being used as a walking working surface and is not designed to support this type of load (See photo X).
- Wooden platforms are being used to access some elevated valves. These platforms are not secured to the ground and do not have ladders/steps to safely reach work areas (See photo X)
- Within the test section of the tunnel, work is performed from a small elevated ledge that does not have the required guardrails necessary to protect workers from falls to a lower level (See photo X).

Recommendation

1. *Elevated valves must be accessed to complete nozzle changes and to perform tests. Currently these valves are accessed by climbing structural support members*. - Provide an elevated platform that is OSHA compliant and has a removable access ladder (**see Exhibit 1**).
2. *An elevated cable trey is being used as a walking working surface and is not designed to support this type of load*.- Provide an OSHA compliant platform so the cable trey will not be used as a walking working surface.
3. *Wooden platforms are being used to access some elevated valves. These platforms are not secured to the ground and do not have ladders*.- Replace the wooden platforms with composite metal and provide an OSHA compliant access ladder.

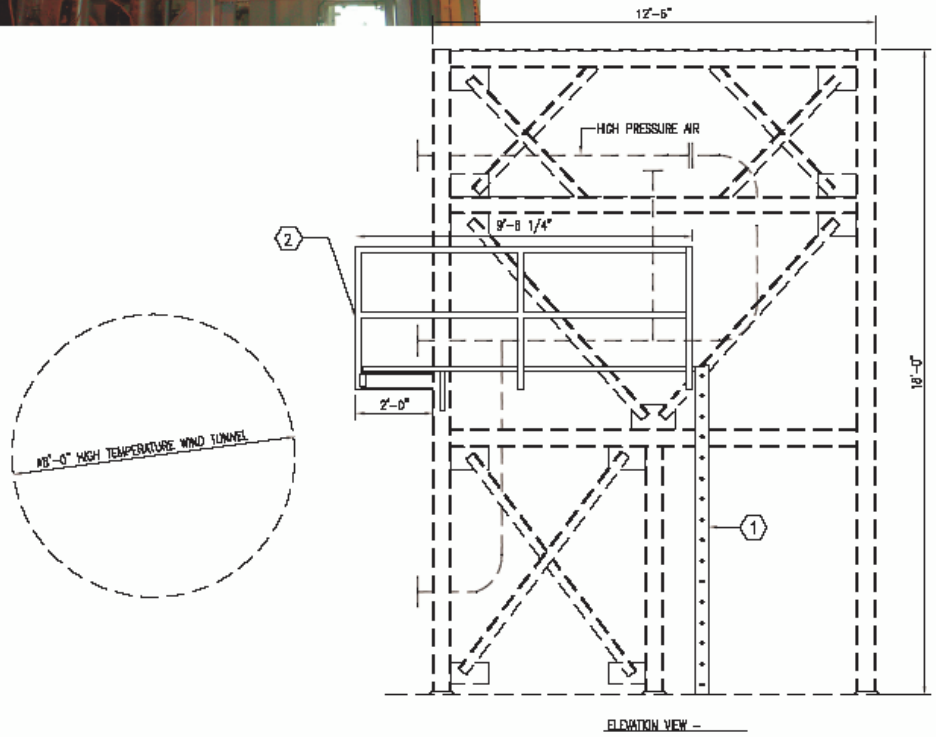
4. *Within the test section of the tunnel, work is performed from a small elevated ledge that does not have guardrails*.- Create a removable grating system that will allow access across the entire top section of the test area. Design this grating to use the pre-existing grating as an attachment point.

SUGGESTIONS:

INSTALL:

(1) REMOVEABLE LADDER

(2) ELEVATED PLATFORM AND HANDRAIL TO ACCESS VALVES



ELEVATION VIEW –

Project: NCAS NASA LaRC– BUILDING 1265 8ft. HIGH TEMPERATURE TUNNEL

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Date	By	Scale NTS	Rev. No.	Dwg. No.
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Exhibit 1.

Managed Fall Protection Program

This task begun as simply identifying fall hazards and making recommendations to eliminate or reduce these hazards. However the customer, NASA LaRC leadership team, wanted to expand beyond this triage approach to fall protection. They approached our team about how to create and implement a fall protection program that would be robust enough to manage their needs in a dynamic research environment. They also wanted this program to have the ability to mature and grow as NASA, OSHA and other regulations that govern fall protection change in the future.

Our proposal to the customer was to build their fall protection program based on 2007 edition of ANSI Z359 Fall Protection Code. Z359 lays out in detail the components of a managed fall protection program. These components include:

- Policy Statement
- Duties and Responsibilities
- Evaluation, Education & Training
- Hazard Identification
- Eliminating & Controlling Fall Hazards
- Rescue Plans & Evacuation Plans
- Incident Investigation
- Evaluating Program Effectiveness

By utilizing Z359 as the template, NASA LaRC will have a fall protection program that assigns responsibilities and is constantly managed at different levels of leadership. This program will have the flexibility to grow and change as Langley Research Center's various missions evolve. The program also allows for a greater level of efficiency by not duplicating efforts such as hazard identification and incident Investigation. Furthermore training requirements will be based on hazard exposure and task and not a broad based system where one size fits all training is delivered.

However the most important aspect of this system is the program evaluation. Leadership must evaluate this program on a regular basis and make the proper adjustments for their changing risks profile. This is what gives this program the ability to adapt and mature over time and allows site leaders to know they are addressing all levels of risk.

Summary

NASA Langley Research Center presented some unique fall hazards. Wind tunnels, thermal chambers, and 300ft gantry cranes are not commonplace in most work environments. Furthermore, the mission is vital and in many instances equipment is one of a kind and making modifications can be extremely difficult. However the processes involved with identifying, remediating and managing fall hazards is similar to those used in all industries. Creativity, flexibility, and integrated hazard solutions were they key to reducing risks associated with fall hazards at NASA LaRC.