3 Second Safety:

A Line-of-Fire

Accident Prevention Technique

US Pipeline Nomination for the TC Energy sponsored

IPLOCA Health and Safety Award

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Executive Summary

Line-of-fire accidents are among the most frustrating and frequently tragic types of accidents in construction. Viewed through the perfect lens of hindsight, they appear particularly simple to prevent. "If only the employee had not been standing there…." "If only the employee had not chosen to be in harm's way…"

If only…

Three-Second Safety isn't a new program, procedure, or policy. Three-Second Safety is a technique to "see" construction safety risks in a new and vastly more effective way. Three-Second Safety is an innovative merger of:

- the traditional technique of short but thoughtful hazard identification scans (*Four Second Safety*),
- cutting-edge techniques from the world of safety psychology (*Cognitive Safety and Human Factors*),
- and the newest peer-reviewed research in hazard recognition (*Energy Method Safety*).

With virtually no bureaucracy or administrative drag, the safety leader takes a very brief pause and conducts three-second hazard identification in quick "bursts" to scan for and address line-of-fire exposures.

Formed and presented in a simple & practical training session that is constantly re-enforced in the field, the elements of Three-Second Safety Training equip the participants with a powerful method to stop the next line-of-fire accident before it happens. It is designed to avoid incidents after which people are left thinking "if only."

Who is US Pipeline?

Companies depend on U.S. Pipeline (USPL) to build the infrastructure necessary to transport energy resources throughout North America. Located in Houston, an international energy capital, U.S. Pipeline (USPL) has a quarter of a century of construction experience and is an industry leader in safety, reliability, quality and environmental stewardship. Utilizing the talents of seasoned construction engineers, project managers, superintendents and crews, USPL specializes in completing complex projects in the most rigorous environments. Projects have been successfully completed in mountainous, urban, agricultural and other topographies. Our portfolio includes more than 5,000 miles of completed pipelines — almost half of those miles involving the construction of large-diameter pipe for some of the world's leading energy companies. In addition to pipeline construction, USPL offers project management, facilities construction, as well as executing pipeline maintenance, integrity and modernization projects. USPL truly is laying the foundation for America's current and future energy needs.

Why 3 Second Safety and is it rooted in scientifically validated findings?

Like many construction companies, USPL enjoyed historically solid safety performance but also suffered periodic serious injuries that seemed to almost "come from out of the blue". Root Cause Analysis of these incidents often exposed puzzling circumstances where otherwise experienced, well-trained, and safety-conscious employees put themselves in unplanned high-energy Line-of-Fire circumstances. In retrospect, it was as if these employees simply didn't *see* the energies involved. And if you can't *see* a hazard, the opportunity to assess and mitigate/control a hazard simply doesn't happen! The reduced situational awareness can be attributed to a number of factors ranging from human (Jeelani et al. 2017), work-related (Namian et al. 2016), safety culture (Pandit et al. 2019), and lack of knowledge (Albert et al. 2017). Thus, this began a journey to search for the best and most novel answers behavioral and applied safety science could offer to prevent Line-of-Fire accidents.

How was the solution conceived and implemented?

Dr. Dianne Stober (private practice) and Dr. Matt Hallowell (U of Colorado, Boulder) were commissioned to work with USPL's safety and operations functions to create a new and innovative training product that blended the best science and applied research from the disciplines of Behavioral Psychology, Adult Learning, and Safety Engineering, respectively (Hallowell 2021). Over a period of 6 months (including a pilot training product that was used to refine the final content), this team worked to develop a field-friendly work product that distilled, blended, and operationalized a technique that is designed to supplement more formal risk management tools such as Job Safety Analyses and Pre-Job Meetings (Bhandari et al. 2022). Because it is a supplement to these more formal risk management tools (making it a practice versus a new written tool), it is applied with zero additional administrative burden, greatly maximizing the practice's uptake, utilization, and ROI for the training.

This training was fully self-funded by USPL (to the tune of approx. $100k) but shared freely at various industry safety meeting and summits, showing a high degree of management support and altruism towards the broadest application possible of this novel and effective technique.

Why does the implementation of this training work the way it does?

The solution was deployed as two training products: a 4-hour session for front-line supervision and a 45-minute session that is merely a condensed version of the 4-hr session. The 45 min session is delivered to ALL front-line USPL project employees during their on-boarding and orientation. There are a few reasons that highlight why the scientific evidence shows this technique to be highly effective.

Firstly, hazard recognition is the first step of situational awareness. Simply, if an individual is unable to observe and identify stimuli (in this case: hazards) in their environment, they will not be able to assess and categorize risks associated to be able to take appropriate decisions (Endsley 1995). Unfortunately, several field experiments (data collected over nearly 5,000 worker-hours) have confirmed repeatedly that on average, workers are able to identify only 45% hazards in their environments (Albert et al. 2014). This is not a product of complacency on their part, rather our collective susceptibility to blind spots as human beings (Hu et al. 2018). Our brains have to focus on a number of tasks that require significant cognitive resources to perform complex problem-solving. This means wherever possible, human beings rely more on instinct and emotional cues (i.e., processed by amygdala that is responsible for flight or fight responses) to preserve energy by reducing cognitive effort. Therefore, there is a need for an intervention that supports workers in identifying hazards better by engaging their temporal lobe of the brain (i.e., part responsible for memory and methodical information processing).

Secondly, the current approaches to identifying hazards is haphazard and relies on individual or collective instincts. The pre-job safety briefs require workers to not only brainstorm hazards associated with their tasks and environment but also does not provide them with any structured framework to identify and discuss hazards. This informality can make discussions around hazards extremely unstructured and prone to lapses. The unstructured nature also increases the susceptibility towards confirmation bias (i.e., finding what you already know you will find) and anchoring bias (i.e., fixating on one or partial information; Kahneman et al. 1982). We need a structured framework to support workers better in identifying hazards.

Third and finally, work rarely proceeds as planned (Sun et al. 2006). Change management programs are not only designed to control cost and time overruns but also safety impacts. We may miss new hazards and/or changing risk profiles of hazards identified as work proceeds. How do we provide our workers with resources on identifying and understanding hazards so that they can make proactive decisions to reinforce safety during work periods? This approach directly addresses this need.

Therefore, this approach takes into account that:

1. Workers do not have necessary training to identify most hazards encountered in workplace.
2. Work often does not proceed as planned.
3. Human beings in general are prone to selective attention to be productive.

The 3-second safety approach tries to tackle these concerns without adding any additional bureaucracy or significant resource investments. Using the energy-wheel approach to identify hazards has been shown over the past decade in practice and academic research to be one of the most effective tools in improving hazard recognition of workers (Hallowell 2021). It is a *mnemonic* that gives workers a simple framework to think about different energies that may be exposed to and how they can cause harm. This is rooted in scientific evidence that suggests that all injuries are a product of some unwanted contact with one or more sources of energies (Haddon 1973). In other words, we are no longer asking workers to think of all the hazards possible without any guidance, rather we are asking them to identify the different sources of energies in the environment they may be exposed to. In other words, we reduce the reliance on abstract thinking and focus on experiential learning for workers which not only reduces cognitive demand but also aids in long-term retention of knowledge (Albert and Hallowell 2013). Hence, it is unsurprising that adding the energy wheel technique to hazard recognition has improved workers' skill on average by **30%** (Albert et al. 2014).

Additionally, we cannot reasonably ask workers to anticipate every single hazard that they may encounter during a work period because changes are common and ubiquitous. By taking a quick pause to scan for hazards frequently using the energy wheel during the work period, we can avoid the "if only" situations. The 3-second technique forces workers to reduce selective attention (i.e., focusing on the task) by heightening their situational awareness. This gives more direction to workers on when to stop work, how to stop work, and when is it safe to resume work – a process which is highly nebulous as it stands.

1. This approach relies on workers' instincts but ensures that they are not using heuristics or biases.
2. This approach requires no additional paperwork.
3. This approach provides clear guidance and opportunities for safety practitioners to engage with workers during work period.

Achievements and The Path Forward.

Fully operational since 2019, the program has helped to achieve zero significant injuries from inception to date and a reduction in Days Away or Restricted Time (DART) by over 50%. The program also has a solid proof of utilization and has been very well received by the safety and operational functions, especially field-level leaders and individual contributors. Here are some testimonials:

"3 Second Safety changed my whole perspective when evaluating hazards on the work site" - Barry Jent (USPL Foreman)

"When conducting the JSA I have found that being trained on the 3SS program helps me notice a lot of the different hazards that I wouldn't have before"- James Batton (USPL Foreman)

"3SS has transformed our safety program and how we evaluate hazards on our projects" - Randy Richmond (USPL Safety Manager)

Although, USPL has noted a significant improvement in lagging indicators, it should be noted that Total Recordable Injury Rate (TRIR) changes over such time frames have been shown to be highly unreliable (Hallowell et al. 2021). While it is important to acknowledge the importance of decline in recordable incidents which is directly attributable to this technique, the bigger win of using this technique is better safety culture. Given the focus is on safety before an incident

happens, we are reinforcing within the workforce that safety is not the absence of injuries but the constant vigilance towards hazards and controls needed to be safe.

While the program is constantly re-enforced and coached to across all USPL Projects, we believe there remains even more opportunities to grow and develop Significant Injury and Fatality (SIF) prevention strategies from this practice, starting with converting activity support and outputs to one or more Leading Safety Indicators to incorporate into USPL's Balanced Safety Performance Scorecard.

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APPENDIX

Three-Second Safety
Training Program Breakdown

The half-day training for 3 Second Safety is broken into three parts. Below are listed the three parts, with their Learning Objectives detailed. Further below is a tabulation of all the slides used in the shortened 45 min version that is delivered to all project employees during their safety orientations.

Part 1: Cognitive and Human Factors in Construction Safety

- **Assess** personal factors (Personal Top 3) that – when properly harnessed - can drive safe operational decision-making and effective hazard identification
- **Identify** brain functions and biases that contribute to risk-taking behavior
- **Learn & Use** cognitive tools and habits that can combat safety blind spots & embedded biases to decrease risk-taking behavior

Part 2: Energy-Based Safety Theory and Use

- **Self-assess** hazard recognition skills and blind spots
- Broadly **identify** hazards using the energy method to recognize a greater proportion of hazards
- **Describe** why some energy sources are missed more frequently than others
- **Explain** how mental short-cuts help us to think quickly and easily identify line-of-fire energy sources

Part 3: The Sum-is-More-than-the-Parts: Putting it together for Three-Second Safety

- Practice how to quickly **scan** a work environment, identify hazards, and predict line-of-fire exposures
- **Design** a personal 3-second safety approach for your work by focusing attention differently than it typically is now
- Effectively **engage** with co-workers to explain and mitigate line-of-fire situations through coaching

45-Min Slide Deck:

3 Second Safety (3SS)

A Prevention Technique for Line of Fire Accidents

1

Learning Objectives

- Understand the importance of hazard recognition skills
- Describe why some energy sources are missed more frequently than others
- Broadly understand the energy wheel and energy theory
- Explain the different sources of energy and how to use the energy method to recognize a greater proportion of hazards
- Understand how mental short cuts help us to think quickly and easily to identify line-of-fire energy sources

2

Why is Hazard Recognition such an important skill?

- If you can't "see" it you can't do anything about it
- Safety is fundamentally about recognizing hazards "before" they turn into incidents
- We aren't nearly as good at Hazard Recognition as we think
- The JSA isn't the end of hazard recognition, it is only the beginning
- Since it is a "skill", it can be taught and improved

3

How good are the "best" at recognizing hazards?

45%

4

Why do we miss so much?

- The human brain has limitations and built in filters
- Safety is fundamentally about recognizing hazards "before" they turn into incidents
- We aren't nearly as good at Hazard Recognition as we think
- The JSA isn't the end of hazard recognition, it is only the beginning
- Since it is a "skill", it can be taught and improved

5

Why do we miss so much? – Brain Filters

- We can't process all data
- *Priming* allows us to be ready to register some data before others
- Data that is *important* to us is more likely to register

6

Brain Filters: Criteria for Registering

7

So What?

- Our brains are programmed for filtering data for what's **Dangerous –Valued - Rewarding**
- Complacency will creep in
- Our conscious capacity is limited and variable (but we can learn ways to h overcome that)
- We need a tool to help us use our brains most effectively. elp

3SS is the tool to keep us on the track

8

What does that look like?

A quick exercise to demonstrate….

9

Count the Number of F's

FINISHED FILES ARE THE

RESULT OF YEARS OF SCIENTIFIC STUDY COMBINED WITH THE EXPERIENCE OF

10

Count the Number of F's

FINISHED FILES ARE THE

RESULT OF YEARS OF SCIENTIFIC STUDY COMBINED WITH THE EXPERIENCE OF YEARS

11

Count the Number of F's

TWO OF THE MOST POWERFUL

12

Count the Number of F's

TWO OF THE MOST POWERFUL

OF ALL HUMAN FEARS ARE THE FEAR OF FAILURE AND THE FEAR OF SUCCESS

13

How do we change?

Energy Based Hazard Recognition

14

A key (not so) new theory

Every injury is the result of the unwanted release of one or more energy sources

Thus, every source of energy is a hazard.

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Energy Sources (The Wheel)

- The wheel is mnemonic, which is just a fancy word for a technique used to help us remember and recall important information.
- Each of the icons represents a different form of energy
- We will go over each but keep in mind that our brains are wired to see some energy sources more easily than others
- The energy method helps point our brains to think about categories of

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Energy Sources defined

Gravity – force caused by the attraction of all other masses to the mass of the earth.

17

Energy Sources defined

Motion – the change in position of objects or substances.

18

Energy Sources defined

Mechanical –energy of components of a mechanical system within otherwise stationary piece of machinery.

19

Energy Sources defined

Sound – is produced when a force causes an object or substance to vibrate.

20

Energy Sources defined

Electrical – the presence and flow of an electric charge.

21

Energy Sources defined

Pressure – energy applied by a liquid or gas which has been compressed or is under vacuum.

THIS IS A 70 PSI TIRE BEING INFLATED TO 75 PSI.....JUST 5 PSI OVER RECOMMENDED

22

Energy Sources defined

Temperature–measurement of differences in the thermal energy of objects

23

Energy Sources defined

Thermal – energy produced by the transfer of heat, combustion, friction, or exposure to caustic physical or health hazards

24

Energy Sources defined

Biological – living organisms that can present a hazard.

25

Energy Sources defined

Radiation – energy emitted from radioactive elements or sources, and naturally occurring radioactive materials.

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Energy Source and Hazards

Every injury is the result of the unwanted release of one or more energy sources.

Thus, every source of energy is a hazard.

Rather than looking for "hazards," workers should instead look for energy sources and device controls to prevent the unwanted release of

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What does that look like?

Examples and a practice exercise..

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29

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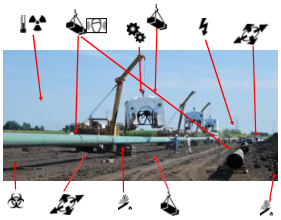

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Your turn…

32

Heavy

Sharp blade

Vehicular traffic

Uneven surface

Compressed gas

Noise

Flying debris

Heat

What hazards did you identify?

33

3SS - What we want everyone to do….

SEE IT

Own It. Solve It. Do It.

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3 Second Safety Summary…..

- Why – because our current methods are good, but not good enough
- How – enhances the ability to "See" what we need to SEE
- What – scanning technique to SEE more, more effectively
- When – all throughout the work

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