WHITE PAPER

# Reducing Errors in Utility Operations: **Why Training, EHS Systems, and Human Performance Need to Work Together**

# Executive Summary

Utility teams make high-consequence decisions every day.

Operators manage energized equipment and switching procedures. Field crews respond to outages, equipment failures, severe weather, changing site conditions, and contractor activity. Supervisors and safety teams must keep actions and decisions aligned with safety, system reliability, and customer service.

The work, from generation to distribution, carries real consequences. A missed handoff, unclear order, outdated procedure, or incomplete training record can create risk that moves quickly through the system.

After something goes wrong, organizations often look first at the person closest to the event. Aviation shows the pattern well. Early reports after a crash often point to possible pilot error because the pilot made the final visible decision.

Utility events can create the same pull. Someone operated the wrong device. Someone missed a step. Someone misunderstood an instruction. Someone failed to see a hazard that had already formed in the work.

**But that explanation rarely goes far enough.**

Most operational errors come from the conditions around the work. Training gaps, weak communication, unclear procedures, fatigue, workload pressure, missing documentation, poor change control, and limited reporting all shape performance before an error occurs.

Reducing those errors requires more than better training alone. It demands better visibility into where work breaks down, how risk repeats, and whether corrective actions change what happens in the field. It also requires learning from past mistakes and near misses.

Training builds knowledge, judgment, and consistency. Software platforms give utilities a place to capture the signals that often sit across separate systems. EHS systems, in particular, can help teams track incidents, near misses, hazards, corrective actions, audit findings, procedure gaps, and performance data.

When these areas work together, utilities connect learning, risk, and action into one practical prevention system.

# The New Pressure on Utility Operations

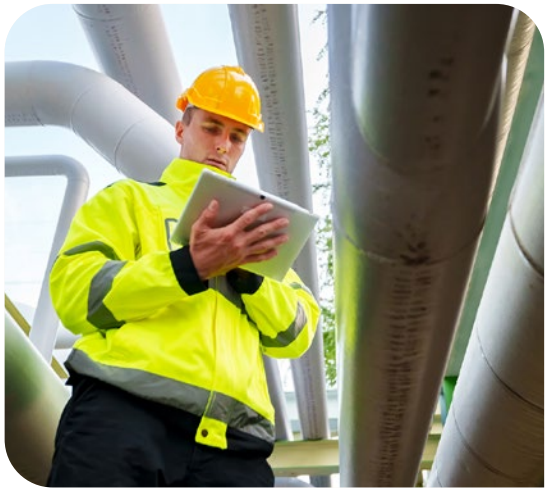
The power industry has always managed high-risk work. The difference now lies in the speed and volume of change.

Utilities need to meet rising electric demand while managing aging infrastructure, storm hardening, grid modernization, cybersecurity requirements, and new generation needs. Large-load growth from data centers and other facilities adds another layer of pressure. NERC has called attention to these risks, noting the need for proactive planning and stronger coordination across planning and operations.

That pressure lands on people, particularly those on the front lines, but also those supervising and supporting them.

### Separation shows up when:

- Training does not connect to current incident trends.
- Corrective actions stay separate from learning plans.
- Procedure updates fail to reach every affected role.
- Near-miss data sits in a system that training teams never see or use.
- Audit findings identify the same weakness again and again without changing how work happens in the field.



The 2025 U.S. Energy and Employment Report from the Department of Energy reported **933,800** electric power generation workers and **1,463,700** transmission, distribution, and storage workers.

**Those numbers show the scale of the training, safety, and operational consistency problem utilities must manage.**

Control room operators need to understand more complex systems that impact wider areas. Field crews need to apply procedures in changing conditions. Safety teams need to see patterns across incidents, near misses, inspections, and corrective actions. Training teams need to build skills faster, especially as experienced workers retire or leave and new employees step into higher-risk roles.

The size of the U.S. energy workforce adds another layer of complexity. The 2025 U.S. Energy and Employment Report from the Department of Energy reported 933,800 electric power generation workers and 1,463,700 transmission, distribution, and storage workers. Those numbers show the scale of the training, safety, and operational consistency problem utilities must manage.

The issue rarely comes from a lack of activity. Most utilities already have procedures, training programs, incident reports, audits, and corrective actions. The risk comes from separation, when those activities happen in different systems, departments, or workflows without a clear path for information to move between them.

Over time, those disconnects make it harder to see where risk is building and harder to prevent the same problems from showing up again.

# Errors Come from Systems, Not Just Individuals

Utility leaders know people make mistakes. But workplace mistakes rarely happen in isolation. They build through the conditions and attitudes that surround the work.

Take a switching error. On the surface, the event may involve a worker selecting the wrong device. But the underlying cause may be more complex, such as similar device names, an unclear switching order, time pressure, a missed read-back, incomplete field verification, or a procedure that no longer matches the current system configuration.

The same pattern can show up in other parts of utility work. A poor shift handoff may reflect an informal turnover process or inconsistent documentation. A missed hazard may trace back to weak job briefings, production pressure, or training that did not prepare workers for a changed condition.  A failure to update a map, a maintenance error, or a misapplication of a new protection system may leave a trap waiting for the right conditions to arise.

OSHA's incident investigation guidance supports this view. OSHA notes that contributing factors often include equipment, procedures, training, and safety program weaknesses. OSHA also explains in its root cause analysis guidance that correcting only the immediate cause may remove a symptom without solving the problem.

**This distinction matters.**

If a utility treats an error as a personal failure, it may retrain one employee, write a corrective action, and close the file. If the same conditions remain, the risk remains. While the person involved learned the lesson, the opportunity lies in sharing that learning across the organization in an open, non-punitive environment.

A stronger approach asks better questions:

- What information did the worker have?
- What did the procedure require?
- Did the procedure match the work as performed?
- Did training prepare the worker for this task and this variation?
- Did communication protocols catch or miss the misunderstanding?
- Did supervisors see signs of risk before the event?
- Did previous near misses point to the same issue?
- Did corrective actions from earlier events fail to reach the field?

These questions shift attention from blame to system performance. That does not remove personal accountability. It gives leaders a clearer view of the conditions they can change.

# Training Reduces Errors When It Builds Real Competency

Training can reduce operational errors, but only when it prepares people for the work they actually perform.

A completed course does not always prove readiness. A signed roster does not prove judgment. A passing score does not always show an employee can apply a procedure under pressure, during a storm response, after a long shift, or during a rare system condition.

Utilities need training that builds practical competence.

OSHA's electric power generation, transmission, and distribution standard, 29 CFR 1910.269, ties training to job assignments, safety-related work practices, and task risk. OSHA states that "the degree of training shall be determined by the risk to the employee for the hazard involved." That language gives safety and training leaders an important anchor. Training should match the risk, not just the calendar.

NERC PER-005-2 reinforces that same idea for bulk electric system operations. It requires a systematic approach to training for employees whose decisions can affect grid reliability. That approach gives utilities a clear reminder: training should connect to the work people perform, the decisions they make, and the consequences those decisions can carry.

## Different roles need different kinds of support:

- A new operator may understand a policy but lack the pattern recognition that experience creates.
- A field employee may know a procedure but needs practice applying it when the job changes.
- A supervisor may know the required handoff steps but needs coaching on how to hold the line when time pressure builds or safety focus is slipping.

## Strong training programs build that capability through several methods:

- Scenario-based learning that goes beyond content review.
- Simulations, drills, and decision exercises that mirror real work.
- Communication practice repeated often enough that workers can use it under stress.
- Learning updates when procedures, equipment, or job conditions change.
- Refresher training when incident trends show a recurring issue.
- Lessons learned from past events and near misses

As experienced workers retire or leave, utilities need a better way to capture what those workers know before their knowledge walks out the door.

Much of that knowledge never makes it into a procedure. It lives in field judgment, pattern recognition, lessons learned from past events, and small decisions experienced workers make without thinking through every step out loud.

Training teams can help turn that knowledge into something the organization can reuse. Structured interviews, field observations, mentoring, scenario design, and job-specific learning paths all give utilities a way to capture practical experience before it leaves the workforce.

That matters as newer employees step into complex roles faster. Utilities need a repeatable way to build skill, judgment, and readiness across teams, shifts, and locations.

# EHS Systems Turn Weak Signals into Action

Training helps people perform the work. EHS systems help leaders see where the work starts to fail. That visibility matters because serious events rarely appear from nowhere.

Utilities often see early warning signs first:

- Near misses
- Recurring corrective actions
- Procedure deviations
- Communication breakdowns
- Audit findings
- Inspection results
- Overdue training
- Repeated hazards
- Informal workarounds


Event reviews that focus on fixing the employee rather than looking at contributors.

The Safety Triangle helps explain why those weak signals matter. Serious events do not happen every day. But a long stretch without a major incident does not always mean the system has become safer.

A utility may go months without a consequential error while near misses, procedure deviations, informal workarounds, and communication breakdowns continue to show up in the work.

That can create a false sense of control. The absence of a major event does not prove that risk has gone down. It may only mean the same conditions have not yet come together in the wrong way.

**The problem comes when those signals sit in different places.**

A near miss may sit in an incident system. A related training gap may sit in an LMS. A procedure concern may live in an audit report. A corrective action may sit in a spreadsheet. A supervisor may know the issue keeps happening but lack a simple way to show the pattern.

**Disconnected information limits prevention.**

OSHA's safety program guidance supports this kind of early-warning approach. It encourages employers to track leading and lagging indicators, review program performance, and use the results to improve. OSHA also notes that workers can often identify hazards, close calls, near misses, and unsafe conditions before those issues appear in formal metrics.

For utilities, that worker-level visibility matters because many early risk signals show up first in the field. A crew may notice repeated procedure confusion. A supervisor may see the same shortcut during a high-pressure task. A near miss may reveal a training gap before that gap contributes to a serious event.

A strong EHS system helps teams turn scattered safety activity into a clearer picture of risk. Incident reports, near misses, minor injuries, hazard observations, audit findings, inspections, and corrective actions all tell part of the story. When teams can view that information together, they see where the same issues keep showing up and decide what needs to change.

**The goal does not stop at better recordkeeping.**

The real value comes when the system helps leaders answer practical questions:

- Which tasks produce repeat deviations?
- Which procedures trigger confusion?
- Which locations generate repeat hazards?
- Which corrective actions stay overdue?
- Which training gaps appear after incidents?
- Which communication failures keep showing up in event reviews?

Those answers help utilities move from reacting to isolated events to correcting the patterns that allow risk to repeat.

# Procedures, Job Aids, and Change Control Create Consistency

Procedures reduce risk only when workers can find them, understand them, trust them, and apply them during real work.

That sounds simple. In utility operations, it can become difficult fast.

Procedures can break down when:

- Requirements vary by site.
- Equipment differs by location.
- Crews rely on informal job aids.
- Work shifts because of weather, outages, customer needs, or system conditions.
- A documented procedure no longer reflects how the task happens in the field.

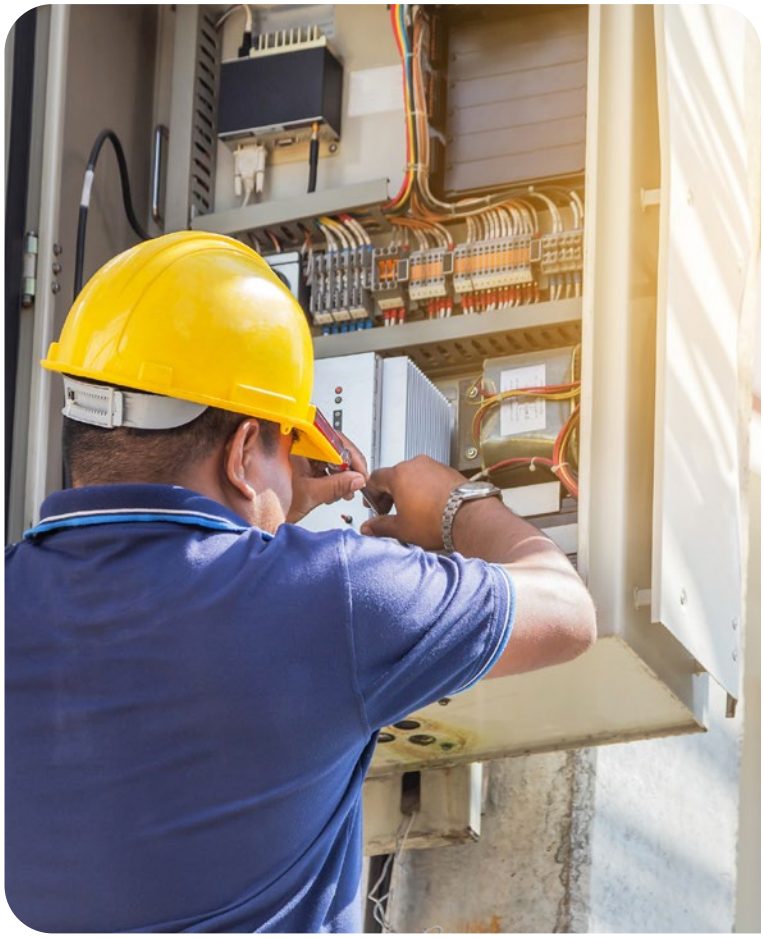
**Those gaps create error traps.**

OSHA's 29 CFR 1910.269 includes detailed requirements tied to hazardous energy control, clearances, grounding, testing, and coordination. OSHA's electric power eTool also notes that job briefings should address hazardous energy sources and the methods used to control potential hazards.

Those requirements point toward a practical truth: utilities need disciplined procedures, but they also need a system that keeps procedures current and connected to training.

Updating a procedure in the system is only the first step. The change needs to reach every affected role. It should trigger a review of related job aids, forms, training, audit criteria, and field expectations. Information should make its way into safety meetings.

Supervisors should know what changed. Workers should know how the change affects their task. Safety teams should know how to verify use in the field.



Without that connection, organizations create a paper gap. The approved procedure says one thing. The training says another. The field practice follows a third path.

That gap creates risk and weakens investigations. After an event, leaders may struggle to determine whether the worker missed the procedure, the procedure missed the work, or the organization failed to communicate the change.

An integrated approach closes that gap. An EHS system manages procedure findings, approvals, audits, and corrective actions. The training system builds understanding and tracks completion. Together, they help leaders confirm that change reaches the people who need it.

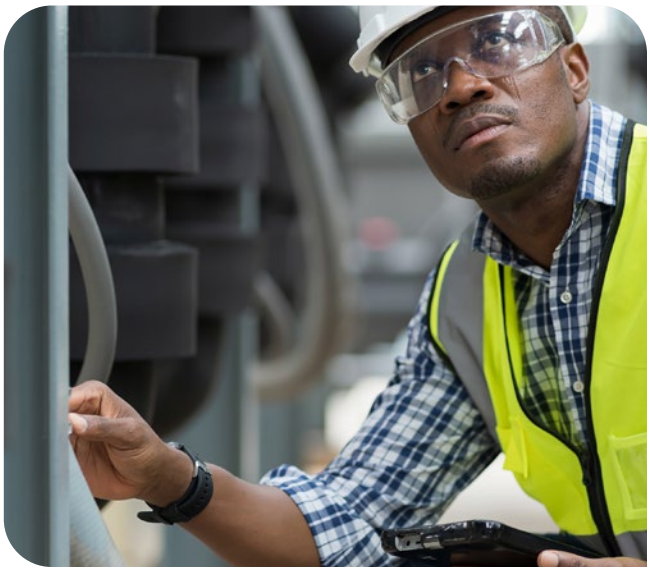
# Communication Failures Remain a Critical Risk Point

Utility work depends on precise communication between people who may not share the same location, visibility, or operating conditions. A control room may see the system one way. A field crew may see something different at the job site. Supervisors, contractors, and emergency response teams may all depend on the same information reaching the right person at the right time.  If everyone in a vehicle knows the destination, the chance of taking a wrong turn decreases significantly.

**Small gaps can carry large consequences, especially when crews issue, receive, or confirm operating instructions.**

Utility reliability requirements reflect that risk. NERC COM-002-4 addresses communication protocols for operating personnel who issue and receive operating instructions, and FERC approved the standard through Order No. 808. The point is practical: critical instructions need a clear, consistent communication process.

This compliance anchor matters, **but communication risk extends beyond the control room.**



Utilities need clear expectations for pre-job briefings, read-backs, repeat-backs, radio protocols, shift handoffs, emergency updates, field-to-control-room coordination, and contractor communication.

The most useful communication practices share a few traits. They help utilities:

- Define when a formal protocol applies.
- Give workers a consistent format for critical information.
- Make confirmation part of the work, not a personal preference.
- Reduce assumptions during high-pressure tasks.
- Create records that leaders can review during audits or event analysis.

**Training and EHS systems should reinforce those habits together.**

Training gives employees practice using the protocol. Event reviews show where the protocol worked or failed. Audit findings show whether teams use it in the field. Corrective actions address weak points.

Refresher training targets the tasks or groups that need support. That connection turns communication from a policy into a work practice.

Rather than waiting for an event to happen, periodic sampling of communications in the day-to-day environment will confirm whether practices are slipping.

# The Integrated Model: Training Plus EHS

Most utilities already have the pieces.

They have training programs. They have procedures. They have incident reports. They have audits. They have corrective actions. They have compliance records. They have supervisors who understand the work and safety teams who understand the risk. They may track errors, but are they learning from the near misses?

## The issue often comes from separation. That separation shows up when:

- Training teams do not see incident trends until months later.
- Safety teams cannot easily connect an event to related training gaps.
- Procedure owners update documents without triggering learning updates.
- Corrective actions focus on one location even though the same condition may exist elsewhere.
- Leaders review safety data without seeing training readiness data beside it.

## An integrated prevention model connects those pieces in one loop:

- A hazard report, near miss, audit finding, or operating error enters the system.
- The organization reviews the event for contributing factors, not just the immediate action.
- Leaders assign corrective and preventive actions with clear ownership.
- Procedure owners update instructions or job aids when needed.
- Training teams assign relevant learning, coaching, or simulation.
- Supervisors verify that the change works in the field.
- Safety and operations leaders track whether the issue recurs.

**That loop helps utilities prevent repeat events.**

For utilities, this is where connected training and EHS capabilities become especially valuable. Training, learning management, reporting, investigations, corrective action tracking, procedure support, and analytics need to work together. A disconnected approach can support individual tasks, but it can also leave gaps between learning, risk, and action.

**The value comes from connection.**

When a near miss reveals a communication breakdown, the organization should be able to document the event, analyze the causes, update the procedure, assign refresher training, track completion, and monitor future reports for recurrence.

When an inspection identifies repeated procedure deviations, leaders should be able to see whether training, supervision, documentation, or work design contributes to the problem.

When a new hazard appears in the field, safety teams should be able to capture it, assign controls, alert affected roles, update training, and verify that the change reached the right people.

That is how training and EHS systems become a prevention system rather than separate administrative functions.

# Conclusion: Reducing Errors Takes a Connected Prevention System

Attention matters, but attention cannot overcome unclear procedures, weak communication, outdated training, or poor follow-through. Utilities reduce errors by fixing the conditions that make errors more likely.

That means building training around real tasks, keeping procedures current, reinforcing communication, capturing weak signals, investigating contributing factors, and tracking whether corrective actions change what happens in the field.

When training and EHS systems work together, utilities gain a clearer way to connect learning, risk, and action. That connection helps teams reduce repeat issues, support compliance readiness, and build safer, more reliable operations.

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