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DOE STANDARD

HUMAN PERFORMANCE IMPROVEMENT HANDBOOK

VOLUME 2: HUMAN PERFORMANCE TOOLS FOR INDIVIDUALS, WORK TEAMS, AND MANAGEMENT

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Foreword

This good practice handbook provides a set of practical methods and techniques for anticipating, preventing, and catching active human errors; and, more importantly, identifying and mitigating latent errors attributable to organizational factors.

As with Volume 1, the practices described are intended to be illustrative, not definitive. They are intended to illustrate how the concepts discussed in Volume 1 have been translated into application and practice in DOE, the commercial nuclear power industry, aviation and similar high hazard endeavors.

When used effectively these type tools can improve human performance in the workplace. By reducing errors, organizations are helping to eliminate events. The handbook is intended for managers and those who report to them, who are responsible for implementing performance improvement enhancements. The tools provided are applicable to workers who touch facility equipment, components, or systems and are capable of altering the status or configuration of them. These tools also apply to scientists, engineers, procedure writers, trainers, and other knowledge workers who create and modify the paper plant and who can make errors and mistakes that can enter into the system and later cause events. Thirdly, the handbook provides error-reduction methods supervisors and managers can use in their quest to identify organizational weaknesses or conditions that increase the likelihood or the consequences of error. Reducing error and managing controls —by eliminating latent system weaknesses—is the human performance paradigm for achieving zero significant events ($R_e + M_c \rightarrow ØE$). An additional intent of this handbook is to establish a common understanding of the standards and conditions for effective application of error detection and prevention methods, hereafter referred to as “tools.”

The primary references used in the development of individual and work team human performance tools described in this document come from “Good Practice” guides titled *Human Performance Tools for Workers*, April 2006; and *A Tool Kit of Proactive Industry Practices to Prevent Errors and Events***,** revised March 2005, from the commercial nuclear power industry’s Institute for Nuclear Power Operations (INPO). The tools described therein reflect years of user experience among INPO's membership, as well as experience INPO has gained from plant evaluations, assistance visits, operating experience, and benchmarking trips to member utilities in the commercial nuclear power industry to validate the usefulness of these tools. Additionally, experience by the Department of Energy (DOE) contractor organizations in the use of several of these tools over the years is further witness to their value. Numerous references were used in the development of the management tools, including DOE and INPO publications and books and articles on accident reduction associated with human error.

Readers are encouraged to refer to the DOE Good Practices that support the DOE Conduct of Operations requirements. These requirements are intended to clearly define and communicate how various types of work are performed so that the work may be done in a reliable, safe and repeatable manner. DOE has previously provided related guidance in a series of documents that include Guide to Good Practices for Lockouts and Tagouts, for Communications, for Operations

Organization and Administration, for Timely Orders to Operators, for Logkeeping, for Independent Verification, for Operations Aspects of Unique Processes, for Operations Turnover, for Control of Equipment and System Status, for Control of On-Shift Training, for Shift Routines and Operating Practice, for Control Area Activities, for Operator Aid Postings, for Equipment and Piping Labeling, for Notifications and Investigation of Abnormal Events. The tools discussed in this handbook may be used to enhance approaches discussed in the Guidance to Good Practices documents.

This handbook is a companion to *Human Performance Handbook, Volume 1: Concepts and Principles*. The tools introduced in Volume 1 to reduce human error and others used to eliminate organizational weaknesses, are described in this volume, along with good practices, supporting applications, and cautions. This handbook is not a requirements document. Organizations are encouraged to assess their human error reduction needs and refer to this handbook to determine what tools, if any, they should embrace in order to improve human performance. No organization is expected to use every tool listed, but rather to see the handbook as a "menu" of tools used in various industries and select those appropriate for use in their organization. The "commonly accepted practices" listed for each tool serve as a *suggested* behavior-based template for the development of site-specific tools. Organizations should avoid changing their error prevention tools if the current tools and behavior standards presently in place are effective.

Also organizations should be mindful that the tools presented in this document are intended as example practices that can enhance implementation of existing requirements, such as those supporting the DOE Integrated Safety Management System, Quality Assurance and Conduct of Operations.

This document was produced by the DOE Office of Health Safety and Security (HSS). Comments and input for future revisions to this document or the production of other tools is encouraged. Communications can be directed to HSS via e-mail at earl.carnes@hq.doe.gov.

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INTRODUCTION

The first two sections of this "Good Practice Handbook" describe several human performance tools that define a set of discrete behaviors to help individuals and work teams anticipate, prevent, or catch errors before they cause harm to people, the facility*[1], or the environment. Section 3 of the document is for use by managers and supervisors in identifying latent errors that lie dormant in the organization, weakening defenses and provoking error. For the human performance tools to provide value in improving safety, workers first must possess a solid foundation in the technical fundamentals of the equipment, systems, and operational processes they work with. Facility equipment, work processes, the organization and its culture, and its oversight processes all contain hidden flaws or latent conditions that could cause harm if work is undertaken without thinking. Safety is not obtained by mindlessly applying human performance tools but rather by people conscientiously applying their knowledge, skills, experience and insights, as well as the tools to accomplish their work goals.

The *Individual Human Performance Tools* described in Section 1 can be used routinely and consistently by single individuals for any work activity, regardless of the hazard or complexity of the task and without prompting or supervisory involvement. Users of this document should also refer to a 2006 document by the National Nuclear Security Administration entitled "Activity **Level Work Planning and Control Processes:** Attributes, Best Practices, and Guidance for Effective Incorporation of Integrated Safety Management and Quality Assurance". This document discusses effective approaches at the activity level – where the work is planned and performed. Incorporation of the attributes into work planning and control processes will help to ensure that ISM and QA requirements are met.

The *Work Team Human Performance Tools* described in Section 2 provide people with error-prevention methods that depend on the work situation, the needs of the task or job, the risks involved; and support from within the organization and the participation of two or more individuals.

The *Management Human Performance Tools* in Section 3, describe various methods and techniques supervisors and managers can use to assist in the identification of latent weaknesses in the organization and the management system.

Each tool is formatted under the following headings:

- ***Overview*** – practical information about the tool's purpose and potential limitations;

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*[1]The word "facility" used in this handbook is a generic term. It is recognized that D&D work is accomplished by projects, laboratory work is accomplished through experiments, and so on. The reader should apply the term "facility" to their recognized unit of work**.**

- ***Use the Tool*** – cues as to circumstances when the tool could be used
- ***Recommended Practices*** – the steps, routines, or procedures generally used in the industry to properly apply the tool; and
- ***At-Risk Practices*** – a set of behaviors, beliefs, assumptions, or conditions that tend to diminish the effectiveness of the tool.*[2]

The "When to Use HPI Tools" matrix on the following two pages illustrates which tool(s) individuals and work teams can use based on their work location and the nature of the work they are doing. For more details about when each tool should be applied refer to the 'Use the Tool' section within each individual tool description.

*[2] These "at risk practices" should not be confused with the formal concept of risk analysis. Rather, "at risk practices" means that the referenced actions could but workers in harms way. The word "risk" is used in two senses in this document. At the activity level, the term refers to the hazards associated with doing work at the activity level. The other sense refers to the analytical consideration of risk; i.e. formal risk analysis that leads to the development of safety controls. It should be understood that formal risk analysis is the responsibility of the organization. Activity level workers should focus on hazards awareness and hazards protection as established in work controls.

When to Use HPI Tools

Location	In the Field (1)			In the Office (2)		
HPI Tool	Prior to Start/ Re-Start	Perform Work	Complete Work	Prior to Start/ Re-Start	Problem Solving	Task Verification
Task Preview	X					
Job-Site Review	X					
Questioning Attitude	X	X	X	X	X	X
Stop When Unsure	X	X	X	X	X	X
Self-Checking	X	X	X	X	X	X
Procedure Use & Adherence	X	X	X	X	X	X
Validate Assumptions				X	X	X
Signature						X
Three-Way Communication		X	X			
Phonetic Alphabet		X	X			
Place-Keeping		X	X			X
Do-Not-Disturb Sign					X	X
Pre-Job Briefing	X			X Technical		
Peer-Checking		X				
Concurrent Verification		X				
Independent Verification		X				
Peer Review						X

Location	In the Field (1)			In the Office (2)		
HPI Tool	Prior to Start/ Re-Start	Perform Work	Complete Work	Prior to Start/ Re-Start	Problem Solving	Task Verification
Flagging		X				
Turnover		X			X	
Post-Job Review			X			X Technical
Project Planning	X			X		
Problem Solving (PACTS)					X	
Decision Making					X	
Project Review Meeting						X
Vendor Oversight	X	X	X	X	X	X
	(1) Ops, Maintenance, Field Support			(2) Engineering, Science, Tech Support		

HUMAN PERFORMANCE TOOLS FOR INDIVIDUALS

The basic purpose of these tools is to help the individual performer maintain ***positive control*** of a work situation**.** Positive control means that what is intended to happen is what happens, and that is all that happens. Before taking an action, a conscientious individual understands the significance of the action and its intended result. Such thinking takes time. All human performance tools deliberately slow things down to ultimately speed things up by avoiding delays that accompany events triggered by active errors. When used conscientiously, these tools give the individual more time to think about the task at hand—about what is happening, what will happen, and what to do if things do not go as expected. The performer's primary goal is to retain positive control at critical steps when error-free performance is essential for safety. Using these human performance tools does not guarantee perfect performance, but individuals can greatly reduce their chances of erring by using the tools thoughtfully and rigorously.

The tools in this category include:

- Task preview
- Job-site review
- Questioning attitude,
- Questioning attitude – in the office or lab
- Stop when unsure
- Self-checking
- Procedure use and adherence
- Validate assumptions
- Signature
- Effective communication
- Place-keeping
- Do not disturb sign

Many of the tools in this "Individual" section might be categorized as "situational awareness" tools. Two of the Individual tools, Procedure Use and Adherence and Validate Assumptions have particular value when performing Rule base work. Situational awareness is defined as the accuracy of a person's current knowledge and understanding of actual conditions compared to expected conditions at a given time. The tools listed in the left-.hand column above help the individual form an accurate understanding of the work and equipment situation, and foster an attitude sensitive to the presence of hazards and the possible consequences of a mistake. Situational awareness refers to the accuracy of a person's current knowledge and understanding of the task at hand and related working conditions compared to actual conditions at a given time. A performer needs an accurate knowledge and understanding of relevant information from the work environment to guide his or her decisions and actions. Situation awareness means the individual clearly understands the job requirements, the equipment condition, and work environment before acting. The situation awareness tools, described below, improve an individual's insightfulness and ability to detect unsafe conditions he or she may not see otherwise. They are particularly helpful in the performance of skill mode work.

TASK PREVIEW

Overview

Before starting work, individuals should conduct a task preview. The review can include reviewing procedures and other related documents to familiarize themselves with the scope of work, task sequences and critical steps; a conversation with those who performed the job in the past; and a walkdown of the job site.

The task preview helps the individuals performing a task consider how their actions affect safety and production. The preview also provides a structured, risk-based review of the work activities from a human performance perspective and enhances the individual's situational awareness while in the field. During the task preview the individual:

- Identifies the critical steps (see definition).
- Considers the possible errors associated with each critical step, and the likely consequences.
- Ponders the "worst that could happen."
- Considers the appropriate human performance tool(s) to use.
- Discusses other controls, contingencies, and relevant operating experience.

Note: Operating experience should include lessons learned from in-house events, equipment work history, and personal experience, as well as relevant industry experience.

Use This Tool

- Before attending a pre-job briefing
- Before starting a job
- Just before performing a critical step
- After interruptions or extended delays in an activity

Recommended Practices When Using this Tool

(S-A-F-E-R):

- **Summarize** the critical steps.
- **Anticipate** errors for each critical step and relevant error precursors.
- **Foresee** probable and worst-case consequences should an error occur during each critical step.
- **Evaluate** controls or contingencies at each critical step to prevent, catch, and recover from errors and to reduce their consequences.

- **Review** previous experience and lessons learned relevant to the specific task and critical steps.

The SAFER process outlined above helps the individual to methodically recognize and address the risk of human error to safety and reliability.

Avoid These At-Risk Practices:

- Not taking the time to review procedures/work documents
- Individuals not prepared for the task
- Omitting a discussion of specific controls for each critical step
- Individuals failing to express concerns they may have
- Not using lessons learned from previous activities for the task

JOB-SITE REVIEW

Overview

The purpose of a job-site review is to improve a person's situational awareness when first arriving at the job site. People should take the time to develop an accurate understanding of critical indicators, system/equipment condition, work environment, hazards, and even team members. Taking the time necessary to get acquainted with the immediate work area helps individuals to establish a healthy sense of uneasiness. It also boosts their questioning attitude and enhances the accuracy of their situation awareness.

Use This Tool

- Upon arriving at the physical work location
- Before interaction with risk-important equipment
- During a walk-down of a work package
- When a potential safety hazard is present
- After extended breaks or interruptions

Recommended Practices When Using This Tool

1. **Explore** the job site for a few minutes by walking around and looking at the work area and adjacent surroundings to identify the following.
   - Industrial safety, radiological, and environmental hazards
   - Trip-sensitive equipment to avoid jarring or disturbing
   - Right system, right equipment, right component
   - Critical parameters or indicators important for task success
   - Error precursors (at critical steps)
   - Conditions consistent with the procedure and pre-job briefing.
2. **Talk** with coworkers or the supervisor about unexpected hazards or conditions and the precautions to take.
3. **Eliminate** hazards, install appropriate defenses, or develop contingencies before proceeding with the task.

Avoid the Following At-Risk Practices

- Hurrying, not taking the time to look around the job site
- Thinking that repetitive work is “routine” or “simple”, meaning “no risk”
- Not talking about hazards or precautions with co-workers
- Not talking about “gut feelings”
- Failing to eliminate hazards or installing appropriate defenses

QUESTIONING ATTITUDE — AT THE ACTIVITY LEVEL

Overview

A questioning attitude fosters thought about safety before action is taken and helps individuals maintain an accurate understanding of work conditions at any given time. This tool alerts people to potential hazards, warning signs, critical activities (steps), error-likely situations, and other uncertainties in the work environment or the work plan. It also encourages the user to stop and resolve those hazards, warnings, error-likely situations, or uncertainties before proceeding with the job. It promotes follow-up when doubt arises with the discovery of facts, not assumptions, to reveal more knowledge about the situation and eliminate the doubt. People, in general, are reluctant to fear the worst, and a healthy questioning attitude will overcome the temptation to rationalize away "gut feelings" that something is not right.

A questioning attitude promotes a preference for facts over assumptions and opinion. Questions such as "What if . . .?" or "Why is this acceptable?" help improve recognition of improper assumptions and possible mistakes. The structured approach described below promotes the discovery of facts. Facts depend on the reliability of the information source and the accuracy of that information. Without sufficient facts, the performer should stop the activity to address an unpredictable work situation that could lead to a serious mistake or significant event.

Use This Tool

- During self-checking ("Think" step of STAR)
- Before performing an important step or phase of an activity
- When making a decision about an important activity
- When experiencing uncertainty, confusion, or doubt
- When experiencing a "gut feeling" that something is not right
- When encountering unanticipated changes in conditions
- When conflicts or inconsistencies exist between plans, procedures, and actual conditions
- After encountering unexpected results
- After discovering missing information or resources
- Upon hearing the danger words: "I assume," "probably," "I think, "maybe," "should be," "not sure," "might," "we've always..." and so forth

Recommended Practices When Using This Tool

1. **Stop, Look, and Listen** – Proactively search for work situations that flag uncertainty (see When to Use the Tool).
    - Periodically pause-timeout-to check the work situation.

- Pause when a flag is recognized.
- Identify inconsistencies, confusion, uncertainties, and doubts.
- State or verbalize the uneasiness or question in clear terms.

2. **Ask questions** – Gather relevant information.
   - What are the "knowns" and "unknowns"?
   - Use independent, accurate, and reliable information sources, especially other knowledgeable persons.
   - Compare the current situation (knowns) with independent sources of information.
   - Consider "what if...?" and/or use a "devil's advocate" approach in a spirit of helpfulness.
   - Identify persistent inconsistencies, confusion, uncertainties and doubts.
3. **Proceed if sure** – Continue the activity if the uncertainty has been resolved with facts. Otherwise, **do not proceed in the face of uncertainty!**
4. **Stop when unsure** – If inconsistencies, confusion, uncertainties, or doubts still exist, do the following.
   - Stop the activity
   - Place equipment and the job site in a safe condition
   - Notify *your* immediate supervisor

Avoid These At-Risk Practices

- Not pausing periodically (timeout) to refresh *your* understanding of the work situation
- Proceeding with a task when questions exist
- Being unaware of critical parameters or margins
- Believing nothing can go wrong
- Believing that repetitive means "routine" or "simple" and carries "no risk"
- Trying to make reality conform to *your* expectations (mental model) rather than seeing what is really around you
- Rationalizing doubts, uncertainties, contradictory information, subtle differences, or anomalies
- Not asking questions when subtle cues suggest disorientation is occurring
- Accepting the first thing that comes to mind, initial impression or assessments, as factual
- Ignoring subtle differences or apparently minor inconsistencies
- Not understanding the basis of the procedure step

- Allowing emotions rather than reason to guide decisions
- Accepting supporting evidence without questioning its validity

QUESTIONING ATTITUDE – WORK PLANNING AND PREPARATION

Overview

Proper planning of and preparation for work play a major role in prevention of error and avoidance of consequences. The NNSA document **Activity Level Work Planning and Control Processes:** Attributes, Best Practices, and Guidance for Effective Incorporation of Integrated Safety Management and Quality Assurance" provides effective practices to enhance both work planning and preparation. A questioning attitude fosters awareness of uncertainty, assumptions, risk factors, and the significance of a decision or action before proceeding. It helps a person make sure that planning, judgment, and decision-making are appropriate for the product in development. Questions, such as "If… then?" "What if …?" and "Why is this okay?" help improve recognition of actual or possible mistakes. A healthy questioning attitude will overcome the temptation to rationalize away a gut feeling that something is not right. To avoid dependence on unsubstantiated assumptions or subjective opinions, a structured approach promotes the discovery of facts.

A good pre-job briefing enhances a person's questioning attitude. From information discussed during the briefing, individuals will *know* the potential hazards, critical activities (steps), risk-important parameters, and error-likely situations and their potential consequences before starting the work activity. The pre-job briefing sensitizes personnel to what should and should not be.

"Cookbooking" of procedures (mindless compliance) and over-reliance on rules of thumb tend to promote an unthinking response to perceived simple problems and will eventually lead to rule-based errors. A questioning attitude will help prevent such at-risk practices.

The questioning attitude practices are intended to enhance guidance contained in the NNSA document and other DOE Conduct of Operations guidance.

Use This Tool

- When uncertain – a gut feeling that something is not right
- When using previously approved evaluations, solutions, designs, or other approved guidance to address a current issue
- When unexpected results are obtained or unfamiliar situations are encountered
- When making a decision about an activity for which a mistake could have adverse consequences
- During the initial phase of the performance of a critical activity, regardless of how often it occurs
- When encountering unexpected information or instructions that conflict with other guidance or procedures
- During experiments or trials
- During engineering evaluations

- During product review meetings
- When preparing and reviewing calculations
- When revising drawings, design criteria, or system descriptions
- When reviewing procurement documents
- When uncertain that the product is in compliance with expectations, procedures, codes, or regulations
- When the definition of success is uncertain
- When approving an engineering product
- During root cause analysis, apparent cause evaluations, and troubleshooting

Recommended Practices When Using This Tool (F-A-C-T-S)

1. **Foresee** technical activities or tasks that involve one or more critical attributes.
    - Ask open-ended questions.
    - Inputs
    - Method(s)
    - Outputs
    - Priorities
    - Awareness of situations that "don't seem right"

Confirm knowns and unknowns (for critical activities).

- Identify and verify critical facts (their source and validity) with current conditions.
- Identify inconsistencies and unverified assumptions.
- Summarize critical parameters.
- Recognize work-related error precursors (risk factors).

Test the current situation.

- Anticipate possible consequences with the current situation.
- Be receptive to the questions of others; use a devil's advocate approach.
- Ask another qualified individual to check and verify the information (peer review).
- Compare the current situation with relevant facility documentation or engineering standards and codes.
- Consider testing, alternate analysis, and calculation.
- Stop when unsure.
- Do not proceed in the face of uncertainty.
- Inform the responsible supervisor.

Avoid These At-Risk Practices

- Dismissing contrary points of view
- Making assumptions
- Using unsuitable rules of thumb
- Believing the source of information is absolutely reliable
- Following a procedure without critical thinking (cookbooking)
- Rationalizing an anomaly away
- Thinking the task is routine or simple
- Believing nothing bad can happen
- Ignoring subtle differences or weak signals
- Not asking for help
- Being unaware of critical attributes of the project or task
- Not questioning adverse impacts that could occur at later stages of the project, beyond the individual's scope or responsibility

PAUSE WHEN UNSURE

Overview

When confronted with confusion or uncertainty, a person is in unfamiliar territory without a defined path forward (knowledge-based performance mode). Given that the chances for error are particularly high in such situations (a 10 percent to 50 percent probability), the best course of action, when unsure, is to **stop**. Whenever a question arises and what to do remains uncertain—stop and ask! Every person has the responsibility and authority to stop work when uncertainty persists (a graded approach of "pause" or "time-out" is also used by some organizations).

DOE facilities have formalized Stop Work processes. These are intended for use by activity level workers when they believe conditions may be unsafe. They are also intended to be used by the organization in circumstances where work may need to be postponed for re-analysis and subsequent safety improvements prior to resuming work.

The Pause When Unsure tool is intended to supplement the existing formalized practices and emphasis that workers approach work deliberatively and mindfully. And if they encounter unexpected conditions or need additional clarification or support, then pausing is a recommended and conservative approach.

Even if it seems simple and straightforward, notify your supervisor, and get help from other people. The "Pause When Unsure" technique prompts performers to gain more accurate information about the work situation from other knowledgeable persons before proceeding with the activity. It involves a stoppage of work long enough to allow individuals, their supervisors, or other knowledgeable persons with expertise to discuss and resolve the issue before resuming the task.

Use This Tool

- When uncertainty, doubt, confusion, or questions persist
- If outside of conditions assumed by a technical procedure
- When encountering conditions inconsistent with the procedure
- When outside the bounds of key parameters
- If beyond the scope of the plan or process
- When unexpected results or unfamiliar situations are encountered
- When something expected does not happen
- When uncertain regarding compliance with expectations or procedures
- When inexperienced or lacking knowledge with a task
- When someone else expresses doubt or concern

Recommended Practices When Using This Tool

1. **Pause** (pause or time-out) the activity.
2. **Place** the equipment and the job site in a safe condition.
3. **Notify** your immediate supervisor.
4. **Get help** from more knowledgeable persons

Avoid These At-Risk Practices

- Dismissing contrary evidence or points of view
- Discounting the concerns of less experienced individuals
- Not asking for help from more knowledgeable persons
- Not asking for help for fear of embarrassment
- Emphasizing “who's” right instead of “what's” right
- Not having clear abort criteria
- Being unaware of critical attributes or critical parameters

SELF-CHECKING

Overview

Self-checking helps a performing individual focus attention on the appropriate component or activity; think about the intended action; understand the expected outcome *before* acting; and verify the results after the action. When used rigorously, self-checking boosts attention and thinking just before a physical action is performed. The performer pauses to take a moment to reflect on the intended action, the component, and its expected outcome; think about whether the proposed action is the right action for the situation; and resolve any questions or concerns before proceeding. When prepared, the performer takes the action, followed by a review of the results of the action to decide if the right result was obtained.

Self-checking is particularly effective for skill-based, repetitive tasks, which people usually perform without a lot of conscious thought. But, attention must peak when the risk is greatest—when altering a component's status. This technique also helps prevent errors when noting, recording, or entering data; performing calculations; and the like.

Use This Tool

- When manipulating or altering equipment or controls
- During physical activities or interfaces with plant equipment (tests, walk-downs, inspections, etc.)
- When entering facility data into a computer or recording it on a form
- When performing a calculation
- When performing an experiment
- When reading a computer readout or other indicator related to any critical attribute
- When revising drawings or procedures using cut-and-paste on a computer or by making handwritten annotations
- Before and during an impending change in equipment status
- When performing critical tasks identified during pre-job briefings
- When assembling components that contain similar parts that potentially could be interchanged

Recommended Practices When Using This Tool

STAR is an acronym people use to help them remember to slow down and concentrate on an important action or task. STAR stands for Stop, Think, Act, Review.

1. **Stop** – Pause.
   - Pause before performing critical activities.

- Eliminate distractions and focus on the activity.

2. **Think** – Understand what is to be done before performing actions.
   - Understand what will happen when correct action is taken on the correct component.
   - Verify that conditions match those discussed during the pre-job briefing.
   - Verify that the action is appropriate, given the equipment status.
   - Identify expected outputs/results of the action.
   - Compare conditions to the controlling document.
   - Consider a contingency if an unexpected result occurs.
   - If uncertain, use the questioning-attitude (FACTS) tool.

3. **Act** – Perform the correct action on the correct component.
   - Follow relevant guidance (procedure, policy, and other guidance).
   - Without losing eye contact with the component, read and touch the component label.
   - Compare the component label with the guiding document.
   - Perform planned actions for the specific activity.
4. **Review** – Verify anticipated result is obtained.
   - Verify that outputs or results match the expected outputs/results.
   - Perform the contingency, if the expected result does not occur.
   - Notify supervisor, as needed.

Avoid These At-Risk Practices

- Not understanding the intent of a procedure step before performing it
- Self-checking without referencing the guiding document (as appropriate)
- Performing several manual actions in rapid succession
- Performing the action when uncertainties or discrepancies exist
- Performing the action when distracted (talking with another person)
- Looking at something other than the component being manipulated
- Not self-checking again after losing visual or physical contact
- Not identifying critical steps and activities in advance
- Not taking the time to verify that results are correct
- Being tired, sleepy, or fatigued

PROCEDURE USE AND ADHERENCE

Overview

Procedure adherence means understanding the procedure's intent and purpose, and following its direction. The user performs all actions as written in the sequence specified by the document. However, if it cannot be used safely and correctly as written, then the activity is stopped, and the procedure is revised before continuing. Consistent and rigorous use of this HPI tool at DOE facilities will improve productivity and safety and reduce unwanted events and occurrence reports.

Procedure quality is paramount to safety and reliability. Following the procedure without question does not guarantee safety because procedures sometimes contain hidden flaws. The completeness, accuracy, and internal consistency of the instructions and their usability (ease of understanding and compliance) all impact the user. Procedures are usually complete and accurate; however, the performer cannot follow them blindly. Experience has shown that procedures do not always contain sufficient information. With this in mind, users should follow procedures mindful of the impact their actions could have on facility equipment before taking the actions.

Use This Tool

- When manipulating, altering, monitoring, or analyzing equipment
- When a procedure exists for a work activity
- When no procedure exists, but there should be (STOP and get help)
- When required by technical specifications or other technical documents

Recommended Practices When Using This Tool

1. **Compare** the working copy to the controlled copy to verify it is the most recent revision.
2. **Review** all prerequisites, limits and precautions, initial conditions, and instructions before starting work; confirm understanding of the procedure's overall purpose and verify it is appropriate for the system or equipment condition.
3. **Use** the procedure according to its designated level of use (continuous, reference, or information) or as directed by management.
4. **Follow** the procedure as written, aware of the potential impact the action can have on equipment.
5. **STOP** the task, place the equipment or system in a safe condition, and contact a supervisor if any of the following situations exist.
   - The step cannot be performed as written.
   - Injury or damage to equipment will occur if used as is.

- Use of the procedure will result in incorrect or unsafe equipment configuration.
- The procedure is technically incorrect.
- Unexpected results are achieved after performing the step.
- The procedure conflicts with another procedure.
- The procedure is otherwise unsafe.

5. **Report** procedure problems when they are found and ensure that important deficiencies are corrected before re-using the procedure.

Avoid These At-Risk Practices

- Not performing a page-check to verify all the pages are included in the procedure before use
- Not reviewing a procedure before performing a job
- Commencing a procedure without establishing initial conditions
- Performing a procedure step without understanding its purpose
- Performing a procedure without knowing the critical steps
- Skipping steps or segments of a “routine” procedure, because those steps have been “unnecessary” in the past
- Using a superseded revision of a procedure
- Following a procedure knowing it will cause harm if followed as written
- Not submitting feedback on technical accuracy and usability

VALIDATE ASSUMPTIONS

Overview

Assumptions are a necessary part of scientific and engineering work so that a problem can be bounded while more information or knowledge is being developed or acquired. For these situations, scientists and engineers devote additional effort to justify why the assumption is conservative and provide detailed evidence that supports it. Knowledge workers must resist inadvertently treating an assumption as fact or forgetting that they made the assumption.

Assumptions can occur during knowledge-based work situations because they ease mental effort by reducing the detail involved. The lack of requisite knowledge also tends to promote erroneous assumptions that may lead to errors and defects. In these cases, an assumption is a special mental shortcut, which becomes particularly tempting during stressful, anxious situations when time may be scarce. Until the additional information is available, engineers and scientists are tempted to make assumptions to improve efficiency or to simply make progress with the task. Qualifying statements, such as “I think ...,” “We've always done it this way,” “I’m pretty sure that …,” “We didn’t have a problem last time,” or “I believe ...,” are hints that an assumption has been made. When assumptions can not be verified, subject matter experts should be called in to bring additional technical expertise to help substantiate inputs, resolve assumptions, and solve the problem.

Use This Tool

- During the conceptual phase of the design or experiment
- In product review meetings
- Before delivery of the product to the customer
- During verification of output document
- During calculations
- During procurement
- Before using preliminary or invalidated vendor data
- When answering technical questions in support of operations

Recommended Practices When Using This Tool

1. **Documentation** – Write down the assumption, citing the following:
    - applicability to the engineering issue;
    - critical attributes affected by the assumption;
    - reasoning and logic;
    - extent of condition and worst-case outcomes; and
    - level of certainty, consistency, and conservatism.

2. **Evidence** – Is there *objective* evidence to support/justify the assumption?
   - Past success(es)
   - Operating experience
   - Expert opinion
   - Reference documents (such as prints, drawings, procedures)
   - Alternative techniques or computer simulations
   - Technical rational for accuracy of assumption
3. **Field Walk-down** – Were in-field factors considered? Perform a hands-on/eyes-on review of the physical environment.
4. **Track and Close Out** – Close out all unverified assumptions as valid or otherwise before delivering the product to the facility customer.

Avoid These At-Risk Practices

- Not documenting an assumption
- Not verifying assumptions because of the perceived competence of the preparer/source
- Relying on assumptions as factual
- Not formally tracking closure of unverified assumptions
- Not recognizing that an assumption has been made
- Not recognizing conflicting input data in two or more design documents
- Not verifying assumptions before delivering an engineering product to a customer
- Not documenting the basis of engineering judgment
- Not reconciling contradictory or disconfirming sources of information
- Relying too heavily on past successes to justify current assumptions

SIGNATURE

Overview

Documentation of engineering, scientific, and other technical products provides a record of the technical rigor applied to the product at its present stage of development. In engineering, for example, it is the documentation of the design of structures, systems, and components in the plant or facility. These products typically make up the quality assurance record of the facility design bases. Before engineering products are released to the next step in an engineering work process, the individual concludes the work by signing or affixing a seal to the document to signify that he or she performed the task completely and accurately in accordance with all standards, procedures, and code requirements.

The purpose of this tool is to remind the user of what a signature or seal means on a technical document. It helps others recognize the significance of the product development process. The signature implies the level of scrutiny an individual has applied to the functionality, accuracy, and safety of the product. A personal signature (or initials) reflects one's commitment to professionalism and can serve as a reminder to the preparer to verify the accuracy of the work product.

Use This Tool

- When preparing, checking, reviewing, verifying, and approving products and services important to safety and reliability
- Before releasing the product to the next step in the related work process
- During engineering evaluations in support of emergent issues
- When approving purchase orders for new equipment
- When procuring safety-related components

Recommended Practices When Using This Tool

The individual affirmatively acknowledges all of the following statements before releasing the product to the next step in the engineering process.

1. **Knowledge** – The individual possesses the knowledge, expertise, qualifications, understanding, and authority to perform the task that has been completed or for the area the signature encompasses. He or she knows the role or function being signed for, such as author, peer reviewer, reviewer, or supervisor.
2. **Involvement** – The individual prepared, reviewed, or supervised (as indicated) the product he or she is signing.
3. **Independent** – The individual possesses the required level of "freedom of thought" from those earlier in the work process.

4. **Quality** – The product satisfies the following criteria.
   - to accepted standards and codes (where applicable)
   - Possesses appropriate factors of safety and design margin.
   - Satisfies all design basis requirements for the intended application; product resolves the problem.
   - conforms is complete and correct in all respects
5. **Right and Proper** – The individual believes the product is the right thing to do.
6. **No Doubt** – The individual has no doubts or uncertainties with the product, as is, at this stage in its development. He or she is willing to take ownership and accountability of its technical accuracy and completeness. Otherwise, the individual stops and asks for help,

Avoid These At-Risk Practices

- Signing a document for work the individual did not perform, oversee, or manage
- Signing a document for an area outside the area of expertise or qualifications
- Deferring to what management wants without critical thinking
- Defining an excessive number of approvers
- Failing to define the meaning and scope of the signature
- Relaxing design standards for expediency
- Relying on one's memory of codes or requirements without looking them up
- Accepting everything as fact
- Not verifying assumptions or justifying the basis for engineering judgment
- Being in a hurry

EFFECTIVE COMMUNICATION

The goal of effective communication is mutual understanding between two or more people, especially communication involving technical information related to facility operation or personnel safety. Effective communication is likely the most important defense in the prevention of errors and events. Oral communication possesses a greater risk of misunderstanding compared to written forms of communication. Misunderstandings are most likely to occur when the individuals involved have different understandings, or mental models, of the current work situation or use terms that are potentially confusing. Therefore, confirmation of verbal exchanges of operational information between individuals must occur to promote understanding and reliability of the communication.

Three-Way Communication

Overview

Three-way or the "repeat back" method is used to communicate changes to physical facility equipment during work activities via face-to-face, telephone, or radio requires three verbal exchanges between a sender and a receiver to promote a reliable transfer of information and understanding. The person originating the communication is the sender and is responsible for verifying that the receiver understands the message as intended. The receiver makes sure he or she understands what the sender is saying.

- First, the sender gets the attention of the receiver and clearly states the message.
- Second, the receiver repeats back the message in a paraphrased form, which helps the sender know if the receiver understands the message. During this exchange, the receiver restates equipment-related information exactly as spoken by the sender. If the receiver does not understand the message, he or she should ask for clarification, confirmation, or repetition of the message.
- Third, the sender informs the receiver whether the message is properly understood, or corrects the receiver and restates the message.

Consider using three-way communication in verbal conversations involving the following.

- Operation or alteration of facility equipment
- Condition of facility equipment or the value of an important parameter
- Performance of steps or actions using an approved procedure
- Task assignments that impact equipment or activities, the safety of personnel, the environment, or the facility

Recommended Practices When Using This Tool

1. Sender states the message.

- When practical, the sender and receiver should be face to face.
- The sender ensures that he/she has the receiver's attention—normally calling the receiver by name or position.
- Sender states the message clearly and concisely.

2. Receiver acknowledges the sender.
   - The receiver paraphrases back the message in his or her own words.
   - Equipment designators and nomenclature are repeated word for word.
   - The receiver may ask questions to verify his or her understanding of the message.
3. Sender acknowledges the receiver's reply.
   - If the receiver understands the message, then the sender responds with "That is correct."
   - If the receiver does not understand the message, the sender responds with "That is wrong" (or words to that effect) and restates the original message.
4. If corrected —
   - Receiver acknowledges the corrected message, again paraphrasing the message in his or her own words.

Avoid These At-Risk Practices

- Sender or receiver not stating his or her name and/or work location when using a telephone or radio.
- Sender attempting to communicate with someone already engaged in another conversation.
- Sender stating too much information or multiple actions in one message.
- Sender not giving enough information for the receiver to understand the message.
- Sender not verifying receiver understood the message.
- Receiver fails to ask for needed clarification of the message, if required.
- Receiver taking action before the communication is complete.
- Receiver not writing the message on paper if there are several items (more than two) to remember.
- Receiver mentally preoccupied with another task.
- Message not being stated loudly enough to be heard.
- Enunciating words poorly.

Phonetic Alphabet

Overview

Several letters in the English language sound alike and can be confused in stressful or noisy situations. For example, some letters sound alike when spoken and can easily be confused such as “D” and “B.” The phonetic alphabet specifies a common word for each letter of the English alphabet. By using a word for each letter there is less chance that the person listening will confuse the letters. Using the phonetic alphabet, “Delta” and “Bravo” are more easily differentiated. The effects of noise, weak telephone or radio signals, and an individual's accent are reduced through the use of the phonetic alphabet.

People use the phonetic alphabet and unit designators when describing unique identifiers for specific components. When the only distinguishing difference between two component labels is a single letter, then the **phonetic alphabet** form of the letter should be substituted for the distinguishing character. For example, 2UL-18L and 2UL-18F would be stated “two Uniform Lima dash Lima eighteen LIMA” and “two Uniform Lima dash eighteen FOXTROT.”

This Tool is Used

- When communicating alphanumeric information related to facility equipment noun names
- When the sender or receiver might misunderstand, such as sound-alike systems, high noise areas, poor reception during radio or telephone communications

Recommended Practices When Using This Tool (standard terms)

Letter	Word	Letter	Word	Letter	Word	Letter	Word
A	Alpha	H	Hotel	0	Oscar	V	Victor
B	Bravo	I	India	P	Papa	W	Whiskey
C	Charlie	J	Juliet	Q	Quebec	X	X-ray
D	Delta	K	Kilo	R	Romeo	Y	Yankee
E	Echo	L	Lima	S	Sierra	Z	Zulu
F	Foxtrot	M	Mike	T	Tango		
G	Golf	N	November	U	Uniform		

Avoid the Following At-Risk Practices

- Using phonetic words other than those designated
- Using slang terms instead of specific or standard terms

PLACE-KEEPING

Overview

Place-keeping involves physically marking steps in a procedure that have been completed. Effective place-keeping prevents omitting or duplicating steps. Managing a procedure, especially a detailed technical procedure with frequent branching and multiple decision points, can place the facility, equipment, or process in jeopardy if the user inadvertently omits a step or performs a series of steps in an incorrect sequence. When using a procedure, an individual's attention constantly shifts from the procedure to the controls, to indicators, to physical equipment, to other people, and so on. Place-keeping has proven to be an important error-prevention technique.

Place-keeping is particularly important for facility status and configuration control, as well as during the reassembly of equipment after maintenance or for any situation when the consequences of skipping, repeating, or partially completing a step could result in adverse consequences. The place-keeping method should help the individual maintain a positive record of steps completed and those not yet performed. If the user is interrupted or delayed, this technique will help him or her return to the last step performed.

Use This Tool

- When performing a continuous-use procedure
- When performing a reference-use procedure on risk-important equipment

Recommended Practices When Using This Tool

Examples of good practice techniques include one or more the following.

1. Blacking-out procedure steps that are "not applicable" or highlighting procedure steps that are "applicable."
2. Marking critical steps in an eye-catching manner before starting work.
3. Signing or initialing a sign-off blank for each step *or* each action.
4. Checking a check box for each step or each action in a step.
5. Circling the step number, denoting it "in progress," and slashing through the circle to indicate completion of the step.
6. Checking or slashing a step number when completed.
7. Initialing step numbers completed to denote the last step completed when blanks are not provided.
8. Annotating completion of a page in the margin of the procedure.

Avoid These At-Risk Practices

- Writing one set of initials followed with a vertical line through remaining signoff blanks for following steps.
- Skipping steps or segments of a familiar procedure because those steps have been unnecessary in the past.
- Following a procedure casually because of past success with the task.
- Signing or checking off a step as completed before it is completed.
- Signing or checking off several steps completed at the same time.
- Using ditto marks (“).
- Not applying some form of place keeping for continuous-use procedures.
- Not verifying completion of the last step checked off, if job was interrupted.

Do Not Disturb Sign

Overview

When scientists, engineers, procedure writers, and work planners, and so on perform risk-important or safety-critical work, it is essential that they maintain their concentration and attention on the task at hand, especially if that task involves a review or a verification of the work product. Managers of such personnel assigned these tasks must control access to these people to prevent them from being distracted from their primary tasks. The "Do Not Disturb" sign provides a means to control this access. The intent of the sign is to limit access and interruption of the responsible individual performing the work or review. The need to sequester or isolate the individual depends on the significance and complexity of the product. Otherwise, the activity can occur at the normal work location. It is important that all workers understand and respect the purpose of the sign.

Use This Tool

- During risk-important work or a review or verification of an technical product.
- When a short turnaround time is requested/demanded for a complex or critical review.
- For any task, especially a repetitive task, for which interruptions could lead to more errors.
- Whenever the preparer requests it to maintain focus on the task.

Recommended Practices when Using This Tool

1. **Develop a Sign** that includes the following information**.**
   - A review of a critical task is in progress.
   - An individual is not to be interrupted.
   - Name and telephone number of the individual's supervisor or alternate point of contact.
2. **Post the Sign** – Place an eye-catching sign at a conspicuous place at the entrance of the individual's work space.

Avoid These At-Risk Practices

- Not using the "Do Not Disturb" sign for risk-important activities
- Posting the sign in an inconspicuous location (not noticeable)
- Ignoring the sign (by others)
- Not indicating the person's supervisor/alternate and contact information on the sign
- Not obtaining supervisor concurrence before using the sign

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HUMAN PERFORMANCE TOOLS FOR WORK-TEAMS

The use of work team human performance tools depends on the task's hazards complexity, and frequency of performance; the duration of an activity (requiring multiple shifts or work groups); and management's need for feedback on work completed. The tools in this category require the coordination and/or participation of two or more individuals, supervisory involvement, and management support. Tools in this category include the following.

- Pre-job briefing
- Technical task pre-job briefing
- Verification practices (Peer check, peer review, concurrent verification, independent verification)
- Flagging
- Turnover
- Post-job review
- Technical task post-job review
- Project planning
- Problem solving
- Decision making
- Project review meeting
- Vendor oversight

PRE-JOB BRIEFING

Overview

A pre-job briefing is a meeting of individual performers and supervisors conducted before performing a job to discuss the tasks, critical steps, hazards, and related safety precautions. This meeting helps individuals to better understand the task(s) to be accomplished and the associated hazards. Participants clarify the task's objectives, roles and responsibilities, and resources. Knowing clearly what you are trying to do improves error recognition. Similarly, precautions, limitations, hazards, critical steps, controls, contingencies, and relevant operating experience are discussed.

The effectiveness of a pre-job briefing depends largely on the preparation of the participants and supervisors. Individuals should come to the pre-job briefing having completed the task preview (individual tool #1). This promotes a quality dialogue that helps participants understand what they are to go do and what to avoid. A good pre-job briefing raises everyone's awareness of critical activities and gives participants time to mentally rehearse performance of critical steps. Pre-job briefings help participants avoid surprises in the field and reinforce the idea that there are no “routine” activities.

The level of detail for a pre-job briefing depends on the job's hazards and complexity and on the proficiency of the individuals assigned. Simple briefings can be conducted for uncomplicated, or repetitive, low-hazard tasks. More detailed briefings are appropriate for complex, or infrequently performed and high-hazard tasks.

Low-Hazard* and *Simple or Repetitive activities usually involve the assigned individual(s) mentally walking through a *task preview* before starting the job. There are no critical steps. Regardless of the hazards, complexity, or frequency of a job, the participant(s) always reviews the personal safety hazards and personal protective equipment (PPE) requirements. Holding a face-to-face meeting with the performer(s) depends on the supervisor's judgment and knowledge of their experience and proficiency with the job.

Low-Hazard* and *Complex or Infrequent work activities need only a standard but thorough brief specific to the job. There may be critical steps; however, the potential harm is limited. But, because of its complexity, the job could hide developing hazards or unsafe conditions from the participants. A complex task can involve any of the following situations.

- Multiple interactions with equipment controls
- Simultaneous activities or use of multiple procedures
- Multiple interpersonal interactions needing significant coordination

- Major changes in equipment or system condition
- Unusual system or equipment configurations
- Limitations of tools and resources, or difficult physical constraints

The supervisor or the lead on the work team can use a standard pre-job briefing checklist to guide the dialogue for these types of activities. For first-time activities, the work lead should consider tailoring the briefing as described below for high-risk and simple/repetitive work.

High-Hazard* and *Simple or Repetitive may characterize much of the work performed in the facility. One or more critical steps likely exist, and the potential for harm or damage is significant. Most events occur during so-called "routine" activities. People may erroneously think that "simple" or "routine" means "no hazards." Prepare for a pre-job briefing for recurring high-hazard jobs, such as safety system surveillance tests, by using a standard checklist that incorporates task-specific information. The content of these forms should be tailored to the particular job, paying close attention to critical steps and hazards.

High-Hazard* and *Complex or Infrequent evolutions fall into a special category of tasks or evolutions. One or more critical steps likely exist, and the potential for injury or damage is high. Activities that place equipment in unusual configurations, require complex coordination with several work groups, or involve complex sequencing, highly hazardous materials, and/or major changes to components are examples of complex or high-risk activities. Reduced safety margins typically challenge these types of work activities. Extra effort is required to provide training and briefings for these tasks. Mockups may be developed to practice and refine the activities before the work in place.

Use This Tool

- Before work activities involving facility equipment
- Once per shift, if the activity exceeds one shift in duration
- After extended delays in an activity

Recommended agenda for a detailed pre-job briefing:

1. **Task purpose,** scope, and nature of work
2. **Review of procedures,** work package documents, drawings, turnover information, prerequisites, and so on. that will be used to complete the task
3. **Task assignments,** identifying and understanding roles and responsibilities, qualifications, personal limitations, handoffs, and the controlling authority
    - Safety hazards and mitigating methods, identification of the following.
    - Safety hazards
    - Work procedures involved
    - Special precautions

- Radiation, confined space, etc. work permit requirements
- Control of energy sources, including permits and clearances
- Personal protective equipment (PPE)
- ALARA requirements

4. **Human performance,** addressing human performance tools for each critical step relevant to risks with nuclear, industrial, radiological, and environmental safety, as well as risks to operations/production (see Task Preview)
    - Special requirements or unusual conditions (as applicable)
    - Resources, tools, and material
    - Technical specifications
    - Structure, system, component, and environmental conditions
    - Use of partial procedures (steps or sections of procedure marked "Not Applicable")
    - Foreign material exclusion (FME) and housekeeping interfaces with other organizations
    - Interaction with other activities planned or in progress
    - Communication methods and potential obstacles to their effectiveness
5. **Operating experience,** specifying how similar errors, events, or the causes of similar events will be avoided
6. **Stop-work or Pause Work criteria,** reviewing contingencies, changes in task conditions or its scope, and person(s) responsible for making critical decisions
7. **Oversight,** defining the degree of management and supervisory involvement
8. **Questions and concerns** individual performers may have with the job

Avoid These At-Risk Practices

- Not planning for the conduct of the pre-job briefing
- Not allowing time for individuals to prepare
- Discussing generalities rather than specifics
- Conducting the meeting as a monologue, without active participation by the assigned individuals
- Individuals failing to express their concerns or ask questions
- Using a "cookbook" approach to the briefing, covering every item on the pre-job briefing checklist in the same manner regardless of its applicability
- Being insensitive to how mind-sets or expectations may disguise problems and warning signals
- Not assigning individual-specific responsibilities for contingencies and abort decisions
- Omitting discussion of error-likely situations, risk factors, possible consequences, and defenses for critical activities

- Conducting the meeting in a noisy or distracting environment
- Holding long briefings which could promote inattention and lack of interest
- Not considering equipment work history or the individuals' personal experience as relevant sources of operating experience
- Not considering the participants' proficiency with the task to determine if the task is considered infrequent
- Covering operating experience irrelevant to the task

TECHNICAL TASK PRE-JOB BRIEFING

Overview

The technical task pre-job briefing is fundamentally different than a briefing for a maintenance or operations activity or experiment because technical tasks usually do not require hands-on performance on facility equipment. They are used to assign personnel specific tasks; to clarify roles, responsibilities, methods, resources, and deliverables; and to identify risk factors, critical parameters, and compensating actions. The discussion takes place between the supervisor and the individual(s) performing the activity.

The primary purpose of the technical task pre-job briefing is to identify and compensate for error-likely situations that could lead to the product jeopardizing the plant or person. The pre-job briefing includes a discussion of human error and its possible consequences for critical attributes of the project, as well as the identification of additional controls or barriers needed. Such thinking increases alertness to risk factors (task-related error precursors) and improves the effectiveness of error-prevention tools during critical segments of technical activities.

The supervisor uses this tool to create a work environment that increases the chances of a defect-free product being produced. To enhance the effectiveness of a pre-job briefing, the individual(s) is given time to preview the task before participating in the briefing, to identify critical attributes, potential error traps, possible consequences, and practical defenses and contingencies against error when performing critical activities. "Reverse" briefings, in which the assigned individual leads the dialogue, help the supervisor ascertain the individual understands the details of the project. In addition, review of previous experience and past mistakes relevant to the task is part of the pre-job briefing dialogue. A dialogue on these topics is particularly important for risk-important activities and promotes understanding between the supervisor and the performer regarding the task deliverables and expectations.

Use This Tool

1. For a new task assignment
2. Before a peer review or verification
3. During turnover
4. Before physical activities or interfaces with plant equipment (walk-downs, inspections, and so forth)
5. After extended breaks (several days) in the activity
6. During vendor activities

Recommended Practices When Using This Tool

1. **Assign a qualified reviewer** to the technical task(s), considering the following.
   - Risks, demands, and complexities of the task

- Relevant skills, qualifications, proficiency, experience, fitness, and attitude of the assigned individual
- Opportunity for assigned individuals to review task-related processes and procedures before the pre-job briefing

2. **Summarize the task accomplishments and risks, using the following.**
   - Scope of problem, the technical task(s) being addressed
   - Personnel roles and responsibilities
   - Critical attributes pertinent to this activity
   - Critical parameters, interfaces, and operating conditions
   - Proposed methods and tools to be used
   - Applicable procedures, codes, and standards
   - Input data sources and how up-to-date they are
   - Key interfaces (with other individuals and/or organizations)

3. **Anticipate challenges to human performance for critical activities using S-A-F-E-R**
   - **Summarize** activities/tasks related to critical attributes.
   - **Anticipate** specific errors or mistakes for each critical activity or phase, in light of task-specific risk factors (especially from previous experience with this activity).
   - **Foresee** credible as well as worst-case consequences on the facility, on personnel, and on the environment if error goes undetected.
   - **Evaluate** methods to prevent and catch errors and related compensatory actions to mitigate identified risk factors, as well as contingencies to prevent/mitigate adverse consequences.
   - **Review** previous experience (lessons learned) relevant to the specific technical task(s).
4. **Ask the assigned individual(s) to summarize, in his or her own words, the following:**
   - Task requirements and proposed methods
   - Critical attributes/functions related to the product
   - Credible consequences of an error or defective product
   - Stop work or abort criteria
   - Concerns he or she may have with the task, as planned and scheduled – renegotiate deadlines, if necessary
   - Individual preparedness to deliver a defect-free product

Avoid These At-Risk Practices (In addition of those in the Pre-job Briefing section)

- Not using lessons learned acquired from previous activities to support the task
- Displaying or expressing a lack of interest (ownership) in the task

- Assigning an individual who lacks experience with required processes
- Not acknowledging the learning curve of the assigned engineer

CHECKING AND VERIFICATION PRACTICES

Verification practices refer broadly to four tools: peer-checking; concurrent verification; independent verification; and peer review. These tools involve a second (or more) person to confirm the actions and results achieved by a performer. While peer-checking (PC) focuses on preventing a mistake by the performer, independent verification (IV) and concurrent verification (CV) focus more on confirming the correct configuration or status of equipment or documents. Peer-review is a defense to detect errors and defects before the completion of documents by reading and checking the quality of another's work product (design, calculation, procedure, work package, etc.)

- "Checking" refers to the confirmation of a correct *action* – prevention of an error by a performer.
- "Verification" refers to the confirmation of the *condition* of equipment or accuracy of documents consistent with the requirements of the governing documents.

Peer-Checking

Background

Peer checking (PC) is a series of actions by two individuals working together at the same time and place, before and during a specific action. PC augments self-checking by the performer—it does not replace it. The purpose of PC is to *prevent* an error by the performer. PC focuses on performing the correct act. PC is the least rigorous of the checking and verification tools.

PC involves:

1. Two people (performer and peer) self-checking in parallel.
2. Both people agree together that the action is the correct action to perform on the correct component.
3. The performer takes the agreed-upon correct action.
4. The peer confirms that the action taken was correct.

This technique takes advantage of a fresh set of eyes. The peer, an individual familiar with the activity, may see hazards the performer does not see. PC is intended to be informal; people can apply peer-checks at any time to any work situation to help them avoid mistakes. Peer-checks can be requested by anyone and performed by anyone familiar with the task and trained in the PC technique. In some cases, management establishes specific actions or classes of actions that require mandatory PC.

Work activities involving tasks or situations such as the following could benefit from the use of PC.

- Critical steps
- Irreversible or otherwise unwanted actions
- Comparisons of test data with acceptance criteria
- Start or stop of major components
- Return to or removal from service
- Identification of correct parts or correct component before maintenance
- During installation of similar components or parts that could be interchanged or installed incorrectly

Recommended Practices When Using This Tool

1. The **performer** self-checks the correct component.
2. The **peer** self-checks the correct component.
3. The **performer** and the **peer** agree on the action to take and on which component.
4. The **peer** observes the **performer**, before and during execution, to confirm that the **performer** takes the correct action on the correct component.

5. The **performer** executes the intended action on the correct component.
6. If the **performer's** action is inconsistent with the intended action, the **peer** stops the **performer.**
7. If the **performer's** action is consistent with the intended action, the **peer** informs the **performer** that the action taken is correct.

Avoid These At-Risk Practices

- Peer is inexperienced with the task.
- Peer is not paying close attention to the performer.
- Peer is unable to view the component.
- Peer is reluctant to correct a more senior performer.
- Peer is not prepared to prevent an error by the performer.
- Peer assumes the performer will not make a mistake.
- Performer acts before the peer is ready to perform the peer-check.
- Performer or peer does not self-check rigorously, assuming the other person will.
- Performer is less attentive to the action, believing the peer will catch any problems.
- PC is over-used, eventually leading to complacency by both parties.

Concurrent Verification

Overview

Concurrent verification (CV) is a series of actions by two individuals working together at the same time and place to separately confirm the condition of a component before, during, and after an action when the consequences of an incorrect condition would subsequently lead to undesired harm to the facility or personnel. CV is similar to PC, but addresses conditions vice actions. PC and CV can be used together.

The process of CV helps users maintain positive control of alterations of risk-important equipment. CV supports the confirmation and documentation of the equipment condition consistent with the procedure. Because it is important to establish the correct equipment condition, the procedure serves as a record of the verification, as indicated by each person's signature or initials, and signifies that the equipment is in the condition specified in the procedure step.

CV is usually reserved for key components, where an error with the action could result in possibly irreversible harm. The primary intent of verification is to confirm the final condition of the equipment. When used conscientiously, CV provides a means to identify an error in the act of establishing the new equipment or component condition.

The performer and verifier attempt to create *freedom of thought* between them. Freedom of thought requires the verifier, to the extent possible, to be mentally objective, without relying on the other person as to what has or has not been done. Because CV requires both individuals to work together, side by side, true independence cannot be achieved. But, each person attempts to be as objective and unbiased as possible during each step of the CV process.

Consider using CV for actions that could lead to irreversible consequences such as the following.

- Nuclear safety: fissile material loss or damage, loss of a safety function, loss of criticality safety control
- Industrial and radiological safety: death, injury, overexposure to ionizing radiation
- Environmental safety: uncontrolled discharge or emission of harmful substances
- Facility safety (including productivity): safety system impairment, equipment damage, and/or property loss

Recommended Practices when Using This Tool

1. Before execution, the **performer and verifier** mutually agree on the action to take, referencing the guiding document separately, and the equipment condition to achieve.
2. The **performer** self-checks the correct component.
3. The **verifier** separately self-checks the correct component.

4. The **performer and the verifier** agree on the final condition of the component.
5. The **verifier** observes the **performer** before and during execution.
    - By one or more of the following methods, the **performer** and the **verifier** separately confirm that the condition and the expected response are correct.
    - Hands-on check (preferred).
    - System response.
    - Remote indication—if multiple remote indicators are available, use as many as possible; if possible, perform at least one check locally to confirm the validity of the remote indication.
6. The **performer** and **verifier** sign or initial the guiding document to record the verification.

Avoid These At-Risk Practices

- Verifier lacks system knowledge or experience with the task.
- Verifier is not closely observing the action of the performer.
- Verifier is significantly "junior" to the performer and may be reluctant to correct the performer.
- Performer or verifier does not self-check carefully, assuming the other person will.
- Performer or verifier uses verbal cues or observed actions of the other individual in place of personal confirmation or self-checking.
- Performer is less attentive to the action, believing the verifier will catch any problems.

Independent Verification

Overview

Independent verification (IV) confirms the condition of equipment or accuracy of documents or calculations required for safe operation. IV is a process by which one individual, separated by time and distance from the action changing the component's state or producing the document, confirms the condition of the component or document. IV is used when an improper component state or document could subsequently cause adverse consequences if the improper condition remains undetected.

The IV process tends to have a higher probability of catching an error than PC or CV, because the verifier is not involved in changing the component's state or producing the document and their knowledge of the system, component, or work situation is unaffected by the performer. The verifier physically checks the condition of the component or document without relying on observation of on oral confirmation by the performer.

Independence exists when the verifier has *freedom of thought* from the performer. Separating the acts of the performer and verifier in time and by distance promotes freedom of thought. *Separation in time* exists such that the verification occurs after initial alignment of the component (or initial verification). *Separation by distance* is established when audible or visual cues of either person are not detectable by the other person. That means the performer, while establishing the desired condition, does not communicate with the verifier, and the verifier is not in a position to either observe or hear the performer.

The specific method used to perform IV will likely vary depending on the type of component, such as air-operated valves, manual-locked valves, fuses, switches, and circuit breakers; or documents. Therefore, management should designate which systems, components, and documents will be verified and the appropriate verification method that will meet the intent of IV, taking into account the physical constraints of the equipment. In many cases, IV occurs as each designated procedure step is performed. However, it may be desirable to perform all IVs at the conclusion of the evolution or document production, if no hazard exists in doing so. The procedure should be specific about the approach to be taken in completing IVs"

Use This Tool

- During system alignments of safety-related or safety-important equipment
- During placement and removal of clearance tags
- During restoration of equipment to service after maintenance
- During alignment of fire protection systems or components
- During installation and removal of temporary modifications such as jumpers, hoses, and so forth
- As-left position of Safety System process instrumentation after maintenance
- When changes in equipment status could adversely impact safety basis

- Verification of design and safety basis calculations
- Verification of operating or maintenance procedures

Recommended Practices when Using This Tool

The **performer** performs the following actions.

1. Self-check the correct component/document.
2. Perform the action specified in the guiding document or applicable codes and standards.
3. Confirm the expected results.
4. Sign or initial the procedure or document.
5. Inform the supervisor upon completion of the task or notify the assigned verifier.

When notified, the **verifier** performs the following actions.

1. Self-check the correct component/document.

   Caution: Use verification methods specified in approved instructions to verify the condition of various component types.

2. Determine the as-found condition, without changing it, using one or more of the following means:
   - physical hands-on check (preferred);
   - remote indication—if multiple remote indicators are available, use as many as possible; if possible, perform at least one check locally to confirm remote indication; and
   - system response.
3. Compare the as-found condition with the guiding document or applicable codes and standards.
4. Notify the supervisor if the component/document condition does not agree with the governing documents.
5. Sign or initial the guiding document if the component condition agrees with the guiding document.
6. Notify the supervisor or performer upon completion of the IV.

Avoid These At-Risk Practices

- Performer and verifier walk to the component location together before the initial act.
- Performer and verifier are co-workers and/or co-located on the same job or evolution.
- Performer is less attentive to the action, believing the verifier will catch any problems.
- Verifier is in close proximity at the time the performer acts.
- Verifier uses only process parameters to determine component status. (Possible alternate flow paths could render process indicators unreliable.)

- Verifier is junior to performer and reluctant to question accuracy of action, design, calculation, or draft procedure.
- Verifier is superficial, believing other verifiers will catch any problems.

Peer Review

Overview

A reviewer provides a defense to detect errors and defects before the completion of documents by reading and checking the quality of another's work product. The purpose of peer-review is to catch errors with a risk-important work product or to verify that a decision or plan of action is appropriate before proceeding. A peer review takes advantage of a fresh set of eyes that may see problems or flaws the responsible preparer did not see or consider. However, the document preparer and the reviewer are equally accountable for the quality of the document.

This tool provides a structured method to help the reviewer identify errors that could lead to failure-likely situations with the product and to obtain assurance that a design-related document meets its intended purpose. This method aids the reviewer in clarifying the purpose and scope of the review, identifying critical attributes of the document, and applying a questioning attitude to the review using the FACTS questioning attitude tool. The peer review is an informal technique and does not supplant procedurally required checklists.

The following practices will help reduce the occurrence of review errors.

- Use qualified reviewers.
- Define the scope of the review. Use review aids (checklists).
- Provide the reviewer with technical input documents.
- Allow sufficient time.
- Avoid an excessive number of reviewers (to avoid team errors).
- Incorporate accountability into the process through periodic work product reviews by management/supervision.

To take advantage of these elements, a peer review involves multiple readings, integrating the above features. These separate readings (reviews) help the reviewer stay focused, minimizing the person's mental workload during each reading while studying the documents associated with the product. Depending on the purposes of each review, each may be done separately.

Depending on the complexity and risk significance of the product, the engineering organization may institute specific administrative standards for certain reviews, such as calculation reviews. Also, for the review to be effective, the reviewer has the same or greater level of qualifications as the preparer with respect to the product or project under review. Documenting the results of a review provides a learning opportunity. Errors with the product can be trended, and comment resolutions can benefit those assigned similar tasks in the future.

Use This Tool

- For reviews of new documents with no predecessor products
- For design documents; experimentation, operating, or maintenance procedures and work packages
- During engineering evaluations
- For informal requests for a review from a coworker
- When verifying a technical decision or plan of action

Recommended Practices When Using This Tool

1. **Define the review**. Clarify the following attributes of the review.
   - Purpose – why
   - Qualified person assigned – who
   - Scope – what
   - Time allotted for the review – when
   - Method – how
   - Acceptance and rejection criteria – quality
2. **Denote the critical attributes.** With the aid of operating experience and knowledge of the product's risk importance, pinpoint the key aspects of the engineering product that could directly affect one or more critical attributes.
3. **Dig for facts.** Using a questioning attitude, take the following steps.
   - 1st reading – Develop a general overview that highlights critical attributes or conditions that could lead to failure.
   - 2nd reading – Verify data and technical accuracy, and validate assumptions related to the critical attributes of the product.
   - 3rd reading – Identify and document concerns and possible resolutions; using a questioning attitude (FACTS), validate conclusions and that the product addresses the stated problem.

Avoid These At-Risk Practices

- Involving the reviewer in document development or preparation
- Using reviews to train less experienced personnel
- Being in a hurry; shortcutting the review time because of schedule pressure
- Performing a concurrent task(s)
- Being interrupted and distracted
- Not documenting the review
- Reviewer not having a questioning attitude

FLAGGING

Overview

An event can result from an individual starting an activity on the wrong similar, but closely located, component or taking a break or being distracted from one component and subsequently going back to work on an adjacent, similar—but wrong—component. If a component is physically near other similar-looking components and is handled multiple times, flagging helps the user consistently touch the correct component. Using self-checking, an individual distinctly marks the correct component with a flagging device that helps the performer visually return to the correct component during the activity or after a distraction or interruption. Individuals can also use flagging to identify similar components that are not to be touched or manipulated.

Managers are encouraged to approve the flagging devices. Devices such as colored adhesive dots, ribbons, colored tags, rope, magnetic placards, or orange electrical tape may be used for this purpose. Flagging devices should not interfere with facility equipment, including the observation of meters and other operating indicators.

Use This Tool

- When handling a component near similar-looking components
- While working on a component that will be manipulated multiple times
- During work near "trip-sensitive" or otherwise risk-important equipment
- When the need for flagging is identified during the pre-job briefing

Recommended Practices When Using This Tool

1. **Identify** the component to be flagged using self-checking.
2. **Flag** the designated component to be handled or worked on using an approved device. Flagging remains in place while work is in progress.
3. **Perform** work assignment or equipment manipulation.
4. **Remove** flagging device(s) when work is complete.

Avoid These At-Risk Practices

- Using similar flags for components to handle and for those not to handle
- Not self-checking or peer-checking before applying flagging
- Using a flagging device that obscures indicators or interferes with equipment
- Using a flagging devise that can easily become dislodged such as a post-it-note
- Not removing a flagging device after completing the task
- Using electrically conductive material for flagging devices

TURNOVER

Overview

Turnover is the orderly transfer of work-related information, tasks, and responsibilities between individuals or crews. A turnover provides time for the on-coming individual(s) to establish an accurate mental model of the work activity (situation awareness) before assuming responsibilities and commencing work. A good turnover helps every individual understand where things stand at the beginning of the shift and what is expected to occur during the shift. Turnovers occur during major facility activities, such as watch or shift exchange of information for the permanent transfer of project responsibilities between two individuals, between off-going and on-coming shifts, or for maintenance tasks exceeding one shift in length or multiple work groups.

Turnovers differ in detail and form depending on the risk importance of the task and the nature of the work involved. Yet all turnovers share a common purpose. Information critical to the successful continuation of a project or activity passes from one group or individual to another in a manner that limits interruption of work and promotes safe and efficient work completion.

Turnovers should be thorough and accurate, as well as brief and simple. Individuals conduct turnovers visually, verbally, and in writing. Walk-down of the work location(s) offers visual confirmation of work and equipment status (for operations and maintenance). Both parties talk about the work situation. As a backup, individuals use three-way communication for risk-important information. The on-coming individual or group is given an opportunity to ask questions and resolve concerns. Oral communication of information, while more convenient, is prone to distortion and may be forgotten. Therefore, a written log guided by a checklist (where appropriate) is important to the safe continuation of the work in progress. The off-going person should be confident that the on-coming person is fully capable of assuming the duties and responsibilities and planned tasks before handing over responsibility for the job.

Use This Tool

- Before or during shift change
- When responsibilities are transferred between people, work groups, or organizations (handoffs)
- When performing emergent, critical, or complex activities over multiple shifts
- When changing responsibilities for tasks in progress

Recommended Practices When Using This Tool

1. **Start a turnover log.** Document the items listed below. The log summarizing the key activities during a shift is also useful information for the relieving personnel.
2. **Identify specific tasks.** The relieving individual or group will perform this step. Consider the following factors during the turnover.

- Status of the job; work completed, work remaining, and equipment status, plus specific parameters and related values
- Schedule requirements, changes, and parallel activities
- Objectives/tasks in progress and milestones to be accomplished
- Procedures being used and last step(s) completed
- Problems, unusual conditions or system lineups and resolution or status
- Critical steps, possible error-likely situations, countermeasures, and contingencies
- Availability and location of resources associated with the tasks and activities
- Key contacts, support personnel, and organizational interfaces

3. **Discuss the information.** The principal individuals conduct a meeting face to face using formal three-way communication on critical information and responsibilities. Each person listens for and challenges assumptions, asking questions as needed.

(4 and 5 for operations and maintenance)

4. **Review the turnover log and walk down the work area.** The on-coming individual independently reviews the turnover log, relevant work documents, status boards, and logs, checking for consistency and accuracy of information before assuming responsibility. Additionally, he or she examines the work location(s), including controls, components, tools, and equipment. The on-coming and off-going individuals should walk down the work location together.
5. **Transfer responsibility.** Officially transfer responsibility for work activities from the off-going individual to the on-coming individual. The off-going person is confident that the on-coming person is fully capable of assuming the duties and responsibilities of the work station and planned tasks before handing over responsibility for the job.

Avoid These At-Risk Practices

- Conducting a turnover while attending to another activity requiring one's attention
- Not having a face to face verbal explanation
- Leaving out critical information or the bases for decisions.
- Not documenting activities and important information
- Performing the turnover in a distracting environment that Interrupts the turnover
- Transferring responsibilities to an on-coming individual who is unprepared
- Turnovers not accommodated in the schedule—hurrying though the process

POST-JOB REVIEW — IN THE FIELD

Overview

Feedback on the initiation, planning, execution, and control of work is highly important for management. Procedure, work process, equipment, tool and supply problems and minor human error require management's attention. Such conditions tend to be latent in nature and accumulate within the organization when uncorrected. When individuals communicate the information, managers have the opportunity to improve. Post-job reviews provide management an opportunity to eliminate weaknesses with processes, programs, policies, and job-site conditions that could challenge event-free performance.

A post-job review is a method of self-assessment conducted after a work activity to solicit feedback from the participants. Usually, the feedback involves a face-to-face meeting between the performer(s) and the supervisor(s). Meetings should be brief and concise, and give performers the opportunity to submit feedback. Individuals should reliably submit feedback on key aspects of work preparation and work performance. Performers and their supervisor should discuss what went well and identify potential enhancements and also identify opportunities for improvement. An effective post-job review identifies lessons learned to improve future task performance and aids closure of the paperwork related to the job.

Some of the more common topics addressed during post job reviews include the following.

- Surprises or unexpected outcomes
- Usability and quality of work documents
- Knowledge and skill shortcomings
- Minor errors during the activity
- Unanticipated job-site conditions and workarounds
- Effectiveness of supervisory support
- Adequacy of tools and resources
- Quality of work planning and scheduling
- Significant lessons learned to record for future reference
- Other obstacles or disturbing “gut feelings” about the work

To reinforce the occurrence and effectiveness of post-job reviews, managers provide timely feedback to supervisors and performers on the resolution of high-interest issues identified during reviews.

Use This Tool

- When completing any work in which complications occurred
- After completing a non-routine or important work activity
- After each high-risk phase of a risk-important project

- At the conclusion of emergent work
- After routine work and improvements have been identified

Recommended Practices When Using This Tool

1. **Forum** – Provide time for a conversation among all active participants or to document their feedback.
2. **Feedback** – Identify what worked well (pluses) that made the task successful and opportunities for improvement (deltas), especially related to critical steps, comparing what actually happened to what was planned to happen.
3. **Forms** – Record the pluses and deltas using the proper feedback forms or methods, and submit to the appropriate organizations to address the information, using the corrective action program as appropriate.
4. **Follow Up** – Provide feedback on the resolution of issues of high interest to the individual performers.

Avoid These At-Risk Practices

- Not performing a post job review or documenting feedback after working on risk-important facility equipment
- Principal participants not involved in the post job review
- No time allotted for the post job review or done in a hurry
- No method of follow-up identified to address issues
- No follow-up with principal performers for high-interest issues
- Post job review or follow-up not done face to face
- Important issues not documented for reference for future pre-job briefings

TECHNICAL TASK POST-JOB REVIEW

Overview

Feedback on the initiation, planning, execution, and control of work is highly important for management. Errors that cause significant events are organizational failures. Consequently, feedback is critical to overall success in the facility, because the severity of consequences is dependent on organizational weaknesses. Post-job reviews provide an early opportunity to inform management about weaknesses in processes, programs, policies, and so forth that can adversely affect technical activity defenses and barriers. An effective post-job review can identify lessons learned to improve future task performance.

A post-job review is a routine self-assessment practice conducted after completion of a technical task. Post-job reviews provide workers and supervisors with a forum to discuss what went well and to identify potential improvements to a particular task, process, project, or risk-important activity. Post-job reviews emphasize identification of flawed defenses, error traps encountered, and consequences of problems encountered. The responsible individuals and supervisors perform the review as soon as practicable after the task or each high-risk phase. The meeting is focused, not laborious. To reinforce the effectiveness of post-job reviews, individuals who provide feedback are updated on the resolution of high-interest issues.

Use This Tool

- As soon as practicable after completing project-level work
- After each high-risk phase of a risk-important project
- At the conclusion of emergent work

Recommended Practices When Using This Tool

1. **Face-to-Face** – Hold a face-to-face meeting of all active participants, led by the task lead.
2. **Pluses** – Identify and document what went well.
3. **Deltas** – Identify and document opportunities for improvement related to the critical activities.
4. **Follow-Up** – Determine the method(s) to follow up problems and successes.
5. **Face-to-Face Again** – Provide face-to-face feedback to individuals on the resolution of a particular performance issue and on issues of high interest to the individuals.

Avoid These At-Risk Practices

- Not performing a post-job review
- Not conducting a face-to-face follow-up
- Not allotting time for a post-job review, or conducting it hastily
- Not having responsible engineers present for the post-job review

- Not having a method of follow-up identified to address issues
- Not following up with engineers for high-interest issues
- Not documenting important issues for future pre-job briefing reference

PROJECT PLANNING

Overview

Project management fundamentals provide a structure for working on tasks with discrete start and end dates, such as modifications and improvement/upgrade initiatives. Usually guided by administrative instructions, project management tools help keep the scope, objectives, and deliverables aligned with the facility business plan. Additionally, a disciplined and structured approach minimizes re-work, assumptions, and omissions by prompting engineers to carefully plan and scope the work. Similarly, project management helps reduce stress and related time pressures by improving communication, foresight, and planning.

Project management includes those activities (or tasks) concerned with achieving a set of goals (project) while optimizing the use of scarce resources (time, money, space, people, and so forth). Such activities involve initiation, planning, controlling, and closure. A project work plan (PWP), as described in the "Recommended Practices" below, usually documents such activities. Applying a methodical approach to the management of any project will reduce the risk of human error.

Effective project management also maintains a low risk of failure over the lifetime of the project. The risk of failure arises primarily from the presence of uncertainty at all stages of a project. One aspect of that uncertainty involves the potential for human error. The human mind cannot reliably and consistently maintain awareness and recall all elements of a project, especially complex projects. The planning, monitoring, and control of a project and the motivation of those involved in it help achieve project objectives on time, within budget, and without defect.

Project management is often the province and responsibility of an individual project manager. This individual seldom participates directly in the activities that produce the result, but rather strives to maintain the progress and productive mutual interaction of various parties in such a way as to reduce the overall risk of failure.

Use This Tool

- During design work
- During work not otherwise guided by established administrative procedures
- During work involving supplemental personnel (subcontractors)

(This tool is not typically used for work considered core business, program, and level-of-effort. These types of work are guided by administrative procedures.)

Recommended Practices When Using This Tool

The PWP may address the following elements (as applicable), which may be listed, referenced, or attached.

1. **Initiate** – Develop a charter that clearly defines the problem, opportunity, or challenge. The following elements could be considered.
   - Accountable project manager
   - Team members
   - Project purpose, objectives, and scope
   - Design authority
   - Customer and stakeholders
   - Deliverables (definition of success)
2. **Plan** – Determine how to address the problem, opportunity, or challenge through use of the following.
   - Project organization, roles, and responsibilities (accountabilities)
   - Customer expectations and stakeholder involvement
   - Organizational and technical interfaces
   - Field walk-down (visual in-field inspection)
   - Work activities schedule, including technical task pre-job briefing(s) and post-job review
   - Project controls to minimize errors during critical activities
   - resources, budget, and support (availability, location, special knowledge, and required skills)
   - Workload management plan (base load versus emergent work)
   - Principal design inputs/outputs and planned design reviews, including specifications, codes, standards, instructions, procedures, and drawings to accomplish work activities
   - Lessons learned from a review of operating experience
   - Risk sources, adverse outcomes to avoid, related critical attributes, and corresponding risk management approach; including project-specific error-prevention/quality requirements and methods that address, as a minimum.
     - verification
     - peer review
     - validation
     - integrated testing or commissioning
3. **Control** – Implement and adhere to the plan and expectations, using several of the following means.
   - Periodic tracking of tasks, especially for critical activities
   - Process adherence (progress/performance measures and reports)
   - Meaningful performance indicators
   - Conflict management
   - Client and stakeholder collaboration and relationships
   - Reinforce the use of the human performance tool

- Recognizing the impact of changes on the project
- Product review meeting schedule, internal/external communication procedures
- Vendor monitoring and control processes communication plan; information and data accessibility
- Document, data, and software control method(s), including control of electronic files and filing of records
- Rewards and celebrations (reinforcing in-process use of human performance tools)

4. **Close** – Hand off to the customer, which includes the following.
   - Product quality evaluation and commissioning results
   - Effectiveness measures (meeting objectives)
   - Client satisfaction
   - Lessons learned

Avoid These At-Risk Practices

- Communicating infrequently or ineffectively
- Excluding stakeholders or customers from the planning process and not obtaining their commitment/ownership of the project
- Spreading responsibility for a project to two or more people
- Treating risk lightly in light of the project's product
- Not having adequate configuration management of the project plan resulting in scope creep and unapproved changes.
- Not identifying human performance controls during planning
- Not publishing a project plan
- Not documenting intermediate decisions
- Not updating team members on changes to the PWP
- Not resolving competing priorities with respect to resources
- Not sufficiently defining or documenting scope
- Frequently changing project team members

PROBLEM SOLVING – WITH PACTS

Overview

Problem-solving is a knowledge-based performance situation. There is no apparent solution, no recognizable pattern, rule, or skill to call upon. Problem-solving involves chaining cause-and-effect relationships in a backward direction to determine why the problem exists. Problems require systematic analysis to identify possible causes. The better approaches to problem-solving are structured, simple, and memorable; and complement well-known data-collection and analysis tools. The **P-A-C-T-S** technique, described below, provides one such structure for problem-solving.

When confronted with a situation that creates a question, a person is in unfamiliar territory—a knowledge-based performance situation. Given that the chances for error are particularly high in a knowledge-based situation (1:2 to 1:10), the best course of action, when unsure, is to pause the activity or task and get another person (at least) involved with the problem. An individual may initiate this tool after getting an unsatisfactory resolution using a questioning attitude (FACTS,). In addition to using a qualified peer, users and field personnel offer an additional wealth of information and insights that may be pertinent to the issue at hand.

Use This Tool

- During troubleshooting
- During conceptual design
- During preparation of product review presentations
- For causal analysis
- In knowledge-based performance situations for the individual
- When a situation cannot be resolved using the FACTS questioning attitude tool

Recommended Practices When Using The PACTS Tool

1. **Problem Statement** – Write a problem statement that describes a gap between what is and what should be, and that is agreed to by all stakeholders; especially those closest to the problem. Breaking large problems into smaller issues may help.
2. **Analysis** – Use structured, objective, repeatable, and approved methods that are consistent with the complexity and importance of the problem.
3. **Causes** – Summarize the cause(s) that, if corrected, will prevent recurrence of the problem and that is consistent with the facts of the analysis and sensitive to supporting and refuting evidence.
4. **Testing** – Corroborate the cause(s) using appropriate testing, independent review, and a questioning attitude; especially with those closest to the problem.

5. **Solution** – Suggest corrective actions for each cause, assessing each solution's risk, benefit, and cost.

Avoid These At-Risk Practices

- Defining the problem in terms of possible causes
- Attempting solutions or changes before defining the problem
- Concluding that a procedure change and/or training will always solve the problem
- Not taking immediate corrective action to prevent recurrence of the situation before implementing long-term corrective actions
- Using subjective, unstructured methods, such as intuition, experience, and brainstorming, for a risk-important issue
- Specifying a cause, if no direct cause can be determined
- Implementing a corrective action when uncertain of the cause
- Deciding without clearly understanding the risks ahead of time
- Ruling out potential causes without justification or facts
- Allowing an individual to dominate the problem-solving process with his or her ideas
- Not having all stakeholders involved, thereby limiting the suitability of the solution
- Avoiding controversy

DECISION MAKING

Overview

Decision-making is a forward-looking method used to anticipate the potential effects of a decision. Personnel attempt to understand all possible effects of various alternatives and choose the one that best meets the needs within known constraints. A professional who follows a methodical decision-making process guards against rule-based and knowledge-based errors.

Conservative decisions place the safety needs of the facility above the near-term production goals of the organization. Most often, the choice to make is clear. However, for purely knowledge-based situations, this may not be apparent. A deliberate, methodical approach promotes better decision-making. For all decisions:

- clarify the goal;
- identify options;
- include appropriate analysis of those options in accomplishing the goal;
- develop a plan to implement the selected solutions; and
- identify ways to measure the effectiveness of the plan.

Decision-making occurs in either a short-term or long-term context. Under some conditions people must make immediate decisions, while others have sufficient time for a more formal analysis. Regardless of the time constraints, facility and personal safety require conservative decisions. The following practices promote conservatism.

- Stay within the safe operating envelope of the facility or equipment (e.g., tech specs).
- Use all available information, resisting the temptation to discount contradictory or disconfirming data.
- Use all available people (expertise) who can provide additional insight; involve management in decision-making, taking advantage of front-line worker input (user stakeholders).
- Minimize as much uncertainty as possible; rely on facts and challenge assumptions.
- Maintain safety despite production pressures.
- Consider the cumulative risk (consequences) of the decision.
- Develop contingency actions.

Team or project leaders can assign a devil's advocate role to promote conservative decision-making by the team, and to monitor and challenge the team decision-making process. A devil's advocate keeps a watchful eye out for possible flaws and oversights, because most people focus on accomplishing the task rather than on what to avoid.

Use This Tool

- When a mistake could have significant consequences
- During the initial or conceptual design phase of a critical activity
- When developing project work plans
- During product review meetings
- When conducting troubleshooting activities
- When preparing product review presentations
- During engineering evaluations and operability determinations
- During final phases of root cause analyses
- When procuring unlike replacement components because like components are not available

Recommended Practices When Using This Tool

1. **Goal** – Write a brief statement that defines the desired future state and the critical attributes for success.
2. **Options** – Develop several alternatives that will achieve the desired outcome, consistent with critical attributes for success.
3. **Analysis** – Gather detailed information on each option to allow in-depth consideration of the following elements.
   - Critical assumptions
   - Potential affects on stakeholders/users
   - Pros and cons of each option
   - Short- and long-term risks, benefits, and costs of each alternative
   - Operating experience relevant to the decision
4. **Plan** – Select options consistent with critical attributes to achieve the goal with the greatest benefit and lowest risk and cost, while considering the following elements.
   - Action plan that identifies who, what, and by when
   - Conservative with respect to critical attributes
   - Contingencies for unintended consequences
   - Abort or hold criteria
   - Communication with and involvement of key stakeholders
5. **Review** – Direct the relevant stakeholder(s) to perform periodic effectiveness reviews; and conduct an independent review of the proposed decision.

Avoid These At-Risk Practices

- Making decisions before defining the goal
- Using subjective, unstructured methods, such as intuition, experience, and brainstorming, for a risk-important issue
- Implementing a decision without clearly understanding the risks
- Not taking immediate corrective action to prevent recurrence of a situation before implementing long-term corrective actions

PROJECT REVIEW MEETING

Overview

Science and engineering are not always exact. It involves judgment, uncertainty, and a degree of risk. To guide the development of the design or experiment, a structured process is necessary. Product Review Meetings use a team approach to coordinate the review of the initial design, and the development and review of changes. The meeting draws on the collective knowledge, skills, and experience of affected parties and stakeholders to improve ownership and quality in addressing the project. The project team clearly understands methods to be used, problems to overcome, and results to be achieved. Diverse and critical opinions are valued, and critical thinking is demanded for all product reviews. The project team will ultimately determine when the project is ready for implementation.

In general, meetings solve problems and aid decision-making that cannot or should not be handled individually. Every meeting requires a responsible person to keep the meeting on task, to address the issues, and to promote teamwork among the participants. An agenda, prepared for every meeting, specifies start/stop times and what to accomplish. Only people who have an important contribution to make should participate. Preferably, meetings conclude with personnel knowing what is to be done, by whom, and by when. For continuity and historical purposes, the chairperson prepares and distributes meeting minutes to the participants. Additionally, management can monitor these meetings through appropriate performance measures.

People may make errors during meetings. Team errors can occur. Meetings involve communication among people who may possess inaccurate perceptions of the issues and who could promote potentially tragic misinterpretations of critical information. Open communication is a key success factor for a product review meeting. Any obstacle that hinders the free flow of communication, such as interpersonal conflicts, must be eliminated before individuals proceed with the task. Processes to identify and conscientiously examine differing professional opinions are widely known and applied. In some cases, the chairperson should designate a devil's advocate to challenge decision-making, assumptions, and various statements of belief that could lead people astray.

Use This Tool

- During meetings related to the initial design of or changes to experiments or engineering designs
- For design changes to safety-related structures, systems, and components subject to configuration control
- Before implementing any complex, temporary system modification
- At multiple points in the design process, to ensure design bases are being met to prevent significant rework or error potential

Recommended Practices When Using This Tool

1. **Membership –** Identify the product review team members by name before convening the initial product review meeting.
2. **Agenda** – Prepare and communicate an agenda for the respective product review meeting, along with the design documents, to the product review team members before the meeting.
3. **Responsibilities** – All product review team members are expected to adhere to the following.
   - Attend and actively participate in all product review meetings.
   - Review the product-related documents before the respective meeting.
   - Prepare and submit comment sheets on the design documents before the meeting.
   - Bring product-related documents and comment sheets to the meeting.
   - Communicate stakeholder concerns, and address limitations.
   - Identify commitments going forward, and assign owners.
   - Avoid scope changes after the midcourse review.

Avoid These At-Risk Practices

- Not scheduling product review meetings far enough in advance to allow team members and stakeholders to attend
- Not issuing an agenda
- Stakeholder organizations not being involved in product review meetings until late in the project
- Inconsistent or unqualified representation from the stakeholder organizations
- Not being prepared for meetings, or not having required reviews completed before sending out meeting copy
- Required team members not being present at meetings
- Not following up on action items in meeting minutes

VENDOR OVERSIGHT

Overview

Typically DOE sites are operated by one or more primary contractors. In turn, a primary contractor may have a number of subcontractors performing work. For certain limited work scopes additional contractors may be brought in to perform limited scope or fixed-time special projects. For purposes of this tool, those limited-scope, special-project contractors are referred to as vendors. Vendors are at high risk for involvement in significant events in the facility. General Employee Training (GET) is often insufficient to compensate for vendors' lack of facility experience, especially with respect to **industrial safety, radiation protection,** and **human performance**.

Vendors need the same coaching and mentoring as facility personnel when they support the DOE contractor workforce. Supplemental personnel must understand that their work practices, especially regarding human performance, must meet the same standards required of facility staff even when the work is performed at their home office.

VENDOR is a mnemonic device (see "Recommended Practices" below) to aid the recall of those attributes, principles, and standards needed to effectively oversee the work of contractors/suppliers/vendors of products and services. .

Use This Tool

- When formal processes governing interactions with vendors and contract personnel are not available
- During the preparation of the contract for vendor services
- When purchasing new equipment
- When obtaining vendor services for on or off-site work
- Following the award of the contract, but before the start of work
- During actual vendor performance
- When returning equipment to a vendor for repair, troubleshooting, or maintenance
- Before completing the contracted job
- Following job completion
- When there is evidence, or suspicion, of improper execution or results
- Before using vendor-supplied information

Recommended Practices When Using This Tool

1. **Validation** of vendor-supplied data and assurances with objective evidence (trust, but verify).
2. **Expectations** related to product specifications, personnel training and qualifications, and station quality processes; especially industrial safety, radiological protection, and error prevention are clearly communicated. Be sensitive to areas of weakness revealed by operating experience.
3. **iN-terdependency** between vendor and customer/client; development of a close working relationship that generates a spirit of cooperation and an appreciation for safety and quality.
4. **Documentation** related to the product or service, which is clear, detailed, and understandable. Vendor problems are documented using the corrective action or non-conformance program.
5. **Oversight** of office and in-field vendor activities; assignment of a responsible individual to coach and mentor the vendor; development of a monitoring plan consistent with vendor's risk-significant role and past performance. Oversight can be designated as continuous, intermittent, or none.
6. **Review** and evaluation of vendor deliverables, documentation, and other products in light of critical attributes, using in-process reviews, inspections, vendor-specific operating experience, and post-job reviews

Avoid These At-Risk Practices

- Assuming the vendor is "expert" and will not make mistakes
- Assuming vendors have the same work standards as DOE facility workers
- Insufficiently verifying or testing vendor-supplied designs
- Providing insufficient oversight of vendor in-process activities
- Failing to avoid the appearance of co-employment.
- Assuming the vendor recognizes the effects of changes to his or her standard product

MANAGEMENT TOOLS

The tools in this category are designed to be used by managers (and supervisors) to help identify latent weaknesses in the organization. These are mainly undetected deficiencies in organizational processes or values that create workplace conditions that provoke error (error precursors) or degrade the integrity of defenses (flawed defenses). Undetected organizational deficiencies plague human performance. Latent errors or conditions are frequently difficult to identify. Once they are created they do not fade away but rather accumulate in the system. Because of their hidden characteristic, limiting the time these vulnerabilities exist is challenging. Managers should aggressively identify and correct vulnerabilities with defenses at the earliest opportunity.

Tools in this category that are described below include the following.

- Benchmarking;
- Observations;
- Self-assessments;
- Performance indicators;
- Independent oversight;
- Work product review;
- Investigating events triggered by human error
- Operating experience;
- Change management;
- Reporting errors and near-misses; and
- Employee surveys

BENCHMARKING

Overview

Benchmarking is the process of comparing the performance of one's own organization in a particular area against other organizations that perform better in the same area and learning what the other organization does to achieve the high level of performance. This comparison may include the identification of beneficial practices, performance standards, and innovative thinking or approaches. Benchmarking is the process of measuring products, services, and practices against the toughest competitors or those companies recognized as industry leaders.

For benchmarking to be effective, managers must evaluate the various aspects of their own organization's performance to first determine performance gaps they agree need to be improved. With these results in hand, locate external organizations whose performance is exemplary and who are willing to share performance information. The learning process most often requires extensive communication between organizations and a visit to the host organization to observe first hand how business is done there. This sets the stage for the inquiring organization to develop plans on how to adopt such best performance practices. Some organizations consider benchmarking a continuous process in which they continually seek to challenge their practices.

Benchmarking is a powerful management tool because it overcomes "Paradigm Blindness." "Paradigm Blindness" can be summed up as the mode of thinking:

- "The way we do it is the best because this is the way we have always done it"; or
- "We can't learn from them because we are really smart and/or they don't understand our situation".

Benchmarking opens organizations to new methods, ideas, and tools to improve their effectiveness. It helps crack through resistance to change by demonstrating other methods of operating than the one currently employed, and demonstrating that they work, because they are being used by others.

Use This Tool

- If a work process is found to be inefficient, ineffective, too costly, or too risk-ridden
- When errors, near-misses, and mishaps are on the rise in a particular area
- When the gap between actual performance varies widely from ideal performance in a given performance area
- When managers recognize the need to dramatically improve how they do business

Recommended Practices When Using This Tool

1. **Identify the problem area**. Gain a thorough understanding of the local process you intend to improve. A range of research techniques may be required that include gap analysis, informal conversations with employees, exploratory research techniques (e.g., focus groups), quantitative research, surveys, process mapping, and so on. Determine both the quantitative measures and qualitative information to be used in the benchmarking process.
2. **Identify external organizations** that have similar processes and challenges. Review their processes to identify similarities and transferability of the way business is carried out.
3. **Identify and select the external organization** that is "best in class" in the process you want to improve. Establish a partnership with this organization.
4. **Establish benchmarking** protocols and exchange information with the partner.
5. **Visit the 'best practice' partner** to witness leading edge practices. Companies usually agree to mutually exchange information beneficial to all parties in a benchmarking group.
6. **Evaluate and implement** using leading edge practices and local conditions to develop implementation plans which include identification of specific opportunities for use of the new acquisition of data, methods, and techniques. Sell the ideas to the local organization to gain demonstrated value from the adaptation of the process.

Avoid These At-Risk Practices

- Failing to pinpoint specific processes or practices that need improving
- Shortcutting the data collection phase in the rush to demonstrate improvement
- Selecting benchmarking partners that are not "best in class" but only different in how they perform
- Failing to account for important differences in the management systems or the processes of the two organizations that preclude successful adaptation of best practices
- Unwillingness to share information with a benchmarking partner
- Failing to follow through in implementing areas for improvement after visiting other facilities falling into the category of "industrial tourism"

OBSERVATIONS

Overview

In-the-field observation of individual performance is a good method to gain information of how well the organization supports work at the job site. The purpose of management behavior observations is to review the quality and effectiveness of work preparation, work practices, and work performance. The purpose is not to criticize or to judge people. Therefore, the main objective of these observations is to identify opportunities to improve the organization of work (work environment, tools, etc.), while monitoring individuals doing work.

The scope of observations should include the whole job, not just performer behavior. In addition to paying attention to performer practices and attention, observers monitor the job-site context, potential hazards, and the controls relevant to the work activity. The results of observations are recorded for trending purposes to help identify strengths and weaknesses over time. Behavior observations can flush out organizational weaknesses that may not be obvious by any other means. When managers and supervisors spend time in the field with individuals doing work, performance improves—error rates tend to decrease.

Use This Tool

- To verify how well the organization supports individuals' performance at the job site
- To reinforce desired behaviors and coach for improvements
- To document strengths and weaknesses of specific work activities
- To identify and document observable latent organizational weaknesses

Recommended Practices When Using This Tool

1. Plan the observation to include watching specific activities and critical steps.
2. Know the critical steps, potential errors specific to the task, and performer weaknesses with the task and include these items in the scope of the observation.
3. Assess presence of obstacles to performance – solve related problems and remove obstacles where possible.
4. Verify availability of appropriate tools and spare parts.
5. Check that individuals possess the proper skills and accurately understand the risk and priorities associated with the task.
6. Reinforce and coach performers on observed behaviors.
7. Correct people on the spot for at-risk and unsafe practices.

8. Ask questions similar to the following to identify error precursors and latent organizational weaknesses that management can address.
   - Was the task accomplished with expected results?
   - Is this the way the job should be performed in the future?
   - Are the procedures accurate?
   - Were resources and information sufficient?
   - Was training for the job adequate and effective?
   - Were planning and scheduling optimized to reduce the potential for human error?
   - Were work processes efficient and supportive?
   - Did supervision provide needed support and appropriate guidance?
   - Is the supervisor aware of performance traps that, if uncorrected, could lead to human error the next time the task is performed?
9. Record the findings and retain for trending and follow up.
10. Follow up on unresolved problems, performance obstacles, and organizational weaknesses.

Avoid These At-Risk Practices

- Failure to plan for the observation, being unprepared, or not knowing what to observe and why
- Unwilling to be critical and intrusive during the observation
- Not asking the hard questions
- Not correcting poor practices or stopping at-risk behaviors
- Focusing totally on the individual's behaviors, and ignoring job-site conditions and organizational processes and values that support individual performance
- Neglecting to provide feedback to the workers and supervisor on the observation
- Failure to record findings or to use those findings to trend performance over time
- Not following through to correct observed organizational weaknesses or error-likely situations

SELF-ASSESSMENTS

Overview

Self-assessment is the formal or informal process of identifying one's own opportunities for improvement by comparing present practices and results with desired practices, results, and standards. Because no one knows better how things are done in the facility than those working in the performing organizations, self-assessments can be the most effective means of identifying latent weaknesses in the organization and in the facility. Managers should be aggressive in the performance of self-assessments for their respective organizations and processes.

Self assessments are required by DOE Order 226.1A, *Implementation of Department of Energy Oversight Policy*. It is not the intent here to supplant, or substitute in anyway, the 'Self-Assessment' process or program formally required by the Department. Rather, this tool is intended to assist managers and supervisors (and human performance practitioners) who do self-assessments make use of the information acquired there to evaluate organizational processes and values against expectations and identify conditions that may adversely affect defenses or provoke error likely situations that set individuals up for failure. Hence, this tool is meant to assist people in assessing the human performance factors associated with self-assessments.

Use This Tool

When using a regularly scheduled self-assessment plan to evaluate current performance and results of management processes against the ideal or expected

- When trends and conditions suggest human performance is waning
- If present practices and results are misaligned with desired goals and objectives
- To evaluate how well the organization is complying with safety codes, regulations, and requirements

Recommended Practices When Using This Tool

1. **Determine the scope** of the organizational processes to address in a self-assessment schedule. These may include procedure development and review, work planning and scheduling, tools and resources, training programs, design and modifications, work processes, management visibility, communication methods and practices, priorities and emphasis (health and safety or production), and so on. In some cases, there are more topics to assess than can reasonably be addressed in a single year, and lists should include multiple years. Annual schedule updates can keep the focus on important areas while not losing sight of areas believed to be performing well.
2. **Define performance objectives** that cover the scope of the processes selected. These should include health, safety, environment, and security requirements; quality requirements; and human performance principles.

3. **Determine appropriate measures and assessments** for each objective. Where appropriate identify an approach for achieving each objective. Measurement and assessment activities should consider the following.
   - Risk (environmental, safety, health, security, and programmatic)
   - Results of previous evaluations and assessments
   - Lessons learned
   - Priorities and resources
4. **Develop a schedule for conducting the performance self-assessments.** Address all topics at some periodicity, but concentrate on problem or critical areas.
5. **Assign responsibilities for performing assessments** and for evaluating results and reporting them to organizational managers. Involve knowledgeable individuals in the organization as well as supervision.
6. **Conduct self-assessments** as planned. Assessments should not interfere with the work flow or be the cause of individuals putting in long hours to support the effort. The objective of self-assessments is to investigate how work is accomplished—to see workplace activities and conditions as is customary and not contrived for the benefit of the assessment.
7. **Ensure that assessment results are documented** and reported, including areas that are performing well and areas needing improvement.
8. **Take corrective actions** as warranted where performance needs improvement and latent weaknesses are identified.
9. **Re-assess** when significant corrective actions have been implemented to ensure that they are effective and to resolve the issues without serious unintended consequences.

Avoid These At-Risk Practices

- Picking and choosing process areas that are easy to assess
- Failing to specify realistic objectives for selected process areas
- Failing to develop reliable and accurate measures
- Failing to assess all appropriate work areas at a reasonable periodicity
- Assigning assessment duties to individuals who are unprepared for the task
- Failing to report findings or provide feedback to the group whose process was assessed
- Not taking the corrective actions necessary to change the process conditions
- Conducting the self-assessment on a deliberately staged work process

PERFORMANCE INDICATORS

Overview

Performance indicators or metrics are parameters measured to reflect the critical success factors of an organization. The purpose of these measures is to provide facility personnel with a way of knowing whether planned activities are occurring as originally intended as well as warning of developing problems.

There are two types of indicators:

- **Lagging** – Measures of **results or outcomes** which represent where you are and what you have accomplished, but do not necessarily predict future accomplishments, and

- **Leading** – Measures of **system conditions,** which provide a forecast of future performance; measures of **organizational "health,"** which can predict results and achievements.

Selecting appropriate and useful performance indicators is a difficult process which requires careful thought, recurring refinement, collaborations, and understanding. Frequently, things are counted because they can be, but provide little insight as to how the organization is functioning now and no clue to future performance. Monitoring results, either good or bad, is a lagging indicator—it may be a worthwhile indicator, but it does not prove that current or past performance will continue. Monitoring processes or behaviors considered important to success provides a leading indicator—a forecast of things to come.

Examples of lagging indicators include the following: industrial safety lost-time injuries per 200,000 man-hours worked, collective radiation exposure, frequency of contamination events, rework (defined broadly as any action that results in loss of time, labor, money, or other resources within a particular period of time), ratio of repeat activities (within 18 months after maintenance) to work orders completed, recurring corrective actions, recurring causal factors.

Examples of leading indicators include the following: time to implement corrective actions, overtime and absenteeism, self-reporting ratio (number of problems identified by workers vs. total number of problems identified), backlogs (e.g., procedure revisions, temporary modifications, leak repairs, work-arounds, work orders, maintenance items), attitudinal/culture surveys, number of in-field observations, suggestions/deficiencies submitted per person per month, number of employee concerns submitted.

Trend Analysis and response is another challenging aspect of using performance indicators. Simple graphing of raw data is sufficient when there are reasonable quantities of data and trending is obvious. However, where there is limited data (e.g., lost time accidents per month) a single event could appear to be a trend. Rolling averages do not improve the analysis of this type of data. Statistical data analysis is required to meaningfully use this data—ensuring appropriate reaction vice knee-jerk response. There are experts, books, and courses which address statistical

data analysis far beyond the scope of this document. The point here is to highlight that beyond selecting the "right" metrics, they must be properly analyzed to achieve their real value.

Use This Tool

- When selecting indicators for a performance monitoring program
  - To document trends in errors, mishaps and near misses over time

Steps When Selecting Performance Indicators

1. Clarify the results statements. Good performance indicators start with good results statements that people can understand and agree on.
   - Carefully consider the result desired – precise wording and intention.
   - Avoid overly broad results statements – use aspects believed to make the greatest difference to improved performance.
   - Be clear about what type of change is implied. What is expected to change – a situation, a condition, level of knowledge, an attitude, or a behavior?
   - Study the activities and strategies directed at achieving change.
2. Develop a list of possible indicators. Use internal brainstorming and experience of other operating units with similar indicators, as well as consultations with experts
   - Be inclusive.
   - Allow free flow of ideas and creativity.
   - Consider the message or unintended consequence of the measurement.
3. Assess each possible indicator using the following criteria for judging appropriateness and utility.
   - **Direct** – Meaning the indicator should measure as closely as possible the result it is intended to measure.
   - **Objective** – An objective indicator has no ambiguity about what is being measured, that is., there is general agreement over interpretation of the results.
   - **Adequate** – Taken as a group, a performance indicator and its companion indicators should adequately measure the result in question.
   - **Quantitative, where possible** – Quantitative indicators are numerical. The numerical precision of quantitative indicators lends them to more agreement on interpretation of results data. Qualitative indicators can supplement the numbers and percentages with a richness of information.
   - **Disaggregate, where appropriate** – Disaggregating people-level program results by gender, age, work group, or some other dimension is often important from a management or reporting point of view.

- **Practical** – An indicator is practical if data can be obtained in a timely way and at a reasonable cost. Managers require data that can be collected frequently enough to inform them of progress and influence decisions.
- **Reliable** – Is the data from the indicator of sufficiently reliable quality for confident decision-making to be obtained?

When assessing and comparing possible indicators, it is helpful to use a matrix with the seven criteria arrayed across the top and the candidate indicators listed down the left side. With a simple scoring scale, for example 1-5, rate each candidate indicator against each criterion. These ratings will help give an overall sense of the indicator's relative merit, and help in the selection process. Be flexible and recognize that all seven criteria may not be equally important.

10. Select the "best" performance indicators.

- They should be the optimum set that meets the need for management—useful information at a reasonable cost.
- Leading indicators are more valuable than lagging indicators, but normally more difficult to select and use.
- Remember the costs associated with data collection and analysis. Limit the number of indicators used to track each objective or result to a few (2-3). Select only those that represent the most basic and important dimensions of your objectives.

11. Determine analysis technique

1. Assign an owner for the indicator
2. Evaluate targets, limits, and trending methodology and periodicity
3. Employ statistical expertise to improve analysis
4. Where possible, analyze past data to evaluate the usefulness of the indicator and analysis technique

Avoid These At-Risk Practices

- Using certain parameters primarily because they are easy to measure
- Failing to obtain general management agreement on the selection of performance indicators
- Selecting indicators, collecting and assessing data and doing nothing with it
- Not being selective about the number indicators and/or the quality of their usefulness

INDEPENDENT OVERSIGHT

Overview

Reviews of facility activities by outside organizations or agencies provide an opportunity to reveal 'blind spots' to facility management and personnel that could otherwise remained hidden. Independent Quality Assurance departments, DOE oversight groups, consultants, regulators and the Defense Nuclear Facilities Safety Board evaluations and assessments provide opportunities to identify these latent conditions. Independent oversight can identify conditions, processes, and practices that fall short of industry best practices and those that could lead to degraded facility performance if uncorrected.

DOE P 226.1A, *Department of Energy Oversight Policy*, establishes a Department-wide oversight process to protect the public, workers, environment, and national security assets effectively through continuous improvement. It includes the full range of oversight, from external independent reviews through self-assessment, which involve evaluation of contractor organizations and Federal organizations that manage or operate DOE sites, facilities, or operations. DOE O 226.1A, *Implementation of Department of Energy Oversight Policy*, promulgates the requirements of this policy.

DOE O 470.2B, *Independent Oversight and Performance Assurance Program*, describes the formal DOE independent oversight program applicable to program and operations offices and to contractor organizations, alike. The Office of Independent Oversight (HS-60) has responsibility for independent oversight within the Department in the areas of safeguards and security; cyber security; emergency management; and environment, safety, and health.

An external independent assessment is essentially a reverse benchmarking exercise. As opposed to doing the research on "best in class" and to travel in order to learn about relevant best practices in other organizations, an external independent assessment group comes to the organization to review its operations and processes against industry standards. In both benchmarking and independent assessments, facility personnel learn first hand just how well their practices and processes compare with industry best practices and standards.

Most independent assessments are not conducted at the recipient managers' invitation. Hence, the supposition is that "if I am being evaluated from outside there must be something wrong." Most managers and supervisors are passionately committed to their work and their organization. Telling a manager his/her operation is below par and requires correcting has the same affect as telling a young mother her baby is ugly—they both become defensive. There is a natural human tendency to resent outsider involvement in local operations. This is partly related to the fact that people don't like to be told what is below standard from those who "don't work here and can't know as much as we do about the operation."

However, people with broad knowledge and experience outside the organization may spot troubled areas and process weaknesses far more readily than individuals living within the system. Managers and supervisors can benefit greatly from the findings of an independent oversight.

This is especially true when they remain dispassionate and objective, remembering that the assessment is evaluating facility processes, practices, and behaviors, not targeting individuals.

Use This Tool

- To gain information that can be used to make improvements in operations and maintenance to comply with best practices and high standards
- To strengthen organizational processes and values
- Following recognition of a need to improve the way business is being done
- To identify issues in an organization at the manager's request

Recommended Practices When Using This Tool

1. **Designate points of contact** (POCs) with the responsibility of assisting members of the independent oversight team with their assessment. POCs can answer questions, refer team members to the right references, and point them to the right people and locations needed to carry out their assignments.
2. **Conduct daily briefings with POCs** for the purpose of communicating status of the oversight and to coordinate how better to support the team's needs.
3. **Attend in-process and close-out debriefs** conducted by the team when invited to acquire input on observations and findings. In doing so, managers more readily understand the developing issues and the team's findings.
4. **Carefully review the draft report** with the assessment team for accuracy and applicability, and provide timely feedback. Resolve misunderstandings, and help correct incorrect statements and conclusions.
5. **Provide copies of the draft and final report** to individuals in the organization for review in order to develop a corrective action plan that addresses findings.
6. **Develop a corrective action plan** indicating the following for each finding.
   - Individuals and organizations responsible for the finding and resolution
   - An analysis of the underlying causal factors (to determine if there are systemic program weaknesses)
   - Steps to address the cause(s) of the finding
   - Planned actions to prevent recurrence of the finding
   - Action completion dates
   - How actions will be tracked to completion

- Mechanisms for verifying closure to ensure that actions are appropriate to prevent recurrence of the finding.

7. **Implement the corrective actions** and track progress to completion. Comply with the assessment requirements for communicating progress.
8. **Follow up with periodic management self assessments** to ensure corrective actions have been institutionalized and are engrained in facility operations and behavior.

Avoid These At-Risk Practices

- Becoming defensive and resistant to outside evaluations and the resulting findings, thereby missing the opportunity to learn and improve from the experience
- Failing to effectively include staff in the process of reviewing the findings, developing the action plan, and working corrective actions, so ownership and commitment to the changes undertaken are diluted
- Doing a cursory analysis of findings that precludes deeper discovery of systemic/ program weaknesses, so the mindset that the "system is fine" prevails and nothing really changes
- Neglecting to perform self-assessments or management reviews to confirm that corrective actions are being thoroughly implemented

WORK PRODUCT REVIEW

Overview

Work product reviews provide accurate feedback to the originators regarding their performance on specific products. Such reviews encourage face-to-face interaction between supervisors and scientists, engineers, procedure writers, and other knowledge workers. Not only are areas for improvement identified on an individual basis, but also strengths are highlighted and communicated to others for emulation. Supervisors can use the results of a review to communicate, coach, and reinforce expectations.

Technical work products are selected periodically. Some products, because of their risk importance, receive routine reviews. Managers can monitor the results of these reviews via the observation process to identify improvement opportunities and factor them into the related training programs. Using a checklist and assigning a grade offers another way to track improvement.

Use This Tool

- Periodically by each manager, supervisor, or team lead
- As required by administrative instructions
- During apparent cause evaluations and root cause analyses

Recommended Practices When Using This Tool

1. **Select Product** – On a periodic basis, select a sample of products for review.
2. **Develop or validate a checklist (or equivalent) of important attributes** to use in the review such as the following. (*Note: These attributes are examples only and should not be considered comprehensive.)*
   - Problem statement and/or solution(s)
   - Project work plan content (if applicable)
   - Potential outcomes related to critical attributes
   - Methods and analytical techniques used
   - Operating experience and lessons learned
   - Risks, hazards, and user-centered design considerations
   - Requirements, standards, and code compliance
   - Implementation planning, oversight, and acceptance testing
   - Input data and sources

- Assumptions
- Documentation and reference software used
- Technical accuracy and usability of procedures
- Reviews and approvals
- Program or procedural obstacles to desired performance
- Surprise situations; for example, unanticipated risk factors, schedule or scope changes, and organizational issues
- Engineering human performance tool(s) applicable to product(s) or related activities

3. **Review the Product** – Use a cross-functional team of knowledgeable personnel to conduct the review. Identify what went well (pluses), opportunities for improvement (deltas), and problems (minuses) for the particular product.

4. **Assess and Document Product Quality** – Document and trend the results of the review. A grade may be assigned, using objective criteria similar to the following.

   A. Excellent: no defects identified or errors found with the delivered product

   B. Satisfactory: errors with little or no impact on product quality or its conclusions

   C. Unsatisfactory: several errors found, or minor rework required

   D. Unacceptable: errors that require significant rework or changes to product conclusions, invalidating the integrity of the product

5. **Follow-Up** – Follow up successes and opportunities for improvement (using methods such as recognition and condition report).

6. **Feedback to Responsible Person(s)** – After the responsible person reviews the written comments, provide face-to-face feedback on the resolution of a particular issue and those of high interest to the responsible person. Provide specific feedback on "excellent," "unsatisfactory," and "unacceptable" grades.

Avoid These At-Risk Practices

- Performing a cursory review of the package—performing a review only to meet a requirement or quota; not carefully evaluating the quality of the work product
- Not gaining a cross-functional perspective on the product
- Not holding subordinate managers or supervising engineers accountable for performing work product reviews
- Not performing the work product reviews early enough to allow for feedback into the normal work cycle for repetitive tasks

INVESTIGATING EVENTS TRIGGERED BY HUMAN ERROR

Overview

A traditional view of events and accidents is that they are caused by shortcomings in human competence, attention, or attitude. It may be under the label of "loss of situation awareness," procedural "violation," or "poor" management. A new and different view is that human error is not the cause of failure, but a symptom of failure—trouble deeper inside the system. Human error is not the chief threat to system safety, but rather latent organizational conditions set the stage for error and determine the severity of the consequences. Human error is not just random. It is tied to features of people's tools, the tasks they perform, and the operating environment in which they work. In this perspective, human error is not the conclusion but rather the starting point of investigations. The point of these investigations should be to prevent recurrence, not simply to find people to punish.

Investigations of accidents or events triggered by active error are usually distorted by hindsight—the analyst's knowledge of facts after the event that were not known, or possibly even knowable, by the individual(s) involved in the event. In traditional investigations, the investigators interview the people involved after gaining an understanding of the requirements and after becoming very familiar with the details of the event. Hindsight predisposes the investigator to search for information that confirms the individual's apparent shortcomings. Further, explaining what people could have or should have done says nothing about why they did what they did. Analyzing events from the perspective of "why did the actions taken seem appropriate at the time?" goes a long way to preventing the same thing from happening in the future.

In human error investigations, a key approach is to recreate the mindsets of those involved in the accident or incident scenario. Knowing the mindset does not mean getting into the mind of the individuals, but rather determining the environment they found themselves in at the time that may have influenced their decision-making process. The challenge, therefore, is to determine why actions of the individuals made sense to them at the time. With this new approach, investigators are encouraged to interview those involved with the incident before acquiring detailed knowledge of the event. This allows the gathering of information without having been biased with previous assumptions and information. This process of recreating the decision-making environment is an attempt to assess the decisions and behaviors in their "context." It is important to obtain a meaningful understanding of how facts—including decisions and behaviors—were influenced. Understanding context is the key to a successful human error investigation and to providing lessons learned for the future."

Use This Tool

- When preventing recurrence is more important than personnel punishment
- To identify latent organizational conditions that create error-likely situations or weaken defenses – contributing to the severity of the incident or accident

Recommended Practices When Using This Tool

Given a description of the event consequences (fatality, injury, facility shutdown, equipment damage, near miss, etc.) follow these steps.

1. **Debrief** the participants to help reconstruct the situation that surrounded them at the time and receive their point of view on the situation.
   - Ask participants to tell the story from their point of view
   - Tell the story back to them to check whether you understand the story as the participants understood it
   - Identify with participants the critical junctures (moments in time when decisions and/or actions were required) in the sequence of events
   - Progressively probe and rebuild how the world looked to people on the inside of the situation at each juncture. At each juncture in the sequence of events, you want to get to know
     - Which cues were observed (noticed or seen or did not notice what he/she had expected to notice?)
     - What knowledge was used to deal with the situation? Did participants have any experience with similar situations that was useful in dealing with this one?
     - What expectations did participants have about how things were going to develop, and what options did they think they had to influence the course of events?
     - How did other operations or organizational influences help determine how they interpreted the situation and how they would act?
2. **Use Questions** to find out how the situation looked to people on the inside at critical junctions.

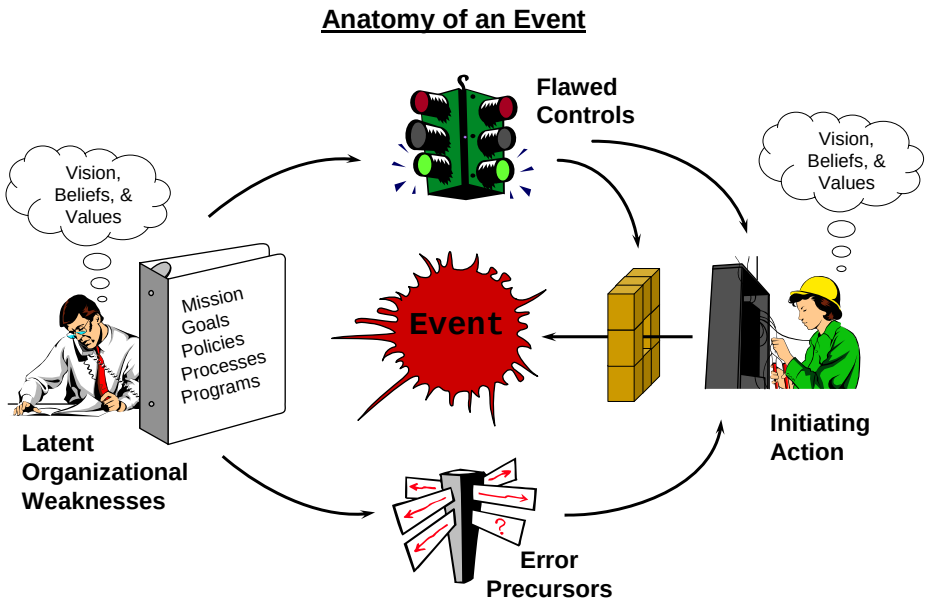
Cues	a. What were you seeing? b. What were you focusing on? c. What were you expecting to happen?
Interpretation	If you had to describe the situation to your crew member at that point, what would you have said?
Errors	What mistakes were likely at this point (for example in interpretation)?
Previous experience and knowledge	a. Were you reminded of any previous experience? b. Did this situation fit a standard scenario? c. Were you trained to deal with this situation? d. Were there any rules that applied clearly here? e. Did you rely on other sources of knowledge to tell you what to do?

Goals	a. What goals governed your actions at the time? b. Were there conflicts or trade-offs to make between goals?
Taking action	a. Was there time pressure? b. How did you judge you could influence the course of events? c. Did you discuss or mentally imagine a number of options or did you know right away what to do?
Outcome	a. Did the outcome fit your expectation? b. Did you have to update your assessment of the situation?

3. **Review the job-site conditions** for each individual involved in the accident.
   - Look for procedures, logs, computer printouts, recorders traces,
   - Review the workplace and the equipment
4. **Assemble all the data acquired to this point** – These data should indicate a sequence of events and activities.
5. **Lay out the sequence of events** in context-specific language – The data as the investigator found them (or factual information) using time and space as organizing bases. Include people's actions and observations and changes in a process that happened.
6. **Divide the sequence of events into episodes (chapters).** An episode is a longer stretch of time that (initially) makes sense from the point of view of the domain. Example: the time taken to taxi out to a runway is a meaningful chunk of time in which particular actions and assessments need to be made to prepare for the next episode (taking off).
7. **Find out what the world looked like during each episode.** Find the data known to have been available to people during each episode (what their process was doing, what data was available). This is the first step toward coupling behavior and situation. Link up all the events that have been identified with the unfolding process.
   - Find out how process parameters were changing over time, both as a result of human influences and of the process moving along. Trace changing pressures, ratios, settings, quantities, modes, rates and so forth.
   - Find out how the values of these parameters were available to people – dials, displays, knobs that pointed certain ways, sounds, mode annunciations, alarms, warnings. There will be mismatches between what was available and what people observed or used that do not explain anything by itself.
   - Decide which of all the parameters counted as a stimulus for behavior under investigation, and which did not. Which of these indications or parameters were actually instrumental in influencing the behavior in the mishap sequence?

8. **Identify knowledge, focus of attention, and goals.** Reconstruct people's unfolding mindset. Explain why their assessments or actions made sense to them at the time. This is done by re-establishing people's knowledge, goals, and attention at the time.
   - People have goals. They are in a situation to get a job done; to achieve a particular aim. People have knowledge. They use this to interpret what goes on around them. People's goals and knowledge together determine their focus of attention..
   - Use the principle that people do reasonable things given their knowledge, their objectives, their point of view and limited resources. This is the step that takes most work

Using the *Anatomy of an Event* model as a guide, complete the following steps.



9. **Identify the task(s) or activities** associated with the initiating action.
10. **Identify the defenses or barriers** that failed to prevent, catch, or mitigate the consequences of the event (the behavior of the individual).
11. **Identify the defenses or barriers** that failed to prevent or mitigate the consequences of the event (the results to the facility).
12. **Identify job-site conditions and error-precursors** that provoked active errors or encouraged violations.
13. For the factors identified in 10, 11, and 12 above **trace the organizational process or cultural contributors**.

Avoid These At-Risk Practices

- Learning too much about the event before debriefing the individuals involved
- Failing to debrief all the individuals involved in the event

- Failing to ask all the questions needed to establish the individuals' frame of mind (context of actions)
- Failing to adequately reconstruct the sequence of events as they occurred
- Assuming the system is sound; and free of latent weaknesses, conditions, or failures
- Ignoring the results of the front-end error investigation in the back-end analysis of flawed defenses, job-site conditions, and organizational contributors
- Concluding that the cause of the event was that the people involved in the event did not act reasonably and not identifying why

OPERATING EXPERIENCE

Overview

The basic logic behind the need for a thorough operating experience program is that serious accidents are almost always preceded by less serious "precursor events." A precursor event is an actual event or condition that has some of the characteristics of a serious accident, but falls short of significant consequence. By taking actions to prevent recurrence of similar events, one is thereby reducing the probability of serious accidents. All major facilities experience individual component and system failures from time to time, almost always with limited to no safety consequences. Many of these operating events include contributions from human and organizational factors. If no steps are taken to correct the fundamental causes of these failures, they will recur and accompanied by other failures or perhaps human errors, will lead to a more serious event or accident. Therefore, an effective Operating Experience (OE) program is a key factor in maintaining the strength of the defense-in-depth concept. The rationale for the importance of a vigorous OE program to promote effective human performance (safety, quality, and productivity) is to:

- learn from the local experience as well as other organizations' experiences with successes, failures, and near-misses;
- identify processes to be improved by "best industry practices";
- identify local organizational conditions similar to those which have led to problems in other organizations;
- identify and quantify events and conditions that are precursors to more serious events;
- discover emerging trends or patterns of potential safety significance; and
- recommend steps to prevent the recurrence of similar events.

In its broad application, OE is defined as all events, conditions, observations, and new information that could affect how work is conducted. This broad definition includes the following categories.

- Actual operating events accompanied by equipment failures, human errors or other anomalous behavior
- Actual failures of systems, structures or components, or human errors, that may or may not have caused an accident
- Adverse safety conditions such as design weaknesses, degraded safety equipment or aging effects that could lead to failures of systems, structures or components

- Organizational or human factor issues such as a degraded safety culture at the facility, high human error rates, weak quality assurance programs, inadequate procedures, inadequate training
- External challenges such as vulnerability to severe weather, flooding, high winds or security threats
- Successes achieved by processes or methods put in place to improve performance

Use This Tool

- To acquire and communicate brief examples of problems and mistakes encountered in actual cases and to present points to consider for avoiding similar occurrences
- To provide relevant information on lessons learned to individuals just in time
- When work history associated with specific jobs is pertinent to the tasks being performed
- To combat the natural human tendency to think "It can't happen here"
- To expand the sharing of good work practices

Recommended Practices When Using This Tool

1. **Collect all relevant OE information** – DOE Order 210.2, *DOE Corporate Operating Experience Program*, outlines how the Department collects and makes available to field elements and contractors OE information through reports, alerts, bulletins, advisories, and summaries, and on its website.
2. **Screen the OE information** for safety significance – Applicable contractor organizations have a designated OE Program Coordinator who functions as a point of contact with the DOE Corporate OE Program. The coordinator does the screening, the internal and external OE communications, and is the primary resource for contractor organizations.
3. **Analyze the OE events** or conditions – Determine local applicability.
4. **Distribute applicable corporate,** external and local OE documents to local potentially-affected personnel for review, analysis and implementation of corrective actions.
5. **Develop, implement and track actions** to correct problems in the causal analysis of operating experience. Be sensitive to organizational or human factor issues such as a degraded safety culture at the facility, high human error rates, and latent organizational weaknesses (e.g., training shortfalls, design flaws, inadequate procedures, deficient equipment or tools, etc.).
6. **Develop lessons learned on successes**. Ensure lessons learned are factored into training, maintenance and work planning, work processes, and design and construction as well as operations.
7. **Follow-up to ensure the actions** are completed satisfactorily.

8. **Establish metrics** to measure program performance and evaluate the effectiveness of actions implemented from lessons learned.

Avoid These At-Risk Practices

- Not retaining the lessons learned and subsequently forgetting them over time
- Doing nothing in response to information learned about others' experiences
- Focusing only on local OE and lessons learned, and disregarding OE information from DOE corporate and from external sources (other industries, other agencies, professional societies, trade associations, universities, other countries)
- Failure to establish performance indicators and track trends on the effectiveness of the corrective actions and lessons learned
- Neglecting to factor OE lessons learned into training or to consider application outside of operations

CHANGE MANAGEMENT

Overview

For the purposes of this document, change management is defined as a methodical planning process to establish the direction of change, align people and resources, and implement the selected modification throughout an organization, large or small.

A methodical approach involving management and leadership is necessary for change to take place in an effective and timely manner. Typically, change management has been reserved for large-scale organizational change and is not considered for day-to-day activities. However, most daily management activity involves some degree of change, such as changes in crew composition, maintenance schedule, policies, procedures, and equipment.

Effective change management reduces the potential for error by managers when they modify their way of doing business. Without a structured approach to planning and implementing change, the error potential for managers and the support staff is unacceptably greater. The following change process is one of many. It is used here as an example because it specifically relates to human performance improvement.

Use This Tool

- To guide implementation of process improvement initiatives

Recommended Practices When Using This Tool

1. **Create a vision** – Conceive a vivid realization of what can be.
2. **Consult the people affected** – Talk to your folks about the proposed change; explain the value and establish the urgency to change from the present way of doing business and get their feedback on the end-game.
3. **Consider the new values, attitudes, and beliefs needed** – Determine what fundamental changes are required to achieve this new way of doing things.
4. **Develop the plan** – Make a vision-oriented implementation plan based on the principles of human performance, input from front-line workers, and on an accurate self-assessment of the present reality; clear goals and next steps—how you are going to achieve the objective.
5. **Identify a Champion** – A member of the management team intimately involved in the change management effort (a sponsor), preferably someone with a passion for improving human performance who possesses the authority to devote resources to the change effort.
6. **Consider a Steering Committee** – Knowledgeable and reputable members of line management and dedicated members of the workforce willing to take a leadership role; a temporary organization established in an advisory capacity; not a problem-

solving committee (the need for a steering committee is dependent upon the significance of the change).

7. **Communicate** – Line management's repetitive efforts to create a shared understanding of the vision, the gap between the present and the vision's future state, and the strategy using multiple forums and mediums; include active clear explanations of expectations and account-abilities.
8. **Empower** – Educate people and align organizational processes to remove barriers to implementation of the strategy.
9. **Implement** – Work the plan, reinforce the desired behavior
10. **Generate short-term successes** – Identify examples that indicate the changes are working and confirm the validity of the vision; reward those who exhibit new behaviors, and build momentum for the rest of the organization.
11. **Have Patience and Perseverance** – Realize change does not normally happen overnight; consolidate gains in behavior via modifications to organizational processes and via leadership focus and attention; promote ongoing efforts for continuous improvement.

Avoid These At-Risk Practices

- Not setting a clear vision
- Not involving affected personnel in the vision or plan
- Failing to set expectations, establish urgency or share understanding of the need for change
- Failing to consider the new values, attitudes and beliefs needed
- Not taking the time to inform people about the coming change
- Assuming that members of the organization know about the change and the value of changing
- Being impatient and failing to stay-the-course when you have done your homework and know this is the proper approach

REPORTING ERRORS AND NEAR MISSES

Overview

DOE contractor organizations use various means to acquire workers' feedback on concerns, conditions, situations, and problems they encounter in the facility. Common feedback mechanisms include employee concerns programs, "hotline" (telephone or internet) for reporting concerns, pre-job briefs, job hazard walk-downs, post-job reviews, employee suggestion forms, safety meetings, and employee participation in committees and working groups. Feedback acquired from these various means primarily addresses irregularities or anomalies associated with the facility, with work processes or with equipment and machinery. Individuals are generally conscientious about reporting such things as the following.

- Physical safety hazards (dysfunctional alarms, burned out warning lamps, deficient tools, leaks and spills, radiation detection equipment malfunctions, personal protection equipment shortfalls, etc.)
- Facility deficiencies (loose stair treads, broken fixtures, HVAC problems, ice on walkways, leaky roof and the like)
- Equipment issues – both plant and office (condition, status, malfunctions, misuse maintenance, etc.)
- Security problems (violations, theft, etc.)
- Work processes (inefficiencies, quality problems, coordination failures, documentation anomalies, etc.)

Organizations that embrace human performance principles and concepts strongly encourage members of their organization to report errors and near misses. Management uses this feedback to identify organizational problems and help individuals and teams learn from these mistakes in order to perform better in the future. Documenting and learning from patterns of failure provide free lessons for organizations that are successful in acquiring this kind of feedback. It is used in training, briefings, drills, exercises, and dry runs. However, most organizations do not do a good job of acquiring feedback on human errors. The focus of this tool is to lay out the prerequisites to establishing an error reporting system. It must be recognized that a change in culture may be required within many organizations before an error reporting system can be undertaken.

Use This Tool

- To obtain information about the nature and extent of active errors taking place
- As a basis for seeking ways to alter practices that provoke error
- To strengthen training and development activities to improve performance
- When management is ready to look beyond the 'tip of the iceberg'

Recommended Practices in the Development of This Tool

A. Create a "Just Culture" – This is a required prerequisite. It involves management getting the balance right between how unintentional errors and willful violations are addressed in the organization. Ideally there should be zero tolerance for reckless conduct balanced by widespread confidence among managers that the vast majority of unintended unsafe acts will go unpunished as honest errors.

1. **Stop naming, blaming, shaming, and retraining** individuals for honest errors. Remember an error is an unintentional departure from an expected behavior—it is something the performer did not intend to do.
   - There is an overwhelming tendency to point fingers at people based on the consequence of their action and not on the intent of the action. If either the violation or error they committed causes an accident or an event of some kind, they are disciplined, but the very same actions (violations and errors) that have no consequence, are ignored or allowed to slide.
   - This means that someone who inadvertently errs is held accountable for their actions in the same way that an individual is who intentionally performs work that violates policy, procedure, or standard.
2. **Select and implement a method** to help determine culpability for serious incidents in which unsafe acts are involved. (These example methods are described in more detail in Volume I, Chapter 4, of the *Human Performance Improvement Handbook*.)
   - The Foresight Test – Ask the question of other people in the workgroup, "Did the individual involved in the incident engage in behavior that others (when asked individually) recognize as being likely to increase the probability of making a safety-critical error?"
   - Culpability Test – If the individual was working while under the influence; was clowning around with equipment or vehicles; was taking unwarranted short cuts; or consciously selected sub-standard or inappropriate tools, equipment, or parts, then they are likely more culpable for their actions
   - The Substitution Test – The following question is asked of several peers of the individual involved in the event: "In light of how events unfolded and were perceived by those involved in real time, is it likely that you (a different person with similar skills and training) would have behaved any differently?" The question can be worded differently: "given the circumstances that prevailed at the time, could you be

sure that you would not have committed the same or a similar type of unsafe act?" If the answers are "no," then blame is likely inappropriate.

- Culpability Decision Tree (CDT) – This is used in conjunction with an organization's accountability policy. The CDT is a logic diagram that managers can follow as they ask questions to determine an individual's intent, expectations, prior knowledge, and prior performance problems associated with their recent unsafe act. By following the logic on the CDT, the manager can gage both individual culpability (for an intentional act to cause harm, reckless violation, and negligent error) and organizational culpability (for induced violation and induced error). See attachment.

3. **Hold the reckless violators accountable**

   - Members of the organization need to know that management is getting the balance right, that willful violators are being disciplined, and that those who commit unintentional errors are not punished.

   - Once people know they are not going to be punished for making an honest mistake or one likely made due to organizational conditions, the climate is ready to introduce an error reporting system.

B. Steps needed to make a successful reporting system. – Once a Just Culture is in place there are challenges to creating an effective reporting system. Listed here are several common barriers followed by a solution for resolving the barrier.

1. ***Natural disinclination*** to confess one's blunders – people do not want to be held up to ridicule

   Solution – *De-identification:* make error reports anonymous or at least confidential (known to a limited few). It is a compromise as total anonymity precludes any follow-up and limited confidentiality may cause some people not to report.

2. ***Suspicion*** that such a report might go on the record and count against the individual in the future.

   Solutions – *Protection:* top management must endorse a policy of indemnity (or at least partial indemnity) against disciplinary procedures for self-reporting. *Separation of Functions:* the group that collects reports should not be in a position to initiate disciplinary action.

3. ***Skepticism*** – "if we go to the trouble of writing a report that reveals system weaknesses, how can we be sure that management will act to improve matters?"

   Solution – *Feedback:* rapid, useful, accessible, and intelligible feedback to the reporting community is essential. Reporting will dry-up if it is perceived that it goes into a 'black hole.'

4. ***Too much time and effort*** – Writing the report is time-consuming. Why should we do it?

   Solution – *Ease of making the report:* should be available to all. Provide for free-form input. A constrained format is less preferred.

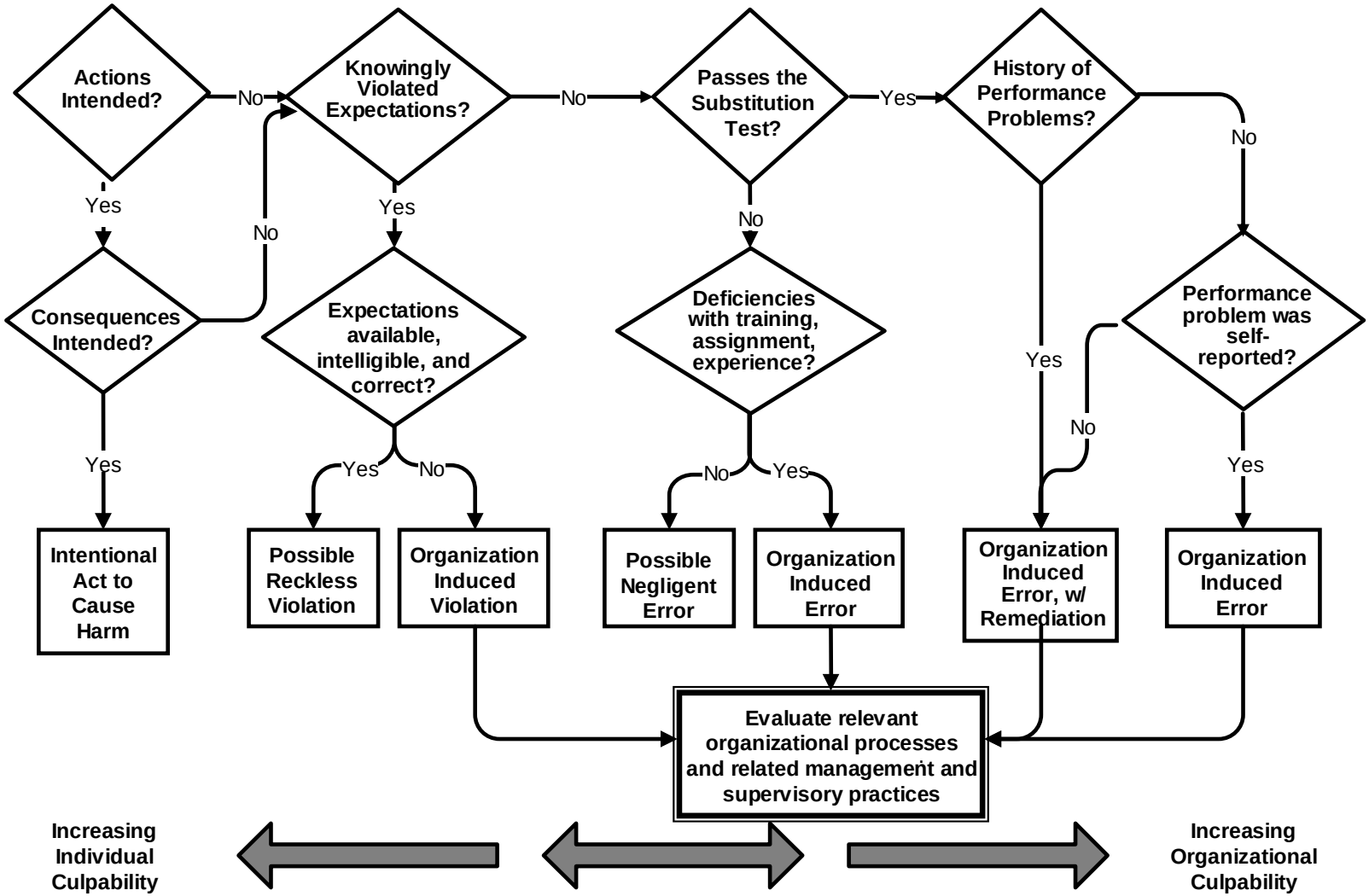
C. A Sound Reporting Strategy – Carry out the following activities with the help of a human performance improvement committee or equivalent.

1. **Inform** people of the forthcoming reporting system. In managers' meetings with employees explain why it is important to obtain feedback on errors and events. Describe expectations and discuss how information will be used.
2. **Designate** an event report coordinator. The coordinator's responsibilities should include tracking and trending reports, providing feedback to the workforce, keeping management informed of significant mishaps and events with a high probability of similar outcomes in the future.
3. **Develop** a report format that is easy to use and complete with useful designators that can help managers better identify latent weaknesses in the system.
4. **Make the report form readily available** in the workplace or on computer desktops. Facility computers should have an icon on the desk top that takes users directly to the reporting form. When they have completed the form, the click of their mouse should send the document to a designated electronic address.
5. **Provide examples** of hypothetical reports. Give people a template representing the level of detail, specificity, and facility reference points that makes clear the expectations.
6. **Encourage** people to report errors and mishaps and reinforce the behavior. Inform people periodically of the significance of their reporting and how the data is being used.
7. **Track and trend errors** from the reporting system. Use this important feedback information to identify areas of high risk or process weaknesses where corrective actions can be taken to reduce error.
8. **Use data** from the reports in ongoing training and lessons learned.

Avoid These At-Risk Practices

- Launching a reporting system without first establishing a Just Culture
- Failing to address the primary reporting barriers that have to be overcome when establishing an error reporting system
- Acquiring data on errors and events and doing nothing with the information
- Using the input from the reporting system in ways that were unintended
- Failing to encourage and reinforce reporting
- Failing to provide timely feedback on reporting errors to members of the organization

CULPABILITY DECISION TREE



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EMPLOYEE SURVEYS

These surveys can be used as a one-time gap analysis tool or periodically to monitor employee trends in values and beliefs regarding the organization. Survey results help managers determine where their time and effort can be applied most effectively to address concerns, misunderstandings, and inappropriate values. Employee responses to surveys can be very useful in assessing various aspects of the organization's processes and safety culture that need management attention. Surveys have also proven useful tools in discovering issues related to human performance awareness and related matters. The survey instruments are presented in the pages below as examples. A brief introduction to each of them follows.

- The Organizational Safety Climate Assessment Questionnaire provides a means to gain feedback from employees regarding safety issues, notably their attitudes and perceptions of the organization's operational practices from a safety perspective.
- The Human Performance Gap Analysis Tool is intended to be completed by the human performance improvement site leadership team in the process of implementing HPI to identify soft spots where the leadership team should focus its attention.
- The Job-Site Conditions Self-Assessment Questionnaire captures the opinions of supervisors and managers on their views of job-site conditions from a human performance-based perspective. When completed, the results shed light on potential organizational weaknesses that provoke specific undesirable conditions.

Use These Tools

- To assess employees' beliefs and attitudes about the organizational safety culture in which they operate
- When initiating a human performance improvement initiative
- Periodically to trend changes in individuals' perceptions of operational practices
- When indicators suggest that human performance factors associated with mishaps and incidences are increasing
- When there is a need to identify potential latent organizational weaknesses

Recommended Practices When Using These Tools

1. **Follow the site regulations** for conducting human subject questionnaires and surveys to ensure workers' privacy and rights are protected**.**
2. **Review and validate** the questions to be used. Develop additional questions and make changes to existing questions as appropriate to fit local conditions.
3. **Determine** how and when to administer the questionnaire.

4. **Inform the** members of the organization to be surveyed of the purpose for doing this activity and answer questions, including how the feedback will be used.
5. **Administer** the questionnaire or survey instrument and assemble the data (consider making the questionnaire or survey available on facility computer desktops so individuals can respond electronically)
6. **Analyze** and interpret the data; obtain management concurrence on the results
7. **Establish** an action plan to address priority problem areas
8. **Inform** the workforce of the results of the survey and action plan and elicit their support.

Avoid These At-Risk Practices

- Failing to validate the questions for use with a specific organization or facility
- Allowing an unstructured and uncontrolled approach to administering the survey
- Neglecting to inform the workforce of the forthcoming survey and its importance
- Failing to keep management informed of the analysis results, interpretation of the data and proposed action plan
- Collecting the data and doing nothing with it
- Failing to provide feedback of the results to the employees who participated

Organizational Safety Climate Assessment Survey

Overview

The Organizational Safety Climate Assessment Survey (OSCAS) assesses an organization's operational practices from a safety perspective. OSCAS is designed to provide managers with a means to survey their employees' attitudes and perceptions with regard to safety issues. Following administration of the survey, managers receive feedback concerning key issues regarding organizational climate, safety culture, human factors, resources availability, workload, and other factors relating to safely managing facility operations. The primary goal of this survey is to identify and correct latent organizational conditions that may lead to increased potential for operational mishaps. With the results of the survey, and other indicators, managers are in position to develop and implement strategies to better their organization's performance. This survey tool is adapted from the Naval Post-Graduate School document *Command Safety Climate Assessment Survey*.

Organizational Safety Climate Assessment Survey

Circle the response that best expresses your experience – Use N/A or don't know as applicable

1. My organization conducts adequate reviews and updates of safety standards and operating procedures.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
2. My organization uses an internal audit and hazard reporting system to catch any problems that may lead to a mishap.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
3. My organization has a defined process to set training goals and to review performance.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
4. My organization closely monitors proficiency and currency standards to ensure workers are qualified.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
5. The leadership in my organization is actively involved in the safety program and management of safety matters.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
6. My organization has a defined process to effectively manage the high-risk operator, maintenance, and technician tasks.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
7. Management has been successful in identifying individuals who pose a risk to safety.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
8. Individuals in my organization effectively manage human errors and report flaws in defenses.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know

9. Managers in my organization work to eliminate latent organizational weaknesses that affect human error.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
10. The leadership in my organization encourages reporting safety discrepancies without the fear of negative repercussions.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
11. Individuals in my organization are willing to report safety violations, unsafe behaviors and hazardous conditions.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
12. In my organization, peer influence is effective in discouraging violations of standard operating procedures.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
13. In my organization, we believe safety is an integral part of all our work.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
14. In my organization, anyone who intentionally violates standards, safety-related procedures, or safety rules, is corrected in a timely manner.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
15. In my organization, violations of operating procedures and regulations, or general operational standards are rare.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
16. Leaders in my organization encourage everyone to be safety conscious and to follow the rules.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know

17. In this organization an individual who persistently violates operational standards and rules will seriously jeopardize his/her standing in the organization.					N/A Don't Know
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
18. I am not comfortable reporting a safety violation, because people in my organization would react negatively toward me.					N/A Don't Know
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
19. My organization has a reputation for high-quality performance.					N/A Don't Know
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
20. My organization sets high quality standards and strives to maintain quality control.					N/A Don't Know
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
21. My organization closely monitors quality and corrects any deviations from established quality standards.					N/A Don't Know
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
22. Quality standards in my organization are clearly stated in formal publications and procedural guides.					N/A Don't Know
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
23. Leaders in my organization allow cutting corners to get a job done.					N/A Don't Know
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
24. Lack of experienced personnel has adversely affected my organization's ability to operate safety.					N/A Don't Know
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	

25. Safety decisions are made at the proper levels by the most qualified people in the organization.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
26. Leaders in my organization consider safety issues during the formation and execution of operational plans.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
27. Leadership in my organization has a clear picture of the risks associated with Operations.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
28. My organization takes the time to identify and assess risks associated with its operations.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
29. My organization does a good job managing risks associated with its operations.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
30. My organization has increased the chances of a mishap due to inadequate or incorrect risk assessment.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
31. I am provided adequate resources (time, staffing, budget, and equipment) to accomplish my job.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
32. Overtime work is sufficiently controlled to preclude fatigue that could affect safety.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
33. In my organization, pre-job briefings are conducted to review complex or safety-related tasks.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know

34. Based on the organization's personnel and other assets, the organization is over-committed. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
35. My organization has incorporated risk assessment into decision-making at all levels. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
36. My supervisor can be relied upon to keep his/her word. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
37. Our leaders and supervisors can be trusted. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
38. My organization's Safety Officer is highly regarded. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
39. Our Safety Officer is influential in promoting safety. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
40. My organization is genuinely concerned about safety. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
41. Leadership in my organization is successful in communicating its safety goals to all personnel. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
42. My organization provides a positive climate that promotes safe operations. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know

43. Leadership in my organization is actively involved in the safety program and management safety matters. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
44. Leadership sets the example for compliance with facility operating standards. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
45. My organization ensures that all members are responsible and accountable for safe operations. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
46. Leadership in my organization willingly assists in providing advice concerning safety matters. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
47. Leadership in my organization reacts well to unexpected changes to its plans. 12. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
48. My organization does not hesitate to temporarily restrict individuals who are under high personal stress from performing safety-sensitive activities. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
48. I am adequately trained to safely conduct the work I do. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
49. Morale and motivation are high in my organization. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know
50. My organization ensures the uniform enforcement of all operating standards among its members. Strongly Disagree Disagree Neutral Agree Strongly Agree	N/A Don't Know

51. My organization provides adequate safety backups to catch possible human errors during high-risk operations.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
52. Good communications flow exists both up and down the organization.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
53. My organization has good two-way communication with other organizations.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
54. Safety education and training are adequate in my organization.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
55. The Safety Department is a well-respected element of my organization.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
56. The Safety Officer position is sought after in my organization.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
57. My organization's Safety Department keeps me well informed regarding important safety information.					N/A
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know

58. The most hazardous activity I perform is—	
59. The most significant actions my unit can take to improve safety is/are—	

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Human Performance Gap Analysis Tool

Purpose

This survey tool was developed to assist the human performance site leadership team (SLT), or similar, in performing a human performance gap analysis. The attributes used in this tool were derived from a variety of references and include key elements observed in top performing organizations. This survey tool has been adapted from the Institute of Nuclear Power Operations Publication 2006-03, *Human Performance Fundamentals Course Reference,* pages 112 through 116.

Method

This analysis tool is intended to guide the user(s) through a series of statements for which each member of the team provides an independent rating. Responses on this internal analysis should be based on the current understanding and opinion of each member and should not require reference to performance reports or other performance indicators. Clarifying comments should be encouraged for identified problem areas

Rating Categories

- Strength: This attribute is an obvious strength, no changes necessary.
- Satisfactory: This attribute appears satisfactory, no further actions anticipated.
- Worrisome: Although functional, this attribute has troublesome symptoms; several aspects need attention.
- Problem: This attribute may be inhibiting plant performance improvement; intervention should be considered.

Interpretation

Each attribute should be summarized for the organization and sorted by the number of respondents rating the attribute as a problem. Some organizations may choose to make responses anonymous; others may choose to identify specific departments. Facilitated discussions of organizational problems can help gain alignment and establish a common understanding of important issues facing the organization.

Suggestions for Follow-up

Resulting actions to the collective analysis of these attributes could include actions such as the following.

- The SLT could conduct facilitated discussions focused on the worrisome or problem areas identified. These discussions should include a clear definition of barriers or impediments to improvement and a consensus agreement on corrective actions for the SLT.

- Self-assessment activities could be focused on developing a clear understanding of the problem. Follow-up interactions could include engaging plant staff to help establish proposed solutions.

- Focused assistance visits from outside organizations should also be considered.

Human Performance Gap Analysis Tool

1. Leaders demonstrate a commitment to improving human performance by establishing, communicating, and reinforcing clear expectations for professional behavior, continuous improvement, appropriate policies, efficient and effective processes, and common values.

(Check the one box to the right of the question that best applies)

Attribute	Strength	OK	Worrisome	Problem
a. Senior management demonstrates commitment				
b. The strategy for improving human performance is understood				
c. Human performance goals are defined and measurable				
d. Individuals can describe in their own words the vision and mission of human performance improvement initiatives.				
e. Expectations are clear				
f. Managers demonstrate commitment and model expected behaviors				
g. Vertical and horizontal alignment of facility priorities				
h. Appropriate resources to reduce HP-related events (balanced procedures, supervision, knowledge)				
i. Desired behaviors are reinforced				

Comments ('Worrisome' or 'Problem' areas):

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2. Organizational processes and values include a defense-in-depth philosophy that considers human fallibility. These processes are also designed to function efficiently and to support safe operation.

(Check the one box to the right of the question that most best applies)

Attribute	Strength	OK	Worrisome	Problem
a. Performance goals are balanced with safety/production				
b. Department operation plans align with the business plan				
c. Work management processes are effective				
d. Procedures are accurate				
e. Procedures are updated in a timely manner				
f. Key initiatives and equipment upgrades are successful				
g. Effective change management is in place				

Comments ('Worrisome' or 'Problem' areas):

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3. Training and leadership experiences are used to improve human and facility performance, including the sharing of operating experience and beneficial techniques to reduce errors and eliminate events. All employees reinforce desired individual behaviors at every opportunity including subordinate and peer coaching. Reward and discipline practices are linked to professional behaviors.

(Check the one box to the right of the question that most best applies)

Attribute	Strength	OK	Worrisome	Problem
a. Training is valued, useful and reinforces expected behaviors				
b. There is universal ownership of training				
c. Workforce is knowledgeable and confident (at all levels)				
d. Professional development is encouraged				
e. Personnel welcome and appreciate coaching				
f. Error avoidance is recognized				
g. Incentives are not based solely on production				
h. Successes are celebrated (individual and unit)				
i. Operating experience is valued and solicited				

Comments ('Worrisome' or 'Problem' areas):

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4. Individuals at all levels demonstrate an intolerance of error-likely situations and flawed defenses, routinely consider how their actions can affect the operating facility, and take the initiative to communicate concerns. Individuals also demonstrate accountability for thorough task preparation, process execution, use of error prevention techniques, and contingency planning.

(Check the one box to the right of the question that most best applies)

Attribute	Strength	OK	Worrisome	Problem
a. There is awareness of top facility issues				
b. Individual awareness-understand consequences of mistakes				
c. Consistent focus on error-prevention (eliminate error-likely situations)				
d. Problems are anticipated				
e. Accountability—applied up front				
f. Clear individual roles and responsibilities				
g. Workforce feels empowered				
h. Self-starters—volunteerism is high				
i. Procedures are followed				

Comments ('Worrisome' or 'Problem' areas):

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5. Individuals at every level seek to continuously improve their performance, equipment performance, the work environment, and organizational processes by aggressively communicating opportunities for improvement. Managers and supervisors promote a continuous improvement culture by being highly responsive to employee input and by involving employees in developing actions to improve processes and techniques. Improvements are pursued through benchmarking, training, and innovation.

(Check the one box to the right of the question that most best applies)

Attribute	Strength	OK	Worrisome	Problem
a. Commitment to improve (publicly asserted)				
b. Individuals search for and eliminate organ. weaknesses				
c. Most improvement issues are self-identified				
d. Most problems are self-identified				
e. Workforce is engaged				
f. Ownership, pride & satisfaction is evident (dedication)				
g. Employee contribution is encouraged				
h. Low problem reporting threshold				
i. Everyone is considered a problem solver				
j. Material condition of the plant and work areas				
k. Feedback is solicited and encouraged				
l. Timely resolution of grievances				
m. Productive and prompt feedback is provided				
n. Benchmarking is valued and effective				

Comments ('Worrisome' or 'Problem' areas):

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6. Managers and supervisors assess and trend human performance through in-field observations, formal assessments, and performance data analyses. Results are used to develop corrective actions, to improve training and are shared with all personnel.

(Check the one box to the right of the question that most best applies)

Attribute	Strength	OK	Worrisome	Problem
a. Intervention occurs when expectations are not met				
b. Effective root cause determinations				
c. Management presence in field is apparent and welcomed				
d. Useful performance indicators and trends are available				
e. Self-assessments are driven from within				
f. Timely feedback				

Comments ('Worrisome' or 'Problem' areas):

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7. A culture exists, involving respect, fairness, and honesty that places a high value on healthy relationships among individuals and among groups. This is evident in the work quality, the conduct of business, and the way communication occurs.

(Check the one box to the right of the question that most best applies)

Attribute	Strength	OK	Worrisome	Problem
a. Mutual respect is demonstrated				
b. Effective communications are evident				
c. Open communications-both directions-frequent/precise				
d. Good teamwork is fostered and apparent				
e. Good conflict management – achieves best solution				
f. Low absenteeism				
g. Professional work environment				
h. Individual responsiveness to management				

Comments ('Worrisome' or 'Problem' areas):

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Job-Site Conditions Self-Assessment Questionnaire

The job-site condition self-assessment questionnaire, when completed, can reveal organizational weaknesses that provoke specific undesirable conditions. The questionnaire is segregated into task-related issues (controlled by the organization) and individual related issues (some controlled by the individual and some controlled by the organization). The questionnaire is further divided into three parts: direction to act, opportunity to act, and willingness to act. Preexisting conditions that stimulate behavior – direction to act — include directives, knowledge, or cues that inform or prompt a person to act. Job-site conditions that set the occasion for behavior – opportunity to act – include those factors that make the action achievable or realizable. Finally, conditions that tend to reinforce the act – willingness to act – are shaped by the match of the individual's motives with the incentives associated with the job or task. These categories attempt to describe the "stimulus-response" components of human behavior.

This instrument is intended for use by supervisors and managers conducting human performance-based self-assessments. The user documents the answers to the questions in the column to the right of the question with a "Y" signifying a yes response or an "N" signifying a no response. All the questions are constructed in the affirmative. Those questions with affirmative answers denote a positive – an area where no problem exists. "No" answers to individual questions single out potential areas of weakness that will require additional investigation. Clustered 'no' responses signal problem areas that require immediate management attention.

Various methods of data gathering are required to complete the questionnaire, including review of the related documents (procedures, directives, and work instructions), observation of work activities in progress, and interviews with individuals who perform the work being reviewed. Self-assessment is considered to be the most powerful tool for locating latent weaknesses in the organization. The job-site conditions self-assessment questionnaire is a very strong supporting tool for data gathering and evaluation. This questionnaire has been adapted from Institute of Nuclear Power Operations Publication 2006-03, *Human performance Fundamentals Course Reference*, pages 93 and 94.

JOB-SITE CONDITIONS SELF-ASSESSMENT QUESTIONNAIRE

	Task-Related Issues		Individual-Related Issues	
Direction to Act	1. Are there sufficient, accessible procedures (or other appropriate signals) to direct a qualified person to perform without error? 2. Are tasks arranged in a logical sequence? 3. Do procedures limit interpretation in the field? 4. Are procedures efficient and designed to avoid unnecessary steps and wasted motion? 5. Are procedures appropriate to the skill level of the assigned personnel? 6. Are procedures free of unnecessary and tiresome repetition? 7. Are good job aids available? 8. Are job aids free of confusion and distracters that slow performance and invite errors? 9. Are directions free of "data glut," striped down to the simplest form, and not buried in extraneous data? 10. Are directions timely? 11. Does the work schedule allow assigned personnel adequate time to perform the task without haste? 12. Are good role models of behavior present? 13. Are job goals, objectives, roles, and responsibilities clear?		22. Are personnel administratively qualified for the assigned task? 23. Do assigned personnel have the aptitude for the job? 24. Do workers have the requisite understanding of fundamental principles, systems, and theory related to the task? 25. Do assigned personnel possess experience and proficiency to perform the task unsupervised? 26. Do personnel have sufficient specialized skills? 27. Do assigned personnel understand task/job objectives? Do they understand the plant need and desired outcomes? 28. Do people understand the consequences of poor performance? 29. Do people meet the 'fitness for duty" requirements? 30. Do workers grasp the fundamentals of human performance? 31. Do personnel comprehend the overall intent of safety requirements as well as technical goals of the assigned task (big picture)? 32. Do workers have the technical concepts to perform well? 33. Are assigned personnel capable of effectively using personal protective equipment required for the task? 34. Do controllable individual-capability error precursors persist at the job site?	- - - - - - -

	Task-Related Issues		Individual-Related Issues	
	14. Are clear and measurable performance standards communicated so that people know how well they are supposed to perform? 15. Do workers accept the expectations and standards as reasonable? 16. Is work-related feedback provided describing results consistent with the standards and not just behavior? 17. Is feedback immediate and frequent enough to help employees remember what they did well or need to improve? 18. Is feedback selective, personal, and specific, limited to a few matters of importance and free of excessive data and vague generalities? 19. Is feedback educational, positive, and constructive so that people learn something from it? 20. Are error traps identified? 21. Do controllable task-demand error precursors persist at the job site?			- - - - -

	Task-Related Issues		Individual-Related Issues	
Opportunity to Act	1. Are the necessary tools on hand for doing the job?	-	14. Are workers matched to the task (mentally, physically, and emotionally)?	-
	2. Are tools reliable, efficient and safe?	-	15. Do workers have the ability to perform the task with accuracy and speed?	-
	3. Are adequate materials, supplies, and assistance usually available to do the job well?	-	16. Are workers free of personal and emotional limitations that could interfere with performance?	-
	4. Does access to the jobsite allow freedom of movement?	-	17. Are people available to perform assigned work when required?	-
	5. Is appropriate personal protective equipment readily available?	-	18. Do personnel have sufficient strength and dexterity to learn to do the job well?	-
	6. Are structures, systems, or components in conditions that minimize obstacles to completing the job?	-	19. Are personnel physically able to perform the assigned task?	-
	7. Is the job site free of demanding, long-term work-arounds?	-	20. Do assigned personnel possess “unsafe” attitudes?	-
	8. Is the human-machine interface conducive to error-free manipulation?	-	21. Do they have a sense of uneasiness toward “touching” plant equipment?	-
	9. Are appropriate forcing functions (such as interlocks or keys) present?	-	22. Do people have a sense of right and wrong?	-
	10. Do plant structures, systems, or components provide feedback on indication of manipulation?	-	23. Do personnel possess a healthy self-esteem?	-
	11. Is teamwork effective? Are relationships among personnel healthy?	-	24. Do personnel possess “intolerance” for error traps at the job site?	-
	12. Do ambient conditions provide comfort and prevent unnecessary interference?	-	25. Is general morale of the workforce positive?	-
	13. Do other controllable work-environment error precursors persist at the job site?	-	26. Do other controllable individual-capability and human nature error precursors persist at the job site?	-

	Task-Related Issues		Individual-Related Issues	
Willingness to Act	1. Is the pay for the job competitive?	-	15. Do work group norms encourage high standards of performance?	
	2. Are there significant bonuses or raises based on good performance?	-	16. Do workers possess a degree of autonomy for the job? Do they have opportunity to exercise their own judgment in the performance of assigned tasks?	-
	3. Does good performance have any bearing on career advancement (potential for promotion to next organizational level)?	-	17. Is the balance of positive and negative incentives in favor of the positive?	-
	4. Are there meaningful non-monetary incentives (such as recognition) for good performance based on results and behavior?	-	18. Does the accountability policy treat people with fairness, honesty, and respect?	-
	5. Are results rewarded? Which ones? Are rewards contingent on results?	-	19. Are personnel aware of opportunities for personal development related to their position?	-
	6. Are rewards awarded with a personal touch?	-	20. Do workers seem to have a desire to perform well when they start a job?	-
	7. Are safe behaviors reinforced? Which ones? Is reinforcement contingent on evidence of behavior?	-	21. Are the incentives provided by the organization meaningful to personnel?	-
	8. Are unsafe behaviors reinforced? Which ones?	-	22. Are task goals or objectives attainable as directed by procedure?	-
	9. Are rewards scheduled well, or do they occur so frequently as to lose meaning or so infrequently as to be useless?	-	23. Are career goals or objectives attainable?	-
	10. Is there an absence of punishment to perform well?	-	24. Do people dread undesirable outcomes if the work is not performed as expected?	-
	11. Is there an absence of hidden incentives to perform poorly?	-	25. Is assigned work meaningful to personnel? Do they receive a sense of accomplishment when the task is complete?	-
	12. Is work structured to allow completion of a whole job? Is work traceable to an individual?	-	26. Do their motives endure? Is the turnover low?	-
			27. Does allegiance to a work group take precedence over safe work methods or adherence to management expectations?	

	Task-Related Issues		Individual-Related Issues	
	13. Do management and coaching styles of immediate supervisor promote healthy relationships?		28. Do personnel feel safe in their jobs even if they err from time to time?	-
			29. Is there trust in the management / leadership team?	-
	14. Do other controllable task demands-work environment-human nature precursors persist at the job site?	-		
		-	30. Do other controllable work environment, individual-capability, and human nature error precursors persist at the job site?	-
				-

DEFINITIONS

The following definitions provide for a common understanding and consistency of terms used in this document or otherwise related to human performance.

- **Active error –** An error that changes equipment, system, or plant state, triggering immediate, undesired consequences.

- **Checking –** The act of confirming the *actions* of a performer are correct, without error.

- **At-risk practice** – A behavior, belief, assumption, or condition that tends to diminish the effectiveness of a human performance tool or that increases the chance of error during an action.

- **Configuration control** – The management of plant operational configuration, physical configuration, design configuration, and design bases to ensure that owner and regulatory requirements are satisfied at all times and to ensure consistency among the design bases and design requirements, the physical plant, and facility configuration information (See INPO AP-929, Revision 1, *Configuration Change Control Process Description*.)

- **Critical attributes** – Risk-related aspects of engineering activities that could directly affect the following.

    - reduction in safety margins
    - alignment of physical configuration and design requirements
    - operability/functionality of risk-important systems and equipment, especially critical components (such as Maintenance Rule equipment)
    - protection against single-point failure vulnerabilities
    - control of human error by the user at critical steps of related activities
    - protection of the environment
    - prevention of regulatory concern
    - adequacy of installation and constructability
    - control of security, generation, and economic risks
    - past success instead of failure used as a basis for design

- **Critical activity/task** – An engineering activity, an evolution, or a task that is *vital* to nuclear safety, industrial safety, environmental protection, regulatory compliance, or plant/system performance. This typically involves one or more critical attributes, such that undetected errors with these activities/tasks will result in intolerable consequences to the plant or to personnel. (*Vital* means the engineering product can have a direct, and possibly immediate, adverse impact either during installation or testing or upon implementation of the product in question.)

- **Critical step** – A procedural step or series of steps or an action that, if performed improperly, will cause irreversible harm to plant equipment or people, or that will significantly affect facility operation. An action that if performed improperly has an immediate negative consequence that cannot be reversed or undone.
- **Defect** – An undesired result of an error committed earlier in the engineering process, which becomes embedded in either the physical plant or design bases documentation.
- **Defense** – Means or measures (controls, barriers, and safeguards) taken to prevent or catch human error; to protect people, plant, or property against the results of human error; and to mitigate the consequences of an error.
- **Engineering assumption** – A hypothesis, theory, supposition, or premise that is **accepted** as true without supporting documentation; design criteria accepted as true or conservative in order to bound inputs. (Alternatively, an *unverified assumption* is an assumption that has not or cannot be validated or trusted as correct without additional data or testing.)
- **Engineering judgment** – The process of applying technical knowledge, experience, and professional intuition to make sound decisions; a decision that would meet the standard of acceptance when compared to a rigorous and analytical evaluation.
- **Error** – Human decisions or actions that unintentionally depart from an unexpected behavior or some standard.
- **Error-likely situation** – A work situation in which there is greater opportunity for error when a specified action or task is performed, because error precursors are present.
- **Error precursors** – Task-related conditions for a specific activity or task that provoke human error and increase the chance of a technical error or an adverse consequence; otherwise referred to as "risk factors." Examples are time pressure, first-time activity, lack of knowledge or experience, and interruptions.
- **Event** – A consequence exceeding some criteria of significance, involving either an unwanted change in the health and well-being of employees, the environment, or safety margins or the ability of the plant to perform its designed functions.
- **Fitness for duty** – An evaluation of an individual's physical and psychological health to determine whether they are able to perform their essential job functions without creating undue risk to themselves or others.
- **Independent** – *Freedom of thought* between a performer and a verifier, created by separating the actions of each individual by physical distance and time, such that audible or visual cues of the performer are not detectable by the verifier before and during the work activity.
- **Irreversible** – Actions and related results that cannot be returned to original conditions by reversing the initiating actions.
- **Knowledge-based performance** – Behavior in response to a totally unfamiliar situation (no skill, rule, or pattern recognizable to the individual); a classic problem-solving situation that relies on personal understanding and knowledge of the system, the present state of a system, and the scientific principles and fundamental theory related to the system; an activity performed with no preprogrammed instructions or rules.

- **Latent condition** – Undetected circumstances or situations such as equipment flaws, a willingness to sacrifice safety margin for immediate production goals, and various process, program, and procedure deficiencies that remain hidden until revealed by periodic testing, self-assessment processes, operating experience, or an event.
- **Latent error** – An error, act, or decision that unknowingly creates an undesired condition(s) embedded in the engineering processes, culture, or plant configuration of plant systems, structures, or components or the design bases or that reduces equipment reliability that remains undetected until revealed by subsequent operational activities.
- **Lesson learned** – A good work practice, innovative approach, or negative experience shared to promote positive information or prevent recurrence of negative events.
- **Operating experience** – Information that relates to the methods in which work is planned and conducted and an organization's missions are performed. Operating experience provides the basis for knowledge and understanding that fosters development of lessons learned and improvement of operational performance.
- **Positive control** – An active measure(s) to ensure that what is intended to happen is what happens, and that is all that happens, when an action is performed.
- **Rule-based performance** – Behavior based on selection of *stored rules* derived from one's recognition of the situation; follows IF (symptom X), THEN (situation Y) logic; an activity performed following stored rules accumulated through experience and training.
- **Safety culture** – An organization's values and behaviors-modeled by its leaders and internalized by its members-that serve to make nuclear safety the overriding priority.
- **Situation awareness** – The accuracy of a person's current knowledge and understanding of working conditions compared to actual conditions at a given time.
- **Skill-based performance** – Behavior associated with highly practiced actions in a familiar situation, usually executed from memory without significant conscious thought; an activity performed using stored patterns or preprogrammed instructions.
- **Team error** – A breakdown of one or more members of a work group that allows other individual members of the same group to err because of either a mistaken perception of another's abilities or the lack of accountability within the individual's group.
- **Technical rigor** – Completeness and accuracy in both the process and the delivered product; cautiously accurate and meticulous; exhibiting strict precision during the performance of action.
- **Uncertainty** – A presence of doubt, confusion, or questions about a work situation.
- **Uneasiness** – An attitude of wariness or apprehension regarding the capacity of individuals to err.
- **Verification** – The act of confirming that the *condition* of a component, or other product of human performance, conforms to the condition required by a guiding document.
- **Work execution** – Those activities related to the preparation for, the performance of work, and the feedback on work activities.

CONCLUDING MATERIAL

Review Activity:	Field and Operations Offices	Preparing Activity:
DOE	AL	HSS
DP-NNSA	CH	**Project Number:**
EM	ID	HFC-0017
NE	NV	
NN-NNSA	OH	
SC	OR	
RW	RL	
	SF	
	SR	
	Carlsbad Field Office (CBFO)	
	Office of River Protection (ORP)	

Area Offices:

Amarillo Area Office

Argonne Area Office

Brookhaven Area Office

Fermi Area Office

Kirtland Area Office

Los Alamos Area Office

Princeton Area Office

Y-12 Area Office

Berkeley Site Office