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Title: EFCOG Best Practice HPI for Knowledge Workers ISM-HPI-22-02

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Report

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Best Practice:

HPI for Knowledge Workers

ISM-HPI-22-02

Task Description

This document is a collection of these best practices as determined by team members.
This best practice attempts to:

- Realize opportunities to break the myth where people believe that HPI does not apply to them as they perform no physical work
- Recommend options to create an environment that promotes intellectual collaboration and trust, enabling candor and vulnerability.
- Explain how errors manifest differently from the same human fallibility. Knowledge workers (KW) have errors that take different perspectives to find and mitigate the unique manifestation of these conditions.
- Help KW identify the critical steps (or risk important steps) in their processes.
- Reduce risk/consequence from KW errors (limit latent errors as well as finding latent conditions), building resiliency into KW tasks. Mitigation strategies may be different.

Contents (CTRL-Click to go to that section)

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Background

Wikipedia:: Knowledge workers are workers whose main capital is knowledge. Examples include programmers, physicians, pharmacists, architects, engineers, scientists, design thinkers, public accountants, lawyers, editors, and academics, whose job is to "think for a living".[1] Knowledge work can be differentiated from other forms of work by its emphasis on "non-routine" problem solving that requires a combination of convergent and divergent thinking.[2] But despite the amount of research and literature on knowledge work, there is no succinct definition of the term.[3]

Knowledge workers must employ a combination of convergent and divergent thinking as part of their work

Career Research: The term knowledge work refers to a profession that utilizes intellectual capital to create, teach, and problem solve. Knowledge work requires significant cognitive activity and dedication to continuous learning on behalf of the practitioner. Day-to-day knowledge work consists of non-routine and non-repetitive activities. Examples of knowledge workers include, but are not limited to, doctors, lawyers, researchers, engineers, and consultants. Knowledge workers have expertise in their fields, and they stay current on theoretical and practical applications in their fields. They add value to their professions and to others through the creation of new theories, information, services, and products. Knowledge work requires formal education and incorporates theoretical knowledge in the creation of new information. Knowledge work is not solely applied tacit knowledge. For example, an experienced waitperson is not a knowledge worker even though he or she may know the menu and the customers at the restaurant very well.

INPO document 05-002, Rev 1: Human Performance for Engineers and other knowledge Workers.

> The primary intent of this document is to provide stations and utilities with a set of engineering-oriented methods to anticipate, prevent, and catch most errors related to the work of engineers and other knowledge workers.
>
> However, there is not a separate document from the Department of Energy (DOE). Knowledge worker concepts are integrated into DOE-HDBK-1028-2009, Human Performance Improvement Handbook

The DOE Human Performance Improvement Handbook (DOE-HDBK-1028-2009) defines knowledge workers and provides includes KW through the handbook. Excerpts associated with KW from Volume 1 include:

Knowledge Worker definition *[Glossary, page v]*

An individual who primarily develops and uses knowledge or information (e.g., scientist, engineer, manager, procedure writer).

Human Performance for Engineers and Knowledge Workers *[page 1-11]*

Engineers and other knowledge-based workers contribute differently than first-line workers to facility events. A recent study completed for the Nuclear Regulatory Commission (NRC) by the Idaho National Engineering and Environmental Laboratory (INEEL) indicates that human error continues to be a causal factor in 79 percent of industry licensee events. Within those events, there were four latent failures (undetected conditions that did not achieve the desired end(s) for every active failure. More significantly, design and design change problems (KW activities) were a factor in 81 percent of the events involving human error. Recognizing that engineers and other knowledge-based workers make different errors, INPO developed a set of tools specific to their needs. Many of these tools have been incorporated into DOE's Human Performance Tools manual.

With engineers, specifically, the errors made can become significant if not caught early. As noted in research conducted at one DOE site, because engineers as a group are highly educated, narrowly focused, and have personalities that tend to be introverted and task-oriented, they tend to be critical of others, but not self-critical. If they are not self-critical, their errors may go undetected for long periods of time, sometimes years. This means that it is unlikely that the engineer who made the mistake would ever know that one had been made, and the opportunity for learning is diminished. Thus, human performance techniques aimed at this group of workers need to be more focused on the errors they make while in the knowledge-based performance mode as described in Chapter 2.

The Workplace *[page 1-12]*

The workplace or job site is any location where either the physical plant or the "paper" plant (the aggregate of all the documentation that helps control the configuration of the physical plant) can be changed. The systems, structures, and components used in the production processes make up the physical plant. Error can come from either the industrial plant or the paper plant. All human activity involves the risk of error. Flaws in the paper plant can lie dormant and can lead to undesirable outcomes in the physical plant or even personal injury. Front-line workers "touch" the physical plant as they perform their assigned tasks. Supervisors observe, direct, and coach workers. Engineers and other technical staff perform activities that alter the paper plant or modify processes and procedures that direct the activities of workers in the physical plant.

Managers influence worker and staff behavior by their oral or written directives and personal example. The activities of all these individuals need to be controlled.

Reducing Error *[page 1-16]*

An effective error-reduction strategy focuses on work execution because these occasions present workers with opportunities to harm key assets, reduce productivity, and adversely affect quality through human error. Work execution involves workers having direct contact with the facility, when they touch equipment and when knowledge workers touch the paper that influences the facility (procedures, instructions, drawings, specifications, etc.). During work execution, the human performance objective is to anticipate, prevent, or catch active errors, especially at critical steps, where error-free performance is necessary. While various work planning taxonomies may be used, opportunities for reducing error are particularly prevalent in what is herein expressed as preparation, performing and feedback.

Difficulty Seeing One's Own Error *[page 2-3]*

Individuals, especially when working alone, are particularly susceptible to missing errors. People who are too close to a task, or are preoccupied with other things, may fail to detect abnormalities. People are encouraged to “focus on the task at hand.” However, this is a two-edged sword. Because of our tendency for mind-set and our limited perspective, something may be missed. Peer-checking, as well as concurrent and independent verification techniques, help detect errors that an individual can miss. Engineers and some knowledge workers, by the nature of their focus on producing detailed information, can be especially susceptible to not being appropriately self-critical.

Latent Errors *[page2-9]*

Usually, there is no immediate feedback that an error has been made. Engineers have performed key calculations incorrectly that slipped past subsequent reviews, invalidating the design basis for safety-related equipment.

Who are Knowledge Workers and what do they do?

In the DOE, knowledge workers may be any of the following occupations (not an all-inclusive list).

- Engineers, scientists, researchers, (can transition between KW and worker)
    - Complex calculations
    - Initial designs
    - Initial testing
- Procedure Writers
- Project Management Office (PMO)
    - Project managers
    - Cost estimators
    - Schedulers
- Assessors and auditors
- Corrective action developers
- Managers
- Designer, developer, etc. of a new process or product
- Instructional design personnel (ADDIE process, except implementation)
- Emergency Preparedness (scenario design, response procedure development, drill conduct, emergency response organization (ERO) equipment maintenance plan, etc.)
- IT professionals
    - Software developers and testers
    - High Performing computer staff
    - Cybersecurity
- Business (Office) professionals
    - Budget, financial forecasting
    - Acquisition, procurement
    - Contracts

What is different about Knowledge Workers?

- These employees are not performing physical work at the point of contact (active errors)
    - However, Knowledge Workers can easily transition from cognitive tasks to physical tasks. Thinking / planning an experiment and then performing that experiment.
- They possess a higher level of formal education and may think differently.
    - Prone to unique errors
    - Knowledge is power
    - Publications matter
    - Elitism
    - Halo effect (*THE* expert/knowledgeable person in this field - Held in high esteem)
- Technical rigor is different (calculation vs. field work)
- Different types of traps or errors can be experienced.
    - A Critical Step is a human action that will trigger immediate, irreversible, and intolerable harm to an asset, if that action or a preceding action is performed improperly. The immediacy requirement for consequences typically eliminates critical steps from applying to KWs. However, Risk Important Actions (delayed, recoverable consequence should an error occur) apply.
    - Critical step caveat - in the transmission of information that would have adverse consequences. Transmission of information consequences may be immediate.
- Distractions for KW may be different (mental fatigue, noise, interruptions)
- Roles can be different. For example:
    - One reviewer checks the math, i.e., reviews what is in front of them
    - Another reviewer checks the purpose of the math, assumptions, methodology, etc. and provides critical feedback, i.e., the bigger picture (what is missing from this analysis, document, etc.) and asks the question, “Is the author giving me what I need, and not necessarily what I asked for?”
    - Terminology may be different at your location: tech checker, editor, reviewers, peer checker, watcher, etc.; PJO, Tailboard, etc.; and reader-worker-checker or reader-doer.

NOTE: If the peer reviewer has the same level of knowledge, then the organization is at-risk of missing what neither person knows.

Knowledge Worker behaviors

- Thinks and acts outside one's own boundaries
  - Were those with relevant experience in other organizations engaged and was their experience incorporated prior to responding to a customer or solving a problem?
  - Were customer interfaces streamlined and coordinated to provide a total integrated solution to the customer? Was the focus on a "one-laboratory" approach?
  - Were successes and failure proactively communicated across organizations?
  - Did the individual reach out to help and support others outside his/her work group?
- Communication model
  - Was more time spent asking open-ended question and listening than informing?
  - Did the individual stop work and make appropriate eye contact when engaging in a dialogue?
  - Did the individual ask clarifying questions and paraphrase to get confirmation?
  - Did the individual focus on adding value when informing?
- Owns and proactively solves problems
  - Did the individual own a problem as if it were his/hers from start to finish regardless of the cause?
  - Was an issue proactively identified even though the issue resided outside their responsibility?
  - Was a relevant business or industry issue proactively identified to the customer?
  - Were commercial issues addressed in the context of a solution and not as a barrier?
  - Does the individual recognize things happen because of them (not to them) by acknowledging reality, owning the issue, finding solutions, and making them happen?
- Thinks strategically on behalf of customers
  - Was a deliberate effort made to understand the customer's business?
  - Were options presented to the customer in a respectful and constructive manner?

Knowledge Worker errors

- Calculations, wording, typographical errors
    - Carried through into the safety bases, operating procedures, material performance/integrity evaluations, dose exposures, etc.
- Impact of KW errors
    - Contribute to latent organizational weaknesses and latent errors (Legacy errors may last for many years before being discovered.)
    - Could lead to significant consequences: mission interruption, injury, added cost, damaged reputation, punitive consequences, etc.
- Perception of KW about errors
    - Frustrating with minimal consequences
    - Unaware of how their processes or errors are complicating the customer's life
        - Example: A new hire doesn't get their first paycheck because payroll made an error entering direct deposit account number and can't fix it without much angst.
- Mitigation strategies for KW
    - KW must ask, "If a mistake is made, how will it be found before a consequence occurs?"
    - No matter what group they work in, have them think about and identify where errors in their work could create (intolerable) risk

Recognizing triggers for error-likely thinking

How do you recognize that you are in Knowledge Based (KB) Performance Mode (*not even aware* that you don't know what you don't know)? Here are some quiet signals that indicate you are in KB performance mode.

- Scratching your head
- Scratching your chin
- Looking "up" for answers
- Saying things like:
    - I think…
    - I believe…
    - I am pretty sure…
    - I am almost certain…
- A gut feeling that something isn't right
- ***Listen*** *for the language* that indicates a concern, uncertainty, assumptions, etc.
    - Identifying this language can lead to further, clarifying, discussion
    - What I'm looking at (or thinking it is)
        - May be biases (confirmation or frequency bias).
        - Instead, one needs to recognize that what your think it is, may not actually be what is going on or what the situation really is.
    - Something is different, but not noticed or acted upon.

    - Clearly identifying assumptions. Are assumptions documents in the correct location in the document (e.g., calculations in engineering documents) and not a note in the body of the document.
    - Using a *do not* vs a *do*
        - For example, don't run in the hall vs. walk slowly in the hall. (What does good look like).
    - The sender is responsible for the quality of the communication (cable company is responsible to deliver your signal, not the customer).
        - Is the receiver ready to catch the message?
        - Does the sender deliver the message in the right tone for it to be received.
            - Is it a suggestion or a requirement: Wear your PPE.

Once you're triggered, the question should be asked, "What does the procedure say?"

Examples of recognizing latent conditions:

- TRU waste drum in-service accumulates waste for a long period of time resulting in CAM alarm (SRNS)
    - SRNL discussed long term use, but failed to identify this as a latent condition
    - Could have been due to lower experience levels
    - Lacking KTR (Knowledge Transfer and Retention) for new workers getting the "experience internalized" prior to retirement of veteran employees.
    - Reflecting on what triggers were present that may have helped identify the latent error
- Identify KW risk
    - RIC analysis – Risk, Impact, and Consequence should an error occur (LBNL)
- Project Management: Identify risks to the project
    - Analyze "one deep" situations where organizations rely on people knowing something or being able to do something.
    - Do we accept the risk, avoid it, transfer it, mitigate it.
    - Go back thru your project management process and integrate it to manage the risk
    - Risks and opportunities analysis (opportunities could be missed if you don't notice it) so you recognize it if it goes that way.
    - What will affect our success?
    - Have second checker
- Resiliency: How to build the capacity to fail safely (INL)
    - Are we resilient enough? Or do we need to do something to build more resiliency?
    - How do you ask effective "what if?" questions?
- Communicate it
    - Conduct event investigations (large expenditures without work being done) to discover "how does it happen?"
        - Develop compensatory actions to improve your process and maybe preclude recurrence
    - In cases where there a few people involved have a small group meeting.
        - Look at contingencies if a mistake is not found
    - Integrate communication strategy into your process

Human Performance Tools for the Knowledge Worker

NOTE: Terminology may be different at your location. Peer Checker, watcher, etc. PJB, Tailboard, etc. Reader-worker-checker or reader doer.

The DOE, Human Performance Improvement Handbook (DOE-HDBK-1028-2009) Volume 2 Human Performance Tools for Individuals, Work Teams, and Management, contains elements related to knowledge workers. Volume 2 states:

> **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.
>
> When effectively used, these type tools can improve human performance in the workplace. …. 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 the system and later cause events. …. 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."
>
> **Validate Assumptions** *[page 22]*
> **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 they assumed.
>
> 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 cannot be verified, subject matter experts should be called in to bring additional technical expertise to help substantiate inputs, resolve assumptions, and solve the problem.

Do Not Disturb Sign *[page 31]*

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.

Project Planning *[page 58]*

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.

Work Product Review *[page 83]*

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.

This is a list of HPI tools recommended for Knowledge Workers.

- Personal safety assessment (2-minute rule)
  1. Was a self-check performed?
  2. Is the person aware of their surrounding and do they take steps to inform others of possible hazards?
  3. Were actions taken to correct any possible hazards?

- Technical Task Pre-job brief for each KW task includes
    - Assumptions
    - References
    - Roles and responsibilities
    - Doing a task-specific risk assessment and identifying the worst that can happen in completing the task and if errors are not found.
        - Was it used prior to a critical activity?
        - Were all necessary personnel included and engaged in the pre-job brief?
        - Was it held in a location free of distractions?
        - Was specific information rather than generalities discussed?
        - Were lessons learned from previous similar activities extracted from the lessons learned database and discussed?
        - Was pre-job brief clearly planned and thought out ahead of time?
        - Was entire scope of activity considered?
        - Were the risks associated with this task or activity quantified and strategies for minimizing them discussed?

- Post-job brief
    - Was a post-job brief used after a critical task?
    - Were lessons learned from the task discussed and documented in the lessons learned database?
    - Were all necessary personnel included?
    - Were actions taken to reduce the risks in future tasks?

- Self-Check
    - Was it performed at a critical step?
    - Was it performed after a distraction?
    - Were distractions eliminated during a planned action?
    - Were actions performed with appropriate procedures?
    - Were questions and discrepancies resolved before action was taken?

- Peer Check
    - Was it used at a critical step?
    - Was peer checker experienced with activity?
    - Was peer checker paying close attention to activity?
    - Was concurrent verification done in combination with peer check?
    - Was peer checker free from distractions or other tasks?

- Procedure use and adherence
  - Were procedures followed when applicable?
  - Was individual performing task qualified and trained in procedures?
  - Were critical steps considered when performing a task?
  - Were all steps performed?
  - Were steps performed in order as required?
  - Was procedure up to date?

- Situational awareness/Questioning attitude
  - Were all "what ifs" considered prior to taking an action?
  - Were questions by others received openly?
  - Was "devil's advocate" position used in decision-making process?
  - Were critical parameters considered?

- 24-hour rule
  - Was the organization's knowledge and experience used?
  - Was help solicited before quality, schedule, or budgets were jeopardized because of trying to solve something without help?
  - Was a manger notified of an issue within 24 hours?
  - Did the manager and individual develop a solution to the issue?
  - Was the individual willing to ask for help when needed?

- Critical task in progress (Do not disturb sign) is a tool that is needed in engineering field
  - Was a valid reason given as to why the worker needs the "Do Not Disturb Sign"?
  - Was the sign checked out with the appropriate manager?
  - Was the correct manager and correct contact information for that manager posted on the sign?
  - Was the sign put in a conspicuous location?
  - Was attention given to not distract or interrupt the concentration of the co-worker? (Care taken when in general area of co-worker)?
  - Was extra care put forth if attention of office mate of a "Not-to-be Disturbed" co-worker is being sought?

- Time out and collaborate
  - Were there uncertainties about intended actions?
  - Was the Time out called in advance of key decision points?
  - Is an expectation or a condition changing?
  - Stop and seek out (SASO) information from a trusted source outside of your own brain.
    - Consider using three (Rule of three) resources (people, reference documents, vendor, SME, mentors, etc.) – so that you get diverse perspectives on what is important, what to be mindful of, and many other pieces of information.

- Validate assumptions

  When to use the tool

  1. During the conceptual phase of design
  2. In design review meetings
  3. Prior to delivery of the product to the customer
  4. During verification of output document
  5. During calculations
  6. During procurement
  7. Prior to use of preliminary or invalidated vendor data

  Behavior Standard

  1. Documentation – Write down the assumption, citing the following:
     a. Applicability to the engineering issue
     b. Critical attributes affected by the assumption
     c. Reasoning and logic
     d. Extent of condition and worst-case outcomes
     e. Level of certainty, consistency, and conservatism
  2. Evidence – is there objective evidence to support/justify the assumption?
     a. Past success(es)
     b. Operating experience
     c. Expert opinion
     d. Reference documents (Such as prints, drawings, procedures)
     e. Alternative techniques or computer simulations
  3. Field Walkdown – were in-field factors considered:" Do a hands on/eyes-on review of physical environment.
  4. Track and Close out – Close out all unverified assumptions as valid or otherwise before delivering the product to the plant customer.

- Vendor oversight
  - Were the expectations clearly communicated to the vendor?
  - Was the documentation for the product or service vice clear, detailed, and understandable?
  - Did oversight of the vendor's activities occur?
  - Was the vendor coached/mentored in error prevention?
  - Was a monitoring plan developed, consistent with the vendor's risk-significant role and past performance?
  - Was data supplied by the vendor objectively validated (trust but verify)?
  - Was the deliverable reviewed and evaluated?

- Problem solving
  - Was a problem statement written, describing the gap between what is and what should be?
  - Did all the stakeholders agree with the statement?
  - Was the problem appropriately analyzed?
  - Were the causes corroborated through appropriate testing, independent review, and questioning attitude?
  - Were corrective actions suggested, assessing each solution's risk, benefit, and cost?

- Turnover

  <u>When to use the tool</u>

  - For emergent work that extends beyond one shift
  - For completed modification packages that may not be implemented for one or more years
  - When performing critical or complex activities over multiple shifts
  - When changing responsibilities for tasks that are in progress
  - When transferring responsibilities between people
  - During shift change

  <u>Behavior Standard</u>

  1. Identify specific tasks that relieving individual will perform. Consider the following factors during the turnover:
     a. Objectives/tasks to be accomplished
     b. Schedule requirements
     c. Key contacts, stakeholders, and organizational interfaces
     d. Status of the job; what has been accomplished so far
     e. Procedure being used
     f. Problems or unusual situations that have been identified
     g. Error-likely situations with critical activities
     h. Location of resources associate with the tasks/activities
  2. Start a turnover log. Document those items listed above. An engineer log summarizing the key activities during a shift is also useful information for the relieving personnel.
  3. Overcommunicate. The principals conduct a turnover face-to-face, using three-way communication on critical data and information. Listen for and challenge assumptions, asking clarifying questions.

- Stop when unsure

  When to use the 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 feeling distrustful of another individual
  - When unexpected results or unfamiliar situations are encountered
  - When something expected does not happen
  - When uncertain regarding compliance with expectations or procedures
  - When unfamiliar with an important work situation
  - When inexperienced or lacking knowledge with a task
  - When someone else expresses doubt or concern

  Commonly accepted practice

  1. Stop the activity
  2. Place the equipment and the job site in a safe condition
  3. Notify your immediate supervisor

Other techniques

GAIN model (seek a deeper understanding of our customer's needs) [Goals, Achievement Value, Issues, Needs]

- Was it used prior to the critical activity?
- Was input gathered from all key stakeholders?
- Were the questions clearly planned and thought out ahead of time?
- Does the individual tailor their approach to add value based on the customer's goals, issues, and needs?

Conflict model

- Was the right response to the conflict pre-planned and executed based on the importance of the issue and the importance of the relationship (Accommodate, Collaborate, Avoid, or Advocate)
- If the customer (internal or external) was hostile or emotionally charged, did the individual deflect the energy, remain centered, and listen before trying to resolve the issue?
- If the customer (internal or external) did not acknowledge the conflict, did the individual proactively engage the customer and surface the issues using facts and figures?

Reuse of engineered products (WRPS)

- Verify previous assumptions/calculations
- Validate assumptions – Basic engineering functions require basic assumptions that are verified or are included as assumptions.
- One engineer may make a certain set of assumptions yet another would make different assumptions. Need to ensure that assumption justification is included.
- Setting expectations for reviews is necessary for standardized and complete review of products
- Need to define the purpose of the calculation
- Pair this tool with "signature" – Since you are part of the team that approved the product, you are responsible for the accuracy of the engineering assumptions/calculations. The following are additional techniques to augment HPI Tools when performing KW tasks.

Narrative log

- Keeping track of every change you make (modeling program)
- Scientist keeping experimental logbooks
- Electronic document signature on PDF documents (LBNL)
    - Utilize for starting work after a stop work.
    - LBNL uses "hello sign" that includes workflow notifications and confirmation emails. Also get an email when the document is complete (all signatures obtained).
    - Many locations use electronic signatures linked to your PIV Card

Pomodoro Technique (Focusing Technique)

- Break up your task with focus thinking for one pomodoro (segment) at a time. Then take a break.
    - CAUTION: Do not spend excessive hours on a segment. Segments should be short period of time (15-25 minutes), then break (5 minutes)
- Beneficial for people who easily get distracted
- Keeps you in conscious decision mode and from drifting into autopilot
    - You cannot stay in this conscious decision mode for extended period
    - You can get decision fatigue if you stay in this mode too long.
    - Course MOOC - Learning how to Learn, Barbara Oakley
        - TEDx: https://www.youtube.com/watch?v=O96fE1E-rf8
        - Website: https://barbaraoakley.com/
- May pair nicely with "do not disturb sign"
- https://www.themuse.com/advice/take-it-from-someone-who-hates-productivity-hacksthe-pomodoro-technique-actually-works
- http://www.youtube.com/watch?v=cH-z5kmVhzU
- https://www.jobillico.com/blog/en/the-pomodoro-technique/

The integration of Knowledge Worker concepts and practices into processes and programs

- Include "basis" for procedure revisions so that they are not removed in the future without knowing why it was added in the first place
    - Ensure procedures include historical knowledge so that the next generation of workers are prepared to do and understand the task
    - Consider referencing KTR techniques so that KW are prepared for taking over
    - Are procedures clear enough for newer workers
- Forward engineers versus reverse engineering
    - Start with the problem statement
    - As an alternative to starting with the problem, Look for solutions
        - "Our solution is…."
- Methods to obtain knowledge
    - Where do KW get their knowledge
        - Books
        - Experience
        - Social media: YouTube, twitter, etc.
    - How to KW retain knowledge
        - Writing it down in a Laboratory Journal
        - Documenting in a file on their own computer or in a shared drive
        - Wiki shared files
        - Video recordings

Knowledge Worker Training

1. Determine the target *population* to tailor the training. For example,
    a. IT
        i. Utilizes agile process, quick and adaptive
        ii. Separate, service organization
        iii. Tendency to re-use code
    b. Engineering
        i. Methodical
        ii. Focus on problems
    c. Planner
        i. Schedules
        ii. Tries to organize the chaos
        iii. Couse should be similar to Procedure Writers course
2. Evaluate if there should be a separate course for KW or should it be integrated into the general HPI training?
    a. Consider including HPI fundamentals (or pre-requisite) in any KW course
    b. Beneficial to separate so the examples and exercises would be relevant to the student.
    c. WRPS:
        i. Initial 1.5 days
            1. Go thru tools and case studies
            2. Let them do the research the tools and report out
            3. Case studies are critical to learning. Case studies are specific engineering errors from WRPS (your location, not a hotel walkway collapse)
            4. Instructor needs to be intimately knowledgeable with the case that you study.
        ii. Refresher 0.5 days
            1. Meet with management team (engineering managers) – what are the issues/things in your area
            2. Focus that refresher on those areas
            3. Looking at error side instead of tools
3. Include Dynamic Learning Activities (DLAs) that are relevant to the student
    a. Banana measurement DLA for how to measure the volume of irregularly shaped tank
        i. Actual event: Miscalculated “time to explosion limit” because they did not take into account the tank “shape.” (shape was an irregular cylinder)
        ii. The classroom error was made when calculating the volume (of the edible portion) of a banana–they did not take into account the skin.
        iii. Contact WRPS for additional information
    b. Bolt Widget DLA

4. Communication activities:
    a. Telephone Game – Communications tool of passing the message to the next person. Shows how our listening and retelling can change the facts
    b. Telestrations Game - you need to draw the phrase, next person must interpret, continues alternating. Get to "see" where it fails.
5. Operating Experience and/or Case Studies relevant to KW student
    a. Local OE is the best source – may have people who were involved in the event available to co-facilitate.
    b. When things went wrong
        i. NYC wind stress building calculation – Citicorp
        ii. Tokai Mura criticality accident
        iii. Tenerife airport disaster
        iv. Piper Alpha
        v. Amtrak Passenger Train 501 Derailment DuPont, Washington December 18, 2017
        vi. HR sent an offer letter to the wrong applicant. They sold their house and had begun to move
        vii. Procurement issued and awarded a significant contract without DOE approval
        viii. Chemical Safety Board case studies
        ix. Giving a task to a new employee, who used the correct place keeping behaviors. Blew a relief valve. Discovered there was an undocumented workaround that this new person did not know about that is normally passed down in OJT
    c. When KW questions discovered issues
        i. Citicorp Center engineering crisis: Skyscraper in New York city that could have toppled over in a high wind. A student doing their thesis asks architect about their concerns.
        ii. Someone asks a question, and the outcome is discovering something was overlooked in the safety basis.
    d. Failure occurs in complex ways
        i. Organizational complexity
        ii. Interrelationship of organizational handoffs
        iii. Complex technology (Black Box, proprietary information)
    e. System 1 and System 2 Thinking for KW
        i. Biases
        ii. Complacency
        iii. Not digging deep enough

Recommended Reading

1. Thomas Davenport: Thinking for a Living: How to Get Better Performances And Results from Knowledge Workers
2. Rob Fisher: Understanding Mental Models – Practically applying performance modes System 1 & 2 and GEMS (https://improvewithfit.com/)
3. Diane Vaughan: The Challenger Launch Decision: Risky Technology, Culture, and Deviance at NASA
4. Todd Conklin: Pre-Accident Investigations: An Introduction to Organizational Safety

Definitions

Critical Step - A human action that will trigger immediate, irreversible, and intolerable harm to an asset, if that action or a preceding action is performed improperly. The immediacy requirement for consequences typically eliminates critical steps from applying to KWs. However, Risk Important Actions (delayed, recoverable consequence should an error occur) apply.

Halo effect - Blind trust in the competence of specific individuals because of their experience or education. Consequently, other personnel drop their guard against error by the competent individual, and vigilance to check the respected person's actions weakens or ceases altogether.

Napoleon's Corporal - If the Corporal understood the battle plan, Napoleon was confident everyone in his army could, meaning they all could execute it. It worked time and time again for one of the greatest military commanders of all time How Napoleon's Corporal Can Help You!

Psychological safety - The ability to share one's thoughts and feelings without risk of damaging one's reputation or standing.

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Best Practice:

Best Practice: The Pocked Human Performance Survival Guide - WRPS

The Pocket Human Performance

SURVIVAL GUIDE

The Ultimate Guide for Engineers

WRPS-56532, Rev. 0

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CONTENTS

This Survival Guide contains the necessary knowledge to implement Human Performance Tools, established by the Institute of Nuclear Power Operations (INPO®), at WRPS to reduce engineering error and to minimize their impacts. There are 15 Human Performance Tools described that are proven to reduce engineering risk and minimize the stress of decision making. The Tools are broken into Fundamental Tools and Conditional Tools.

Fundamental Human Performance Tools - human performance tools that are used regularly for any work activity, regardless of the risk or complexity of the task, and without prompting.

Conditional Human Performance Tools - human performance tools that depend on the situation, the needs of the task or job, or the risk involved.

Rigorous and thoughtful use of the enclosed information will result in a well planned, documented, and executed engineering product.

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Chief Engineer's Message

In the spring of 2012, shortly after my arrival at WRPS, I initiated a Causal Analysis of Problem Evaluation Reports (PER) written for the last two and half years that were related to technical errors, process deficiencies and engineering procedural non-compliances. The Causal Analysis identified five (5) focus areas that if properly addressed would eliminate about 85% of the engineering issues that occurred in the assessment period. The WRPS engineering management team, with expert assistance from URS, met and developed corrective actions to address each focus area. The corrective actions have been incorporated into our 2013 Engineering Improvement Plan.

One of the focus areas is Human Performance. The Institute of Nuclear Power Operations (INPO) has been studying Human Performance for more than 30 years (since Three Mile Island). They have developed many Human Performance tools during that time to improve human reliability by reducing human error through correction of the conditions that cause the errors. A WRPS team has researched INPO guidance on Human Performance, developing training and tools for WRPS Engineering to reduce human errors. These tools are provided in this Survival Guide.

Are there processes and behaviors that can eliminate all errors and accidents? Many experts within INPO believe yes – all errors and accidents are preventable. We could debate the issue for a long time but I believe we can all agree that there are processes and behaviors that can reduce errors that have unacceptable consequences attached to them. For example, each of us could quickly list several steps we take every day to avoid car accidents. This Survival Guide can help us avoid errors in our engineering work. Please join me in choosing to make fewer errors by appropriately incorporating this Guide into your daily activities.

David Little

Chief Engineer

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HUMAN PERFORMANCE TOOL

Task / Tool	FUNDAMENTAL TOOLS					
	TT Prejob Brief	Self-Checking	Questioning Attitude	Validate Assump-tions	Signature	Project Planning
Involvement in a Calculation	X	X	X	X	X	
Involvement in a Design Modification	X	X	X	X	X	
Involvement in a Path Forward	X	X	X	X	X	
Involvement in a Operating Plan	X	X	X	X	X	
Involvement in a USQ/D	X	X	X	X	X	
Involvement in a Technical Review	X	X	X	X	X	
Involvement in a Procedure	X	X	X	X	X	
Involvement in a Work Package	X	X	X	X	X	
Involvement in a MT	X	X	X	X	X	
Involvement in a DA/DE Meeting	X	X	X	X		
Involvement in a SOW or Specification	X	X	X	X	X	
Involvement in a Walkdown	X	X	X	X		
Involvement in a PrHA	X	X	X	X		
Involvement in a Technical Task Request	X	X	X	X		
Involvement in Functional Acceptance Criteria	X	X	X	X		
Involvement in a Technical Report	X	X	X	X	X	
Involvement in a Redline Revision	X	X	X	X	X	
Involvement in a Flow Sheet	X	X	X	X	X	
Involvement in a Temp Mod	X	X	X	X	X	X
Involvement in a NCR	X	X	X	X	X	
Involvement in a SDDR	X	X	X	X	X	
Involvement in a Safety Basis Change	X	X	X	X	X	X
Involvement in a System Health Report	X	X	X	X	X	
Involvement in Startup/Testing	X	X	X	X	X	X
Involvement in a Turnover	X	X	X	X	X	
Involvement In Software Development	X	X	X	X	X	

*Use a graded approach when selecting and implementing Conditional Human Performance Tools

QUICK REFERENCE CHART

CONDITIONAL TOOLS*

		Vendor Oversight	Do Not Disturb Sign	Peer Review	Problem-Solving	Decision-Making	Turnover	Product Review Meeting	TT Postjob Review	Work Product Review
			X	X	X			X		
		X	X	X		X		X	X	X
			X	X	X	X			X	
			X	X	X			X		X
			X	X						X
			X	X						X
			X	X	X	X		X	X	X
			X	X	X	X		X	X	X
			X	X	X	X		X		X
					X	X		X		
			X	X				X	X	X
					X					
			X	X	X	X		X		
				X	X			X	X	
			X	X	X			X		
				X	X	X		X		
			X	X	X	X		X	X	X
			X	X	X	X	X	X	X	X
		X			X					
			X	X				X		X
				X				X		
		X		X	X	X	X			
							X			
		X		X	X	X		X	X	X

TECHNICAL TASK PREJOB BRIEF

WHY

Technical task prejob briefings (TTPBs) involve the preparation and discussion of an engineering task before it is performed. This discussion generally happens between the engineer(s) and his or her task lead or manager. They are used to assign personnel specific tasks; to clarify Roles, Responsibilities, Authorities, and Accountabilities (R2A2), methods (TFC-ENG Series Procedures), resources (time), and deliverables; and to identify risk factors, critical parameters, and compensating actions. This briefing may also be used to discuss performance mode recognition, lessons learned, and common error precursors.

WHEN

- For a new task assignment
- Prior to a peer review or verification
- During turnover
- Prior to physical activities or interfaces with facility equipment (tests, walkdowns, inspections)
- After extended breaks (several days) in the activity
- During vendor activities

HOW

During the TTPB, the following items should be discussed on a graded approach with respect to the complexity of the task. A follow up meeting/email/phone call may be needed to answer some questions prior to starting an engineering activity.

1. **Assign a qualified individual to the technical task, considering the following factors**:

- 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 the task-related processes and procedures before the prejob 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)
- Review the Task Demands, Work Environment, Individual Capabilities, and Human Nature (**TWIN**) diagram for common error precursors on Page 36
- Review the Performance Mode Recognition Flow Chart on Page 37

3. **Anticipate challenges to human performance for critical activities using SAFER (Summarize, Anticipate, Foresee, Evaluate, and Review), as follows**:

- **S**ummarize critical activities/tasks related to critical attributes.
- **A**nticipate specific errors or mistakes for each critical activity or phase.
- **F**oresee credible as well as worst-case consequences on the facility, on personnel, and on the environment if error goes undetected.
- **E**valuate methods to prevent and catch errors and related compensatory actions to mitigate identified risk factors, as well as contingencies to prevent/mitigate adverse consequences.
- **R**eview previous experience (lessons learned) relevant to the specific technical task(s).

4. **Ask the assigned individual(s) to verbally summarize, in his or her own words, the following**:

- Task requirements and proposed methods
- Personal preparedness to deliver a defect-free product
- Concerns he or she may have with the task, as planned and scheduled
- Critical attributes/functions related to the product
- Credible consequences of an error or defective product
- Stop work or abort criteria
- Renegotiate deadlines if necessary

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
- 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

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SELF CHECKING

WHY

Self-checking is an attention-management technique to help focus attention to the critical tasks in an engineering evolution. If used correctly, self-checking boosts attention at important points in an activity before an important action is performed or before self determined information is used in a step that could cause an error or defect. Think of self-checking as a "mini mental timeout", or "personal hold points" to ensure positive control over the task.

WHEN

- During physical activities or interfaces with facility equipment (tests, walkdowns, inspections)
- During calculations
- When performing critical tasks identified during prejob briefings
- During time pressure and following a task interruption
- When reading a computer readout or other indicator related to any critical attribute
- When recording data

HOW

If uncertain, resolve apparent questions before proceeding. When physically and mentally prepared, take the action, and follow by a review of the results of the action.

Remember the mnemonic STAR (Stop, Think, Actions, and Review).

1. **Stop:**

- Pause before performing critical activities
- Eliminate distractions and focus on the activity

2. **Think:**

- Understand what is to be done before performing actions
- Verify that conditions match those discussed during the Prejob briefing
- Compare conditions to the controlling document
- Validate input data and sources
- Identify expected outputs/results
- Refer to Questioning Attitude (FACTS see page 10), if uncertain

3. **Actions:**

- Follow relevant guidance (procedure, policy, and other engineering guidance)
- Perform planned actions for the specific activity
- Use appropriate tools (e.g., calculator, software program)

4. **Review:**

- Verify that outputs or results match expected outputs/results
- Notify the 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

QUESTIONING ATTITUDE

WHY

A questioning attitude fosters awareness of uncertainty, assumptions, risk factors, and the significance of a decision or action before proceeding. It helps the engineer make sure that planning, judgment, and decision-making are appropriate for the task going forward.

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 prejob briefing enhances a person's questioning attitude. From information discussed during the briefing, engineers 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 prejob briefing sensitizes personnel to what should and should not be.

WHEN

- During a prejob brief
- 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 questions about vendor activities arise
- 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 engineering evaluations
- During product review meetings
- When preparing and reviewing calculations

HOW

Remember the mnemonic FACTS (Foresee, Ask open-ended questions, Confirm knowns and unknowns, Test the current situation, and Stop when unsure).

1. **Foresee** technical activities or tasks that involve one or more critical attributes.
2. **Ask open-ended questions.**

- Inputs
- Method(s)
- Outputs
- Priorities
- Awareness of situations that "don't seem right"

3. **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)

4. **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

5. **Stop when unsure.**
- Do not proceed in the face of uncertainty
- Inform the responsible 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
- 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

Technical Task Prejob
Self Checking
Questioning Attitude
Validate Assumptions
Signature
Project Planning
Vendor Oversight
Do Not Disturb Sign
Peer Review
Problem Solving
Decision Making
Turnover
Product Review Meeting
Technical Task Postjob
Work Product Review

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VALIDATE ASSUMPTIONS

WHY

Assumptions are a necessary part of engineering work so that a problem can be bounded. For situations such as these, engineers devote additional effort to justify why the assumption is conservative, providing detailed evidence that supports it. Engineers can inadvertently treat an assumption as fact or can forget that they made the assumption. Engineering judgment is applied and documented only when all uncertainties are bounded by the margins in the analysis and when inputs cannot be further substantiated. All assumptions are documented, tracked, and verified, leading to their closure before the product is delivered to the customer or placed into service.

WHEN

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

HOW

Remember the mnemonic DEFT (Documentation, Evidence, Field walkdown, and Track and close-out).

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
- 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 (e.g., prints, drawings, procedures)
- Alternative techniques or computer simulations
- Technical rational for accuracy of assumption

3. **Field Walkdown** – 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 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

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SIGNATURE

WHY

Documentation of engineering products provides a record of the design of structures, systems, and components in the facility. Engineering 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 an engineering document. It helps others in the related engineering process recognize the level of technical rigor applied to the engineering product at its present stage of development. The signature implies the level of scrutiny an individual has applied to the functionality, accuracy, and safety of the product. Because a signature or initials (including electronic) reflects one's professionalism and character, it is important that personnel not *give away* their signatures.

WHEN

- When preparing, checking, reviewing, verifying, and approving products and services important to facility 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 facility equipment
- When procuring safety-related components

HOW

The engineer affirmatively acknowledges all of the following statements before releasing the product to the next step in the engineering process via Signature:

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, reviewer, peer reviewer, supervisor, or peer.
2. **Involvement** – The individual prepared, reviewed, or supervised 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:

- Possesses appropriate factors of safety and design margin
- Satisfies all design basis requirements for the intended application; product resolves the problem
- Conforms to accepted standards and codes
- 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

PROJECT PLANNING

WHY

Project management fundamentals provide a structure for working on engineering 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 WRPS business plan. Additionally, a disciplined and structured approach prevents rework and minimizes 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 (e.g., time, money, space, and people). Such activities involve initiation, planning, controlling, and closure. This tool is to be utilized when formal Project Management is not required for a task.

WHEN

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

HOW

Consider the following items during an Engineering evolution.

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

2. **Plan** – Determine how to address the problem, opportunity, or challenge through use of the following:

- Project organization, roles and engineers, and responsibilities
- Customer expectations and stakeholder involvement
- Organizational and technical interfaces
- Field walkdown
- Work activities schedule, including technical task Prejob briefing(s) and postjob review
- Project controls to minimize errors during critical activities
- Resources, budget, and support (availability, location, special knowledge, and required skills)
- Workload management plan

- Design inputs and outputs required, 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
- Vendor monitoring and control processes communication plan; information and data accessibility; stakeholder participation

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
- Meaningful performance indicators
- Conflict management
- Client and stakeholder collaboration and relationships
- Human performance tool reinforcement
- Recognizing the impact of changes on the project
- Product review meeting schedule, internal/external communication procedures
- Vendor monitoring
- Document, data, and software control method(s), including control of electronic files and filing of records

4. **Close** – Hand off to the customer, which includes the following:

- Product quality evaluation
- Effectiveness measures
- 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 project work plan
- Not resolving competing priorities with respect to resources
- Not sufficiently defining or documenting scope
- Frequently changing project team members

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VENDOR OVERSIGHT

WHY

Vendors need the same coaching and mentoring as WRPS Engineers when they supplement the workforce (subcontract personnel) or perform subcontracts. Supplemental personnel must understand that their work practices, especially regarding human performance, must meet the same standards required of WRPS Engineering. **VENDOR** (Validation, Expectations, N-terdependency, Documentation, Oversight, and Review) is a mnemonic device to aid the recall of those attributes, principles, and standards needed to effectively oversee the work of contractors/suppliers/vendors at WRPS. Without the benefit of a formal process to govern interactions with vendors or contract personnel, use this technique.

WHEN

- 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 prior to the start of work
- During actual vendor performance
- When returning equipment to a vendor for repair, troubleshooting, or maintenance
- Prior to completing the contracted job
- Following job completion
- When there is evidence, or suspicion, of improper execution or results
- Before using vendor-supplied information

HOW

Remember the mnemonic VENDOR.

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 quality processes, especially industrial safety, radiological protections, and error prevention are clearly communicated. Be sensitive to areas of weakness revealed by operating experience.

3. **N-terdependency** between vendor and customer/client; development of a close working relationship that generates a spirit of cooperation and an appreciation for nuclear safety.
4. **Documentation** related to the product or service, that is clear, detailed, and understandable.
5. **Oversight** of office and in-field vendor activities; assignment of a responsible engineer 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 postjob reviews.

Avoid These At-Risk Practices

- Assuming the vendor is "expert" and will not make mistakes
- Assuming vendors have the same work standards as WRPS 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

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DO NOT DISTURB SIGN

WHY

When engineers perform risk-important or safety-critical work, it is essential that they maintain their concentration and attention on the task, especially if that task involves a review or a verification of product [e.g., calculation, design, Unreviewed Safety Question (USQ), etc.] related to nuclear safety. Managers or task leads of such personnel assigned to these tasks must 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. This tool can also be expanded to the Microsoft® Office Communicator status of "Do Not Disturb".

WHEN

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

HOW

1. **Post the Sign/Status** – Place an eye-catching sign at a conspicuous place at the entrance of the engineer's work space, where the work or review will occur, and change Microsoft® Office Communicator status.

2. **Inform Others** – The sign provides the following information:

- That a review of a critical task is in progress
- That the worker or reviewer is not to be interrupted
- The name and telephone number of the individual's supervisor

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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PEER REVIEW

WHY

A reviewer provides a defense to detect errors and defects prior to 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. The WRPS Technical Review and Checking process are governed by TFC-ENG Series Procedures. This peer review tool can be used to supplement the existing process.

This tool provides an informal method to help the reviewer identify errors that could lead to failure-likely situations with the product. 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 (page 10).

WHEN

- For reviews of new documents with no predecessor products or design documents
- During engineering evaluations
- For informal requests for a review from a coworker
- When verifying a technical decision or plan of action

HOW

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

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

To take advantage of these elements, a define, denote, and dig (**3D**) peer review contains multiple readings, integrating the above features. These separate readings help the reviewer stay focused, minimizing the person's mental workload during each reading while studying the documents associated with the product.

1. **Define the review**. Clarify the following attributes of the review:

- Qualified person assigned – who
- Purpose – why
- Scope – what
- Method – how
- Acceptance and rejection criteria – quality
- Time allotted for the review – when

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

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PROBLEM SOLVING

WHY

Problem-solving is a classic knowledge-based performance situation. No apparent solution, pattern, rule, or skill is recognizable. Problem solving involves chaining cause-and-effect relationships in a backward direction to determine why the problem exists. Therefore, problems require systematic analysis to identify possible causes. The better approaches to problem-solving are structured, simple, and memorable and complement popular data-collection and analysis tools. The **PACTS** 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 (i.e., 1 in 2 to 1 in 10), the best course of action, when unsure, is to pause the activity or task and get another person involved with the problem. An individual may initiate this tool after getting an unsatisfactory resolution using a questioning attitude (FACTS, page 10). 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.

WHEN

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

HOW

Remember the mnemonic PACTS (Problem statement, Analysis, Causes, Testing, and Solution).

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

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DECISION MAKING

WHY

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. An engineer who follows a methodical decision-making process guards against rule-based and knowledge-based errors.

Conservative decisions place the safety of the worker, the public and the environment 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; personnel, facility, and environmental safety require conservative decisions. The following practices promote conservatism:

WHEN

- When a mistake could have adverse 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

HOW

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 effects 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) 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

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TURNOVER

WHY

In its simplest form, a turnover is the systematic and orderly transfer of work-related information between two individuals and the subsequent relief of one individual by the other. Turnover may involve a small work team or a crew. Turnover can occur during major activities, such as watch or shift exchange of information, or for simple projects. 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. Turnover is often misunderstood and, in some cases, misused. As with most processes, there are basic principles that apply to a good turnover.

WHEN

- During shift changes
- For emergent work that extends beyond one shift
- For completed modification packages that may not be implemented for one or more years
- When performing critical or complex activities over multiple shifts
- When changing responsibilities for tasks in progress
- When transferring responsibilities between people

HOW

1. **Identify specific tasks** the relieving individual will perform.

Consider the following factors during the turnover:

- Objectives or tasks to be accomplished
- Schedule requirements
- Key contacts, stakeholders, and organizational interfaces
- Status of the job; what has been accomplished so far
- Procedures being used
- Problems or unusual situations that have been identified
- Error-likely situations with critical activities
- Location of resources associated with the tasks/activities

2. **Start a turnover log**. Document those items listed above. An engineer log summarizing the key activities during a shift is also useful information for the relieving personnel.

3. **Over communicate**. The principals conduct a face-to-face turnover, using three-way communication on critical data and information. Listen for and challenge assumptions, asking clarifying questions.

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

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PRODUCT REVIEW MEETING

WHY

Engineering is not an exact science. Engineering involves judgment, uncertainty, and a degree of risk. Because engineering is characteristically a human endeavor, checks, reviews, and verifications are necessary to achieve effective and safe designs. To guide the development of the design or design changes, especially those associated with quality-related structures, systems, and components, a structured process is necessary. A product review meeting uses a team approach to coordinate the review of the initial design and the development and review of design changes. The meeting draws on the collective knowledge, skills, and experience of affected parties and stakeholders to improve ownership and quality in the resolution of the problem. The design 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 issue and to promote teamwork among the participants. An agenda, prepared for every meeting, specifies start and stop times and what to accomplish. Only people who have an important contribution to make participate. Preferably, meetings conclude with personnel knowing what is to be done, by whom, and by what date/time. For continuity and historical purposes, the chairperson prepares and distributes meeting minutes to the participants. Additionally, management can monitor the quality and attendance of these meetings through appropriate performance measures.

WHEN

- During meetings related to the initial design of or 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

HOW

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 prior to 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 prior to the respective meeting.
- Prepare and submit comment sheets on the documents prior to 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

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TECHNICAL TASK POSTJOB REVIEW

WHY

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 WRPS engineering organizational success. Postjob reviews provide an early opportunity to inform management about weaknesses in processes, programs, policies, and so forth that can adversely affect engineering activity defenses and barriers. An effective postjob review can identify lessons learned to improve future task performance.

A postjob review is a routine self-assessment practice conducted after completion of an engineering task. Postjob reviews provide engineers and managers with a forum to discuss what went well and to identify potential improvements to a particular task, project, or other risk important activity. Postjob reviews emphasize identification of flawed defenses, error traps encountered, and consequences of problems encountered. The responsible engineer(s) and manager(s) perform the review as soon as practicable after the task or each high-risk phase. The meeting is brief and to the point. To reinforce the effectiveness of postjob reviews, individuals who provide feedback are updated on the resolution of high-interest issues.

WHEN

- 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

HOW

1. **Face-to-Face** – Hold a face-to-face meeting of all active participants, led by the lead engineer.

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 individual.

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

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WORK PRODUCT REVIEW

WHY

Work product reviews provide accurate feedback to an engineer(s) regarding their performance for specific products. Such reviews encourage face-to-face interaction between mangers and engineers. Not only are areas for improvement identified on an individual basis, but also strengths are highlighted and communicated to others. Management can use the results of a review to communicate, coach, and reinforce expectations. Engineers can use this tool to gain insight on performance and strive for continuous improvement.

WHEN

- Periodically by each manager or responsible person
- At the discretion of the engineer
- As required by administrative instructions
- During apparent cause evaluations and root cause analyses

HOW

1. **Select Product** – As determined above, select a sample of product (after approval) for review from among those that affect one or more critical attributes.

2. **Review Product** – Using a cross-functional team of knowledgeable personnel to conduct the review, identify what went well (pluses) and opportunities for improvement (deltas) for the particular product. Preferably, the review is guided by a checklist of important attributes, such as the following:

- 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

- Documentation and reference software used
- Margin (contingency) management
- Technical accuracy and usability of procedures
- Reviews and approvals
- Program or procedural obstacles to desired performance
- Surprise situations (e.g., unanticipated risk factors, schedule or scope changes, and organizational issues)
- Human performance tool(s) applicable to product(s) or related activities

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

- Excellent: no defects identified or errors found with the delivered product
- Satisfactory: errors with little or no impact on product quality or its conclusions
- Unsatisfactory: several errors found, or minor rework required
- Unacceptable: errors that require significant rework or changes to product conclusions, invalidating the integrity of the product

4. **Follow-Up** – Follow up successes and opportunities for improvement.

5. **Feedback to Responsible Person(s)** – After the responsible person(s) 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(s). Provide specific feedback on "satisfactory," "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

Technical Task Prejob
Self Checking
Questioning Attitude
Validate Assumptions
Signature
Project Planning
Vendor Oversight
Do Not Disturb Sign
Peer Review
Problem Solving
Decision Making
Turnover
Product Review Meeting
Technical Task Postjob
Work Product Review

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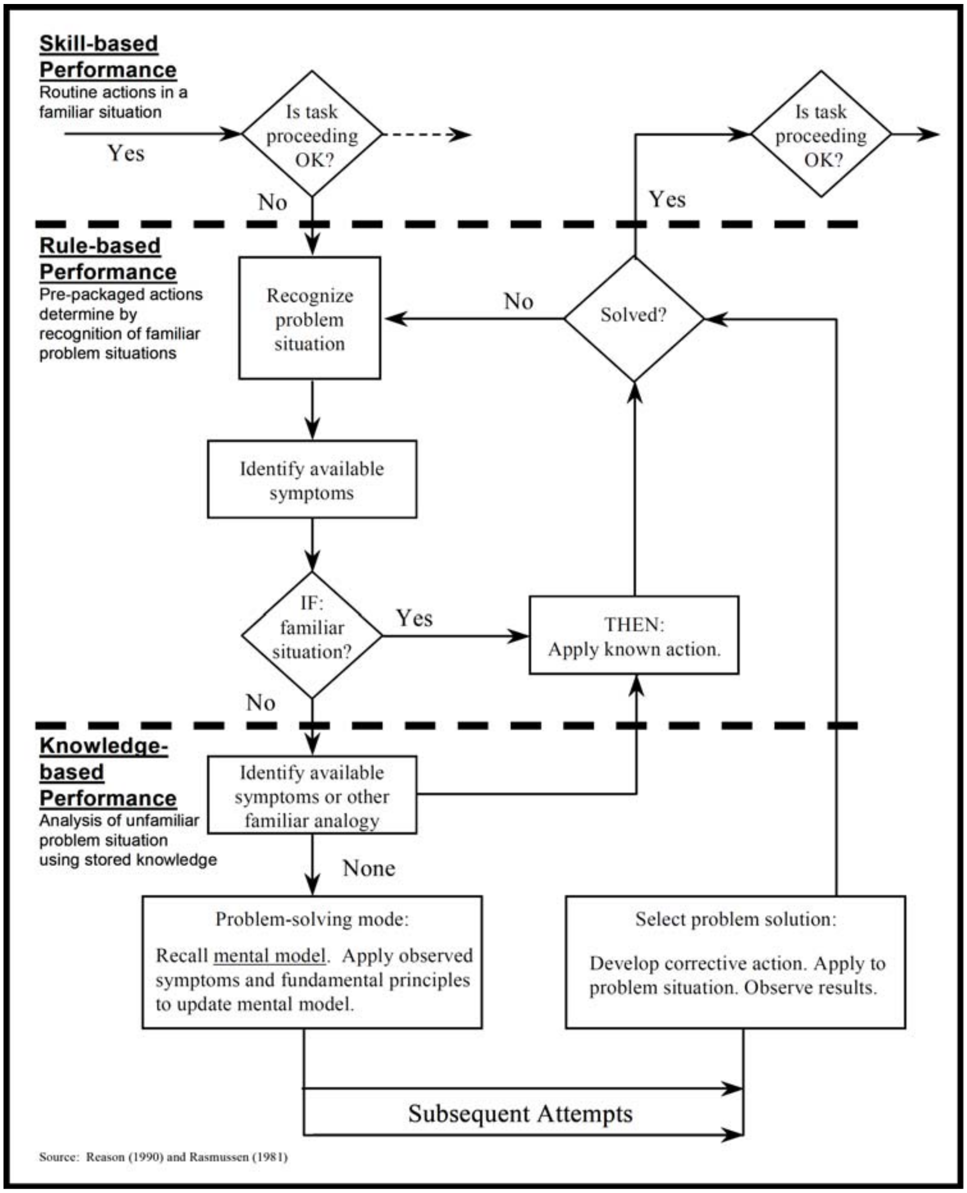
TWIN DIAGRAM FOR COMMON ERROR PRECURSORS

Task Demands	Individual Capabilities
• Time pressure (in a hurry)	• Unfamiliarity with task/first time
• High workload (large memory)	• Lack of knowledge (faulty mental model)
• Simultaneous, multiple actions	• New techniques not used before
• Repetitive actions/monotony	• Imprecise communication habits
• Irreversible actions	• Lack of proficiency/inexperience
• Interpretation requirements	• Indistinct problem-solving skills
• Unclear goals, roles, or responsibilities	• Unsafe attitudes
• Lack of or unclear standards	• Illness or fatigue; general poor health
Work Environment	**Human Nature**
• Distractions/interruptions	• Stress
• Changes/departure from routine	• Habit patterns
• Confusing displays or controls	• Assumptions
• Work-arounds/OOS instrumentation	• Complacency/overconfidence
• Hidden system/equipment response	• Mind-set (intentions)
• Unexpected equipment conditions	• Inaccurate risk perception
• Lack of alternative indication	• Mental shortcuts or biases
• Personality conflict	• Limited short-term memory

PERFORMANCE MODE RECOGNITION CHART



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REFERENCES AND SUPPLEMENTAL MATERIAL

References

This guide contains information derived from the following references and acknowledgement is due to INPO® for it's content. The information presented in this guide is for educational purposes only and should not be used in lieu of approved procedures, but as an aid to enhance activities or performance.

1. INPO® 05-002 Good Practice Revision 1 (February 2007), Human Performance Tools for Engineers and Other Knowledge Workers.
2. INPO® 06-003 Manual (October 2006), Human Performance Reference Manual.

Supplemental Material

1. DOE Handbook 1028-2009, Human Performance Improvement Handbook Volume 1: Concepts and Principles.
2. DOE Handbook 1028-2009, Human Performance Improvement Handbook Volume 2: Human Performance Tools for Individuals, Work Teams, and Management.
3. T13062, Human Performance Fundamentals for Engineers and Knowledge Workers.

NOTES

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This Survival Guide belongs to ______________________________

[redacted]

Engineers like to solve problems. If there are no problems handily available, they will create their own problems.—Scott Adams

Best Practice:

Best Practice: Training Lesson Plan- HPI Tools for Engineering - CNS

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A. References/Operating Procedures:

- DOE-HDBK-1028-2009, *HPI Handbook, Volume 1: Concepts and Principles*
- DOE-HDBK-1028-2009, *HPI Handbook Volume 2: Human Performance Tools for Individuals, Work Teams, and Management*

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G. **Controlling Information:** N/A

H. **Introduction:** N/A

I. Terminal Objective:

- Upon completion of this course, employees will be able to identify, discuss and apply HPI Fundamentals and Tools as they relate to Mission Engineering activities.

J. Enabling Objectives:

- EO1 Define Human Performance Improvement
- EO2 Discuss the 5 Principles of HPI
- EO3 Define HPI Critical Step
- EO4 Discuss Error Definitions and Types
- EO5 Discuss HPI and Engineering Leadership's Role
- EO6 Discuss Organizational Culture
- EO7 Discuss HPI and Knowledge Worker Role
- EO8 Discuss Human Performance Error Prevention Tools

K. Presentation:

Human Performance Tools for Engineering Leadership, Engineers & Knowledge Workers

An introductory review of Human Performance tools for Engineers

Terminal Objective:

Upon completion of this course, employees will be able to identify, discuss and apply HPI Fundamentals and Tools as they relate to Mission Engineering activities.

To provide HPI tools and concepts to assist execution of safe, quality and secure work

- Identifying the Traps & Triggers that affect performance;
- Introducing some HPI Tools that can be used to reduce/prevent error and how to apply them, and;
- Understanding how "defenses" are used to prevent errors and events.

By understanding the above:

- Recognize error traps, error triggers, and error-likely situations;
- Reduce the errors that can lead to events; and
- Develop effective defenses to prevent events and/or reduce their consequences.

Bottom Line: To minimize the frequency and severity of events at CNS

https://www.youtube.com/watch?v=FGoaXZwFIJ4
(Note, this video came from the DOE's National Training Center with permission to use it from them.)

Enabling Objectives:

EO1 Define Human Performance Improvement

EO2 Discuss the 5 Principles of HPI

EO3 Define HPI Critical Step

EO4 Discuss Error Definitions and Types

EO5 Discuss HPI and Engineering Leadership's Role

EO6 Discuss Organizational Culture

EO7 Discuss HPI and Knowledge Worker Role

EO8 Discuss Human Performance Error Prevention Tools

EO1 - Define Human Performance Improvement (HPI)

Human Performance Improvement (HPI) - a series of behaviors executed to accomplish specific task objectives (results) by anticipating, identifying, reducing error-likely situations and managing defenses utilizing HPI tools.

Human Performance (HP) - A series of behaviors executed to accomplish specific results (HP = Behavior (B) + Results (R)).

EO2 – Discuss the 5 Principles of HPI

The Five Principles of Human Performance

- People are fallible and even the best make mistakes.
- Error-likely situations are predictable, manageable, and preventable.
- Individual behavior is influenced by organizational processes and values.
- People achieve high levels of performance based largely on the encouragement and reinforcement received from leaders, peers, and subordinates.
- Events can be avoided by an understanding of the reasons mistakes occur and application of the lessons learned from past events.

EO3 – Define HPI Critical Step

HPI Critical Step - is a procedure step, series of steps, or action that if done improperly will cause irreversible harm to equipment or people, or significantly impact plant operation. This is different than the Operating Critical Step.

Operating Critical Step – operational steps that have the greatest potential risk of damage to personnel, product, facility, environmental damage or radioactive contamination above threshold limits as applicable to all processes, e.g., War Reserve (WR), Nuclear Explosive Like Assembly (NELA), testbeds, or components. (Pantex Writer's Manual – MNL-293084)

HPI Critical Steps can include:

- Safety Instructions (Traffic Safety)
- General Instructions
- Procedures (maintenance, operating, etc.)
- Reader Worker Checker

EO4 – Discuss Error Definitions and Types

Error Definitions:

1. Error – a human action that unintentionally departs from expected behavior
2. Error Precursors – Existing conditions that increase human error rates
3. Error-likely situations – A work situation in which there is a greater opportunity for error due to specific precursors or actions

Error Types:

1. Active Errors - changes to equipment, systems or processes that trigger immediate undesirable consequences. Ex: Calculation done incorrectly or not verified, Retrofits to machines can introduce new hazards.
2. Latent Errors - unknowingly create an undesired condition(s) embedded in the engineering processes of plant systems or the design bases, or that reduces equipment reliability that lie dormant. (ME errors mostly fall here.)

EO5 – Discuss HPI and the Engineering Leadership Role

Now let's begin with…

Engineering Leadership's role in establishing good Human Performance

"The devil is in the details, and everything we do *{to ensure safe, secure and quality operations of CNS}* is a detail."

Adapted from Admiral Hyman G. Rickover

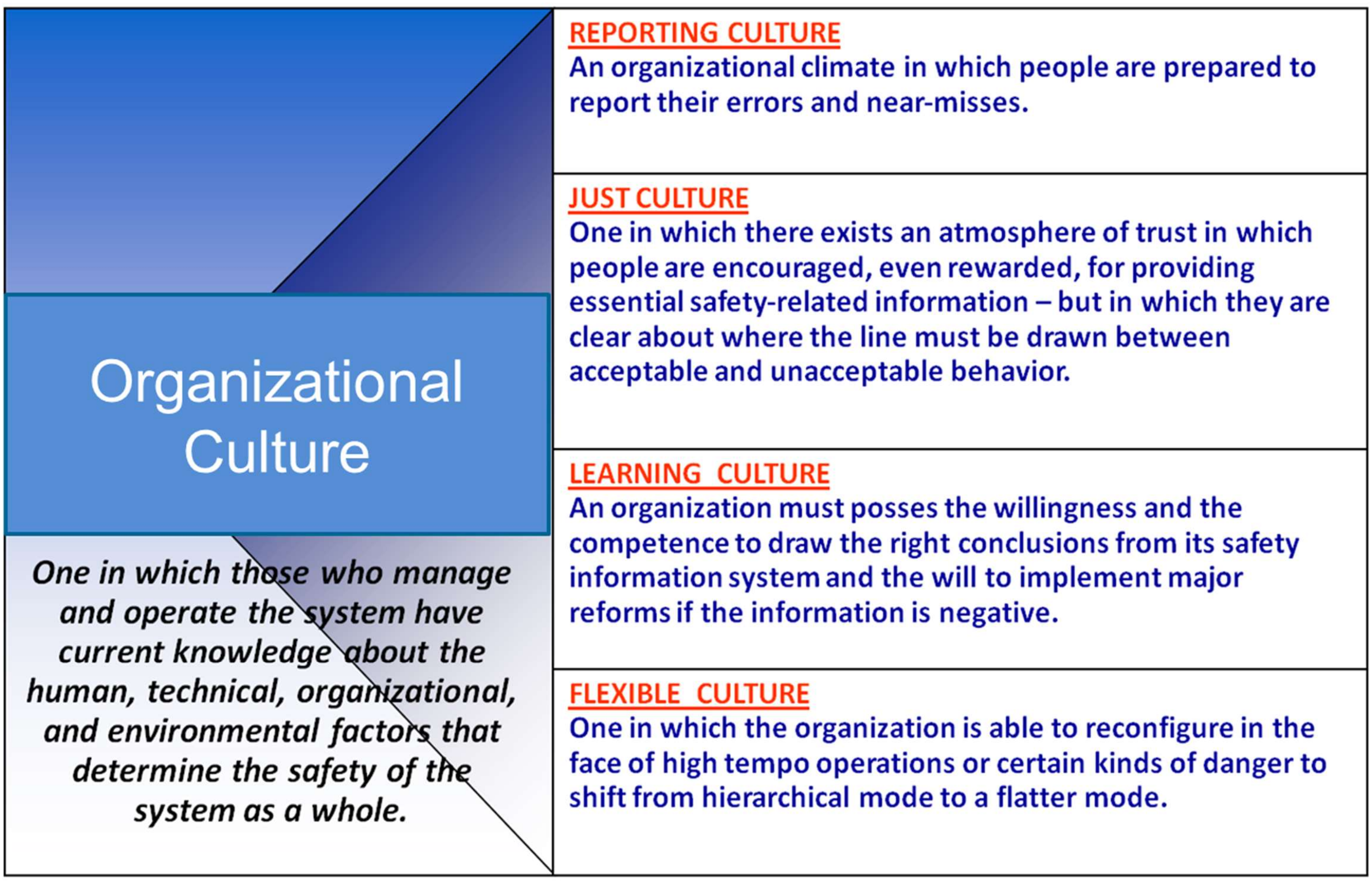
Founder of the U.S. Nuclear Navy

What Defines a Leader?

A leader is:

Any individual who takes *personal responsibility* for his/her **performance** as well as the organization's or plant's **performance** and attempts to influence the improvement of the processes and equipment that support them.

EO6 – Discuss Organizational Culture



(NOTE: Image was created/drawn in-house)

Culture and Values

- Managers must develop a culture with the *values, behaviors, and knowledge* that supports excellent human performance.
- Culture is not a written document. Leaders establish a culture through their actions and behaviors by fostering an environment free from retribution.
- Desired behaviors must be presented such that they are *embraced* by field and knowledge workers.
    - Communicate clear standards and expectations
    - Coach behaviors that don't meet expectations
    - Recognize correct behaviors through positive reinforcement

CNS Leaders Learn from Events - Part of a Strong Culture is a Learning Organization

If an event occurs, learn from it!

(NOTE: Original image removed due to IRO concerns.)

Role of Engineering Leadership

- Develop a clear understanding of HPI Knowledge Worker Fundamentals and Tools –Discussed in depth later in this training.
- Believe normalization of deviance is occurring and look for every opportunity to identify and correct.
- Don't just reinforce the tools, but create/sustain the right culture.
- Ensure every interaction leaves the right perception of what is most important.
- Treat human performance and Nuclear Safety Culture as a subset of overarching culture.

Are We Reinforcing Bad Behavior…

- If the completed product is good, are leaders looking at how it was completed before giving positive feedback?
    - Are we reinforcing bad behavior by not understanding how work gets done?
    - Example: If critical work is completed late, desired performance may instill bad habits that late work is acceptable. Leaders should address poor patterns of behavior to prevent future organizational issues.
- What is the perceived nature of the first question leaders ask when checking on the status of work?
    - When leaders ask for status of work, it can be perceived as a top priority by the employee. Employees may drop other priorities or may rush completion of a task due to lack of understanding of importance of the task. Be clear on deliverable dates and expectations.
- How often are our staff coached to minimize distractions & interruptions in the course of completing critical work?
- Multi-tasking

How do we achieve the desired performance?

- Develop new human performance tools?
- Increase the frequency of refresher training on existing tools?
- Increase observation and coaching to change behaviors?

Or, are there existing tools for the worker and leadership?

Questions

1. Human performance Improvement (HPI) is a series of _______________ executed to accomplish specific task objectives (results) by anticipating, identifying, reducing error-likely situations and managing defenses utilizing HPI tools.
    a. Results
    b. People
    c. Accomplishments
    d. Behaviors
2. Any individual can be a leader.
    a. True
    b. False
3. The Five Principles of Human Performance are (Check all that apply):
    - Individual behavior is influenced by organizational processes and values.

- People achieve high levels of performance based largely on the encouragement and reinforcement received from leaders, peers, and subordinates.
- Error-likely situations are predictable, manageable, and preventable.
- People are fallible and even the best make mistakes.
- Events can be avoided by an understanding of the reasons mistakes occur and application of the lessons learned from past events.

Answers:

1. D, Behaviors
2. A, True
3. All

Now let's talk about the…

The Knowledge Worker and HPI

It's About the <u>Thinking</u>

Using HPI tools to influence the thinking process to achieve thorough technical products and decisions

"Thinking is the hardest work there is,

which is probably the reason why so few engage in it." ***- Henry Ford***

(NOTE: original image of Henry Ford removed due to IRO concerns.)

EO7-Discuss HPI and Knowledge Worker Role

Focus Human Performance tool use on "Thinking" and Recognition / Self-awareness of Pitfalls

- Emphasize use of tools to "think;" these are discussed in the upcoming slides.
- Encourage self-awareness of being in knowledge space (e.g. troubleshooting, technical evaluations, conflicting information, trend analysis, frequency of performance, unknowns present); including self-awareness of "At risk practices to avoid"
- Don't feel too comfortable in the "process"; keep your intellectual curiosity

Qualified, thinking individuals using the right tool(s), at the right time, can achieve the right outcome.

Why Human Performance Improvement for Error Prevention?

1. Specific errors are preventable. Structured thinking can help people more consistently identify error traps before doing work.
2. All behavior, good and bad, is reinforced by the consequences that the individual experiences when the behavior occurs. Because of consequences, what happens to workers when they exhibit certain behaviors is an important factor in improving human performance.
3. Applying the concepts of human performance helps us avoid significant events, both proactively and reactively.
4. We still learn from our mistakes but we can also use the concepts of human performance to anticipate, predict, and prevent HPI Critical Errors that lead to significant events.

Perspective on Some Knowledge Worker Tools

- Assuming you understand and follow the procedures, these tools along with the processes help keep you out of trouble. Procedures are set up to catch errors such as verification or peer reviews: Help keep us on right track - Following Basic Processes – Examples - same CART and interference in the field – walk downs not done ahead of time
- Conduct of Engineering and other Procedures
- Procedures are YOUR Friend and help to keep you out of trouble

Remember HPI Critical Step

HPI Critical Step –is a procedure step, series of steps, or action that if done improperly will cause irreversible harm to equipment or people, or significantly impact plant operation.

Using a graded approach helps assess the human activity's potential impact on personal, nuclear, radiological, plant, and environmental safety.

1. Do you think the purpose of HPI is to eliminate <u>all</u> errors?

Answer: No, it would be impossible to do.

2. Which errors are we trying to prevent?

Answer: HPI Critical Step Errors as well as other errors such as taking cell phones into unapproved areas.

3. What are some examples of critical steps in your work?

Possible answers: Key procedure steps, verification of calculations, following signs, rad worker permits, etc.

EO8- Discuss Human Performance Error Prevention Tools

<u>Knowledge Workers Tools</u>

1. Self-Checking
2. Questioning Attitude/Stop or Pause when unsure
3. Validate Assumptions
4. Do Not Disturb Sign
5. Peer Review
6. Signature
7. Turnover
8. Technical Task Pre-Job Briefing
9. Technical Task Post-Job Review

Self-Checking

The purpose of this tool is an attention-management technique to help focus attention on the appropriate component, to think about the intended action (activity) and its expected outcome before performance, and to verify results after performance. Self-checking helps prevent errors when physical equipment is touched. Use STAR dialogue of STOP, THINK, ACT and REVIEW.

When to use the tool:

- During physical activities or interfaces with plant equipment (tests, walk downs, inspections, and so forth)
- During development of calculations or other quality related documents
  - Documents on which others will act – procure, perform fieldwork, etc.
  - They need to be correct!
- When performing critical tasks identified during pre-job briefings
- During time pressure (a hurried feeling), and following a task interruption
- When reading a computer readout or other indicator related to any critical attribute
- When recording data
- When your routine has been altered

Self-Checking – At Risk Practices to Avoid

- Not identifying critical steps and activities in advance
- Not self-checking again when distracted after initially self-checking and losing visual or physical contact
- Self-checking without the guiding document
- Attempting to perform more than one action at a time or two unrelated activities concurrently such as talking on phone or conversing with another
- Continuing the action when questions or discrepancies occur
- Looking at something other than the component to be manipulated

- Being tired, sleepy, or fatigued

Questioning Attitude/Stop When Unsure

A questioning attitude/stop or pause when unsure fosters awareness of uncertainty, assumptions, risk factors, and the significance of a decision or action before proceeding. This works in conjunction with a good technical brief.

When to use the tool:

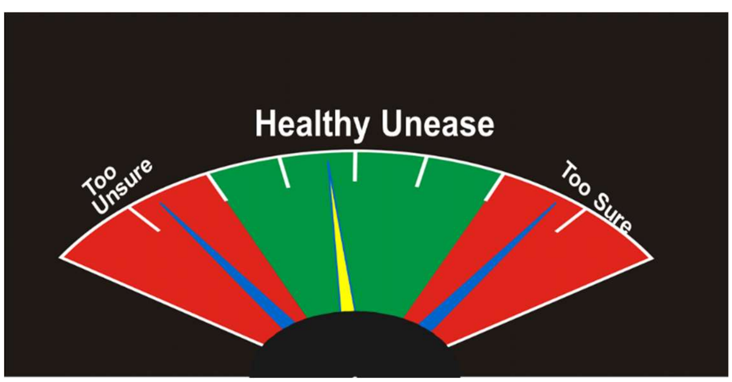
- When uncertain; a gut feeling that something is not right
- When using previously approved evaluations, solutions, designs, or other approved guidance to address a current issue
- When unexpected results are obtained or unfamiliar situations are encountered
- When questions about vendor activities arise
- 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 engineering evaluations
- When preparing and reviewing calculations
- When revising drawings, design criteria, or system descriptions
- During troubleshooting

Questioning Attitude/Stop When Unsure - At Risk Practices to Avoid

- 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”
- Dismissing contrary points of view
- Making assumptions
- Not asking for help

Questioning Attitude (Mindfulness) – with pause • difficult to measure, relies on individual skills • can be “observed” based on recognition of critical tasks or attributes of the activity, validating interim solutions, confirmation of known and unknown conditions, obtaining input from other engineers/organizations

A healthy questioning attitude will overcome the temptation to rationalize away a gut feeling that something is not right.



(NOTE: image was created in-house)

Validate Assumptions

Assumptions are a necessary part of engineering work so that a problem can be bounded. Due to their importance, assumptions must be justified with appropriate evidence. Assumptions can be inadvertently treated as fact or forgotten. Hence, Assumptions must be documented, tracked, and verified before the product is used or implemented with objective evidence; or protected by other measures.

When to use the tool:

- During the conceptual phase of design
- During the work development phase – validate field conditions through walk downs
- In product review meetings
- Prior to delivery of the product to the customer
- During verification of output documents (calculations, procurement specifications, etc.)
- Prior to use of preliminary or invalidated vendor data
- When answering technical questions in support of operations

Validate Assumptions Example – 9720-5 Criticality Accident Alarm System (CAAS) and Depleted Uranium (DU) Shielding

In support of the building 9720-5 safety analysis, a computer model was developed to estimate the quantity of DU filled containers that could be stored in the facility so that they would not interfere with the facility's CAAS' ability to detect an inadvertent nuclear criticality throughout the facility. The model included an assumption that the stack height of the material in each of the proposed cages was no more than 8 ft. The results of the model showed the stacking and location of containers that were acceptable. The stack height, however, was not properly translated from the model to control implementation as a protected assumption. As a result, implementing drawings for the operations personnel were not appropriately modified or annotated to indicate this limit. This was later discovered when the stack height of the materials in the cages containing DU were questioned and found to be greater than analyzed in the specific cage.

The solution to this issue included a rewrite of the analysis, revision to the loading drawing, and a new weekly Inspection for 9720-5 CAAS Stacking Height Limitations and Assumptions.

Validate and protect assumptions – especially in calculations.

Validate Assumptions – At Risk Practices to Avoid

- 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 documenting an assumption
- 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
- Using past successes to justify current assumptions
- Not highlighting and planning to protect the assumption (e.g., safety basis input)

Do Not Disturb Sign and what it means

The "Do Not Disturb" sign provides a simple means to control access and interruption of the responsible individual performing work.
When engineers perform risk-important or safety-critical work, it is essential that they maintain their concentration and attention on the task at hand

When to use the tool:

- During risk-important work or a review or verification of an engineering 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

Use as designed with clear understanding to not interrupt critical work

Questions

1. We still learn from our mistakes but we can also use the concepts of human performance to anticipate, predict, and prevent HPI Critical Errors leading to significant events.
    a. True
    b. False
2. It is possible to eliminate all errors by using HPI.
    a. True
    b. False
3. You should use self-checking (check all that apply)
    - When my best reviewer is not available.
    - When performing critical tasks identified during pre-job briefings
    - During time pressure (a hurried feeling), and following a task interruption
    - When reading a computer readout or other indicator related to any critical attribute
    - When recording data
    - When your routine has been altered
    - During development of calculations or other quality related documents
    - During physical activities or interfaces with plant equipment (tests, walk downs, inspections, and so forth)

4. ________________ must be justified with appropriate evidence.
    a. Assumptions
    b. Activities
    c. Practice
    d. Vendors

Answers:
1. A, True
2. B , False
3. All except first choice
4. A, Assumptions

Do Not Disturb Sign – At Risk Practices to Avoid

- 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)
- Only works if reinforced by management
- Avoid multi-tasking and focus directly on the critical task

Peer Review

The purpose of peer-review is to catch errors with a risk-important work product or task.
A reviewer provides a defense to detect errors and defects prior to the completion of work tasks by reviewing, checking, and/or observing the results or execution of another’s work product.
Keep in mind that the performer and the reviewer are equally accountable for the quality of the work.
When to use the tool:

- For reviews of new documents with no predecessor products
- For design documents
- During engineering evaluations
- For informal requests for a review from a coworker
- When verifying a technical decision or plan of action

Peer Review – At Risk Practices to Avoid

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

Signature and what it means

Signature

The purpose of this tool is to remind the user of what a signature or seal means on a document.
Human Performance studies show that more than 2 signatures is often ineffective because of an inherent tendency to place an assumed reliance on previous signatures and not fully review the document prior to signing. Engineering documents use checker/verifier to help eliminate this problem.

When to use the tool:

- when preparing, checking, reviewing, verifying, and approving products and services important to plant 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 plant equipment
- when procuring components

Signature – At Risk Practices to Avoid

- signing a document for an area outside the individual's area of expertise or qualifications
- signing a document for work the individual did not perform
- approving a document for work the individual did not oversee or manage
- deferring to what management wants without critical thinking
- relaxing design standards for expediency
- assuming the previous person in the engineering process did a good job, especially if that person is perceived as expert or experienced
- not verifying assumptions or justifying the basis for engineering judgment
- being in a hurry

Lessons Learned from Signature and its' intent:

In an electrical shock event at Pantex, the designated Fire Protection Engineer was considered a contributing factor to this event. In this particular event, 3 Electricians were working an outage and received shocks while working. From a human performance perspective, they had performed their absence of energy checks and were struggling to understand why the shocks occurred and attempted to rationalize it. The final cause was an unknown back feed. No one was hurt.

The Fire Protection Engineer was responsible for reviewing the work and giving his approval. He was relatively new to the position and his turn over of work consisted of reviewing a few pages in the work package itself. His understanding of his signature and what it meant was to review those few pages in the work package and approve by signing the front of the work package. During the causal analysis, it was determined through interviews that others interpreted his signature as the "engineer" over the complete work package with his review and signature meaning just that.

When the causal team reviewed his information, it was determined that his interpretation was because of the turn over of this work to him from the engineer that previously did this work.

As a result of this investigation, the fire protection engineer determined the importance of this work and formalized this information for turn over to fire protection engineers. He also shared his lessons learned to his work team. When he realized the importance of his signature and what it meant to the work, he has tried to convey the message of the importance of his signature and that the need to fully understand what that means by asking questions and not making assumptions prior to signing documents.

Turnover

For various reasons, the need to transition work between individuals in an orderly manner may arise. The purpose of this management/leadership tool is systematic and orderly transfer of work-related information between two individuals and the subsequent relief of one individual by the other. Turnover may involve a small work team or a crew. Some good practices/behaviors to use for good turnover include a turnover log and effective communication.

When to use the tool:

- For emergent work that extends when someone changes jobs, etc.
- For completed modification packages that may not be implemented for one or more years
- For starts and stops of projects
- When performing critical or complex activities over multiple shifts
- When changing responsibilities for tasks in progress
- When transferring responsibilities between people or work groups

Turnover – At Risk Practices to Avoid

- Leaving out critical information or the bases for decisions
- Not having an effective verbal explanation for turnover verification
- Not documenting activities in an engineer log as they occur during the shift
- Performing the turnover in a distracting environment
- Interrupting a turnover
- Conducting a turnover in a hurry; or allowing insufficient time for a turnover

Technical Task Pre-Job Briefs

The purpose of the Technical Task Pre-Job Briefings involve the preparation and discussion of an engineering activity before it is performed. Management/leadership uses this tool to assign personnel specific tasks; to clarify roles, responsibilities, methods, resources, and deliverables; and to identify risks, critical factors and compensatory measures, as appropriate.

- Uses a graded approach such as simple briefings for less complicated tasks and a more detailed briefing for more complicated tasks.
- The difference is the Eng TTPJB does not require hands-on performance like maintenance.

When to use:

- for a new task assignment
- prior to a peer review or verification
- during turnover
- prior to physical activities or interfaces with plant equipment (tests, walk-downs, inspections, and so forth)
- after extended breaks (several days) in the activity
- during vendor activities

Technical Task Pre-Job Brief - At Risk Practices to Avoid

- Discussing generalities rather than specifics especially what has to go right and HPI critical steps
- Omitting discussion of error-likely situations, risk factors, possible consequences, and needed defenses for critical activities
- Conducting the briefing as a monologue by the manager, with no active engagement by the person(s) assigned the task
- Not planning for the conduct of the briefing
- Not allowing time for individuals to prepare

- Conducting separate briefings held for the principals involved
- Not using lessons learned captured from previous activities to support the task at hand
- Assigning an engineer who lacks experience with the stakeholder's systems or processes

Technical Task Post-Job Briefing

The purpose of Technical Task Post- Job Reviews is to provide an early opportunity to inform management about weaknesses in processes, programs, policies, and so forth that can adversely affect engineering activity defenses and barriers. An effective review can identify lessons learned to improve future task performance.
Face-to-face meetings serve as a better forum to conduct these briefings and include strengths and opportunities for improvement.

When to use the 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

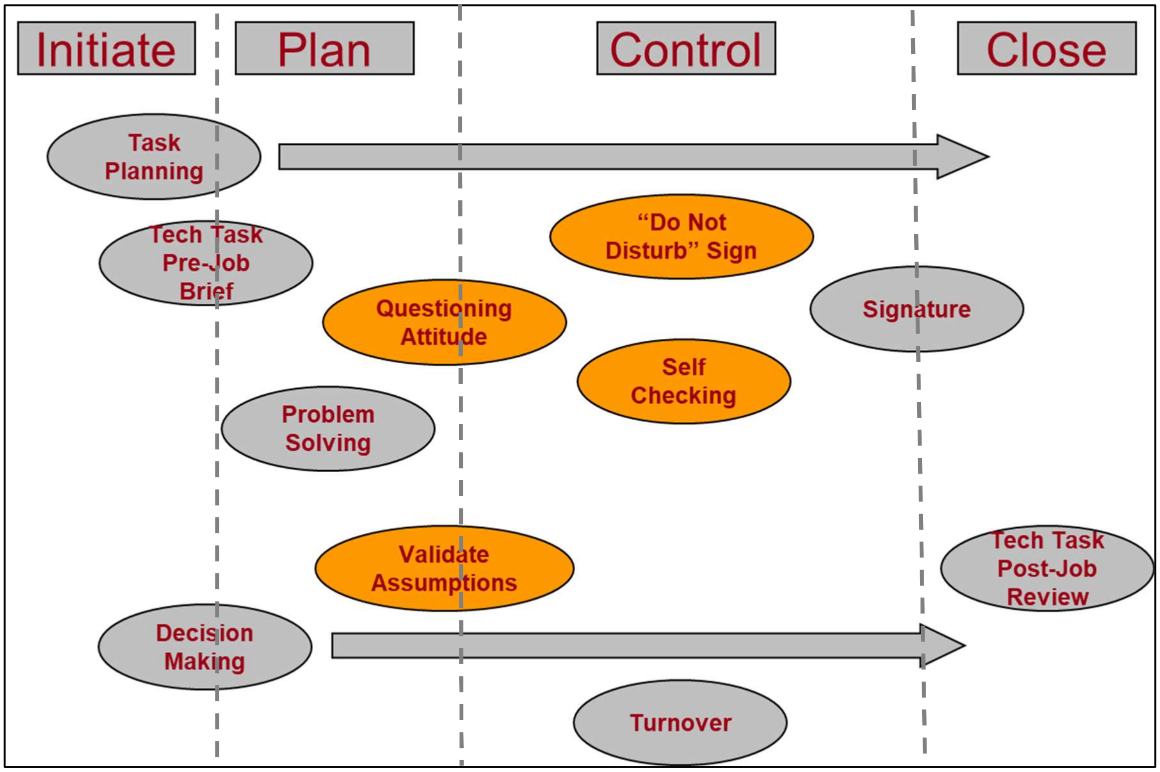
Technical Task Post-Job Briefing – At Risk Practices to Avoid

- Not performing a post-job review
- Not conducting a post-job review or 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

- Technical Task Post-Job Reviews– reinforce the tool
  - a few sites have stated this tool has helped them improve performance
  - difficult to maintain discipline to use the tool (i.e., easy to move on to next site need)

Applying the Tools



(NOTE: Image was created in-house)

Where and When Do You Apply

- Security matters
  - Use of repositories
  - Cell phones
- All your technical work
- Home
- All that you do

The important thing is not to stop questioning."
- Albert Einstein
(NOTE: Image of Albert Einstein removed due to IRO concerns.)

Ownership of Human Performance

- Take ownership and pride in your work; protect each other from making errors
- "Own your signature". Your signature is you – It represents your professional integrity. It signifies your standard of quality. Don't let your signature be associated with poor quality work
- Don't use the review process to correct your work – it should be ready for signature when you release it for review
- Demonstrate positive reinforcement of behaviors associated with using these tools, and acknowledgement that errors in our work are learning opportunities

"If you don't have time to do it right the first time...When will you ever have time to fix it?"

Questions:

1. The purpose of peer-review is to catch ___________ on an important work product or task.

   a. Lies

   b. Evaluations
   c. Information
   d. Errors

2. Human Performance studies show that more than _____ signatures is often ineffective because of an inherent tendency to place an assumed reliance on previous signatures and not fully review the document prior to signing. Engineering documents use checker/verifier to help eliminate this problem.
   a. 1
   b. 2
   c. 3
   d. 4

3. If someone you trust has reviewed and signed a document before you, it is not necessary for you to review, and you should just sign it without reviewing yourself.
   a. True
   b. False

4. When should you perform a Technical Task Pre-Job Brief? (Check all that apply)
   a. for a new task assignment
   b. prior to a peer review or verification
   c. during turnover
   d. prior to physical activities or interfaces with plant equipment (tests, walk downs, inspections, and so forth)
   e. after extended breaks (several days) in the activity
   f. during vendor activities
   g. Never

Answers:

1. D, Errors
2. B, 2
3. B, False
4. Check first 6 boxes

L. **Application:** N/A
M. **Summary/Review:** N/A
N. **Evaluation:** Questions will be embedded throughout the online course.
O. **Closing:** N/A