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Title:	EFCOG Human Performance Improvement Task Group - Task 20-2, Asking Better Error Precursor Questions for Effective Job Planning, Pre-Job Briefs, and Event Investigations
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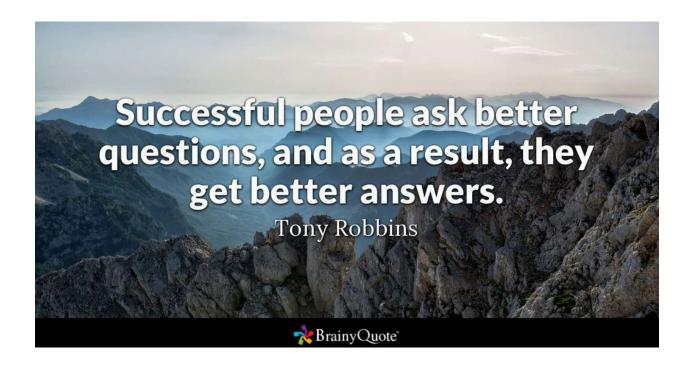# Human Performance Improvement Task Group

Task 20-2

Asking Better *Error Precursor* Questions for Effective Job Planning, Pre-Job Briefs, and Event Investigations

Successful people ask better questions, and as a result, they get better answers.

Tony Robbins

Background

The second principle of human performance states: "error-likely situations are predictable, manageable, and preventable." An error-likely situation comes into play when task-related factors exceed the capabilities of the individual, creating a mismatch at the point when the individual is "touching" either the physical or the paper plant. The simple presence of adverse conditions cannot be error-likely unless a specific action is to occur within that set of adverse conditions.

Error precursors are unfavorable conditions embedded in the job site that create mismatches between a task and the individual. Error precursors interfere with successful performance and increase the probability for error. Error precursors are, by definition, prerequisite conditions for error and, therefore, exist before an error occurs. If discovered and removed, job-site conditions can be changed to minimize the chance for error. This is more likely if people possess an intolerance for error precursors or error traps. Error precursors are not mysterious or obscure. To the contrary, they are noticeable, even obvious, if people look for them.

DOE-HDBK-2009-1028, Volume 1, *Concepts and Principles*, Chapter 2 Attachment A, provides a full list of "Error Precursors," which were compiled from a study of INPO's event database and from human performance, ergonomics, and human factors sources. The table below is the "short list" of the more common conditions associated with events triggered by human error, listed by order of impact.

Task Demands	Individual Capabilities
1. Time Pressure (in a hurry)	1. Unfamiliarity with task / First time
2. High workload (large memory)	2. Lack of knowledge (faulty mental model)
3. Simultaneous, multiple actions	3. New techniques not used before
4. Repetitive actions / Monotony	4. Imprecise communication habits
5. Irreversible actions	5. Lack of proficiency / Inexperience
6. Interpretation requirements	6. Indistinct problem-solving skills
7. Unclear goals, roles, or responsibilities	7. Unsafe attitudes
8. Lack of or unclear standards	8. Illness or fatigue; general poor health or injury

Work Environment	Human Nature
1. Distractions / Interruptions	1. Stress
2. Changes / Departure from routine	2. Habit patterns
3. Confusing displays or controls	3. Assumptions
4. Work-arounds / OOSβ instrumentation	4. Complacency / Overconfidence
5. Hidden system / equipment response	5. Mind-set (intentions)
6. Unexpected equipment conditions	6. Inaccurate risk perception
7. Lack of alternative indication	7. Mental shortcuts or biases
8. Personality conflict	8. Limited short-term memory

Basis for Task

A *Postcursor Video* by Dr. Jake Mazulewicz, JMA Human Reliability Strategies (www.reliableorg.com/resources) was the inspiration for the EFCOG Human Performance Improvement Task Group (HPI TG) to have a conversation about Error Precursors.

In 2019 the HPI TG commenced work on compiling a list of questions "to better discover error precursors" (Task 20-2). A sub team was created to review each error precursor and formulate questions that may lead to a deeper conversation about that particular error precursor.

Approach

The HPI Task Group began work on this task by brainstorming ideas for questions for each category on the "short list" of precursors from Volume 1 of the DOE HPI Handbook (sometimes referred to as the TWIN card). Later, as a sub team began to review, organize, and consolidate the questions related to each precursor, it was determined that the definitions for each of these common precursors, found in Attachment B to Chapter 2 of the Handbook, should be included along with the "name" from the short list, so that the full meaning of the precursor would be readily discernible. Proposed questions for each precursor were selected and refined that could be used in several workplace scenarios, such as job planning, pre-job briefings, and accident investigations. During discussions about the usefulness of the questions that had been drafted, it soon became apparent that the team needed to also include "assumptions" related to the precursors that, while not explicitly stated in the DOE Handbook, were believed to be necessary so that distinctions between the various precursors could be understood, and to articulate attributes of the environment and organization in which a given question would likely be posed.

As just intimated, discussions among the team revealed that that some precursors are closely related–even those in different categories. Accordingly, in addition to the assumptions, notes were also added in the assumptions column to provide references to other precursors for similar but distinct conditions. Some precursors, by nature, were very narrow, resulting in few questions; while other precursors can be broadly applied, resulting in a lengthy list of questions that could be posed to discover the potential existence of that precursor in its various forms.

The team tried to use common language, so that the user and listener would not need to be well-versed in HPI terminology to discover important elements of the task. Over time, the team did conclude that the users and listeners, in some cases, should have enough understanding of and/or experience with fundamental HPI principles, in order to make the posing of the question more likely to discover the precursor–which has been indicated in the assumptions column for such precursors. The common language should also facilitate using the questions less as an interrogation and more as part of a conversation in which a "questioning attitude" prevails, so that error-likely situations can be discovered. More broadly, utilizing the questions developed, such a conversation should go beyond simply running down the short list of precursors, to more of a "systems thinking" approach – to anticipate, monitor, respond and learn.

Three rounds of reviews of the proposed questions were conducted. Questions were refined, duplicates were removed, others were deleted, and some new questions were added. Once the final list was compiled, it was reviewed by the larger HPI Task Group. Comments and suggestions were reviewed for incorporation.

The final product of this initial effort, found in Attachment 1, consists of a table listing each of the common precursors, grouped by category, along with the HPI Handbook definition, questions that could be asked to help discover the precursor, and assumptions associated with both the precursor itself as well as the setting in which questions about it would be posed.

As a tool, it is envisioned that the individual(s) who are preparing to conduct a job-planning session, a pre-job briefing, etc., would consider the nature of the task involved, the personnel involved, and the environment in which the work is scheduled to occur, and would select specific questions from the table pertaining to the precursors that are most likely to exist for this instance, to be used in the meeting. For a post-work scenario, such as a post-work review or an event investigation, the questions would be selected based on the essential known facts and outcomes.

"Top 10 Questions"

The combined set of available questions for the entire list of precursors was significant. Considering that in some cases, the individual(s) conducting the meeting might not have time to go through the entire table and select specific questions, the team decided to create a "Top 10 Questions" list. Various members of the HPI Task Group ranked the 10 questions that they believed were the most useful and would discover multiple error precursors. Based on the ratings received, the 10 most-frequently-selected questions were identified. This list was also reviewed by the larger HPI Task Group community.

The final "Top 10 Questions" were then sent out to HPI Task Group members to "test drive." A survey was created to track the test-drive results. Results from the survey respondents may be found in Attachment 2. It was around this time that COVID-19 restrictions began to be implemented throughout the DOE complex, which significantly impacted most sites' ability to test "in the field." Many employees, including HPI Practitioners who would be facilitating application of the test, were transitioned to working remotely.

Additionally, the list of precursors related to the "top 10" questions from the survey results was compared to the event trending-code data for the Los Alamos National Laboratory for 2014-2019. The results of this analysis may be found in Attachment 3.

Top 10 Questions to Discover Error Precursors
Under what conditions should you pause/stop work?
What potential interruptions or distractions might arise during execution of this task?
What is different today from our usual routine?
Are there any situations going on with the work team that can affect the deliverable?
What has to go right the first time and/or every time – in other words, are there critical steps or risk-important steps?
What do we "expect" to see and do as we begin work and/or as task performance progresses? How will we validate this is the actual condition?
Is there anything new about how we are to perform this job?
Are there any aspects of the job or potential obstacles that could cause misunderstanding between team members?
What verbal communication tools are most effective for this particular job?
Even though we have performed this task a bunch of times before, is there some reason we should do some aspect/part of it differently this time?

Note to User: The questions in the table above can be used in any order, and not all 10 question have to be asked. In fact, all the questions in the full table in Attachment 1 are always available for your use, based on your situation and needs. As the Top 10 Questions are not all-inclusive to discover all precursors that may be present in the specific situation to be discussed, if you have the time to prepare, you should select the questions that you think will best discover precursors specific to the task and the work group that will be, are, or were involved.

Additional Analysis

A survey was conducted to analyze the impact of the top 10 questions (Attachment 2).

Furthermore, one member of the HPI Task Group at Flour Idaho (ICP), tested the incorporation of these questions into their Pre-Job Briefings. Details of this analysis may be found in Attachment 4.

General Guidance

The contents of this document are intended to be *reference* material. Users do not need to ask any specific number of questions. Be selective for the task your about to do. If, over time, event trending data shows an increase in a particular precursor in your organization, then consider selecting alternate questions from the lists that are directed at discovering that particular precursor.

When asking questions, use empathy, and try to establish a personal connection (like you are starting a conversation) before starting to ask these probing questions. If through the course of asking the questions the team discovers that a precursor condition is very likely to exist, then the team should explore possible (consequential) outcomes to either remove or mitigate the condition and/or the likelihood for errors to result from its existence.

Planners and job-briefers can reframe questions into the future tense. Similarly, event investigators should rephrase questions to use the past tense.

HPI Practitioners are encouraged to proactively interact with investigators, planners, and briefing leaders, promoting the use of the tools herein to start a conversations

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Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions

Task Demands	1. Time Pressure (in a hurry)	Urgency or excessive pace required to perform action or task
		
		Manifested by shortcuts, being in a hurry, and an unwillingness to accept additional work or to help others
		
		No spare time
			• Do you have enough time to complete your workload safely and correctly?
			• Is there anything with a specific time constraint?
			  ○ Extraordinary, unreasonable, beyond normal
			  ○ Recognition of "the why" – need to have job finished by _____ because of _____ (e.g., due/expiration date, return system to normal service, etc.)
			• Is there something preventing you from doing this task in the allotted time?
			• Does anyone have an appointment or meeting they need to go to?
			• Under what conditions should you pause/stop work?
			• How would you request an extension if you need more time to complete a task?
			  ○ Do you feel comfortable requesting an extension?
				• Time pressures (both internal and external; at individual and/or team level) are recognizable by team members and are seen as being a potential cause for increased errors to occur due to hurrying or distraction.

Task Demands	2. High workload (large memory)	Mental demands on individual to maintain high levels of concentration; for example, scanning, interpreting, deciding, while requiring recall of excessive amounts of information (either from training or earlier in the task)	• Do you feel overwhelmed? Stretched too thin? • Are there aids (procedures, checklists, etc.) that help us recall the regulations/safety requirements for your task? • Is there something that really makes this task mentally "hard" to do? If so, what can we do about it? • Do I have a sufficient skill level to manage all the moving parts? • Do I need help (need two people, or operator aid) because of the things I have to mentally keep track of? • What is it that makes this task (mentally) hard? And what can I do about it?	• Task involves steps that entail concurrent collection and interpretation of multiple data points. • No memory aids are available for recording data points • No operator aids are available to reference standards, criteria, etc. **Note**: For other memory-related errors see also: • *Human Nature – Stress* (for impacts on memory/concentration due to internally-generated concerns) • *Human Nature – Limited short-term memory* (for errors related to limitations on simultaneous attention to multiple channels of information)

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions
Task Demands	3. Simultaneous, multiple actions	Performance of two or more activities, either mentally or physically, that may result in divided attention, mental overload, or reduced vigilance on one or the other task	• What deliverables do you have or what else is on your plate that you may be trying to do concurrent with this task? • Is there something not related to this task keeping you from doing this task? • Are there things that will take you out of your role that will cause you to "do multiple things at one time?" • Do you feel adding/subtracting steps would be beneficial without compromising safety? • Are there actions that must be done simultaneously? How do you ensure both will be done correctly? • Does anyone have any other responsibilities that could conflict with this task?	• Task (or assigned duties) requires individual(s) to have multiple roles or duties, which could compromise focus on one role/duty. **Note**: For other types of simultaneous activities see: • *Work Environment – Distractions/Interruptions* (for errors related to conditions associated with concurrent activities in the work area)
Task Demands	4. Repetitive actions / Monotony	Inadequate level of mental activity resulting from performance of repeated actions; boring Insufficient information exchange at the job site to help individual reach and maintain an acceptable level of alertness	• Are there elements of this task that could become monotonous or repetitive? • What would be the consequences if you were to disengage? • Could you "go on autopilot"? Is there something important that you could miss? ○ Autopilot: a state or condition in which activity or behavior is regulated automatically in a predetermined or instinctive manner	• Workers know what "engagement" means and what it means to be "disengaged."
Task Demands	5. Irreversible actions	Action that, once taken, cannot be recovered without some significant delay No obvious means of reversing an action	• What are the critical steps associated with this task? • Are there any "point(s) of no return"? • What is the worst that can go wrong and at what point in the task sequence would that be? • When (which steps) should you pause/stop work? • Is there hold point and what's the objective of this hold point?	• Workers know what constitutes a "critical step" and a "non-routine step". • Workers understand the purpose of a hold point beyond verifying that a quality or safety requirement has been satisfied.

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions
Task Demands	6. Interpretation requirements	Situations requiring "in-field" diagnosis, potentially leading to misunderstanding or application of wrong rule or procedure	• If a diagnosis or decision is required, how will the right diagnosis or decision be made? • Can this step be interpreted in multiple ways? • Do your work package (WP) or procedures provide you with adequate direction to perform a task or process? Are they vague? • Are the procedure steps clear and specific? • What other guidance do you need to do the task right? • Explain what you're going to do for step X. o How is step X performed and what is your role in that? • Under what conditions should you pause/stop work? • What would you do if you were confused about a step in the written procedure? • Has there been an issue with any steps in the past? • Have you been unsure about any of the steps in the past? • Do you know who to go to for clarity? • Procedure writer: Have you observed the work to be done? • Planner: Did you look at the feedback from the previous jobs? • Planner: What was the feedback from the previous jobs?	• Interpreting which requirements apply to the situation based on what is diagnosed is inherent in the task. • Misdiagnosis of the problem presupposes selection of the wrong course of action. • Diagnosis of the situation and an understanding of various courses of action based on the diagnosis are part of the skill base of the worker. **Note**: For other types of misdiagnosis see: • *Individual Capabilities – Indistinct problem-solving skills* (for potential errors due to underdeveloped problem-solving skills)

Task Demands	7. Unclear goals, roles, or responsibilities	Unclear work objectives or expectations
		
		Uncertainty about the duties an individual is responsible for in a task that involves other individuals
		
		Duties that are incompatible with other individuals
			• **Goals:**
			   o What are the goals of this task?
			   o Do we feel confident with our goals
			   o Does our work package (WP) or procedures clearly outline our goal (task objective)?
			• **Roles and Responsibilities:**
			   o What are your roles and responsibilities in this task or job?
			   o Is everyone here that needs to be here – even if they are not "required" to be here?
			   o Is there anyone serving in a role other than what they'd normally do?
			   o Who has the authority to make decisions or provide clarification about who does what or how they should do it?
				• Everyone understands their own role as well as the role of everyone else.
				• Everyone has a good understanding of their own duties and at least a correct idea of the duties of others on the team.
				• Prior experience performing this task is had by some members of the team such that differences in roles is clear and incompatibilities between roles can be recognized.

Attachment 1
Error Precursor Questions for Job Planning, Pre-Job Briefs, and Event Investigations

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions
Task Demands	8. Lack of or unclear standards	Ambiguity or misunderstanding about acceptable behaviors or results; if unspecified, standards default to those of the front-line worker (good or bad)	- In general, what procedures, guides, instructions, and work packages are needed for similar tasks? - Are they present in this task? - What procedures aren't needed? - What other guidance do you need to do the task correctly? - If there is a gap in our instructions, is there something else in place that makes up for it? - Do you know who to go to for clarification? - Are pause/stop-work criteria understood? - Have there been any recent changes that affect the standards? - What does "done" look like?	- The "norm" for activities performed by the group is a balanced combination of written work instructions, procedure-use level, and pre-requisite training and qualifications that is consistent from job to job. - Questions posed are seeking to find if the job about to be performed is significantly different (lesser) in the specificity or balance in behaviors for how the job is to be performed and/or standards for what constitutes satisfactory/acceptable completion.
Task Demands	Other Error Precursors	- Confusing procedure/Vague guidance - Excessive communication requirements - Delays; idle time - Complexity/High information flow - Long-term monitoring - Excessive time on task		Supervisor and workers have sufficient understanding of errors, error precursors, and the wisdom in trying to identify precursors that may exist before starting work, especially those that are less common.

Attachment 1
Error Precursor Questions for Job Planning, Pre-Job Briefs, and Event Investigations

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions

Individual Capabilities	1. Unfamiliarity with task / First time	Unawareness of task expectations or performance standards
		
		First time to perform a task (not performed previously; a significant procedure change)
			• Questions for a pre-job briefing;
			  o Are each of you familiar with what you'll be asked to do on this job? (Reference to HPI Tool: Task Preview)
			  o Are you aware of task expectations or performance standards?
			  o Is this the first time (or first time in a while) that you've performed the task (or doing it this way)?
			• What has to go right the first time and/or every time – in other words, are there critical steps or risk-important steps?
			• Under what conditions should you pause/stop work?
			• Are there new people on the job/team?
			• Who is the most experienced/familiar at this?
			  o Consider asking whether this person can be approached for advice if he/she is not on the team.
			• Explain why you are confident to safely operate the/any new equipment
			• Can you operate all of the equipment that your role requires?
			• Has the procedure changed since the last time you performed the work? Who has never performed this task (even if qualified)?
				• There is some level of basic education, training, and/or experience that the worker(s) is (are) assumed to have as a basis for assigning him/her (them) to perform the task. (It is unlikely that there is a qualification program in place.) The focus is that he/she (they) has (have) not performed this specific task before.

Individual Capabilities	2. Lack of knowledge (faulty mental model)	Unawareness of factual information necessary for successful completion of task; lack of practical knowledge about the performance of a task	• What do we "expect" to see and do as we begin work and/or as task performance progresses? How will we validate this is the actual condition? • Do you know and can you explain "why" all the steps for this job that you will be involved in are necessary? • If you find that there is a lack of factual information necessary for successful completion of the task, when will you pause/stop work? • How should recent system changes impact our understanding of the system?	• Employees have training and/or experience in the mechanics of the task, but may lack deeper knowledge or experience about the system, how it responds under a variety of conditions, and/or how feedback from it is obtained. **Note**: Refer to DOE-HDBK-1028-2009, volume 1, page 2-28 for additional information on "Mental Models."

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions
Individual Capabilities	3. New techniques not used before	Lack of knowledge or skill with a specific work method required to perform a task	• What are the critical differences between the new technique we will be using today and the old/previous technique? • How is the new equipment we will be using today different from the old equipment? • Does this new equipment have any additional/new capabilities? • On this task, we'll be using the new Illudium Q-36 Explosive Space Modulator (from *Haredevil Hare*)…. • Did all of you review the instructions (manual) and/or complete the certification training? ○ Possible follow-up: "Do you feel that training was adequate? • Is there anything new about how we are to perform this job? • Has the system changed in such a way that we will be doing some aspect of the task differently? • Are there additional [hold] points at which you will pause or stop work to verify something because of a new technique or new equipment? • Who can you contact if you have questions about the new equipment/technique or if things don't go as planned? • If the procedure has been updated or revised, how was that communicated to you? • Have the supporting systems/processes been integrated properly prior to using the new techniques/? • Do you feel confident that everyone knows their task and that everyone's on the same page?	• Workers are knowledgeable and skilled in the task and associated techniques previously specified. However, for this iteration there is a new element (or technique) to the task.

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions

Individual Capabilities	4. Imprecise communication habits	Communication habits or means that do not enhance accurate understanding by all members involved in an exchange of information	• What are your expected communications during this task?
			• Are there any points where we need to ensure everyone clearly and correctly understands what others said?
			• Are there any aspects of the job or potential obstacles that could cause misunderstanding between team members?
			   o Are non-verbal communications (e.g., hand signals) uniform and understood?
			• Is there any equipment (e.g., respirators) or conditions (e.g., noise) that could impede communications?
			• What is the best way to communicate to others during this task?
			• What verbal communication tools are most effective for this particular job?
			   o Will we be using letters (B, C, D,) where we should be using the phonetic alphabet (Bravo, Charlie, Delta)?
			   o Will we be using numbers that sound like other common words (e.g., 2 vs. to or too, 4 vs. for)?
			   o Will we be using words that sound similar and so could be misheard (e.g., open, closed vs. open, shut)?
			   o Communications equipment; such as two-way radios, headsets, etc.
			• Will verbal communications be impeded in some way (e.g., high-noise area, lack of direct line-of-sight)?
			   o Possible follow-up: "Are those tools available to you?"
			• Are you familiar with using this phone system/radio that we will be using?
			• Is language a concern (English as a second language, accents, regional inflections/pronunciations, local slang/nomenclature, literacy concerns, etc.)?
			• What assumptions are being made about communication protocols and the targets of that communication?
			• What are the emergency communication protocols?
			• Are the procedures for this job clear and specific regarding communications that are a required part of this task?
			• Have there been any problems communicating tasks or instructions when this task was performed previously?
				• Task involves multiple persons who must communicate accurately during task execution in order for task to be completed successfully.
				• Over time, communications during team members who have worked together frequently may have become less formal (e.g., specialized, shortened, unique to the group, etc.)
				• Task may involve means of communications that can be degraded, corrupted, or impaired by atypical workplace conditions.
				
				Note: For other types of inaccurate communications see:
				• *Task Demands – Interpretation requirements* (for potential errors associated with interpretation of written instructions)

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions

Individual Capabilities	5. Lack of proficiency / Inexperience	Degradation of knowledge or skill with a task because of infrequent performance of the activity	• Is this something you do frequently? Have you been successful every time?
			• How many times have you done this before?
			   ○ Possible follow-up: How confident do you feel you can perform this task correctly and safely?
			• When was the last time you performed this task?
			   ○ Are there people who have not performed this task in a while (i.e., more than 6 months ago).
			   ○ How did it go the last time?
			• Who has previous experience that can coach or provide guidance?
				• There is some level of training and qualification, and/or experience that the worker(s) is(are) assumed to have as a basis for assigning him/her(them) to perform the task.

Individual Capabilities	6. Indistinct problem-solving skills	Unsystematic response to unfamiliar situations; inability to develop strategies to resolve problem scenarios without excessive use of trial-and-error or reliance on previously successful solutions
		
		Unable to cope with changing facility conditions
			• What will we do when we experience something "interesting" (not seen before, curious, unexpected, surprises, etc.)?
			• Do you have multiple options – and know which one to use – when problems or need to make a decision arise
			• Do we have the system experience necessary to truly find and resolve the *problem* and not just the symptom?
			   ○ Do we know exactly how we'll troubleshoot _____ when we run into a problem?
			   ○ Do we know who to ask, when we may not know what is needed?
			   ○ Is there other information necessary to help solve this problem?
			• If you come upon something unexpected, what steps will you take?
			• How will we handle something that is different than the way we performed this job last time?
			• Let's discuss a contingency plan in the event that X happens.
			• Under what conditions should you pause/stop work?
			• How will we recognize changes in environmental or operating parameters that could affect our understanding of "how things are going?"
				• Task is expected or has been shown to require assessment and diagnosis during the course of task execution.
				• Written instructions provide multiple paths that require a decision as to which path to follow.
				
				Note: For other errors related to problem-solving see:
				• *Task Demands – Interpretation requirements* (for tasks/situations that require in-field diagnosis and then application of procedural rules)

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions
Individual Capabilities	7. "Unsafe" attitudes for critical tasks	Personal belief in prevailing importance of accomplishing the task (production) without consciously considering associated hazards Perception of invulnerability while performing a particular task Pride; heroic; fatalistic; summit fever; Pollyanna; bald tire	• Why is this task critical? • What are the steps that make this task critical? o Why are those step(s) critical? • Who's done this task "too many times?" • Do we have any of these attitudes: pride, heroic, fatalistic, summit fever, overly optimistic, continuing to do what we've always done, etc.? • How important is it to you that you finish this task today? • Have we considered the impact of this desire to complete the task? • What things should we consider so we are mindful of our attitude, beliefs, and assumptions that may blind us to the seriousness of the hazards?	• Task is critical or involves critical steps. • The prevailing organizational culture emphasizes safety and quality as essential considerations for performing work. • There is not external pressure (to the workers) to complete this job. Questions are seeking to find if individuals recognize the need for deliberate and controlled actions due to the critical nature of the task. **Note**: See DOE-HDBK-1028-2009, volume 1, page 2-4 thru 2-8 for more information about "Unsafe Attitudes." **Note**: For other types of "unsafe" attitudes for critical tasks see: • *Task Demands – Time pressure* (for pressure to complete a task by a certain time)
Individual Capabilities	8. Illness or fatigue; general poor health or injury	Degradation of a person's physical or mental abilities caused by a sickness, disease, or debilitating injury Lack of adequate physical rest to support acceptable mental alertness and function	• What's your energy level today on a scale from 1 to 10? • Is there someone who is "not on their A game" today? • Are you *really* prepared to do this task – mentally and physically? • Has anything changed with you personally that could affect your ability to be 100% on this job? • Does anyone have any physical limitations that might come into play today? • Are there any job accommodations necessary (that you are comfortable to discuss)? • Has anyone heard about the flu bug going around…? • Is there any impact from allergies, elevation change (Pressure change), time zone changes, daylight savings time, for today's task? • Do you know when your body needs a break? Can you take a break when that happens? • For those returning from a lost-time injury/accident, has the doctor released you to return to work?	• The organizational and/or work team culture does not discourage employees from admitting when they are tired or somewhat ill and should probably only perform "light duty" tasks. • Workers generally understand how fatigue or illness can increase likelihood of errors. **Note**: Take into consideration any facility protocols, procedures, policies, etc. pertaining to Equal Employment Opportunity, Affirmative Action, and Diversity, Employees with Temporary Impairments, Employees with Disabilities, etc.

Attachment 1
Error Precursor Questions for Job Planning, Pre-Job Briefs, and Event Investigations

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions
Individual Capabilities	Other Error Precursors	- Unaware of Critical Parameters - Inappropriate values - Major life event: medical, financial, or emotional - Poor manual dexterity - Human Factors: Designed for right-handed operation (and you are left-handed) - Low self-esteem; moody - Questionable ethics (bends the rules) - Sense of control/Learned helplessness - Personality type		Supervisor and workers have sufficient understanding of errors, error precursors, and the wisdom in trying to identify precursors that may exist before starting work, especially those that are less common.
Work Environment	1. Distractions/Interruptions	Conditions of either the task or work environment requiring the individual to stop and restart a task sequence, diverting attention to and from the task at-hand	- What potential interruptions or distractions might arise during execution of this task? - How would you handle distractions during this task? - Is there anything else going on in this [work] area that could interrupt or delay us? - Could your cell phone, radio, pager, etc. cause an interruption/distraction? - Where do you keep your cell phone when doing this task? - Are you aware of any planned oversight activities occurring simultaneously on/with the job being done? - Are you mentoring someone during this process that could be sufficiently distracting and affect your performance? - What challenges do you face in trying to focus on executing this task in this area? - What type, or level, of work environment distractions/interruptions would force you to pause/stop work?	- Personnel being assigned have familiarity with the task as well as the area where it will be performed. **Note**: For other types of distractions/interruptions see: *Human Nature – Stress* (for distraction related to concern over one's own ability to perform the task satisfactorily) *Task Demands – Time pressure* (for distraction from pressure to complete a task by a certain time) *Task Demands – Simultaneous, multiple actions* (for distractions related to other assigned tasks or duties)

Attachment 1
Error Precursor Questions for Job Planning, Pre-Job Briefs, and Event Investigations

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions

Work Environment	2. Changes/Departure from routine	Departure from a well-established routine
		
		Unfamiliar or unforeseen task or job site conditions that potentially disturb an individual's understanding of a task or equipment status
			• Are there any job site conditions that are different today that we need to be aware of?
			  o Can any conditions change during task performance?
			  o Could anything force you to do this task differently than normal?
			  o What other obstacles in the work area do we have to adapt to, or manage?
			  o Any environmental conditions that might impact this job? Examples include noise, weather changes, interesting activities that grab your attention, etc.
			  o What will we do to remind ourselves of the changed condition?
			  o Are there hazards that may change, causing reconsideration of controls or mitigating strategies? Do we need to do a Real Time Risk Assessment as the task progresses?
			• What is different today from our usual routine?
			• Are there any non-task related changes or departures from routine individual or team?
			  o Is a critical team member away for training or out sick?
			  o Is there anything different/new going on in this area?
			  o Any work steps or procedures changed since the last time you executed this task?
			  o Has there been a time change [from Daylight Savings Time]?
			• What about the system –its processes, equipment, or supporting systems – has or may have changed since we last did this job?
			• Is there a point at which we need to pause and re-brief?
			• Are there any external groups we need to communicate with during this job to confirm the status of [equipment X] or [system Y]?
				• Personnel being assigned have sufficient familiarity with the task and how it is typically performed, as well as the typical conditions in the area where it will be performed this time, to recognize steps that could be impacted by certain atypical conditions.
				
				Note: Change/departures from routine may drive the worker from skill-based or rule-based performance mode, and he/she now may be in knowledge-based mode. The individual and/or team needs to fully understand the deviation before proceeding.
				
				Note: For other types of unfamiliar situations see also:
				• *Human Nature – Assumptions (*for errors arising out of suppositions made without verification of facts)
				• *Individual Capabilities – Lack of Knowledge* (for errors resulting from lack of practical knowledge about the task)

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions

Work Environment	3. Confusing displays or controls	Characteristics of installed displays and controls that could possibly confuse or exceed working memory capability of an individual
		
		Examples:
		
		• missing or vague content (insufficient or irrelevant)
		
		• lack of indication of specific process parameter
		
		• illogical organization and/or layout
		
		• insufficient identification of displayed process information
		
		• controls placed close together without obvious ways to discriminate conflicts between indications
			• Are there look-alike equipment, components, or controls?
			• Do field labels on the screen match those in the procedure?
			• What are the key indications that we need to see on the screen or get from the monitor/display?
			• Are there any system parameters that may look similar on the screen?
			  o Could color blindness cause an error in this case?
			• Do you know what to look for to determine if something is wrong with the displays and controls?
			• What pitfalls or lessons learned would you alert a trainee to on this display/control?
			• Are the displays or controls labeled in a manner that *you* understand?
			  o Is analog vs. digital a factor that needs to be considered?
			• Are controls "human factored" (i.e., look-alike controls are distinguishable; differences in similar plant designs are highlighted)?
				• Workers have some frame of reference (from training or experience) as to what and how information is or should be displayed on equipment used in this task.

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions
Work Environment	4. Workarounds / OOS instrumentation	Uncorrected equipment deficiency or programmatic defect requiring compensatory or non-standard action to comply with a requirement; long-term material condition problems that place a burden on the individual	- Have we confirmed all instrumentation is properly working? - Is there some piece of equipment/system indicator/tool that is out of service? If so, how are we going to deal with it? - Any uncorrected equipment deficiencies or defects? - What compensatory action will be taken for out-of-service (OOS) equipment? - Since we will be using a work-around, will the system respond the way we expect it to? If not, then how will we determine how the system is going to respond? - If X is the one we prefer to use, but have to use Y today because X is out of service/not available, then what are we going to do differently?	- The organizational culture is generally not tolerant of defective or unreliable equipment. - The intolerance for "workarounds" is healthy and is understood. (However, this may not be the organization's/group's reality). **Note**: Some additional considerations are: - Is there a "culture of poverty" where out of service equipment is tolerated? - Has an appropriate engineering analysis been performed to determine the effectiveness of long-term workarounds? **Note**: For potential for errors due to unfamiliarity with the task due to workarounds or OOS instrumentation see: *Individual Capabilities – New techniques not used before* (for instances where the workaround may not have been trained, or communicated to the person)
Work Environment	5. Hidden system/equipment response	System response invisible to individual after manipulation Lack of information conveyed to individual that previous action had any influence on the equipment or system	- Does any action cause a response that you cannot detect? (e.g., Pressure change, radiation field change without a detector, temperature change)? - What do we need to do to obtain information about the system (that is normally not displayed or readily available)? - Is there anything about the way the system does or does not respond that makes you uneasy? - Do you have equipment or barriers in place to monitor the status of hazards when/after we do step X? - After which steps should you pause/stop work to check the status of X?	- Worker(s) have sufficient understanding of *normal* system operation, how it responds to various inputs or changes, and its feedback mechanism - Primary indicators of the state of concern of the system are not readily available (gauge, meter, etc.).However, secondary sources of information may not be regularly monitored (or may not be readily available).

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions
Work Environment	6. Unexpected equipment conditions	System or equipment status not normally encountered creating an unfamiliar situation for the individual	• Is there some equipment condition here that any of us has not normally encountered? • Is the system or equipment in a status that is different from how we normally encounter it? o What is normal?	• Workers are very familiar with task, and system involved or equipment normally/typically used, what mode that system/equipment is typically in, and can deduce differences with system/equipment for this evolution. • Employees may have limits of their understanding of how this system operates? If the system conditions are beyond their understanding, compensatory/mitigating actions are required? • Sudden, unexpected condition, that requires either an immediate (emergency action required) or delayed (pause/stop to think about it) response. **Note**: For other forms of unfamiliar situations see also: • *Individual Capabilities – New techniques not used before* (where the unexpected equipment condition may not have been trained, or communicated to the individual). • *Individual Capabilities – Lack of Knowledge* (where the individual may transition from skill/rule-based performance mode to knowledge-based mode)
Work Environment	7. Lack of alternative indication	Inability to compare or confirm information about system or equipment state because of the absence of instrumentation	• What secondary indication do we have that the indicator is functioning properly? • What two indications (or alternate indicators) can confirm actions have been performed correctly? • Is there another way to confirm that each action has been completed correctly for each step? • What common mistakes would you alert a trainee to regarding the instruments that indicate system status?	• Workers are familiar enough with system/equipment to recognize when system readings about its state may need to be confirmed by an alternate or independent indication. • There is not a secondary indicator built into the system.

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions

Work Environment	8. Personality conflict	Incompatibility between two or more individuals working together on a task causing a distraction from the task because of preoccupation with personal differences	• Do workers on the team have a history of conflict that could impact today's work? If so, is there a need to discuss this privately? Possible reasons for conflict are:
			  o Related, but not similar, craft
			  o Union vs. non-union
			  o Differences personality or temperament
			  o Safety vs. Production or Research
			  o Differences in work styles/approaches
			  o Management/workforce relationships or treatment
			• Are you comfortable working with the other people on this task?
			• Are there any situations going on within with the work team that could affect the deliverable?
				• For workers: Organizational or team culture is such that workers will openly admit that they have personal differences with another team member.
				• For supervisors: Supervisor is aware of differences between team members but believes they are manageable.
				
				Note: Personal conflicts (e.g., people not being civil to each other) typically impact co-located workers (by evoking empathy for other humans being treated poorly). This can have a long=lasting detrimental impact on teamwork.

Work Environment	Other Error Precursors	• Back shift or recent shift change • Excessive group cohesiveness/peer pressure • Production overemphasis • Adverse physical climate (habitability) • No accounting of performance • Conflicting conventions; stereotypes • Poor equipment layout; poor access • Fear of consequences of error • Mistrust among work groups • Meaningless rules • Nuisance alarms • Unavailable parts or tools • Acceptability of "cook booking" practices • "Rule book" culture (Following rules without thinking) • Equipment sensitivity (inadvertent actions) • Lack of clear strategic vision or goals • Identical and adjacent displays or controls • Out-of-service warning systems • Lack of procedure place-keeping	• Supervisor and workers have sufficient understanding of errors, error precursors, and the wisdom in trying to identify precursors that may exist before starting work, especially those that are less common.

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions
Human Nature	1. Stress	Mind's response to the perception of a threat to one's health, safety, self-esteem, or livelihood if task is not performed to standard Responses may involve anxiety, degradation in attention, reduction in working memory, poor decision-making, transition from accurate to fast Degree of stress reaction dependent on individual's experience with task	Task performance stress: • Do you feel confident in doing the job you are about perform because of any inexperience or lack of proficiency? • Is there something impacting your confidence to perform this job to standard? External Stressors (beyond HDBK definition): • Does anyone have anything unusual and/or personal going on at this time that might cause you to be distracted and affect your performance? • Are there any stressors or distractions in your personal life or job right now that could impact your ability to be at your best?	• Workers can recognize that they have stress related to their ability to perform the task satisfactorily. **Note**: For other types of "stress" see also: • *Work Environment – Distractions/Interruption*s (for stress induced by conditions related to either the task or the work environment) • *Task Demands – High Workload* (for errors resulting from mental demands inherent in execution of the task)

Human Nature	2. Habit patterns	Ingrained or automated pattern of actions attributable to repetitive nature of a well-practiced task
		
		Inclination formed for particular train/unit because of similarity to past situations or recent work experience
			• Do we have any habits or habit patterns that increase the likelihood of errors or consequences?
			  o Examples: Routine shortcuts, deviations, or violations, etc.
			  o Example: Not mindfully ensuring that we validating or verifying things are almost always as expected. (They could be different *this* time).
			• Is there something different or new about the system or equipment we will be working on today, that should drive us to consider modifying the steps we perform habitually?
			• Even though we have performed this task a bunch of times before, is there some reason we should do some aspect/part of it differently this time?
			• Has there been a recent procedure change that changes some aspect of how we are supposed to perform this task?
				• Although skill-based (automatic) behavior is the most reliable and error-free, these questions seek to determine if there is some aspect/condition that, **for this iteration**, should drive a break from skill-based mode to rule-based mode in order to select a different or varied action at a specific point in task execution.
				
				Note: For other types of "habit patterns" see also:
				• *Human Nature – Mindset*
				• *Human Nature – Assumptions*
				• *Human Nature – Mental shortcuts (biases)*
				• *Task Demands – Repetitive Actions / Monotony* (where person is on "autopilot" or "cruise control")
				• *Work Environment – Unexpected Equipment Conditions*

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions
Human Nature	3. Assumptions	Suppositions made without verification of facts, usually based on perception of recent experience; provoked by inaccurate mental model Believed to be fact Stimulated by inability of human mind to perceive all facts pertinent to a decision	• How will you/we verify assumptions we make before or during this job? • Are there facts that are suspect or we need to confirm to be true? (Ensure assumptions are noted as such.) • Have you answered your own question? (Knowledge-based incorrect mental model where you do not consulted a peer/supervisor/SME, but rely on your own conclusions) • At what point might you have to make in-field decisions on this task that maybe should be checked with someone else before proceeding? • Are there any conditions that should cause you/us to pause/stop work if they are different from what you/we expected?	• The task to be performed is likely one that is frequently performed and/or sufficiently familiar to the workers assigned that conditions and system states will be assumed to be generally the same as previous iterations. **Note**: For other types of "assumptions" see also: • *Individual Capabilities – Lack of Knowledge (*for unawareness of necessary facts related to performance of the task)*
Human Nature	4. Complacency / Overconfidence	A "Pollyanna" effect leading to a presumption that all is well in the world and that everything is ordered as expected Self-satisfaction or overconfidence, with a situation unaware of actual hazards or dangers; particularly evident after 7-9 years on the job Underestimating the difficulty or complexity of a task based upon past experiences	• Is it possible to be overconfident when performing this job? • How many times have you done this job/task before? • How do we maintain a "healthy respect for what can go wrong?" • What do you do to prevent complacency/overconfidence?	• Questions need to strike a balance between the desire for workers to feel trusted and the need to collectively look for error-likely situations that could be missed from a decreased appreciation for the hazards involved due to repeated experience where nothing (of significance) went wrong. **Note**: The Pollyanna principle (also called Pollyannaism or positivity bias) is the tendency for people to remember pleasant items more accurately than unpleasant ones. Research indicates that at the subconscious level, the mind tends to focus on the optimistic, while at the conscious level, it tends to focus on the negative. **Note**: For other types of "complacency/overconfidence" see also: • *Individual Capabilities – Lack of proficiency* (where a person hasn't done this in a while, but is nonetheless confident they can do it again).

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions
Human Nature	5. Mind-set (intentions)	Tendency to "see" only what the mind is tuned to "see" (intention); preconceived idea Information that does fit a mind-set may not be noticed and vice versa; may miss information that is not expected or may see something that is not really there; contributes to difficulty in detecting one's own error(s)	• Is there a likelihood to "see" only what we "want to see" instead of what is actually there? • How will we avoid "seeing" the familiar? • What do you do to prevent yourself from "seeing only what you're attuned or expect to see?" • How will we maintain our awareness of anomalies as we focus on the task at hand? • What does "good" look like for you with this task? • What is the worst thing that could happen, when or at what point(s) is it likely to happen, and how would you/we recognize indications that it might be happening? • Under what conditions should you pause/stop work and do further evaluation, rather than change/adapt the plan "on the fly"?	• Task is routine / frequently performed, and setting where it will be performed is normal/typical. Although skill-based (automatic) behavior is the most reliable and error-free, these questions seek to determine if there is some aspect/condition that, **for this iteration**, should drive a break from skill-based mode to rule-based mode in order to at a specific point in task execution to objectively confirm/check system feedback before proceeding to the next step. **Note**: For other types of being "tuned to see" see also: • *Human Nature – Assumptions* (for errors stemming from what the individual expects to see **during** the course of task performance) • *Individual Capabilities – Lack of knowledge* (regarding faulty mental models about information that is necessary for successful task completion)
Human Nature	6. Inaccurate risk perception	Personal appraisal of hazards and uncertainty based on either incomplete information or assumptions Unrecognized or inaccurate understanding of a potential consequence or danger Degree of risk-taking behavior based on individual's perception of possibility of error and understanding of consequences; more prevalent in males	• What could go wrong and how likely is it to happen? • What are the consequences of inaccurately perceiving the risk? • What risks are not in our work documents (e.g., weather, day of the week, overtime hours worked) for our assigned task? • If something goes wrong today, what do you think it could/would be? • Is there Operating Experience/Lessons Learned info about doing this kind of job that could help us check that we correctly understand all the risks? Follow-Up: Discuss contingency plan for risk if a consequence occurs.	• In terms of job planning, many tasks are based on skill of the worker. Questions need to strike a balance between workers' need to feel respected for their expertise (and for the learning that comes from experience), and the need to collectively look for error-likely situations that could be missed from a decreased appreciation for the hazards involved due to repeated experience where nothing (of significance) went wrong. • People are aware of things (risks) they do and do not know, however they sometimes are not aware of the things (risks) they do not know. Even worse they may think they know, but really do not know what they need to know about the risk.

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions

Human Nature	7. Mental shortcuts or biases	Tendency to look for or see patterns in unfamiliar situations; application of thumb rules or "habits of mind" (heuristics) to explain unfamiliar situations:
		
		• confirmation bias
		
		• frequency bias
		
		• similarity bias
		
		• availability bias
			• Let's review our rationale for our general approach to the task.
			• Have you heard about something with this task that may erroneously influence our decision-making?
			• What incidents have you ran into before on similar tasks?
			• How do you verify/validate that an action you originally intended to perform is appropriate for a given unfamiliar situation?
			• Have you reviewed the prints or operating manual before you started the activity?
			• Could past situations or solutions influence our decision-making now?
				• Questions need to strike a balance between our dependency on workers to recognize (and linchpin) process/system gaps (which flows from their knowledge and experience), and the need to collectively look for error-likely situations that result when one condition is mistaken for another.
				• If presented with an unfamiliar situation or condition (Knowledge based), then biases and shortcuts are used to move us to known solutions (rule or skill based) where performance is more comfortable.
				
				NOTE: For additional information about Mental shortcuts (biases) see DOE-HDBK-1028-2008, Volume 1,
				    • Page 2-2, Avoidance of Mental Strain
				    • Page 2-29, Mental Biases (shortcuts)

Human Nature	8. Limited short-term memory	Forgetfulness; inability to accurately attend to more than 2 or 3 channels of information (or 5 to 9 bits of data) simultaneously The mind's "workbench" for problem-solving and decision-making; the temporary, attention-demanding storeroom we use to remember new information	For workers: • What will tax our ability to remember important elements of this task as we perform it? Is there something we need to do to remind ourselves when we get to that step? • How will you remember something important (from our task) two hours from now? • How often do you actually plan to refer to the reference-use or information-use procedure during this task? For job planners: • Are we asking employees to do something that has not been documented in the work instructions?	• Task involves steps that entail concurrent collection and interpretation of multiple data points. • In this instance, no memory aids will be available for recording data points. • In this instance, no operator aids will be available to reference standards, criteria, etc. • The task may involve relatively short pauses between steps, or the execution of those steps. **Note**: For other memory-related errors see also: • *Task Demands – High workload* (for errors related to tasks involving steps that entail concurrent collection and interpretation of multiple data points) • *Human Nature – Stress* (for other impacts on available short-term memory).

Category	Precursor	DOE-HDBK-108-2009 description	Question to discover precursor presence	Assumptions in posing these questions
Human Nature	Other Error Precursors	- Pollyanna effect - Limited perspective (bounded rationality) - Avoidance of mental strain - First day back from vacation/days off - Sugar cycle (after a meal) - Fatigue (sleep deprivation and biorhythms) - Tunnel vision (lack of big picture) "Something is not right" (gut feeling) - Pattern-matching bias - Social deference (excessive professional courtesy) - Easily bored - Close-in-time cause-effect correlation - Difficulty seeing own errors - Frequency and similarity biases - Availability bias - Imprecise physical actions - Limited attention span - Spatial disorientation - Physical reflex - Anxiety (involving uncertainty)		Supervisor and workers have sufficient understanding of errors, error precursors, and the wisdom in trying to identify precursors that may exist before starting work, especially those that are less common.

Attachment 2: Error Precursor Question Analysis

Using an online survey, respondents were asked to select the error precursors that they believed each question could discover. The highlighted precursor (in yellow) is the source (from the larger list) for this question. Only the most frequently selected precursors for each question are included in this section. Lists are sorted by the number of responses, then alphabetically by category, and then by number in original precursor list.

(1) Under what conditions should you pause/stop work?

Precursor	Number of responses
Task Demands 5. Irreversible actions	4
Task Demands 7. Unclear goals, roles, or responsibilities	4
Individual Capabilities 1. Unfamiliarity with task / First time	4
Individual Capabilities 7. "Unsafe" attitudes for critical tasks	4
Work Environment 1. Distractions/Interruptions	4
Work Environment 2. Changes/Departure from routine	4
Task Demands 1. Time Pressure (in a hurry)	3
Task Demands 6. Interpretation requirements	3
Individual Capabilities 2. Lack of knowledge (faulty mental model)	3
Individual Capabilities 8. Illness or fatigue; general poor health or injury	3
Work Environment 4. Workarounds / OOS instrumentation	3
Work Environment 6. Unexpected equipment conditions	3
Human Nature 6. Inaccurate risk perception	3

(2) What potential interruptions or distractions might arise during execution of this task?

Precursor	Number of responses
Task Demands 3. Simultaneous, multiple actions	4
Work Environment 1. Distractions/Interruptions	4
Task Demands 6. Interpretation requirements	3
Individual Capabilities 1. Unfamiliarity with task / First time	3
Work Environment 2. Changes/Departure from routine	3
Work Environment 3. Confusing displays or controls	3

Attachment 2: Error Precursor Question Analysis

(3) What is different today from our usual routine?

Precursor	Number of responses
Work Environment 2. Changes/Departure from routine	4
Task Demands 1. Time Pressure (in a hurry)	2
Task Demands 7. Unclear goals, roles, or responsibilities	2
Individual Capabilities 1. Unfamiliarity with task / First time	2
Individual Capabilities 3. New techniques not used before	2
Individual Capabilities 4. Imprecise communication habits	2
Work Environment 1. Distractions/Interruptions	2
Work Environment 7. Lack of alternative indication	2
Human Nature 1. Stress	2
Human Nature 6. Inaccurate risk perception	2

(4) Are there any situations going on with the work team that can affect the deliverable?

Precursor	Number of responses
Task Demands 2. High workload (large memory)	3
Task Demands 3. Simultaneous, multiple actions	3
Individual Capabilities 1. Unfamiliarity with task / First time	3
Individual Capabilities 2. Lack of knowledge (faulty mental model)	3
Work Environment 8. Personality conflict	3
Human Nature 5. Mind-set (intentions)	3
Task Demands 1. Time Pressure (in a hurry)	2
Task Demands 7. Unclear goals, roles, or responsibilities	2
Individual Capabilities 4. Imprecise communication habits	2
Work Environment 1. Distractions/Interruptions	2
Human Nature 1. Stress	2
Human Nature 2. Habit patterns	2
Human Nature 3. Assumptions	2
Human Nature 4. Complacency / Overconfidence	2

Attachment 2: Error Precursor Question Analysis

(5) What has to go right the first time and/or every time – in other words, are there critical steps or risk-important steps?

Precursor	Number of responses
Task Demands 5. Irreversible actions	4
Individual Capabilities 1. Unfamiliarity with task / First time	4
Task Demands 8. Lack of or unclear standards	3
Work Environment 2. Changes/Departure from routine	3

(6) What do we "expect" to see and do as we begin work and/or as task performance progresses? How will we validate this is the actual condition?

Precursor	Number of responses
Individual Capabilities 2. Lack of knowledge (faulty mental model)	4
Individual Capabilities 6. Indistinct problem-solving skills	3
Work Environment 2. Changes/Departure from routine	3

(7) Is there anything new about how we are to perform this job?

Precursor	Number of responses
Individual Capabilities 3. New techniques not used before	4
Individual Capabilities 1. Unfamiliarity with task / First time	3
Individual Capabilities 2. Lack of knowledge (faulty mental model)	3
Individual Capabilities 5. Lack of proficiency / Inexperience	3
Work Environment 4. Workarounds / OOS instrumentation	3
Work Environment 6. Unexpected equipment conditions	3
Human Nature 7. Mental shortcuts or biases	3

(8) Are there any aspects of the job or potential obstacles that could cause misunderstanding between team members?

Precursor	Number of responses
Individual Capabilities 4. Imprecise communication habits	4
Task Demands 1. Time Pressure (in a hurry)	3
Task Demands 2. High workload (large memory)	3
Task Demands 3. Simultaneous, multiple actions	3
Task Demands 6. Interpretation requirements	3
Human Nature 3. Assumptions	3
Human Nature 5. Mind-set (intentions)	3
Human Nature 6. Inaccurate risk perception	3

Attachment 2: Error Precursor Question Analysis

(9) What verbal communication tools are most effective for this particular job?

Precursor	Number of responses
Human Nature 3. Assumptions	4
Task Demands 7. Unclear goals, roles, or responsibilities	3
Individual Capabilities 4. Imprecise communication habits	3
Work Environment 8. Personality conflict	3

(10) Even though we have performed this task a bunch of times before, is there some reason we should do some aspect/part of it differently this time?

Precursor	Number of responses
Work Environment 1. Distractions/Interruptions	3
Human Nature 2. Habit patterns	3
Human Nature 6. Inaccurate risk perception	3
Task Demands 4. Repetitive actions / Monotony	2
Task Demands 6. Interpretation requirements	2
Individual Capabilities 4. Imprecise communication habits	2
Work Environment 2. Changes/Departure from routine	2
Work Environment 3. Confusing displays or controls	2
Work Environment 5. Hidden system/equipment response	2
Human Nature 3. Assumptions	2
Human Nature 7. Mental shortcuts or biases	2

Attachment 2: Error Precursor Question Analysis

The most frequently selected precursors from the survey are:

Precursor	Number of responses
Work Environment 2. Changes/Departure from routine	24
Individual Capabilities 1. Unfamiliarity with task / First time	23
Work Environment 1. Distractions/Interruptions	23
Individual Capabilities 4. Imprecise communication habits	22
Task Demands 6. Interpretation requirements	21
Task Demands 7. Unclear goals, roles, or responsibilities	21
Individual Capabilities 2. Lack of knowledge (faulty mental model)	21
Human Nature 3. Assumptions	19
Task Demands 3. Simultaneous, multiple actions	18
Task Demands 8. Lack of or unclear standards	18
Work Environment 4. Workarounds / OOS instrumentation	18
Human Nature 6. Inaccurate risk perception	18
Individual Capabilities 3. New techniques not used before	16
Work Environment 3. Confusing displays or controls	16
Work Environment 6. Unexpected equipment conditions	15
Human Nature 2. Habit patterns	15
Individual Capabilities 6. Indistinct problem-solving skills	13
Individual Capabilities 7. "Unsafe" attitudes for critical tasks	13
Work Environment 7. Lack of alternative indication	13
Human Nature 1. Stress	13
Human Nature 5. Mind-set (intentions)	13
Task Demands 5. Irreversible actions	12
Individual Capabilities 5. Lack of proficiency / Inexperience	12
Work Environment 8. Personality conflict	12
Task Demands 1. Time Pressure (in a hurry)	11
Human Nature 7. Mental shortcuts or biases	11
Task Demands 2. High workload (large memory)	10
Human Nature 4. Complacency / Overconfidence	9
Work Environment 5. Hidden system/equipment response	7
Individual Capabilities 8. Illness or fatigue; general poor health or injury	6
Task Demands 4. Repetitive actions / Monotony	3
Human Nature 8. Limited short-term memory	2

Attachment 3: Error Precursor Question Comparison

The top 10 error precursor questions were compared to the Los Alamos National Laboratory (LANL) Causal Evaluation HPI Trend Codes from 2014-2019. The comparison indicated that the majority of the top 10 questions will work well, however the list may not discover some prevalent error precursors in the LANL data set; such as *Unexpected Equipment Conditions*. In this case LANL may need to consider adjusting the questions to better discover the more prevalent precursor(s). Another option is to investigate if the LANL trend coding is correct, based on DOE-HDBK-1028-2009 definitions.

Precursor	Survey Total	LANL Total	Delta
Task Demands 1. Time Pressure (in a hurry)	11	22	-11
Task Demands 2. High workload (large memory)	10	3	7
Task Demands 3. Simultaneous, multiple actions	18	8	10
Task Demands 4. Repetitive actions / Monotony	3	8	-5
Task Demands 5. Irreversible actions	12	2	10
Task Demands 6. Interpretation requirements	21	23	-2
Task Demands 7. Unclear goals, roles, or responsibilities	21	23	-2
Task Demands 8. Lack of or unclear standards	18	14	4
Task Demands - Other Error Precursors	3		3
Individual Capabilities 1. Unfamiliarity with task / First time	23	7	16
Individual Capabilities 2. Lack of knowledge (faulty mental model)	21	30	-9
Individual Capabilities 3. New techniques not used before	16	4	12
Individual Capabilities 4. Imprecise communication habits	22	11	11
Individual Capabilities 5. Lack of proficiency / Inexperience	12	9	3
Individual Capabilities 6. Indistinct problem-solving skills	13		13
Individual Capabilities 7. "Unsafe" attitudes for critical tasks	13		13
Individual Capabilities 8. Illness or fatigue; general poor health or injury	6		6
Individual Capabilities - Other Error Precursors	0		0
Work Environment 1. Distractions/Interruptions	23	15	8
Work Environment 2. Changes/Departure from routine	24	38	-14
Work Environment 3. Confusing displays or controls	16	8	8
Work Environment 4. Workarounds / OOS instrumentation	18	3	15
Work Environment 5. Hidden system/equipment response	7	43	-36
Work Environment 6. Unexpected equipment conditions	15	104	-89
Work Environment 7. Lack of alternative indication	13	13	0
Work Environment 8. Personality conflict	12		12
Work Environment- Other Error Precursors	1		1
Human Nature 1. Stress	13	1	12
Human Nature 2. Habit patterns	15	17	-2
Human Nature 3. Assumptions	19	23	-4
Human Nature 4. Complacency / Overconfidence	9	25	-16
Human Nature 5. Mind-set (intentions)	13	11	2
Human Nature 6. Inaccurate risk perception	18	10	8
Human Nature 7. Mental shortcuts or biases	11	1	10
Human Nature 8. Limited short-term memory	2		2
Human Nature -Other Error Precursors	0		0
Total	472	476	-4
Sample Size	5	2952	

Attachment 4: Application at Flour Idaho
(Idaho Cleanup Project)

"Enhanced Error Precursors" Card Pilot

Continual improvement in worker safety is the objective of Integrated Safety Management System Core Function 5. The next step was integrating the 10 EFCOG HPI Error Precursor questions into operations and tailoring them to meet Fluor Idaho's work control process needs.

With the support of the HPI EFCOG committee, Fluor Idaho used the 10 Error Precursor questions as a pilot to support and enhance their precision operations process. The first step was determining if the 10 Error Precursor questions were already integrated into the Fluor Idaho procedures and processes. Although Fluor Idaho has established procedures and process that currently integrate the HPI Error Precursors, particularly in the pre-job brief process and pre-job brief form (ICP form 434.14), they determined the currently phrased 10 Error Precursor questions may strengthen the pre-job brief process by facilitating a more structured discussion on specific aspects of the work activity and lead to the discovery of new information that would reduce the likelihood of error during work performance.

To support the process an "Enhanced Error Precursor" index card was developed with the 10 Error Precursor questions consolidated into 8 totals questions. A note was added at the end of each of the 8 Error Precursor questions to show how it cross referenced the existing questions on the pre-job brief form (ICP form 434.14). The concept of the "Enhanced Error Precursor" index card was to keep it simple and support the job supervisors during pre-job briefs.

As part of management's commitment to precision operations and continuous improvement to enhance worker safety, Fluor Idaho Senior Leaders on the Integrated Operations Council (IOC) approved implementing a short-term pilot effort using the enhanced list of Error Precursor questions during performance of pre-job briefings.

The IOC was interested in Job Supervisor/Pre-Job Briefer feedback and if the enhanced questions had a positive influence on pre-job discussions resulting in a more interactive pre-job brief and enhancement of safety.

A 5" X 8" Index Card was developed and printed with 8 questions that correspond to Form 434.14, Pre-Job Brief Checklist, with a focus on the 5 Step Questioning Process. The index cards could be used by the Job Supervisors/Pre-Job Briefers to augment their pre-job and was distributed throughout the projects for use and collection of feedback. The Index Card was title "Enhanced Error Precursors" and are shown below in this attachment.

The Job Supervisor/Pre-Job Briefer had the option to choose which job to apply the Index Card and could use any or all of the questions during their pre-job briefings. They responded by filling in the "Date," "Job Supervisor" name, circle if the activity was Operations or Maintenance, and placed an "X" in the checkbox on the card if the questions strengthened the overall pre-job discussion. If a question was not used, they were asked to indicate "not used". Completed index cards were turned in to their facility point-of-contact when they are completed (end of the day or shift).

Attachment 4: Application at Flour Idaho
(Idaho Cleanup Project)

After a few weeks of use by the Job Supervisor/Pre-Job Briefer, feedback on the index card and process was solicited during the Maintenance Center of Excellence (COE) meeting. Based on feedback the "Enhanced Error Precursor" index card was revised and distributed for another month of the pilot program with approval from the IOC Senior Leaders. Data trending from the "Enhanced Error Precursor" index cards was presented to the IOC Senior Leaders in two separate meetings.

The results of the total data were trended over a 2-month period with the goal to use the Enhanced Error Precursor index cards during pre-job briefs to facilitate pre-job discussions. The questions were intended to increase employee participation to raise safety awareness in the work activity or environment. The following were identified from the pilot:

Summary from Pilot Data

- 500 cards were distributed for Ops/Maintenance/Force Account to Pilot. Force Account participated in the second month of the pilot effort.
- 93 cards returned to date (73/19/1) Great participation with predominantly operations type of work activities.
- Cards were revised with feedback from Maintenance COE Agenda for Aug/Sept. and new cards were made available in the later part of Sept.
- During the pilot Supervisors chose the questions they believed added value to the discussion.
- Results show some good discussions took place during pre-job using the enhanced questions that raised safety awareness of hazards in the work activity or environment.
- Notably, during the pilot every question was used in a pre-job brief discussion indicating all the questions add a level of value.
- Questions 2, 1, 7, 8, and 6 were the top 5 most frequently used; respectively, indicating they may have been considered to be of the most value to the discussions or work activity to be performed:
  - Interruptions and distractions
  - Specific conditions for pausing or stopping work
  - Effective Communication tools
  - What is different about this routine task
  - Expected conditions at start and during the task

Conclusion

The conclusion was the pilot was success with the recognition that each of the "Enhanced Error Precursor" questions added value to the pre-job discussion and in many examples lead to the discovery of new information that would reduce the likelihood of error during work performance yielded. The IOC Senior Leaders agreed to keep the "Enhanced Error Precursor" index card and continue to encourage Job Supervisors to use the index cards during pre-job briefs. The index cards will be revised to only include 5 questions at one time with the rotation of the original 8 Error Precursor questions. To further facilitate the use of the index cards, the feedback from the cards will be captured during Operations and Maintenance COE meetings with recommendations on periodically updating the index card with other questions from the original 8 Error Precursor questions.

Attachment 4: Application at Flour Idaho (Idaho Cleanup Project)

(ORIGINAL) Index Card

Enhanced Error Precursor 5 Step Questions

Date: _____ **Job Supervisor:** _____

Activity Type: Maintenance or Operations (circle one)

NOTE: This card contains questions that can be used to augment the pre-job brief to encourage discussion and participation by the work group and correspond to the pre-job checklist question 7 and question13, 5 Step questioning process. The purpose of this pilot effort is to continuously evaluate for improvements to enhance safety and precision of work.

QUESTION and corresponding Form 434.14 item #	PRECURSOR	CHECK the Box if the Question Strengthened the Overall Pre-Job Brief Discussion?
1. Under what conditions should you pause/stop work? **(Corresponds with 434.14 question 7)**	Task Demands - Interpretation requirements	▭
2. What potential interruptions or distractions might arise during execution of this task? • How would you handle distractions during this task? • Is there anything else going on in this [work] area that could interrupt or delay us? **(Corresponds with 434.14 question 13 Steps 1 & 3)**	Work Environment – Distractions / Interruptions	▭
3. What is different today from our usual routine, or is there anything new about how we are to perform this job? **(Corresponds with 434.14 question 13 Steps 1, 3 or 4)**	Work Environment – Changes / Departure from routine Individual Capabilities - New techniques not used before	▭

Attachment 4: Application at Flour Idaho (Idaho Cleanup Project)

QUESTION and corresponding Form 434.14 item #	PRECURSOR	CHECK the Box if the Question Strengthened the Overall Pre-Job Brief Discussion?
4. Are there any situations going on with the work team that can affect the deliverable, or aspects of the job or potential obstacles that could cause misunderstanding between team members? **(Corresponds with 434.14 question 13 Steps 1 & 3)**	Work Environment – Personality conflict Individual Capabilities - Imprecise communication habits	▭
5. What must go right the first time and/or every time – in other words, are there critical steps or risk-important steps? **(Corresponds with 434.14 question 13 Step 2)**	Individual Capabilities - Unfamiliarity with task / First time	▭
6. What do we "expect" to see, or do as we begin work and/or as task performance progresses? How will we validate this is the actual condition? **(Corresponds with 434.14 question 13 Steps 1 & 2)**	Individual Capabilities - Lack of knowledge (faulty mental model)	▭
7. What verbal communication tools are most effective for this particular job? • Will we be using letters (B, C, D,) where we should be using the phonetic alphabet (Bravo, Charlie, Delta)? • Will we be using numbers that sound like other common words (e.g., 2 vs. to or too, 4 vs. for)? • Will we be using words that sound similar and so could be misheard (e.g., open, closed vs. open, shut)? • Communications equipment; such as two-way radios, headsets, etc. **(Correspond with 434.14 question 13 Step 5)**	Individual Capabilities - Imprecise communication habits	▭
8. Even though we have performed this task a bunch of times before, is there some reason we should do some aspect/part of it differently this time? **(Corresponds with 434.14 question 13 Step 1)**	Human Nature - Habit patterns	▭

Please return completed forms to Jane Doe at MS 1234

Attachment 4: Application at Flour Idaho (Idaho Cleanup Project)

(ENHANCED) Index Card

Enhanced Error Precursor 5 Step Questions

Date: _____ Job Supervisor: _____

Activity Type: Maintenance or Operations (circle one)

NOTE: This card contains questions that can be used to augment the pre-job brief to encourage discussion and participation by the work group and correspond to the pre-job checklist question 7 and question13, 5 Step questioning process. The purpose of this pilot effort is to continuously evaluate for improvements to enhance safety and precision of work.

QUESTION and corresponding Form 434.14 item #	PRECURSOR	CHECK the Box if the Question Strengthened the Overall Pre-Job Brief Discussion?	CHECK the Box if the Question was not used please.
1. Under what **specific** conditions should you pause/stop work? **(Corresponds with 434.14 question 7)**	Task Demands - Interpretation requirements	☐	☐
2. What potential interruptions or distractions might arise during execution of this task? • How would you handle distractions during this task? • Is there anything else going on in this [work] area that could interrupt or delay us? **(Corresponds with 434.14 question 13 Steps 1 & 3)**	Work Environment – Distractions / Interruptions	☐	☐
3. What is different today from our usual routine, or is there anything new about how we are to perform this job? **(Corresponds with 434.14 question 13 Steps 1, 3 or 4)**	Work Environment – Changes / Departure from routine Individual Capabilities - New techniques not used before	☐	☐

Attachment 4: Application at Flour Idaho (Idaho Cleanup Project)

QUESTION and corresponding Form 434.14 item #	PRECURSOR	CHECK the Box if the Question Strengthened the Overall Pre-Job Brief Discussion?	CHECK the Box if the Question was not used please.
4. Are there any situations going on with the work team that can affect the deliverable, or aspects of the job or potential obstacles that could cause misunderstanding between team members? **(Corresponds with 434.14 question 13 Steps 1 & 3)**	Work Environment – Personality conflict Individual Capabilities - Imprecise communication habits	☐	☐
5. What must go right the first time and/or every time – in other words, are there critical steps or risk-important steps? **(Corresponds with 434.14 question 13 Step 2)**	Individual Capabilities - Unfamiliarity with task / First time	☐	☐
6. What do we "expect" to see, or do as we begin work and/or as task performance progresses? How will we validate this is the actual condition? **(Corresponds with 434.14 question 13 Steps 1 & 2)**	Individual Capabilities - Lack of knowledge (faulty mental model)	☐	☐
7. What verbal communication tools are most effective for this particular job? • Will we be using letters (B, C, D,) where we should be using the phonetic alphabet (Bravo, Charlie, Delta)? • Will we be using numbers that sound like other common words (e.g., 2 vs. to or too, 4 vs. for)? • Will we be using words that sound similar and so could be misheard (e.g., open, closed vs. open, shut)? • Communications equipment; such as two-way radios, headsets, etc. **(Correspond with 434.14 question 13 Step 5)**	Individual Capabilities - Imprecise communication habits	☐	☐
8. Even though we have performed this task a bunch of times before, is there some reason we should do some aspect/part of it differently this time? **(Corresponds with 434.14 question 13 Step 1)**	Human Nature - Habit patterns	☐	☐

Please return completed forms to Jane Doe at MS 1234
If applicable, please print any relevant "Comments" on the back of this Card.