LESSONS LEARNED IN REVIEWING PROCESSES SUPPORTING PROCEDURAL ADHERENCE

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Abstract

Due to the importance of procedures and procedural adherence in reducing the risk of human error, assessing procedural adherence is a component of the Canadian Nuclear Safety Commission's regulatory compliance program. This paper presents a model used during regulatory inspections of processes supporting procedural adherence. A checklist used to collect information during work observations is also described. Lessons learned during procedural adherence inspections are discussed. The procedural adherence review framework presented in this paper may also be useful for nuclear facilities as they carry out internal reviews of procedures and procedural adherence.

Introduction

The Canadian Nuclear Safety Commission (CNSC) regulates the nuclear industry in Canada. Regulatory Policy P-119 requires CNSC staff to verify that licensees and license applicants minimize the potential for human error (2000). Human factors compliance reviews focus on the processes established by the applicant or licensee to minimize human error potential.

Procedures are used to direct a number of activities in high reliability environments. Due to the importance of procedures and procedural adherence in reducing the risk of human error, assessing procedural adherence is a component of the CNSC's regulatory compliance program.

Model for Assessing Procedural Adherence

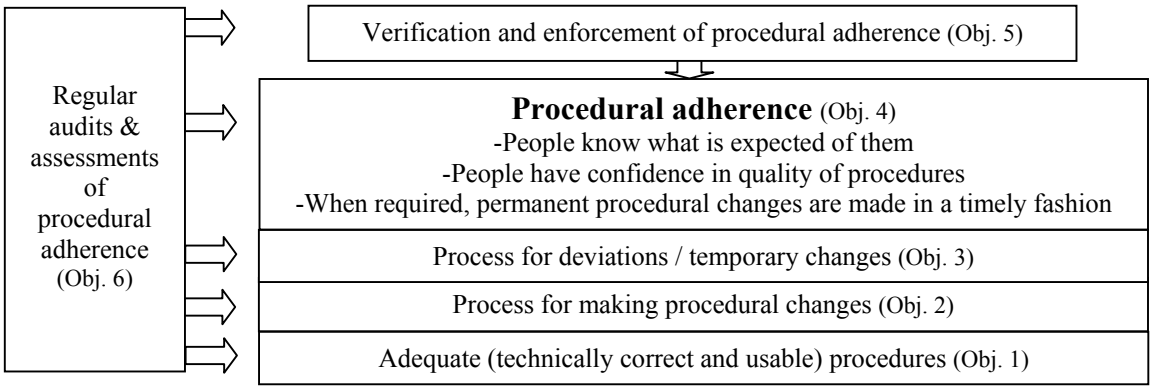
A model-based regulatory approach compares the actual performance of a regulated activity with a model of how this activity should be performed (Fiset & McRobbie, 2005). The model may be based on a standard, guideline, regulatory guide, or collection of good practices. Any significant discrepancy between the actual performance and the model can thus be identified and used for corrective purposes. Figure 1 shows a model for assessing procedural adherence.

The CNSC's Power Reactor Operating Licences have a number of requirements, including the need for nuclear power plants (NPPs) to establish and implement a quality assurance program that conforms to the Canadian Standards Association (CSA) N286 series of quality assurance standards. The inspection objectives used for assessing procedural adherence, which are shown in Figure 1, are supported by requirements in the CSA N286.0 and N286.5 standards.

There is evidence that procedure adherence is more likely when staff view procedures as being useful and describing "the quickest and most efficient ways of doing the job" (Reason & Hobbs,

2003, p. 71). Therefore, several of the inspection objectives aim at ensuring that processes are in place to support procedural adherence. The first three objectives, which serve as the foundation for procedural adherence, focus on ensuring the procedures support staff in carrying out their tasks. To support staff in carrying out their work, procedures need to be technically accurate and written in a format that considers human performance. A station-specific writer's guide is one way of ensuring consistency in the way procedures are written. The writer's guide can incorporate guidance for writing procedures to reduce the risk of human error (Wieringa, Moore & Barnes, 1998).

Processes are needed for staff to raise concerns about procedures (Objective 2). For example, a field operator may see a more efficient way to complete a job than is presented in the procedure. Following a review to ensure the proposed method is technically correct, the procedure could be updated to present the more efficient way of performing the task. In order for workers to be motivated to identify improvements, they need to receive feedback about their requests for change and see that accepted procedural changes are made in a timely fashion. Workers may also need deviations or temporary changes to procedures in order to complete a task. Therefore, nuclear facilities need a process for approving temporary changes (Objective 3). A facility's commitment to procedural adherence is demonstrated by providing workers with procedures that are technically accurate and usable and by giving them processes for identifying changes to enhance procedure usability.



Objective 1: Procedures are clear, concise, and contain adequate information and direction for personnel to understand the work and perform it effectively. Only the most recent version of a procedure is used.
Objective 2: There is an efficient and effective process for making procedural changes.
Objective 3: There is a process for identifying and approving deviations or temporary changes when problems with procedures are identified while doing work.
Objective 4: Personnel comply with procedures.
Objective 5: There are mechanisms in place for verification and enforcement of procedural adherence.
Objective 6: There are mechanisms in place to audit and assess the effectiveness of policies, procedures and practices related to procedural adherence. Root causes of procedural non-adherence are identified and corrected.

Figure 1: Model for Assessing Procedural Adherence

Objective 4 aims at ensuring that workers utilize the procedures. Several methods can be used to evaluate this objective, such as interviews, reviews of event reports, and direct work observations.

Each method has advantages and shortcomings, so regulatory reviews of procedural adherence include a variety of methods.

Field observations are particularly relevant when assessing procedural adherence but they also present a number of challenges. During inspections, a variety of work activities may be observed by staff with different backgrounds and perspectives. It is useful to have a checklist to structure the collection of information during work observations and to ensure that key information is collected consistently. A checklist that has been developed for inspection activities is shown in Figure 2. This checklist prompts the observer to consider aspects of the work environment, equipment design, and procedure usability that may impact on procedure use. In case of non-adherence, the checklist prompts questioning to determine why the procedure was not followed. The "5 whys method" is included on the checklist since experience has shown that the root cause is usually found by asking "why" five or fewer times. Using a checklist during work observations assists in ensuring that different CNSC inspectors collect information systematically, comprehensively and consistently.

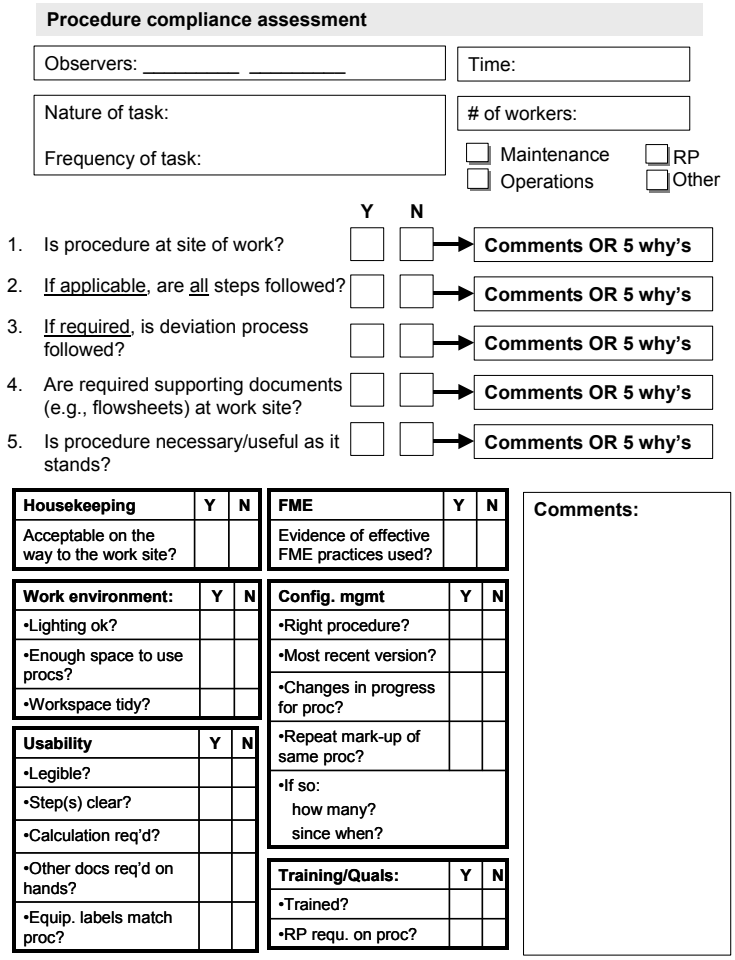


Figure 2: Checklist Used for Assessing Procedural Adherence

Nuclear facilities need methods for ensuring staff are meeting expectations for procedural adherence (Objectives 5 and 6). The arrows in the model reflect the importance of considering processes that support procedural adherence during audits and assessments. In order to identify appropriate corrective actions, the station needs to understand why procedural non-adherence occurs. NPPs may use a variety of methods for ensuring adherence, ranging from work

observations to internal audits. Reviews of trends in event reports are also an important tool for identifying areas of weakness in procedural adherence. Regulatory reviews of procedural adherence also focus on ensuring that nuclear facilities have adequate processes in place for oversight of procedural use and adherence.

Lessons Learned

The following lessons have been drawn from human factors activities when CNSC staff have inspected processes supporting procedural adherence during regulatory compliance activities.

1. The checklist in Figure 2 is a useful tool for human factors specialists and other staff to structure the collection of information during work observations and to ensure that key information is collected consistently.
2. Prior to carrying out inspection activities, it is important to determine all types of documents that support work. Field inspection activities have demonstrated that guidance is derived not only from procedures, but from a number of ancillary documents such as flowsheets, schematics, detailed work orders and maintenance manuals. Documents such as work permits and manufacturer manuals were used extensively in some cases and provided procedural guidance to the workers. Therefore, the quality of these ancillary documents is just as important as the quality of the procedures for ensuring successful task performance.
3. NPPs specify that some procedures require verbatim, step-by-step compliance. However, people may identify other ways of working than the one prescribed by the procedure, which are both technically acceptable and more practical to carry out. For example, the procedure might require the user to go up and down stairs a number of times, while another, equally technically correct formulation, might have the user complete steps on one floor before moving to another floor. The fact that verbatim compliance is often mandated may set the user up for non-compliance unless there is a procedure validation process that involves a walkdown of the procedure in the plant and a mechanism for requesting procedural changes related to usability. This point has been identified through other research in the area of maintenance procedures: "The reasons often quoted for staff not following maintenance procedures and permits are that they are perceived to be inaccurate, out-of-date, impractical, too time consuming, or that they do not describe the *best* way of carrying out the work" (HSE, 2000, p. 31).
4. Experience has shown that table-top validations, day-to-day use, or even casual work observation and coaching are not always powerful enough to identify procedural non-compliance during conduct of step-by-step procedures.
5. NPPs have processes for staff to raise concerns about procedures. The number of concerns raised may be reduced by ensuring that the procedure validation process considers the practicality of carrying out the procedure.
6. Work observations have revealed a subtle issue when several users cooperate in carrying out a task using a common procedure. When multiple station staff members are involved in carrying out steps in a procedure, it is important that the roles and responsibilities of each participant are clearly understood and that there is a clear specification of who is actually responsible for the in situ execution of the whole procedure. The expectation about which participants need a copy of the procedure should also be clearly stated.
7. Procedures often undergo an iterative development process based on the operating experience of senior staff. It is important that new staff understand the key operating experience that serves as the rationale for the current state of procedures and the consequences of non-compliance.
8. Procedure adherence, as a concept, has far reaching implications as it encompasses any deviation between the "actual" and the "expected" conduct of work. It follows that it is possible

to use several cues in addition to actual work observation to assess whether a strong culture of procedural adherence exists in a given facility. For example, if sub-standard performance can be observed in a number of areas such as foreign material exclusion (FME), housekeeping practices, or use of steam doors, then it would be somewhat surprising that a strong culture of procedural adherence exists. On the other hand, strong performance in these areas suggests that a culture of procedure adherence exists. The checklist shown in Figure 2 was modified to include sections on housekeeping and FME to reflect this relationship.

Future Activities and Improvements

Our work in assessing procedural adherence has triggered some fundamental questions. For example, nuclear facilities must establish a balance between procedural adherence and maintaining a questioning attitude from the workers. This balance needs to be well understood, especially if verbatim compliance is sought. However, people adopt certain behaviors naturally when using procedures; research indicates that a user can work as a "procedure follower" or as a "problem solver" (de Brito & Boy, 1999). Each type of behavior has advantages and disadvantages, and may influence both procedure adherence and efficacy in carrying out the work. This has been recognized by the Canadian nuclear industry and instructions to staff include understanding the purpose of procedures before work proceeds and stopping work if there are any questions until they are resolved. The regulator must also be sensitive to this balance when carrying out inspection activities. More research is required to better understand the appropriate mix of procedure following and problem solving behavior involved for the procedures users so as to enhance human performance and ultimately to reduce human error.

Another issue worthy of further research is the complexity of procedures. A procedure that is too detailed and complex may actually impede rather than enhance human performance, yet there is often a tendency to "improve" a procedure by adding details to it. Some knowledge exists that indicates that the level of detail and the amount of guidance provided in a procedure should take into account the risk and the level of training of the procedure users (Dien, Montmayeul, Bozec et al., 1991). This remains a difficult topic and even though promising research has been and continues to be carried out in this area (Park, Jung & Ha, 2001), more work is required.

Conclusion

The CNSC has a mandate to evaluate measures implemented by nuclear facilities to address human factors and to determine whether these measures provide for protection of the environment and the health and safety of persons. As part of this mandate, CNSC staff evaluates processes supporting procedure adherence, including methods for monitoring that staff are complying with procedures.

Regulatory reviews of procedure adherence include a variety of methods, such as documentation reviews, interviews with staff and work observations. To ensure that field activities are carried out in a systematic fashion, a checklist was developed to capture key information during work observations. The checklist encompasses several areas relevant to procedure adherence. Based on initial use, the checklist provides a method for capturing consistent information during work observations.

Although the model and checklist presented in this paper were prepared for regulatory reviews, they may also be useful for nuclear facility staff during their internal reviews of procedures and procedural adherence.

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