

**HUMAN PERFORMANCE: AN ESSENTIAL ELEMENT IN  
MATERIALS CONTROL AND ACCOUNTABILITY**

CONF-960767-68

**Sonja B. Haber and Jack Allentuck  
Department of Advanced Technology  
Brookhaven National Laboratory  
Upton, New York USA**

RECEIVED  
SEP 19 1983  
OSTI

**ABSTRACT**

The importance of the role of human performance in the successful and effective operation of many activities throughout many industries has been well documented. Most closely related to the materials control and accountability area is the work in human factors that has been ongoing in the U.S. nuclear industry since the Three Mile Island Nuclear Power Plant accident in 1979. Research related to the role of human reliability, human-system interface, and organization and management influences has been and is still being conducted to identify ways to enhance the safe and effective operation of nuclear facilities. This paper will discuss these human performance areas and how they relate to the materials control and accountability area. Particular attention will be focussed on the notion of "safety culture" and how it can be defined and measured for understanding the values and attitudes held by individuals working in the materials control area.

It is widely believed that the culture of an organization, which reflects the expectations and values of the management of an organization, is a key element to the operation of that organization. The human performance element is one which has not received a great deal of consideration in the materials control and accountability area and yet it will be demonstrated that it is an essential

---

This work performed under the auspices of the U.S. Department of Energy, under Contract No. DE-AC0276CH00016.

component to ensure the success of safeguards activities.

**INTRODUCTION**

The importance of the role of human performance in the successful and effective operation of many activities throughout many industries has been well documented. The understanding and enhancement of the effectiveness of human performance in high-risk, high reliability systems and organizations is related to three main areas: organizational and management factors, human-system integration, and human reliability. The human-system integration area concerns the integration of human capabilities/intelligence into the design of complex systems to support safe and efficient operations. The human reliability area involves the evaluation of the reliability of human performance during the operation, maintenance and testing of a system or facility to support safe and efficient operations. The organization and management area is concerned primarily with the impact of organizational and management factors on performance during various type of operations. It is this latter area of organization and management factors that is the focus of this paper and the role of human performance in the materials control and accountability area.

Most closely related to the materials control and accountability area is the work in human performance that has been ongoing in the U.S. nuclear industry since the Three Mile Island Nuclear Power Plant accident in 1979. Research

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED *or*

**MASTER**

related to the role of human reliability, human-system integration, and organization and management influences on performance has been and is still being conducted to identify ways to enhance the safe and effective operation of nuclear facilities. Particular attention has often been placed on the notion of "safety culture". This paper focuses on how the concept of safety culture can be redefined in the context of the materials control and accountability area.

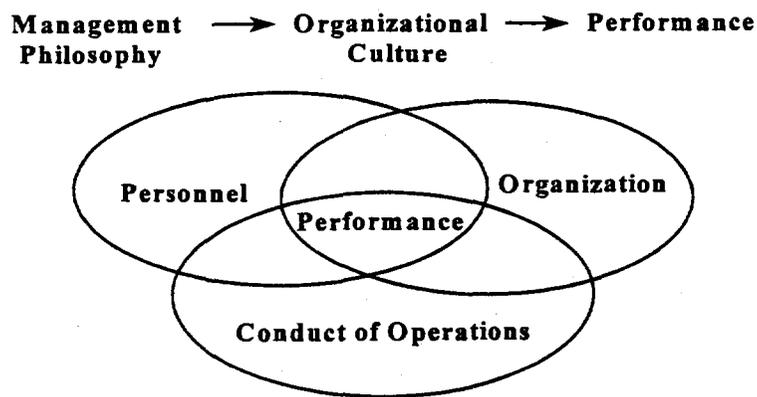
It is widely believed that the culture of an organization is a key element in the successful achievement of the organization's goals. The culture of an organization (1) is comprised of the common values, attitudes and beliefs of the individuals working within that organization and which influences their behavior or performance within the organization. For example, the notion of a safety culture is an assembly of characteristics, attitudes, and values in organizations, individuals, and operating practices which establish that organizational safety issues are given an overriding priority and receive the attention warranted by their significance. Safety culture is the representation of a management philosophy which reflects the values and attitudes of importance placed upon those processes within an organization which have significant consequences for safety.

While a certain management philosophy is necessary to have a strong organizational culture, the philosophy must be supported by observable personnel actions, organizational structures, and formal conduct of operations to achieve the desired performance.

Therefore, to create a materials control and safeguards culture there must be a management expectation of the importance of safeguarding nuclear materials over the achievement of production goals. An organization which ensures that this expectation is never sacrificed for the sake of other goals, with the possible exception of safety under emergency conditions, has taken the first step in creating this "nuclear materials safeguards culture".

#### **THE CONCEPT OF A NUCLEAR MATERIALS SAFEGUARDS CULTURE**

The notion of safety culture implies the pervasive acceptance at all levels of the organization of commitments and responsibilities of individuals that contribute to safety. In a similar fashion, the notion of a nuclear materials safeguard culture should signify a pervasive acceptance of



**FIGURE 1. THE ELEMENTS OF PERFORMANCE**

**DISCLAIMER**

**Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.**

## DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

commitments and responsibilities that contribute to minimizing the probability of theft or diversion of nuclear materials. Using the elements of performance described earlier, a nuclear materials safeguards culture is comprised of:

- Personnel Actions - The behaviors, awareness, commitments, responsibilities and ownership by individuals at all organizational levels that contribute to the goals of materials control and accountability;
- Organizational Factors - The organization, programs, processes, and structures that both reflect priorities on nuclear materials control and facilitate improvements in meeting the goals of materials control and accountability; and
- Conduct of Operations - The principles, practices, and discipline that institutionalize and formalize desired materials control and accountability performance.

Many of the facets of these elements are already in place at Department of Energy (DOE) facilities because they reflect good common sense and they are called for in the DOE orders. However, several aspects of the elements are not currently addressed in the orders and it is those, especially with respect to the organizational factors that will be focussed on. These factors are important in supporting the development of a nuclear materials safeguards culture.

## **ORGANIZATIONAL FACTORS**

Organizational performance has been recognized to lead to overall effective or ineffective facility performance. The organizational factors and their dimensions that have been identified to impact overall performance are identified in Table 1 (2).

Each of the *factors* are defined by the organizational dimensions which comprise it. In general they are defined as follows:

CULTURE Culture refers to the characteristics of the social environment of the organization, such as the norms, rules, and common understandings, that prescribe appropriate working relationships and behaviors.

COMMUNICATION Communication refers to the transfer of meaningful information from one party to another. This factor includes communication at all levels of the organization. It includes who communicates with whom on a daily or weekly basis, the informal and formal communication structures, and the top-down and bottom-up communication networks.

### MANAGEMENT OVERSIGHT/

DECISION MAKING Decision making involves the active searching of the environment for conditions which require a decision, the development and analysis of possible alternatives, and the selection of a particular alternative. Management oversight includes the attention and involvement of management in all aspects of the organization's operations.

HUMAN RESOURCE MANAGEMENT Human resource management refers to the efficient allocation of people in order to meet the demand requirements placed on the organization by the operating system.

ORGANIZATIONAL CLARITY Organizational clarity refers to organization of work, both formal and informal, specifying how work is performed, how individuals and departments work together and who within the organization is responsible for various aspects of work. Additionally, the factor refers to the level of understanding each individual and department has regarding the responsibilities of others.

<b>CULTURE</b>	<b>COMMUNICATION</b>
Organizational Culture	External Communication
Time Urgency	Interdepartmental Communication
Ownership/Performance	Intradepartmental Communication
Quality	
<b>MANAGEMENT OVERSIGHT/DECISION MAKING</b>	
Problem Identification	
Goal Setting/Prioritization	
Resource Allocation	
Organizational Learning	
<b>HUMAN RESOURCE MANAGEMENT</b>	<b>ORGANIZATIONAL CLARITY</b>
Training	Centralization
Technical Knowledge	Coordination of Work
Personnel Selection	Formalization
Performance Evaluation	Roles and Responsibilities
	Organizational Knowledge

**TABLE 1. ORGANIZATIONAL FACTORS AND DIMENSIONS**

**ORGANIZATIONAL FACTORS AND NUCLEAR MATERIALS SAFEGUARDS CULTURE**

To support the development of a nuclear materials safeguards culture, several of the organizational factors identified above need to be better addressed by both DOE in its orders, and by facilities in their operations. By example:

ORGANIZATIONAL CLARITY The basic requirements of DOE Order 5633.3B (3) include among other things the designation of a management official responsible for the control and accountability of nuclear materials who shall be

organizationally independent from responsibility for other programs. The level of management to which such an individual should report remains unstated. Reporting to either the site manager or the facility manager poses the same problem since both have other programmatic responsibilities including production requirements. The resolution of this organizational structure problem resides in the clearly defined expectation that safeguarding nuclear material takes precedence over other programs. It also can be facilitated by clearly defined roles and responsibilities within the organization which support the development of the nuclear materials safeguards culture.

The extent to which there are well-defined rules, procedures, policies, and/or standardized methods for routine activities within an organization contributes to organizational clarity. Facilities should prepare a well-organized conduct of materials control and accountability operations manual which contains specific policies applying to such operations. Such a manual constitutes a higher level document than a procedures manual and would be used by management in identifying those procedures which must be implemented to facilitate achieving materials control and accountability objectives. A policy on configuration management, for example, would be included to assure that when equipment or processes are changed, appropriate changes are made to related procedures and to training requirements.

COMMUNICATION DOE Order 5633.3B, does not specifically address facilitating communication to management by lower level staff on concerns with regard to materials control and accountability practices or suspicious activities. A communications channel for this purpose should be established and should be free from any features which would tend to inhibit expression of such concerns. Personnel should be encouraged to understand that it is a personal responsibility to be vigilant to assure that improper materials control and accountability activities are noted and reported.

MANAGEMENT OVERSIGHT/  
DECISION MAKING DOE Order 5633.3B requires facilities which have material balance areas which contain Category 1 quantities of Special Nuclear Material (SNM) to develop a program of Daily Administrative Checks. Such a program essentially involves a walk through to assure that there are no obvious abnormalities or obvious missing items. By assigning a member of management to accompany the materials control and accountability staff who undertakes the walk-through, management has an opportunity to demonstrate that it takes its own "hands-on"

involvement and takes its materials control and accountability responsibilities seriously.

HUMAN RESOURCE MANAGEMENT A personnel reliability program covering all individuals who have access to SNM or materials accountancy data is a DOE requirement. The identification of individuals who may not meet personnel reliability criteria depends, among other things, on the observations of individual workers by supervisors and co-workers. Social relationships and day-to-day associations in the workplace over extended periods of time, may taint objective observation and uninhibited reporting. Alternative approaches need to be considered.

DOE Order 5633.3B requires that the materials control and accountability plan must provide for the training of staff engaged in measurements and other materials control and accountability activities. Training should also be directed toward educating individuals on their role and relationship in achieving overall materials control goals. Training may be a very viable mechanism for enhancing loyalty and commitment to the organization and dedication to its goals. The actual delivery of training is not addressed in the order. What methods are used to train and qualify people is an important element in effective job performance which deserves serious consideration by management.

These are just a few examples of how organizational factors can impact the development and facilitation of a nuclear materials safeguards culture through their influence on human performance.

### MEASURING SUCCESS

Some assessment of the organizational culture to ascertain the success in achieving a nuclear materials safeguards culture needs to be made. Several approaches are available:

- Performance-based measures can be developed using criteria and attributes deemed desirable or indicative of the materials safeguards culture. These can be observed and self-assessed by the facility or externally assessed by inspectors. Measures can also be correlated to existing indicators of successful safeguards performance;
- The organizational factors and dimensions identified above are all measurable by a variety of techniques. Those which are most relevant to the implementation of a nuclear materials safeguards culture can be identified and assessed through the use of checklists, interviews, and scaling techniques; and
- Surveys have been widely used as a tool to assess culture in an organization. The survey can be designed to query individuals on the various attributes believed to comprise the culture. The survey also provides a broad sampling of the individuals within an organization, a descriptive profile of the organization's culture at one point in time which can then be used as a baseline against which comparisons of other points in time can be made, and comparisons of the profiles across organizations can also be made.

## SUMMARY

In summary, the philosophy of management, the goals of the organization, and the strategic choices

management makes, determine the culture of the organization. The aspect of culture most immediately affected by these factors is what is valued by the organization. The extent to which these values are recognized and shared reflects the strength of the organizations' culture. Organizational factors, along with these shared values, influence the operating structures of the organization, its human resource management practices, and the style of its managers and supervisors. To the extent that these shared values and behavioral norms can be measured and evaluated, data collection of this type is important in understanding the element of human performance in the nuclear materials safeguards culture.

## REFERENCES

1. R. A. Cooke and E. H. Burack, "Measuring Norms and Expectations With the OCI", Organizational Culture Inventory, Level V Manual, p.13, Human Synergistics, Chicago, Illinois (1987).
2. D. A. Shurberg and S. B. Haber, "Techniques to Assess Organizational Factors: Progress to Date", Brookhaven National Laboratory, Technical Report A-3956-1-7/94, Upton, New York (1994).
3. DOE Order 5633.3B, "Control and Accountability of Nuclear Materials", U.S. Department of Energy, Washington, D.C. (1994).