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Building on the Principles
for Enhancing Professionalism

Principles for a Strong Nuclear Safety Culture

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Introduction

Principles for a Strong Nuclear Safety Culture describes the essential attributes of a healthy nuclear safety culture (hereafter "safety culture"), with the goal of creating a framework for open discussion and continuing evolution of safety culture throughout the commercial nuclear electric generating industry. The principles and associated attributes described have a strong basis in plant events.

Basic principles are addressed herein, rather than prescribing a specific program or implementing methods. These principles and attributes, when embraced, will influence values, assumptions, experiences, behaviors, beliefs, and norms that describe what it is like to work at a specific facility and how things are done there. Principles appear in boldface type. Attributes help clarify the intent of the principles.

Utility managers are encouraged to make in-depth comparisons between these principles and their day-to-day policies and practices and to use any differences as a basis for improvement.

This document is complementary to, and should be used in conjunction with, previously published principles documents. It builds on and supports *Principles for Enhancing Professionalism of Nuclear Personnel*, March 1989. It contains concepts consistent with those described in *Management and Leadership Development*, November 1994; *Excellence in Human Performance*, September 1997; *Principles for Effective Self-Assessment and Corrective Action Programs*, December 1999; and *Principles for Effective Operational Decision-Making*, December 2001.

This document was developed by an industry advisory group in conjunction with the staff of the Institute of Nuclear Power Operations (INPO) and with broad input from the nuclear industry worldwide.

Background

A variety of **watershed events** over the years have influenced the safety culture at U.S. nuclear electric generating plants. The industry had its first significant wake-up call in 1979 as a result of the accident at Three Mile Island Nuclear Station. Many fundamental problems involving hardware, procedures, training, and attitudes toward safety and regulation contributed to the event.

In 1986, the Chernobyl accident was a stark reminder of the hazards of nuclear technology. This accident resulted from many of the same weaknesses that led to the Three Mile Island accident. In addition, it highlighted the importance of maintaining design configuration, plant status control, line authority for reactor safety, and cultural attributes related to safety.

Response from industry and regulatory organizations to both these events was sweeping. Improvements were made in standards, hardware, emergency procedures, processes, training (including simulators), emergency preparedness, design and configuration control, testing, human performance, and attitude toward safety.

More recent events, such as the 2002 discovery of degradation of the Davis-Besse Nuclear Power Station reactor vessel head, have highlighted problems that develop when the safety environment at a plant receives insufficient attention. A theme common in these cases is that, over time, problems crept in, often related to or a direct result of the culture at the plant. Had these problems been recognized and resolved, the events could have been prevented or their severity lessened. The series of decisions and actions that resulted in these events can usually be traced to the shared assumptions, values, and beliefs of the organization.

These events and the notion that culture is a key ingredient in the overall success of the plant form the basis for this document.

Organizational culture is the shared basic assumptions that are developed in an organization as it learns and copes with problems. The basic assumptions that have worked well enough to be considered valid are taught to new members of the organization as the correct way to perceive, think, act, and feel. Culture is the sum total of a group's learning. ***Culture is for the group what character and personality are for the individual.***

In addition to a healthy organizational culture, each nuclear station, because of the special characteristics and unique hazards of the technology—radioactive byproducts, concentration of energy in the reactor core, and decay heat—needs a strong **safety culture**.

> ***Safety culture: An organization's values and behaviors—modeled by its leaders and internalized by its members—that serve to make nuclear safety the overriding priority.***

Implied in this definition is the notion that nuclear power plants are designed, built, and operated (and intended) to produce power in a safe, reliable, efficient manner; that the concept of safety culture applies to every employee in the nuclear organization, from the board of directors to the individual contributor; that the focus is on nuclear safety, although the same principles apply to radiological safety, industrial safety, and environmental safety; and that nuclear safety is the first value adopted at a nuclear station and is never abandoned.

The strength of a facility's safety culture could lie anywhere along a broad **continuum**, depending on the degree to which the attributes of safety culture are embraced. Even though safety culture is a somewhat intangible concept, it is possible to determine, based on observable attributes, whether a station tends toward one end of the continuum or the other.

A **safety-conscious work environment** (freedom to raise concerns without fear of retribution) is but one (albeit important) element of a strong nuclear safety culture.

Commercial nuclear electric generating plants are designed, built, and operated to produce electricity. **Safety, production, and cost control** are necessary goals for the operation of such a plant. These outcomes are quite complementary, and most plants today achieve high levels of safety, impressive production records, *and* competitive costs, reinforced by decisions and actions made with a long-term view. This perspective keeps safety as the overriding priority for each plant and for each individual associated with it.

Nuclear safety is a **collective responsibility**. No one in the organization is exempt from the obligation to ensure safety first.

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Principles for a Strong Nuclear Safety Culture

Safety culture: An organization's values and behaviors—modeled by its leaders and internalized by its members—that serve to make nuclear safety the overriding priority.

The following principles are described in this document:

1. Everyone is personally responsible for nuclear safety.
2. Leaders demonstrate commitment to safety.
3. Trust permeates the organization.
4. Decision-making reflects safety first.
5. Nuclear technology is recognized as special and unique.
6. A questioning attitude is cultivated.
7. Organizational learning is embraced.
8. Nuclear safety undergoes constant examination.

Principles and Their Attributes

1. Everyone is personally responsible for nuclear safety.

Responsibility and authority for nuclear safety are well defined and clearly understood. Reporting relationships, positional authority, staffing, and financial resources support nuclear safety responsibilities. Corporate policies emphasize the overriding importance of nuclear safety.

Attributes:

- The line of authority and responsibility for nuclear safety is defined from the board of directors to the individual contributor. Each of these positions has clearly defined roles, responsibilities, and authorities, designated in writing and understood by the incumbent.
- Support groups, such as human resources, labor relations, and business and financial planning, also understand their roles in contributing to nuclear safety.
- People and their professional capabilities, values, and experiences are regarded as the nuclear organization's most valuable asset. Staffing levels are consistent with the demands related to maintaining safety and reliability.
- Board members and corporate officers periodically take steps to reinforce nuclear safety, including visiting sites to assess management effectiveness first-hand.
- The line organization, starting with the chief executive officer, is the primary source of information and the only source of direction. Other parties, such as oversight organizations and committees, review boards, and outside advisors, who provide management information essential to effective self-evaluation, are not allowed to dilute or undermine line authority and accountability.
- All personnel understand the importance of adherence to nuclear safety standards. All levels of the organization exercise healthy accountability for shortfalls in meeting standards.
- Relationships among utilities, operating companies, and owners are not allowed to obscure or diminish the line of responsibility for nuclear safety.
- The system of rewards and sanctions is aligned with strong nuclear safety policies and reinforces the desired behaviors and outcomes.

2. Leaders demonstrate commitment to safety.

Executive and senior managers are the leading advocates of nuclear safety and demonstrate their commitment both in word and action. The nuclear safety message is communicated frequently and consistently, occasionally as a stand-alone theme. Leaders throughout the nuclear organization set an example for safety.

Attributes:

- Managers and supervisors practice visible leadership in the field by placing "eyes on the problem," coaching, mentoring, and reinforcing standards. Deviations from station expectations are corrected promptly.
- Management considers the employee perspective in understanding and analyzing issues.
- Managers and supervisors provide appropriate oversight during safety-significant tests or evolutions.
- Managers and supervisors are personally involved in high-quality training that consistently reinforces expected worker behaviors.
- Leaders recognize that production goals, if not properly communicated, can send mixed signals on the importance of nuclear safety. They are sensitive to detect and avoid these misunderstandings.
- The bases, expected outcomes, potential problems, planned contingencies, and abort criteria for important operational decisions are communicated promptly to workers.
- Informal opinion leaders in the organization are encouraged to model safe behavior and influence peers to meet high standards.
- Selection and evaluation of managers and supervisors consider their abilities to contribute to a strong nuclear safety culture.

3. Trust permeates the organization.

A high level of trust is established in the organization, fostered, in part, through timely and accurate communication. There is a free flow of information in which issues are raised and addressed. Employees are informed of steps taken in response to their concerns.

Attributes:

- People are treated with dignity and respect.
- Personnel can raise nuclear safety concerns without fear of retribution and have confidence their concerns will be addressed.
- Employees are expected and encouraged to offer innovative ideas to help solve problems.
- Differing opinions are welcomed and respected. When needed, fair and objective methods are used to resolve conflict and unsettled differing professional opinions.
- Supervisors are skilled in responding to employee questions in an open, honest manner. They are recognized as an important part of the management team, crucial to translating safety culture into practical terms.
- The effects of impending changes (such as those caused by sale or acquisition, bargaining unit contract renegotiations, and economic restructuring) are anticipated and managed such that trust in the organization is maintained.
- Senior management incentive programs reflect a bias toward long-term plant performance and safety.
- Complete, accurate, and forthright information is provided to oversight, audit, and regulatory organizations.
- Managers regularly communicate to the workforce important decisions and their bases, as a way of building trust and reinforcing a healthy safety culture. Worker understanding is periodically checked.

4. Decision-making reflects safety first.

Personnel are systematic and rigorous in making decisions that support safe, reliable plant operation. Operators are vested with the authority and understand the expectation, when faced with unexpected or uncertain conditions, to place the plant in a safe condition. Senior leaders support and reinforce conservative decisions.

Attributes:

- The organization maintains a knowledgeable workforce to support a broad spectrum of operational and technical decisions. Outside expertise is employed when necessary.
- Managers, supervisors, and staff clearly understand and respect each other's roles in decision-making.
- Plant personnel apply a rigorous approach to problem-solving. Conservative actions are taken when understanding is incomplete.
- Single-point accountability is maintained for important safety decisions, allowing for ongoing assessment and feedback as circumstances unfold.
- Candid dialogue and debate are encouraged when safety issues are being evaluated. Robust discussion and healthy conflict are recognized as a natural result of diversity of expertise and experience.
- Decision-making practices reflect the ability to distinguish between "allowable" choices and prudent choices.
- When previous operational decisions are called into question by new facts, the decisions and associated underlying assumptions are reviewed to improve the quality of future decisions.

5. Nuclear technology is recognized as special and unique.

The special characteristics of nuclear technology are taken into account in all decisions and actions. Reactivity control, continuity of core cooling, and integrity of fission product barriers are valued as essential, distinguishing attributes of the nuclear station work environment.

Attributes:

- Activities that could affect core reactivity are conducted with particular care and caution.
- Features designed to maintain critical safety functions, such as core cooling, are recognized as particularly important.
- Design and operating margins are carefully guarded and are changed only with great thought and care. Special attention is placed on maintaining fission product barriers and defense-in-depth.
- Equipment is meticulously maintained well within design requirements.
- Insights from probabilistic risk analyses are considered in daily plant activities and plant change processes.
- Plant activities are governed by comprehensive, high-quality processes and procedures.
- Employee mastery of reactor and power plant fundamentals, as appropriate to the job position, establishes a solid foundation for sound decisions and behaviors.

6. A questioning attitude is cultivated.

Individuals demonstrate a questioning attitude by challenging assumptions, investigating anomalies, and considering potential adverse consequences of planned actions. This attitude is shaped by an understanding that accidents often result from a series of decisions and actions that reflect flaws in the shared assumptions, values, and beliefs of the organization. All employees are watchful for conditions or activities that can have an undesirable effect on plant safety.

Attributes:

- While individuals expect successful outcomes of daily activities, they recognize the possibility of mistakes and worst-case scenarios. Contingencies are developed to deal with these possibilities.
- Anomalies are recognized, thoroughly investigated, promptly mitigated, and periodically analyzed in the aggregate.
- Personnel do not proceed in the face of uncertainty.
- Workers identify conditions or behaviors that have the potential to degrade operating or design margins. Such circumstances are promptly identified and resolved.
- Employees understand that complex technologies can fail in unpredicted ways. They are aware that latent problems can exist, and they make conservative decisions considering this potential.
- Group-think is avoided through diversity of thought and intellectual curiosity. Opposing views are encouraged and considered.

7. Organizational learning is embraced.

Operating experience is highly valued, and the capacity to learn from experience is well developed. Training, self-assessments, corrective actions, and benchmarking are used to stimulate learning and improve performance.

Attributes:

- The organization avoids complacency and cultivates a continuous learning environment. The attitude that "it can happen here" is encouraged.
- Training upholds management standards and expectations. Beyond teaching knowledge and skills, trainers are adept at instilling nuclear safety values and beliefs.
- Individuals are well informed of the underlying lessons learned from significant industry and station events, and they are committed to not repeating these mistakes.
- Expertise in root cause analysis is applied effectively to identify and correct the fundamental causes of events.
- Processes are established to identify and resolve latent organizational weaknesses that can aggravate relatively minor events if not corrected.
- Employees have confidence that issues with nuclear safety implications are prioritized, tracked, and resolved in a timely manner.

8. Nuclear safety undergoes constant examination.

Oversight is used to strengthen safety and improve performance. Nuclear safety is kept under constant scrutiny through a variety of monitoring techniques, some of which provide an independent "fresh look."

Attributes:

- A mix of self-assessment and independent oversight reflects an integrated and balanced approach. This balance is periodically reviewed and adjusted as needed.
- Periodic safety culture assessments are conducted and used as a basis for improvement.
- The pitfalls of focusing on a narrow set of performance indicators are recognized. The organization is alert to detect and respond to indicators that may signal declining performance.
- The insights and fresh perspectives provided by quality assurance, assessment, employee concerns, and independent oversight personnel are valued.
- Senior executives and board members are periodically briefed on results of oversight group activities to gain insights into station safety performance.

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