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COMMENTS ON COLLECTIVE UNDERSTANDING OF SAFETY CULTURE

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and

ORGANIZATION HALF-LIFE

The Un-Monitored Disintegration in Reactor and Public Safety

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SPECIFIC HISTORY OF THE ISSUE

The concept that an "appropriate safety culture" is a necessary ingredient for the safe operation of a nuclear facility is not new. Safety culture and its contribution towards the effective material condition management of nuclear plant equipment has been known for over two decades. The Nuclear Regulatory Commission (NRC), as well as the nuclear industry, have wrestled with plant cultural issues since the Three Mile Island Accident in 1979. The discovery of the seriously corroded reactor vessel head at the Davis-Besse Nuclear Plant in February 2002 is the most recent reminder of the safety and economic consequence resulting from a lack of genuine commitment to the safe operation of a nuclear reactor. In this case, the irreparable damage to the reactor vessel head was the result of a deliberate refusal to perform routine inspection and maintenance on a critical reactor pressure vessel component.

This is not the first time that the failure to perform requisite maintenance on plant equipment has occurred at the Davis Besse Nuclear Plant. The types of problems recently identified at the Davis-Besse Nuclear Plant result from a lack of technical competence and management integrity. The degraded reactor vessel head is only a symptom of those problems.

Subsequent to the Loss of Main and Auxiliary Feedwater Event at the Davis Besse Plant on June 9, 1985, the Nuclear Regulatory Commission (NRC) promulgated its findings and conclusions as to why the event occurred in NUREG-1154 (See also Harold Denton letter to licensee dated August 14, 1985). The NRC's investigation concluded that the underlying causes of this event were:

1. The lack of attention to detail in the care of plant equipment;

2. A history of performing troubleshooting, maintenance and testing of equipment, and of evaluating operating experience relating to equipment in a superficial manner, and as a result, the root causes of problems were not always found and corrected;

3. The engineering design and analysis effort to address equipment problems was frequently either not utilized or was not effective; and

4. That equipment problems were not aggressively addressed and resolved.

In addition to the discovery of the irreparable damage to the reactor vessel head last year, FirstEnergy has since identified a significant number of additional plant component problems which currently render their respective systems inoperable and unable to assure adequate safety margins upon demand in the anticipated accident scenarios. These recent discoveries signify that the previously cited underlying causes surrounding the Loss of Auxiliary Feedwater Event still exist at the Davis-Besse Nuclear Plant.

SPECIFIC CHARACTERISTICS OF THE ISSUE

To illustrate the characteristics of an "appropriate safety culture", consider the following:

Hypothesis #1:

An appropriate safety culture (mindset) mandates the existence of a pro-active maintenance regimen for all plant equipment (regardless of classification) thereby eliminating, or at a minimum, reducing the number of premature or end-of-life component failures.

Corollary:

An appropriate safety culture does not exist in an environment or climate where equipment is routinely neglected and/or ignored prior to the anticipated failure.

Hypothesis #2:

An appropriate safety culture exits when employees are confident that their concerns affecting the material condition of plant equipment will be expeditiously addressed and resolved to the satisfaction of all facets of plant

management.

Corollary:

An appropriate safety culture does not exist in an environment or climate where equipment concerns are afforded disproportionate consideration dependant upon the source of the concern.

Hypothesis #3:

An appropriate safety culture exists when employees who raise legitimate equipment concerns receive positive recognition for raising the concerns from all facets of plant management.

Corollary:

An appropriate safety culture does not exist in an environment or climate where employees who raise legitimate equipment concerns are disciplined for doing so, or are otherwise intimated, harassed or ostracized by either management or workplace peers.

Hypothesis #4:

An appropriate safety culture exists when equipment issues are timely reviewed by all facets of plant management before a final disposition is determined.

Corollary:

An appropriate safety culture does not exist in an environment or climate where equipment issues are dispositioned without obtaining the satisfaction and feedback of the originator of the concern.

Hypothesis #5:

An appropriate safety culture exists when plant economics, undoubtedly a factor to be considered, does not

indiscriminately interfere with a decision to perform immediate corrective action to prevent equipment failure.

Corollary:

An appropriate safety culture does not exist where plant equipment concerns are deferred indefinitely because of "perceived" economic restraints.

SPECIFIC ANALYSIS OF THE ISSUE

With respect to why some nuclear facilities perform better than others, Commissioner Zech of the NRC stated in the March/April 1988 issue of **NUCLEAR INDUSTRY** that:

> " If there is one key, it is what I call leadership involvement...leadership involvement with an emphasis on, and real understanding of, quality. How far down the organization does the chief executive officer look to find out why his plant isn't operating as well as it should?...through the operators, to the maintenance people, to the technicians. Communications is so important...Standardization is important, if this industry is going to survive in our country."

The necessary ingredients to achieve a desirable safety culture (mindset) include:

* Management Leadership
* Personnel Integrity
* Technical Competence
* Personal Reliability
* Two-Way Communications

Mr. William Kiesler, President, Nuclear Maintenance Integration Consultants Corporation (NuMIC Corp.) will more fully develop these attributes in the discussion that follows.

ORGANIZATION HALF-LIFE
The Un-Monitored Disintegration in Reactor and Public Safety

INTRODUCTORY STATEMENT

Organization culture and its importance to reactor and public safety is not a new topic or issue. Culture and its impact to the effective material condition management of a nuclear plant have been known for over two decades. To hold the license to a nuclear power plant is to hold the public trust. As such, nuclear and public safety is an integration of technical and moral requisites.

All personnel and administration at a nuclear plant exist for one purpose. The purpose is to operate the facility within requisite material conditions in structures, systems and components. The technical complexity of a nuclear plant inherently skews attention away from the human dimension that affects equipment management. However, it is ethics, as much as physics, that determine the margin-of-safety at a nuclear plant.

The hole in the reactor vessel head at the Davis-Besse Nuclear Plant has now revealed beyond argument that culture is the dominant influence in reactor safety. Reality is that culture can override all engineered bases. Culture is not a "soft" issue regarding reactor safety.

CULTURE, ORGANIZATION HALF-LIFE & RISK-BASED MANAGEMENT

Culture is not a "soft" issue in reactor and public safety - it is the most dominant factor. Just as radioactive material decays to a lower energy, the same is true of organization personnel behaviors. Organization half-life is a characteristic that becomes visible when it is ignored. Organization half-life must be pro-actively managed to prevent material condition degradation if actual reactor and public safety are to be achieved. The management of organization half-life was first advanced by Mr. Ollie Bradham at the V. C. Summer Nuclear Plant. Davis-Besse illustrates and confirms that organization half-life is the disintegration factor in reactor and public safety that is un-monitored.

The lack of safety culture at a nuclear plant does not mean there is no culture. At Davis-Besse, the culture is one of systemic refusal to perform requisite maintenance. Retrospective from today,

the Davis-Besse culture has sustained through three management regimes. Approximately every eight (8) years since commencing commercial operations, the Davis-Besse nuclear plant has yielded an unacceptable equipment challenge to the nuclear plant's established margin-of-safety. The common denominator in each of these eight (8) year half-life periods is the recurring failure of regulatory oversight to recognize the degrading culture prior to the equipment challenge of the margin-of safety. That regulatory failure is not by complacency, nor laxity, nor nuance.

Davis-Besse has a distinctive organization half-life regarding reactor and public safety that must not be ignored. As the nuclear industry postured towards risk-based management, the culture at Davis-Besse was inappropriately not factored. The culture at Davis-Besse embracing superficial analysis and inspection as well as the systematic refusal to perform maintenance has always been incompatible with risk-based management strategies. The hole in the reactor vessel head or something similar to it was inevitable and the occurrence was anticipated, if not predicted, as early as 1988.

Since 1988, the nuclear industry has deviated from its ethical foundations. Risk-based management is sound science, but risk-based management requires a much higher degree of organization self-discipline than other more prescriptive strategies. The science of risk-based management has truly been misapplied. Risk-based management can stratify maintenance priority, however, risk-based management cannot eliminate maintenance. This fallacy is being articulated from the highest levels of the nuclear industry. This is not some nuance in perception. The articulations are contrary to nuclear industry experience.

The pinnacle nuclear events over the years show an interactive failure between safety-related and non-safety-related equipment. Nothing in a nuclear plant should be allowed to run to failure, not even light bulbs. The hole in the reactor vessel head at Davis-Besse is an indicator - not a statistical outlier.

The premise of operating some equipment by a run-to-failure premise is unacceptable in lieu of pro-active maintenance. Where there is a lack of safety culture, the run-to-failure mentality infects the managing organization and impacts safety-related and quality-related structures, systems and components. Erosion and corrosion are known to be functions of how a nuclear plant is managed. Just as the Davis-Besse reactor vessel head is being destructively examined for the industry, the same level of examination needs to be performed regarding the historical culture of the licensee.

NuMIC's determinations are counter-intuitive as to how risk-based management strategies have been implemented to date. Material condition control is a by-product of organization culture

management moreso than simply systematic maintenance. While human emotion cannot "will" a pressure vessel's integrity to retain pressure, human emotion dictates human action. Degradation is a continual time related process that challenges material condition. Degradation always demands that humans perform some action(s) upon the structures, systems and components in a timely manner. At a nuclear plant the time constants in material condition degradation are longer than inherent organization half-lives.

ATTRIBUTES OF EFFECTIVE SAFETY CULTURE

The attributes of an effective safety culture are identifiable and quantifiable. Because human performance is the dominant influence upon the material condition of a nuclear plant, there are cause and effect scenarios between human behaviors and structures, systems and components. The Nuclear Maintenance Integration Consultants' efforts concluded that:

(1) Nuclear Safety Culture is an integration of high ethical standards and technical competence (Figure 1).

* Leadership actions promulgate ethical standards into technical competence and organizational etiquette (decorum).

* Leadership philosophy and its beliefs (actions) are the determinant of the resulting organization's culture.

* It is the personal integrity of executives in leadership that governs a nuclear plant's material condition over the life of the license.

* Executives' actions demonstrate their core values and they must communicate from the highest level that "people drive programs and not that programs drive people".

* Leadership actions moreso than statements signal the convictions that earn management respect.

(2) Overall Margin-of-Safety is a combination of Personnel Integrity and Equipment Material Condition (Figure 1).

* Personnel integrity influences the material condition. Material condition must never influence personnel integrity. In an effective nuclear safety

culture, personnel reliability profile standards are prevalent throughout the licensee at all organizational tiers.

(3) The organization recognizes that the degradation of material condition is a function of wear, aging and culture (Figure 2).

* Degradation induces a dynamic into information management, equipment management and productivity management that is constantly changing throughout the life of a nuclear plant.

(4) Pro-active material condition control is a strategic by-product of four concurrent managements - information management, equipment management, organization management, and productivity management. Organization management is dominant in the integration of information, equipment and productivity (Figure 3).

(5) Operations, Maintenance and Engineering are enterprise-wide, interrelated functions, not merely departments (Figure 4).

* Each function is a sub-culture that requires obvious and continual executive leadership of personnel and administration integration.

* Organizational feedback from the lowest levels to the executive level is requisite and must be continuously sought and acted upon by senior leadership through formal programmatic efforts.

* Leadership recognizes that organizational communications from the bottom to the top is the foundation of material condition management. Data in and of itself is not information. The feedback from Maintenance personnel (capital M) throughout the licensee organization is the most critical feedback in material condition management. Programmatic architecture and procedures for systematic maintenance alone do not inherently deliver effective material condition management.

WHAT SHOULD THE ACRS RECOMMEND TO THE COMMISSION?

The linkage of organizational culture indicators to the plant material condition indicators is necessary to assure continued

reactor and public safety. This linkage should be codified in law similarly to the regulation of the Maintenance Rule. It has already been demonstrated that not all licensees can perform meaningful self assessment with appropriate resolution.

The industry is on the verge of introducing particulate plutonium via Mixed-Oxide Fuel into material condition management and maintenance practices at commercial nuclear power plants. An unprecedented break from the traditional practices of the Department of Energy at Defense Nuclear Facilities must occur. The regulatory failures at Davis-Besse are directly relevant to this issue. The superficial regulatory inspections which overlooked the growth of a hole in the reactor vessel head also allowed unacceptable radiological conditions to exist at Fernald (Ohio) and Paduka (Kentucky). The Fernald and Paduka conditions must never occur at a commercial facility with respect to particulate plutonium. The fact remains that there has never been any long-term operation of a facility (which handled particulate plutonium) that did not allow the contamination to migrate beyond the facilities.

The ACRS is the only entity with vested interfaces to the Nuclear Regulatory Commission, the Department of Energy, the Department of Defense and the Defense Nuclear Facilities Safety Board. The ACRS is the only body that is currently empowered to lead an industry advance towards the establishment of a meaningful nuclear safety culture within both the industry and the regulatory agency with responsibility for the protection of the public. Two efforts appear requisite.

(1) The ACRS should demand the research, development and codification of standards (that are invoked by law) which marry organization culture relative to nuclear plant material condition.

    Nuclear safety culture that delivers an actual margin-of-safety requires a more advanced integration of behavioral sciences with engineering and physics than currently exists today. There is evidence suggesting that the demise of the nuclear industry from its early ethical foundations is at a level of deterioration that is alarming.

(2) The ACRS should demand that a nuclear industry Code of Ethics be created and formally promulgated through training of all nuclear plant personnel throughout the nation in an effort to begin elevating personnel integrity and reliability.

    The nuclear industry has drifted into an era where the most critical aspects to nuclear safety from organizational feedback regarding material condition management are routinely thwarted as anti-company,

anti-industry and whistleblowing. This mentality has permeated the ranks of the licensees and the regulators alike to the point where reactor and public safety are now being seriously challenged.

CONCLUSION

The leaders in the nuclear industry of just one generation removed understood one thing profoundly. No one can make a nuclear plant perform by rhetorical superlatives. Those who set the industry standards understood that excellence is the personification of ideals. Excellence was a single word - integrity. The hole in the reactor vessel head at Davis-Besse has illustrated that no amount of science or financial resources can offset those original understandings that had originally garnered the public's trust.

The challenge now before the ACRS is truly of national and international dimension. It is not unprecedented. The culture change that occurred at the Oconee Nuclear Station between 1974 and 1984 delivered Duke Power Company from the brink of financial default to becoming the first American nuclear plant at the top of the world in performance. The Duke Power success was achieved from its leadership and organization advancing technology to address reality. It was not the application of technology to offset leadership.

The Number One Canon of ASME International's Code of Ethics in its Nuclear Codes and Standards policies and procedures clearly states:

> "Engineers shall hold paramount the public safety, health and welfare."

The license of a nuclear plant is a contract with the public. The license was issued upon a premise that the licensee continually assure to the public that the material condition of structures, systems and components conform with the design from, fit and function.

Nuclear plants are not cars, nor trains, nor planes. The decades-old comparisons for justifying nuclear safety are a technological naivete now that we have experienced a through wall breach of a reactor vessel head's pressure boundary. The staggering energy contained in a nuclear plant core must never be underestimated. This is the most pro-nuclear industry statement that can be made in light of the past realities.

The ASME Code of Ethics states that "engineers" not "science" shall hold paramount the public safety, health and welfare. Culture is reactor and public safety. Culture is shaped exclusively by the integrity of executive leadership. Excellence must be personified.

A senior executive at the Davis-Besse Nuclear Plant once made the following statement regarding the Davis-Besse plant. He said, "If my superior tells me that the wall is brown, why should I ask the cleaning lady what color it is?" The answer is so simple. You must ask her because she knows what color the wall is. To not ask her can give executives "a hole in the head". This is not a metaphor. It never was.

Thank you for the opportunity to appear before you today.

BACKGROUND OF WILLIAM N. KEISLER

Mr. Keisler began his career with the Duke Power Company at the Oconee Nuclear Station in 1974. He began consulting in 1984. His experience includes almost 20 years of ASME Nuclear Codes and Standards activities in Section XI of the Boiler and Pressure Vessel Code. His Section XI activities include Repairs, Replacements, Welding, Maintenance, Installation and Leak testing, and Pressure Testing. He was the initial Chairman of the Working Group on Replacements.

Between 1987 and 1991 Mr. Keisler conducted private research and development in culture/material condition management. Those efforts included consulting with several nuclear industry executives of national renown. Two of those individuals were Mr. Ollie Bradham and Mr. Ed Smith. These two gentleman were central to the Oconee Nuclear Station rise to excellence - Mr. Smith as Plant Manager and Mr. Bradham as Superintendent - Maintenance. Mr. Bradham eventually became Vice-President-Nuclear at the South Carolina Electric & Gas owned V. C. Summer Nuclear Plant. Mr. Smith additionally served on the Toledo Edison Company Nuclear Review Board for the Davis-Besse Nuclear plant in 1987. Mr. Smith received ASME's George Westinghouse Award for his contributions to the industry in managing the Oconee's start-up and operation.

The Oconee Nuclear Station's Unit 2 was the first American reactor to achieve a world endurance record run. In 1987, the Oconee Nuclear Plant and the V. C. Summer Nuclear Plant were two of only five nuclear plants in the nation to be rated as Category 1 Level of Excellence by INPO. Mr. Keisler also interfaced with individuals at the Batelle Memorial Institute Human Affairs Research Center (HARC) in Seattle, WA. Batelle HARC performed a number of analyses for the Nuclear Regulatory Commission (NRC) regarding the status of maintenance, the Maintenance Rule, and

comparisons of the domestic nuclear industry internationally and with other industries.

In 1987 Mr. Keisler established a unique company, Nuclear Maintenance Integration Consultants Corporation (NuMIC Corp.), to assemble strategic capabilities for material condition management services within the nuclear industry. In the mid-1980's, Mr. Keisler served as a senior consultant to the Assistant Plant Manager-Maintenance at the Davis-Besse Nuclear Plant. In the fall of 1986 at Davis-Besse, Mr. Keisler managed the shaft replacement of the Reactor Coolant Pumps (RCPs) at Davis-Besse. That project required the complex management of equipment (over 10,000 components and sub-components) and 150 craft personnel. The cultural problems and their relationship to the plant's material condition were observed by Mr. Keisler at that time, particularly when compared against the leading plants in the nation. Mr. Keisler documented his findings and observations pursuant to the requirements of 10 CFR 50.54(f) in a specific 1987 PM Program Assessment Report issued on June 20, 1988. One section in the Report was entitled "Maintenance Human Factors".

The research and development by NuMIC from 1987 to 1991 is unique and credible. It is unique in that it encapsulated direct experience with nuclear facilities representing the complete spectrum in performance. The ASME Section XI activities provided a continuing opportunity to factor the national evolution of safety-related repairs, replacements, and modifications issues. Because the Davis-Besse dilemma is at the center of global nuclear industry matters, these research and development efforts regarding culture and its relationship to material condition management offer specific credibility in today's heightened awareness of the significance of an "appropriate safety culture".

FIGURE 1

NUCLEAR SAFETY CULTURE

The integration of moral and technical requisites.

(Behavioral Sciences + Physics & Engineering)

CODE OF ETHICS

Technical Competence • Leadership • Etiquette (Decorum)

OVERALL MARGIN OF SAFETY

PERSONNEL INTEGRITY	PHYSICAL MATERIAL CONDITION
Technical & Management Competence	Engineered Design Bases
Emotional Stability / Safety Conciousness	As-Built Structures, Systems & Components
Individual Performance • Accountability	Configuration Management
Organization Half-Life Management	Material Condition Management

FIGURE 2

NUCLEAR PLANT PHYSICAL INTEGRITY (MATERIAL CONDITION)

Margin-Of-Safety • Degradation
vs
Design Bases • As-Built • Probabilistic Core Damage

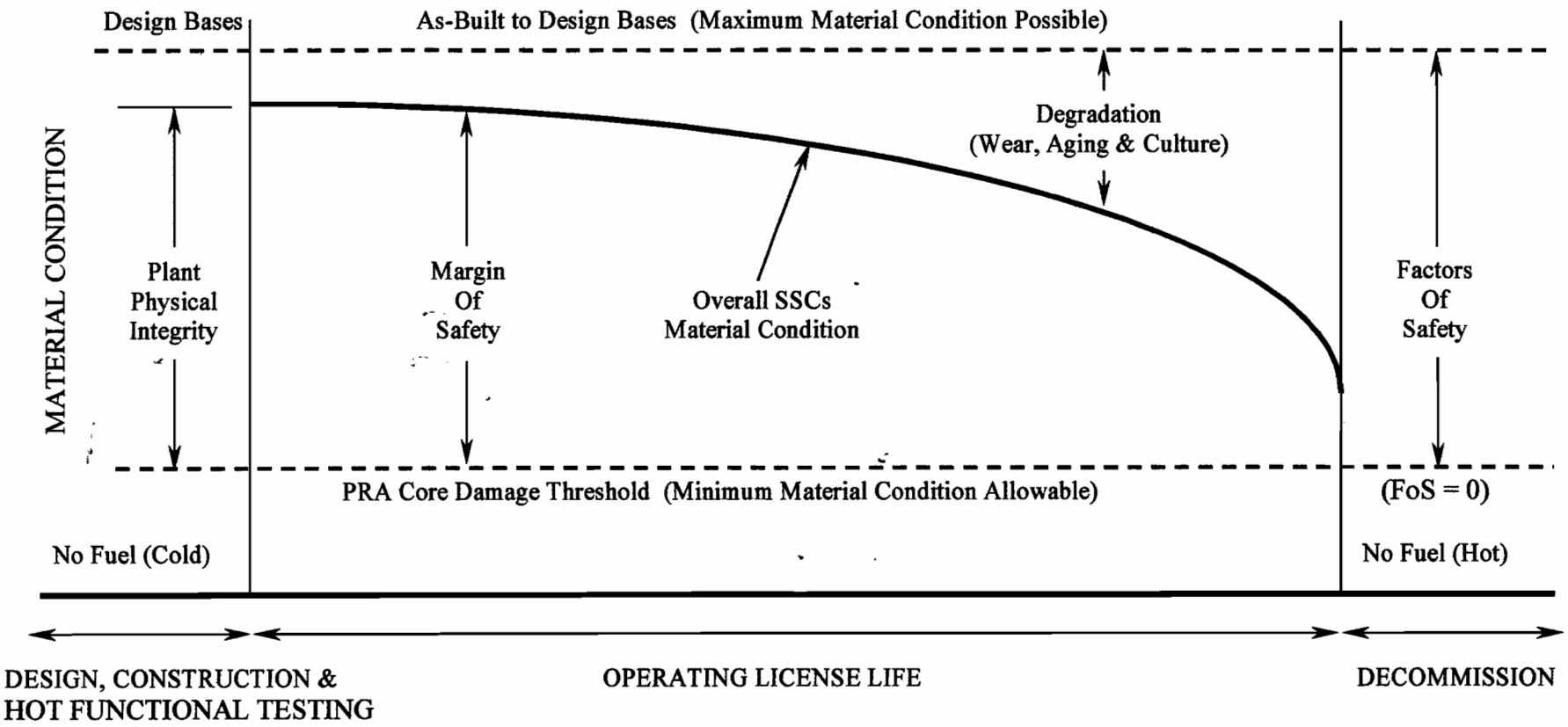

FIGURE 3

CONCURRENT MANAGEMENTS
For
MATERIAL CONDITION MANAGEMENT

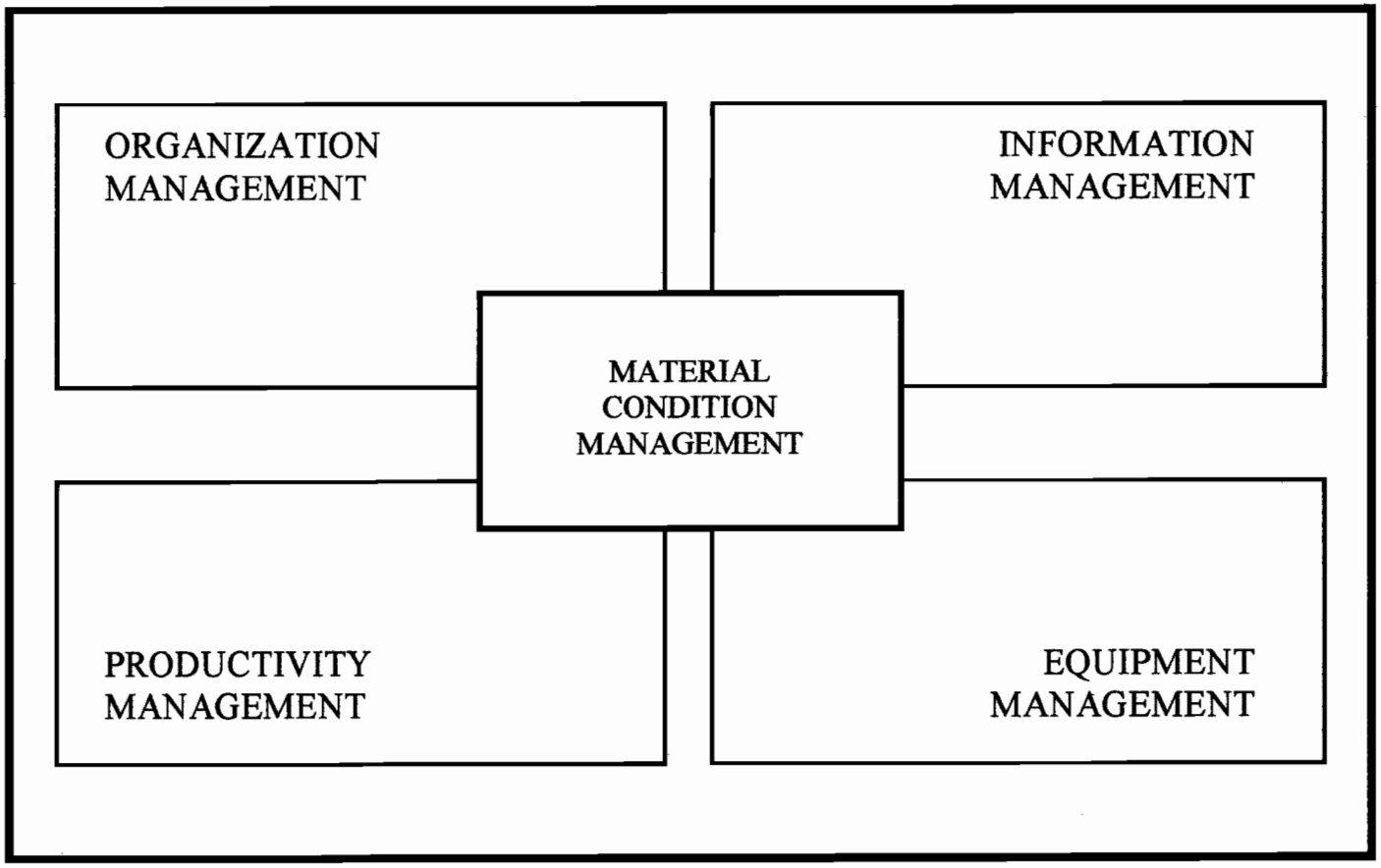

FIGURE 4

ENTERPRISE-WIDE FUNCTIONS
For
MATERIAL CONDITION MANAGEMENT