NUREG/CP-0183

Proceedings of the Advisory Committee on Reactor Safeguards Safety Culture Workshop

June 12, 2003

U.S. Nuclear Regulatory Commission
Advisory Committee on Reactor Safeguards
Washington, DC 20555-0001

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ABSTRACT

The Advisory Committee on Reactor Safeguards (ACRS) held a workshop on June 12, 2003 regarding safety culture at nuclear power plants. Topics discussed by the industry and the NRC staff included: initiatives, methodologies, guidelines, and adopted approaches for safety culture; effective criteria for evaluating safety culture; assessing the rigors of safety culture programs; and the implications on the safe operation of nuclear power plants. Specific objectives for the workshop included gathering information on domestic and international activities, and determining the attributes of effective safety culture. The workshop was organized into two panels. One panel discussed the collective understanding of safety culture, and the other panel discussed the attributes of safety culture.

The morning panel presenters included Mr. Ashok Thadani, Director of the NRC Office of Nuclear Regulatory Research; Mr. Charles Dugger, Vice President, Nuclear Operations-Nuclear Energy Institute; Dr. Thomas Murley, Safety consultant; Mr. Howard Whitcomb, III, Attorney at Law; Mr. William N. Keisler, Nuclear Maintenance Integration Consultants; Mr. David Collins, Engineering Analyst; and Mr. Alan Price, Vice President, Dominion Nuclear Connecticut.

The afternoon panel presenters included Mr. David Trimble, NRC staff; Ms. Clare Goodman, NRC staff; Mr. George Felgate, Institute of Nuclear Power Operations; Mr. Lew Meyers, Chief Operating Officer- First Energy Nuclear Operating Co.; Mr. Jack Grobe, NRC/Davis-Besse Oversight panel; Mr. Geoff Wright, NRC- Inspection team leader; Mr. William O'Connor, Vice President Nuclear Generation- Detroit Edison; and Ms. Sonja B. Haber, Human Performance Analysis Corporation.

The Committee plans to continue following-up on the progress of this matter during future meetings.

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ABBREVIATIONS

ACRS	Advisory Committee on Reactor Safeguards
ALWR	Advanced Light Water Reactor
CFR	Code of Federal Regulations
COL	Combined Operating License
DBA	Design Basis Accident
DOE	Department of Energy
FENOC	First Energy Nuclear Operating Corporation
GDC	General Design Criteria
HRO	High Reliability Organization
IAEA	International Atomic Energy Agency
INPO	Institute of Nuclear Power Operation
INSAG	International Nuclear Safety Advisory Group
LOCA	Loss-of-Coolant Accident
MIT	Massachusetts Institute of Technology
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
NRR	Office of Nuclear Reactor Regulation
NuMIC	Nuclear Maintenance Integration Consultants Corporation
OECD	Organization for Economic Cooperation Development
PRA	Probabilistic Risk Assessment
RES	Office of Nuclear Regulatory Research
RPV	Reactor Pressure Vessel
SCWE	Safety Conscious Work Environment
SCWERT	Safety Conscious Work Environment Review Team
SOER	Significant Operating Experience Report
SRM	Staff Requirements Memorandum
TMI	Three-Mile Island
USA	Utility Service Alliance

1 INTRODUCTION

Dr. George Apostolakis, Workshop Chairman, Advisory Committee on Reactor Safeguards, (ACRS), stated that the purpose of this workshop was to discuss initiatives, methodologies, guidelines, and adopted approaches for safety culture. Specific objectives for the workshop included gathering information on domestic and international activities and determining the attributes of effective safety cultures. The workshop was organized into two panels. Panel A discussed the collective understanding of safety culture, and Panel B discussed the attributes of safety culture.

2 COLLECTIVE UNDERSTANDING OF SAFETY CULTURE

2.1 Safety Culture Panel A

2.1.1 Overview

Mr. Ashok Thadani, Director of the NRC's Office of Nuclear Regulatory Research, stated that the current Commission guidance regarding safety culture is given in the policy statement on the conduct of nuclear power plant operations, issued in 1989, and in the staff requirements memorandum (SRM) on SECY-02-0166, "Safety Conscious Work Environment." The policy statement states that "management has a duty and obligation to foster the development of a safety culture at each facility and to provide a professional working environment, in the control room and throughout the facility, that assures safe operation." The guidance in SRM/SECY-02-0166 is as follows: The staff should monitor the efforts of foreign regulators to measure and regulate safety culture and assess effectiveness of their efforts. The staff should monitor efforts to develop objective measures/indicators of safety culture.

Safety culture is defined by INSAG-4 as "that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance."

Mr. Thadani stated that the staff has been monitoring and evaluating international activities, especially in developing objective measures that serve as indicators of plant safety concerns that could be the result of problems with safety culture. Both domestic and international operating experience have shown that safety culture has been an important influencing factor in significant events. It is important to understand the early and persistent signs of deteriorating safety culture. This may include performance indicators or other regulatory guidance. The staff is assessing potential followup initiatives.

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Safety Culture Panel

Presented at the Advisory Committee on Reactor Safeguards Workshop on Safety Culture

By

Ashok Thadani, Director
Office of Nuclear Regulatory Research
Nuclear Regulatory Commission

June 12, 2003

Safety Culture - Background

- Policy Statement on Conduct of Operations (54FR3424) -1989
- SRM/SECY-02-00166 "Safety Conscious Work Environment"

Safety Culture Definition

- "... That assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance

Safety Culture - Research

- RES Organizational Factors Research (Mid-1980s - Mid-1990s)
- Example Reports:
  - PNL - "Organizational Analysis and Safety for Utilities With Nuclear Power Plants," NUREG/CR-3215 (1983)
  - BNL - "Influence of Organizational Factors on Performance Reliability," NUREG/CR-5538 (1991)

Safety Culture - International Activities

- IAEA
  - INSAG Guidance
  - Safety Culture Services
  - Technical Conferences
- OECD/NEA
  - Reports
  - SEGHOF
  - Technical Conferences

Safety Culture - International Activities

- UK – Licensing Condition 36
- Canada – CNRC Conducts Safety Culture Evaluations
- Sweden – SKI Issued General Safety Regulations Focusing on Quality of Key Processes for Safety
- France – IRSN Expects Written Commitment to Safety and SCWE
- Finland – Safety Culture Is Formally Included in Regulations
- Spain – Conducts Safety Culture Evaluations

Operating Event Analysis (NUREG/CR-6753)

- Human Performance Errors Determined for 37 Events Identified Through the ASP Program (92-97)
- Organizational Factors Contributed to a High Percentage of Events, As Exemplified by Errors in
  - » Design and Design Change Work Practices (81%)
  - » Maintenance Practices and Work Controls (76%)
  - » Management and Supervision (50%)

Safety Culture - Foreign Events

- Philippsburg-2
  - Emergency Borated Water Management Issues
- Brunsbuettel
  - Incomplete Feedback of Operating Experience
  - Operations Continued With Safety System Out of Order
- Tepco
  - Systematic Failure to Report Inspection Issues
- Dampierre
  - Procedures Not Strictly Followed
  - Operators Did Not Exhibit a Questioning Attitude
- Paks
  - Exaggerated Self-Confidence in Management
  - Overwhelming Enforcement in the Interest of Production

Safety Culture - Domestic Events

- IP-2
  - Inadequate Procedures
  - Re-qualifications Failures
  - Communications Problems
- Cooper
  - Cyclical Performance
  - Numerous Management Changes
- Millstone
  - Scwe
  - Lack of Trust in Management
- Davis-Besse
  - Safety Culture Identified As Root Cause

Conclusion

- Staff Has Been Monitoring and Evaluating International Activities Especially in Developing Objective Measures That Serve As Indicators of Plant Safety Concerns That Could Be the Result of Problems With Safety Culture
- Both Domestic and International Operating Experience Has Shown That Safety Culture Has Been an Important Influencing Factor in Significant Events
- It Is Important to Understand the Early and Persistent Signs of Deteriorating Safety Culture. This May Include Performance Indicators or Other Regulatory Guidance
- Staff Is Assessing Potential Follow-up Initiatives

2.1.2 Overview

Mr. Charles Dugger, Vice President of Nuclear Power Operations/Nuclear Energy Institute (NEI), presented NEI views on safety culture. He indicated that safety culture should start at the very top of an organization and it is a continuous challenge. Understanding safety culture requires a global look at an organization. Overall, the nuclear industry has done an excellent job of working on and improving safety culture. Mr. Dugger noted that some of the values of safety culture are maintaining equipment in top working order, finding problems and fixing them, recognizing employee's efforts, being self-critical, communicating effectively, and fostering professionalism.

Understanding safety culture, the global look, requires better communication, alignment with shared vision and goals, self-assessment and benchmarking against the best, staying current as the industry grows, human performance, industrial safety, and training. Safety culture is an amorphous concept and requires constant pressure and managing the changes.

Mr. Dugger stated that no new rulemaking is required and that overregulation can undermine good management practices. However, objectivity is not possible. Some of the measures that an organization can use to improve safety culture are plant performance indicators, corrective action categories, human performance indicators, surveys, and external oversight. Also included in the regulation are the baseline inspections, the reactor oversight process, the review of performance indicators, management visits, and inspector observations.

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Safety Culture

Chuck Dugger
Vice President, Nuclear Operations
Nuclear Energy Institute

Overview

- Safety Culture starts at the very top of an organization
- Safety Culture is a continuous challenge
- Understanding Safety Culture requires a global look at an organization
- Overall, the nuclear industry has done an excellent job of working on and improving Safety Culture

Overview

- There is a place for regulation with in the broad concept of Safety Culture
- We should not attempt to regulate actual Safety Culture

Start at the Top

- Safety must lead all other goals and objectives
- The values of an organization establish the basis for their Safety Culture

Values

- Operate the plant safely
- Maintain equipment in top working order
- Find problems and fix them once
- Recognize employee efforts
- Be self critical
- Communicate effectively
- Foster professionalism

Understanding Safety Culture
The Global Look

- Communications
- Alignment
- Self-assessment and Benchmarking
- Human Performance
- Industrial Safety
- Training

Communications

- Access to senior management
- Drilling into the organization
- Providing multi-forums for discussion
- Building relationships
- Management presence
- Employee concerns

Alignment

- Clay layers
- What should people understand?
- Shared vision and goals

Self-assessment and Benchmarking

- Assessing against the best
- Best practices
- Change management
- Staying current as the industry grows

Human Performance

- The second great step in plant improvements
- Where does it start?
- How do you know when you are getting it right?

Industrial Safety

- Much of our safety culture started here
- A good indicator of other things

Training

- This is where it all starts
- Behaviors in training
- Expectations and standards
- Carry the training forward

Safety Culture the Continuous Challenge

- Safety Culture is an amorphous concept
- Change must be managed
- Constant pressure
- Sensitive to change
- Sensitive to culture
- Sensitive to unions

Working on and Improving Safety Culture

- How does an organization measure Safety Culture?
- Plant performance indicators
- Corrective action categories
- Human performance indicators
- Surveys
- External looks

Regulation is Already There

- The baseline inspections
- Reactor oversight process
- Review of performance indicators
- Management visits
- Inspector observations

No New Rulemaking

- Focus on the results
- Review root causes
- Over regulation can undermine good management practices
- Objectivity is not possible
- Potentially leads to a minimum standard

2.1.3 Early Signs of Deteriorating Safety Performance

Dr. Thomas E. Murley, Safety Consultant, stated that safety culture was first introduced by the International Nuclear Safety Advisory Group (INSAG) in 1986. Safety culture refers to an organization's basic values, attitudes toward conservative operation, quality, and professionalism. Safety culture involves everyone whose attitude may influence nuclear safety, not only the utility operators but also the regulatory body.

Establishing an effective safety culture and recognizing related trends is still a recent initiative. As more studies are performed and experience is gained, the role of the regulator in promoting and evaluating safety culture will continue to evolve.

The accident at the TMI-2 plant in 1979 indicated that more attention should be paid to the human factor aspects of safety such as operator qualifications and training, emergency operating procedures, accident mitigation, and emergency planning. Safety culture must permeate all levels of an operating organization.

Some of the attributes of a good regulatory safety culture are a clear organizational commitment to the priority of safety matters, clear lines of responsibility within the regulatory body, a program of initial and continuing training to maintain regulatory staff competence, a personal commitment to safety from every staff member, clear guidance for conducting safety inspections and reviews, clear regulatory acceptance criteria, a commitment to regulatory intervention that is proportionate to the safety implications, and the use of risk insights in decisionmaking.

Dr. Murley indicated that it is not really possible to quantitatively measure safety culture. However, the regulator can monitor early signs of declining safety performance, before conditions become so serious that regulatory sanctions must be imposed. Most nuclear plants collect and publish a standard set of performance indicators such as automatic trips, system failures, forced outage rate, and collective radiation exposure. However, these are lagging indicators, and by the time negative trends in the performance indicators are evident, the plant is well into a stage of declining performance. Therefore, the regulator will have to look for signs of declining performance and subsequently evaluate whether there are signs of a weak safety culture, which may be the root cause of declining performance.

Signs of a potentially weak safety culture are ineffective plant management, ineffective work planning and programs, lack of self-assessment and quality assurance audits, lack of clear accountability and responsibility for fixing problems, management policy to dispute and defy the safety regulator, the practice of deferring regulatory commitments, isolation (no participation or exchanges of information with other plants), and complacency in industry activities with current performance.

Dr. Murley pointed out that the regulator has to find the proper balance between intervening too early or too late when signs of either a weak safety culture or actual declining performance are observed. If the intervention is to early, the operator may not agree on the nature and extent of the problems; if the intervention is too late, the declining performance may not be arrested before serious safety problems become evident.

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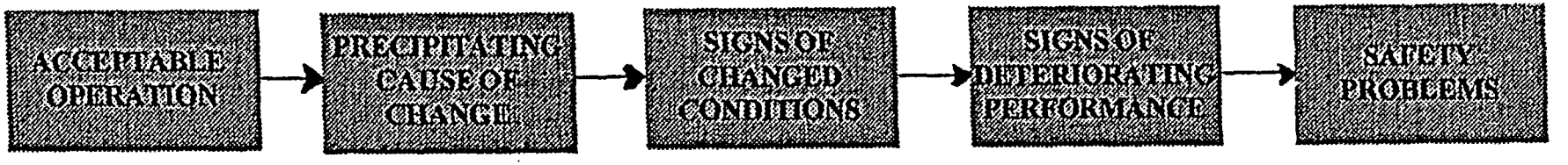
EARLY SIGNS OF DETERIORATING SAFETY PERFORMANCE

Thomas E. Murley

ACRS

June 12, 2003

DETERIORATING PERFORMANCE - MODEL



SOME PRECIPITATING CAUSES OF CHANGE

- NEW MANAGEMENT - INEFFECTIVE LEADERSHIP
- CHANGE IN MANAGEMENT PHILOSOPHY TO EMPHASIZE INCREASED PRODUCTION AND LOWER COSTS

COMPLACENCY DEVELOPS OVER TIME

- KNOWLEDGE AND SKILLS OF "NUCLEAR PIONEERS" IS NOT PASSED ON VIA PROCEDURES TO NEXT GENERATION
- AGING EQUIPMENT PROBLEMS OVERCOME THE MASKING EFFECTS OF HIGH PLANT CAPACITY FACTORS

EARLY SIGNS OF ACTUAL DETERIORATING PERFORMANCE

OPERATIONS

OPERATOR ERRORS DUE TO INATTENTION TO DETAILS
VALVE ALIGNMENT ERRORS
MISALIGNMENT OF ELECTRICAL AND MECHANICAL SYSTEMS
ERRORS IN CONTROL ROD MANIPULATIONS
OPERATOR ERRORS DUE TO TRAINING INADEQUACY
FAILURE TO PERFORM EQUIPMENT CHECKS AND SURVEILLANCES
FAILURE TO FOLLOW OPERATING PROCEDURES
DECISION-MAKING DOMINATED BY CONCERN FOR PRODUCTION
LARGE NUMBER OF EMPLOYEE GRIEVANCES
PLANT RESTART AFTER AN INCIDENT WITHOUT FULL ANALYSIS

EARLY SIGNS OF ACTUAL DETERIORATING PERFORMANCE

MAINTENANCE

LARGE BACKLOG OF OVERDUE MAINTENANCE WORK ITEMS
LARGE BACKLOG OF INOPERABLE EQUIPMENT
INADEQUATE CONTROL OF MAINTENANCE WORK
REACTOR TRIPS CAUSED BY MAINTENANCE ERRORS
LEAKING VALVES
POOR HOUSEKEEPING
POOR MATERIAL CONDITION OF PLANT EQUIPMENT
FAILURE TO FOLLOW MAINTENANCE PROCEDURES

EARLY SIGNS OF ACTUAL DETERIORATING PERFORMANCE

ENGINEERING DESIGN AND SAFETY ANALYSIS

PLANT CHANGES NOT INCORPORATED INTO DESIGN BASIS DOCUMENTS
INADEQUATE QUALIFICATION OF EQUIPMENT FOR ACCIDENT CONDITIONS
INADEQUATE FIRE PROTECTION DESIGN AND EQUIPMENT QUALIFICATION
SUPERFICIAL EVALUATION OF ANOMALOUS EQUIPMENT BEHAVIOR
INADEQUATE RESPONSE TO OPERATING EXPERIENCE OF OTHER PLANTS
LARGE BACKLOG OF DESIGN CHANGE MODIFICATIONS
INADEQUATE SUPPORT OF OPERATORS WITH TIMELY SAFETY ANALYSES
POOR PREPARATION OF PLANT MODIFICATIONS

EARLY SIGNS OF ACTUAL DETERIORATING PERFORMANCE

RADIOLOGICAL CONTROLS

POOR PLANNING OF RADIOLOGICAL PROTECTION FOR MAINTENANCE WORK

INADEQUATE RADIOLOGICAL POSTING OF WORK AREAS

WORKER OVEREXPOSURE

INADEQUATE RADIOLOGICAL TRAINING OF WORKERS

WEAK ALARA PROGRAM

UPWARD TREND IN COLLECTIVE RADIATION EXPOSURE

EARLY SIGNS OF ACTUAL DETERIORATING PERFORMANCE

OUTAGE ACTIVITIES

POOR PLANNING OF WORK ACTIVITIES

POOR CONTROL OF WORK ACTIVITIES THROUGHOUT THE SITE

FAILURE TO MAINTAIN ADEQUATE SHUTDOWN COOLING

HIGH COLLECTIVE RADIATION EXPOSURE

POOR INDUSTRIAL HEALTH AND SAFETY RECORD

EARLY SIGNS OF ACTUAL DETERIORATING PERFORMANCE

ACCIDENT PRECURSOR ANALYSIS

FAILURE TO RECOGNIZE POTENTIAL ACCIDENT PRECURSORS

NO FORMAL PROGRAM FOR ANALYZING OPERATING EVENTS

EARLY SIGNS OF ACTUAL DETERIORATING PERFORMANCE

REGULATORY RELATIONS

LONG DELAYS OR FAILURE TO MEET REGULATORY COMMITMENTS

FAILURE TO MAINTAIN OPERATION WITHIN CURRENT LICENSING BASIS

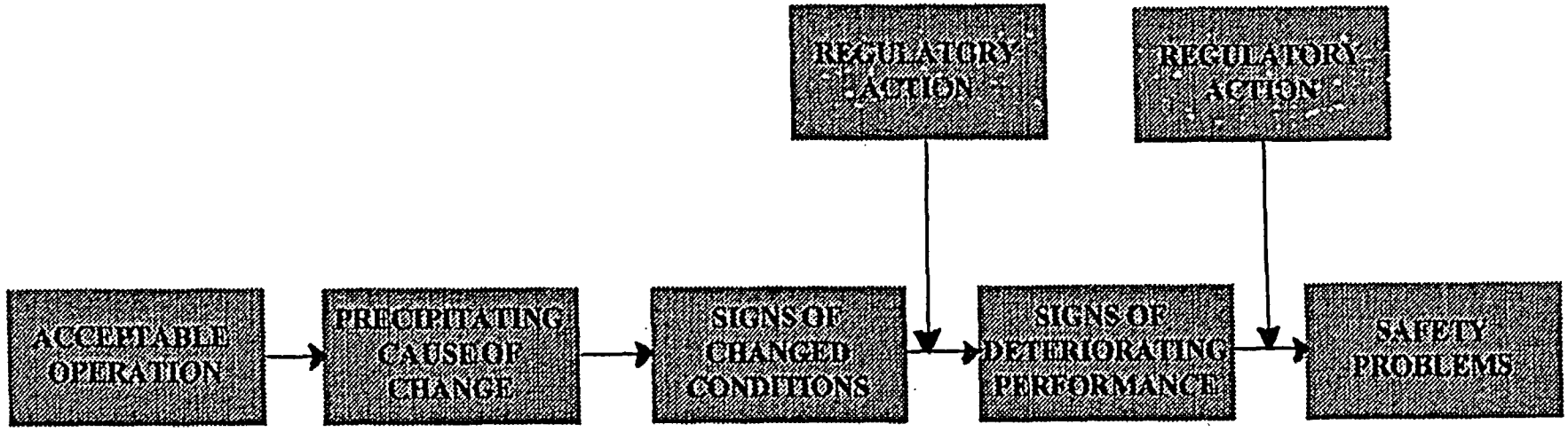
INADEQUATE RESPONSE TO REGULATORY CORRESPONDENCE

POSSIBLE REGULATORY ACTIONS

A) WHEN SEVERAL SIGNS OF ACTUAL DECLINING PERFORMANCE ARE PRESENT BUT THE PLANT APPEARS TO BE OPERATING SMOOTHLY. (THE MASKING EFFECT OF HIGH CAPACITY FACTORS)

B) WHEN SEVERAL SIGNS ARE PRESENT AND THEY CLEARLY POINT TO POTENTIAL SAFETY PROBLEMS

DETERIORATING PERFORMANCE - MODEL



POSSIBLE EARLY REGULATORY ACTIONS WHEN SIGNS POINT TO SAFETY CULTURE PROBLEMS

- SENIOR ON-SITE INSPECTORS LOOK FOR EARLY SIGNS
- ENHANCED DIAGNOSTIC TYPE TEAM INSPECTIONS
- CRITICAL PERFORMANCE EVALUATIONS
- SENIOR MANAGEMENT MEETINGS BETWEEN REGULATOR AND OPERATOR

POSSIBLE REGULATORY ACTIONS FOR DECLINING PERFORMANCES

THOROUGHLY DOCUMENT THE SIGNS OF DECLINING PERFORMANCE IN INSPECTION REPORT

CRITICAL PERFORMANCE EVALUATION

SENIOR MANAGEMENT MEETINGS BETWEEN REGULATOR AND OPERATOR

LICENSE CONDITIONS

ORDERS OR DIRECTIONS TO PLANT OPERATORS

THE ROLE OF THE NUCLEAR REGULATOR IN PROMOTING AND EVALUATING SAFETY CULTURE

ACRS

June 12, 2003

T. Murley

IMPORTANCE OF SAFETY CULTURE TO NUCLEAR SAFETY

WE NOW KNOW THAT A GOOD SAFETY CULTURE IS ESSENTIAL FOR OVERALL NUCLEAR SAFETY

SAFETY CULTURE MUST PERMEATE ALL LEVELS

- CORPORATE MANAGEMENT
- PLANT MANAGEMENT
- OPERATING STAFF

ROLE AND ATTITUDE OF REGULATOR

THE OPERATOR HAS THE SOLE RESPONSIBILITY FOR SAFELY OPERATING THE NUCLEAR POWER PLANT

THE REGULATOR HAS THE RESPONSIBILITY FOR INDEPENDENTLY ASSURING THAT NUCLEAR PLANTS ARE OPERATED SAFELY

THE RELATIONSHIP BETWEEN REGULATOR AND OPERATOR CAN INFLUENCE THE OPERATOR'S SAFETY CULTURE EITHER POSITIVELY OR NEGATIVELY

ROLE AND ATTITUDE OF REGULATOR

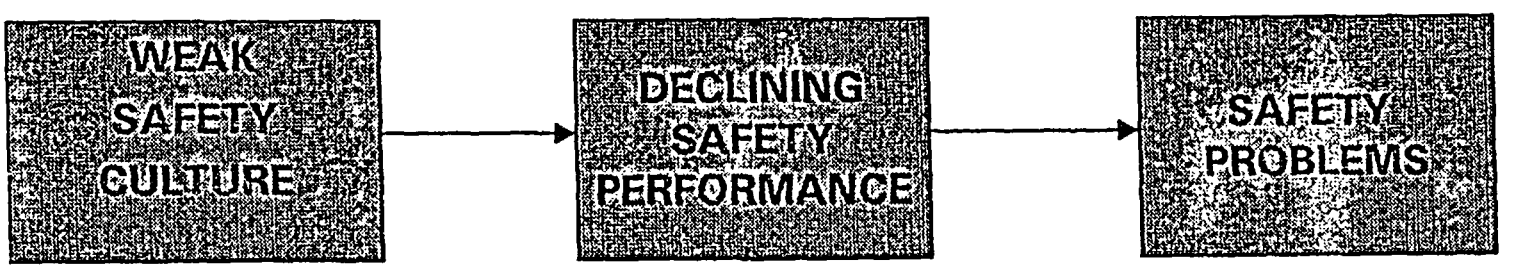
A REGULATORY BODY SHOULD SET A GOOD EXAMPLE IN ITS OWN PERFORMANCE

- TECHNICALLY COMPETENT
- SET HIGH SAFETY STANDARDS FOR ITSELF
- GOOD JUDGMENT IN REGULATORY DECISIONS
- DEAL WITH OPERATORS IN PROFESSIONAL MANNER

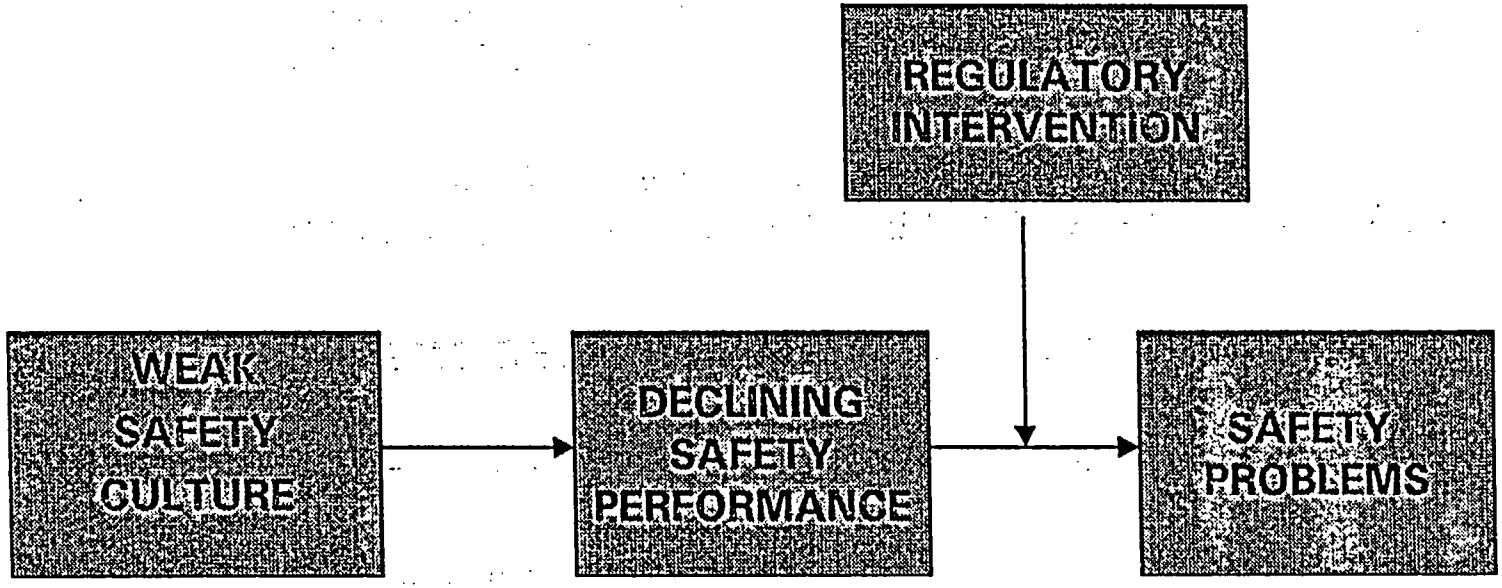
SOME ATTRIBUTES OF A GOOD REGULATORY SAFETY CULTURE

- A CLEAR ORGANIZATIONAL COMMITMENT TO PRIORITY OF SAFETY MATTERS
- CLEAR LINES OF RESPONSIBILITY WITHIN THE REGULATORY BODY
- A PROGRAM OF INITIAL AND CONTINUING TRAINING TO MAINTAIN REGULATORY STAFF COMPETENCE
- A PERSONAL COMMITMENT TO SAFETY FROM EVERY STAFF MEMBER
- GOOD COMMUNICATION AND COORDINATION BETWEEN ORGANIZATIONAL UNITS OF THE REGULATORY BODY
- CLEAR GUIDELINES FOR CONDUCTING SAFETY REVIEWS
- CLEAR REGULATORY ACCEPTANCE CRITERIA
- A COMMITMENT TO TIMELY REGULATORY DECISIONS, AND
- A COMMITMENT TO REGULATORY INTERVENTION THAT IS PROPORTIONATE TO THE SAFETY CIRCUMSTANCES

REGULATORY EVALUATION MODEL



REGULATORY INTERVENTION TO LOOK FOR DECLINING PERFORMANCE



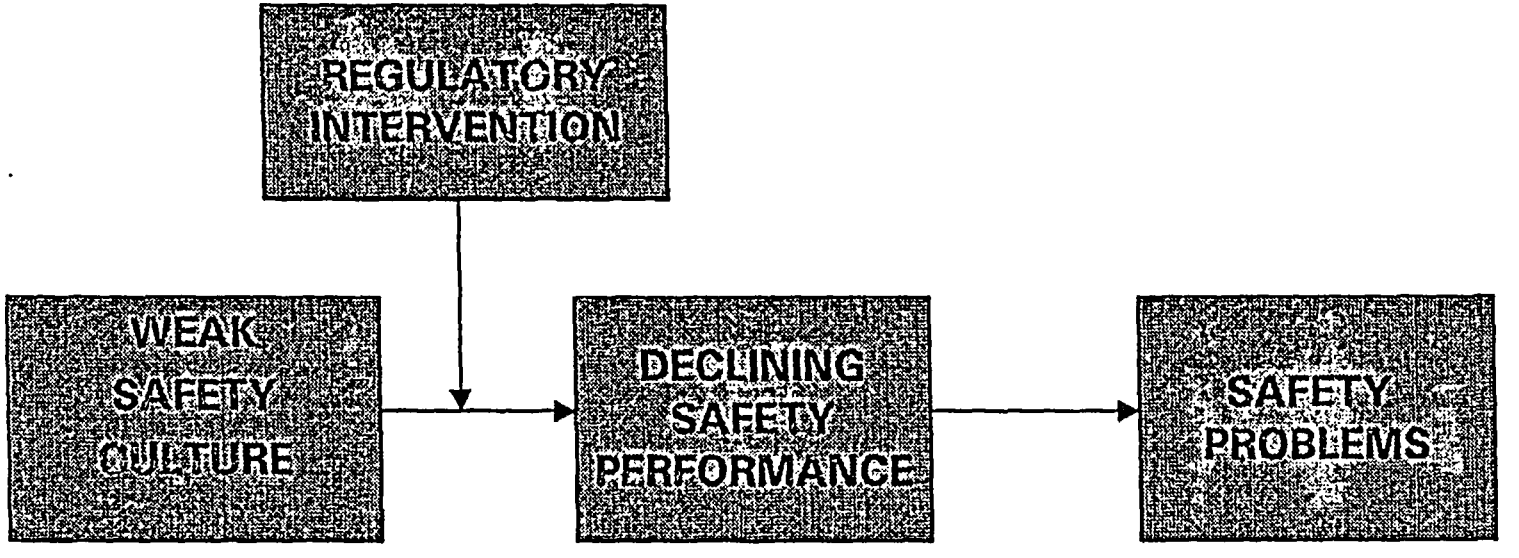
PERIODIC SAFETY ASSESSMENT

- OBSERVATIONS BY SITE INSPECTORS AND SPECIALIST INSPECTORS
- REVIEWS BY REGULATORY SAFETY SPECIALISTS
- REVIEWS OF TRENDS IN EVENT REPORTS BY THE OPERATOR
- REVIEW OF THE EFFECTIVENESS OF OPERATOR'S CONTROLS TO IDENTIFY, CORRECT AND PREVENT PROBLEMS
- REVIEW OF WORK BACKLOG AND DELAYS IN IMPLEMENTING PRESCRIBED ACTIONS
- ASSESSMENT OF DAY-TO-DAY INCIDENTS

EARLY SIGNS OF DETERIORATING PERFORMANCE

- OPERATIONS
- MAINTENANCE
- ENGINEERING DESIGN AND SAFETY ANALYSIS
- PLANT DOCUMENTATION
- RADIOLOGICAL CONTROLS
- OUTAGE ACTIVITIES
- EVENT ANALYSIS
- REGULATORY RELATIONS

REGULATORY INTERVENTION TO LOOK FOR WEAK SAFETY CULTURE



SIGNS OF WEAK SAFETY CULTURE

- MANAGEMENT
- PROGRAMS
- SELF-ASSESSMENT
- ACCOUNTABILITY
- REGULATORY RELATIONS
- ISOLATION
- ATTITUDES

REGULATORY RESPONSE STRATEGIES

GRADUATED APPROACH OF ESCALATING REGULATORY ATTENTION

- SPECIAL SURVEILLANCE
- MEETINGS WITH PLANT MANAGEMENT
- MEETINGS WITH TOP CORPORATE MANAGEMENT
- OFFICIAL CORRESPONDENCE
- POSSIBLE ENFORCEMENT SANCTIONS

2.1.5 Comments on Collective Understanding of Safety Culture

Mr. Howard C. Whitcomb III, Attorney at Law, stated that the concept that an "appropriate safety culture" is a necessary ingredient for the safe operation of a nuclear facility is not new. The contribution of safety culture to the effective material condition management of nuclear plant equipment has been known for over two decades. The NRC and the nuclear industry have wrestled with plant cultural issues since the TMI accident in 1979. The discovery of the seriously corroded reactor vessel head at the Davis-Besse in February 2002 is the most recent reminder of the safety and economic consequences of a lack of genuine commitment to the safe operation of a nuclear reactor. The problems at Davis-Besse resulted from a lack of technical competence and management integrity. The degraded reactor vessel head is only a symptom of those problems.

Mr. Whitcomb discussed some aspects of the issue. For example, an appropriate safety culture mandates the existence of a proactive maintenance regimen for all plant equipment (regardless of classification), thereby eliminating, or at least reducing, the number of premature end-of-life component failures. As a 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. Another element of safety culture is that employees are confident that their concerns affecting the material condition of plant equipment will be expeditiously addressed and resolved. As a corollary, an appropriate safety culture does not exist in an environment or climate where equipment concerns are afforded disproportionate consideration.

Mr. Whitcomb stated that the ingredients for a desirable safety culture include management leadership, personnel integrity, technical competence, personal reliability, and two-way communications.

2.1.6 Organization Half-Life, The Un-Monitored Disintegration in Reactor and Public Safety

Mr. William Kiesler, President, Nuclear Maintenance Integration Consultants Corporation (NuMIC), discussed the attributes of safety culture. He stated that safety 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. The organization's half-life (an analogy from radioactive decay) is a characteristic that becomes visible when it is ignored. This half-life must be proactively managed to prevent material condition degradation.

The lack of safety culture at a nuclear plant does not mean there is no culture. At Davis-Besse, the culture was one of systemic refusal to perform requisite maintenance. Davis-Besse had a distinctive organization half-life regarding reactor and public safety issues that must not be ignored. As the nuclear industry postured towards risk-based management, the culture at Davis-Besse was inappropriately not factored.

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 is cause-and-effect scenarios between human behaviors and structures, systems and components. NuMIC concluded that:

- Nuclear safety culture is an integration of high ethical standards and technical competence.
- Overall margin of safety is a combination of personnel integrity and equipment material condition.
- The organization recognizes that the degradation of material condition is a function of wear, aging, and culture.
- Proactive material condition control is a strategic byproduct 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
- Operations, maintenance, and engineering are enterprise-wide, interrelated functions, not merely departments.

Mr. Kiesler concluded by stating that the ACRS should demand the research, development, and codification of standards which marry organizational culture and nuclear plant material condition. In addition, it should demand that a nuclear industry code of ethics be created and formally promulgated through training of all nuclear plant personnel.

Presentation To The

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Nuclear Safety Workshop
June 12, 2003 * Rockville, MD

COMMENTS ON
COLLECTIVE UNDERSTANDING OF SAFETY CULTURE

By
Howard C. Whitcomb, III, Esq.

and

ORGANIZATION HALF-LIFE

The Un-Monitored Disintegration in Reactor and Public Safety

By
William N. Keisler
Nuclear Maintenance Integration Consultants

COMMENTS ON
COLLECTIVE UNDERSTANDING OF SAFETY CULTURE
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
JUNE 12, 2003
ROCKVILLE, MD

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

Technical & Management Competence

Emotional Stability / Safety Conciousness

Individual Performance • Accountability

Organization Half-Life Management

PHYSICAL MATERIAL CONDITION

Engineered Design Bases

As-Built Structures, Systems & Components

Configuration Management

Material Condition Management

FIGURE 2

NUCLEAR PLANT PHYSICAL INTEGRITY (MATERIAL CONDITION)

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

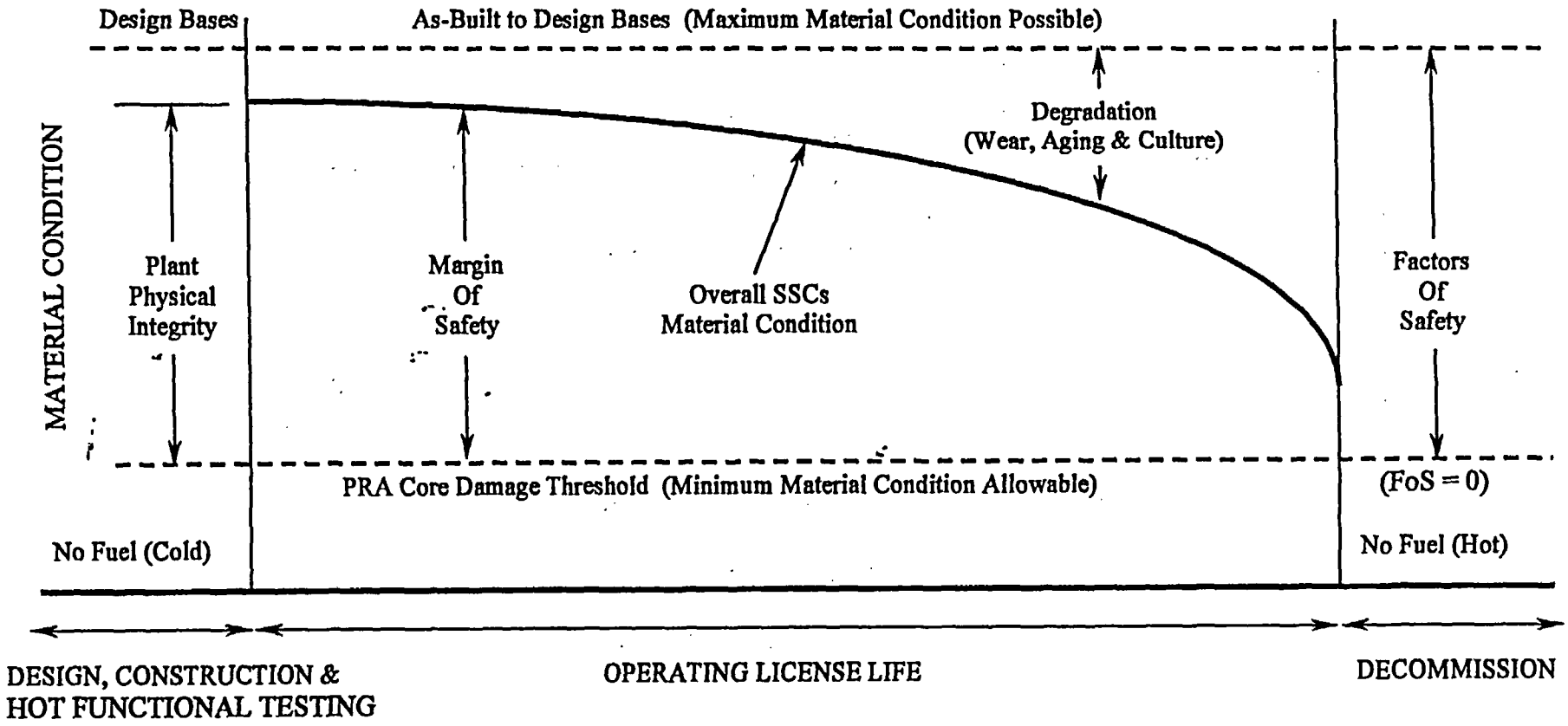


FIGURE 3

CONCURRENT MANAGEMENTS
For
MATERIAL CONDITION MANAGEMENT

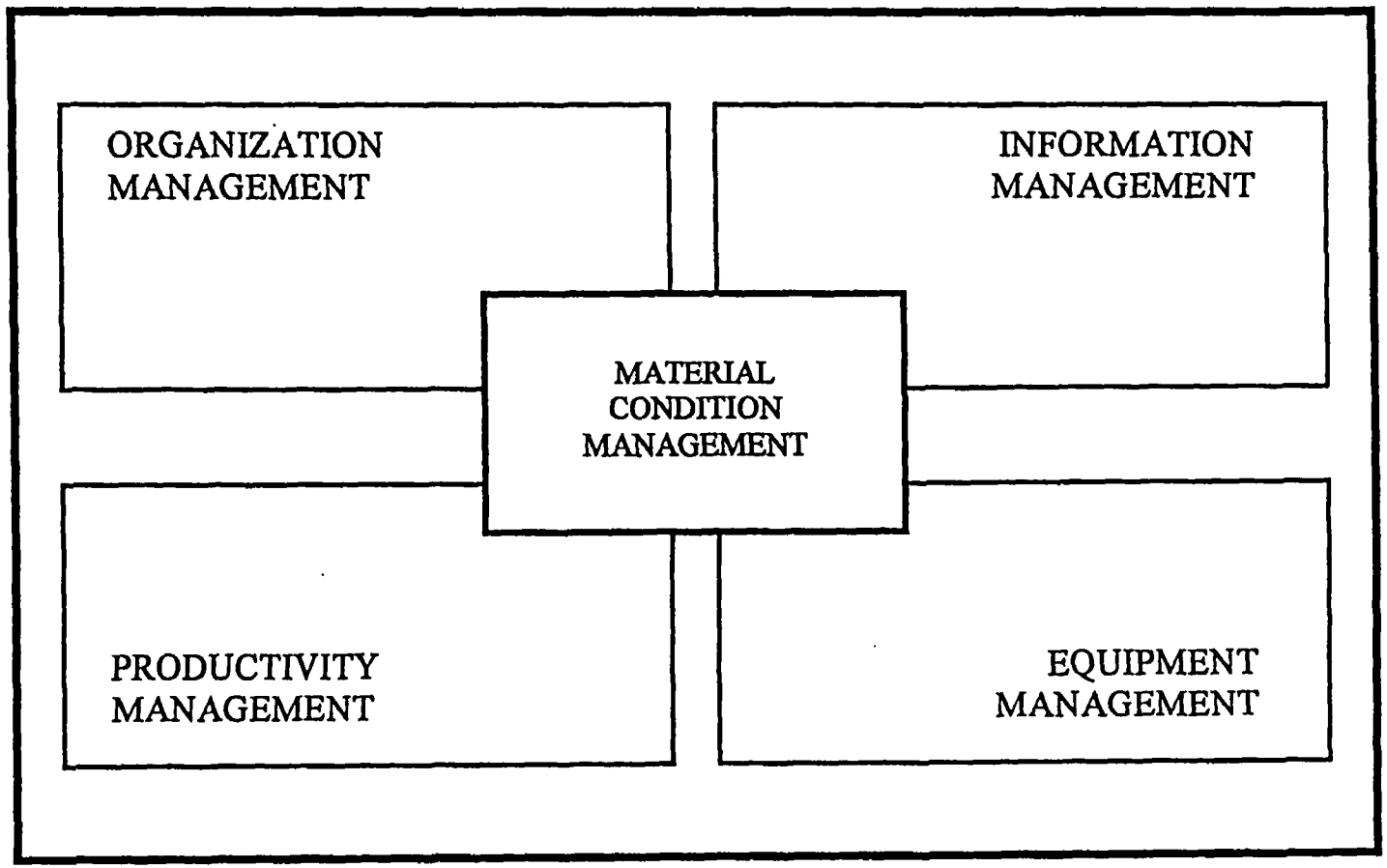
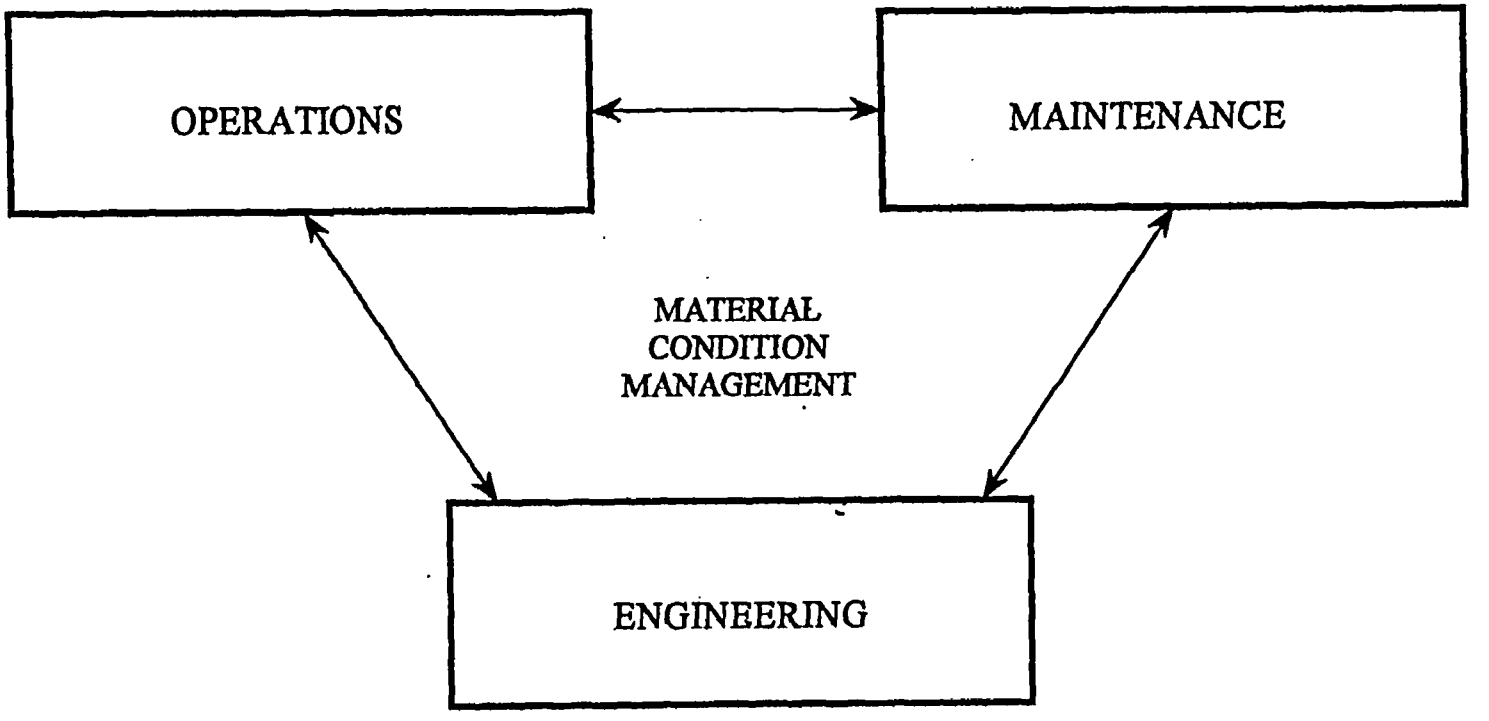


FIGURE 4

ENTERPRISE-WIDE FUNCTIONS
For
MATERIAL CONDITION MANAGEMENT



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2.1.7 Managing Safety Culture

Mr. David Collins, Engineering Analyst, briefed the Committee regarding the management of safety culture. He stated that the results of an Institute of Nuclear Power Operation (INPO) study suggest that the root causes of 70% of the most significant operating events are insufficient appreciation of risks, insufficient questioning attitude toward these risks, and a nonconservative approach to reactor safety. Mr. Collins quoted former NRC Chairman Richard Meserve as follows: "the term safety culture has not been crisply defined...given that the concept is not crisply defined, it is not surprising that neither the NRC nor other organizations have found an unambiguous way to measure it."

Mr. Collins also quoted MIT Professor Edgar Schein: "One could argue that the only thing of real importance that leaders do is to create and manage culture...." A new definition of safety culture could be: "A leadership attitude that ensures a hazardous technology is managed ethically so individuals and the environment are not harmed."

Mr. Collins discussed several key concepts in managing safety culture. He emphasized that to manage safety culture you have to be able to measure it, and to measure something you have to be able to define it. Deregulation and competition have created a need in the industry for adaptive cultures. The determinants of safety culture are the ethical attitudes of trust, care, and commitment to excellence.

Mr. Collins noted that the key to effective safety culture assessment is the institutionalization of a regular dialog with workers. Creating an objective, risk-based management method for safety culture requires developing a baseline of data from U.S. plants. Plants need INPO and the NRC to do better safety culture assessments. Mr. Collins said that Davis-Besse is probably no worse than many other operating plants.

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Managing Safety Culture

Dave Collins
Engineering Analyst
June 2003

Why Manage SC?

INPO 02-005 Analysis of 20 SOE's

Root Cause for 70% of the most significant operating events:

- insufficient appreciation of risks
- insufficient questioning attitude toward these risks.
- non-conservative approach toward reactor safety.

Key Concept 1

To *manage* something you have to be able to *measure* it.

To *measure* something you have to be able to *define* it.

Defining Safety Culture

Former NRC Chair Richard Meserve

2002 INPO CEO Conference:

"The term safety culture has not been crisply defined... given that the concept is not crisply defined, it is not surprising that neither the NRC nor other organizations have found an unambiguous way to measure it."

Topics: Safety Culture

- Defining
- Creating
- Destroying
- Measuring
- Managing

Defining Safety

Ethics is caring about people

Safety is caring that no physical harm comes to people

So Safety is a type of Ethical Behavior

Defining Culture

The Simplest Definition Of Culture:

"The Way We Do Things Around Here"

What Creates Culture?

MIT Professor Dr. Edgar Schein:

"...one could argue that the only thing of real importance that leaders do is to create and manage culture..."

Creating Org Safety Culture

Leadership attitude of ethical management

- Reinforce clear expectations for ethical behaviors within the org
- Demonstrate ethical behavior themselves

Key Concept 2

A New Definition for Safety Culture:

A leadership attitude that ensures a hazardous technology is managed ethically so individuals and the environment are not harmed

Safety Culture Champion

Dr. Jonathan Wert, President Management Diagnostics Inc, Consultant to the Nuclear Industry:

"There must be a champion for Nuclear Safety Culture. The CNO or President should be that champion. Leadership drives the culture."

MDI-WERT.COM

Determinants of a Healthy NSC

Trust

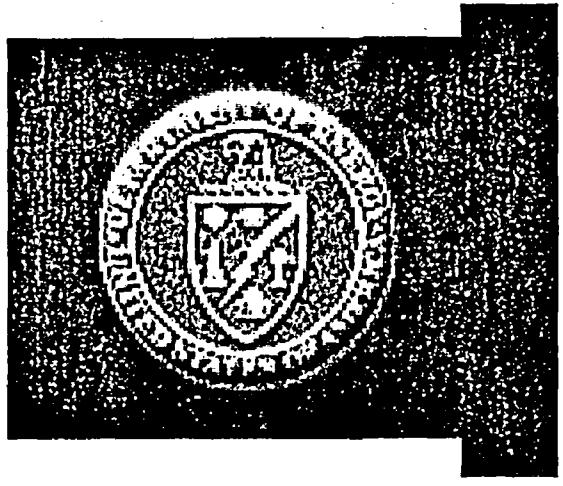
- Doing The Right Thing
- Millstone Recovery
- John Carroll MIT
- Rickover's "saydo":
- Dominion Reactor Head Replacements

Dominion
It all starts here:

Safety Culture Management

Determinants of a Healthy NSC

Commitment to Excellence



- Rickover's "rising standards of excellence"
- INPO's "excellence in human performance
- Olivier's "best of the best" program

Determinants of a Healthy NSC

Dominion
It all starts here:

Care and Concern

Herb Kelleher, CEO SW Airlines

- "Take care of the employees, and they will take care of the company"
- Millstone Lee Olivier
- Dominion's work / life balance, Thomas Capps, James O'Hanlon, Alan Price

Key Concept 3

Determinants

The determinants of a safety culture are the Leadership demonstrated ethical attitudes (behaviors) of:

- Trust
- Commitment to Excellence
- Care

The Need for Adaptive Cultures

An adaptive culture is one that maintains a proper safety focus as production becomes more and more lean

Strategic Management Textbook by Thompson and Strickland:

"The outstanding trait of an adaptive culture is that top leadership demonstrates genuine care for the well-being of all key constituencies"

Key Concept 4

Adaptive Cultures

Deregulation and the resulting competitive forces have created a need in our industry for adaptive cultures

The most important determinant of an adaptive culture is having top leadership that demonstrates genuine care for the well-being of all key constituencies

What Destroys Safety Culture

7/02 John Beck's final Safety Culture comments to Millstone leadership:

"Never forget that previous management failed so miserably, not because they were not intelligent and not because they did not understand clearly what successful economics looked like in a competitive environment.

They failed because they were arrogant, dismissive and refused to listen to the issues and concerns of the people who make this place run."

What Destroys Safety Culture

- NU CNO
  - We can no longer afford to be a Cadillac, we must become more like a Chevy (commitment to excellence)
  - If it is not absolutely necessary to do something, it is necessary to not do it (commitment to excellence)
  - We have to do things differently now to be competitive. If you don't like it, there are 100 people right outside that door waiting to take your place (care and concern)
  - Employee responded: "what about company loyalty to employees?"
  - CNO: "if you want loyalty, I suggest you get a dog." (trust, care)
- NU Board of trustees:
  - "we never saw the 14 different reports on the pervasive shoot the messenger attitude within the nuclear org" (lack of care – or lack of culture metrics?)

What Destroys Safety Culture

- DB Root Cause Analysis Report:
  - "Operators believed the keys to the plant had been taken away from them" (trust, care, commitment to excellence)
  - "Management behavior demonstrated an active disregard for the authorities and responsibilities of licensed personnel" (trust, care)
- INPO Findings
  - Weaknesses in boric acid control program (trust, excellence)
  - General decline in plant performance and Considerable pushback from the plant staff (trust, excellence)
- FENOC CEO Peter Berg
  - "Indications were that DB was a strong performing plant…capacity factor of 99.7% in 2001…500 day run…5.5 million hours no lost-time accident…that didn't raise any red flags with us, would it with you?" (lack of care – or lack of culture metrics?)

Measuring Safety Culture

Metrics: how do you measure this stuff?

What to Measure

Leadership Skills

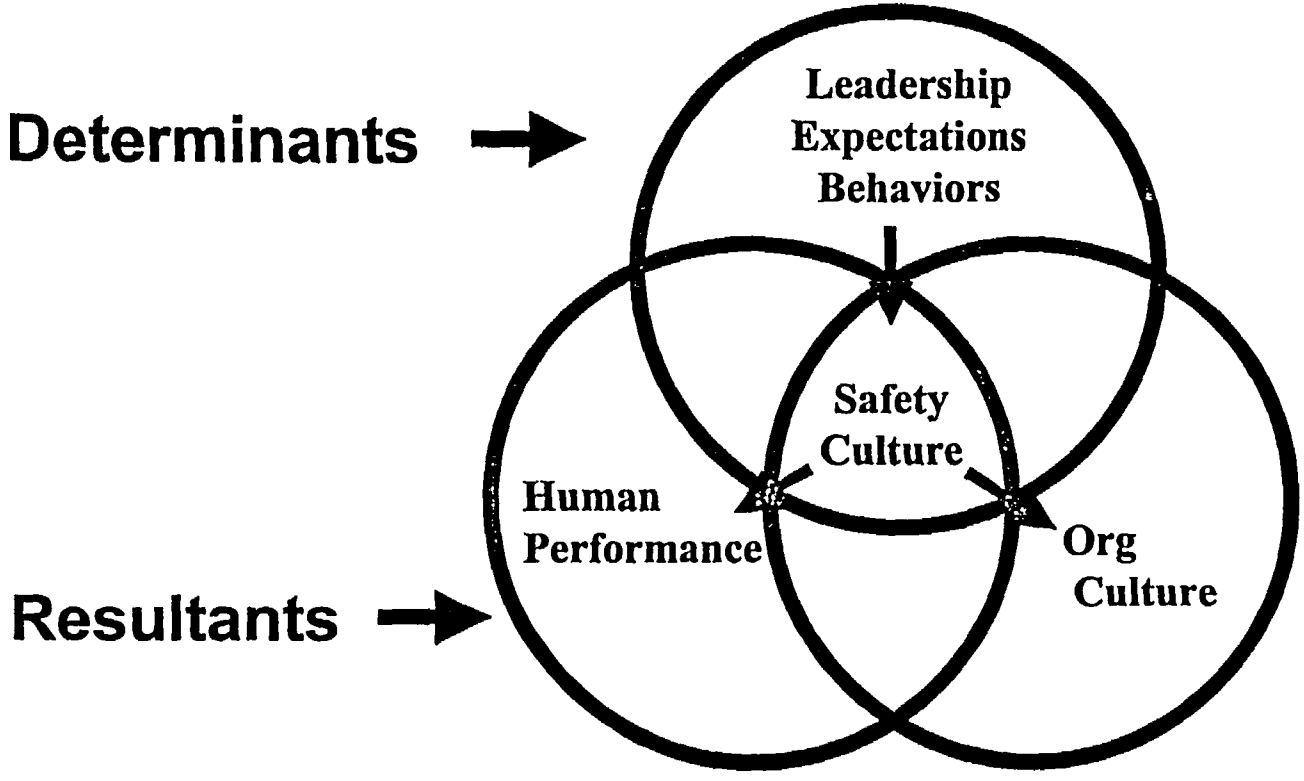
INPO SOER on Davis Besse:

- Assess that your organization has the leadership skills to maintain the proper focus on safety
- Identify long term unexplained abnormal conditions

Measuring Leadership Skills

Lou Holtz:
"If you want to know if you have a good leader, you need to ask three questions:
- **Can I trust you?**
- **Are you committed to excellence?**
- **Do you care about me?"**

Measuring Leadership Skills



Safety Culture Management

Measuring Leadership Skills

John Sorensen, author of NUREG 1756 "Safety Culture – A Survey of the State of the Art"

David –

I think the idea of using leadership culture as a surrogate for safety culture is a good one. I think there is a reasonable chance that management could accept the kind of measurement you are proposing. The importance of suitable metrics shouldn't be underestimated. You have laid out a very promising approach. I think it has a good chance of advancing the "state-of-the-art".

Measure the Determinants to Manage

Determinants → Function → Resultants

Diet
Exercise → Body Fitness → Weight
Body Fat
BP

Leadership
Behavior
Attitudes → Culture Fitness → Org Culture
LOWs
HP

Safety Culture Management

Key Concept 5

Managing Culture

HP and Org Culture behaviors are the resultants of the safety culture.

To manage Safety Culture it is Leadership Behaviors, the determinants, that need to be measured and controlled.

Where to Get Information

Listening to the Worker

INPO HP Fundamentals:

- The worker is the best source of information about the weakness of the organization.
- Finding and eliminating LOWs improves dramatically when worker feedback and communication are encouraged.

Institutionalize Dialogs

Dr. John Carroll of MIT

- Institutionalize surveys and dialogs with workers
- Establish criteria for culture performance
- The survey itself is almost irrelevant, it's the conversations around the survey and the actions based on those conversations that are important

Key Concept 6

The Key To Effective
Safety Culture Assessment:

Institutionalizing Dialogs With Workers

Methods for Measuring

INPO:

- Develop approaches for institutionalizing worker feedback

Plant - Institutionalize Surveys and Dialogs with Workers

- Identify leadership behavior
- Identify long-standing LOWs
- Identify constraints
- Identify attitudes

Methods for Managing

INPO

- Promote HP Leadership and Org training
- Promote training above CNO level

Plant

- Improve Leadership Behavior
- Improve CAP
- Improve resources

NRC

- Monitor Leadership Behavior
- Monitor risk of LOWs
- Use ROP PI's

Methods for Oversight: ROP

ROP Oversight

July 9, 2001 ACRS ROP meeting,

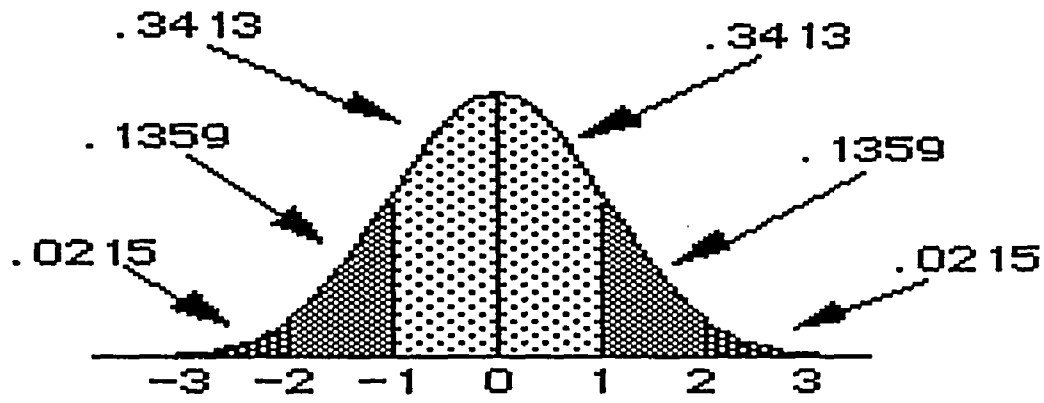
Mr. Johnson of ROP:

> The problem was ... we predicated, about 15 out of the last 4 of them, you know, we over-predict.

Methods for Oversight: ROP

Perform objective, risk-based safety culture assessments:

- Plot LOW Risk (quantity, significance, time) for all U.S. plants on a normal distribution
  - Upper tail is Resource problems
  - Lower tail is Reporting problems



Key Concept 7

Creating an objective / risk-based management method for SC requires developing a baseline, which requires analyzing LOW data from U.S. plants.

Summary of Key Concepts

- To manage something you have to be able to measure it. To measure something you have to be able to define it.
- Safety Culture is a leadership attitude that ensures a hazardous technology is managed ethically, so that individuals and the environment are not harmed
- Deregulation and competition has created a need in our industry for adaptive cultures
- The determinants of safety culture are the ethical attitudes of Trust, Care and Commitment to Excellence

Summary of Key Concepts

- HP and Org Culture behaviors are the resultants of the safety culture. To manage Safety Culture, it is Leadership Behavior that must be measured and controlled.
- The key to effective safety culture assessment is the institutionalization of regular dialogs with workers
- Creating an objective / risk-based management method for SC requires developing a baseline of LOW data from U.S. plants.

Conclusion

- Plants need INPO and the NRC to do better SC, CAP assessments
- DB SC is probably no worse than many other plants out there
- Everyone who manages nuclear should be trained in SC (fostering and assessment) especially above the CNO level
- SC and CAP assessments affect:
  - Availability of plant resources
  - SOE risk
  - Quality of work life

ACRS Safety Culture Comments

5/02 ACRS Meeting

MR. ROSEN: I don't want to be here three years from now with another plant, XYZ plant, that's had a serious incident, maybe even an accident, whose root cause was the same kind of safety culture deficiencies that happened at Davis-Besse.

MR. APOSTOLAKIS: Yes, of course.

MR. ROSEN: And that we didn't do something different. That we just saw Davis-Besse, knew what the root cause was and safety culture and said "Okay, we'll just keep doing the same regulatory stuff we have now."

CHAIRMAN BONACA: Exactly. Exactly.

MR. ROSEN: Because what that is is an embodiment of the commonest definition of insanity, right? Doing the same thing over and over and expecting different results.

MR. APOSTOLAKIS: I'm with you. I'm with you.

End

Supplementary info follows

DB – What INPO Knew

- INPO knew of weaknesses in Davis-Besse's boric acid control program, and about a history of industry events dealing with boric acid corrosion of carbon steel dating back many years, but did not know about or suspect the extent of damage to the reactor vessel head.
- INPO knew of technical and organizational factors that Davis-Besse had experienced over time that ultimately contributed to the event, but did not assemble the pieces into a whole picture.
- INPO knew about a general decline in plant performance based on plant assessments, and that there had been considerable pushback from the plant staff on evaluation issues. However, INPO did not conclude that there was a degradation in safety culture at the plant.

What INPO is Planning

- A case study of the Davis-Besse event, with emphasis on management and leadership issues.
- Emphasis on the term "safety culture," not in terms of "good" or "bad," but a healthy discussion of the broad continuum between these extremes.
- Changes in a number of processes, such as more extensive outage observations and plant walk-downs, better follow-up of long-standing issues and a more focused look at how plants use operating experience.

Culture Comments

6/02

Millstone Senior Resident NRC Inspector Tony Cerni:

"Nothing was ever put in place after recovery to prevent what occurred here in 1996 from happening again either at Millstone or somewhere else in the industry"

Culture Comments

July 9, 2001 ACRS meeting, discussing SC and the ROP

MR. ROSEN: ...a plant that has a good safety culture, in my view, can go to people in the plant and they understand what's important about what controls risk at the plant, and what they do in their jobs that effects risk. And that's another big piece of the safety culture, you know, that you don't measure now and I think needs to be thought about. You talked about corrective action programs and thinking about coming up with appropriate guidance for them Well, I think that exists. I think the INPO performance objectives and

Culture Comments

- Mike Sellman, president and CEO of Nuclear Management Company, on the CEO's role in building a strong safety culture in a multiple plant environment:
- "If you leave operators in the control room with poor procedures and an incentive plan focused on earnings per share and budget reduction, the next time you say 'safety first,' operators are going to think it's just a act."

Culture Comments

7/02 John Beck's final Safety Culture comments to Millstone leadership:

" Never forget that previous management failed so miserably, not because they were not intelligent and not because they did not understand clearly what successful economics looked like in a competitive environment.

They failed because they were arrogant, dismissive and refused to listen to the issues and concerns of the people who make this place run."

Culture Comments

Oliver Kingsley, president and chief executive officer, Exelon Generation:

" Safety is a result of fundamentals that are always followed no matter what the situation is. It's a culture of high standards, high expectations and sound fundamentals that are well executed."

(EXCELLENCE)

Culture Comments

Steven Covey
Principle-Centered Leadership
Trust:

- **Most of us work and live in environments that are rather hostile to the development of conscience. I've heard executives say that they can't win this battle of conscience because expediencies require lies, cover-ups, deceit or game playing. That's just part of the job, they say. I disagree. I think such rationalization undermines trust within their cultures.**

Culture Comments

Steven Covey Principle-Centered Leadership Arrogance:

- "With the humility that comes from being principle-centered, we can better learn from the past, have hope for the future, and act with confidence, not arrogance, in the present. Arrogance is the lack of self-awareness; blindness; an illusion; a false form of self-confidence; and a false sense that we're somehow above the laws of life. Real confidence is anchored in a quiet assurance that if we act based on principles, we will produce quality-of-life results."

Endorsements

David –

I think the idea of using leadership culture as a surrogate for safety culture is a good one. I think there is a reasonable chance that management could accept the kind of measurement you are proposing. The importance of suitable metrics shouldn't be underestimated. You have laid out a very promising approach. I think it has a good chance of advancing the "state-of-the-art".

John Sorensen, author of NUREG 1756 "Safety Culture – A Survey of the State of the Art"

Endorsements

June 1999

David -

I resonate with your formulation of trust as both "trust in their values" and "trust in their competence", i.e., trust that they care ... trust that they will act effectively and consistently with these values to get things done. I hope they elevate SCWE and leadership to where there can be regular assessments and reflective conversations around those assessments.

Dr. John Carroll, Professor of Behavioral and Policy Sciences, MIT Sloan School of Management.

Endorsements

August 2002

Dave,

Very good stuff. Your tool, used intelligently, could be of benefit to management if they chose to take advantage of it. If nothing more, it would reinforce the already existing knowledge of where the "hot spots" were and why.

John Beck, President Little Harbor Consulting,

Safety Culture Consultant for Millstone Recovery

Endorsements

Hi Dave,

I'm impressed with your work - it's well thought out and has a fair amount upside benefit if it can be implemented.

Dr. Michael Quinn, Nuclear Culture Consultant, Head of the Employee Task Force Study of the Millstone culture

Endorsements

David,

I consider you to be much more qualified than any of the academicians, psychologists or navy nukes that I know or have read about. You have actual experience with nuclear safety culture where the "rubber hits the road".....ground zero on the firing lines.

Dr. Jonathan Wert
Management Diagnostics Inc.
Management and Culture Consultant for the Industry

Endorsements

Dave

I welcome your survey being performed in the Oversight Department. I would like to see the survey administered across the Millstone site. I feel it would provide useful data to assist Oversight in performing it's SCWE monitoring function.

Paul Parulis, Manager of Millstone Oversight

Endorsements

May 2003 Letter from Paul Blanch, Nuclear Safety Consultant, to the NRC Commissioners:

There is a state of the art risk-based safety culture measurement method that has been developed by a technical specialist at Millstone. This person has studied the various culture measurement methods applied at Millstone post recovery. Working with unpublished MIT studies of nuclear plant culture, and various culture experts, this person has developed what may be an optimal tool for culture measurement.

Endorsements

David:

I don't at all mind your using our experience at Millstone as a model of how to successfully make change. And as you have indicated in your e-mail .... in any business, let alone nuclear. You can treat people with a deep rooted respect and care and still make the hard business decisions...it's how it's communicated, it's the level of trust in the organization etc. Really centering around the three questions you quote (trust, commitment to excellence, does the boss care about me). Again, your paper was extremely thoughtful and well written. Good luck with it.

Leon Olivier Millstone Plant Manager during recovery, current president of CL&P

2.1.8 Overview

Mr. Alan Price, Vice President of Dominion Nuclear Connecticut, stated that the Millstone nuclear plant is adopting the International Atomic Energy Agency's (IAEA's) definition of safety culture. Dominion Nuclear is following a safety culture model that begins with a policy-level commitment, management commitment, and individual commitment that enhances strong safety culture.

The senior plant manager's role is to affirm and articulate a strong safety culture vision, establish clear organizational values and priorities, and be accountable. In addition, managers should encourage teamwork, build trust, expect an organizational shared understanding of the details, and champion safe operation.

Plant operations and maintenance will be based on conservative decisions with a profound respect for the reactor core, commitment to training and continuous learning, risk-informed decisions, adherence to plans and procedures, and a focus on nuclear fuel integrity and safety.

Performance monitoring includes measuring and paying attention to trends and use of industry and internal operating experience. In addition, employee behavior will include sensitivity to degraded plant conditions, questioning unusual or unexpected results, focusing on human performance, and being willing to advance issues important to safety. Employees at all levels should advance safety issues without fear of reprisal.

Mr. Price noted that some of the safety culture metrics could be equipment reliability (e.g., long-range plans, forced outages, system and component performance trends); organizational effectiveness (e.g., integrated and cross functional assessments, reactivity management, leadership assessments); and adherence to standards (e.g., procedure quality, commitment to training, corrective actions).

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Safety Culture

ACRS
June 12, 2003

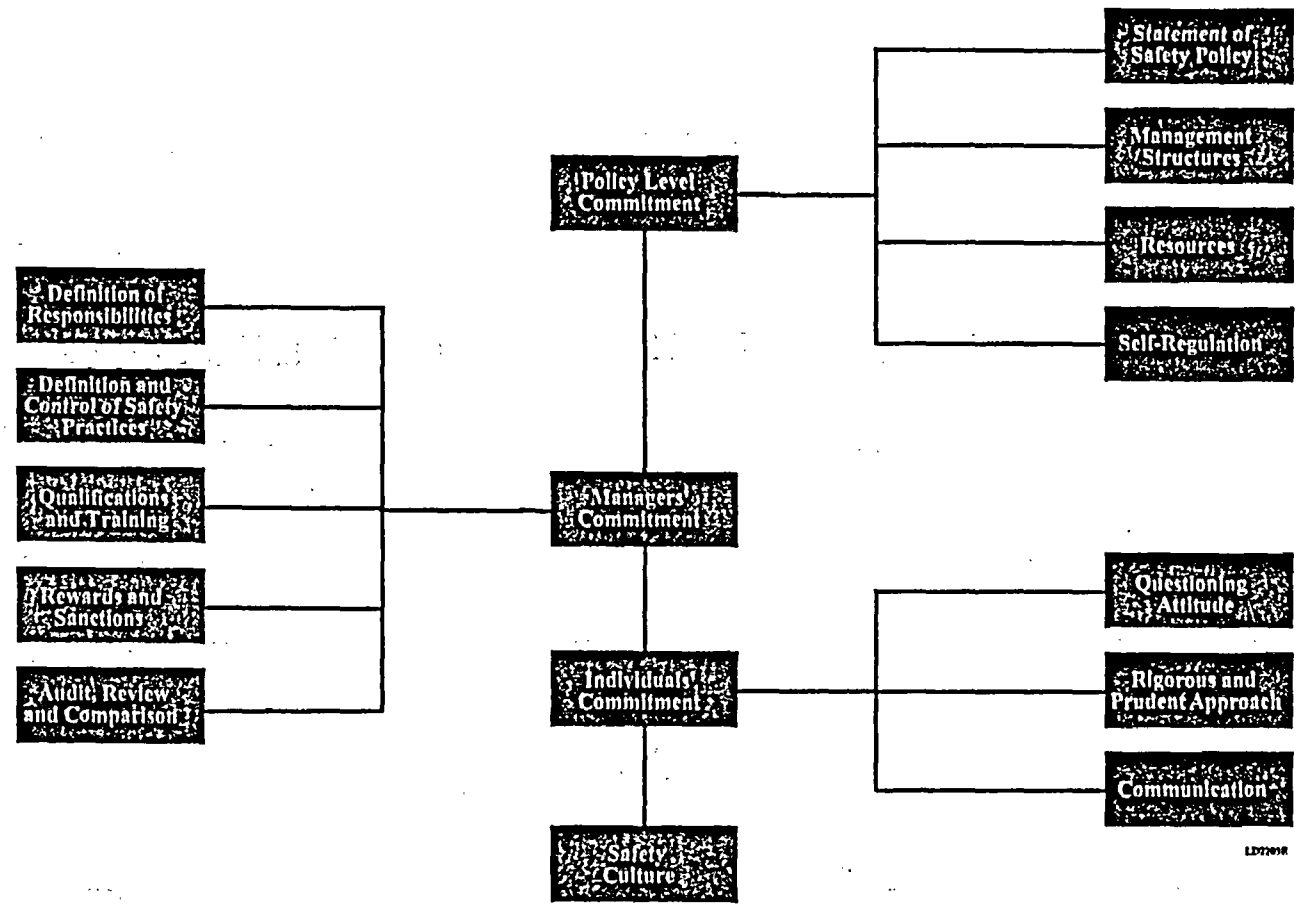
Alan Price VP Dominion Nuclear Connecticut

Definition - Safety Culture*

Safety Culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance.

***International Atomic Energy Agency Vienna, 1991**

Safety Culture Model



Senior Plant Managers Role

- Affirm and articulate a strong safety culture vision
- Establish clear organization values and priorities
- Be accountable and expect organization accountability, encourage teamwork, build trust
- Understand and expect an organizational shared understanding of the details
- Be visible, vigilant, and champion safe operations

Plant Operations

- Conservative decisions with a profound respect for the reactor core
- Commitment to training and continuous learning
- Sets standard for plant
- Defense in depth plant management
- Risk informed decisions
- Adherence to procedures
- Continuous learning
- Focus on nuclear fuel integrity and safety

Plant Maintenance

- Adherence to plans, procedures, and schedules
- Strong interface between maintenance activities and plant operations
- Strong quality assurance program focused on safety related equipment
- Continuous learning, use of internal and external experiences
- Craft ownership

Engineering

- Understands and controls design basis
- Establish and maintain engineering programs
- Healthy and respectful interface with Operations/Maintenance/Training
- Operational Focus
  - Day to Day
  - Long Term
  - Equipment Reliability

Employee Training and Skill

- Highly skilled operators and technicians
- Use of industry and internal operational experience
- Use of training programs
- Management knowledge of the plant
- Management rotation and mentors

Performance Monitoring

- Measuring and paying attention to trends
- Use of industry and internal operating experience
- Predictive risk analysis
- Internal and external performance assessments
- Work environment feedback

Plant Investments

- Modeling guides investment (Value Model)
  - Safety Function?
  - Industrial or Environmental safety impact?
  - Regulatory requirement?
  - Reliability requirement?
  - Return on investment?

Employee Behaviors

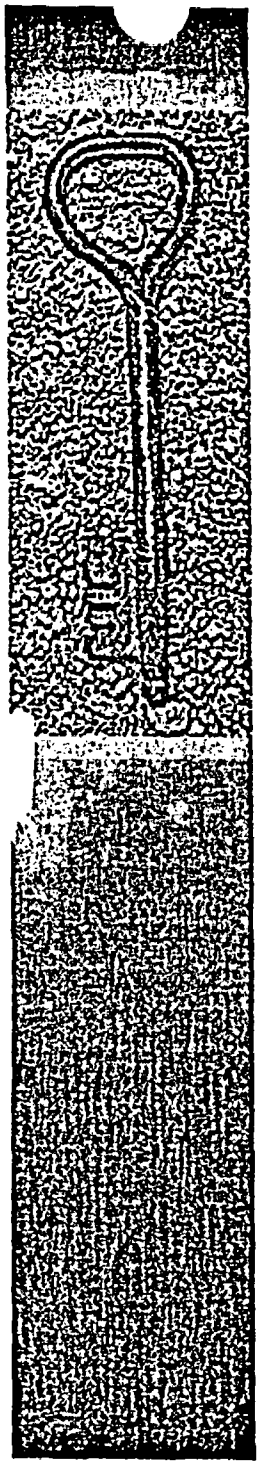
- Sensitivity to degraded plant conditions
- Questioning unusual or unexpected results
- Focus on continuous learning
- Focus on human performance
- Willing to advance items important to safety

Safety Conscious Work Environment

- Employees at all levels advance safety issues without fear of reprisal
- Management and employee training
- Alternate paths established for resolving safety issues
- Senior management review of potential or perceived reprisals
- Share trust and respect at all organization levels

Safety Culture Measurements

- Equipment Reliability
  - System and component performance and trends
  - Long range plans
  - Forced outages
  - Outage planning and execution
- Organizational Effectiveness
  - Integrated and cross functional assessments
  - Reactivity management
  - Operating experience – internal and external
  - Leadership assessments and feedback loops
- Adherence to Standards
  - Procedure quality, use, and adherence
  - Commitment to training
  - Corrective actions



Questions?

3 ATTRIBUTES OF SAFETY CULTURE

3.1 Safety Culture Panel B

3.1.1 NRC Staff — Overview and Status

Mr. David Trimble, Office of Nuclear Reactor Regulation (NRR) and Ms. Clare Goodman, NRR, cited the IAEA's definition of safety culture. The current Commission guidance regarding safety culture is outlined in the policy statement on the conduct of nuclear power plant operations (1989), SRM/SECY-98-059, "Proposed Options for Assessing the Performance and Competency of Licensee Management," SRM/SECY-98-176, "Proposed Options Assessing a Licensee's Safety Conscious Work Environment," and SRM/SECY-02-0166, "Safety Conscious Work Environment."

The policy statement stated that "management has a duty and obligation to foster the development of a safety culture at each facility and to provide a professional working environment, in the control room and throughout the facility, that assures safe operations."

SECY-98-059 led to SRM-98-059, which approved only the current staff practice of inferring licensee management performance from performance-based inspections, routine assessments, and event followup. The SRM eliminated FY 1998-2000 resources directed at developing a systematic method for inferring management performance.

SECY-98-176 directed the NRC staff to continue "with current policy, with the addition of the development and implementation of additional guidance and training to inspectors in support of more complete and consistent program implementation."

SRM-02-0166 on safety conscious work environment gives the staff guidance on safety culture as follows: the staff should monitor the efforts of foreign regulators to measure and regulate safety culture and assess their effectiveness—staff should monitor efforts to develop objective measures/indicators of safety culture.

The NRC staff currently relies on 10 CFR Part 50, Appendix B, Criterion V, "Instructions, Procedures, and Drawings," and Criterion VI, "Document Control." Other procedures of NRC rules and guidance include 10 CFR 50.36, "Technical Specifications"; the Standard Review Plan; Regulatory Guide 1.33, "Quality Assurance Program Requirements"; inspection procedures such as emergency operating procedures, plant procedures, and human performance.

Ms. Goodman stated that the NRC staff is currently monitoring international safety culture developments and plans to assess limited attributes of safety culture through the inspection process. In addition, the staff will identify and implement only those regulatory improvements within current Commission guidance. The staff will also seek Commission guidance and approval if needs are identified for regulatory enhancement exceeding current Commission guidance.

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ACRS SAFETY CULTURE WORKSHOP

NRC Staff – Overview and Status

June 12, 2003

Clare Goodman, Lisamarie Jarriel,
J. J. Persensky, David Trimble

Outline

- Current Commission Guidance
- Attributes of Safety Culture
- How NRC Currently Addresses Attributes
- Conclusions

Safety Culture Definition

- " . . . That assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance."

Current Commission Guidance

- Policy Statement on the Conduct of Nuclear Power Plant Operations (54FR3424) -1989
- SRM/SECY-98-059 "Proposed Options for Assessing the Performance and Competency of Licensee Management"
- SRM/SECY-98-176 "Proposed Options Assessing a Licensee's Safety Conscious Work Environment"
- SRM/SECY-02-0166 "Safety Conscious Work Environment"

INSAG 15
Safety Culture Attributes

- Commitment
- Use of Procedures
- Conservative Decision Making
- Reporting Culture
- Challenging Unsafe Acts
- Learning Organization
- Underpinnings
  - Communications
  - Clear Priorities
  - Organization

Commitment – Characteristics

- Shared vision of maintaining/improving safe operations
- Management exhibits safety-first practices

Commitment - NRC Rules/Guidance

- Policy Statement – Conduct of Nuclear Power Plant Operations
- 10 CFR 50.36(c)(5), Technical Specifications
- Standard Review Plan, (SRP) Chapter 13, Sections 13.1.1, 13.1.2 and 13.1.3

Use of Procedures - Characteristics

- Clearly written and fit their purpose
- Address main risks
- Understandable and relevant to users
- Can be practicably applied in work place
- Applied consistently and conscientiously

Use of Procedures - NRC Rules/Guidance

- 10 CFR Part 50, Appendix B, Criterion V Instructions, Procedures, and Drawings & VI Document Control
- 10 CFR 50.36 (c)(5), Technical Specifications
- Standard Review Plan, (SRP) Chapter 13, Section 13.5.2
- R.G. 1.33 - Quality Assurance Program Requirements
- IP 42001 Emergency Operating Procedures
- IP 42700 Plant procedures
- IP 71841 Human performance

Conservative Decision Making - Characteristics

- Questioning attitude
- Rigorous and prudent approach
- Well tested systems rely on defense-in-depth
- Stop, think, act, review
- Conservative course of action

Conservative Decision Making - NRC Rules/Guidance

- 10 CFR 50.59 - Changes, tests, and experiments
- GL 91-18 - Resolution of Degraded and Nonconforming Conditions
- IP 71111.15 - Operability Evaluations
- IP 71111.14 - Personnel Performance Related to Non-routine Plant Evolutions and Events
- Policy Statement - Conduct of Nuclear Power Plant Operations

Reporting Culture – Characteristics

- Employees encouraged to report all concerns
- Concerns addressed on a prioritized basis
- Horizontal Communication
- Feedback to those who report/others impacted
- Appropriate balance between blame free and culpable incidents

Reporting Culture - NRC Rules/Guidance

- 10 CFR Part 50, Appendix B, Criterion XVI Corrective Action
- 10 CFR 50.7 Employee Protection
- 10 CFR 50.5 Deliberate Misconduct
- 10 CFR 50.73 Licensee event report system
- IP 71152 Identification and resolution of problems
- Policy Statement - Freedom of Employees in the Nuclear Industry to Raise Safety Concerns without Fear of Retaliation

Challenging Unsafe Acts and Conditions – Characteristics

- Identifying and correcting unsafe work conditions
- Encourage employees to challenge existing unsafe conditions
- Minimize complacency with work practices or plant conditions
- Recognizing importance of safety systems and requirements

Challenging Unsafe Acts NRC Rules/Guidance

- 10 CFR Part 50, Appendix *B*, Criterion XVI Corrective Action
- IP 71152 Identification and resolution of problems
- Policy Statement - Conduct of Nuclear Power Plant Operations

Learning Organization - Characteristics

- Benchmarking search for improvements and new ideas
- Operational experience –Internal & External
- Monitoring and providing feedback
- Active involvement and teamwork
- Self-assessment

Learning Organization - NRC Rules/Guidance

- 10 CFR 50.120 Training and qualification of nuclear power plant personnel
- 10 CFR Part 50, Appendix B, Criterion XVI, Corrective action
- IP 41500 Training and qualification effectiveness
- IP 71152 – Identification and resolution of problems
- Reg. Guide 1.8 Personnel selection and training

Underpinning Issues-Characteristics

- Communications
  - Effective system for communication of safety issues
- Clear Priorities
  - Clarity about the key agreed objectives for safety enhancements
  - Objectives are prioritized and achievable
  - People accountable for their delivery
- Organization
  - Clarity about who is responsible and accountable for carrying out work

Underpinning Issues - NRC Rules/Guidance

- 10 CFR Part 50, Appendix B, Criterion XVI, Corrective action
- IP 71152 – Identification and resolution of problems
- Standard Review Plan, SRP Chapter 13, Sections 13.1.1, 13.1.2, and 13.1.3

Conclusions

- Monitor international safety culture developments
- Monitor events involving safety culture
- Assess limited attributes of safety culture through inspection process
- Identify and implement only those regulatory improvements within current Commission guidance
- Will seek Commission guidance/approval if needs are identified for regulatory enhancement exceeding current Commission guidance

3.1.2 Institute of Nuclear Power Operations Safety Culture Attributes

Mr. George Felgate, Director/Analysis Division, Institute of Nuclear Power Operations (INPO), briefed the Committee regarding INPO's perspective on safety culture. INPO's mission is to promote the highest levels of safety and reliability and excellence in the operation of nuclear electric generating plants. Mr. Felgate stated that safety culture is fundamental to INPO's mission and it is always a part of INPO's activities. INPO focused on functional issues such as operations, maintenance, and engineering. INPO's approach is to have an overall look by a team of professionals with broad experience with the understanding that if safety culture is unhealthy, it will show up in symptoms.

INPO's working definition of safety culture is "That set of attributes that results in nuclear safety being the overriding priority at the station." This definition is similar to the INSAG-4 definition. The symptoms that INPO looks for include operators' ability to implement emergency operating procedures; how operators approach evolutions affecting core reactivity; problems not reported or allowed to linger; safety systems unavailable longer than need be; and operators (or others) not stopping when uncertain or facing unexpected conditions. Other symptoms include how risk is measured and managed and how comfortable plant staff are in raising problems.

Mr. Felgate stated that the lessons learned from Davis-Besse are that INPO needs to better recognize and more openly address safety focus (culture); and INPO needs to improve its ability to uncover the organizational factors that detract from a strong safety culture. INPO developed a Davis-Besse significant operating experience report (SOER) that was issued in November 2002. The SOER is a top-level operating experience document. Every utility is expected to implement its recommendations with INPO's followup during plant evaluation.

The SOER includes a brief event description, causes and contributors, and recommendations. Three specific recommendations were noted. These are case study discussions with all members of the management team; performing a self-assessment of safety culture; and identifying and documenting abnormal plant conditions.

INPO's planned actions include the development of a safety culture task force to review industry and international input; reviewing safety culture self-assessments; and implementing of enhanced evaluation process. In addition, INPO is developing a set of attributes (possibly in the form of principles); case studies; courses and seminars; and warning flags.

INPO
Safety Culture Attributes

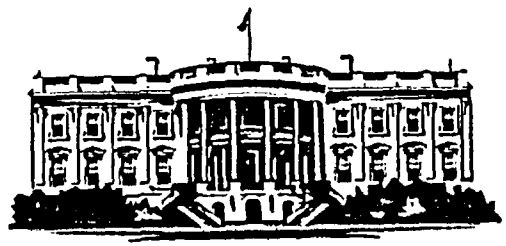
ACRS – June 12, 2003
George Felgate
Director, Analysis Division

Outline

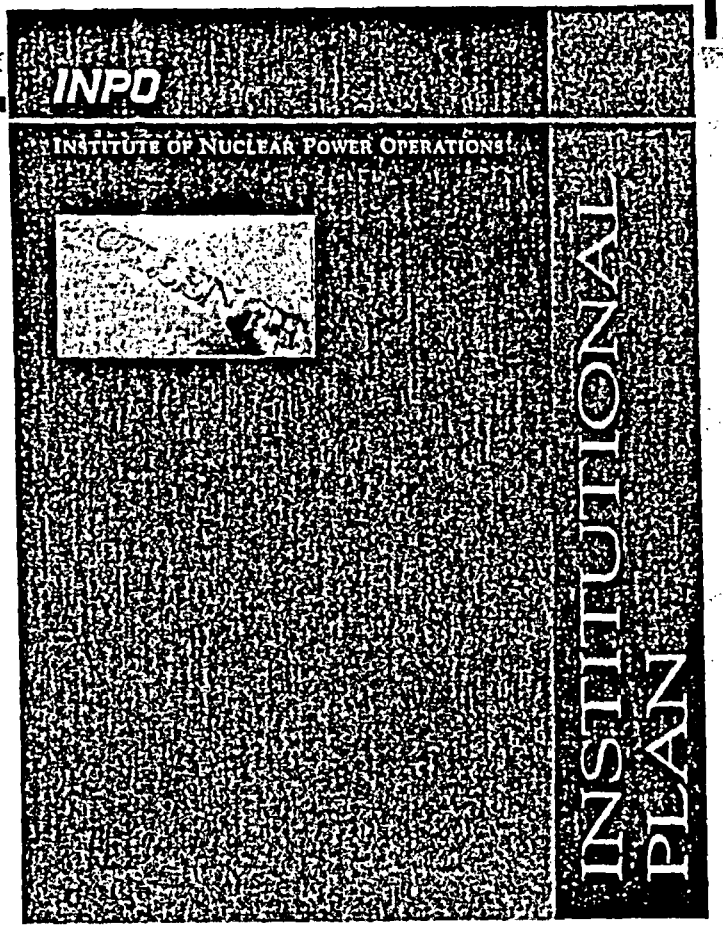
- Safety culture – INPO's perspective
- Davis-Besse lessons for INPO
- Davis-Besse Significant Operating Experience Report (SOER)
- Actions in progress and planned

President's Commission on the Accident at Three Mile Island

- Set and police its own **standards of excellence**
- Integration of **management responsibility**
- Systematic gathering/analysis of **operating experience**
- Agency-**accredited training** institutions
- Operator continuing training & plant **simulators**
- Dramatic change in **attitude toward safety** (*Safety Culture*)



INPO's Mission



To promote the highest levels of safety and reliability—to promote excellence—in the operation of nuclear electric generating plants

Safety Culture at INPO

- Fundamental to INPO's mission
- Always a part of INPO activities (not necessarily by that name)
- Appeared as "safety focus," "deep respect for the core," "reactivity management"
- While in the fabric, we focused on functional issues (operations, maintenance,
  engineering, et al)

Safety Culture at INPO

- Principles for Enhancing Professionalism of Nuclear Personnel *("The nuclear professional is thoroughly imbued with a great respect and sense of responsibility for the reactor core - for reactor safety - and all his decisions and actions take this unique and grave responsibility into account.")*
- INPO Performance Objectives & Criteria *("Individuals at all levels consider nuclear safety as the overriding priority.")*
- 1996 CEO Conference: *"Safety Focus During Changing Times"*
- Moved toward "cross-functional" evaluations in 1996
- 2002 CEO Conference: *"Safety Culture: Building It, Keeping It"*

INPO's Approach

- Overall look by team of professionals with broad experience
- If safety culture is unhealthy, it shows up in symptoms

Safety Culture: (Working Definition)

"That set of attributes that results in nuclear safety being the overriding priority at the station."

- Similar to INSAG-4 definition
- Similar to INPO Performance Objective SC.1

"Symptoms" We Look For

- Operators' ability to implement EOPs
- How operators approach evolutions affecting core reactivity
- Problems are not reported or are allowed to linger (leaks, deficient equipment)
- Safety systems are unavailable longer than need be
- Operators (or others) do not stop when uncertain or facing unexpected conditions

More "Symptoms"

- How risk is measured and managed
- Do modifications that are installed adequately consider the margin to safety
- How comfortable are plant staff in raising problems

Davis-Besse Lessons for INPO

- *INPO needs to better recognize and more openly address safety focus (culture)*
- *INPO needs to improve its ability to uncover the organizational factors that detract from a strong safety culture*

Davis-Besse SOER

- INPO's top level operating experience document
- Every utility expected to implement the recommendations – INPO follows up during plant evaluation
- Issued in November 2002
- First "Red" SOER since 1997

SOER Features

- Event description (brief)
- Causes and Contributors
- Recommendations (three)

Recommendations

- Case study discussion with all members of the management team
- Perform a self-assessment of safety culture
- Identify and document abnormal plant conditions – long term unexplained conditions

Actions In Progress / Planned

- Safety culture task force
  - Impacts all INPO cornerstones
  - Industry input and advice
  - International input
- Safety culture self-assessments being reviewed by INPO
- Enhanced evaluation process implemented

Actions In Progress / Planned

- Set of attributes (possibly in the form of Principles)
  - Learnings from utility self-assessments
  - Event based
- Case studies
- INPO courses and seminars
- Warning flags

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3.1.3 Organizational Safety Culture

Mr. Lew Meyers, Chief Operating Officer, First Energy Nuclear Operating Company (FENOC), discussed FENOC's organizational safety culture, including the historical perspective, safety culture model, and safety culture improvement. In March 2002, the degradation of the reactor pressure vessel (RPV) head at Davis-Besse was discovered. FENOC's return-to-service plan consists of seven blocks designed to improve and sustain performance. These are the reactor head resolution plan, program compliance plan, containment health assurance plan, system health assurance plan, restart test plan, management and human performance excellence plan, and restart action plan.

In August 2002, the root cause analysis of the RPV head degradation found that plant management had a less-than-adequate nuclear safety focus. The production focus, established by management, combined with taking minimum actions to meet regulatory requirements, resulted in the acceptance of degraded conditions. Such conditions were identified at a relatively low threshold, but not properly classified or evaluated by management. The attributes found included lack of management intrusiveness, inadequate implementation of corrective actions, material condition issues not resolved, and written policies not supporting a strong safety focus.

FENOC's definition of safety culture is the same as that of INSAG. FENOC's definition of safety conscious work environment is "That part of a safety culture addressing employee willingness to raise issues and management's response to these issues."

FENOC developed a safety culture model with three areas of focus. These are individual commitment, plant management commitment, and policy- or corporate-level commitment. The individual commitment area includes drive for excellence, questioning attitudes, rigorous work control, a prudent approach, open communications, and nuclear professionalism. The plant management commitment area includes commitment to safety, goals and teamwork, ownership and accountability, qualification and training, commitment to continuous improvement, cross-functional work management and communication, and an environment of engagement and commitment. The policy- or corporate-level commitment includes statement of safety policies, management value structure, resources, self-assessment, and independent oversight.

FENOC actions taken to improve safety culture belong in these three areas. Under the policy-level commitment, FENOC established a corporate organization structure; established an independent executive-level quality assurance position; established a safety conscious work environment policy; and enhanced values, mission, and vision statements. Under the management-level commitment, FENOC appointed a new, proven senior management team; improved the problem-solving and decision-making process; established an engineering assessment board; and provided leadership in action training. Under the employee commitment, FENOC provided reactor head case study training; supervisor refresher training on leadership in action; requalified all root cause evaluators; and established a site integration plan for alignment and leadership development interventions.

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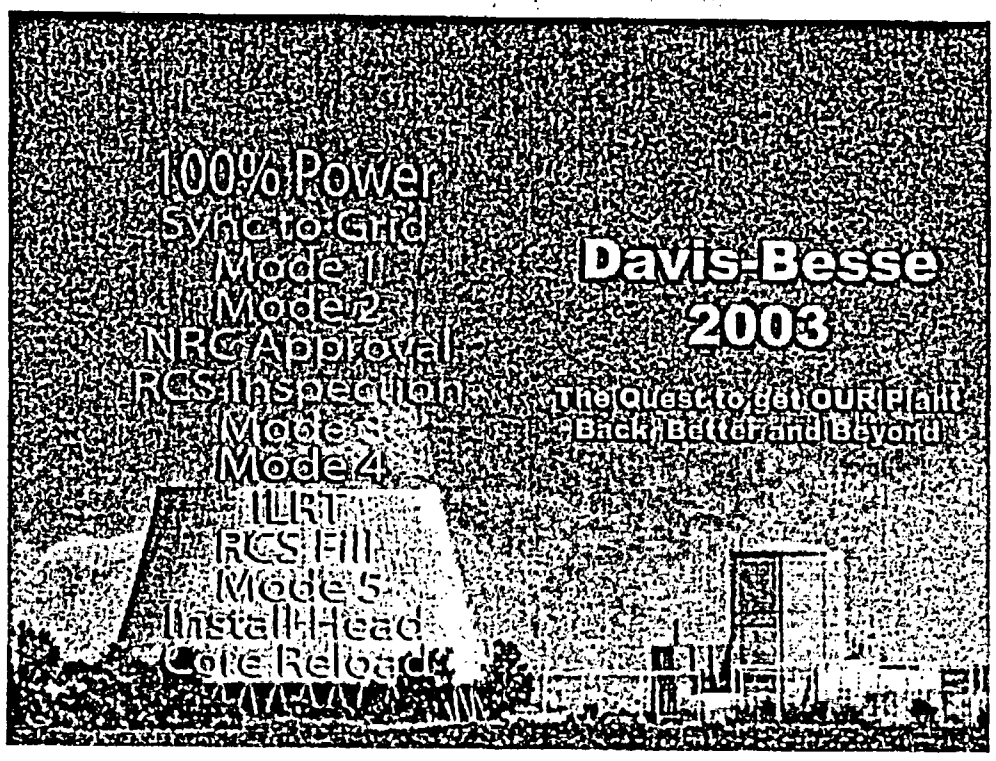
FENOC

Davis-Besse Nuclear Power Station



Advisory Committee on Reactor Safeguards

Workshop on Safety Culture

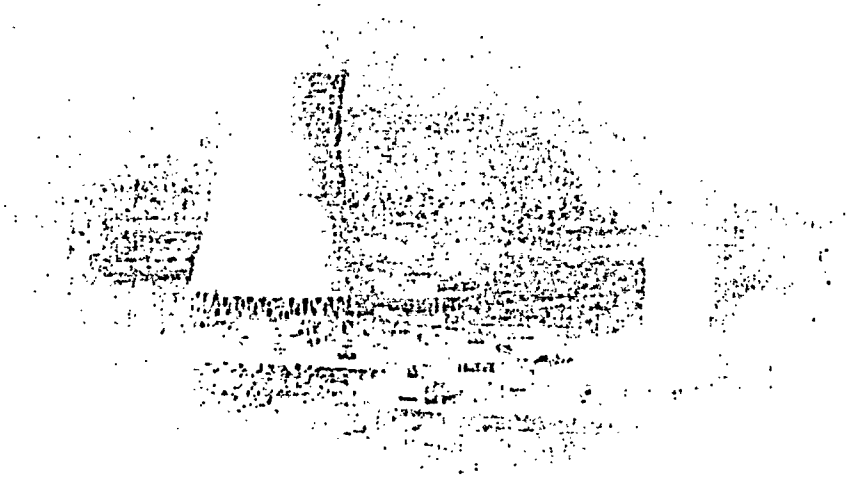
June 12, 2003

FirstEnergy®

Davis-Besse
Nuclear Power Station
June 12, 2003

FENOC

Organizational Safety Culture



Davis-Besse
Nuclear Power Station

June 12, 2003

Lew Myers

Chief Operating Officer - FENOC

FirstEnergy®

Organizational Safety Culture

Desired Outcome

Discuss the FirstEnergy Nuclear Operating Company (FENOC) Organization's Safety Culture, Including

- Historical Perspective
- Safety Culture Model
- Safety Culture Improvement

FirstEnergy®

Organizational Safety Culture
Historical Perspective

- March, 2002 - Degradation of Reactor Pressure Vessel (RPV) Head Discovered
  - NRC Manual Chapter 0350 Process for Extended Shutdowns
  - FENOC Return to Service Plan Consists of Seven Building Blocks Designed to Improve and Sustain Performance

FirstEnergy®

Return to Service Plan

Restart Overview Panel

- Reactor Head Resolution Plan
- Program Compliance Plan
- Containment Health Assurance Plan
- Restart Action Plan
- System Health Assurance Plan
- Restart Test Plan
- Management and Human Performance Excellence Plan

FirstEnergy®

FENOC

Organizational Safety Culture
Historical Perspective

- August, 2002 - Root Cause Report on RPV Head Degradation Found That Plant Management Had a Less Than Adequate Nuclear Safety Focus
  - Production Focus, Established by Management, Combined With Taking Minimum Actions to Meet Regulatory Requirements, Resulted in Acceptance of Degraded Conditions
  - Conditions Were Identified at Relative Low Threshold, but Not Properly Classified or Evaluated by Management

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Organizational Safety Culture

Historical Perspective

Attributes Found by Management and Human Performance Root Cause

- Lack of Management Intrusiveness
- Isolationism by Plant Organization
- Inadequate Implementation of Corrective Action Process
- Root Causes Lacked Rigor
- Operability Evaluations Were Narrowly Focused
- Operations Leadership Was Focused on Only Operating the Plant
- Material Condition Issues Were Not Resolved
- Silo Mentality Between Plant Work Groups
- Written Policies Did Not Support a Strong Safety Focus

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Organizational Safety Culture

Understanding Safety Culture

- August, 2002 - Employee Safety Conscious Work Environment Survey by FENOC
- January, 2003 - Developed FENOC Safety Culture Model
- January - February, 2003 - Independent Review of Safety Culture at Davis-Besse Conducted by Performance, Safety, and Health Associates, Inc.
  - Sonja B. Haber, Ph.D. - Project Manager
- March, 2003 - Employee Safety Conscious Work Environment Survey by FENOC

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Organizational Safety Culture

FENOC Definitions

Safety Culture

That assembly of characteristics and attitudes in organizations and individuals which establishes an overriding priority towards nuclear safety activities and that these issues receive the attention warranted by their significance.

Safety Conscious Work Environment

That part of a Safety Culture addressing employee willingness to raise issues and management's response to these issues.

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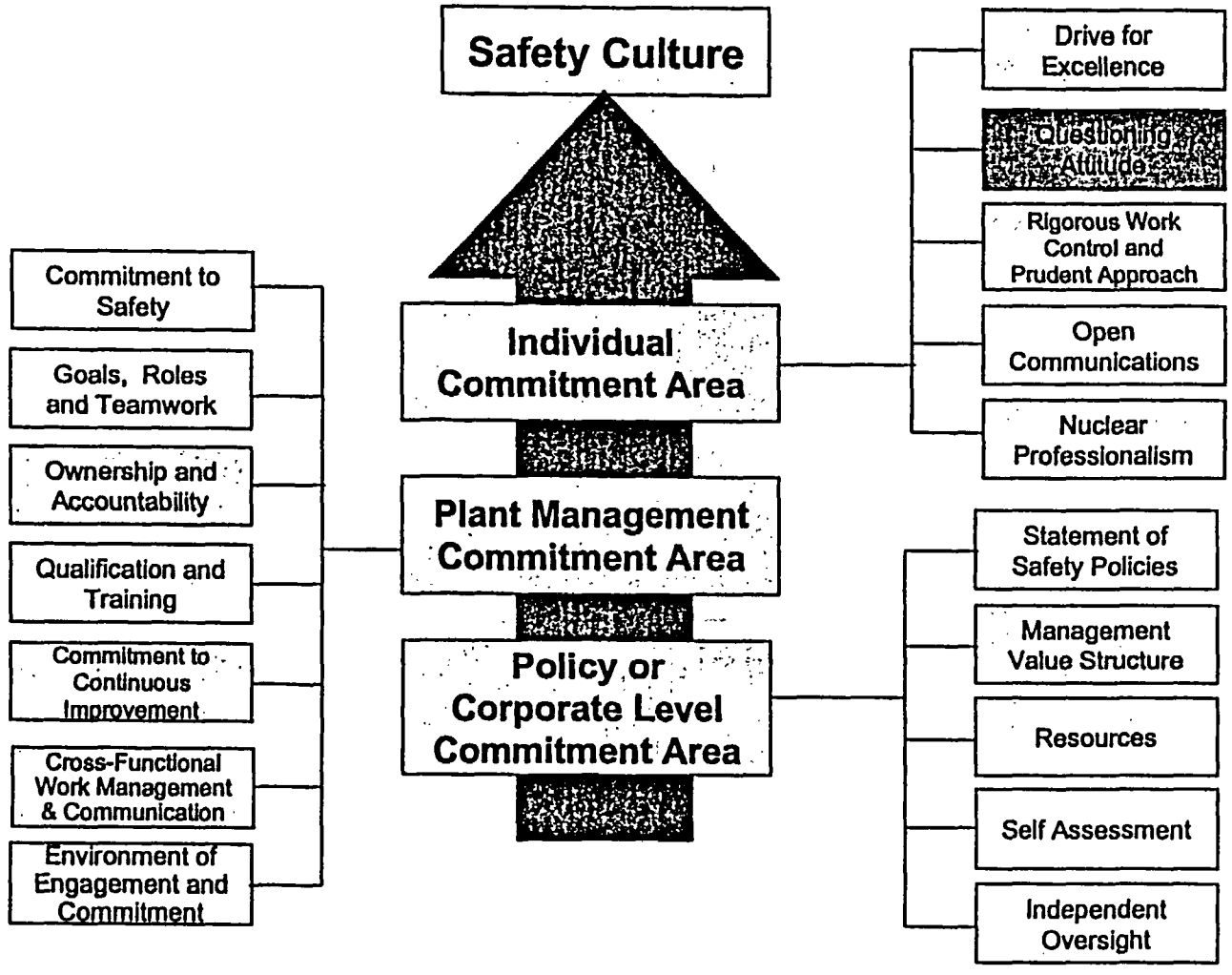
FENOC Safety Culture Model



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FENOC

Example of Safety Culture Criteria

INDIVIDUALS' COMMITMENT AREA

CRITERIA RELATED TO QUESTONING ATTITUDE

Challenges are welcomed

ATTRIBUTE	RED	YELLOW	WHITE	GREEN
Quality of pre-job briefs	Management observations and QA field observations show that most pre-job briefs are not acceptable.	Management observations and QA field observations show that most pre-job briefs are acceptable.	Management observations and QA field observations show that, with some exceptions, pre-job briefs are acceptable.	Management observations and QA field observations show that pre-job briefs in general are acceptable.
Percent of CRs per person per group	Less than 13% of individuals wrote CRs during the past 30 days.	Between 13-15% of individuals wrote CRs during the past 30 days.	Between 15-17% of individuals wrote CRs during the past 30 days.	More than 17% of individuals wrote CRs during the past month.
Number of programmatic CRs	The number of programmatic CRs indicates that individuals in general are reluctant to write CRs on programmatic and management issues.	The number of programmatic CRs indicates that most individuals are willing to write CRs on programmatic and management issues.	The number of programmatic CRs indicates that a large majority of individuals are willing to write CRs on programmatic and management issues.	The number of programmatic CRs indicates that individuals in general are willing to write CRs on programmatic and management issues.
Program and process error rate	>0.48 program and process errors per 10,000 hours worked.	<0.48 program and process errors per 10,000 hours worked.	<0.30 program and process errors per 10,000 hours worked.	<0.27 program and process errors per 10,000 hours worked.
Raising problems	Management observations and NQA field observations show that most individuals are not raising problems encountered in the field.	Management observations and NQA field observations show that most individuals are raising problems encountered in the field.	Management observations and NQA field observations show that a large majority of individuals are raising problems encountered in the field.	Management observations and NQA field observations show that individuals in general are raising problems encountered in the field.

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Davis-Besse Nuclear Power Station
June 12, 2003

FENOC

FENOC Actions Taken to Improve Safety Culture

- Policy Level Commitments
  - Board of Directors Passed Resolution on Nuclear Safety
  - Established Policy on Nuclear Safety Culture
  - Created Chief Operating Officer Position
  - Created Executive Vice President - Engineering Position
  - Established FENOC Corporate Organization Structure
  - Established Independent Executive-Level Quality Assurance Position
  - Greatly Strengthened the Employees Concerns Program
  - Established a Safety Conscious Work Environment Policy
  - Enhanced FENOC Values, Mission, and Vision Statements

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FENOC Actions Taken to Improve Safety Culture

- Management-Level Commitment
  - Appointed New Proven Senior Management Team
  - Brought in a Number of New Managers
  - Established Management Observation Ties to Plant Risk
  - Implemented Major Improvements in Plant Safety Margin
  - Strengthened Corrective Action Program
  - Established an Engineering Assessment Board
  - Assigned Owners and New Expectations for Engineering and Programs
  - Improved Problem-Solving and Decision-Making Process
  - Revised Competencies in Appraisal Process to include Nuclear Professionalism and Nuclear Safety Consciousness
  - Provided Leadership in Action Training on Additional Competencies

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FENOC
Davis-Besse Nuclear Power Station
June 12, 2003

FENOC

FENOC Actions Taken to Improve Safety Culture

- Employee Commitment
  - Communication and Alignment
    - 4C Meetings (Compliments, Communications, Concerns, and Changes)
    - Town Hall, All Site, and Department Meetings
    - Stand Downs
  - Provided Reactor Head Case Study Training
  - Supervisor Refresher Training on Leadership in Action
  - Supervisor Training on Safety Conscious Work Environment
  - Implemented Operator Leadership Plan
  - Strengthened Individual Ownership and Commitment
    - Engineering Rigor
    - Operability Decision-Making
    - Operator License Responsibilities Training
    - Shift Manager Command Responsibility
  - Requalified All Root Cause Evaluators
  - Established a Site Integration Plan for Alignment and Leadership Development Interventions

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FENOC

Organizational Safety Culture

Closing Remarks

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Davis-Besse Nuclear Power Station
June 12, 2003

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3.1.4 Management & Human Performance Inspection at Davis-Besse

Mr. Jack Grobe, Chairman, Davis-Besse Oversight Panel, NRC, briefed the Committee regarding the management and human performance inspection at Davis-Besse. Mr. Grobe stated that the regulatory basis for inspection, 10 CFR 50, Appendix B, Criterion XVI, "Corrective Action," requires that significant conditions adverse to quality be promptly identified and corrected; and that the causes of significant conditions adverse to quality be identified and actions are taken to preclude repetition. The reactor head degradation at Davis-Besse was a significant condition adverse to quality requiring correction and action to preclude repetition.

Mr. Grobe stated that the Davis-Besse root cause for failing to identify head degradation was that the staff and management at Davis-Besse had a less-than-adequate nuclear safety focus. In addition, weaknesses existed in nuclear safety culture, standards, and decisionmaking. Also, management ineffectively implemented processes, and thus failed to detect and address plant problems as opportunities arose.

Mr. Grobe indicated that the results of the management and human performance inspection, other NRC inspections, and ongoing licensee assessments, when combined, will allow the Oversight Panel to make an informed decision on the effectiveness of the licensee's management and human performance corrective actions. The corrective actions include an evaluation of the licensee's internal and external review processes to assess safety culture; evaluation of the licensee's long-term approach to monitoring continued safety culture improvement; and evaluation of the licensee's assessment of safety conscious work environment (SCWE) and safety conscious work environment review team (SCWERT) effectiveness.

Mr. Geoff Wright, NRC Inspection Team Leader - Region III, stated that the NRC inspection guidance includes INSAG-4, "Safety Culture," INSAG-11, "Developing Safety Culture in Nuclear Activities: Practical Suggestions to Assist Progress," INSAG 13, "Management of Operational Safety in Nuclear Power Plants," and INSAG-15, "Key Factors in Strengthening Safety Culture." Other members of the NRC inspection team are Mr. J. Persensky (RES), Ms. Clare Goodman (NRR), Ms. Lisa Jarriel (NRR), Mr. Rick Pelton (NRR), Mr. John Beck (NRC Consultant), and Mr. Mike Brothers (NRC Consultant).

In conclusion, Mr. Grobe indicated that 10 CFR Part 50, Appendix B, provides the regulatory basis for inspection, and that the inspection is being accomplished through an expert team using existing NRC policy and international guidance. The results of the inspection will be discussed during future public meetings.

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Briefing for the
Advisory Committee on Reactor Safeguards
June 12, 2003

MANAGEMENT & HUMAN PERFORMANCE INSPECTION AT DAVIS-BESSE

Jack Grobe, Chairman
Davis-Besse Oversight Panel
Geoff Wright
Inspection Team Leader

Regulatory Basis for Inspection

10 CFR 50, Appendix B, Criterion XVI, "Corrective Action" requires that:

- Significant conditions adverse to quality are promptly identified and corrected.
- The cause of significant conditions adverse to quality is identified and actions are taken to preclude repetition.

The reactor head degradation was a significant condition adverse to quality requiring correction and action to preclude repetition.

Licensee's Root Cause for Failure to Identify Head Degradation

- Staff and Management Exhibited Less than Adequate Nuclear Safety Focus
- Weaknesses Existed in Nuclear Safety Culture, Standards, and Decision-Making
- Management ineffectively implemented processes, and thus failed to detect and address plant problems as opportunities arose.

M&HP Inspection Output

The results from this inspection, other NRC inspections, and ongoing licensee assessments, when combined, will allow the Oversight Panel to make an informed decision on the effectiveness of the licensee's Management and Human Performance corrective actions.

Davis-Besse Oversight Panel Inspection Plan for Management and Human Performance (M&HP) Area

- Phase 1 - Review Cause Analyses for Proper Scope and Depth
- Phase 2 - Review the Plan and Implementation of Corrective Actions to Assure Causes are Addressed
- Phase 3 - Review Corrective Action Effectiveness

M&HP Phase 3 Inspection Plan

- Evaluate Licensee's Internal and External Review Processes to assess safety culture
- Evaluate Licensee's Long-Term Approach for monitoring continued safety culture improvement
- Evaluate Licensee's Employee Concerns Program Effectiveness
- Evaluate Licensee's Assessment of Safety Conscious Work Environment (SCWE) and Safety Conscious Work Environment Review Team (SCWERT) Effectiveness

Inspection Guidance

NRC Guidance

- 1989 Policy Statement on Conduct of Nuclear Power Plant Operation
- 1996 Policy Statement on Freedom of Employees to Raise Safety Concerns Without Fear of Retaliation
- NRC Inspection Procedure on Identification and Resolution of Problems
- NRC Inspection Procedure on Resolution of Employee Concerns

Inspection Guidance (cont'd)

Internationally Recognized Guidance/International Nuclear Safety Advisory Group (INSAG) Documents

- INSAG 4, "Safety Culture"
- INSAG 11, "Developing Safety Culture in Nuclear Activities: Practical Suggestions to Assist Progress
- INSAG 13, "Management of Operational Safety in Nuclear Power Plants"
- INSAG 15, "Key Factors in Strengthening Safety Culture"

Inspection Team

Geoff Wright, NRC, RIII

J Persensky, NRC, RES

Clare Goodman, NRC, NRR

Lisa Jarriel, NRC, NRR

Rick Pelton, NRC, NRR

John Beck, NRC Consultant

Mike Brothers, NRC Consultant

Safety Culture Assessment Process Inspection Methodology

- Inspection Approach
- Inspection Method

Conclusions

- 10 CFR 50, Appendix B provides regulatory basis for inspection
- Inspection being effectively accomplished through an expert team using existing NRC policy and International guidance
- Results of inspection will be discussed at a Public Meeting

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3.1.5 Utility Service Alliance Nuclear Safety Culture Assessment

Mr. William O'Connor, Vice President of Nuclear Generation, Detroit Edison,Chairman of the Board, Utility Service Alliance (USA), stated that the Utility Service Alliance member stations consist of Nebraska Public Power District (Cooper); Omaha Public Power District (Fort Calhoun); Energy Northwest (Columbia); Nuclear Operating Corporation (Wolf Creek); Pennsylvania Power & Light (Susquehanna); American Electric Power (D.C. Cook); and Detroit Edison Company (Fermi 2).

The strategic objectives of the Utility Service Alliance are to improve station operational safety and effectiveness; to provide industry leadership; and to increase economic benefit. Utility Service Alliance uses the same definition of safety culture as INSAG-4. It defines the safety conscious work environment (SCWE) as "a work environment in which employees are encouraged to raise safety concerns and where concerns are promptly reviewed, given the proper priority based on their potential safety significance...." Mr. O'Connor indicated that SCWE is one element of a strong safety culture. Utility Service Alliance is using a credible survey that will be completed by July 2003.

Mr. O'Connor stated that culture instilled in the operating staff can have negative or positive effects on the decisionmaking processes. A proper balance must exist between nuclear safety and production concerns. A strong production focus could result in unintended effects on site safety culture. Management is the driving force in shaping organizational cultures. Complacency, isolationism, arrogance, and nonintrusiveness are cultural attributes that can result in the propagation of a nonquestioning attitude and can lead to living with degraded conditions and justifying minimum standards.

Some of the attributes of a strong safety culture include safety over production; management oversight; rigor staff capability; problems identified and reported; independent oversight backed by management; learning from others; regulatory compliance; and maintain or improve safety margins.

For the assessment development, Utility Service Alliance uses the SOER, INPO principles for effective operational decisionmaking, INPO warning flags from recent extended shutdowns, Utility Service Alliance team input, Davis-Besse 0350 public meetings, Davis-Besse root cause evaluations, INPO safety focus during changing times, and INPO principles for effective self-assessments and corrective action programs. Other guidance includes INPO managing by experience, NRC policy statement for nuclear employees raising safety concerns without fear of retaliation, and NRC SECY-97-260, [Resolution of Public Comments in Response to Request for Public Comments in the Federal Register Notice, "Safety Conscious Work Environment."]

Utility Service Alliance uses a scoring matrix for assessment development. The scoring matrix includes items such as management recognizes potentially degraded conditions by demonstrating such behaviors as ensuring personnel are knowledgeable and understand safety expectations, are aware of proper equipment or system operation trends, and maintain a questioning attitude. The scoring criteria range from 1 through 5 as follows: (1) needs much improvement, (2) needs some improvement, (3) competent, (4) strength, and (5) exceptional. The scores are posted on the wall during assessment week. Averages for scoring should be above 3.0. Below 3.0 would indicate warning flags. Assessment results at Fermi 2 identified strengths such as "management emphasizes safety over production, no reluctance to raise issues, and strong partnership between management and craft." Typical areas for improvement included "significance of some events not recognized, not enough supervisor time in the field, updating operations standards and formality, and fragmented reliability improvement initiatives in the work control process."

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ACRS Safety Culture Work Shop
June 12, 2003

Utility Service Alliance (USA)
Nuclear Safety Culture Assessment

William O'Connor
VP Nuclear Generation, Detroit Edison
Chairman of the Board, Utility Service Alliance

Agenda

- What is the Utilities Service Alliance?
- Why perform a Safety Culture Assessment?
- What is Safety Culture and Safety Conscious Work Environment?
- USA Assessment Development/Implementation
- USA Assessment Results

USA Member Stations

- ⌘ Nebraska Public Power District (Cooper)
- ⌘ Omaha Public Power District (Fort Calhoun)
- ⌘ Energy Northwest (Columbia)
- ⌘ (Wolf Creek) Nuclear Operating Corporation
- ⌘ Pennsylvania Power & Light (Susquehanna)
- ⌘ American Electric Power (DC Cook)
- ⌘ Detroit Edison Company (Fermi 2)

USA Vision:

"Together, we will be a fleet of safe, cost-effective, top-quartile operators."

Strategic Objectives:

- ⌘ Improve Station Operational Safety & Effectiveness
- ⌘ Provide Industry Leadership
- ⌘ Increase Economic Benefit

Why perform a Safety Culture Assessment?

USA BOARD MEETING
JUNE, 2002

- *Are any of the USA member plants exhibiting the same weaknesses/symptoms that existed at Davis-Besse?*

What is Safety Culture?

"that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance."

From: International Nuclear Safety Advisory Group (INSAG-4)

What is a Safety Conscious Work Environment?

"...a work environment in which employees are encouraged to raise safety concerns and where concerns are promptly reviewed, given the proper priority based on their potential safety significance..."

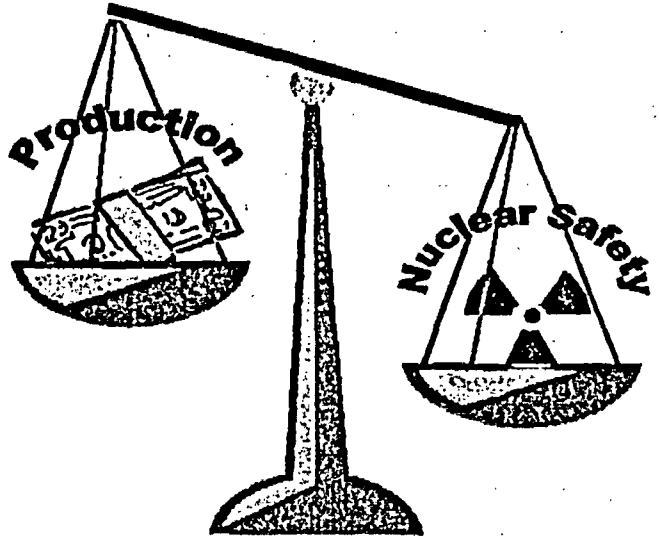
From: Commission Papers SECY-97-260

SCWE SURVEY

SCWE is one element of a strong Safety Culture. USA is using a credible survey.

- NEI 97-05 - (21 Questions) 4 Areas:
  - Safety Conscious Work Environment
  - Employee Concerns Program
  - Management Conduct & Performance
  - Corrective Action Process
- Survey of USA members to be completed by July, 2003.

Safety over Production

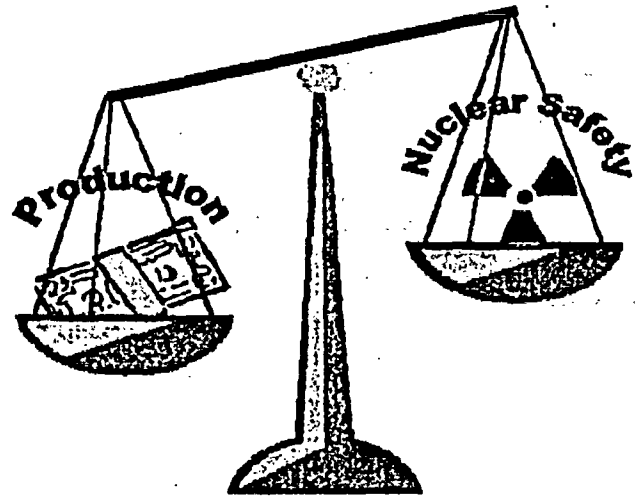


Culture instilled in the staff can have negative or positive affects on the decision making processes. A proper balance must exist between nuclear safety and production concerns. A strong production focus could result in a unintended affects on site safety culture.

Management is the driving force in shaping organizational cultures.

Production over Safety

Production Focus ($$$) can contribute to:

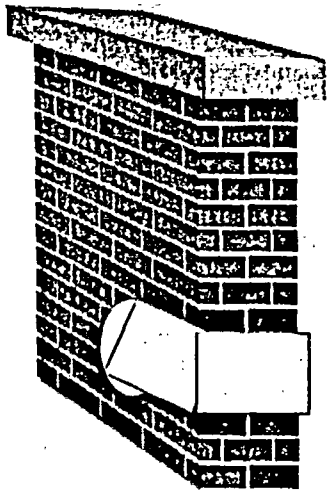


- Complacency
- Isolationism
- Arrogance
- Non-Intrusiveness

These cultural attributes can result in the propagation of a non-questioning attitude & can lead to living with degraded conditions and justifying minimum standards.

Attributes of a Strong Safety Culture

MANAGEMENT BEHAVIORS



SAFETY OVER PRODUCTION

MANAGEMENT OVERSIGHT

EXPECTATIONS

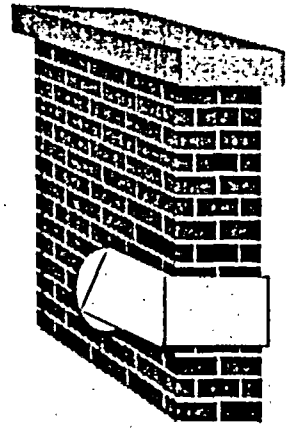
COACHING

ACCOUNTABILITY

RESOURCES

RELIABLE PLANT

CAP RIGOR STAFF CAPABILITY



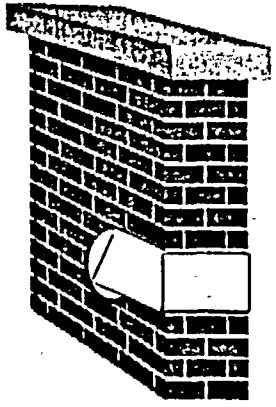
PROBLEMS IDENTIFIED REPORTED

SIGNIFICANCE RECOGNIZED

MULTI-DISCIPLINED TEAMS

TECHNICAL RIGOR

INDEPENDENT OVERSIGHT



CAPABLE

INTRUSIVE

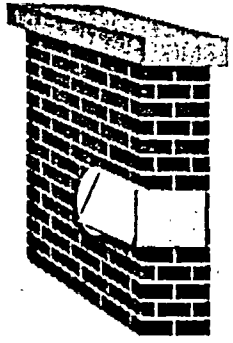
CREDIBLE

EFFECTIVE

BACKED BY MANAGEMENT

INDEPENDENT

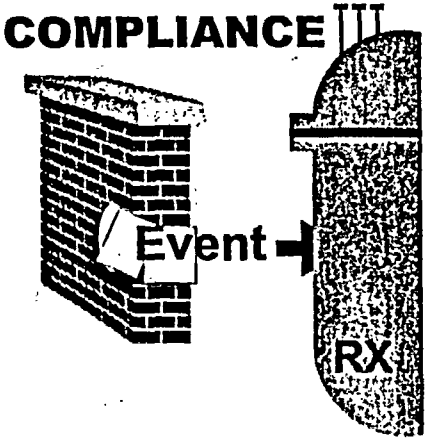
OPERATING EXPERIENCE



LEARNING FROM OTHERS MIS-FORTUNES

BENCHMARK

REGULATORY COMPLIANCE



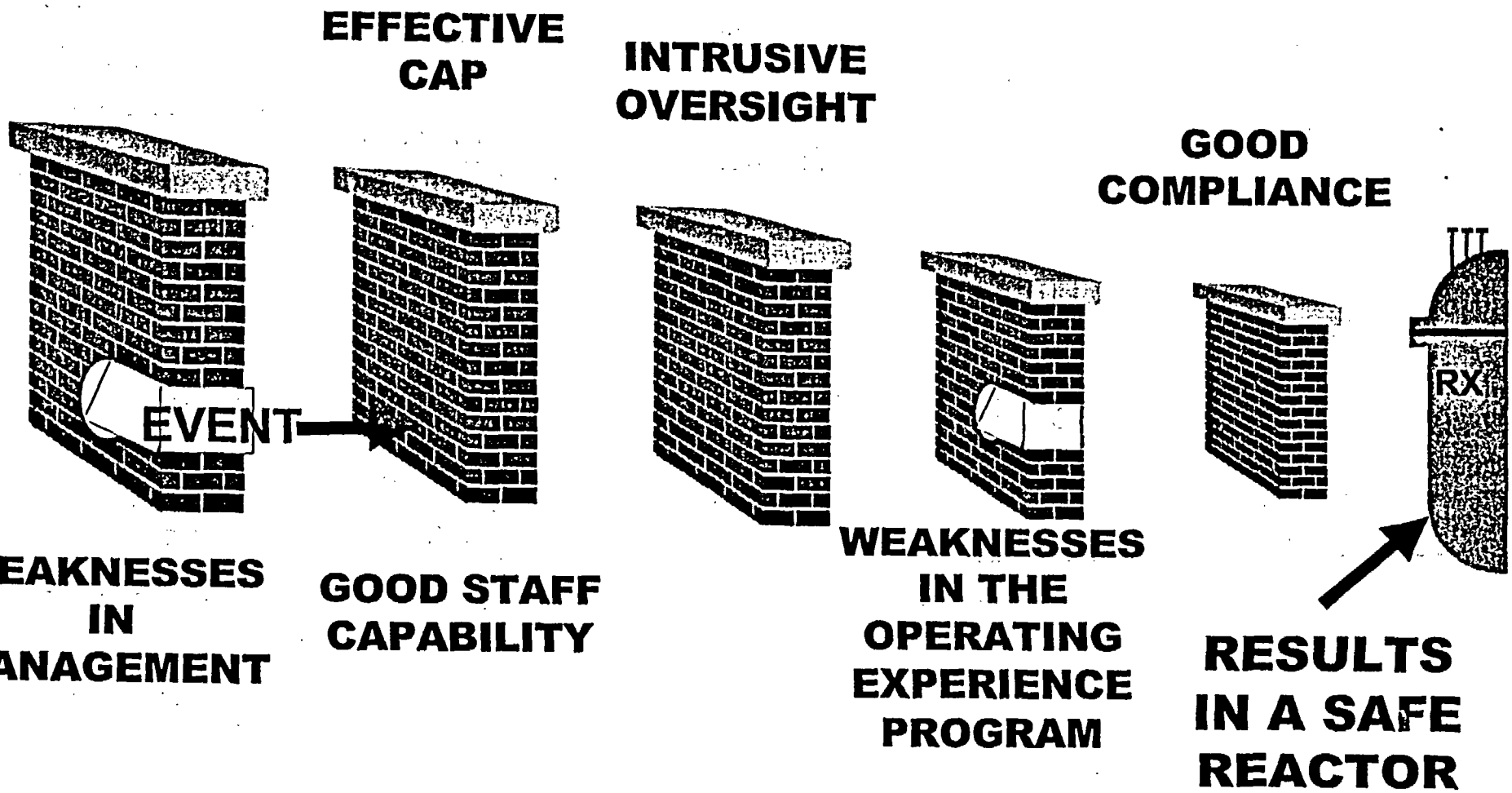
PROCEDURES

REGULATIONS

DESIGN BASIS

MAINTAIN OR IMPROVE SAFETY MARGINS

Safety Culture
USA Strive For Excellence



Assessment Development

- SOER 02-4
- INPO Principles for Effective Operational Decision Making
- INPO Warning Flags From Recent Extended Shutdowns
- USA Team Input
- Davis-Besse 0350 Public Meetings
- Davis-Besse Root Cause Evaluations

Assessment Development

- ⌘ INPO 02-005 Analysis of Significant Events
- ⌘ INPO 97-002 Performance Objectives and Criteria
- ⌘ INPO 97-003 Safety Focus During Changing Times
- ⌘ INPO Principles for Effective Self Assessments and Corrective Action Programs

Assessment Development

- INPO 98-003 Managing by Experience
- NRC Policy statement for nuclear employees raising safety concerns without fear of retaliation
- R. A. Meserve Meeting on Safety Culture
- NRC SECY-97-260 Resolution of public comments Federal Register SCWE

Assessment Development
Example Behavior Attributes

- INPO "Principles for Effective Operational Decision-Making" states:
- ***Attributes***
  - ***Personnel recognize potentially degraded conditions through the following:***
    - ***knowledge and understanding of safety expectations, including design and licensing basis***
    - ***awareness of proper equipment or system operation and trends***
    - ***a questioning attitude***

Assessment Development Example Scoring Matrix

Conditions that potentially challenge safe, reliable operation are recognized and promptly reported for resolution.

1.B.1 Management recognizes potentially degraded conditions by demonstrating these behaviors:	SCORE	AVE
a. Ensuring personnel are knowledgeable and understand safety expectations, including design and licensing bases		
b. Ensuring personnel are aware of proper equipment or system operation and trends		
c. Ensuring personnel maintain a questioning attitude		

Assessment Development Interview Question Banks

NOTE CROSS REFERENCE TO SCORING MATRIX

Rating	Para.	Question
2	1.B.1.b	Does the station have trending program to assist in the identification of repetitive equipment issues? Answer: *Corrective Action Program trending does not always provide useful information to Engineering. For example the F606 valve motor has failed several times in the past 15 years.*

Assessment Development Scoring Criteria

SCORING CRITERIA				
1	2	3	4	5
NEEDS MUCH IMPROVEMENT Usually shows undesired behavior. Rarely shows desired behavior.	**NEEDS SOME IMPROVEMENT** Sometimes shows undesired behavior, sometimes desired.	**COMPETENT** Usually shows desired behavior. Rarely shows undesired behavior.	**STRENGTH** Usually shows desired behavior with very strong skills.	**EXCEPTIONAL** Almost always shows desired behavior with highest skills.

Assessment Implementation
Use of Scoring Matrix

SCORES POSTED ON THE WALL DURING ASSESSMENT WEEK

1.B.1 Management recognizes potentially degraded conditions by demonstrating these behaviors:	SCORE	AVE
a. Ensuring personnel are knowledgeable and understand safety expectations, including design and licensing bases	1,2,3, 2,2	2.00
b. Ensuring personnel are aware of proper equipment or system operation and trends	2,2,2,3 3,3,3,3	2.63
c. Ensuring personnel maintain a questioning attitude	4,4,4,5 3,3,3	3.70

Assessment Development
Creating Interview Questions

⌘Interview Question Banks Developed For:

- ⌧Senior Management
- ⌧Middle Management
- ⌧Engineering
- ⌧Operations
- ⌧Oversight
- ⌧Craft

Assessment Implementation Scoring

- Assessment Scoring documented on:
  - Field Note Collection Sheets
    - (Plant tours & misc. observations)
  - Question Banks
    - (Interview ~ 80 people)
  - Observations Guides
    - (Meetings, Briefs, Control Room)

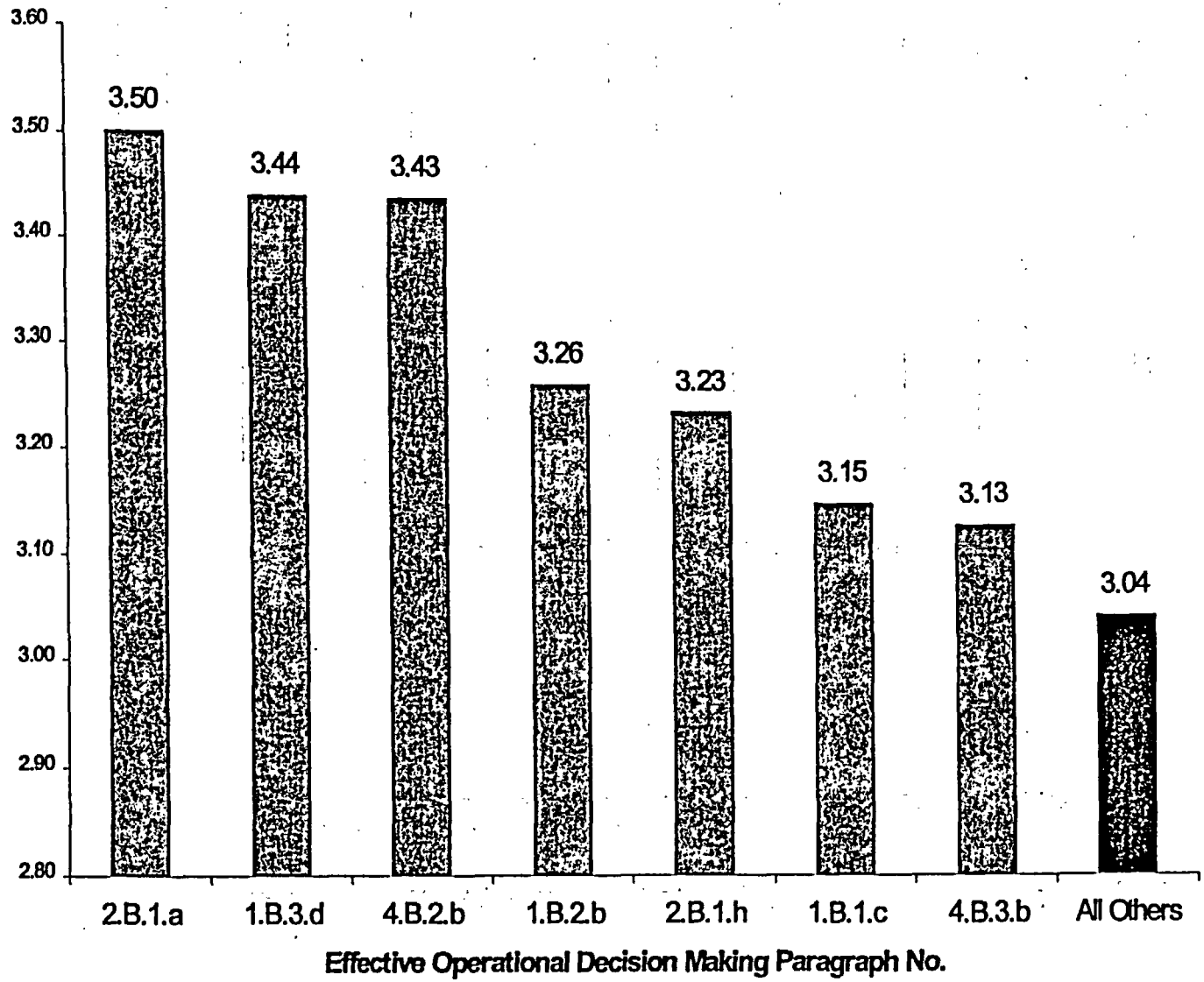
Example Material Reviewed Prior to Assessment Week

- JCOs
- Root Cause Reports
- Sampling of problem reports
- Adverse Trends
- QA Audits, Surveillances
- Self Assessments
- Corrective Action Backlog

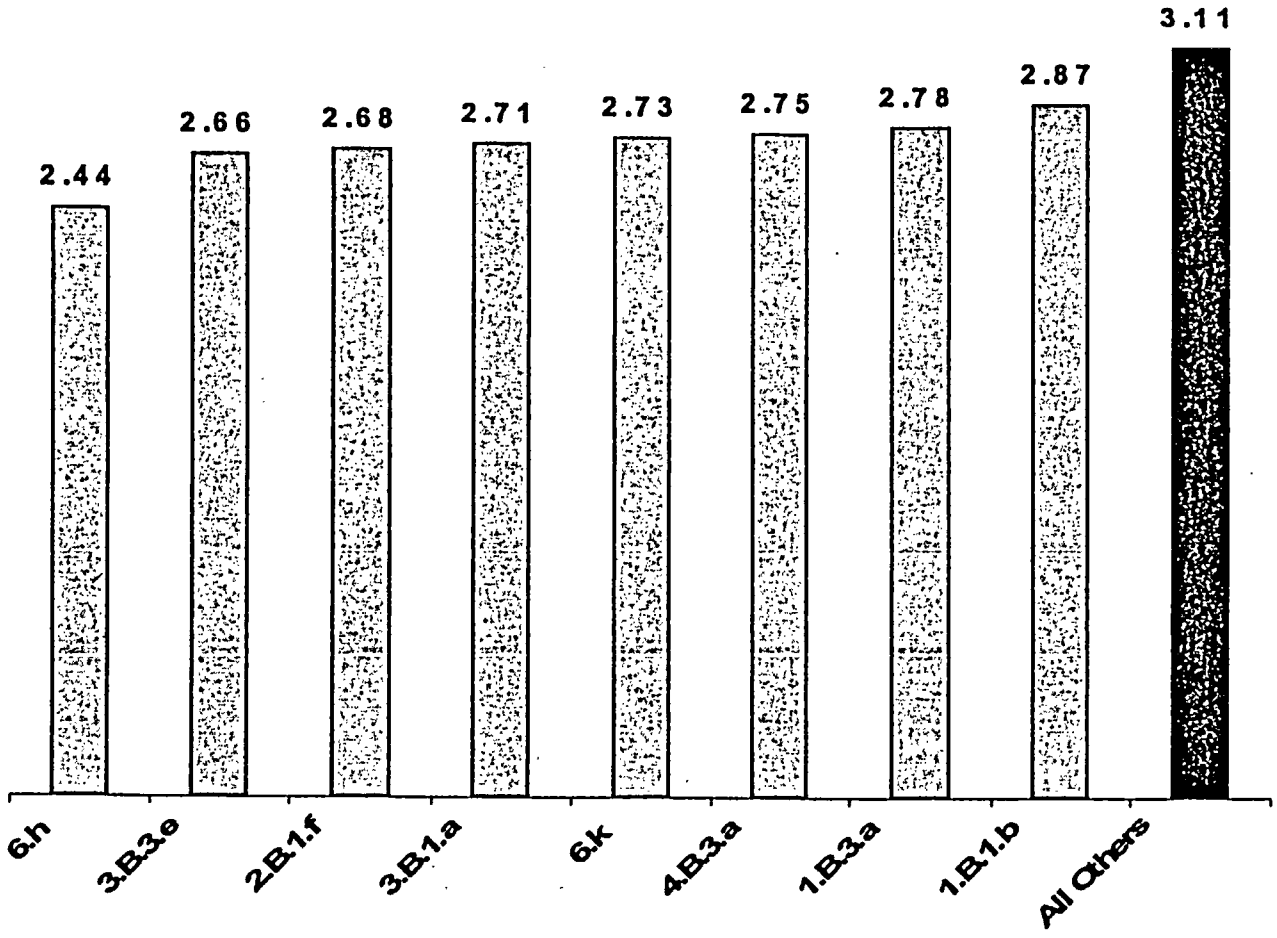
Example Material Reviewed Prior to Assessment Week

- O&M and Capital Cost Trend Info
- Management Policy on Safety
- Human Performance Clock Resets
- Deferred Outage Work
- NRC Reports (Violations, LERs, etc.)
- Corporate Review Board Meeting Minutes
- Staffing Stability

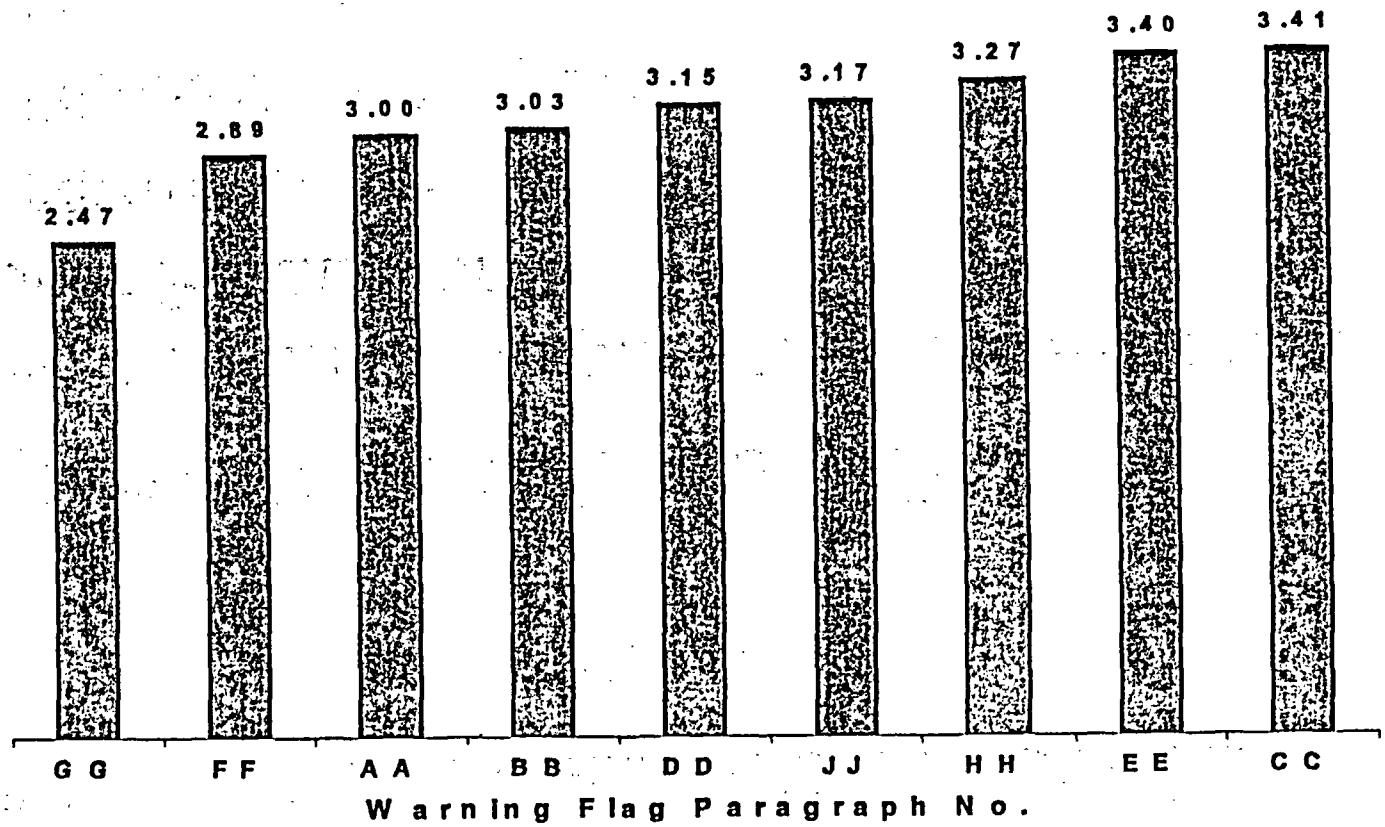
Site Assessment Report Strengths



Site Assessment Report
Areas for Improvement



Site Assessment Report
Warning Flags



Assessment Results
Fermi 2

- **Typical Strengths Identified**
  - Management emphasizes Nuclear Safety over Production.
    - **Business Plan**
    - **Incentive Program**
    - **Management involvement**
  - No reluctance to raise issues.
  - Strong partnership between management and craft.

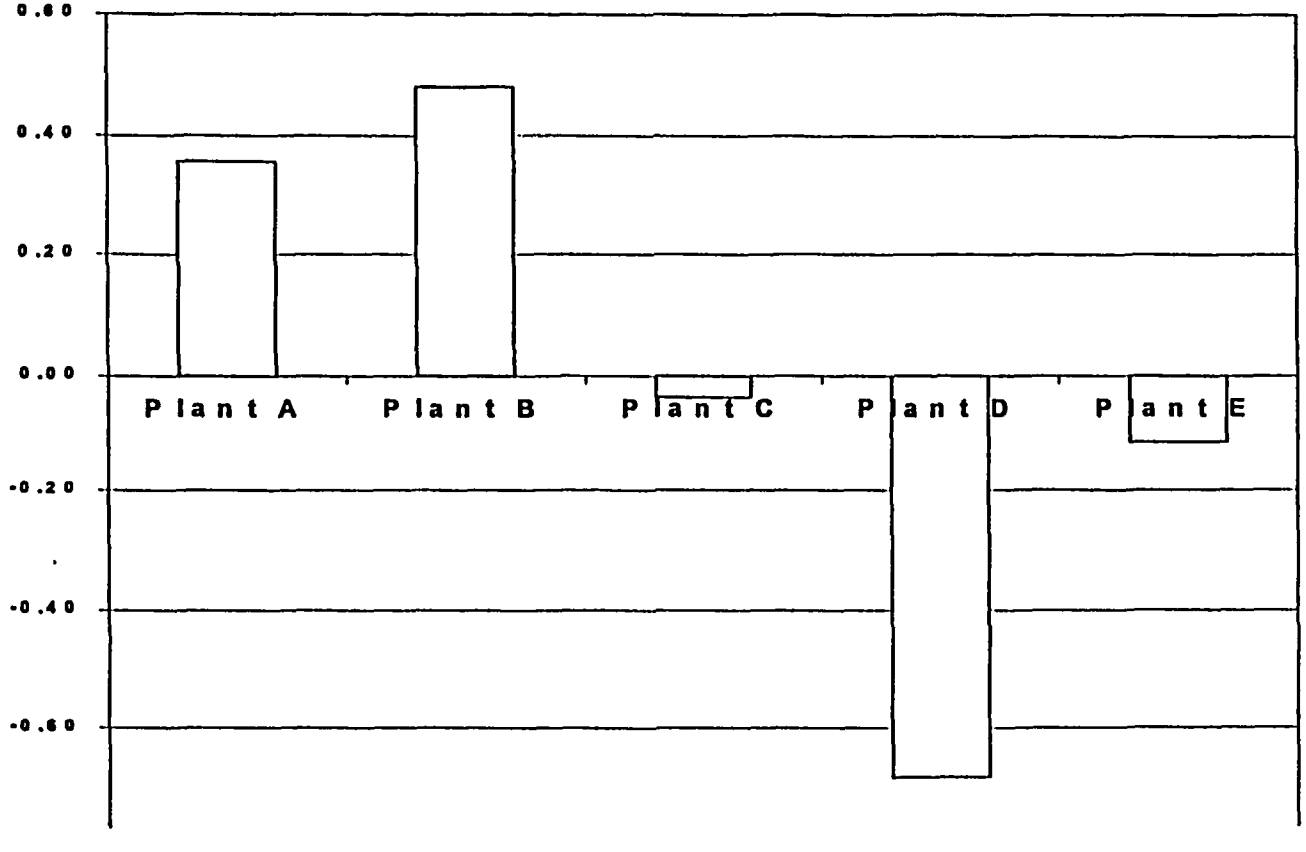
Assessment Results
Fermi 2

⌘Typical Areas for Improvement cont'd

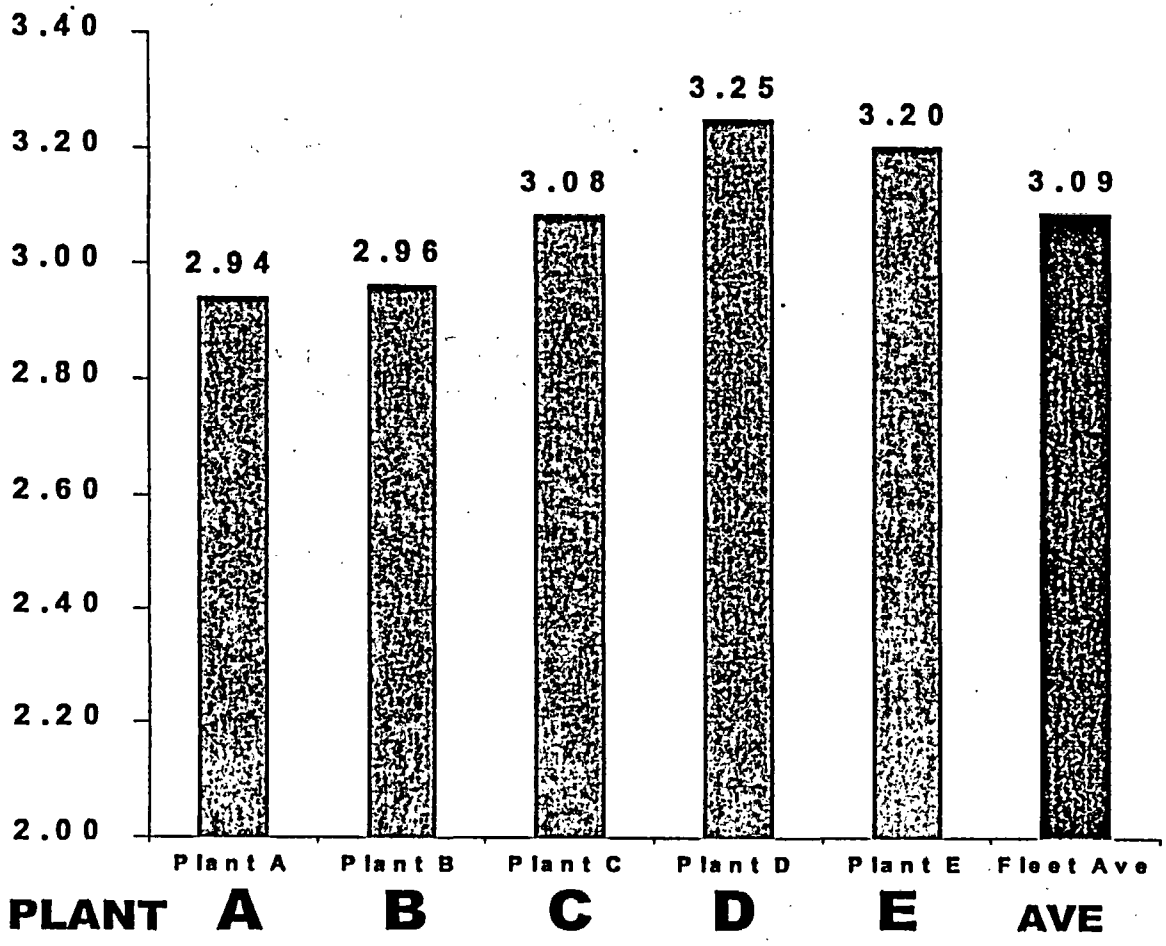
- ⌧Work control process. Reliability improvement initiatives fragmented.
- ⌧Operations standards and formality.
- ⌧Supervisor time in the field.
- ⌧Significance of some events not recognized.
- ⌧CAP problem report categorization.

Roll-Up Report
INPO WARNING FLAGS

JJ Self-Critical - Oversight organizations demonstrate an unbiased outside view and deliver tough messages. Self Assessments find problems and address them.



Roll Up Report



2	**NEEDS SOME IMPROVEMENT** Sometimes shows undesired behavior, sometimes desired.
3	**COMPETENT** Usually shows desired behavior. Rarely shows undesired behavior.
4	**STRENGTH** Usually shows desired behavior with very strong skills.

Where Do We Go From Here?

- The Assessment is a Spot Check!
- How do we continuously monitor Safety Culture?

Where Do We Go From Here?

Significant Operating Experience Report 02-4

RED - Immediate Attention
Determination of Action Within
90 Days of Issue Date

November 11, 2002

Incorporate similar assessments in the organization's ongoing assessment programs.

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3.1.6 Attributes of Safety Culture

Dr. Sonja B. Haber, Human Performance Analysis Corporation, briefed the Committee regarding the evolution of safety culture attributes. The first element is the identification of organization and management behaviors impacting safety performance and methods for assessment. There are 17 organizational behaviors identified that impact safety performance. By conducting a survey, a broad sample of individuals in the organization can be obtained.

The second element is the set of characteristics of high-reliability organizations (HROs). Ms. Haber quoted Roberts and Bea (2001) as follows: "A unique set of organizations that depend on human performance to avoid incidents involving significant adverse consequences in terms of employee and public health and safety." She indicated that HROs are successful at getting employees to buy into the big picture through consistent communication and team work to arrive at a common path forward, and being "learning organizations" by aggressively seeking to know what they do not know. Successful HROs place heavy emphasis on promoting a positive safety culture. Dr. Haber uses the INSAG-4 definition of safety culture, and adopts the Schein model of culture (artifacts, claimed values, and basic assumptions). The stages of safety culture development include compliance, performance, and process.

The third element is safety culture characteristics. Ms. Haber stated that safety culture characteristics that are important for the existence of a positive safety culture within a nuclear facility have been identified to include: safety is a clearly recognized value; accountability for safety is clear; safety is integrated into all activities; a safety leadership process exists; and safety culture is learning-driven.

Ms. Haber indicated that safety culture attributes are definable and assessable. Tools are available for the diagnosis of the absence or presence of attributes important to safety culture. Strategies can be implemented to ensure organizational alignment on the development, implementation, and continuous improvement of a positive safety culture. Criteria could be better defined from an empirically generated database to understand the distribution of safety culture characteristics across the industry.

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ACRS Safety Culture Workshop

Attributes of Safety Culture – Panel B

Presented by:

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Background

• 1987 – 1995	U.S. Nuclear Regulatory Commission
• 1990 – 1992	Department of Energy
• 1995 – present	Canadian Nuclear Safety Commission
• 1995 – 1998	Soviet Designed Reactors
• 1998 – present	IAEA Safety Culture Evaluations/ Workshops
• 2000 – 2002	CIEMAT (CSN/Utilities – Spain)
• 2003	Davis-Besse Safety Culture Evaluation

Evolution of Safety Culture Attributes

- Identification of Organization and Management Behaviors Impacting Safety Performance and Methods for Assessment
- Characteristics of High Reliability Organizations
- Safety Culture Characteristics

Identification and Assessment of Organizational Behaviors

- 17 organizational behaviors identified which impact safety performance
- Data collection tools developed for assessment of organizational behaviors
- Multiple tools to assess each behavior systematically and objectively
- Tools allow for collection of quantitative and qualitative data
- Collection of convergent data from multiple tools is unique

Characteristics of High Reliability Organizations (Roberts and Bea, 2001)

A unique set of organizations that depend on human performance to avoid incidents involving significant adverse consequences in terms of employee and public health and safety.

HROs are successful at:

- Getting employees to buy into the big picture through consistent communication and teamwork to arrive at a common path forward
- Being "learning organizations" by aggressively seeking to know what they don't know
- Using measurement to manage so that reward and incentive systems recognize the costs of failure as well as the benefits of reliability

Culture is the umbrella over these characteristics and influences their implementation. Successful HROs place heavy emphasis on promoting a positive safety culture.

IAEA Safety Culture Model

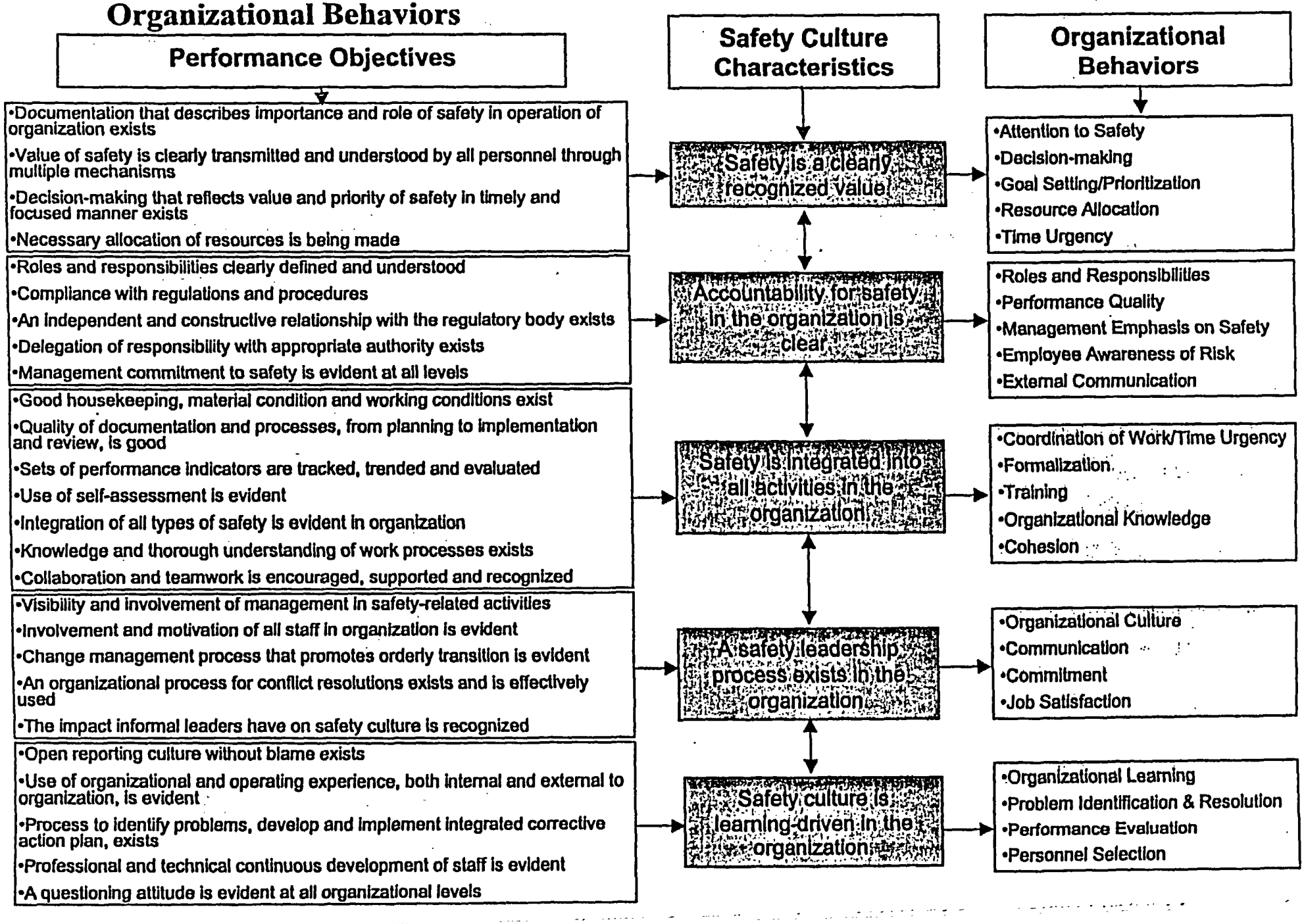
- INSAG – 4 definition of safety culture
- Safety culture exists in an organizational context
- Schein model of culture
  - Artifacts
  - Claimed values
  - Basic assumptions
- Stages of safety culture development
  - Compliance
  - Performance
  - Process

Safety Culture Characteristics

- Safety is a clearly recognized value
- Accountability for safety is clear
- Safety is integrated into all activities
- A safety leadership process exists
- Safety culture is learning-driven

Specific performance objectives and criteria allowing assessment of presence or absence of each characteristic have been identified.

Relationship Between Safety Culture Characteristics, Performance Objectives and Organizational Behaviors



Implications

- Safety culture attributes are definable and assessable
- Tools are available for the diagnosis of the absence or presence of attributes important to safety culture
- Some behaviors have been more successful at differentiating between organizations
- Strategies can be implemented to ensure organizational alignment on the development, implementation, and continuous improvement of a positive safety culture
- Criteria could be better defined from an empirically generated database to understand the distribution of safety culture characteristics across the industry.

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10. SUPPLEMENTARY NOTES

11. ABSTRACT *(200 words or less)*

The Advisory Committee on Reactor Safeguards (ACRS) held a workshop on June 12, 2003, regarding safety culture at nuclear power plants. Topics discussed by the industry and the NRC staff included: initiatives, methodologies, guidelines, and adopted approaches for safety culture; effective criteria for evaluating safety culture; assessing the rigors of safety culture programs; and the implications on the safe operation of nuclear power plants. Specific objectives for the workshop included gathering information on domestic and international activities, and determining the attributes of effective safety culture. The workshop was organized into two panels. One panel discussed the collective understanding of safety culture, and the other panel discussed the attributes of safety culture.

12. KEY WORDS/DESCRIPTORS *(List words or phrases that will assist researchers in locating the report.)*

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