

ISAT - *Independent Self Assessment Team*

An Assessment of Zion Nuclear Power Station

An Independent Self Assessment

February 18, 1997

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Mr. Harold W. Keiser
Vice President, Chief Nuclear Operating Officer
1400 Opus One, Suite 900
ComEd Company
Downers Grove, Illinois 60515

Dear Harry,

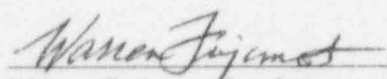
We are pleased to have completed your request for an independent assessment of the performance at Zion Station. The results of our assessment are summarized in the enclosed report, and respond to your request that we identify the fundamental causes or "whys" that drove declining performance.

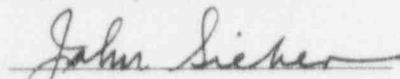
We appreciate the spirit of openness, cooperation and interest shown by ComEd personnel with whom we interacted during the course of the assessment. We acknowledge ComEd management for steadfastly maintaining our independence and their commitment to critical self assessment.

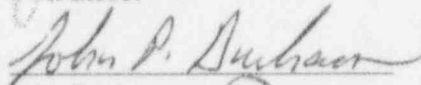
The decision to subject Zion Station and the Nuclear Operations Division to an independent self assessment is an aggressive and credible step toward your goal of sustaining superior performance. We believe that the aggressive actions you have begun will address the fundamental causes that our assessment identified. We wish you the utmost success in those efforts.

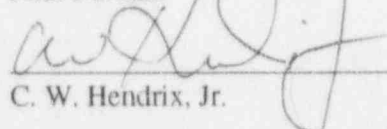
Sincerely,

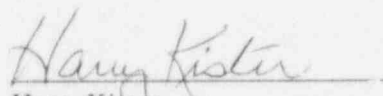
The Independent Self Assessment Team

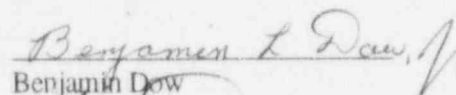

Warren Fujimoto, Leader


John Sieber


John Durham


C. W. Hendrix, Jr.


Harry Kister


Benjamin Dow


Fred Dacimo

1.0 INTRODUCTION

1.1 Objective of Independent Self Assessment

The Independent Self Assessment Team (ISAT) was assembled at the request of the Chief Nuclear Officer of the ComEd Nuclear Operations Division (NOD). The Independent Self Assessment (ISA) was led by a core group of seven senior nuclear consultants external to the ComEd organization, who were requested to conduct an independent assessment of performance at Zion Station (Zion). The assessment was intended to provide ComEd management with an independent perspective on major performance weaknesses, with particular emphasis on the fundamental causes of those weaknesses. The ISAT was also invited to provide insights concerning the effectiveness of ongoing and planned ComEd initiatives to improve identified performance issues and to recommend post-assessment steps.

1.2 Methodology and Standards for Assessment

The ISAT assessed performance at Zion over the past two years in five functional areas: Operations and Training, Maintenance, Engineering and Technical Support, Plant Support, and Management and Organization. The ISAT's assessment process consisted of three phases.

In Phase 1, over a three week period, the core team performed a detailed review of existing performance monitoring and assessment documentation. These documents included, but were not limited to, NRC inspections, evaluations, and ComEd assessments, corrective action documents and performance improvement plans. Essentially all of the weaknesses described in this ISA report were identified in these documents.

In Phase 2, over a two week period, the ISAT verified the Phase 1-identified weaknesses based upon Zion observations, interviews and further document reviews. The core team members were augmented by INPO and industry peers in connection with the Phase 2 work.

In Phase 3, over a two week period, utilizing the results of Phases 1 and 2, associated causal factors for Zion weaknesses in four functional areas (operation, maintenance, engineering and plant support) were documented by the core team (Attachment A). A set of fundamental causes were then developed for the assessment of management and organization.

As the assessment proceeded, the ISAT determined that it would deliver maximum value by concentrating on the performance weaknesses and the underlying causes. The ISAT's emphasis was placed on problem definition and identification of fundamental causes, rather than corrective actions. Consequently, the ISAT did not focus upon the effectiveness of ongoing and planned improvement initiatives. The ISAT acknowledges that many corrective actions were in the process of being developed, and some were already implemented, to address Zion weaknesses.

The ISAT did not conduct detailed assessments of the performance of the oversight and assessment functions within the ComEd nuclear organization, nor did it assess the performance of the regulatory assurance functions at Zion. In the context of its integrated review of Management and Organization, the ISAT examined the end results and effects of the ComEd oversight and assessment functions. Those end results and effects are described in the Fundamental Cause Assessment in Section 3 of this report.

The ISAT's standard for assessment of performance reflected its collective experience and was intended to represent the performance of a best-performing plant. Unless otherwise specifically stated, this standard applied to all phases of the ISAT assessment. The ISAT focused on the end results of NOD decisions. The ISAT did not attempt to define the specific actions that ComEd management should take to assure safety, regulatory compliance or best-performance.

The ISAT did not reevaluate ComEd's historical decision making processes or the conditions under which decisions were made. The ISAT placed emphasis on communication of observations and causal factors to assist ComEd in understanding and accelerating its efforts to resolve the issues which are critical to achievement of sustained excellent performance at Zion.

1.3 Assessment Team Membership and Composition

The core members of the ISAT and their respective assessment responsibilities and backgrounds are:

<u>Member</u>	<u>Assessment Responsibility</u>	<u>Background</u>
Warren Fujimoto	Team Leader and Management and Organization	Former Vice President Pacific Gas & Electric Co. Diablo Canyon 28 years nuclear power experience
Harry Kister	Management and Organization	Former USNRC, Region I, III and Headquarters I&E 36 years nuclear power experience
John Durham, P.E.	Engineering and Technical Support	Former Engineering Manager Impell Corp.; Carolina Power & Light 23 years nuclear power experience
Dr. Benjamin Dow	Engineering and Technical Support	Former Manager Nuclear Services, Arkansas Power & Light 23 years nuclear power experience
C.W. Hendrix, Jr.	Maintenance	Duke Engineering Services, Manager of Maintenance Engineering Services 25 years nuclear power experience
Fred Dacimo	Operations	Former Operations Vice President, Northeast Utilities 20 years nuclear power experience
John Sieber	Plant Support	Former Senior Vice President and Chief Nuclear Officer, Duquesne Light Company 36 years nuclear power experience

The core ISAT members were augmented by INPO evaluators and industry peers, as follows:

<u>Augmented Team Personnel</u>	<u>Assessment Responsibility</u>	<u>Organizational Affiliation</u>
L. Thibault	Management & Organization	INPO
Vince Roppel	Maintenance	INPO
Mike Ballard	Engineering	INPO
George Northcutt	Operations	INPO
Jose Ritter	Management & Organization	INPO
Jim Vandergrift	Maintenance	Entergy - ANO
Bob Azzarello	Engineering	Entergy - Waterford
John Hesser	Engineering	APS - Palo Verde
Joe Waid	Operations	Entergy - ANO
Bob Gillespie	Operations	D.C. Cook

The ISAT received support from Jim Abel, JoEllen Burns and Bill Fitzpatrick of ComEd, who served as liaisons to the line organization and were instrumental in gaining prompt access to information, documents and individuals.

2.0 FUNCTIONAL AREA CAUSAL FACTORS

The ISAT's supporting observations and causal factors for operations, maintenance, engineering and plant support are summarized below.

2.1 Operations and Training

The ISAT found that models for and definitions of conservative operations decision making were not in place and nonconservative decisions were observed. Management accepted low standards, manifested in tolerance of deficient conditions and a lack of operational excellence toward improving performance. Training was not used to deliver and reinforce expectations, communicate standards of performance, or prepare operators for organizational change. Operations management has not maintained an active ownership of training. Operations did not have an understanding of and a commitment to the principle that strong economic performance must be driven by operational excellence. The ISAT observed a lack of bargaining unit buy in to management expectations and operational excellence, inhibiting improved performance.

2.2 Maintenance

Weaknesses within the maintenance organization can be attributed to issues related to the work control process, preventive maintenance program, maintenance department management, and change management. The work control process has been hampered by an ineffective scheduling process and an inability to manage emergent work, which are attributable to implementation of changes to the work control systems without a fully integrated change plan. Preventive maintenance (PM) effectiveness has been limited because management has not viewed the PM program as the key factor in maintaining plant system and equipment availability and reliability. Maintenance management has neither clearly and consistently communicated expectations and standards, nor implemented effective performance measures. Personal accountability for problem identification and resolution has not been emphasized. Maintenance and bargaining unit leadership have not recognized that in order to achieve excellent performance they must work as a team to address long-standing issues. Changes to processes, procedures and practices have not been supported by effective action plans, standards of performance, bargaining unit buy in, accountability and first line supervisors functioning as change agents.

2.3 Engineering and Technical Support

Engineering has not effectively addressed long-standing issues in the areas of work management, system engineering, work quality, equipment performance, materiel condition and configuration management. Effective work management has been limited by work backlogs, ineffective screening and prioritization, and resource constraints. System engineering has lacked the resources, experienced personnel and training to effectively implement the system engineering function. Past engineering and safety evaluations have often been noted as inadequate. Long-standing materiel condition and equipment problems have resulted from resource limitations and untimely corrective action. Design and licensing basis documentation has not been completely defined, updated, and consistently maintained. Zion engineering has not always functioned effectively as the design authority and technical conscience of the station.

2.4 Plant Support

The plant support organizations, which consist of radiation protection, chemistry, fire protection, security and emergency planning, have generally performed their assigned responsibilities adequately. Weaknesses were noted in the areas of collective worker radiation exposure, contaminated plant areas, radiation protection performance monitoring and fire protection materiel condition.

3.0 FUNDAMENTAL CAUSE ASSESSMENT - MANAGEMENT AND ORGANIZATION

Upon completion of the Phase 1 and 2 reviews, the ISAT team conducted a review of the causal factors for operations, maintenance, engineering and plant support, and conducted a fundamental cause assessment for the management and organization functional area. Four fundamental causes were evident from the analysis of the causal factors: commitment to excellence, leadership, standards and management skills. Under each of the fundamental causes, the core team identified a set of contributing causes. The fundamental and contributing causes are stated below.

3.1 Commitment to Excellence

ComEd has not consistently maintained focus on the vision of world class performance and a commitment to the principle that strong economic performance must be driven by excellence in nuclear operations and uncompromising safety. The following factors contributed to this fundamental cause:

- There has not been sufficient and consistent appreciation of the resources needed to achieve and sustain long-term best-plant performance. An overemphasis on budget control has resulted in decisions that have hindered or eliminated important improvement projects.
- The organization has not continually pursued a safety culture ahead of production and budgets. Production and budget incentives appear to drive the organization.

3.2 Leadership

Senior management has not consistently provided the leadership to achieve excellence in nuclear operations and safety. The following factors contributed to this fundamental cause:

- Leadership has not always fostered an environment that promoted high standards, shared values, personnel accountability and conservative decision making.

- Improvement initiatives have not resulted in sustained performance improvements and management has not been held accountable for results.
- Accountability has not been consistently understood, practiced or enforced. Accountability often appears to mean discipline to the organization. To many employees, accountability is perceived as punishment rather than coaching and communicating high standards and expectations.
- Training programs have not routinely been viewed as a means to effect change and obtain results. There has been a lack of appreciation for the benefits that training provides. Training has not been continuously evaluated and updated.
- Leadership has not always been able to gain bargaining unit ownership and commitment to nuclear operations excellence.

3.3 Standards

Senior NOD and Zion management have not established consistently high standards of performance. Standards have been accepted by management that result in a tolerance of deficient conditions and nonconservative decisions. The following factors contributed to this fundamental cause:

- Corrective actions at times have been slow, narrowly focused, deferred or incorrectly prioritized to resolve important process, materiel condition and configuration management issues.
- Engineering has not routinely been considered as an essential function for the safe and reliable operation of the station and, therefore, resources have not been provided to correct long-standing issues.
- The operations department has not fully assumed primary leadership in assuring the safe operation of Zion.

3.4 Management Skills

The nuclear organization did not have the required management skills to improve substandard performance, to monitor and continue improvement efforts and to implement sound oversight programs. Senior management did not have a good understanding of the significance and depth of issues at Zion. The following contributed to this fundamental cause:

- Nuclear oversight organizations have not effectively evaluated the available information on plant performance and have not been forceful in influencing constructive management actions for improved performance.
- The budgeting prioritization process has not supported activities for improving station performance. Zion was given an annual budget amount to plan work for the year, rather than planning the work for the year and then acquiring the necessary funds.
- Lessons learned were frequently not communicated, implemented and monitored within the nuclear organization.

- Numerous personnel changes have contributed to instability and distrust, which has hindered upward communication and delayed resolution of important issues. As a result, personnel changes have often not resulted in performance improvement.
- Management personnel selection did not always match a candidate's skills and experience with existing station performance issues.
- Change management has been more like a trial and error process rather than a process which is planned, implemented, evaluated and adjusted, as necessary. There has been a lack of understanding of what it takes to effect change, including the buy in of personnel.

4.0 CONCLUSION

This report provides a brief summary of the ISAT's findings. The ISAT's intent is to provide sufficient detail in its description of the fundamental cause assessment and the functional area causal factors (Attachment A) so that ComEd management can formulate responsive and effective remedial actions.

The ISAT acknowledges the excellent cooperation it received from all elements of the ComEd organization. In addition, the ISAT recognizes ComEd management for understanding the need for an independent self-assessment, maintaining the independence of the Independent Self Assessment (ISA) and sustaining their commitment to the pursuit of vigorous self-criticism.

ATTACHMENT A
ZION INDEPENDENT SELF ASSESSMENT
CAUSAL FACTOR SUMMARY

2.0 FUNCTIONAL AREA CAUSAL FACTORS

The following discussion summarizes the causal factors derived by the ISAT for each of the functional areas of operations, maintenance, engineering, and plant support. As indicated in Section 1.2 of the ISA report, the ISAT's standard for assessment of performance reflected its collective experience and was intended to represent the performance of a best-performing plant. The ISAT's documentation review was generally focused upon the past two years and its observations were of current performance. The ISAT did not reevaluate ComEd's historical decision making process or the conditions under which decisions were made. In addition, the ISAT was directed by ComEd management to identify issues and make critical observations using a low evidentiary threshold. In other words, ComEd management did not expect the ISAT to definitively demonstrate the existence, frequency or breadth of a particular problem. Instead, when the ISAT's observation and experience indicated the likely existence of a particular problem, it was expected to identify that problem so that ComEd management could take appropriate action.

2.1 Operations and Training

The ISAT review of Zion operations uncovered seven major areas of concern. The findings describe in broad terms "what is missing" or "what prevents" Zion from becoming a best-performing plant. Causal factors for each of the seven areas are provided below.

2.1.1 Conservative Operating Philosophy

Within the operations organization there is a lack of appreciation for conservative decision making and the role it has in the defense-in-depth concept. Operations does not act as a standards bearer or as the gatekeeper for safety.

2.1.1.1 Causal Factors

- No clear definition has existed for conservative decision making and no role model of a conservative decision maker existed.
- Conservative decisions are seldom reinforced or celebrated to demonstrate desired behavior.
- Production and schedule have been the overriding considerations in making hour-to-hour decisions. Current senior management philosophy on conservative operations is in its early stages of implementation.
- Simulator training is not used as a tool to reinforce expectations for conservative decision making.

2.1.2 Tolerance of Deficient Conditions

Management and operators have accepted deficient conditions. Acceptance of these deficient conditions is not in keeping with industry standards. Further, these deficient conditions have affected plant performance. At Zion, little ownership of performance improvement existed. Specifically, operators have not taken a lead role in improving performance.

2.1.2.1 Causal Factors

- Corrective actions are administrative in nature and do not appear to prevent recurrence.
- Problem identification forms (PIFs) are viewed as speeding tickets and do not substantively address issues.
- Action Requests (ARs) are not written to identify all issues because operators believe less important issues will not be corrected.
- The standards of the organization are too low and are not consistent with an excellence in operations philosophy.

2.1.3 Line Management Ownership of Training

Training was not utilized to deliver and reinforce expectations, communicate standards of performance, or prepare operators for organizational change. Training was not utilized as a tool to drive change to improve operations performance. Training is viewed as a license requirement with minimal impact on human performance. It is used only to "brush up" on technical skills. Operations management has not maintained an active ownership of training.

2.1.3.1 Causal Factors

- Because training is not recognized as a vehicle to make change, management has not taken a personal and aggressive interest in training. A lack of ownership of training is clearly evident.
- Poor enforcement of standards exists including inadequate critiques and a tolerance of late arrival to class.
- An uncooperative atmosphere exists between instructors and shift personnel. The majority of feedback to the ISAT on training was negative.

2.1.4 Operations Human Performance Plan

The operations performance plan does not address the centerpiece of operational excellence which is human performance. There have been numerous occasions where human performance has been deficient. Operator human performance is a significant issue at Zion.

2.1.4.1 Causal Factors

- Operations department expectations are not clear and lead to confusing standards on human performance.

- There has been a long-standing reluctance to confront substandard human performance. Previous management has indirectly promoted a culture of inaction on human performance issues.
- There has been a lack of feedback and coaching by supervision on human performance issues. This is a result of lack of supervisory skills, lack of management support for tough decisions that address human performance and a low understanding of the impact of positive feedback on human performance.

2.1.5 Operational Excellence

The attributes utilized for assessment of operational excellence are the following:

- Good procedure quality
- Strong procedural adherence
- Sound communication techniques
- Solid self-checking programs
- Positive operator bearing with a questioning attitude
- Conservative decision making
- Good use and acceptance of supervisory oversight
- Technical competence and attention to detail

During the ISAT visit to Zion, numerous signs and posters were observed which addressed being "committed to world class performance" of which operational excellence is an integral part. This was considered a visible sign of management's commitment to excellence and a continual reminder to employees of management's philosophy.

When individuals in operations were observed it became apparent that few individuals did a reasonable job of demonstrating any of the aforementioned eight attributes of operational excellence. From conversations with operators it was apparent that there was little recognition as to how an individual could contribute to improving performance of Zion operations.

2.1.5.1 Causal Factors

- Individuals did not recognize that a fundamental commitment to operational excellence and nuclear safety results in long-term economic performance. These individuals did not understand that the best-performing plants were invariably the most cost competitive. Little recognition existed of the INPO study regarding this subject.
- Operations management does not communicate consistent expectations as to what constitutes excellence.
- Zion has had an insulated culture. Individuals do not realize that the nuclear industry has significantly changed. More importantly, in certain instances they do not realize how much they must change just to catch-up with acceptable industry practices. Mediocrity appears to have been acceptable at Zion, indicating a lack of understanding of operational excellence.

2.1.6 Gap Between Management and the Bargaining Unit

As previously identified, the ISAT also determined that bargaining unit and management relations require additional attention. It appears to the ISAT that management and bargaining unit personnel do not understand that the success of Zion requires interdependence of action, one group cannot succeed without the other. A philosophy of "we are all in this together" does not exist.

The gap between management and the bargaining unit is a significant issue confronting Zion. The ISAT is not aware of a nuclear station that has achieved high levels of performance without a fully engaged workforce. At Zion, management has pointed to the bargaining unit as the source of declining performance while the bargaining unit has pointed to management. Both sides have not taken responsibility to resolve their differences.

2.1.6.1 Causal Factors

- There is a perception of a hidden agenda on the part of management and on the part of the bargaining unit. Full disclosure of the "whys" of actions taken by both management and the bargaining unit does not always appear to exist.
- A class system is perceived. All decisions appear to the workers as being made on the "sixth floor" by senior management.
- A high degree of mistrust exists. The bargaining unit does not trust or believe management, and management does not trust the motives of the bargaining unit.
- Poor communications exist. Issues are not completely shared, expectations are not continuously reinforced and dialogue is not fostered.

2.1.7 Bargaining Unit Pathway to Management

A number of Nuclear Station Operators (NSOs) are at the upper limit of their bargaining unit career path. Most licensed shift supervisors (LSS) are instant senior reactor operators (SRO) while many of the NSOs have had many years of experience in Zion operations. This difference in experience has created an "us versus them" situation and also amplifies the difference between a supervisory position and an operator position.

2.1.7.1 Causal Factors

- The bargaining unit views the union as a protective umbrella; a promotion is viewed as a loss of this protection.
- Inconsistent standards result in confrontations between the NSOs and Control Room Supervisors (CRSs). This widens the gap between the bargaining unit and management which in turn reduces the interest and motivation in being promoted to management.
- The bargaining unit perceives the existing operations standards as unclear in certain areas and unnecessary in others. If promoted into management, they would be responsible for enforcing standards that have been poorly received.

- The adversarial relationship between the bargaining unit and management contributes to the reluctance to pursue advancement.

2.2 MAINTENANCE

During the assessment of the maintenance function, four issues were raised which impact Zion's ability to identify, prioritize, plan, schedule and execute work. These issues have resulted in large work backlogs, poor materiel condition, and low system and equipment availability and reliability. These issues involve substandard performance in the following areas:

- Work control process
- Preventive maintenance program
- Maintenance department management
- Change management

These major issues, along with significant subtler issues, are discussed in detail below.

2.2.1 Work Control Process

The work control process at Zion has not supported identification, prioritization, planning and execution of work. This resulted in significant work backlogs and hindered station responses to issues important to safety and production. There is a work request backlog of more than 2200 items and as much as fifty percent of the work on the schedule is emergent work which has not been effectively planned. The problems in the work control area may be masking other concerns such as worker skill and productivity.

2.2.1.1 Causal Factors

- The primary cause for work control system deficiency issues is a lack of an effective change management methodology for implementation of significant changes in Zion processes and procedures. Changes to the work management system and the creation of the Fit It Now (FIN) team were implemented without a fully integrated change plan. The impact on implementing organizations (maintenance, operations and scheduling) and their roles in the change process were not completely considered.
- Management support during implementation was weak. The mission for the FIN team was not clearly defined and communicated. The process owner, who initiated the change for the work control system, was moved two months after implementation began. A new process owner was not assigned until five months later. This change management approach has resulted in a lack of ownership of the work control system by Zion personnel and misdirection of the FIN team. Personnel have no faith in these processes and consequently do not support those activities that would make them function properly.

2.2.2 Preventive Maintenance (PM) Program

The PM program is not being properly implemented. There are numerous PM tasks past their due date. In addition, there are over 100 PMs past their critical date. This has been a long-standing problem and has been previously identified. A NOD program to standardize and streamline the PM programs at all ComEd stations is being implemented at Zion. At present, problems with work planning, scheduling and execution are nullifying the impact of these improvement efforts.

2.2.2.1 Causal Factors

- Management has not provided the leadership and clear communication of expectations required to ensure that an effective PM program has been developed and implemented.
- The PM program is given a lower priority than issues related to production. PM tasks have been routinely delayed due to resource unavailability or grid conditions.
- Management has not viewed the PM program as a key factor in maintaining Zion reliability and availability.

2.2.3 Maintenance Department Management

The overall management of the maintenance department has not met high standards in a number of areas. Maintenance management has not clearly and consistently communicated expectations and standards.

Holding first line supervisors and workers accountable for meeting challenging standards has not been a part of Zion's culture. Supervisors are not in the field to the extent required to ensure that maintenance work meets accepted standards. The training program for supervisors and workers is weak.

This has resulted in maintenance department performance that is below industry standards. Significant work backlogs exist. Rework, when measured, has been significant. The PM program is not being implemented, equipment reliability is low and plant materiel condition is poor. Overall, work skills appear to be weak.

2.2.3.1 Causal Factors

- There has not been a maintenance department practice of holding workers personally accountable for identification and resolution of problems.
- Maintenance management has tolerated low standards. As a result, those activities which establish performance at or above industry standards and long-term improvement are not supported. These include: developing and implementing challenging expectations; tracking expectation implementation with the appropriate performance indicators; holding supervisors and workers accountable; developing and implementing effective training programs; and challenging those corporate, station and department policies that hinder achieving top performance in maintenance.

- Maintenance management and bargaining unit leadership have not recognized that in order to succeed they must work as a team to address long-standing issues.

2.2.4 Change Management

The inability to create and implement effective change management plans has impacted maintenance department performance. The implementation of the Electronic Work Control System (EWCS) and twelve week schedule offer clear examples. There are numerous examples of process, procedure and methodology changes undertaken without considering the impact on other departments and processes. Action plans are not always documented and, if they are, implementation is typically not tracked. First line supervisors and workers are not engaged in or held accountable for making the changes required to achieve top performance.

2.2.4.1 Causal Factors

- The changes required to improve maintenance department performance at Zion involve problems with long-standing, fundamental policies, processes and procedures. They involve addressing bargaining unit and management relations. A key element that has been missing in previous change plans is the selection, training, empowerment and support of first line supervisors as the principal implementors of required changes. This has been a significant barrier to implementing change.
- Maintenance management has set standards of performance that are below those typically set by industry. There has been no accountability for changing these standards. As a result, there is no driving force for resolving the difficult challenges associated with implementing the changes needed to achieve best performance in the maintenance department.

2.3 ENGINEERING AND TECHNICAL SUPPORT

The engineering organization was assessed to determine its performance as the design authority and technical conscience of Zion. The ability of the engineering organization to provide high quality and responsive engineering and technical support to other station organizations was also assessed.

The ISAT determined that the performance of Zion's engineering is significantly below that of best-performing plants. Engineering has primarily focused on resolving short-term emerging issues. Engineering has not effectively addressed long-standing equipment issues, necessary programs and resource issues needed to establish and sustain good performance. This has been demonstrated by repeated equipment failures, inadequate design and licensing basis documentation, increasing backlogs and inadequate safety evaluations. The following areas were found to be in need of improvement:

- Work management
- Engineering work quality
- System engineering function
- Long-standing equipment and materiel condition
- Design basis and configuration management

Deficiencies in these areas have been identified in the past, were confirmed in this assessment and have existed for several years. The reasons for these deficiencies are discussed below.

Past leadership of the engineering organization has not been effective in establishing, communicating, and enforcing high standards of performance. Low standards of performance have been tolerated, and less than adequate work products have been accepted. Corporate and Zion engineering management have not provided the direction, focus and coaching needed for the staff to be successful. Contributing to this has been the large turnover of supervisors and group leads within the engineering organization.

Zion engineering is a reasonably young organization. Prior to 1993, the majority of design engineering was performed by architect engineers. The Zion engineering organization was developed without a well-defined implementation plan.

Engineering has generally supported day-to-day operations but has failed to plan for and manage its long-term responsibilities. Resource constraints in engineering were not effectively communicated to other station groups and support of other departments for work prioritization was not obtained. A lack of engineering teamwork was noted during the evaluation. Engineering teamwork with the station for work prioritization was lacking. Strong teamwork was not exhibited during engineering meetings or in meetings with other station departments.

Performance goals and measurement indicators have not been established and consistently implemented to improve engineering performance. Corporate and Zion management have not committed the appropriate resources to achieve engineering excellence. Engineering has not been a self-critical learning organization. It has not implemented corrective actions known to be important. An environment exists where individuals do not bring errors or problems forward for the purpose of improving performance. Finally, Zion engineering has not postured itself to be the technical conscience of the station which is needed to achieve and sustain excellence in operations.

The performance of engineering in each area noted above is discussed below:

2.3.1 Work Management

There has been inadequate identification and control of engineering work activities. There has also been ineffective screening and prioritization of requested engineering work by operations, maintenance and engineering. Priorities frequently change and engineering is not always working high priority items with the proper individuals to support Zion's needs. The lack of effective work management inhibits engineering from being proactive and having the ability to self-identify and correct problems in a timely fashion.

2.3.1.1 Causal Factors

- Engineering lacks an effective work control system to manage its workload.
- There is clearly too much work to do with the resources available. Resource constraints in engineering have not been effectively communicated to other site groups.
- Engineering management has not been an effective champion for engineering issues and "driven home" the need to address important engineering work in a timely and complete fashion.

2.3.2 Engineering Work Quality

Past engineering evaluations and safety evaluations have often been inadequate. In some instances the design basis was not well understood.

2.3.2.1 Causal Factors

- The importance and significance of safety evaluations and assessments have not been fully appreciated by the engineering staff.
- The safety culture within engineering is weak. The engineering staff has not recognized the need to make changes to improve the safety culture.
- Design and licensing basis information has not always been maintained up-to-date.
- In some cases, the technical knowledge of the engineering staff is deficient. Past training has not been sufficient to improve performance.

2.3.3 System Engineering

A proactive system engineering function is not being implemented. System engineers are mainly reacting to daily requests for support and are frustrated by constantly changing priorities.

2.3.3.1 Causal Factors

- System engineers have not been able to fulfill their roles and responsibilities. System engineers are often engaged in nonsystem engineering activities such as project management, work package preparation and routine post maintenance testing. There is a lack of task prioritization and system engineers are mainly reacting to short-term crises.
- Training has not been effectively used to improve system engineering performance. System engineers have not been required to determine system design, operational and testing requirements and assure these requirements are met.

2.3.4 Long-Standing Equipment and Materiel Conditions

The identification and resolution of long-standing equipment problems have not always been rigorously pursued by engineering. A number of long-standing and recurring equipment problems have not been resolved.

2.3.4.1 Causal Factors

- Management has not provided sufficient resources or reinforced the timely resolution of many equipment problems. The cause of equipment problems is not always determined unless there is an immediate impact on Zion operation.
- Proper root cause analysis has not always been utilized.
- Corrective action programs to address equipment problems have been developed and planned but not implemented.

2.3.5 Design Basis and Configuration Management

Lack of design basis information and configuration management control have been identified on a number of occasions. Discrepancies between the Updated Final Safety Analysis Review (UFSAR), Technical Specifications, plant drawings, and as built conditions have been identified.

2.3.5.1 Causal Factors

- Zion design and licensing bases documentation has not been completely defined, has not been updated and is not easily accessible. Existing Design Basis Documents (DBDs) do not contain sufficient information and are not maintained current.
- Budget constraints have affected the completeness of design information documents.
- Zion engineering has not postured itself to be the design authority and technical conscience of the station. Engineering management has not effectively championed configuration management issues and "driven home" the need to address these issues in a timely and complete fashion.

2.4 PLANT SUPPORT

Plant support consists of radiation protection, chemistry, fire protection, security and emergency planning. At Zion, plant materiel condition and housekeeping present challenges to the quality of the radiation protection program and the fire protection program. The radiation protection program is also impacted by the practices of plant workers doing work within the radiologically posted area (RPA). All plant support functions are adversely impacted by the failure of management to prioritize and allocate the resources necessary to maintain high performance in the plant support areas. Notwithstanding these adverse factors, the plant support functions have been implemented adequately.

2.4.1 Radiation Protection

2.4.1.1 Worker Radiation Exposure

2.4.1.1.1 Causal Factors

- The radiation source term in the plant is higher than the industry median. Over sixty-five "hot spots" exist in the plant. Additional effort is needed to reduce or eliminate these hot spots. A prime example of major hot spots in containment is the resistance temperature detector (RTD) manifolds in each reactor coolant loop. Most utilities removed the RTD manifolds some years ago.
- The cobalt reduction program, while initially making progress, has slowed recently to the point that little progress is being made.
- Early boration, commonly used during major shutdowns at pressurized water reactors that have been effective in reducing the source term, have only recently been adopted at Zion.

- Radiation worker practices contribute to higher radiation worker dose. Observations and records of worker practices include: workers awaiting work lingering in areas other than the low dose area, a worker not following the radiation work permit (RWP) and work instructions, resulting in a significant uptake of airborne radioactivity; and numerous examples of poor housekeeping practices. On the positive side, a training program called "enhanced N-GET" was developed which has been successful in significantly reducing personal contamination events (PCE). However, current plans are to discontinue the program.
- Conduct of maintenance contributes to the higher worker exposure at Zion. Analysis of ALARA exposure records indicates that emergent work is a major contributor to the failure to achieve ALARA goals. While it is expected that unplanned emergent work will add dose to total worker exposure, the degree of emergent work undermines the dose goal setting process, thus reducing the effectiveness of the ALARA process. In addition, this places added burden on the radiation protection department to hurriedly prepare an ALARA analysis that might not be as effective as an analysis that was prepared in ample time before the actual performance of the job. Further, repeat work and rework unnecessarily add to worker exposure.
- Full management support for the ALARA Program has not existed and ownership of dose by departments and sections is not consistent. For example, the chairman and several key members of the ALARA review committee failed to show up for a scheduled committee meeting. In response, the new site vice president appointed himself the new chairman. He rescheduled the meeting for later in the day and required the attendance of senior Zion management.

2.4.1.2 Contaminated Plant Area

2.4.1.2.1 Causal Factors

- The apparent cause of the large number of contaminated areas is the material condition of plant equipment. Leaks and drips from piping and components cause widespread contamination. Accumulation of leakage products and chemical deposits have caused the contamination levels of these areas to become higher. Continued neglect of the buildup of contamination in the RPA will continue to cause inefficient operation and maintenance of Zion.
- Poor housekeeping in some areas (i. e., anti-C clothing, mop heads, ladders, loose plastic, a detached catch basin, loose buckets, 55 gallon drums and caustic were scattered on the floor) exacerbates the contamination issue.

2.4.1.3 Radiation Worker Practices

2.4.1.3.1 Causal Factors

- Poor radiation worker practices are due in part to a low level of mentoring and coaching by supervision of their workers in the field. Many workers report that their supervision is seldom seen at the job site.

- Workers seldom write PIFs on the activities of other workers, so the opportunities to learn the extent of radiation worker problems and to develop specific remedies to correct those problems are missing.

2.4.1.4 Performance Indicators and Benchmarking

2.4.1.4.1 Causal Factors

- A lack of meaningful management performance indicators and benchmarking at Zion contributes to management's inability to fully appreciate the extent to which corrective actions must be applied to become a best-performing plant. Therefore, development of extensive performance indicators to help to manage these areas was not considered important.

2.4.2 Chemistry

The analytical equipment, techniques, quality control and expertise to perform accurate and consistent analysis has been demonstrated by the chemistry staff. The bases for chemical treatment programs at Zion have been consistent with industry practice.

2.4.3 Emergency Planning

Except as noted below, the performance of emergency planning at the station is satisfactory.

2.4.3.1 Operations Support Center

2.4.3.1.1 Causal Factors

- The location of the OSC is not shielded nor does it have a filtered breathing air supply and would therefore not be habitable during a significant release from the plant. It would be a best practice to change the location of the OSC to a shielded, filtered location.

2.4.4 Fire Protection

2.4.4.1 Material Condition of Fire Protection Equipment.

2.4.4.1.1 Causal Factors

- Cognizant personnel indicate that the reason for the large number of outstanding work orders is the low priority given to maintenance of fire protection equipment.

2.4.4.2 Fire Protection Equipment

2.4.4.2.1 Causal Factors

The root causes of the high rate of emergency lighting failures was determined to be:

- A failure to recognize that the failure rate was excessive.
- No root cause analysis was performed.
- Inadequate surveillance procedure.

- Failure to follow procedure.
- Failure to take corrective action.

In addition, 6 volt battery voltage readings were recorded for some 12 volt batteries. The issues surrounding the emergency battery issues indicate a breakdown of management control over the testing and maintenance of this important fire protection system.

2.4.5 Security

2.4.5.1 Security Performance

2.4.5.1.1 Causal Factors

- The cause of a moderate decline in security performance was determined to be low morale caused by excessive overtime resulting from staffing shortfalls. The corrective actions of the security department were examined and determined to be adequate. However, the overall effectiveness of those plans should be reevaluated periodically until performance regains its proper level.