Docket No. 50-336
B14611

Attachment 1

Millstone Nuclear Power Station, Unit No. 2

Independent Review Team Report

September 1993

INDEPENDENT REVIEW TEAM REPORT

MILLSTONE UNIT 2

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Date Sept. 9, 1993

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1.0 INTRODUCTION

In May 1993, a leak developed in the body-to-bonnet joint of 2 inch letdown valve 2-CH-442 on Millstone Unit 2. The valve was not isolable from the primary system, and a decision was made to use an injection repair process while maintaining the unit at power. Repeated repairs were attempted over the ensuing months with varying degrees of success. In early August, during one of these repairs, the valve leakage suddenly increased and the plant was promptly shut down. Upon disassembly, it was determined that one of the four studs connecting the bonnet to the valve body was broken. The significance of this event was the potential for a Small Break Loss of Coolant Accident (SBLOCA) with the attendant decreased margin of safety and the risk of injury to employees.

During the shutdown to replace this valve and the subsequent startup, three noteworthy operating events occurred.

- Primary system drain valves were left open during restoration from a freeze seal. This resulted in the inadvertent draining of water from the Reactor Coolant System (RCS) to the containment sump.

- A steam generator nitrogen purge line was not isolated from the secondary system while the plant was in cold shutdown. This resulted in an overpressurization of this line upon plant heat up.

- An automatic reactor trip resulted from low steam generator level.

Plant management assembled teams to investigate these events. Attention was focused on the cause of the stud failure on 2-CH-442. Metallurgical evaluations were initiated which remain incomplete at the time of this report.

On Thursday, August 19, Northeast Utilities (NU) Site Management directed that a review group be formed. This initiative was further strengthened on Friday, August 20 when senior NU management directed that an Independent Review Team (IRT) be assembled immediately at the Millstone Site to evaluate this event and the recent operating history of Millstone Unit 2. The direction to the IRT, as described in Appendix I, was to determine the causes for the apparent decline in the unit performance and to re-evaluate the basis for continued operation of the unit.

2.0 INDEPENDENT REVIEW TEAM (IRT) COMPOSITION

The IRT was established as an assessment organization, independent of the operating line organization. The group reports directly to the Chief Nuclear Officer (CNO) of NU. The CNO has designated a corporate officer, the VP, Nuclear-Engineering Services, Northeast Utilities Service Company (NUSCO), to chair the committee. This Officer is the Chairman of the company's highest level nuclear safety oversight committee (Nuclear Review Board) for the Haddam Neck Plant and Millstone Unit 3.

To aid in assuring independence of the line organization and in gaining the broadest perspective of the overall issues, senior level managers joined the team from North Atlantic Energy Services Corporation (NAESCO), the Institute of Nuclear Power Operations (INPO), and Connecticut Yankee Atomic Power Company (CYAPCO).

Team Members

E. A. DeBarba, Chairman, VP-Nuclear, Engineering Services, NUSCO
M. F. Ahern, Supervisor, Procurement Engineering, NUSCO
M. V. Bonaca, Director, Nuclear Engineering, NUSCO
P. Callaghan, Manager, Nuclear Safety Engineering, NUSCO
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3.0 PROCESS

The Charter, Appendix I, describes the scope of the IRT. This scope includes an assessment of the bases for continued operation of Millstone Unit 2 and the cause for the decline in performance. The IRT was directed to perform this review expeditiously.

The IRT was chartered to review Millstone Unit 2 operations from the beginning of the current fuel cycle to the present to gain the proper perspective. The assessment relied partially upon previous reviews performed by other assessment organizations, e.g., the NU Quality Organization, INPO, the Nuclear Regulatory Commission (NRC), and other task forces. The IRT relied heavily on interviews with key individuals within the NU organization, both at the Millstone Site and at corporate headquarters in Berlin. Management levels of the Millstone Unit 2 chain of command were interviewed, from the President and Chief Executive Officer, to the Supervising Control Operators. In addition, other supervisors, individuals in key support roles, and selected management peers on other Millstone units were also interviewed.

In all cases the interviewees were candid and cooperative. The IRT considers the identities of the individuals interviewed and the specific information provided to be confidential. Therefore, this report will not identify the source of any specific comment. The IRT avoided making any judgements based solely on the comments of a single individual. The IRT utilized multiple sources to develop and validate its conclusions.

The IRT utilized a process similar to that used during INPO plant evaluations, wherein individual observations are grouped under broad headings and reviewed for common themes. Themes were established and subsequently validated by either direct observation or interviews. The IRT met as a group to discuss these common themes and to debrief from interviews. During the

course of these discussions the category of design control was revised to more accurately reflect the issue of "Letdown Valve 2-CH-442" and the category of configuration control was expanded to capture the overall issue of "Operational Performance".

This report presents the IRT's findings and conclusions for each of the issues evaluated. An "Assessment of the Basis for Current Operations" is included along with short and long term recommendations for performance improvement.

4.0 BACKGROUND

Millstone Unit 2 has a long history as a capably managed and operated nuclear power plant. The unit is staffed by an experienced group of dedicated personnel, and the turnover rate is low. Prior to 1991, the Unit had received generally good Systematic Assessment of Licensee Performance (SALP) and INPO scores. The Licensed Operator Requalification program at Millstone Unit 2 has historically been very strong. Millstone Unit 2 has had steam generator problems since early in life, which have posed recurrent challenges to plant operation. The steam generators were replaced in 1992 during an eight month refueling and maintenance outage.

The 1991 SALP concluded that a performance decline had taken place at Millstone Station. In response to this performance decline, and to address broader issues within the NU nuclear organization, the Performance Enhancement Program (PEP) was undertaken. This program addresses the root causes of the decline in nuclear performance.

In 1993, Millstone Unit 2 had a series of events which indicate a decline in performance. The unit has had five reactor trips at power, and three additional Reactor Protection System

initiations with the controls rods fully inserted since startup from the refueling outage. As of August 6, the date of the shutdown for 2-CH-442, eleven valve mispositioning events had occurred for the year. The Unit has received nine Notices of Violation from the NRC since the first of the year. The unit has recently received three severity level IV violations for recurring configuration control problems. In the cover letter to the inspection report, the NRC noted a concern with the ineffectiveness of previous corrective actions to prevent recurrence.

Finally, in early August, the unit experienced the 2-CH-442 valve event. During the associated outage, the unit experienced two configuration control events and an automatic reactor trip at low power. A time line of the noteworthy events since January 1, 1993, is attached as Appendix III.

5.0 ISSUES

5.1 LETDOWN VALVE 2-CH-442

The events surrounding the repair efforts and ultimate failure of the stud on 2-CH-442 have been reviewed in detail by the IRT. A detailed analysis of the timeline for the 2-CH-442 valve event is included as Appendix II. The review of this event resulted in two findings which are discussed below.

- The significance of the repair activity was not fully appreciated. At different times during the repair work on 2-CH-442, questions were raised by various individuals. These questions ranged from personnel safety to valve operability pertaining to a potential valve body crack. These questions were brought to the attention of the employees' supervision and were dispositioned based on technical arguments. These issues were not viewed in the broader context of failure consequences. When faced with a structurally degraded valve and the possibility of a crack, the discussion focused on the Technical Specification implication of a crack. The underlying concern of the material condition of the valve and its location in the RCS boundary were lost. Each communication with the NRC reflected a growing level of concern on their part. This did not result in a step back and a "big picture" review by management. The repair evolution was widely known throughout NU but the significance was not truly appreciated. In retrospect for this event, the NU organization's threshold for shutdown was too high.

- The organization was overconfident. Injection repairs have been used at NU in the past with acceptable results. Based upon this experience, the significance of the potential consequences was minimized. No safety evaluation was required by NU procedures. The significant differences of

the application to a primary system versus a secondary system valve as it relates to the consequence of failure were not fully appreciated. Drilling and peening were not effectively communicated or controlled. The focus was on technical evaluations and not on implementation control. Due to the history of successes, a high level of confidence was placed on the expertise of NU's Corporate Stress Analysis personnel as well as the vendors performing the injections.

Conclusions

While the stud failure of 2-CH-442 did not result in significant physical consequences, it could have resulted in a serious event with nuclear safety consequences. This event is an example where overconfidence in a familiar process and in technical evaluations led to a poorly executed process. The thought process remained narrowly focused and the evolution progressed too long before a decision to shutdown was made.

5.2 OPERATIONAL PERFORMANCE

The IRT identified the following trends during its review of the current operational history of Millstone Unit 2.

- The operational philosophy at Millstone Unit 2 has not always been sufficiently conservative to assure excellence in operation. Decisions regarding operability have been too narrowly focused at times. Operators need to better appreciate their unique position and responsibilities as holders of NRC licenses to operate the unit. As license holders, they have a responsibility to challenge issues with which they do not agree. Operators who make difficult conservative decisions must be positively reinforced by management.

- The operators' standards were not high enough to ensure excellence in operation. The operators have tolerated unsatisfactory performance in the areas of plant operations (five trips at power this year), configuration control, reportability, and operability. Because their standards were not high enough, the declining performance trend was not recognized by the operators.

- The operators have delegated a few aspects of ownership of the plant. Operability determinations have relied excessively on input from the Duty Officer and Station Management. Other departments were allowed to manipulate valves that historically were within the responsibility of the Operations Department. This condition has resulted in some of the observed configuration control problems. The implementation of the Integrated Team (I-Team) has led to a reduction in operator awareness of work in progress and potential confusion as to who is in charge.

Conclusions

The operators of any nuclear power plant bear a unique responsibility for nuclear safety. Exercising this responsibility properly requires that they hold themselves, their peers, and their management to the highest standards of performance. Good operators are, of necessity, questioning operators. They do not automatically accept everything that is presented to them. If the operators allow their standards to be lowered, they reduce their ability to recognize problems. The result is that poor performance may not be recognized.

5.3 MANAGEMENT/ORGANIZATIONAL ISSUES

The IRT has concluded that the following management issues were directly related to the performance decline at Millstone Unit 2.

- The priority of nuclear safety over production goals has not always been properly communicated. The need to continue operation was communicated frequently, while nuclear safety sometimes appeared only to be implied. Nuclear safety was sometimes equated with adherence to a narrow set of regulatory requirements. Questioning attitudes were not always encouraged. Because of this, the first priority of nuclear safety may not always have been in proper focus.

- Management has accepted minimum standards. Management had developed an approach to evaluating the operability of Technical Specification governed equipment that was based on very narrow interpretations of minimum regulatory requirements. Management had allowed the continued use of informal configuration controls in spite of the number of valve mispositioning events.

- Management had not effectively reinforced accountability. Some supervision believed that accountability consisted mainly of counseling individuals even after repeated performance deficiencies. Management did not hold supervision accountable to effectively correct performance issues. In some instances, management characterized average results as excellent performance.

- Management had not been effective in addressing recurrent weaknesses. There have been indications of performance weaknesses which have existed for a period of time, which should have identified the need to improve performance. There have been both external assessments, such as SALP and INPO, as well as internal reports, Plant Information Reports

(PIR's), Licensee Event Reports, that have indicated a decline in performance. Management response to date has not been effective in reversing the trend.

- Management had not effectively managed change. Program changes such as the I-Team were implemented without an effective transition plan. This resulted in some confusion in roles and responsibilities which contributed to events such as the inadvertent draining of the RCS water when melting the freeze seals.

- Too much senior management time has been spent on non-operational matters, detracting from the time available to focus on needed changes in culture and standards. Millstone Station demands a stronger leadership presence on site. On a site as complex and varied as Millstone, strong leadership presence is essential to give the site a consistent direction.

Conclusions

The priority of nuclear safety over production goals must be clearly communicated, with an emphasis being placed on safe, conservative operations. Reliance on statements regarding safety ethic is not sufficient. There is a need for management to lead by example; e.g., by encouraging questioning attitudes, by endorsing a conservative operating philosophy, and by continuously demonstrating management commitment to safe, conservative operations. Management needs to raise the standards that define conservative operation, by raising expectations on equipment (definition of operability) and operating personnel alike. Observations by external organizations and constructive questioning by staff personnel should be viewed as aids to improve operations and to raise standards and expectations. Higher standards of operation will aid in the recognition of emerging problems and in the prompt implementation of aggressive corrective actions to address them.

5.4 ROOT CAUSE AND CORRECTIVE ACTION

The IRT looked at various elements of the root cause and corrective action programs.

- Root cause activities at Millstone Unit 2 have often focused on individual events rather than the collective effect of similar events. Review of individual events led to narrow corrective actions which were more effective in identifying symptoms than in addressing underlying causes. Corrective actions have not been effective in a number of areas. Some examples include: reactor trips, work control, feedwater control, and valve mispositions.

It should be noted that the IRT has reviewed the initiatives associated with the recently formed PIR Task Force and considers these initiatives as an effective method to improve the capabilities of Millstone Unit 2 staff to assess, evaluate, and identify causes and causal factors associated with events and issues. This initiative should help the line organization to more effectively evaluate events such that all issues resulting from a structured review are captured and addressed. Instilling the concepts that the PIR investigators will gain from this initiative to line management and supervision should result in improved cause determinations.

5.5 INDEPENDENT ASSESSMENTS

The independent assessment organizations (Plant Operations Review Committee, Quality Services, and Nuclear Review Board) have not been effective in recognizing the organizational performance decline at Millstone Unit 2 and in ensuring the implementation of the appropriate corrective actions.

These organizations have identified a number of technical issues and selected declining performance trends (e.g., procedure compliance, human performance events, and corrective action program deficiencies) via their own reporting mechanisms. These issues and other sources of performance information (NRC, INPO) are not well integrated, assessed, and evaluated in a way that would identify on a real time basis that an organizational performance adverse trend.

A number of initiatives (e.g., PEP Action Plans, restructuring of Nuclear Review Boards, and organizational change within Quality Services) are underway to improve the effectiveness of these independent organizations. Executive management must take action to ensure these organizations provide independent assessment conclusions in a way that organizational performance can be assessed, that line management takes action when the performance needs to be improved, and that corrective actions are evaluated for lasting effectiveness.

5.6 PEP EFFECTIVENESS

The PEP was developed in early 1992 in order to reverse the declining performance trend of the NU nuclear program observed in 1991. The PEP is a comprehensive program which includes series of Action Plans designed to address:

Series 1 - People, Culture, and Management Issues
Series 2 - Programs and Processes
Series 3 - Self-Assessment Capability
Series 4 - Other Programs

Implementation of PEP Action Plans has been underway for approximately one year. However, some actions will not be completed until 1996.

The cultural and management issues, as well as some of the programmatic issues identified by this review, are within the scope of the PEP Action Plans. Implementation of these PEP Action Plans has not yet been completed. Therefore, it would be premature to reach any conclusions regarding the effectiveness of the PEP Action Plans.

5.7 EVENT INVESTIGATION TRIGGERS

The IRT has concluded that the events evaluated in this report should have prompted more timely response and involvement of NU nuclear management. The significance of the events surrounding 2-CH-442 and unit restart after repair should have prompted a management review. The IRT has reviewed the reasons why the nuclear group did not take prompt action in response to these events.

The IRT believes that the belated response of nuclear management is due to low organizational sensitivity to the operational events in question. Two factors contributed to lowering the sensitivity of the organization to these events:

- Management did not fully appreciate the significance of the events surrounding 2-CH-442. There was general comfort with the repair procedure of 2-CH-442 at power, which was not perceived as challenging the integrity of the valve. The significance of the broken stud identified during valve replacement was not fully appreciated. The events surrounding restart were viewed as isolated events, and were not viewed as part of an eight month trend.

- Continuity of management presence was negatively affected by external assignments and other activities. This lack of continuity prevented management from appreciating the global significance of events that occurred over some period of time.

6.0 ASSESSMENT OF THE BASIS FOR CURRENT OPERATIONS

In the course of its evaluation, the IRT has raised a number of issues that have the potential to affect the basis for current operations at Millstone Unit 2. The team feels that, while these issues are significant and warrant prompt action to correct them, nonetheless the unit staff will safely operate the plant while the needed changes are implemented. In order to support this conclusion, these changes should be implemented in three phases.

Immediate Actions

The issues which the team felt needed immediate corrective action fell in the areas of operational philosophy, configuration control, and work on principal safety barriers. The team felt that there was a need for an immediate change in operational philosophy to make it more conservative. The team noted that the Millstone Station Vice President has been placed directly in charge of the operation of Millstone Unit 2. The team is comfortable that this interim change, coupled with a direct communication to the operators of management expectations for conservative operation, is adequate in the near term to ensure that a conservative operational philosophy is used to run the unit.

In the area of configuration control, the team noted that the new Millstone Unit 2 "Performance Improvement Initiative" contains near-term action plans to formalize the configuration control processes at the unit. The team has reviewed the plans and considers them adequate.

Finally, in the area of work on principal safety barriers, the team noted that the NU nuclear plants have implemented the team's recommendations regarding repairs on any RCS components and the performance of safety assessments for injection repairs on any QA Category I components.

Short Term Recommendations (Section 7.1)

The issues addressed by these recommendations are: communicating management expectations for conservative operation of the plant, reinforcing management's standards, reinforcing the special role of licensed operators on the front line of nuclear safety, and management's expectation that the operators reassert their ownership of the plant. The team believes that based on the immediate actions taken to date, the issues raised above can be addressed adequately in the short term.

Long Term Recommendations (Section 7.2)

These recommendations are necessary to provide a basis for improved plant performance and to create a plant culture where events such as 2-CH-442 are precluded before challenging nuclear safety.

In summary, the IRT believes that the current basis for operation of Millstone Unit 2 is sound. The team believes that some fundamental changes in culture at the unit are needed. The team also believes that the immediate actions already taken and the short and long term actions recommended will provide a basis for the needed cultural changes. Finally, the team recommends that management expeditiously implement the short term recommendations in order to assure that the basis for operation of Millstone Unit 2 remains sound.

7.0 RECOMMENDATIONS

As a result of the IRT review of recent Millstone Unit 2 events and in light of the performance issues identified in Section 5, the IRT has developed the following recommendations. These recommendations have been divided into "short term" and "long term" recommendations. "Short term" recommendations are intended to assure that specific weaknesses identified by the IRT review are corrected to ensure performance improvement. "Long term" recommendations are intended to reinforce the organization's focus on its primary mission of safe operation, to bolster morale, to foster a clear sense of direction for improvement, and to effect lasting improvement in the performance of Millstone Unit 2.

7.1 Short Term Recommendations

1. Senior Management should hold face-to-face meetings with the employees and appropriate support personnel of Millstone Unit 2 in order to reinforce management's expectations for safe, conservative operation of the unit. These meetings should be held in small enough groups to facilitate an open dialog with employees. Management's expectations on safe, conservative operations must be clear and unambiguous. The following key points should be considered:

   - Reinforce the principle that safe conservative operations is the top priority.

   - Discuss the seriousness of the 2-CH-442 event and the potential consequences of that event.

   - Discuss the seriousness of some of the precursor events involving human error, valve mispositions, plant trips,

and general performance of the unit. This discussion should not be punitive in nature, but should focus on the need for vigilance and a willingness to self evaluate one's individual performance and the performance of the organization on a continuous basis.

- Discuss the leadership role that each manager and supervisor is responsible for establishing. Reinforce the need to review and evaluate all aspects of an issue, to include nuclear safety, industrial safety, regulatory concerns, industry experience, etc. Encourage managers and supervisors to solicit input from other parts of the organization as appropriate and establish a healthy questioning attitude.

- Reinforce higher management standards beyond minimum regulatory requirements.

- Reinforce accountability at all levels of the organization.

- Reinforce the need to carefully manage change such that the implementation of program changes do not lead to confusion.

2. Senior management should hold face-to-face meetings with all Millstone Unit 2 license holders in order to reinforce the unique responsibility these individuals have in regard to nuclear safety. Management must reinstill in the Senior Reactor Operators that they are ultimately the owners of the plant and that all their actions must reflect this fact. Management must challenge the operators to set their personal standards in order to ensure excellence in operations. Management must reinforce its expectations that timely, conservative operability calls must be made and that these calls will have the support of the organization.

3. A review of the interface between the work control group, (I-Team), and the on-duty Shift Supervisor should be performed to address the weakness in the management of configuration control.

7.2 Long Term Recommendations

1. Corrective actions at Millstone Unit 2 are often too narrow in scope to ensure meaningful long term results. Station management should develop a method to assess the effectiveness of corrective actions.

2. The operational philosophy of Millstone Unit 2 needs to be more conservative to assure excellence in operations. Millstone Unit 2 management and supporting organizations must make their top priority instilling a conservative operating philosophy in the unit staff. Management must demonstrate by word and deed that it is committed to conservative operation and that it welcomes input from all quarters that support this end. The staff must realize that when they make a conservative decision, they will be backed up by management. Strong leadership needs to be provided by unit and station management in order to effect the necessary improvement.

3. Millstone Station has an excessive number of "acting" managers in key positions within the organization. Review the practice of designating acting positions. Define under what conditions an acting position will be named and for how long.

4. In filling future vacancies at Millstone Unit 2, consideration should be given to the need to expand breadth of perspective and diversity of experience. (A minority opinion disagrees that this recommendation is necessary for Millstone Unit 2.)

5. Since January of 1993, multiple valve mispositions have occurred at Millstone Unit 2.

   Unit management has instituted a number of corrective actions. The effectiveness of these actions should be independently assessed.

6. In addition to the immediate actions, clear guidelines should be developed to specify under what conditions safety assessments are required when performing work on primary safety barriers (i.e., fuel clad, reactor coolant system pressure boundary, and the containment pressure boundary). These guidelines should recognize current industry and NRC perspectives.

7. Senior NU management must develop effective methods, both programmatic and managerial, of gauging unit performance in real time. These methods must have the ability to spot adverse trends early enough to take effective corrective action, and form independent review teams as necessary.

8. Senior NU management should evaluate the aggregate impact on organizational effectiveness of the many changes currently underway. This impact needs to be monitored and the programmatic changes impacting the organization may need to be slowed if they appear to absorb too much management time in critical areas or cause excessive management distraction.

9. NU should share appropriate lessons learned from this experience with the entire NU organization and with the rest of the industry.

APPENDIX I

INDEPENDENT REVIEW TEAM

CHARTER

INDEPENDENT REVIEW TEAM CHARTER

TEAM MEMBERS:

E. A. DeBarba - Chairman
M. F. Ahern
M. V. Bonaca
P. Callaghan
C. H. Clement
M. S. Kai
J. J. LaPlatney
B. L. Drawbridge (NAESCO)
D. Gillespie (INPO)

1.0 Purposes

The function of the Independent Review Team (IRT) is to perform an assessment, on an advisory basis to the Chief Nuclear Officer, to determine whether the basis for current operation of Millstone Unit No. 2 is sound. Additionally, the review will focus on management actions, root cause evaluations and corrective actions taken to determine their appropriateness and whether they will assure lasting correction to the identified problems. Finally, the review will consider lessons learned for purposes of sharing with the entire NU nuclear organization and the industry as appropriate.

2.0 Reason

A series of events involving Millstone Unit 2 occurred in a relatively short period of time raising concerns on the part of executive management with the operations of Millstone Unit 2.

3.0 Review Categories

Design Control

- o Technical thought processes
- o Process Control
- o Procedural Adherence

Configuration Control (Plant Systems)

- o Process Review
- o Work Control
- o Procedural Adherence

3.0 Continued

Management Involvement

- o Management Decision Processes
- o Organizational Teamwork
- o Questioning Attitude
- o Safety Ethic

Event Investigation Triggers

- o Management Process for initiating an independent review team.

Root Cause and Corrective Action Overview

4.0 Review Process

The IRT will gather data from a variety of sources including PIRs, LERs, internal assessments, trend reports and external reports over at least the last 8 months. Additionally, interviews of key personnel will be conducted to aid the assessment particularly in the areas of understanding thought processes and attitudes. The review is targeted to complete by September 3, 1993.

5.0 Deliverables

At the completion of the review, the team will prepare a report identifying findings and recommendations as appropriate. Additionally, during the course of the review, significant findings and observations will be communicated to management.

Approved By: J. F. Opeka 8/24/93

J. F. Opeka
Executive Vice President - Nuclear

APPENDIX II

LETDOWN VALVE 2-CH-442

APPENDIX II

LETDOWN VALVE 2-CH-442

This section provides an overview of the application of Northeast Utilities' design and work control processes to repair valve 2-CH-442. The technical thought processes, process control, and procedural adherence are all reviewed. Collectively, these processes brought NU very close to a Small Break Loss of Coolant Accident with attendant decreased margin of safety and the risk of injury to employees.

Technical Thought Processes

When 2-CH-442 was found to have a body to bonnet leak it was regarded as a fairly routine maintenance job. While the non-isolable nature of the valve was recognized, sealing valve leaks was seen as a safe evolution. Millstone Station has a history of successful leak repairs and a site procedure - ACP-QA-3.33 - to implement them.

The initial action was to check the valve body to bonnet studs to assure that they were preloaded. A mechanic used a hand wrench to do this. The studs were found to be preloaded.

Several alternatives were then considered: shut down, freeze seal to isolate and repair, drill and inject through the bonnet, drill and inject the split line, and clamp and inject. Drilling and injecting the split line was selected to minimize stresses, reduce the chance of injecting into the process fluid, and to ease subsequent valve weld repairs.

Corporate support was enlisted to evaluate the affect of the repair process on the structural integrity of the valve. Two major attributes were identified by Stress Analysis Engineering: the injection pressure and the location of the holes. NUSCO Stress Analysis Engineering views their job as evaluating the

impact of the process on structural integrity. Reliance is placed on the lead engineer for the other aspects of the job.

The Maintenance Department formally evaluated injection pressure and sealant volume. Of three important attributes (pressure, drill location, and volume), pressure was selected for the Quality Services Department (QSD) to verify. This was continuously checked and stayed within limits throughout. Drilling occurred outside the recommended limits. This was identified by the Maintenance Department, evaluated by Stress Analysis Engineering, and found to be acceptable. Sealant volume was not monitored initially. A QSD surveillance identified this as a shortcoming and it was added as an inspection attribute. It does appear to have exceeded the prescribed limit. However, the goal (no injection into the process fluid) was achieved.

During the growing number of injections, various inspectors indicated concern for their personal safety. Consequently, a surveillance activity was initiated. This surveillance identified the lack of control over injected volume. While the execution of the repair bothered the QSD personnel, the repair engineering appeared complete and no specific violations could be identified. QSD believed that there was no technical justification to stop the job.

Throughout the repair activity, split line injection was a holding action until a clamp could be installed. The initial vendor designed clamp could not be used due to an unanticipated interference with a boss on the valve body. The next design was developed within the Maintenance Department and led by the Department Head. The thought process was for this clamp to be

designed in a deliberate fashion so that it would work on the first application. This design was responsive to input from the Corporate welding and stress analysis groups.

While the clamp design proceeded, leak injection activities continued. The goal was to maintain leakage less than the Technical Specification limit of one gpm for unidentified leakage. The injection vendor proposed peening.(Note that EPRI's NMAC document does allow peening on leak repairs.) After reviewing the tools to minimize loads and understand the process, NU approved it. Subsequent NU discussions and visual evaluation by a highly experienced stress engineer considered the peening acceptable.

When the injection vendor reported a crack, the Duty Officer entered containment with a qualified visual inspector. The inspector believed that the indication was a crack and the Duty Officer called the Unit Director and recommended shutdown. In evaluating this recommendation, the Unit Director obtained assistance from Stress Analysis. The Stress personnel reported that it was highly unlikely that this was a crack since the material was ductile, thick, and had no major deterioration. For the next two days, the indication was evaluated and ultimately determined not to be a crack. While the evaluation continued, recommendations for shut down by other personnel were not forwarded to the Unit Director. It was believed that these recommendations were redundant to the previous shut down recommendations. Calculations were performed which showed that the bonnet would remain attached even if one stud failed.

Throughout this period, the Unit Director made it clear that shutdown would be undertaken if there was a crack. For example,

he encouraged Stress personnel to personally look at the valve. Also, when he found that stress personnel were developing options for a replacement valve and for a structural clamp to allow operation with a crack, he conservatively discouraged further work on the structural clamp.

Additional injections were undertaken to provide a dry surface for the installation of the welded clamp. During this injection, the valve began to leak unexpectedly. The Unit was immediately shut down. It was later found that one of the four studs had broken.

PROCESS CONTROL

Process Used for Repair of 2-CH-442

The leak of 2-CH-442 was discovered on May 24, 1993 during a containment entry to investigate a reported boric acid build up on 2-CH-515. AWO MP2-93-07225 was written for a leak repair to correct the body-to-bonnet leak. Per ACP-QA-3.33, NCR 293-090 was generated on May 27 to disposition the body-to-bonnet leak. The NCR disposition was to repair by injecting the valve body-to-bonnet joint. The repair was done in accordance with Maintenance Procedure MP2721M, "Leak Sealing Procedure".

NUSCO had evaluated the structural adequacy of drilling the split line and specified the pressure requirement (memos MCE-SA-93-184, dated June 1, 1993 and MCE-SA-93-193, dated June 4, 1993). Form SF365 specified a maximum pressure of 2485 psi with an injection volume limit of one cubic inch. The inspection plan (SF207) specified that the characteristic to be verified was the injection pressure. The work performed on June 4 under AWO-M2-93-07225

included installation of two injection valves and two injections. While the second injection was initially successful, a leak was noted one hour later and AWO-M2-93-07864 was written to reinject. NCR 293-091 was generated on June 9 to disposition the continuing leakage from 2-CH-442. The disposition was again to repair by injecting the valve body-to-bonnet joint. A maximum of four new injection valves were allowed. NUSCO was again consulted and specified a maximum pressure of 3500 psi and also provided a drawing that showed the restricted areas for drilling (memo MCE-SA-93-200, dated June 9, 1993). A calculation (MP2-LOE-292EM) was developed to specify the pressure limit and the drilling requirements. The NCR disposition included peening operations. AWO-M2-93-07864 documented the work performed on June 11, 1993 and June 12, 1993. Two injection valves were installed and several injections were performed. Peening was noted on June 12. Concerns were identified about the professional attitude of the personnel from the initial vendor. Further, the clamp prepared by this vendor did not work. It was decided to switch to another vendor.

NCR 293-093 was written to disposition the use of Sealants X-36A and B since these sealants were non-QA. This was dispositioned USE-AS-IS since the materials satisfy the chemistry requirements. On June 10, 1993, NUSCO was requested to address the acceptability of the as drilled locations since they did not conform to the supplied drawing. NUSCO dispositioned the drilling as acceptable via three part memo dated June 10, 1993. Surveillance QSD-93-082 was performed and documented on June 15, 1993. No areas of procedural and/or programmatic non-compliance were identified.

APPENDIX II

LETDOWN VALVE 2-CH-442

NCR 293-094 was generated on June 11, 1993 to disposition the continuing leak. The disposition was to reinject and add two more valves if necessary. If this was unsuccessful, a clamp would be installed. NUSCO had evaluated the seismic impact and the acceptability of drilling into the stud holes as part of the clamp design (memo MCE-SA-93-203 and three part memo, both dated June 11, 1993, and calculation TMR-047). While not documented in the AWO, the stud holes were apparently drilled on June 12, 1993.

AWO M2-93-07939 was generated and documents the repair effort from June 12 to August 5, 1993. This documents the repeated attempts to stop the leak by injection.

Another surveillance, QSD-93-087, was performed and documented on June 23, 1993. Overall the work was noted as being performed using good workmanship practices and in a safe manner. A list of work and/or safety issues were developed for future consideration. One program non-compliance was noted with respect to upgrading the non-QA material with an NCR rather than Commercial Grade Dedication. This was evaluated and closed on July 30.

As a result of concerns about personnel safety raised by inspectors, another surveillance QSD-93-093 was performed and documented on July 8. The surveillance identified the need to verify injection volume. This was added as an inspection attribute in the July 13 inspection and was included in the subsequent inspections.

In preparation for installing the clamp, NUSCO was requested to evaluate the tap injection holes with a larger diameter. The plan for the clamp was also discussed with NUSCO Welding & Material

APPENDIX II

LETDOWN VALVE 2-CH-442

Test Engineering since the design involved welding. Welding requirements were specified in memo CTS-93-803 dated July 28, 1993.

On August 2, NCR 293-115 was developed to document the identification of a linear indication present on the valve body of 2-CH-442. AWO's M2-93-09522 and M2-93-09534 were generated to perform a dye penetrant exam. The first was inconclusive because of water from the leak. The second exam was negative. NUSCO Stress Engineering performed a number of "what if" calculations (MP2-LOE-324-EM) to evaluate the impact of a crack on the stud and structural integrity. NRC questions were factored into revisions of the calculation.

NCR 293-113 was prepared to document the installation of a clamp to stop the leak. The clamp involved welding bar stock to valve body/bonnet flanges on two sides, encapsulation with a clamp on the other two sides and injection to stop the leaks. The welding had been evaluated by NUSCO (three part memo on August 3 and memo CTS-93-803 dated July 28).

AWO M2-93-09431 dated August 2 was used to install the clamp. Work was stopped when excessive leakage was encountered.

Procedural Adherence

For leak repairs, Station Procedure ACP-QA-3.33 specifies: preparation of Automated Work Orders; completion of Form SF365; initiation of a Nonconformance Report; a follow up Nonconformance Report if further repair is needed; and initiation of an AWO to track replacement. All of these steps were done. The ACP allows documentation by means of a Telecon, however, in this instance, written documentation was requested and received from NUSCO.

APPENDIX II

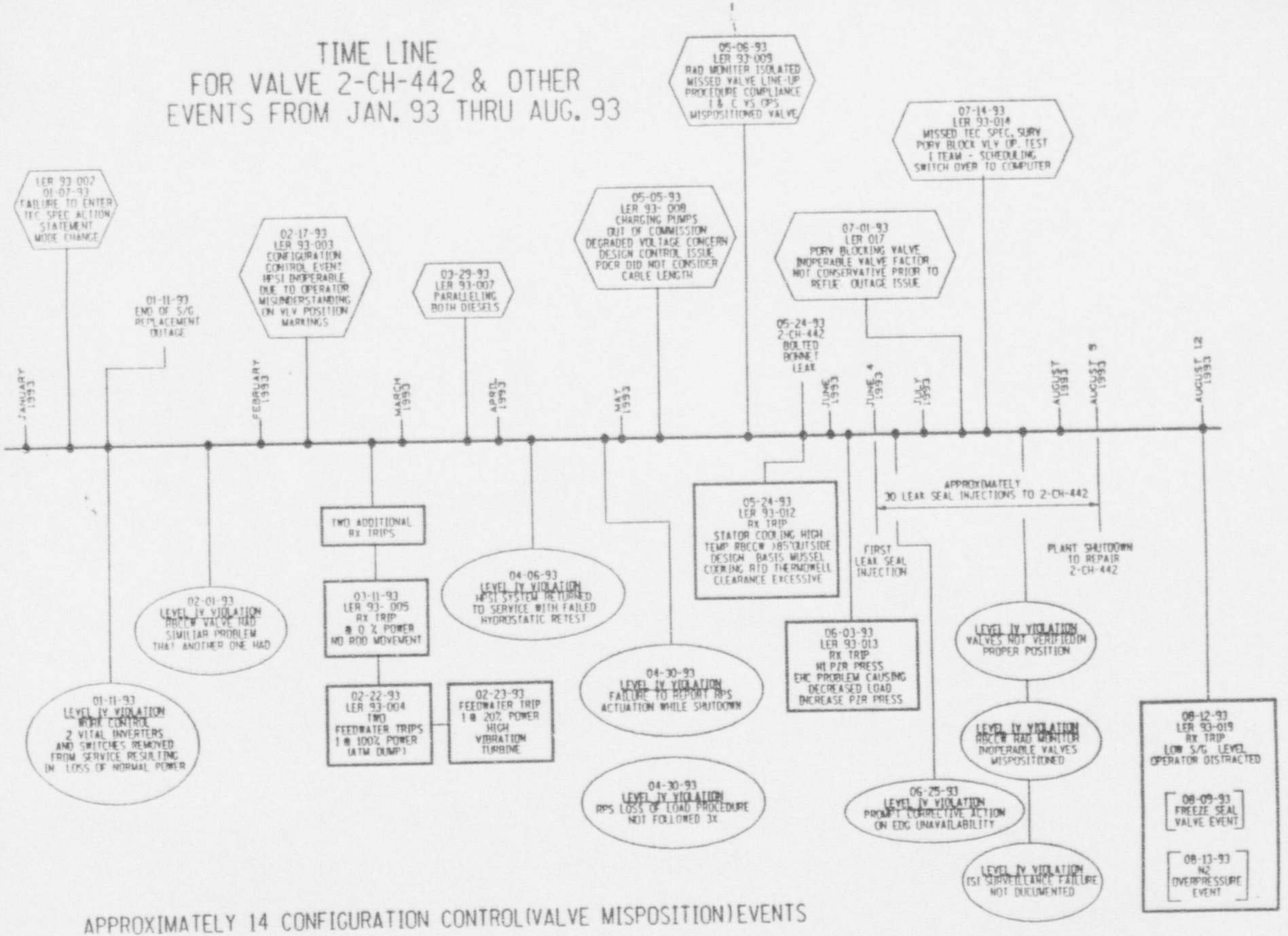
LETDOWN VALVE 2-CH-442

A procedure change to Maintenance Procedure MP2721M was completed to specify the steps to implement the leak repair. Quality Services identified one program non-compliance that was addressed and closed on July 30, 1993. Additionally, as a result of failure of the stud, QSD performed another surveillance on August 19, 1993 and identified a number of findings. The IRT identified no other issues associated with procedural adherence.

APPENDIX III

EVENT SUMMARY

TIME LINE FOR VALVE 2-CH-442 & OTHER EVENTS FROM JAN. 93 THRU AUG. 93



APPROXIMATELY 14 CONFIGURATION CONTROL(VALVE MISPOSITION)EVENTS

Docket No. 50-336
B14611

Attachment 2

Millstone Nuclear Power Station, Unit No. 2

J. F. Opeka Memorandum to Shift Supervisors

September 1993

NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

September 3, 1993
JFO-93-G-219

MEMO

TO: All Shift Supervisors

FROM: J. F. Opeka, Executive Vice President--Nuclear
Ext. 5323, Berlin

SUBJECT: Shift Supervisor Responsibilities

As a shift supervisor, you play a vitally important role in assuring the safe operation of our nuclear units. Numerous evaluations have confirmed the importance of leadership, decision making, and implementation of the command functions in assuring plant safety. These are key job elements of the shift supervisor position, elements where my expectations regarding your performance are very high.

Also, I have a tremendous amount of respect for you as a person, manager, and operator, and also for the responsibilities entrusted to you by both NU and the NRC.

The topic of safe operation is frequently discussed at all levels of the organization, and I know that your management fully reinforces this mandate through frequent discussions of their expectations with you. Nonetheless, due to the unique role that you play as a shift supervisor, I have decided to communicate to you, directly, my expectations of you.

Your role is that of a "Manager" of your shift operations. This is a command function which entails leadership and decision-making responsibilities that go beyond an operator's role. You establish and maintain the professional attitude and manner in which you and your shift perform and are perceived by the public. Your responsibilities do not require the personal manipulation of controls nor the personal supervision of one small segment of unit operations. Rather, they involve the direction and ownership of all unit activities. In particular during abnormal operation, transients, or accident conditions, your direct command and integrated knowledge of the unit are a necessity.

Your specific duties are delineated in the technical specifications and in various plant administrative procedures and you are well aware of them. Specifically, you should recognize your special role of being at the the front line of ensuring nuclear plant safety. My expectations are that you will conduct the activities under your authority conservatively, diligently, and in conformance with the governing procedural requirements. It is imperative we operate our nuclear units safely. Operating our nuclear plants safely is the most important corporate goal we have. If you believe based on your experience and training that an activity is unsafe, you should stop the activity and assure that safety is restored, even if this means shutting down the unit. Conservative decisions on your part will be supported by management.

There is no one better in our organization to set an example, not only for your shift, but for the entire nuclear group. You are in a unique, highly visible position to act as a positive role model for all of us. Your responsibility includes instilling in your operating crew my expectations. We appreciate your hard work, and rely upon you to provide the conservative leadership on shift which is a crucial element of our efforts to achieve excellence in nuclear operations.

cc: S. E. Scace
J. P. Stetz
G. H. Bouchard
F. R. Dacimo
H. F. Haynes
D. J. Ray
J. D. Becker
M. H. Brothers
P. J. Przekop
J. A. Ruttar
T. C. Feigenbaum
J. M. Black

LIST OF SHIFT SUPERVISORS SEPTEMBER 1993

Millstone Unit No. 1

E. E. Berry
R. C. Kraemer
D. R. Latz
J. R. Nowell
J. E. Olson
R. M. Schmidtknecht
G. C. Zitka

Millstone Unit No. 2

O. M. Emborsky
R. S. Gauzza
D. B. Mooney
M. P. Mullin
L. R. Nelson
A. C. Olechnowicz
W. E. Strong

Millstone Unit No. 3

D. E. Ashinghurst
D. B. Brodsky
E. J. Fetterman
J. R. Franks
R. F. Martin
L. E. Olson
R. K. Walker

Connecticut Yankee

J. F. Houff
R. L. Morgan
J. F. Piontkowski
P. G. Rainha
R. J. Reeves, Jr.
D. M. Reilly
R. A. Willis

Docket No. 50-336
B14611

Attachment 3

Millstone Nuclear Power Station, Unit No. 2

J. F. Opeka Memorandum to Nuclear Group
Vice Presidents, Directors, Managers, and Supervisors

September 1993

NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

MEMO

September 10, 1993
JFO-93-G-231

TO: Nuclear Group Vice Presidents, Directors, Managers, and Supervisors

FROM: J. F. Opeka
(Ext. 5323)

SUBJECT: Millstone Unit No. 2 Independent Review Team Results

Most of you are no doubt aware of recent events at Millstone Unit No. 2 which indicate a negative trend in overall Millstone Unit No. 2 performance. These events include multiple instances of valve mispositioning, preventable automatic reactor trips, actuation of the reactor protection system while shutdown, and a reactor coolant system leak from an unisolable valve in the letdown system. This valve had been the subject of ongoing maintenance activity over several months to repair a leak. The leak rate increased significantly when one of the body-to-bonnet studs broke. This one event is particularly serious because the potential existed for an unisolable loss of coolant accident if additional studs had failed.

In response to these events, I commissioned an Independent Review Team (IRT), chaired by Eric DeBarba, to assess, independent of the Millstone Unit No. 2 organization, this event and whether the basis for continued operation of Millstone Unit No. 2 is sound, and also to develop recommendations to improve performance. The review focused on the appropriateness of management actions, root cause evaluations, and corrective actions to determine their appropriateness.

The IRT presented the results of their assessment to the nuclear group vice presidents and directors and Millstone Unit No. 2 managers on Friday, September 3, 1993, and has since completed its report. The report is being sent today to the NRC. The transmittal letter and report are attached to this memorandum.

The IRT found the basis for continued operation of Millstone Unit No. 2 to be sound given the actions taken to date. However, the IRT also fourd deficiencies in several areas, including operational philosophy, management oversight, and root cause determinations. Recommended actions, immediate, short-term, and long-term, were developed by the IRT and are included in the report. These recommendations are being implemented.

The seriousness with which I take these events and the report cannot be overstated. I am giving this report wide distribution. Each of you should read this material carefully and take to heart the lessons we must learn as an organization from this event. Each of you also should discuss these lessons with your subordinates, peers, and management. I encourage you to discuss openly the IRT's assessment, and I expect that you will bring any questions you may have to the attention of your management.

Nothing is more important than the safe, conservative operation of our nuclear units. The events which have occurred at Millstone Unit No. 2 indicate that this philosophy has not, at all times, guided our actions. Let me be very clear: WE WILL OPERATE OUR NUCLEAR UNITS SAFELY OR NOT AT ALL. OUR STANDARDS OF PERFORMANCE MUST BE CONSISTENT WITH THIS PHILOSOPHY.

cc: T. C. Feigenbaum