April 15, 2003

EA-03-053

Mr. John T. Conway
Vice President Nine Mile Point
Nine Mile Point Nuclear Station, LLC
P.O. Box 63
Lycoming, NY 13093

SUBJECT: NINE MILE POINT NUCLEAR STATION - NRC SPECIAL INSPECTION REPORT 50-220/03-003 - PRELIMINARY WHITE FINDING

Dear Mr. Conway:

On March 7, 2003, the NRC completed a special inspection of the Nine Mile Point Nuclear Station, Unit 1. The enclosed report documents the inspection findings which were discussed at the completion of the inspection with you and other members of your staff during an exit meeting on March 7, 2003.

This inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The team reviewed selected procedures and records, observed activities, and interviewed personnel. In particular, the inspection reviewed event evaluations, including technical analyses, root cause investigation, relevant performance history, and extent of condition to assess the significance and potential consequences of the degraded condition of the reactor building closed loop cooling (RBCLC) system.

This report discusses a finding that appears to have low to moderate safety significance. As described in Section 4OA3 of this report, this finding involves inadequate implementation of corrective actions for significantly degraded piping in the RBCLC system. There were numerous prior opportunities to identify and correct this problem. This finding was assessed using the reactor safety Significance Determination Process (SDP) as a potentially safety significant finding that was preliminarily determined to be White (i.e., a finding with some increased importance to safety, which may require additional NRC inspection). The finding has low to moderate safety significance because a pipe rupture in the RBCLC system could result in an initiating event and loss of certain equipment necessary to mitigate plant transients and accidents.

Following identification of the degraded piping, you implemented appropriate corrective actions by replacing most of the RBCLC system piping located in the drywell with improved hardware and design. With these compensatory measures in place while long term corrective actions are being developed, our inspectors determined that an immediate safety hazard does not exist.

The finding also appears to be an apparent violation of NRC requirements and is being considered for escalated enforcement action in accordance with the "General Statement of Policy and Procedure for NRC Enforcement Actions" (Enforcement Policy), NUREG-1600. The current Enforcement Policy is included on the NRC's Website at http://www.nrc.gov/what-we-do/regulatory/enforcement.html.

We believe that we have sufficient information to make our final risk determination for the performance issue regarding inadequate corrective action for the degraded RBCLC system. However, before the NRC makes a final decision on this matter, we are providing you an opportunity to either submit a written response or to request a Regulatory Conference where you would be able to provide your perspectives on the significance of the finding, the bases for your position, and whether you agree with the apparent violation. If you choose to request a Regulatory Conference, we encourage you to submit your evaluation and any differences with the NRC evaluation at least one week prior to the conference in an effort to make the conference more efficient and effective. If a Regulatory Conference is held, it will be open for public observation. The NRC will also issue a press release to announce the Regulatory Conference.

Please contact Mr. James M. Trapp at (610) 337-5186, within 10 business days of the date of this letter to notify the NRC of your intentions. If we have not heard from you within 10 days, we will continue with our significance determination and enforcement decision and you will be advised by separate correspondence of the results of our deliberations on this matter.

Since the NRC has not made a final determination in this matter, no Notice of Violation is being issued for this inspection finding at this time. In addition, please be advised that the number and characterization of the apparent violation described in the enclosed inspection report may change as a result of further NRC review.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosures will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

If you have any questions, please contact Mr. Trapp at (610) 337-5186.

Sincerely,

/RA/

Wayne D. Lanning, Director
Division of Reactor Safety

Docket No. 50-220
License No. DPR-63

Enclosures: 1) Inspection Report 50-220/03-003 w/Attachment: Supplemental Information
2) NRC Special Inspection Team Charter

cc w/encl:
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ENCLOSURE 1

U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Docket No:	50-220
License No:	DPR-63
Report No:	50-220/03-003
Licensee:	Nine Mile Point Nuclear Station, LLC (NMPNS)
Facility:	Nine Mile Point, Unit 1
Location:	P. O. Box 63 Lycoming, NY 13093
Dates:	February 10, 2003 - March 7, 2003
Inspectors:	S. Pindale, Senior Reactor Inspector (Team Leader) S. Chaudhary, Reactor Inspector E. Cobey, Senior Reactor Analyst E. Knutson, Resident Inspector
Approved by:	James M. Trapp, Chief Projects Branch 1 Division of Reactor Projects

SUMMARY OF FINDINGS

IR 05000220/2003-003; 02/10/2003 - 03/08/2003; Nine Mile Point, Unit 1; Special Inspection Team of Degraded Piping in the Reactor Building Closed Loop Cooling System.

The inspection was conducted by two regional inspectors, one resident inspector, and one regional senior reactor analyst. One preliminary White finding was identified. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using IMC 0609, "Significance Determination Process" (SDP). Findings for which the SDP does not apply may be Green or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 3, dated July 2000.

A. Inspector Identified and Self-Revealing Findings

Cornerstones: Initiating Events and Mitigating Systems

- **Preliminary White.** An apparent violation of 10 CFR 50, Appendix B, Criterion XVI, "Corrective Action," was identified by the team associated with the failure to evaluate significant conditions adverse to quality involving degraded piping in the reactor building closed loop cooling (RBCLC) system. The failure to adequately identify and evaluate equipment problems, and correct deficiencies, resulted in repetitive and continued degraded piping conditions in the RBCLC system. Specifically, a RBCLC system piping leak occurred on May 15, 2002, due to significant pipe corrosion, primarily as a result of inadequate piping design, application and operation. Additionally, numerous RBCLC system leaks occurred during several preceding years. However, the cause for these leaks was not determined and appropriate corrective actions were not implemented. This led to further degradation of the RBCLC system piping such that additional significant leaks occurred on December 5, 2002, and again on December 12, 2002. These significant leaks in December 2002 were accompanied by a significant reduction in the pipe wall which degraded the structural integrity of the affected piping sections.

  This finding has low to moderate safety significance, based on the results of the phase three SDP analysis, because the degraded RBCLC piping resulted in an increase in the likelihood of the loss of the RBCLC system due to piping failure, which directly affected the initiating events cornerstone. The loss of the RBCLC system would also result in the loss of cooling to several other risk significant systems (e.g., feedwater/condensate pumps, recirculation pumps, shutdown cooling heat exchangers, etc.) following a loss of coolant accident or a loss of all AC power event where AC power is recovered prior to core damage, which directly affected the mitigating systems cornerstone. (Section 4OA3.4; AV 50-220/03-03-01)

REPORT DETAILS

Summary of Plant Status

The reactor building closed loop cooling (RBCLC) system provides cooling for various reactor auxiliary equipment, as well as balance of plant equipment. Major components supplied by the system included the drywell air coolers, reactor recirculation pump coolers, reactor building equipment drain tank cooler, fuel pool heat exchangers, shutdown cooling system, control room air conditioning equipment, instrument air compressors, and the high pressure injection system (i.e., feedwater pumps, feedwater booster pumps, and condensate pumps). The RBCLC system is a safety-related, risk-significant system that is required to operate during normal plant operations and accident conditions.

In May 2002, and again on December 5 and 12, 2002, the licensee experienced substantial leaks in RBCLC small bore (less than 2" diameter) piping. Following evaluation and analysis of these leaks, the licensee discovered notable and widespread wall thinning in RBCLC piping sections, which were most severe at threaded mechanical connections (where piping thickness was the smallest due to the thread roots). This reduction in wall thickness was ultimately attributed to a combination of general corrosion, flow-assisted corrosion, and galvanic corrosion.

Prior to 2002, there had been numerous additional small bore piping leaks within the RBCLC system at threaded mechanical joints. Repair methods for these leaks varied, and included tightening the connection or fittings, replacing components (such as flow switches), seal welding the threaded connections, and replacing affected pipe sections. Around May 2000, chloride and sulfate concentrations in the RBCLC system were found to be elevated. Near the same time, RBCLC system oxygen levels were found to be significantly below normal levels, and iron particulate levels were high. These parameters indicated an increased corrosion rate, however, efforts to identify the cause and correct the abnormal chemistry parameters were unsuccessful.

The NRC team's review of the event details determined the root and contributing causes for the degraded RBCLC piping included: inadequate system design, inadequate corrective actions, and degraded RBCLC system water chemistry. Subsequent to the December 12, 2002, leak, several immediate corrective actions were implemented, including extensive RBCLC small bore piping and fitting replacement with improved piping material and design. Longer term similar actions were also in progress for the remaining RBCLC piping sections that had not been replaced. In addition, the licensee was continuing their efforts to determine the cause and corrective actions for the unexpected and unexplained chemistry parameters.

The performance deficiency was the failure, prior to December 12, 2002, to determine the cause of a significant condition adverse to quality and implement appropriate corrective actions to prevent further degradation of the RBCLC system. The NRC team determined that the licensee's structural analysis did not provide evidence that the as-found condition of the degraded piping in the RBCLC system retained sufficient strength, and consequently, the structural integrity of the affected RBCLC system piping may not have been maintained when subjected to design loading conditions. The safety significance of the inspection finding, based on the increase in core damage frequency due to internal and external initiating events, was determined to be White, which represents a finding of low to moderate safety significance.

4. OTHER ACTIVITIES (OA)

4OA3 Event Followup

1. Degraded RBCLC Piping Due to Corrosion

a. Inspection Scope

This inspection was conducted in accordance with NRC Inspection Procedure 93812, “Special Inspection,” to assess the licensee’s actions associated with the December 5 and 12, 2002, discovery of two instances where portions of the RBCLC piping were significantly corroded such that leaks occurred in the system. The licensee conducted event evaluations following each incident to determine the root cause and corrective actions. The team reviewed the associated design basis documents, calculations, and other related documents. A list of the documents reviewed by the team is provided as Attachment 1 to this report.

The team reviewed aspects of the historical performance of the RBCLC system relative to prior leaks and associated licensee actions and evaluations. The team also examined portions of degraded RBCLC piping that had been removed from the system, walked down portions of the system, and interviewed licensee personnel.

Chronology of System Leakage

The RBCLC system piping was designed and installed in accordance with the B31.1-1955 Code for Pressure Piping. The pipe was Schedule 40 carbon steel and threaded connections were used for many of the small bore piping connections. The nominal wall thickness for 1-1/2 inch diameter Schedule 40 and 80 pipe is 0.145 and 0.200 inches, respectively. The use of threaded connections reduces the nominal wall thickness as the threads are cut into the pipe, thereby further reducing the pipe wall thickness at the root of the threads. In addition, the system also contained several dissimilar metal joints (e.g., carbon steel to stainless steel; and carbon steel to bronze) at several of the piping connections. While this was not prohibited by the piping design code, direct connection (without insulating barriers) of dissimilar metals can lead to galvanic corrosion.

The team reviewed documentation of RBCLC system leaks dating back to 1991. In July 1991, the unit was shut down to investigate increased drywell leakage. The source of the leakage was RBCLC from the recirculation pump seal coolers. At that time, a total of seven out of ten recirculation pump seal cooler threaded pipe connections were found to be leaking. These connections consisted of threaded pipe joints, as opposed to welded pipe sections. The licensee attributed the leakage, as documented in deviation event report (DER) 1991-0560, to thermal expansion and vibration which caused the mechanical connections to loosen. The licensee determined the root cause of the event to be an inadequate system design.

In February 1992, DER 1992-0480 documented that the long term corrective actions of DER 1991-0560 had not been implemented. The corrective action in this DER recommended that the long term corrective actions from DER 1991-0560 should be implemented prior to closing DER 1992-0480. Despite continuing issues with recirculation pump seal cooler leaks through the 1990's (as documented in DER 2002-2383), this recommendation was not implemented, and modification N1-80-83 was subsequently canceled in 1994.

In September 2000, two recirculation pump seal cooler leaks were identified and documented in DER 2000-3268. Both leaks were from threaded connections between the RBCLC piping and the coolers. The cause of the leaks (i.e., whether the leakage was through the mechanical joints or through-wall degradation of the piping) was not positively identified. However, the DER noted that attempts to stop the leak by tightening the connections were unsuccessful. Both leaks were repaired by seal welding.

During a mid-cycle outage in May 2002 to investigate drywell leakage, two significant RBCLC leaks were identified in the drywell, as documented in DER 2002-2383. One leak was from a recirculation pump seal cooler mechanical joint. Again, the cause of the leak was not positively identified, although attempts to tighten the joint did not stop the leakage. This leak was repaired by seal welding. The other leak was from the downstream threaded connection to a flow switch in RBCLC piping to the 14 recirculation pump. This leak was repaired by replacing the flow switch and the immediate upstream and downstream piping. Subsequent vendor analysis identified the apparent cause of the flow switch leak as galvanic corrosion of the downstream pipe, due to dissimilar metals in the flow switch and the piping. Flow turbulence downstream of the flow switch continually exposed fresh metal and allowed the galvanic action to progress to failure. Although the results of the vendor analysis results were available in July 2002, they were not factored into the corrective action process and, consequently, were not addressed until after the subsequent RBCLC leaks were identified in December 2002.

On December 5, 2002, Unit 1 shut down to investigate an increase in unidentified drywell leakage. The source was found to be RBCLC system leakage from the threaded joint on the downstream side of the outlet check valve from the 11 drywell equipment drain tank cooler. The apparent cause, as identified in DER 2002-5166, was a combination of galvanic corrosion between dissimilar metal components (bronze check valve, carbon steel piping) and turbulent flow downstream of the check valve. The leak was repaired by eliminating the check valve and replacing the associated piping. Additional actions associated with this DER included the following:

- Eliminating the outlet check valve from the other (12) drywell equipment drain tank cooler;
- Replacing susceptible pipe assemblies at the outlet of the recirculation pump motor and seal cooler lines, and eliminating check valves and dissimilar metal joints;

- Completing seal welding of RBCLC lines to the recirculation pump seal coolers; and

- Replacing flow switches and connecting piping for the two recirculation pumps that had not had this done within the last four years.

One week later, on December 12, 2002, a leak was identified at the RBCLC inlet connection to the 11 drywell cooler heat exchanger. The leak was from the threaded connection of a pipe nipple to a threaded elbow, originating in a pinhole at the root of the exposed portion of the threads. The licensee (DER 2002-5280) identified that the apparent cause for this leak was general corrosion combined with the tapered threads on the original construction Schedule 40 piping. This threaded joint was not a dissimilar metal joint (it was all carbon steel).

In response to the most recent problem, the unit was shut down. The corrective action for this leak was to replace all drywell air cooler inlet and outlet piping. Additional actions associated with DER 2002-5280 included replacement of the majority of RBCLC piping inside the drywell with Schedule 80 piping using welded (rather than threaded) connections. The recirculation pump motor cooler piping was determined to be in good condition and was not replaced; and the upstream piping to the equipment drain tank was determined to be acceptable until the refueling outage scheduled for Fall 2004.

<u>RBCLC Chemistry Control</u>

In early 2000, unexplained changes in the RBCLC water chemistry parameters began to occur. Over a period of several months, the dissolved oxygen concentration decreased from its normal value of about 3000 ppb (parts per billion) to essentially zero. Subsequently, in June 2000, DER 2000-2139 was written to document an increase in RBCLC water conductivity, and chloride and sulfate concentrations. Typically, such changes are the result of service water system leakage into the RBCLC system.

Attempts to identify the source of the chloride and sulfate contamination have been unsuccessful to date. Contaminant concentrations have, for the most part, been maintained within specification by performing system feed-and-bleeds (i.e., purging the water volume in the system). The cause for the oxygen depletion has not been determined. The feed-and-bleed evolution used aerated water (oxygen concentration on the order of 3000 ppb), however, the RBCLC oxygen concentration remained approximately zero. This indicated that some process was continuing to consume the dissolved oxygen. The licensee had also identified elevated concentrations of soluble and insoluble iron in the RBCLC water since the year 2000, which was consistent with the oxygen depletion mechanism being the result of corrosion.

2. Root and Contributing Causes of Degraded RBCLC Piping

a. Inspection Scope

The team reviewed the licensee's event evaluation reports and cause analyses associated with the RBCLC system pipe leaks and degraded piping. The team also independently assessed the root and causal factors for the event. The team reviewed data and corrective action program documents, conducted plant tours, and interviewed personnel, including station management.

b. Findings

The team concluded that the licensee's cause evaluations prior to the December 12, 2002, leak did not effectively evaluate the observed degraded piping. The licensee's actions, subsequent to this leak, have included a comprehensive cause investigation and also an evaluation to determine how the organizational and cultural environment affected previous attempts to correct this problem. The licensee appropriately identified that general corrosion, galvanic cells, and flow-assisted corrosion degraded the RBCLC system integrity and led to the leaks.

The licensee's investigation identified several preliminary findings, including: station personnel did not use effective problem solving techniques; weaknesses in technical rigor/justification; high standards for thorough problem solving were not reinforced; and personnel did not demonstrate judicial use/application of failure analysis examinations.

The NRC team's review of the event details determined the following regarding the root and contributing causes for the degraded RBCLC piping:

- *Inadequate System Design:* The use of threaded (vs. welded) connections with Schedule 40 piping (nominal wall thickness of 0.145") resulted in a thin base material at the piping connections, particularly at the roots of the threads. Dissimilar metals in various system components resulted in galvanic corrosion which, in some cases, accelerated the wall loss of the internal piping surface to the point of loss of adequate structural integrity and through-wall leakage.

- *Inadequate Corrective Actions:* In 1991, DER 1991-0560 identified threaded connections at the recirculation pump seal coolers as a system design deficiency and recommended corrective action to implement a previously identified modification (N1-80-83) to redesign the connections. However, this corrective action was initially not acted upon, as identified by DER 1992-0480, and ultimately was canceled. Corrective actions associated with several of the leaks consisted, in part, of seal welding at the threaded pipe joints. This action was superficial in that it only eliminated the immediate symptom (the leak) and made no attempt to identify the root cause of this significant condition adverse to quality. In addition, the failure analysis for the leaking flow switch, which identified galvanic corrosion and turbulent flow as the cause of failure, was not factored into the corrective action program, and therefore, was not promptly acted upon. Corrective actions associated with the December 5, 2002 leak, while more extensive than in previous cases, were still not adequate to identify the root cause of the system degradation and to prevent the additional failure, that occurred one week later.

- *Degraded RBCLC System Water Chemistry:* Actions over about two years have been unsuccessful in identifying the source of chloride and sulfate contamination, and the cause for the oxygen depletion. While the cause of these issues remains unknown, they apparently have contributed to accelerated system degradation through corrosion, as evidenced by the coincident increase in soluble/insoluble iron content of the water. Attempts to identify the source of dissolved hydrogen and nitrogen have also been unsuccessful.

While the licensee's recent efforts to identify the root and contributing causes of degraded RBCLC piping were acceptable after the December 12, 2002 leak, some of the causes remained undetermined. In particular, the licensee has not yet been able to identify the source of the abnormal chemistry parameters in the RBCLC system. The licensee's efforts were continuing in this area to identify and diagnose the RBCLC system abnormal chemistry parameters.

3. Structural Integrity of RBCLC Degraded Piping

a. Inspection Scope

The team interviewed personnel, conducted a partial system walkdown, and reviewed the licensee's engineering evaluations associated with the structural integrity of the as-found condition of the 1-1/2" diameter degraded piping in the RBCLC system to independently assess the condition of the degraded RBCLC system piping. In particular, the team reviewed the licensee's preliminary evaluation of the system structural integrity as documented in engineering report NER-1S-031, Rev. 00A. The licensee evaluated the condition that they determined represented the worst case condition. This evaluation considered the pipe degradation, and RBCLC system static and dynamic loading (including additional loading potentially caused by transients initiating in other systems).

The limiting location was the circumferential ligament adjacent to the section where the December 5, 2002, leak occurred. It was located in the threaded area of the RBCLC piping one thread adjacent to the leak. Engineering report NER-1S-031 documented evaluations pertaining to the following:

- Failure analysis of a section of 1-1/2" diameter pipe installed at the RBCLC return line from the 11 drywell sump cooler (105-04) between check valve CKV-70-362 and ball valve VLV-70-363;

- Collapse load analysis for the above pipe to determine the collapse moment capacities for various temperature conditions and sustained loads (dead weight plus operating loads). The method used in calculating collapsing moment were per Appendix F of ASME Code, Section III;

- Piping analysis for pipe between line No. 105-04 and the 4" diameter header pipe; and

- A comparison of applied moments to the calculated collapsing moment capacities for the applicable loading conditions:

  - Load Case ‘a’: Dead weight, design pressure 125 psig, normal RBCLC system operating temperature 100°F, and 0.05 maximum ground acceleration for seismic loads.

  - Load Case ‘b’: Dead weight, design pressure 125 psig, and a drywell temperature of 240°F as a result of a small break loss of coolant accident.

  - Load Case ‘c’: Dead weight, transient pressure of 142 psig, combined with a drywell temperature of 215°F as a result of a loss of offsite power event.

The results of the piping analysis documented in NER-1S-031 were used as input to an inelastic finite element analysis using the ANSYS Computer Program for the various load conditions. This analysis was used to evaluate the structural integrity of the existing ligament geometry in the threaded piping section.

b. Findings

The licensee determined the collapse moment capacity and the applied moment for each of the three load cases. The collapse moment capacity relates to the calculated strength of the RBCLC piping, based upon material properties. Inherent in the licensee’s analysis was that they assumed the remaining material in the measured ligament (after the significant corrosion occurred), retained the properties of the original piping/metal material. The applied moments were calculated for each of the loads that would result in these cases. The analysis assumed that the integrity of the pipe would not be maintained if the applied moment exceeded the collapse moment.

The calculated collapse moment capacities (criteria) and applied moments are summarized in the following table (Note: all units are ft-lbs).

Load Case	Calculated collapse moment capacity (Criterion)	Criterion, including measurement tolerance	Applied moment
a	37.8	36.6	37
b	42	40.7	40
c	42	40.7	38

Although the applied moment exceeded the collapse moment capacity for load case ‘a,’ the licensee stated that the applied moment was within 1% of the reduced collapse moment capacity (criteria above).

The licensee stated that there was no leak evident at the ligament that was analyzed (downstream of bronze check valve CKV-70-362). They concluded that this location and configuration was a critical section and was the worst case (and bounding) for the purpose of analysis. They also concluded that the critical piping section would retain sufficient structural integrity to prevent collapse of the piping when subjected to the design loading conditions. While the team did not identify a location or configuration that would be more bounding, the team determined the absence of leak was not an indication of structural integrity and/or loading capacity. Further, a leak can be prevented by a barrier that does not have any significant structural capacity.

The team identified several additional concerns associated with the licensee’s analysis, assumptions, and methodology. For example, the pipe wall thickness assumed in the finite element analysis was a very thin ligament at the root of the pipe thread, and in some cases, only a few thousandths of an inch. The material behavior in thin ligaments may be significantly different than that assumed in the analysis. Very thin carbon steel material may not exhibit the homogenous isotropic behavior assumed in the licensee’s analysis; the grain size of the metal significantly affects the structural properties. The material properties assumed in the analysis was based on the original certified material test report (CMTR) supplied with the piping purchase order.

In addition to the above uncertainties in the material properties, there are potential of negative cumulative errors in wall thickness measurements, i.e. magnification and calibration tolerance/error in the electron microscope, and the caliper or other measuring tools and equipment.

The removed section of the pipe was visually examined by the inspection team to assess the material condition. The removed sections indicated a highly corroded piping section with missing thread root. Even where the material was not missing, a flash light illumination indicated a material ligament so thin that it appeared nearly translucent. The team also learned that a full section of the pipe was able to be broken apart manually following removal by maintenance personnel.

Finally, the team noted that the licensee’s analyses and evaluations were based on assumptions that had not been substantiated by test and/or verifiable data. As such, the licensee’s results were considered preliminary by the licensee and their consultants.

In summary, although the RBCLC system remained in operation and functional during the operating cycle, the team concluded that the licensee's evaluation did not provide an adequate basis to demonstrate that the piping in the RBCLC system retained sufficient structural strength/integrity when subjected to loading conditions during postulated events. In addition, the team concluded that a passive failure of the degraded RBCLC piping was a dominant failure mode, which resulted in an increased likelihood of a loss of RBCLC initiating event.

4. Corrective Actions

a. Inspection Scope

The team interviewed licensee personnel, reviewed related corrective action program documents, and reviewed associated licensee evaluations associated with the degraded piping. The adequacy, extent and timeliness of the licensee's corrective actions were also assessed.

b. Findings

Corrective Actions Implement for RBCLC Leakage

In December 2002, the licensee identified significant and widespread degradation of the RBCLC system piping due to corrosion. This degradation occurred despite numerous prior opportunities to identify, determine the root causes and correct the condition. Leaks had occurred over the previous several years due to significant degradation of small bore piping (less than 2" diameter), and a failure of this size line would result in failure of the RBCLC system.

The team determined that the leaks that occurred on May 15, 2002, represented an opportunity to recognize the potential significant degradation of the RBCLC system. The more significant of the two leaks occurred at a threaded connection on the downstream side of a flow switch associated with one of the five recirculation pump coolers. The second leak at a threaded mechanical pipe connection associated with another recirculation pump cooler was seal welded. At that time, the licensee attributed those leaks to inherent leakage associated with threaded connections and noted that leaks at the pipe connections for the seal cooling piping to and from the recirculation pumps had been a chronic problem for many years. They failed to adequately evaluate the cause and extent of the degraded condition. Further, the licensee failed to evaluate an associated flow switch failure analysis report (performed by a vendor), which was dated July 29, 2002, and provided relevant insights regarding the nature and extent of the corrosion in the RBCLC system. This failure analysis was not included in the licensee's corrective action process, and therefore, was not adequately reviewed.

The December 5, 2002, leak also represented an opportunity for the licensee to perform a detailed cause analysis and implement comprehensive corrective actions. This leak was located adjacent to the 11 equipment drain cooler discharge check valve. The licensee concluded that the carbon steel pipe was experiencing wall thinning on the downstream side at and near threaded connections to either bronze or austenitic stainless steel components, and that this degradation due to galvanic corrosion was accelerated due to turbulent flow conditions. The area at the threaded connection that showed the most severe degradation consisted of a very thin ligament of corroded metal. Although the licensee identified several RBCLC pipe areas for further inspection and repair, these actions failed to properly identify and characterize the cause and extent of the degradation mechanism. Specifically, the licensee failed to recognize that general internal pipe corrosion contributed substantially to the pipe wall thinning, and that the inspection scope for susceptible piping areas should have extended beyond dissimilar metal, turbulent flow interfaces.

Soon after the startup from the December 5, 2002, forced outage, another leak occurred on December 12, 2002. The investigation of this leak revealed additional RBCLC piping that was substantially degraded. During the extent of condition evaluation, the licensee again identified wall thinning due to corrosion. However, in this instance, a dissimilar metal and galvanic corrosion mechanism was not present. The licensee had not previously considered that the carbon steel to carbon steel connections may also exhibit significant corrosion. Further, the effect of threads on pipe wall thickness in conjunction with the pipe wall thinning (absent a galvanic mechanism) had not been considered during the previous evaluations.

<u>Assessment of Corrective Actions</u>

In evaluating the RBCLC system leak history and associated licensee corrective actions, the team made several observations. In particular, the team determined that the licensee's efforts in response to the problems over the years were focused on fixing symptoms (leaks) rather than identifying causes, determining extent of condition, and implementing effective corrective actions. For example, the team observed the following:

- For the RBCLC system leaks identified in May 2002 and earlier, the apparent causes did not consider mechanisms other than leakage across the threads. DER 2002-2383 stated that it is *expected* that threaded piping connections that are not seal welded will leak over an extended period of time. The cause analysis was not sufficiently rigorous to identify that the Schedule 40 pipe wall thickness at the threaded area was significantly less than the rest of the system. Therefore, the cause analysis, extent of condition assessment and scope of repairs were not sufficient to preclude additional RBCLC leakage.

- Seal welding was proposed and implemented on threaded connections as a housekeeping measure. This activity could potentially stop an active leak as a temporary measure. However, because seal welding is not designed or credited to restore structural integrity, it could also mask significant internal degradation and allow continued internal corrosion to further degrade the structural integrity of the pipe.

- The licensee recognized the degraded chemistry parameters in the RBCLC system (high chloride and sulfate concentration, low oxygen, high iron), existed for over two years, however, the cause of these conditions had not been identified. The licensee's feed-and-bleed activities of the system only temporarily and marginally improved the chemistry conditions.

- In 1980, a modification was initiated to eliminate certain RBCLC threaded connections in the drywell (in particular, threaded joints in recirculation pump coolers to eliminate a possible leakage source). However, the modification was not installed, and was canceled in 1994 based on low priority and continued satisfactory system performance (two successful operating runs).

The team reviewed the licensee's corrective actions following the December 12, 2002 leak (after the licensee fully recognized the cause and extent of condition). Several immediate corrective actions were implemented. These activities included extensive replacement of RBCLC piping and fittings inside the drywell. The majority of RBCLC fittings and pipe (about 90%) was replaced with the more robust schedule 80 piping. The remaining piping was determined to be acceptable through calculations in combination with ultrasonic and visual inspections. Also, the new piping sections were connected by welded joints (except in some cases, where prohibited by physical interference problems).

Longer term similar actions are also in progress for RBCLC piping located outside the drywell. The licensee similarly evaluated the existing condition of the RBCLC piping outside the drywell by ultrasonic and visual inspections, and concluded that there was sufficient pipe wall thickness and structural integrity to support interim continued operation of the RBCLC system. Current licensee plans are to replace all 3" and smaller diameter RBCLC system piping (inside and outside the drywell) with Schedule 80 welded joint piping within two years. The licensee performed testing and conducted an evaluation and determined that the larger than 3" piping was not subject to a similar type of failure mechanism. Regarding the chemistry issues, the licensee has been developing an action plan to identify the source of loss of oxygen (oxygen injection and detection), and the source of the other elevated parameters. The team found the licensee's completed and planned corrective actions to be appropriate.

<u>Performance Assessment</u>

The licensee's failure, prior to December 12, 2002, to determine the cause of a significant condition adverse to quality and implement corrective action to prevent repetition, despite prior opportunities to do so, was a performance deficiency. This failure allowed the RBCLC system to continue to degrade due to several factors, including inadequate design and poor system chemistry. The system degraded significantly due to general corrosion, galvanic corrosion, and flow-assisted corrosion.

In accordance with Inspection Manual Chapter (IMC) 0612, Appendix B, "Issue Disposition Screening," the team determined that the issue was more than minor because the issue was associated with the equipment performance attribute of both the initiating events and mitigating systems cornerstones. The significantly degraded RBCLC piping resulted in an increase in the likelihood of the loss of the RBCLC system due to piping failure, which directly affected the initiating events cornerstone. The loss of the RBCLC system would also result in the loss of cooling to the feedwater and condensate pumps, the recirculation pumps, the drywell coolers, the shutdown cooling heat exchangers, and two of three instrument air compressors following a loss of coolant accident or a loss of all AC power (SBO) event where AC power is recovered prior to core damage, which directly affected the mitigating systems cornerstone. Section 4OA3.5 discusses the risk analysis and assessment associated with this finding.

Enforcement

Title 10 to CFR Part 50, Appendix B, Criterion XVI, "Corrective Action," requires, in part, that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to prevent repetition. Contrary to this requirement, when significant conditions adverse to quality occurred prior to, and on May 15, 2002, involving degraded RBCLC system piping, the licensee failed to determine the cause and the extent of the condition and failed to take appropriate corrective actions to prevent recurrence. Specifically, an RBCLC system piping leak occurred on May 15, 2002, due to significant pipe corrosion, primarily as a result of a inadequate piping design, application and operation. Additionally, numerous RBCLC system leaks occurred during several preceding years. However, the cause of this condition was not determined and corrective actions were not taken, and as a result, corrosion continued to further degrade RBCLC system piping such that additional significant leaks occurred on December 5, 2002, and again on December 12, 2002. These significant leaks in December 2002 exhibited severe pipe wall loss and degraded the structural integrity of the affected piping sections. This was an apparent violation of 10 CFR 50, Appendix B, Criterion XVI. **(AV 50-220/03-003-01)**

5. Risk Significance and Analysis of Event

a. Inspection Scope

The team evaluated the licensee's safety and availability assessment of the degraded condition of the RBCLC system, including the associated assumption and evaluation criteria, analysis methodology, and design inputs. The team also performed an independent risk assessment of the finding related to the degraded RBCLC system. The team evaluated the duration of the degraded condition, and the safety implications associated with the cause of the degradation. The team also interviewed the cognizant licensee risk, engineering, and operations personnel.

b. Findings

SDP Phase 1:

In accordance with NRC IMC 0609, Appendix A, “Significance Determination of Reactor Inspection Findings for At-Power Situations,” the team conducted a significance determination process (SDP) Phase 1 screening and determined that the finding degraded both the initiating event and mitigating systems cornerstones. Therefore, a SDP Phase 2 evaluation was required.

SDP Phase 2:

The SDP Phase 2 process was not designed to estimate the risk significance of a finding that resulted in an initiating event that induces a second initiating event.

SDP Phase 3:

Internal Initiating Events:

The NRC’s Standardized Plant Analysis Risk (SPAR) model, Revision 3.01, was used to evaluate the significance of this finding. The team determined that the SPAR model needed to be revised to link the loss of RBCLC event tree and the anticipated transient without scram (ATWS) event tree and to reflect the possibility of a recirculation pump seal leak following the loss of the RBCLC system. This revision resulted in an increase in the baseline core damage frequency from 7.88E-6 per year to 7.91E-6 per year.

Assumptions:

1. The performance deficiency existed for in excess of a year. Therefore, the team used an exposure time of 1 year.

2. The RBCLC system piping was significantly degraded and lacked adequate structural integrity. Therefore, the dominant failure mode of the RBCLC system involved a passive failure of the piping which resulted in an increase in the likelihood of a loss of RBCLC initiating event. The initiating event frequency was determined by taking into account the existing failure modes of the system, the lack of structural integrity of the piping, the numerous leaks from the RBCLC piping over the years, and the likelihood of a leak before break in the piping. Applying engineering judgement, the team concluded that the loss of RBCLC initiating event frequency was approximately 5.0E-2 per year.

3. Loss of coolant accidents and SBO events result in drywell temperatures that induce thermal stresses in the RBCLC piping in excess of the structural capability of the piping. Therefore, the team used a conditional failure probability of 1.0 for the RBCLC system in these events.

4. Failure of the RBCLC piping would result in the inability to remove heat from the recirculation pump seals. Without cooling, the likelihood of a recirculation pump seal leak increased substantially. Therefore, the team used a seal failure

probability of 0.5, which was based on the licensee's recirculation pump seal package test results.

5. Failure of the RBCLC piping would result in system leakage in excess of the automatic makeup capability for the system. Consequently, the RBCLC expansion tank level would be lost and the operating RBCLC pumps would fail due to inadequate net positive suction head (NPSH).

   The team did not credit recovery of the RBCLC system because under certain entry conditions, Annunciator Response Procedure N1-ARP-H1, "Control Room Panel H1," directed the starting of the standby RBCLC pump; and Annunciator Response Procedure N1-ARP-H1, Special Operating Procedure N1-SOP-8, "RBCLC Failure," and Operating Procedure N1-OP-11, "Reactor Building Closed Loop Cooling System," did not provide guidance to secure the operating RBCLC pumps when inadequate NPSH existed. Also, no procedural guidance existed to isolate an RBCLC leak and recover the RBCLC system. In addition, because each of the dominant accident sequences involved the failure of operator actions prior to when RBCLC would have been recovered, the likelihood of the failure of the operators to recover RBCLC would be dependent on those prior failures. Consequently, the team considered the likelihood of the operators' failure to recover the RBCLC system too high to credit.

The team revised the SPAR model to reflect these assumptions, determined a revised core damage frequency for the exposure period (1.32E-5 per year) and calculated the change in core damage frequency (ΔCDF) for this finding due to internal initiating events.

ΔCDF = [(1.32E-5 per year) - (7.91E-6 per year)]
= 5.29E-6 per year (White)

This result was dominated by the following accident sequences.

Contribution to ΔCDF	Core Damage Sequence Description
4.03E-6	• IE - Loss of RBCLC due to the degraded piping condition • Instrument air (IA) fails following the loss of RBCLC • RCS inventory is lost via either a stuck open SRV or unisolated recirculation pump seal leaks • Condensate and feedwater fail due to loss of RBCLC • Operators successfully depressurize to low pressure • Core Spray successfully provides inventory control • Suppression Pool Cooling fails due to loss of IA • Shutdown Cooling fails due to loss of RBCLC • Containment spray fails • Containment venting fails due to loss of IA
5.71E-7	• IE - Small break loss of coolant accident (SLOCA) • RBCLC fails due to the degraded piping condition following the SLOCA • IA fails following the loss of RBCLC • Condensate and feedwater fail due to loss of RBCLC • Operators successfully depressurize to low pressure • Core Spray successfully provides inventory control • Suppression Pool Cooling fails due to loss of IA • Containment spray fails • Containment venting fails due to loss of IA
5.26E-7	• IE - Loss of RBCLC due to the degraded piping condition • IA fails following the loss of RBCLC • Condensate and feedwater fail due to loss of RBCLC • Emergency condensers fail • Operators successfully depressurize to low pressure • Core Spray successfully provides inventory control • Suppression Pool Cooling fails due to loss of IA • Shutdown Cooling fails due to loss of RBCLC • Containment spray fails • Containment venting fails due to loss of IA
6.80E-8	• IE - Loss of RBCLC due to the degraded piping condition • IA fails following the loss of RBCLC • RCS inventory is lost via two or more stuck open SRVs • Condensate and feedwater fail due to loss of RBCLC • Core Spray successfully provides inventory control • Suppression Pool Cooling fails due to loss of IA • Shutdown Cooling fails due to loss of RBCLC • Containment spray fails • Containment venting fails due to loss of IA

External Initiating Events:

The Nine Mile Point Unit 1 probabilistic risk assessment (PRA) model U1PRA01B, dated February 2002, includes external initiating events (e.g., seismic and fire initiating events). Therefore, the team evaluated the results obtained using the licensee's PRA model to determine the risk contribution of the significantly degraded RBCLC piping due to external initiating events.

Seismic:

The Nine Mile Point Unit 1 PRA model has six categories of seismic events. The model uses the EPRI seismic hazards curves to estimate the frequencies of each of these events. The baseline seismic-induced CDF is approximately 1.25E-6 per year. The licensee's PRA documentation stated that the model results using the Lawrence Livermore National Laboratory seismic hazard curves would be higher by approximately a factor of five.

The team concurred with the licensee's conclusion that the significantly degraded RBCLC piping would fail during any seismic event of 0.05g or greater in magnitude. The licensee revised their PRA model to reflect this degraded condition and determined that the increase in seismic-induced CDF was approximately 1.03E-7 per year. This result was dominated by a seismic-induced loss of offsite power, failure of the RBCLC piping, failure of instrument air, and failure to remove decay heat from containment. The team reviewed the results and concluded that the results were reasonable and that seismic events did not contribute significantly to ΔCDF.

Fire:

The team determined that there were no fire scenarios that would result in conditions that would fail the significantly degraded RBCLC piping. In addition, the team determined that the significantly degraded RBCLC piping did not adversely impact the mitigation of any fire events. Therefore, the team concluded that fire events did not contribute significantly to ΔCDF.

High Winds, Floods, and Other External Events (HFO):

The team determined that there were no HFO events that would result in conditions that would fail the significantly degraded RBCLC piping. In addition, the team determined that the significantly degraded RBCLC piping did not adversely impact the mitigation of any HFO events. Therefore, the team concluded that HFO events did not contribute significantly to ΔCDF.

Potential Risk Contribution due to Large Early Release Frequency:

In BWR Mark I containments, only a subset of core damage accidents can lead to large, unmitigated releases from the containment that have the potential to cause prompt fatalities prior to population evacuation. Core damage sequences of concern for BWR Mark I containments are inter-system loss of coolant accident, ATWS, SLOCA, and transient sequences. Because the dominant accident sequences for the case involving the significantly degraded RBCLC piping were transient and SLOCA sequences, the finding was screened for its potential risk contribution to large early release frequency (LERF). Using NRC Inspection Manual Chapter 0609, Appendix H, "Containment Integrity SDP," the team determined that the dominant accident sequences did not result in a contribution to LERF because these sequences resulted in core damage following containment failure due to a loss of containment heat removal. Thus, evacuation of the population would have been carried out in sufficient time so that these accident sequences would not have resulted in a contribution to LERF.

Licensee's Risk Assessment:

The licensee performed a risk evaluation of the degraded RBCLC piping and concluded that the ΔCDF was 9.0E-7 per year and the ΔLERF was 7.5E-8 per year. The team reviewed the licensee's results and concluded that the differences were primarily attributable to a difference in three assumptions.

First, the licensee assumed that the RBCLC piping was degraded, but it retained structural integrity for all initiating events except loss of coolant accidents, loss of drywell cooling events, and seismic events greater than 0.05g in magnitude. The licensee did not assume that the likelihood of the loss of RBCLC initiating event increased due to the condition of the RBCLC piping. The team evaluated the licensee's assumption and concluded that it was not the most appropriate assumption for the condition.

Second, the licensee assumed that the RBCLC system would fail at one preferential location and that the recirculation pump seals would be cooled by the boil off of the water that would remain in the system following the pipe rupture. As a result, the licensee assumed that the likelihood of the recirculation pump seal leak remained unchanged. The team evaluated the licensee's assumption and concluded that there was no basis to assume that the RBCLC piping would fail at one preferential location and that the remaining water in the system would adequately cool the recirculation pump seals. As a result, the team evaluated the licensee's assumption and concluded that it was not the most appropriate assumption for the condition.

Lastly, the licensee assumed that recovery of the RBCLC and IA systems was possible to provide long term heat removal from containment. The licensee assumed that the likelihood of the operators' failure to recover the RBCLC system was 0.1. The licensee based this assumption largely on the time available to perform the recovery actions and reliance on assistance from the Technical Support Center and the Emergency Operations Facility. The team evaluated the licensee's assumption and concluded that it was not the most appropriate assumption for the condition for the reasons described above (Phase 3 Assumption 5).

Analysis - Conclusion:

The safety significance of the inspection finding based on the increase in core damage frequency due to internal and external initiating events is White (ΔCDF = 5.39E-6 per year). The safety significance of the inspection finding based on the increase in large early release frequency is Green (ΔLERF < 1.0E-7 per year). Therefore, the safety significance of the inspection finding is White. A White finding represents a finding of low to moderate safety significance.

4OA5 Other

(Closed) URI 50-220/2002-06-02: RBCLC System Piping Degradation Due to Corrosion. This item was opened to evaluate the safety and risk significance of the degraded condition of the RBCLC system. This NRC special inspection team performed this evaluation, and identified associated licensee performance deficiencies as documented in this inspection report. Therefore, this item is closed, and further tracking and follow-up of this issue will be accomplished via the enforcement tracking/violation open item identified in this report (See Section 4OA3.4 of this report).

4OA6 Meetings, including Exit

The inspectors presented the inspection results to Mr. J. Conway, Vice President, Nine Mile Point, and other members of licensee management at the conclusion of the onsite inspection on February 14, 2003, and on March 7, 2003, upon completion of the combined onsite and in-office inspection activities. The licensee acknowledged the findings presented. The team reviewed some proprietary documents during the inspection, and these documents were identified and discussed by the NRC at the exit meeting. Based upon subsequent discussions with the licensee, none of the information presented at the exit meeting and included in this report was considered proprietary.

ATTACHMENT 1

KEY POINTS OF CONTACT

Licensee Personnel

M. Alvi, Lead Engineer, Design Structural
K. Churchill, System Engineer
K. Embry, Licensing Engineer
T. Kulczycky, Principle Engineer, Reliability Engineering
T. Kurtz, Engineering Services
B. Montgomery, Manager, Engineering Services
J. Murphy, Engineer, Mechanical Design
B. Randall, General Supervisor, System Engineering
J. Richards, Manager, Chemistry

NRC Personnel

G. Hunegs, Senior Resident Inspector, NMP
J. Trapp, Chief, Projects Branch 1, Region I

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-220/2003-03-01	AV	Failure to Determine the Cause of a Significant Condition Adverse to Quality and Implement Corrective Action to Prevent Repetition, Associated with Severe Corrosion of the RBCLC System.

Closed

50-220/2002-06-02	URI	RBCLC System Degradation

LIST OF DOCUMENTS REVIEWED

Drawings:

C-18011-C	Instrument Air System P&I Diagram, Sheet 1, Rev. 48
C-18018-C	Reactor Shutdown Cooling System P&I Diagram, Sheet 1, Rev. 25
C-18022-C	RBCLC System P&I Diagram, Sheet 2, Rev. 43
C-18022-C	TBCLC System P&I Diagram, Sheet 3, Rev. 30
C-18298-C	RBCLC System Piping at Drywell Air Coolers and Equipment Drain Sump Pit Coolers, Rev. 6
C-18299-C	RBCLC System Piping at Drywell Air Coolers and Equipment Drain Sump Pit Coolers, Rev. 5
C-26855-C	RBCLC System No. 70 Piping Isometric, Rev. 2

Calculations:

S13.4-70-TP15 RBCLC, Rev. 0

Licensing Documents:

Nine Mile Point Unit 1 Technical Specifications
Updated Safety Analysis Report - Nine Mile Point Unit 1 Nuclear Station

Deviation Event Reports (DER):

1991-560
1992-480
1993-339
2000-2139
2000-3268
2001-5201
2002-2383
2002-3143
2002-5166
2002-5193
2002-5193
2002-5280
2002-5305

Procedures:

N1-OP-11 Reactor Building Closed Loop Cooling System, Rev. 20
N1-MRM-REL-0104 Maintenance Rule Manual, Rev. 16
N1-MRM-REL-0105 Maintenance Performance Criteria, Rev. 14

Miscellaneous Documents:

Failure Analysis of Flow Switch from the RBCLC to Recirculation Pump 32-190 Cooling Water, NMP-1, dated July 29, 2002

Design Change Package N1-02-219 Drywell Equipment Drain Tank Coolers RBCLC Outlet Re-design," Rev. 0

Draft Evaluations

DER 2002-5305 Category 1 Root Cause Evaluation (Organizational and Cultural Assessment - Unit 1 RBCLC System Events)

Safety and Availability Assessment - Unit 1 - RBCLC Pipe Leakage Inside Primary Containment

Reliability Group Technical Report - Unit 1 Drywell Heatup and RBCLC Drain Unit Cooler Piping Temperature Response Evaluation

Safety and Availability Assessment - Unit 1 - RBCLC Leak Study

LIST OF ACRONYMS USED

AC	Alternating Current
ASME	American Society of Mechanical Engineers
ATWS	Anticipated Transient Without Scram
AV	Apparent Violation
BWR	Boiling Water Reactor
CDF	Core Damage Frequency
CFR	Code of Federal Regulations
CMTR	Certified Material Test Report
DER	Deviation Event Report
ECCS	Emergency Core Cooling System
EPRI	Electric Power Research Institute
FW	Feedwater
HFO	High Winds, Floods, and Other External Events
IA	Instrument Air
IE	Initiating Events
IMC	Inspection Manual Chapter
LERF	Large Early Release Frequency
MDC	Mechanical Design Criteria
MS	Mitigating Systems
MSIV	Main Steam Isolation Valve
NEI	Nuclear Energy Institute
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission
ppb	Parts Per Billion
PRA	Probabilistic Risk Assessment
RBCLC	Reactor Building Closed Loop Cooling
RCS	Reactor Coolant System
SBO	Station Blackout
SDP	Significance Determination Process
SLOCA	Small Break Loss of Coolant Accident
SPAR	Standardized Plant Analysis Risk
SRV	Safety Relief Valve
TBCLC	Turbine Building Closed Loop Cooling
URI	Unresolved Item
ΔCDF	Change in Core Damage Frequency
ΔLERF	Change in Large Early Release Frequency

ENCLOSURE 2

February 4, 2003

MEMORANDUM TO:	James Trapp, Manager Special Inspection Steve Pindale, Leader Special Inspection
FROM:	A. Randolph Blough, Director /RA/ Division of Reactor Projects
SUBJECT:	SPECIAL INSPECTION CHARTER - NINE MILE POINT UNIT NO. 1

A special inspection has been established to inspect and assess the reactor building closed loop cooling (RBCLC) system piping degradation that was identified at Nine Mile Point Unit 1 in December 2002. The special inspection will be conducted onsite during the week of February 10, 2003, and will include:

Manager:	James Trapp, Chief, Projects Branch 1
Leader:	Steve Pindale, DRS
Members:	Suresh Chaudhary, DRS Edward Knutson, Resident Inspector at Nine Mile Point Eugene Cobey, Senior Risk Analyst - Part Time

On December 5, Unit 1 was shut down due to unidentified system leakage inside the drywell. Leakage was subsequently identified from the RBCLC system. The piping degradation resulted in system leaks and potentially adversely impacted the structural integrity of the system. The RBCLC system is cooled by service water and provides demineralized water to cool auxiliary equipment located in the reactor, turbine and waste disposal building. The RBCLC system provides cooling water to major components including equipment drain tank coolers, drywell air coolers and recirculation pump coolers located in the drywell in addition to fuel pool heat exchangers, instrument air compressors, feedwater pumps, condensate pumps and feedwater booster pumps.

This special inspection was initiated in accordance with NRC Inspection Procedure 71153 “Event Follow-up” and NRC Management Directive 8.3, “NRC Incident Investigation Program.” The decision to perform this special inspection was based largely on the postulated loss of safety function of the feedwater coolant injection system (high pressure reactor makeup source is dependent on RBCLC) and the increased conditional core damage probability (CCDP) for this condition. The inspection will be performed in accordance with the guidance of NRC Inspection Procedure 93812, “Special Inspection,” and the inspection report will be issued within 45 days following the exit meeting for the inspection. If you have any questions regarding the objectives of the attached charter, please contact James Trapp at 610-337-5186.

Attachment: Special Inspection Charter

Special Inspection Charter
Nine Mile Point Unit No. 1
Reactor Building Closed Loop Cooling System Piping Degradation

The objectives of the inspection are to determine the facts and assess the conditions surrounding the reactor building closed loop cooling system piping degradation that occurred at Nine Mile Point Unit 1 on December 2002. Specifically the inspection should:

a. Assess the adequacy of the licensee's root cause evaluation of the condition.

b. Assess the adequacy of the licensee's extent of condition review and corrective actions for the condition.

c. Assess the effectiveness of prior corrective actions for the previous leaks in the reactor building closed loop cooling system.

d. Evaluate the licensee's assessment of the risk significance of the condition, including evaluation of all input assumptions.

e. Independently evaluate the risk significance of the condition.

f. Assess the applicability/effectiveness of the licensee's piping inspection program.

g. Assess the design adequacy of the RBCLC piping material compatibility.

h. Document the inspection findings and conclusions in a special inspection report in accordance with Inspection Procedure 93812 within 45 days of the exit meeting for the inspection.