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PG&E Letter DCL-10-096

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20852

Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Response to NRC Letter dated July 14, 2010, Request for Additional Information (Set 8) for the Diablo Canyon License Renewal Application

Dear Commissioners and Staff:

By letter dated November 23, 2009, Pacific Gas and Electric Company (PG&E) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for the renewal of Facility Operating Licenses DPR-80 and DPR-82, for Diablo Canyon Power Plant (DCPP) Units 1 and 2, respectively. The application included the license renewal application (LRA), and Applicant's Environmental Report – Operating License Renewal Stage.

By letter dated July 14, 2010, the NRC staff requested additional information needed to continue their review of the DCPP LRA.

PG&E's response to the request for additional information is included in Enclosure 1. LRA Amendment 7, resulting from the responses, is included in Enclosure 2 showing the changed pages with line-in/line-out annotations.

PG&E revises Table A4-1, "License Renewal Commitments," for the following commitments: (1) Enhance the Fuel Oil Chemistry Program to provide for one-time supplemental ultrasonic thickness measurements of accessible portions of fuel oil tank bottoms; (2) DCPP will revise the test procedure acceptance criteria to specifically preclude repositioning a tube more than once without capping or replacing. This will preclude repositioning a tube having chrome plated surfaces from the chrome being moved out of the areas of known wear.

If you have any questions regarding this response, please contact Mr. Terence L. Grebel, License Renewal Project Manager, at (805) 545-4160.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on August 12, 2010.

Sincerely,

James R. Becker
Site Vice President

pns/50329603
Enclosures
cc: Diablo Distribution
cc/enc: Elmo E. Collins, NRC Region IV Regional Administrator
Nathanial B. Ferrer, NRC Project Manager, License Renewal
Kimberly J. Green, NRC Project Manager, License Renewal
Michael S. Peck, NRC Senior Resident Inspector
Alan B. Wang, NRC Project Manager, Office of Nuclear Reactor Regulation

**PG&E Response to NRC Letter dated July 14, 2010
Request for Additional Information (Set 8) for the
Diablo Canyon License Renewal Application**

RAI B2.1.14-1

License renewal application (LRA) Section B2.1.14 states that the Fuel Oil Chemistry Program manages loss of material due to general, pitting, crevice and microbiological influenced corrosion on the internal surface of components in the emergency diesel fuel oil storage and transfer system, portable diesel fire pump fuel oil tanks, and portable caddy fuel oil tanks. Although license renewal boundary drawing LR-DCPP-21-107721-05 shows the diesel fuel oil pump head tank as within the scope of license renewal, it is not clear from the program description whether this aging management program (AMP) is used for the inspection of the fuel oil pump head tank. Please confirm if this tank is inspected by this AMP or explain how this tank is age managed.

PG&E Response to RAI B2.1.14-1

The fuel oil pump head tanks are small volume tanks managed by the License Renewal Application (LRA), Section B2.1.14, "Fuel Oil Chemistry." These tanks will be age managed similar to the portable diesel-driven fire pump fuel oil tanks and the portable caddy fuel oil tanks. See revised LRA, Section B2.1.14, in Enclosure 2.

RAI B2.1.14-2

Generic Aging Lessons Learned (GALL) Report AMP XI.M30 states that an ultrasonic thickness (UT) inspection should be performed on tank bottoms to ensure that significant degradation is not occurring. LRA Section B2.1.14 states that UT inspections of fuel oil tanks will be performed only if visual inspection indicates degradation of the tank. It is noted that this was not identified as an exception to the GALL Report. Provide justification for performing UTs only if the visual inspection indicates there is degradation.

PG&E Response to RAI B2.1.14-2

License Renewal Application (LRA) Sections A1.14, B2.1.14, "Fuel Oil Chemistry" and Table A4-1, "License Renewal Commitments," have been revised to require one-time ultrasonic wall thickness measurements of accessible portions of fuel oil tank bottoms. See revised LRA Sections A1.14, B2.1.14, and Table A4-1 in Enclosure 2.

RAI B2.1.21-1

In LRA Section B2.1.21, the applicant states that its program is an existing program that is consistent with GALL AMP XI.M37. GALL AMP XI.M37 program element "acceptance criteria" states:

> *Appropriate acceptance criteria such as percent through-wall wear will be established. The acceptance criteria will be technically justified to provide an adequate margin of safety to ensure that the integrity of the reactor coolant system pressure boundary is maintained. The acceptance criteria will include allowances for factors such as instrument uncertainty, uncertainties in wear scar geometry, and other potential inaccuracies, as applicable, to the inspection methodology chosen for use in the program. Acceptance criteria different from those previously documented in NRC acceptance letters for the applicant's response to Bulletin 88-09 and amendments thereto should be justified.*

During its review of the applicant's supporting documentation, the staff noted that the AMP currently uses a 68% through-wall loss as the current acceptance criterion for the program as recommended by Westinghouse. The staff observed that this acceptance criterion is also the value cited in the applicant's response to NRC Bulletin 88-09. It is the staffs understanding that Westinghouse recommended that Diablo Canyon Nuclear Power Plant (DCPP) apply a 10% uncertainty value to the flux thimble tube program to account for instrument and wear scar geometry uncertainties, and recommended that this be accomplished by subtracting 10% of the tube nominal wall thickness value from the measured wall thickness readings taken during the outages. However, the current plant procedure for evaluating the nondestructive examination measurements against the acceptance criteria does not appear to call for any corrections to account for a 10% error in instrument or wear scar geometry uncertainties.

The staffs review further reveals that additional important sources of uncertainty appear not to be accounted for in the current implementation of the acceptance criterion and the wear (rate) projection, thus increasing the concern that the overall monitoring and trending do not meet the GALL Report recommended technically justified conservatism. For instance, the close proximity of support conditions may have an unaccounted impact on the calibration for the eddy-current testing (ECT)/procedure used to determine the wear depth. This determination of depth for the volumetric degradation also requires certain flaw-shape conditions to be satisfied to maintain a level of conservatism. Furthermore, these uncertainties in the measurement not only affect the examination of acceptance criterion but also introduce error in the wear rate projection apart from the inaccuracy or uncertainty of the trending method itself. The staff seeks additional clarification on the types of uncertainties that are accounted for in either the "detection of aging effects," "monitoring and trending," or "acceptance criteria" program elements for this AMP.

Clarify which document in the current licensing basis clearly provides the reference basis for the 68% through-wall wear acceptance criterion for this AMP, and clarify how instrument and thimble tube wear scar geometry uncertainties are accounted for in either the "detection of aging effects," "monitoring and trending," or "acceptance criteria" program elements for the program, as is recommended in the GALL AMP and NRC Bulletin 88-09. Clarify whether (and if so how) proximity effect uncertainties for supports in the vicinity of the thimble tubes are accounted for in program's ECT depth reading estimate methodology.

PG&E Response to RAI B2.1.21-1

As discussed below, NRC Bulletin 88-09 required licensees to establish thimble tube wear acceptance criteria based on technical justification, which included allowances for such items as inspection methodology and wear scar geometry uncertainties. As indicated below, the NRC staff closed its review of Bulletin 88-09 based on a commitment from PG&E to implement a program in accordance with the Bulletin requirements. The NRC staff acceptance in letter dated May 5, 1988, was not based on any specific acceptance criteria for wear. Therefore, the PG&E licensing basis had no specific acceptance criteria for thimble tube wear.

Supporting Assessment:

PG&E Letter DCL-88-208, dated August 26, 1988, responded to NRC Bulletin 88-09 and requested NRC staff concurrence to implement a thimble tube inspection following the Unit 2 Second Refueling Outage (2R2). NRC letter dated September 15, 1988, approved PG&E's request to implement a thimble tube inspection program following 2R2.

PG&E Letter DCL-89-280, dated November 10, 1989, responded to NRC Bulletin 88-09 and stated that the acceptance criteria for the Unit 1 third refueling outage (1R3) would be 60 percent, and that a 10 percent penalty would be added to the eddy current results to account for uncertainty. DCL-89-280 also indicated that in the future, this criterion may be refined subsequent to testing to include allowances for changes in inspection methodology, industry operating experience, and recommendations from the Westinghouse Owner's Group (WOG). DCL-89-280 further noted that WOG is currently working on a project to establish criteria for measuring, predicting, and dealing with thimble tube wear.

NRC letter dated May 5, 1989, closed the NRC staff review of Bulletin 88-09 for Diablo Canyon Power Plant (DCPP) and noted that the NRC staff reviewed DCL-88-208, and concluded that it constitutes a commitment to establish and implement an inspection program that meets all the recommendations of NRC Bulletin 88-09.

In 1990, Westinghouse issued a DCPP-specific calculation, MED-PCE-8649, as the basis for flux thimble tube inspection criteria. MED-PCE-8649 recommended that to account for eddy current machine error, which was considered to be 10 percent maximum, that 10 percent be added to the measured reading and then compared to 68 percent wall loss. PG&E procedures were revised to adopt the acceptance criterion of 68 percent with 10 percent uncertainty added to the actual wear scar depth measurement.

In January 1991, Westinghouse issued a generic flux thimble tube evaluation, WCAP-12866, which based its evaluation upon samples of actual flux thimble tubes collected from utilities, including DCPP tubes from 1R3. WCAP-12866 indicated the comparison of eddy current measurements of the thimble wear scars to those measured by mechanical means showed that eddy current identified the scar being as deep or deeper than it actually was. This result indicates it was not necessary to add any uncertainty to the eddy current indications. Based on test results, it was determined that a thimble tube can safely remain in service with up to an 80 percent wall loss.

The WCAP-12866 recommended acceptance criterion is 80 percent through-wall wear which includes allowances for instrument uncertainty, uncertainties in wear scar geometry, and other potential inaccuracies. The current thimble tubes used for replacement at DCPP are slightly larger than the original tubes, having an outside diameter (OD) of 0.315 in. vs. 0.302 in., with a corresponding inside diameter (ID) of 0.210 in. vs. 0.20 in. In addition, since the Unit 1 fourteenth refueling outage (1R14), all replacement tubes have a 12 foot chrome plated band electrolytically applied to the portion of the tube which extends from below the bottom head of the reactor vessel up through the lower internals guide structure to a few inches above the fuel bottom nozzle. The chrome band is approximately 0.0025 in. to 0.0035 in. thick. In discussions with Westinghouse, the larger OD tubes are less susceptible to wear, probably because they are stiffer. As described in WCAP-12866, the tubes range from 0.201 in. to 0.268 in. ID. Therefore, the tubes used at DCPP, both original and replacement tubes, are bounded by the evaluations contained in WCAP-12866. In addition, it should be pointed out that tubes from DCPP removed during 1R3 were used as part of the sample for the inspections and burst tests documented in WCAP-12866. The L-13 tube, which failed during cycle 2C14, was a 0.210 in. ID tube with a 16-inch chrome band at the area of the fuel bottom nozzle that was installed during Unit 2 tenth refueling outage (2R10).

In February 1991, PG&E revised the plant procedure on flux thimble tube inspections to remove the 10 percent uncertainty based on implementing wear equations and after confirming the accuracy of the testing method used in 1R4. PG&E reviewed WCAP-12866 recommendations and determined that the 68 percent criterion without consideration for any additional uncertainty was conservative and bounded by the WCAP-12866 results.

It is PG&E's understanding that the NRC has previously accepted the 80 percent allowable throughwall wear acceptance value in WCAP-12866 since the acceptance criterion was based on conservative burst tests on Westinghouse thimble tube designs that supported this acceptance criterion for thimble tubes in Westinghouse designed nuclear power plants.

The DCPP thimble tube management program monitors and takes corrective actions for observed degradation. The program uses a 68 percent acceptance criteria including equations for wear and incorporated corrective actions taken in response to the L-13 thimble tube leak. Based on this, PG&E believes that the DCPP thimble tube management program will ensure that the thimble tubes will maintain their intended function during the period of extended operation.

RAI B2.1.21-2

GALL AMP XI.M37 program element "monitoring and trending," states, "[t]he wall thickness measurements will be trended and wear rates will be calculated. Examination frequency will be based upon wear predictions that have been technically justified as providing conservative estimates of flux thimble tube wear."

The "operating experience" program element for the Flux Thimble Tube Program discussed the impacts of a leak that occurred in thimble tube L 13 in 2006.

The staffs current understanding is that tube L 13 has the following relevant operating history:

- *Replacement of the tube in refueling outage (RO) 2R 1 0*
- *16% throughwall wear detected in the tube during RO 2R11 with no corrective action taken on the tube (Le., the tube met the acceptance criterion on throughwall wear)*
- *Additional 30% throughwall wear detected in the tube during RO 2R12 (Le., 46% throughwall wear reading, and realignment of the thimble tube as a corrective action*
- *An approximate 40% to 46% throughwall wear reading occurring in the realigned area of the tube, as measured during RO 2R13, with a second realignment of the tube as a corrective action prior to entering into operating cycle 14*

Both the DCPP "incremental wear" and "cumulative wear" projection methods are based on a two-reading linear extrapolation method. However, the historic wear data for tube L 13 may indicate that wear in tube L13 may be occurring at an increasingly non-linear fashion (e.g., -9.6% wall loss per year between 2R10 and 2R11, -18% wall loss per year between 2R11 and 2R12, and -27.5% wall loss per year between 2R12, and 2R13). Thus, it is not evident whether PG&E's linear "incremental wear" and "cumulative wear" projection methods for the DCPP flux thimble tubes are conservative, particularly if wear occurring in a thimble tube is occurring at an increasingly non-linearly rate over time.

Provide the basis for why the "incremental wear" and "cumulative wear" projection methods for the Flux Thimble Tube Inspection are considered to be capable of conservatively projecting the amount of wear in a thimble tube to the next scheduled thimble tube inspection outage, especially if wear rates in the thimble tubes can increase non-linearly over time.

PG&E Response to RAI B2.1.21-2

The L-13 thimble tube failure was caused by flow-induced wear and plant practices that allowed multiple repositioning of thimble tubes. Corrective actions have been taken to address this event to mitigate such flow-induced wear during operation. Based on the corrective actions taken to date, PG&E believes that the flux thimble tube program incremental wear and cumulative wear projection methods for the Diablo Canyon Power Plant (DCPP) flux thimble tubes are appropriately conservative for managing wear during the period of extended operation.

PG&E will revise the test procedure acceptance criteria to specifically preclude repositioning a tube more than once without capping or replacing. This will preclude repositioning a tube having chrome plated surfaces from the chrome being moved out of the areas of known wear. PG&E anticipates revising this procedure prior to refueling outage Unit 1 sixteenth refueling outage (1R16), which is starting in October 2010. This procedure will be revised prior to entering the period of extended operation. See revised License Renewal Application, Table A4-1, "License Renewal Commitments," in Enclosure 2.

Supporting Assessment:

As discussed in the NRC request for additional information above, the DCPP flux thimble tube operating experience included a throughwall leak that occurred in flux thimble tube L-13 on August 31, 2006. A manual valve was closed that isolated the leak. The leak appeared to be caused by accelerated wear/wear-induced fatigue of the L-13 thimble tube due to flow induced vibration in combination with multiple wear scars in a short length of tube, which was not prevented by the thimble tube wear management program. The L-13 tube was one which had been repositioned twice. Based on Unit 2 fourteenth refueling outage (2R14) Unit 2 eddy current data, this led to three wear scars, two existing and a new one forming, within a 10-inch band of tube, which PG&E believes destabilized the tube and caused it to vibrate more and thus to wear more rapidly. The position of these wear scars was approximately six feet below the core plate in the lower internals guide tube. L-13 had been repositioned by six inches and capped during the Unit 2 third refueling outage (2R3) and remained capped until the Unit 2 tenth refueling outage (2R10) when it was replaced with a 16-inch chrome banded Westinghouse replacement part. The 16-inch band protected the bottom nozzle area only and did not provide protection for the thimble tube in the lower internals. The L-13 thimble tube was repositioned five inches during the Unit 2 twelfth refueling outage (2R12) and again five inches during the Unit 2 thirteenth refueling outage (2R13) due to 46 percent wear at the upper tie plate area. Repositioning the thimble tube 10 inches prevented the 16-inch chrome band from protecting wear areas at the fuel bottom nozzle. This exposed an unplated portion of the thimble tube to the bottom nozzle and caused eventual failure of the tube due to flow induced fretting.

L-13 was the only thimble tube to be repositioned more than once in Unit 2. In Unit 1 there were four tubes which had been repositioned more than once, all were repositioned twice. These tubes were in locations E-9, H-13, F-14 and H-15. Three of these tubes were replaced in the Unit 1 fourteenth refueling outage (1R14), and one, E-9, was capped in 1R14 and was replaced in Unit 1 fifteenth refueling outage (1R15).

The actions taken to respond to the failure of L-13 were:

1. The acceptance criteria in the test procedure were revised to require capping or replacing tubes that met any of the following criteria: greater than 25 percent wear per year, any tubes that had to be repositioned more than twice, any tube with multiple wear scars - any two of which measured greater than 40 percent, any tubes that had to be repositioned more than a total of 6 inches, or any tube that cannot be inspected.

   The 25 percent wear per year, tubes repositioned more than 6 inches, and multiple wear scars over 40 percent criteria, were intentionally chosen to prevent a repeat of the L-13 failure.

2. DCPP replaced thimble tubes using Westinghouse supplied tubes, having an extended chrome plated band, in 1R14, 2R14, and 1R15. Ten tubes were replaced in 1R14 and 2R14. Eleven tubes were replaced in 1R15. Based on the eddy current results in the Unit 2 sixteenth refueling outage (2R16), up to nine more tubes will be replaced during 2R16. The eddy current results in 1R15 and 2R15 for the tubes replaced in 1R14 and 2R14 showed no signs of wear. This is consistent with previous industry experience.

   The tubes chosen for replacement were ranked by extent of wear, with the tubes exhibiting the most wear being ranked highest, with a second tier ranking imposed to assure that the optimum pattern of core coverage was achieved to provide a satisfactory core flux map. If highly worn tubes were not replaced and failed the acceptance criteria, or were predicted to do so during the following cycle, they were capped and the isolation valves were closed.

3. A portion of the L-13 thimble tube was sent to Westinghouse for analysis. The Westinghouse failure analysis corroborated the conclusion that the cause of the failure was thimble tube wear caused by flow-induced vibration. It also documented that the wear scars were consistent with those previously observed.

4. DCPP removed the thimble tube and capped the L-13 guide tube in 2R14. There is not currently a thimble tube installed at the L-13 position.

   Based on the eddy current results from 2R3 and 2R14, PG&E believes that the thimble tube failed at the location of the bottom nozzle. This could not be verified during 2R14 due to fact that DCPP injects zinc into the primary system coating the thimble tubes in a black zinc oxide; this makes a visual inspection to find a flaw in the tube problematic.

<u>RAI B.2.1.21-3</u>

In the "operating experience" element for the Flux Tumble Tube Inspection Program, the applicant states that it made the following changes to the program after the leak that occurred in tube L13 in 2006: (1) added a corrective action to cap or replace a thimble tube which exhibits a wear rate greater than 25 percent/year, (2) added a corrective action to cap or replace a thimble tube which has two wear scars greater than 40 percent through-wall and (3) added a corrective action to cap or isolate a thimble tube which is chrome plated and has been repositioned greater than eight inches.

The operating experience discussion of the 2006 leakage event in DCPP Unit 2 Thimble Tube L13 did not explain why a leak had occurred in the tube so soon after returning to power operations during Unit 2 Operating Cycle 14, even after realigning (repositioning) the tube position during RO 2R13. The staff is concerned that, based on this operating experience, a leak may develop in a DCPP thimble tube in less than the time associated with one full operating cycle (Le., in less than 18 months).

Provide your basis for adding each of the additional corrective actions that have been discussed in the "operating experience" program element of this AMP (Le., explain what they are intended to prevent and what they will accomplish if implemented). Provide your basis for why the "detection of aging effects" activities, "monitoring and trending" activities, "acceptance criteria" and "corrective actions" for the program, when taken into account of each other, are considered to be sufficient and capable of ensuring that the program will be capable of detecting wear in the flux thimble tube (and of taking appropriate corrective action), prior to the occurrence of a full through-wall failure of a thimble tube at the facility.

<u>PG&E Response to RAI B2.1.21-3</u>

The acceptance criteria in the surveillance test procedure were revised to require capping or replacing tubes which met any of the following criteria: greater than 25 percent wear per year, any tube with multiple wear scars - any two of which measured greater than 40 percent, or any tubes that had to be repositioned more than a total of 6 inches.

The 25 percent wear per year, tubes repositioned more than 6 inches, and multiple wear scars over 40 percent criteria were intentionally chosen to prevent a repeat of the L-13 failure.

Diablo Canyon Power Plant (DCPP) will additionally revise the test procedure acceptance criteria to specifically preclude repositioning a tube more than once without capping or replacing. This will preclude repositioning a tube having chrome plated surfaces from the chrome being moved out of the areas of known wear. As discussed in the response to RAI B2.1.21-2, PG&E anticipates completing this procedure revision prior to the Unit 2 sixteenth refueling outage (1R16), which is starting in October 2010. This procedure will be revised prior to entering the period of extended operation. See revised License Renewal Application, Table A4-1, "License Renewal Commitments," in Enclosure 2.

Supporting Assessment:

The corrective actions to the failure of the L-13 thimble tube included:

1. The acceptance criteria in the surveillance test procedure were revised to require capping or replacing tubes that met any of the following criteria: greater than 25 percent wear per year, any tube with multiple wear scars - any two of which measured greater than 40 percent, any tubes that had to be repositioned more than a total of 6 inches, or any tube that cannot be inspected. These actions were taken to prevent potential through wall wear of the thimble tubes.

2. DCPP replaced thimble tubes using Westinghouse supplied tubes having an extended chrome plated band, in the Unit 1 fourteenth refueling outage (1R14), the Unit 2 fourteenth refueling outage (2R14), and the Unit 1 fifteenth refueling outage (1R15). Ten tubes were replaced in each unit during 1R14 and 2R14. An additional eleven tubes were replaced in 1R15. Based on the eddy current results from the Unit 2 sixteenth refueling outage (2R16), up to nine more tubes will be replaced in Unit 2 during 2R16. The eddy current results from 1R15 and the Unit 2 fifteenth refueling outage (2R15) for the tubes replaced in 1R14 and 2R14 showed no signs of wear. This is consistent with previous industry experience. The tubes chosen for replacement were ranked by extent of wear, with the tubes exhibiting the most wear being ranked highest, and a second tier ranking imposed to assure that the optimum pattern of core coverage was achieved to provide adequate coverage for a core flux map. If highly worn tubes were not replaced and failed the acceptance criteria, or were predicted to fail during the following cycle, they were capped and the isolation valves were closed.

RAI B2.1.21-4

The staffs understanding is that DCPP flux thimble tubes are ASME Code Class 1 reactor coolant pressure boundary components for portions of the tubes that are external to the reactor vessel. As a result, the flaw evaluation criteria in the ASME Code Section XI, Article IWA-3000 may apply to the flux thimble tubes, including any applicable flaw proximity rules in this article.

The staff has observed that the Flux Thimble Tube Inspection Program currently permits more than one repositioning of a flux thimble tube, which would leave more than one worn area (more than one wear related flaw) in a degraded thimble tube in service. However, it is not evident whether the "monitoring and trending" activities for the Flux Thimble Tube Inspection Program apply applicable flaw proximity rules in the ASME Code Section XI, Article IWA-3000 (or similar provisions) for thimble tubes that are left in service with multiple wear scars.

Clarify whether the current monitoring and trending program element bases for the program applies the ASME Code Section XI proximity rules or similar considerations for tubes that are repositioned more than once and that leave multiple wear scars in service. Provide your basis for not including such measures in the "monitoring and trending" activities of the AMP if the flux thimble tubes are categorized as ASME Code Class 1 components.

PG&E Response to RAI B2.1.21-4

As discussed in the response to Request for Additional Information B2.1.21-2 and B2.1.21-3, PG&E will revise the test procedure acceptance criteria to specifically preclude repositioning a tube more than once without capping or replacing. This will preclude repositioning a tube having chrome plated surfaces from the chrome being moved out of the areas of known wear. PG&E anticipates revising this procedure prior to Unit 1 sixteenth refueling outage (1R16), which is starting in October 2010. This procedure will be revised prior to entering the period of extended operation. See revised License Renewal Application, Table A4-1, "License Renewal Commitments," in Enclosure 2.

LRA Amendment 7

LRA Section	RAI
Section A1.14	B2.1.14-1
Table A4.1	B2.1.14-2, B2.1.21-2, B2.1.21-3, B2.1.21-4
Section B2.1.14	B2.1.14-1 & B2.1.14-2

A1.14 FUEL OIL CHEMISTRY

The Fuel Oil Chemistry program manages loss of material on the internal surface of components in the emergency diesel fuel oil storage and transfer system, portable diesel driven fire pump fuel oil tanks, and portable caddy fuel oil tanks. The program includes (a) surveillance and monitoring procedures for maintaining fuel oil quality by controlling contaminants in accordance with applicable ASTM Standards, (b) periodic draining of water from fuel oil tanks, (c) visual inspection of internal surfaces during periodic draining and cleaning, (d) one-time ultrasonic wall thickness measurements of accessible portions of ~~the~~ fuel oil tank bottoms ~~if there are indications of reduced cross-sectional thickness found during the visual inspection~~, (e) sampling and analysis of new fuel oil before it is introduced into the fuel oil tanks, and (f) supplemental one-time inspections of a representative sample of components in systems that contain fuel oil by the One-Time Inspection program (A1.16).

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
4	Enhance the Fuel Oil Chemistry program to: • Include the periodic draining, cleaning, and visual inspection of the diesel generator day tanks, the portable diesel-driven fire pump fuel oil tanks, and portable caddy fuel oil tanks, and • Include sampling of the new fuel oil prior to introduction into the portable diesel-driven fire pump tanks and portable caddy fuel oil tanks, and • Provide for one-time supplemental ultrasonic thickness measurements ~~if there are indications of reduced cross sectional thickness found during the visual inspection~~ of accessible portions of ~~the diesel~~ fuel oil ~~storage~~ tank bottoms, ~~diesel generator day tanks, portable diesel-driven fire pump fuel oil tanks, and portable caddy fuel oil tanks,~~ and • State that trending of water and particulate levels is controlled in accordance with DCPP Technical Specifications and plant procedures for the diesel fuel oil storage tanks and the diesel generator day tanks, and • Include monitoring and trending of water and sediment levels of new fuel oil for the portable diesel driven fire pump fuel oil tank and portable caddy fuel oil tanks, and • State acceptance criteria for new fuel oil being introduced into the portable diesel driven fire pump fuel oil tanks or portable caddy fuel oil tanks.	B2.1.14	Prior to the period of extended operation
35	DCPP will revise the test procedure acceptance criteria to specifically preclude repositioning a tube more than once without capping or replacing. This will preclude repositioning a tube having chrome plated surfaces from the chrome being moved out of the areas of known wear.	B2.1.21	Prior to the period of extended operation.

B2.1.14 FUEL OIL CHEMISTRY

Program Description

The Fuel Oil Chemistry program manages loss of material due to general, pitting, crevice and microbiological influenced corrosion on the internal surface of components in the emergency diesel fuel oil storage and transfer system, portable diesel fire pump fuel oil tanks, and portable caddy fuel oil tanks. The program includes (a) surveillance and monitoring procedures for maintaining fuel oil quality by controlling contaminants in accordance with applicable ASTM Standards (ASTM D1796, D2276, and D4057), (b) periodic draining of water from fuel oil tanks, (c) visual inspection of internal surfaces during periodic draining and cleaning, (d) one-time ultrasonic wall thickness measurements of ~~the~~ accessible portions of fuel oil ~~storage~~ tank bottoms ~~if there are indications of reduced cross sectional thickness found during the visual inspection~~, (e) inspection of new fuel oil before it is introduced into the fuel oil tanks, and (f) supplemental one-time inspections of a representative sample of components in systems that contain fuel oil by the One-Time Inspection program (B2.1.16).

Fuel oil quality is maintained by monitoring and controlling fuel oil contaminants in accordance with applicable ASTM Standards (ASTM D1796, D2276, and D4057). This is accomplished by periodic sampling and chemical analysis of the fuel oil inventory at the plant and sampling, testing, and analysis of new fuel oil prior to delivery and offload into the fuel oil tanks.

The Fuel Oil Chemistry program specifies the requirements for corrective actions when the fuel oil parameters are out of specification. If a sample of the new fuel oil does not meet acceptance criteria prior to offload into the diesel fuel oil storage tanks, delivery is discontinued or not allowed. All samples are taken in accordance with ASTM D4057, with the exception of the portable diesel driven fire pump fuel oil tanks, fuel oil pump head tanks, and the portable caddy fuel oil tanks.

The Fuel Oil Chemistry program uses fuel additives to minimize fuel breakdown and tank corrosion. During the off-loading of new fuel oil shipments into the fuel oil tanks, DCPP adds a biocide to minimize biological activity and a fuel stabilizer/ corrosion-inhibitor to prevent biological breakdown of the diesel fuel oil and prevent tank corrosion.

Tank coatings are not credited for the prevention of any aging effects for license renewal at DCPP. The One-Time Inspection program (B2.1.16) is used to verify the effectiveness of the Fuel Oil Chemistry program.

Checking and removal of accumulated water in the diesel fuel oil storage tanks once every 31 days (monthly) eliminates the necessary environment for bacterial survival. Periodic inspection for and removal of accumulated water minimizes fouling, the amount of water, and the length of contact time of the fuel oil system. ASTM Standard D1796 is used for determination of water and sediment contamination in new diesel fuel oil prior to offload into the diesel fuel oil storage tanks.

Diesel fuel oil day tanks are checked for accumulated water every 31 days (monthly) in accordance with the DCPP Technical Specifications, and the water is removed. The fuel oil in the diesel fuel oil day tanks is analyzed quarterly for total particulate contamination in accordance with ASTM D2276 using the limits specified in the DCPP Technical Specifications.

Fuel oil from the diesel fuel oil storage tanks is analyzed every 31 days (monthly) to maintain chemical content using the limits specified in the DCPP Technical Specifications for total particulate contamination, in accordance with ASTM D2276. A diesel fuel oil storage tank bottom sample is taken quarterly, as well as a recirculation and a multilevel sample. The diesel fuel oil storage tanks are drained, cleaned, and visually inspected every 10 years to detect potential aging effects.

The Fuel Oil Chemistry program will include periodic draining, cleaning and visual inspection of the diesel fuel oil day tanks, the portable diesel driven fire pump fuel oil tanks, and portable caddy fuel oil tanks.

The Fuel Oil Chemistry program will ~~provide for~~ include one-time supplemental ultrasonic thickness measurement~~s if there are indications of reduced cross sectional thickness found during the visual inspection~~ of ~~the diesel~~ accessible portions of fuel oil ~~storage~~ tank bottoms~~, diesel generator day tanks, portable diesel-driven fire pump fuel oil tanks, and portable caddy fuel oil tanks~~.

NUREG-1801 Consistency

The Fuel Oil Chemistry program is an existing program that, following enhancement, will be consistent with exception to NUREG-1801, Section XI.M30, Fuel Oil Chemistry.

Exceptions to NUREG-1801

<u>Program Elements Affected</u>

Scope of Program - Element 1

NUREG-1801 specifies the use of ASTM Standards D1796, D2276, D2709, D6217, and D4057. DCPP only uses D1796, D2276, and D4057. The testing conducted using ASTM D1796 gives quantitative results that, together with the Technical Specification acceptance criteria, meet the intent of the ASTM D2709 method. The use of

ASTM D2276, along with acceptance criteria for total particulate concentration of less than 10 mg/liter, instead of ASTM D6217, is required by DCPP Technical Specifications 5.5.13.c.

Preventive Actions - Element 2 and Monitoring and Trending - Element 5

NUREG-1801 specifies periodic removal of water in the tanks. Water is not removed from the portable diesel-driven fire pump fuel oil tanks, portable caddy fuel oil tanks, or the fuel oil pump head tanks. These are small tanks that do not have provisions to remove water from the tank bottoms. Consumption of fuel oil for the portable diesel-driven fire pump fuel oil tanks and portable caddy fuel oil tanks is the result of quarterly surveillance tests to run the pump for at least 30 minutes. The fuel oil pump head tanks are replenished on a daily basis with fuel oil from the day tanks. During this process the excess fuel from the fuel oil pump head tanks returns to the day tanks.

The frequent addition of fuel oil and the annual draining and cleaning of the portable diesel-driven fire pump fuel oil tanks and portable caddy fuel oil tanks obviates the need for periodic water removal. New fuel oil is tested in accordance with the Fuel Oil Chemistry program prior to introduction into the portable diesel-driven fire pump fuel oil tanks and portable caddy fuel oil tanks.

The fuel oil pump head tanks are filled with fuel oil from the fuel oil day tanks. The fuel oil day tanks are checked for accumulated water every 31 days (monthly), and the water is removed. The frequent addition of fuel oil and the absence of water from the fuel supply assure that water is not being introduced into or accumulating in the fuel oil pump head tanks. Therefore, periodic removal of water from the fuel oil pump head tanks is not necessary.

Parameters Monitored or Inspected - Element 3

NUREG-1801 specifies periodic sampling for particulate concentration.

The fuel oil in the portable diesel-driven fire pump fuel oil tanks and portable caddy fuel oil tanks will not be analyzed for particulate concentration since the pumps are tested quarterly. The consumption of fuel oil during the quarterly surveillance test (pump run time of at least 30 minutes) would remove any particulates that accumulated in the tanks. The frequent addition of diesel fuel oil obviates the need for this sampling. Provisions do not exist to sample for particulates. New fuel oil is tested in accordance with the Fuel Oil Chemistry program prior to introduction into the portable diesel-driven fire pump fuel oil tanks and portable caddy fuel oil tanks.

The fuel oil in the fuel oil pump head tanks will not be analyzed for particulate concentration since the fuel oil in the fuel oil pump head tanks is replenished with fuel oil from the day tanks on a daily cycle. Provisions do not exist to sample for particulates directly from the fuel oil pump head tanks. The fuel oil pump head tanks are filled with fuel oil from the fuel oil day tanks. The fuel oil from the diesel fuel oil day tanks is analyzed quarterly for total particulate contamination in accordance with ASTM D2276 using the limits specified in the DCPP Technical Specifications. The frequent addition of fuel oil and the absence of elevated levels of particulates from the fuel supply assure that high levels of particulates are not being introduced into or accumulating in the fuel oil pump head tanks.

Parameters Monitored or Inspected - Element 3 and Detection of Aging Effects Element 4

NUREG-1801 specifies the use of ASTM Standard D4057 for fuel oil sampling.

ASTM D4057 is not used on the portable diesel-driven fire pump fuel oil tanks, fuel oil pump head tanks, or portable caddy fuel oil tanks. These tanks are too small for multi-level samples to apply. Furthermore, the pumps are tested quarterly. The consumption of fuel oil is the result of the quarterly surveillance test to run the pump for at least 30 minutes. The frequent addition of diesel fuel oil obviates the need for this sampling. New fuel oil is tested in accordance with the Fuel Oil Chemistry program prior to introduction into the portable diesel-driven fire pump fuel oil tanks and portable caddy fuel oil tanks.

Provisions do not exist to take samples directly from the fuel oil pump head tanks. The fuel oil pump head tanks are filled with fuel oil from the fuel oil day tanks. The samples taken from the fuel oil day tanks are taken in accordance with ASTM D4057, with the exception of the portable diesel driven fire pump fuel oil tanks, fuel oil pump head tanks, and the portable caddy fuel oil tanks.

Parameters Monitored or Inspected - Element 3 and Acceptance Criteria - Element 6

NUREG-1801 states that ASTM Standards D1796 and D2709 are used for determination of water and sediment contamination. DCPP uses only ASTM D1796 and not D2709. The use of ASTM D1796, along with acceptance criteria for water and sediment contamination of 0.05 volume percent, is required by DCPP Technical Specifications Bases Surveillance Requirement 3.8.3.3.c. The testing conducted using ASTM D1796 gives quantitative results that, together with the Technical Specification acceptance criteria, meet the intent of the ASTM D2709 method.

NUREG-1801 specifies the use of a filter with a pore size of 3.0 microns. DCPP uses a filter with a pore size of 0.8 microns per ASTM D2276, Method A as stated in the DCPP Technical Specifications 5.5.13.c.

Acceptance Criteria - Element 6

NUREG-1801 requires the use of ASTM D6217 for determination of particulates. DCPP uses only ASTM D2276 and not ASTM D6217. The use of ASTM D2276, along with acceptance criteria for total particulate concentration of less than 10 mg/liter, is required by DCPP Technical Specifications 5.5.13.c.

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

Preventive Actions - Element 2 and Detection of Aging Effects - Element 4

Procedures for the diesel generator day tanks and the portable diesel-driven fire pump fuel oil tanks will be enhanced to include the periodic draining, cleaning, and visual inspection of the diesel generator day tanks, the portable diesel-driven fire pump fuel oil tanks, and portable caddy fuel oil tanks.

Parameters Monitored or Inspected - Element 3 and Monitoring and Trending - Element 5

Procedures for the portable diesel-driven fire pump tanks will be enhanced to include sampling of the new fuel oil prior to introduction into the portable diesel-driven fire pump tanks and portable caddy fuel oil tanks.

Detection of Aging Effects - Element 4

Procedures will be enhanced to ~~provide for~~ include one-time supplemental ultrasonic thickness measurements ~~if there are indications of reduced cross sectional thickness found during the visual inspection~~ of ~~the diesel~~ accessible portions of fuel oil storage tank bottoms~~, diesel generator day tanks, portable diesel-driven fire pump fuel oil tanks, and portable caddy fuel oil tanks~~.

Monitoring and Trending - Element 5

Procedures for the diesel fuel oil storage tanks and the diesel generator day tanks will be enhanced to state that trending of water and particulate levels is controlled in accordance with DCPP Technical Specifications and plant procedures.

Procedures for the portable diesel driven fire pump fuel oil tanks will be enhanced to include monitoring and trending of water and sediment levels of new fuel oil for the portable diesel driven fire pump fuel oil tank and portable caddy fuel oil tanks.

Acceptance Criteria - Element 6

Procedures for the portable diesel driven fire pump fuel oil tanks will be enhanced to state acceptance criteria for new fuel oil being introduced into the portable diesel driven fire pump fuel oil tanks or portable caddy fuel oil tanks.

Operating Experience

The Fuel Oil Chemistry program has been effective in monitoring and controlling diesel fuel oil chemistry to mitigate aging effects. Based on a review of the Corrective Action Program, DCPP has taken timely and effective corrective action to address diesel fuel oil quality concerns and diesel fuel oil system performance issues when requirements were not met. The DCPP operating experience findings for this program identified no unique plant specific operating experience; therefore DCPP operating experience is consistent with NUREG-1801. Maintenance Rule Periodic Assessments and surveillance testing results have proven that the effects of aging are adequately being managed so that the intended functions are maintained consistent with the current licensing basis for the period of extended operation.

In 1988, while performing a surveillance test procedure on the diesel generator, a fuel oil filter became clogged due to biofouling in the day tank. In response, DCPP developed and implemented a biocide, sampling, and inspection program to inhibit the growth of fungus in the diesel generator day tanks. The biofouling event was attributed to lack of sampling and biocide addition to the fuel oil.

During routine quarterly bottom samples of the diesel fuel oil storage tank 0-1 taken in March of 2000, the bulk of the samples taken appeared to be cloudy. There was no water identified in these samples. Samples were sent to an off-site laboratory for evaluation. The results indicated that the cloudiness was precipitation of boron as boric acid, which is a result from the biocide used in the fuel oil. The concentration of the biocide added was evaluated, and DCPP revised the procedure for new fuel.

In 2006, there had been several instances where DCPP noticed an increase in particulates in the fuel oil storage and day tanks. In no case did the particulate level ever exceed the Technical Specification limit of 10 mg/liter; however, samples were sent to an off-site laboratory for further evaluation. The results from the laboratory came back satisfactory. Results were entered into the chemistry database, and subsequent samples were closely monitored for any increasing trends. Later samples showed the particulate level to decrease.

Fuel oil quality parameters, including water and sediment ~~volume percentage~~ contamination, are routinely monitored and maintained within acceptance limits and no adverse trends have been identified. In addition, to mitigate against corrosion, the integrity of the diesel fuel oil system is monitored by a leak detection system, which continuously monitors for fuel oil leakage in the fuel oil piping within the trenches, as well as fuel and water leakage in the diesel fuel oil transfer pump vaults and the underground diesel fuel oil tanks. No occurrence of leakage has been detected since the installation of this system in 1994, thus providing further indication that the fuel oil chemistry is maintained to prevent the loss of components' intended function.

The Fuel Oil Chemistry program operating experience information provides objective evidence to support the conclusion that the effects of aging will be adequately managed so that the structure and component intended functions will be maintained during the period of extended operation.

Conclusion
The continued implementation of the Fuel Oil Chemistry program, supplemented by the One-Time Inspection program (B2.1.16), provides reasonable assurance that aging effects will be managed such that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current