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Supplement 01

Joint Applications Report for Containment Integrated Leak Rate Test Interval Extension

CEOG Task 2027

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WCAP 15715

Supplement 01

Joint Applications Report for Containment Integrated Leak Rate Test Interval Extension

CEOG Task 2027

December 2001

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Cross Comparison Tables (from WCAP-15715)

Attached are the CEOG Cross Comparison Tables from WCAP-15715, "Joint Applications Report for Containment Integrated Leak Rate Test Interval Extension." Calvert Cliffs specific results have been added to these Tables.

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B1.1 System Description

The primary function of containment is to prevent the release of radioactive material from either the containment atmosphere or the reactor coolant system to the outside environment.

The Calvert Cliffs containment vessel structures consist of a post-tensioned, reinforced concrete cylinder and dome connected to and supported by a massive reinforced concrete foundation slab. The cylinder wall thickness is increased at six equally spaced locations to form vertical buttresses for pre-stressing tendon end anchorage. Reinforced openings in the cylinder wall are provided for equipment and personnel access as well as for electrical and mechanical feed through. The entire interior surface of the structure is lined with a ¼ inch thick welded ASTM A36 steel plate that serves as a leak tight membrane. The net free volume of containment is 2,000,000 ft^3.

The principal dimensions of the containment are:

Inside Diameter	130 ft.
Inside Height	181 ft. 8 in.
Vertical Wall Thickness	3 ft. 9 in.
Dome Thickness	3 ft. 3 in.
Foundation Slab Thickness	10 ft.

The containment vessel structure includes one personnel air lock; one personnel escape airlock, one equipment hatch, and one fuel transfer tube penetration.

All containment penetrations are leak tight assemblies welded to the containment liner. Piping penetrations in the containment have isolation valves to allow isolation of the containment structure from the surrounding environment. Portions of the liner that must resist full design pressure, such as penetrations, are made of ASTM A-300 steel. At all penetrations, the liner is thickened to reduce stress.

The containment vessel design leak rate is 0.2 percent /day leakage by weight of the original content of air, at design pressure of 50 psig and design temperature of 276 F. The calculated peak accident pressure for the design basis accident at CCNPP Unit 1 and Unit 2 does not exceed 50 psig.

B1.2 CCNPP Operating Experience

Type A Testing History

The Calvert Cliffs Unit 1 and Unit 2 Type A Test history provides substantial justification for the proposed ILRT test interval modification. Six Type A Tests were performed over an eighteen-year history on Unit 1 and five Type A Tests were performed on Unit 2 over a fifteen-year history with successful results.

Calvert Cliffs Unit 1 has performed six Type A full-pressure, 50 psig, containment leak rate tests; a pre-operational Type A test (12/1/73) and periodic Type A tests on 3/6/78, 6/22/82, 5/20/85, 5/27/88, and 7/5/92. Calvert Cliffs Unit 2 has performed five Type A full-pressure, 50 psig, containment leak rate tests; a pre-operational Type A test (4/14/76) and periodic Type A tests on 10/15/79, 12/18/82, 10/24/85, and 12/16/91. Pre-operational Type A tests employed a full pressure (50 psig) and a reduced pressure (25 psig) test. Periodic Type A tests employed both the calculated Mass Point Leakage Rate method and the Total Time Leakage Rate method.

Unit 1

Unit 1 Pre-operational Type A Test (December 1, 1973)

The Unit 1 Pre-operational Type A containment Integrated Leakage Rate Test was successfully completed on December 1, 1973 with the following results. The measured leak rate at peak test pressure of 50 psig was 0.0466%/Day. The measured leak rate at reduced test pressure of 25 psig was 0.0134 %/Day. The Type A test report was provided to the NRC dated March 1, 1974.

First Periodic Type A Test of Unit 1

The first Unit 1 periodic Type A Integrated Leak Rate Test was successfully completed on March 6, 1978 with the following results. The calculated Mass Point Leakage Rate was 0.097 %/Day with a 95% UCL of 0.108 %/Day. The 95% UCL Total Time Leakage Rate was 0.176 %/Day. The Periodic Type A Test report was provided to the NRC on 7/13/1978.

Second Periodic Type A Test of Unit 1

The second Unit 1 periodic Type A Integrated Leak Rate Test was successfully completed on June 22, 1982 with the following results. The calculated Mass Point Leakage Rate was 0.021 %/Day with a 95% UCL of 0.026 %/Day. The 95% UCL Total Time Leakage Rate was 0.086 %/Day. The Periodic Type A Test report was provided to the NRC on 11/30/1982.

Third Periodic Type A Test of Unit 1

The third Unit 1 periodic Type A Integrated Leak Rate Test was successfully completed on May 20, 1985 with the following results. The calculated Mass Point Leakage Rate was 0.032 %/Day with a 95% UCL of 0.035 %/Day. The 95% UCL Total Time Leakage Rate was 0.069 %/Day. The Periodic Type A Test report was provided to the NRC on 8/5/1985.

Fourth Periodic Type A Test of Unit 1

The fourth Unit 1 periodic Type A Integrated Leak Rate Test was successfully completed on May 27, 1988 with the following results. The calculated Mass Point Leakage Rate was 0.022 %/Day with a 95% UCL of 0.026 %/Day. The 95% UCL Total Time Leakage Rate was 0.080 %/Day. The Periodic Type A Test report was provided to the NRC in May 1988.

Fifth Periodic Type A Test of Unit 1

The fifth Unit 1 periodic Type A Integrated Leak Rate Test was successfully completed on July 5, 1992 with the following results. The calculated Mass Point Leakage Rate was 0.0771 %/Day with a 95% UCL of 0.0824 %/Day. The 95% UCL Total Time Leakage Rate was 0.0703 %/Day. The Periodic Type A Test report was provided to the NRC in July 1992.

Unit 2

Unit 2 Pre-operational Type A Test (April 14, 1976)

The Unit 2 Pre-operational Type A containment Integrated Leakage Rate Test was successfully completed on April 14, 1976 with the following results. The measured leak rate at peak test pressure of 50 psig was 0.019 %/Day. The measured leak rate at reduced test pressure of 25 psig was 0.004 %/Day.

First Periodic Type A Test of Unit 2

The first Unit 2 periodic Type A Integrated Leak Rate Test was successfully completed on November 15, 1979 with the following results. The calculated Mass Point Leakage Rate was 0.052 %/Day with a 95% UCL of 0.064 %/Day. The 95% UCL Total Time Leakage Rate was 0.128 %/Day. The Periodic Type A Test report was provided to the NRC on 2/15/1980.

Second Periodic Type A Test of Unit 2

The second Unit 2 periodic Type A Integrated Leak Rate Test was successfully completed on December 18, 1982 with the following results. The calculated Mass Point Leakage Rate was 0.013 %/Day with a 95% UCL of 0.023 %/Day. The 95% UCL Total Time Leakage Rate was 0.071 %/Day. The Periodic Type A Test report was provided to the NRC on 7/1/1983.

Third Periodic Type A Test of Unit 2

The third Unit 2 periodic Type A Integrated Leak Rate Test was successfully completed on November 24, 1985 with the following results. The calculated Mass Point Leakage Rate was 0.052 %/Day with a 95% UCL of 0.060 %/Day. The 95% UCL Total Time Leakage Rate was 0.104 %/Day. The Periodic Type A Test report was provided to the NRC on 2/27/1986.

Fourth Periodic Type A Test of Unit 2

The fourth Unit 2 periodic Type A Integrated Leak Rate Test was successfully completed on January 16, 1991 with the following results. The calculated Mass Point Leakage Rate was 0.055 %/Day with a 95% UCL of 0.061 %/Day. The 95% UCL Total Time Leakage Rate was 0.118 %/Day. The Periodic Type A Test report was provided to the NRC on 5/29/1991.

Summary Type A Testing History

Containment Integrated Leak Rate results using the Calculated Mass Point Leakage Rate Method and Total Time Leak Rate method both demonstrate that Calvert Cliffs Unit 1 and Unit 2 are very low leakage containments. The average value of the Calculated Mass Point Leakage values is less than 25% of the Acceptance Criteria value.

B2.0 ASSESSMENT OF RISK FOR CCNPP

The purpose of this section is to provide a risk informed assessment for extending the CCNPP Integrated Leak Rate Test (ILRT) interval from ten to twenty years. The risk assessment is performed as described in the main body of this report.

In addition, the results and findings from the CCNPP Individual Plant Examination (IPE) (Reference B-1) are used for this risk assessment. Specifically the approach combines the use of the CCNPP Individual Plant Examination (IPE) results and findings with the methodology described in EPRI TR-104285 (Reference B-3) to estimate public risk associated with extending the containment Type A testing.

The change in plant risk is evaluated based on the change in the predicted releases in terms of person-rem/year and Large Early Release Frequency (LERF). Changes to Type A testing have no impact on CDF.

B2.1 Overview

In October 26, 1995, the NRC revised 10 CFR 50, Appendix J. The revision to Appendix J allowed individual plants to select containment leakage testing under Option A "Prescriptive Requirements" or Option B "Performance-Based Requirements." Calvert Cliffs Nuclear Power Plant (CCNPP) selected the requirements under Option B as its testing program.

The current surveillance testing requirement, as outlined in NEI 94-01 (Reference B-2) for Type A testing, is at least once per 10 years based on an acceptable performance history (define as two consecutive periodic Type A tests at least 24 months apart in which the calculated performance leakage was less than $1.0L_a$). However, CCNPP seeks to extend the test interval for Type A testing from ten years to fifteen years based on the substantial cost savings from extending this test interval and the low risk impact.

B2.2 Assessment of Risk

The risk impact of extending the ILRT (Type A) interval from its current interval of 10 years to 15 years, is evaluated from a potential public exposure impact (as measured in person-rem/year) and from a Large Early Release (LERF) perspective as identified in Regulatory Guide 1.174. The methodology used accounts for large releases and computes the LERF metric. The analysis examined the CCNPP IPE and subsequent PSA upgrades for plant specific accident sequences which may impact containment performance. Specifically, as discussed in the main body of this report, core damage sequences were considered with respect to which EPRI event class they are in (EPRI TR-104285 Class 1, 2, 3, 4, 5, 6, 7 or 8 events in terms of containment integrity – Reference B-3).

Table B2-2 presents the CCNPP PSA frequencies for these eight accident classes.

B2.2.1 Quantification Of Base-Line Frequency For Accident Classes

The eight EPRI accident class frequencies were determined, using the methodology described in the main body of this report, as described in the following paragraphs:

Class 1 Sequences: This group consists of all core damage accident progression bins for which the containment remains intact. Class 1 sequences arise from those core damage sequences that have long term heat removal capability available via containment sprays or fan coolers. PSA upgrades performed over the past several years have resulted in an overall plant CDF estimate of 1.10E-4/year.

Releases from Class 1 events are calculated based on the design basis L_a. This is consistent with the assumption that the containment is intact.

Class 2 Sequences: This group consists of all core damage accident progression bins for which a pre-existing leakage due to failure to isolate the containment occurs. These sequences are dominated by failure-to-close large (>2-inch diameter) containment isolation valves. Such sequences contribute to the plant LERF. The frequency per year for these sequences is determined from the CCNPP PSA as the sum of those release classes that indicate core damage in the presence of an unisolated containment.

Class 2 releases for CCNPP analyses are associated with loss of isolation failures resulting in a through containment equivalent leakage from a pipe greater than 2 inches in diameter. In this study the Class 2 containment leakage is estimated by a 100 wt% /day containment leakage. A 100 wt% per day release is equivalent to a release from a pipe diameter of about 2.5 inches and containment operation at design pressure.

Class 3 Sequences: Class 3 endstates are developed specifically for this application. The Class 3 endstates include all core damage accident progression bins for which a pre-existing leakage in the containment structure exists. The containment leakage for these sequences can be grouped into two categories, small leaks or large.

The resulting values for $F_{Class\ 1}$, $F_{Class\ 3A}$, and $F_{Class\ 3B}$ as a function of ILRT interval are presented in Table B2-1.

Table B2-1
Frequency of Type A Leakage for a Given Test Interval

As Class 3A represents a small pre-existing containment leak, its value was set to bound the maximum quantified release identified in Table 4-2 of NUREG-1493. The largest identified release multiple was $21L_a$. Class 3A releases were therefore quantified as $25L_a$. For CCNPP units this results in a containment leakage rate of 5 wt% per day.

Class 3B releases are assumed to be greater than $100L_a$ (or 20 wt% per day). Releases in this category were represented by a 100 wt% per day release which is roughly equivalent to a release from a 2.5 inch orifice. This leakage is essentially equivalent to $500L_a$ (for CCNPP) and is considered a very conservative estimate of potential containment releases that may result from extension of Type A containment Testing.

<u>Class 4 Sequences:</u> This group consists of all core damage accident progression bins for which a failure-to-seal containment isolation failure of Type B test components occurs. Because these failures are detected by Type B tests, this group is not evaluated any further.

<u>Class 5 Sequences:</u> This group consists of all core damage accident progression bins for which a failure-to-seal containment isolation failure of Type C test components occurs. Because these failures are detected by Type C tests, this group is not evaluated any further.

<u>Class 6 Sequences:</u> This group is similar to Class 2. These are sequences that involve core damage accident progression bins for which a failure-to-seal containment leakage due to failure to isolate the containment occurs. These sequences are dominated by misalignment of containment isolation valves following a test/maintenance evolution, typically resulting in a failure to close smaller containment isolation valves. All other failure modes are bounded by the Class 2 assumptions.

Class 7 Sequences: This group consists of all core damage accident progression bins in which containment failure induced by severe accident phenomena occurs (i.e. H_2 combustion).

Class 8 Sequences: This group consists of all core damage accident progression bins in which containment bypass occurs.

Table B2-2 provides a summary of the CCNPP Release Class frequencies and the assumed leakage for each Class.

Table B2-2
CCNPP Mean Containment Frequencies (from the PSA) and Representative Releases

B2.2.2 CCNPP population dose per reactor year

Plant-specific release analysis was performed for CCNPP to evaluate the doses to the population, within a 50-mile radius from the plant. The releases for Classes 1 through 7 are based on post large Loss-Of-Coolant Accident (LOCA) as shown in Table B2-3 and the releases for Class 8 events are based on Bypass events as shown in Table B2-4. These tables tabulate the whole body population dose within 50 miles. Calculations were performed using RADTRAD Version 3 (Reference B-6) assuming a containment source term equivalent to TID-14844. Intact containment release computations were validated via comparisons with CCNPP FSAR results (Reference B-1, Section 14.24).

LBLOCA dose models with defined leakages are assumed to be representative for all containment leakage release classes. Bypass releases based on iodine and noble gas releases are identified in the IPE study for the dominant sequence. Population estimates are based on CCNPP SAMA projections to 2030 (Reference B-5, Table 2-19). Atmospheric dispersions are based on mean weather data obtained at the plant site and reported in the plant updated FSAR (Reference B-4, Figure 2.3).

Table B2-3
CCNPP Population Dose – LOCA

Table B2-4
CCNPP Population Dose – Bypass Events

Table B2-5
CCNPP Containment Leakage Rate and Dose – for Accident Classes

The above results when combined with the frequencies presented in Table B2-2 yields the CCNPP baseline mean consequence measures (risks, in terms of person-rem/yr) for each accident class. The resulting risks (in terms of person-rem/yr), for each accident class, are presented in Table B2-6 below.

Table B2-6
CCNPP Mean Baseline Risk - for Accident Classes

Based on the above values, the percent risk contribution associated with the "intact" containment sequences for Class 1 and Class 3 ($\%Risk_{BASE}$) is as follows:

$$\%Risk_{BASE} = [(Risk_{Class\ 1\ BASE} + Risk_{Class\ 3A\ BASE} + Risk_{Class\ 3B\ BASE}) / Total_{BASE}] \times 100$$

Therefore, the total baseline risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.11 %.

B2.2.3 Risk Impact of Extending Type A Test Interval From 10 To 15 And 20 Years

Using the methodology described in the main report that was used above to determine baseline risk values (see Table B2-6), the risk values were determined for the Current 10 year ILRT test interval, a 15 year ILRT test interval, and a 20 year ILRT test interval. These risk values are presented below in Table B2-7.

Table B2-7
CCNPP Risk Values vs ILRT Interval (Person-Rem/yr to 50-Miles)

Based on the above values, and using the methodology described in the main report, the percent risk contribution (%Risk$_N$, for values of N of 10, 15 and 20 years) for Class 1 and Class 3 is determined and yields the results summarized in Table B2-8, below. Also, the percent change in risk due to ILRT interval extensions is determined and presented in Table B2-8.

Table B2-8
CCNPP Percent Risk Increases from ILRT Interval Extensions

	Description	Current 10 year ILRT interval	15 year ILRT interval	20 year ILRT interval
%Risk$_N$	Percent risk contribution for Class 1 and Class 3	0.20%	0.26%	0.33%
Δ%Risk$_{\text{Base to N}}$	Percent increase in total risk due to an N-year ILRT over the baseline case	0.09%	N/A	N/A
Δ%Risk$_{10\text{-}N}$	Percent increase in risk due to an N-year ILRT over the 10 year case	N/A	0.07%	0.14%

B2.2.4 Change In Risk In Terms Of Large Early Release Frequency (LERF)

Section 5.2.4 of the main body of this report discusses the quantification of LERF. This analysis assumes that Class 2, 3B, 6, 7 and 8 lead to large leak rates. The baseline LERF frequency, for the 3 in 10 year inspection interval, is determined as shown in Table B2-9. The estimate for Class 7 includes only the portion of Class 7 identified in the PSA as representing early containment failure.

Table B2-9
CCNPP Baseline LERF Frequency Calculation

Impact of ILRT Test Interval Extensions on Large Early Release Frequency (LERF)

Table B2-10 presents the frequencies for each large release class, for each of four ILRT intervals. The total LERFs are also listed, along with the increase in LERF from the current LERF, and the percent increase from the current LERF.

Table B2-10
CCNPP LERF Variation as a Function of Change in Inspection Interval

B3.0 SUMMARY OF RESULTS

Baseline ILRT Interval Results (For this evaluation, the baseline risk contribution is taken as the original inspection interval at the time that the IPE was done; that is, three inspections per 10 year interval.)

1. The baseline risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.11 % of total risk.

2. The baseline LERF is 1.533E-5 per year.

Ten Year ILRT Interval Results

1. The current Type A 10-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.20 % of total risk.

2. The increase in total risk from extending the ILRT test interval from the baseline interval to current 10 year interval is 0.09 %.

3. The LERF with a 10 year ILRT interval is 1.534E-5 per year.

4. The increase in LERF from extending the ILRT test interval from the baseline interval to the current 10 year interval is 1.62E-8 per year.

5. The % increase in LERF from extending the ILRT test interval from the baseline interval to 10 years is 0.11 %. Since the CDF is not changed as a result of the extended ILRT interval, the increase in LERF is due only to the small increase (0.11 %) in conditional containment unreliability.

Fifteen Year ILRT Interval Results

1. Type A 15-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.26 % of total risk.

2. The increase in total risk from extending the ILRT test interval from the current 10 year interval to 15 years is 0.07 %.

3. The LERF for the 15 year interval is 1.536E-5 per year.

4. The increase in LERF from extending the ILRT test interval from the 10 year interval to 15 years is 1.212E-8 per year.

5. The % increase in LERF from extending the ILRT test interval from the 10 year interval to 15 years is 0.08 %. Since the CDF is not changed as a result of the extended ILRT interval, the increase in LERF is due only to the small increase (0.08 %) in conditional containment unreliability.

Twenty Year ILRT Interval Results

1. Type A 20-year ILRT interval risk contribution of leakage, represented by Class 1 and Class 3 accident scenarios is 0.33 % of total risk.

2. The increase in total risk from extending the ILRT test interval from the current 10 year interval to 20 years is 0.14 %.

3. The LERF for the 20 year interval is 1.537E-5 per year.

4. The increase in LERF from extending the ILRT test interval from the 10 year interval to 20 years is 2.424E-8 per year.

5. The % increase in LERF from extending the ILRT test interval from the 10 year interval to 20 years is 0.16 %. Since the CDF is not changed as a result of the extended ILRT interval, the increase in LERF is due only to the small increase (0.16 %) in conditional containment unreliability.

B4.0 REFERENCES

B-1 Calvert Cliffs Nuclear Power Plant Individual Plant Examination, BGE, December 1993.

B-2 NEI 94-01, Revision 0 "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50," Appendix J, July 26, 1995.

B-3 EPRI TR-104285, "Risk Assessment of Revised Containment Leak Rate Testing Intervals," August 1994.

B-4 CCNPP UFSAR, BGE, Revision 26.

B-5 NUREG-1437, Supplement 1 "Generic Environmental Impact Statement for License Renewal of Nuclear Plants - Regarding the Calvert Cliffs Nuclear Power Plant Final Report," USNRC, October, 1999.

B-6 NUREG/CR-6604, Supplement 1, RADTRAD: A Simplified Model for RADionuclide Transport And Dose estimation, SNL, Bixler, N.E. et al, June, 1999.

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I, Philip W. Richardson, depose and say that I am the Licensing Project Manager of Westinghouse Electric Company, LLC (Westinghouse), duly authorized to make this affidavit, and have reviewed or caused to have reviewed the information which is identified as proprietary and described below.

I am submitting this affidavit in conformance with the provisions of 10 CFR 2.790 of the Commission's regulations for withholding this information. I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged, or as confidential commercial or financial information.

The information for which proprietary treatment is sought, and which document has been appropriately designated as proprietary, is contained in the following:

- *WCAP-15691-P, Supplement 1 containing updated Tables 5-2, 5-4, 5-6 through 5-9d, & 6-1, and Appendix B, "Application of the Joint Application Report to Calvert Cliffs Nuclear Power Plant (CCNPP), Units 1 and 2," dated December 2001.*

Pursuant to the provisions of Section 2.790(b)(4) of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information included in the document listed above should be withheld from public disclosure.

i. The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse. It consists of risk-informed methodology and probabilistic data for justifying modifications to the containment integrated leak rate test interval.

ii. The information consists of test data or other similar data concerning a process, method or component, the application of which results in substantial competitive advantage to Westinghouse.

iii. The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public.

iv. The information is being transmitted to the Commission in confidence pursuant to 10 CFR 2.790 with the understanding that it is to be received in confidence by the Commission.

v. The information, to the best of my knowledge and belief, is not available in public sources, and any disclosure to third parties has been made pursuant to regulatory provisions or proprietary agreements that provide for maintenance of the information in confidence.

vi. Public disclosure of the information is likely to cause substantial harm to the competitive position of Westinghouse because:

   a. A similar product is manufactured and sold by major competitors of Westinghouse.

   b. Westinghouse has invested substantial funds and engineering resources in the development of this information. A competitor would have to invest similar expense and resources to generate the equivalent information.

   c. The information consists of risk-informed methodology and evaluation results concerning extension of the containment integrated leak rate test interval at Calvert Cliffs 1 & 2, the application of which provides Westinghouse a competitive economic advantage. The availability of such information to competitors would enable them to design their product to better compete with Westinghouse, take marketing or other actions to improve their product's position or impair the position of Westinghouse's product, and avoid developing similar technical analysis in support of their processes, methods or apparatus.

d. In pricing Westinghouse's products and services, significant research, development, engineering, analytical, manufacturing, licensing, quality assurance and other costs and expenses must be included. The ability of Westinghouse's competitors to utilize such information without similar expenditure of resources may enable them to sell at prices reflecting significantly lower costs.

e. Use of the information by competitors in the international marketplace would increase their ability to market services by reducing the costs associated with their technology development. In addition, disclosure would have an adverse economic impact on Westinghouse's potential for obtaining or maintaining foreign licenses.

Philip W. Richardson
Licensing Project Manager

Sworn to before me this 18th day of December 2001.

Laurie J. White
Notary Public

My Commission expires: 8/31/04

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