U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-331/94005(DRSS)

Docket No. 50-331 License No. DPR-49

Licensee: Iowa Electric Light and Power Company
IE Towers
P. O. Box 351
Cedar Rapids, IA 52406

Facility Name: Duane Arnold Energy Center

Inspection At: Duane Arnold Site, Palo, Iowa

Inspection Conducted: February 7-11, 1994

Inspector: J. House 3/8/94
Date

Approved By: William G. Snell, Chief 3/8/94
Radiological Controls Section 2 Date

Inspection Summary

Inspection on February 7-11, 1994 (Report No. 50-331/94005(DRSS))
Areas Inspected: Routine announced inspection of the chemistry program including: audits, quality assurance, chemistry comparisons, radiological environmental monitoring program (REMP), post accident sampling system and an inspection followup item (Inspection Procedure (IP) 84750).
Results: The licensee's performance in the chemistry comparison program was very good (27 agreements in 27 comparisons). The laboratory QA/QC program was well managed. The water chemistry program included hydrogen addition to reactor coolant and plant water quality was outstanding. The water quality program represents a strength. Audits were performance based and very detailed. Management of the REMP was very good and reflected the licensee's ownership of the program.

DETAILS

1. Persons Contacted

*P. Bessette, Regulatory Communications Supervisor
*D. Boone, Helpers Supervisor
*R. Hite, ALARA Supervisor
*W. Holden, Supervisor, Radiation Protection Training
*B. Klotz, Group Leader, Quality Assurance
*L. Kriege, Supervisor, Chemistry
*R. Leib, Radiological Engineer
*R. Lewis, Foreman, Chemistry
*W. McVicker, Foreman, Chemistry
*G. Van Middlesworth, Asst. Plant Superintendent
*R. Murrell, Regulatory Communications Specialist
*K. Peveler, Manager, Quality Assurance
*R. Perry, Health Physics Supervisor
*D. Robinson, Regulatory Communications Specialist
*L. Root, President, IES Utilities Inc.
*D. Schebler, Radwaste Supervisor
*G. Taylor, Environmental Supervisor
*E. Wienola, Quality Assurance Specialist
*T. Wilkerson, Radiation Protection Manager
*D. Wilson, Plant Superintendent
*K. Young, Manager, Nuclear Licensing

*J. Hopkins, Senior Resident Inspector, NRC

The inspector contacted other licensee personnel during the inspection.

*Present at the Exit Meeting on February 11, 1994

2. Licensee Action on Previous Inspection Findings (IP 84750)

(Closed) Inspection Followup Item (50-331/92014-01): The faulty indicator on residual heat removal (RHR) loop B valving system for the post accident sampling system (PASS) had been repaired. The Corrective Maintenance Action Request number A-12735 was completed and licensee representatives stated that the valve indicator was operational. This item is closed.

3. Management, Organization and Training (IP 84750)

The Chemistry Department, which is part of the Radiation Protection Organization, consists of the following:

Chemistry Supervisor
Chemical Engineers (2)
Effluent & Environmental Engineer
Environmental Technician
Production Standards Specialist

Chemistry Foremen (2)
Chemistry Technicians (12)

The chemical engineers were responsible for plant systems including all water parameters, environmental permits, corrosion control and upgrading chemistry instrumentation. The environmental engineer was responsible for environmental monitoring including the annual environmental report, effluent dose assessments and release reports, and meteorological data management. The production standards specialist (qualified chemistry technician) was responsible for the laboratory QA program including instrument performance, laboratory cross check programs and method validation. The two chemistry foremen (qualified chemistry technicians) were responsible for scheduling, data review, chemistry equipment management and procedure maintenance.

Of the 12 chemistry technicians (CTs), 11 were fully qualified and met the ANSI N18.1 1971 standard. The CT in the training program did not cover backshifts alone. The Training Department maintained a training laboratory which was separate from the plant chemistry laboratory. Analytical equipment included a total organic carbon analyzer, ion chromatograph, spectrophotometer, turbidimeter, pH and conductivity meters and atomic absorption spectrophotometer. Radiochemistry counting equipment included a gamma spectroscopy system and gas flow proportional counters for alpha and beta counting. The training lab was very well equipped and the instructor appeared very knowledgeable about instrument operation.

No violations or deviations were identified.

4. Water Chemistry Control Program (IP 84750)

The licensee's water chemistry program was consistent with the Electric Power Research Institute (EPRI) BWR Owners Group Guidelines. Analysis of grab samples provided most of the data used for trending water chemistry parameters and these data were maintained in a computer data base. Water quality parameters were reviewed daily by licensee management. Trend plots were reviewed monthly by engineering. A review of selected charts from the previous two years indicated that reactor coolant chemistry parameters were within the EPRI guidelines and that water quality was excellent. Licensee representatives stated that during the first six months of 1993, their water quality was rated number two for BWRs in the United States by an industry group.

CHEMISTRY PARAMETERS

	EPRI Achievable Levels	DAEC 1993	DAEC 1992
Reactor Water			
Conductivity (μS/cm)	$\leq$ 0.20	$\leq$ 0.070	$\leq$ 0.080
Chloride (ppb)	$\leq$ 15.0	$\leq$ 1.0	$\leq$ 1.0
Sulfate (ppb)	$\leq$ 15.0	$\leq$ 1.0	$\leq$ 1.0
Silica (ppb)	$\leq$ 100	< 100	< 100
Feedwater			
Conductivity (μS/cm)	$\leq$ 0.06	$\leq$ 0.060	$\leq$ 0.060
Copper (ppb)	$\leq$ 0.10	$\leq$ 0.020	$\leq$ 0.030
Iron (ppb)	$\leq$ 2.00	$\leq$ 2.000	$\leq$ 3.000
Dissolved Oxygen (ppb)	20-50	within 20-50	within 20-50
Condensate			
Conductivity (μS/cm)	$\leq$ 0.08	$\leq$ 0.060	$\leq$ 0.060

Microsiemens Per Centimeter (μS/cm)
Parts Per Billion (ppb)

The licensee has maintained very low levels of chloride and sulfate in reactor water which was reflected in the conductivity levels that averaged less than 0.08 microsiemens/centimeter (μS/cm)--less then 50% of the EPRI achievable limit.

Feedwater and condensate chemistry parameters were also very good. Conductivity averaged 0.06 μS/cm or less (theoretical limit is 0.055 μS/cm). A licensee representative stated that oxygen was injected into the feedwater train. This additional oxygen in the feedwater system protects the magnetite layer on the carbon steel pipes which in turn prevents or reduces the formation and release of iron oxides into the feedwater.

Since July 1987, the licensee has used hydrogen water chemistry, and monitored crack growth and electrochemical potential (ECP) of recirculation piping with the crack arrest verification (CAV) system. The plant went online in 1974 and the original recirculation piping is still in place. The safe ends, which are transition pieces of piping connecting the reactor vessel to the recirculation piping, were replaced in 1977 according to a licensee representative. In 1985, some crack indications appeared on the recirculation piping, and weld overlays were used to mitigate this condition. Since the addition of hydrogen water chemistry there has been no evidence of cracking in the recirculation piping. The

licensee has observed a relationship between conductivity, pH and concentration of chromium compounds. The presence of hydrogen tended to maintain the chromium species plated out, the pH about neutral (7) and the conductivity lower than normally observed in a BWR. Loss of hydrogen resulted in an increase in the oxidation state of chromium, forming chromates which were soluble and increased the chromate concentration in the reactor water. This reaction also resulted in a pH drop and an increase in conductivity. This observation may help explain the low conductivity levels observed by the licensee, and also, the elevated chromate levels observed in boiling water reactors that do not add hydrogen to the reactor water.

The licensee has developed and maintained an excellent water quality program which is a strength.

A comparison of boron concentrations and volumes in the standby liquid control tank, for the past 12 months, with Technical Specifications (T/S) indicated that the analysis requirements had been met.

No violations or deviations were identified.

5. Chemistry Comparison Program (IP 84750)

The inspector submitted chemistry samples to the licensee for analysis as part of a program to evaluate the laboratory's capabilities to monitor nonradiological chemistry parameters in various plant systems with respect to regulatory and administrative requirements. These samples had been prepared and standardized for the NRC by the Analytical Chemistry Division of Oak Ridge National Laboratory (ORNL). The samples were analyzed by the licensee using routine methods and equipment.

The samples were diluted by licensee personnel in order to bring the concentrations within the ranges normally analyzed by the laboratory. These samples were then analyzed in a manner similar to that of routine samples. The results are presented in Table 1 which also contains the criteria for agreement. These criteria are based on ORNL analyses of the standards and on the relative standard deviations (RSD) derived from the results of nuclear power plants participating in a 1986 interlaboratory comparison (Table 2.1, NUREG/CR-5442, Evaluation of Non-Radiological Water Chemistry at Power Reactors). The acceptance criteria were that the licensee's value should be within 2 Standard Deviations (SD) of the ORNL value for agreement and between 2 and 3 SD for qualified agreement. A qualified agreement may indicate a bias in the assay.

The licensee analyzed nine unknowns at three concentrations each. Although the 27 comparisons were agreements, several analyses were qualified agreements and the data indicated that there were some biases in the analyses. There appeared to be an instrument problem with the atomic absorption spectrophotometer (AAS) as the three concentrations of chromium were negatively biased by 8% to 12% and the three iron analyses contained a positive bias of approximately 9%. Licensee representatives stated that a vendor representative was scheduled to perform maintenance

on the instrument in the near future. Following repair of the AAS, the iron and chromium unknowns were rerun and the results were closer to the known values. The three sodium analyses had negative biases, however, this was due to the acid matrix of those samples which interferes with the ion chromatographic analysis. The low level sodium was rerun after it was neutralized and the result was considerably closer to the true value which indicated that the acidic matrix had interfered with sodium binding to the column. The licensee's performance in the chemistry comparison program was very good.

The inspector reviewed the results (Table 2) of a liquid radwaste sample split performed during the previous Confirmatory Measurements inspection (Inspection Report 92014 (DRSS)). The comparison criteria are contained in Attachment 1. Of the four analyses, two were agreements (tritium and gross beta), and two could not be compared (strontium 89 and 90) due to poor counting statistics, which was a result of very low concentrations of those isotopes in the sample. The comparison results appeared adequate.

No violations or deviations were identified.

6. Chemistry Quality Assurance/Quality Control (IP 84750)

The chemistry quality assurance (QA) program was defined by PCP 1.2, Chemistry Quality Control Program, Revision 2, October 12, 1993. The program incorporated control charts, independent controls and multiple point calibration curves. Control charts were reviewed daily by chemistry technicians, monthly by foremen and quarterly by the Production Standards Specialist. Data from selected charts was, in general, randomly scattered about the mean indicating that instrument performance was under statistical control. Control charts were neat, easily read and provided a quick appraisal of instrument performance. No instrument problems were observed during this review.

The licensee had two laboratory crosscheck programs. The interlaboratory program was vendor supplied, unknowns were received quarterly and were analyzed by technicians assigned to the instruments used in those analyses. This program measures overall laboratory performance and the results were good. No significant analytical problems were evident from a review of selected data from this program. The intralaboratory program was used to measure the performance of individual technicians. Acceptance criteria were statistically based using analysis history. Technicians had been tested as required and retested when results were beyond the acceptance criteria. Results of this program were very good. The use of two crosscheck programs along with the control chart data and results of the NRC chemistry comparison program indicated that the licensee's chemistry QA program was very good.

No violations or deviations were identified.

7. Post Accident Sampling System (IP 84750)

The inspector reviewed the status of the Post Accident Sampling System (PASS). Grab samples from the PASS were analyzed in the laboratory as the only inline monitor was a conductivity meter. The PASS is required to be operated semiannually and during emergency response drills. A review of selected data indicated that the system had been exercised as required. Analyses included chloride, pH, boron, hydrogen, oxygen and gamma spectroscopy. The licensee had demonstrated that the PASS sample was representative of the bulk reactor coolant as required by NUREG 0737. Ratios of activity (sodium-24) in the reactor coolant to the PASS samples were 0.923 and 1.026 which were excellent agreements and indicated that the PASS sample was representative of the reactor coolant.

No violations or deviations were identified.

8. Audits (IP 84750)

The inspector reviewed Audit I-92-25, conducted November 16, 1992 through January 22, 1993, of the Chemistry Department. Areas assessed included:

Quality Control Procedures
Instrument Calibration and Performance
Laboratory Personnel Performance Testing
Environmental Controls and Laboratory Safety
Personnel Training
Analytical Equipment Preventive Maintenance

The audit team evaluated the collection, shipment and receipt of samples by the laboratory; sample preparation and analysis; data evaluation, reporting and monitoring of results. The audit team covered chemistry activities systematically and the report indicated that the department had an effective quality assurance program. The one finding from the previous audit had been addressed adequately. The audit team was knowledgeable of the chemistry program and performed a technically competent review of the chemistry program. This was due, in part, to the inclusion of a chemistry supervisor from another utility as part of the audit team.

Audit Report I-93-08 of the Radiological Environmental Monitoring Program (REMP) was conducted April 26 through June 15, 1993. The audit team included an outside consultant. The following areas were reviewed:

Sampling Program and Ingestion Pathways
Land Use Census
Environmental Sample Collection
Vendor Laboratory Participation in Crosscheck Program
REMP Reporting and Documentation
Outside Reviews of REMP Vendor Laboratory

Deficiencies from previous audits had been adequately addressed as was the one finding from the current audit. The audits were detailed and performance based.

No violations or deviations were identified.

9. Radiological Environmental Monitoring Program (IP 84750)

The inspector reviewed the Radiological Environmental Monitoring Program (REMP) and the 1992 Annual Operating Report which appeared to comply with the REMP requirements. Environmental samples had been collected and analyzed as required. Missing samples were documented, the causes investigated and noted in the report. A review of environmental sample data indicated that operation of the Duane Arnold Energy Center had no effect on the environment. The land use census had been reviewed by conducting a house to house inspection. Water usage from the Cedar river was surveyed by boat. The licensee had continued to monitor building trends in the plant vicinity. Based on this review, no changes in the sample plan were recommended.

A tour of selected air sampling stations was conducted with the REMP technician responsible for sample collection. The technician was observed replacing air particulate and charcoal filter media, collecting air flow data and testing the filter train for air in-leakage; none was detected. The equipment had current calibration stickers and was in good operating condition. The licensee had recently replaced the air sampler housings with lockable aluminum units. Replacement of the air sampler equipment was much easier with the new housings and they appeared to provide better protection from the elements. A review of calibration records indicated that air sampling equipment was calibrated as required and reference flowmeters were calibrated by a vendor laboratory using National Institute of Science and Technology (NIST) traceable equipment. Licensee personnel were knowledgeable of the REMP program which appeared to be operating satisfactorily.

No violations or deviations were identified.

10. Inspection Followup Items

Inspection Followup Items (IFI) are matters which have been discussed with the licensee, which will be reviewed further by the inspector, and which involve some action on the part of the NRC or licensee or both. One IFI is closed in Section 2.

11. Exit Interview

The scope and findings of the inspection were reviewed with licensee representatives (Section 1) at the conclusion of the inspection on February 11, 1994. The inspector discussed the following items with licensee representatives.

The inspection followup item in Section 2.
Licensee performance in the chemistry comparison program.
The laboratory quality assurance program.
The water chemistry/quality program.
The self assessment program.
The REMP.
The PASS.

During the exit interview, the inspector discussed the likely informational content of the inspection report with regard to documents or processes reviewed during the inspection. Licensee representatives did not identify any such documents or processes as proprietary.

Attachments:
1. Table 1, Radiological Confirmatory Measurements Program Results 2nd Quarter 1992
2. Attachment 1, Criteria for Comparing Confirmatory Measurement Results
3. Table 2, Chemistry Comparison Results 1st Quarter 1994

TABLE 1
Nonradiological Chemistry Comparisons Results
Duane Arnold Energy Center
February 7-11, 1994

Analyte		Method[1]	Conc[2]	Ratio[3]	Acceptance Ranges[4] ± 2RSD	± 3RSD	Result[5]
			ppb				
Chloride	A	IC	5	1.098	0.933-1.067	0.900-1.100	A+
	B		10	1.058	0.919-1.081	0.887-1.113	A
	C		20	1.061	0.926-1.074	0.895-1.105	A
Rerun	A		8	1.062	0.933-1.067	0.900-1.100	A
Sulfate	A	IC	5	1.052	0.895-1.105	0.842-1.158	A
	B		10	1.026	0.895-1.105	0.868-1.132	A
	C		20	0.999	0.900-1.100	0.867-1.133	A
Sodium	J	IC	5	0.830	0.863-1.137	0.784-1.216	A+
	K		10	0.843	0.859-1.141	0.788-1.121	A+
	L		15	0.832	0.862-1.138	0.789-1.211	A+
Rerun	J		5	0.962	0.863-1.137	0.784-1.216	A
Iron	G	AA/FL	400	1.095	0.904-1.096	0.854-1.146	A
	H		800	1.090	0.903-1.097	0.857-1.143	A
	I		1600	1.102	0.903-1.097	0.855-1.145	A+
Rerun	G		400	1.080	0.904-1.096	0.854-1.146	A
	H		800	1.048	0.903-1.097	0.857-1.143	A
	I		1600	1.020	0.903-1.097	0.855-1.145	A
Copper	G	AA/FL	400	0.980	0.904-1.095	0.859-1.141	A
	H		800	0.995	0.904-1.096	0.857-1.143	A
	I		1600	0.985	0.904-1.096	0.857-1.143	A
Nickel	G	AA/FL	400	1.040	0.936-1.064	0.906-1.094	A
	H		800	1.048	0.938-1.062	0.908-1.092	A
	I		1600	1.071	0.938-1.062	0.907-1.093	A
Chromium	G	AA/FL	400	0.920	0.905-1.095	0.855-1.145	A+
	H		800	0.876	0.903-1.097	0.854-1.146	A+
	I		1600	0.883	0.903-1.097	0.853-1.147	A+
Rerun	G		400	0.980	0.905-1.095	0.855-1.145	A
	H		800	0.950	0.903-1.097	0.854-1.146	A
	I		1600	0.915	0.903-1.097	0.853-1.147	A
	S	Spec	50	0.986	0.906-1.094	0.859-1.141	A
Silica	T		100	1.014	0.906-1.094	0.859-1.141	A
	U		250	0.978	0.909-1.091	0.860-1.136	A

Analyte		Method[1]	Conc[2]	Ratio[3]	Acceptance Ranges[4] ± 2RSD	± 3RSD	Result[5]
			ppm				
Boron	D	Titr	15	1.006	0.979-1.021	0.968-1.032	A
	E		50	1.013	0.979-1.021	0.968-1.032	A
	F		80	1.000	0.979-1.021	0.968-1.032	A

1. Methods: Titr - Titration
IC - Ion Chromatography
Spec - Ultraviolet/Visible Spectrophotometry
AA/FL - Atomic Absorption Spectrophotometry
Flame

2. Conc: Approximate concentration analyzed.

3. Ratio of Licensee mean value to NRC mean value.

4. The relative standard deviations (RSD) in the sixth and seventh columns represents the coefficient of variation obtained from averaging licensee data from the preceding cycle (Table 2.1 of NUREG/CR-5244). A result is considered to be in agreement if it falls within the ±2 SD range; a qualified agreement if it lies outside ±2 SD, but within ±3 SD; and in disagreement if it is outside the ±3 SD range.

5. Result:
A = Agreement: Licensee value is within ±2 SDs of the NRC mean value.
A+ = Qualified agreement, licensee is between ±2 and ±3 Sds of the NRC value.
D = Disagreement: licensee value is outside ±3 Sds.

ATTACHMENT 1

CRITERIA FOR COMPARING ANALYTICAL MEASUREMENTS

This attachment provides criteria for comparing results of capability tests and verification measurements. The criteria are based on an empirical relationship which combines prior experience and the accuracy needs of this program.

In these criteria, the judgment limits are variable in relation to the comparison of the NRC's value to its associated one sigma uncertainty. As that ratio, referred to in this program as "Resolution", increases, the acceptability of a licensee's measurement should be more selective. Conversely, poorer agreement should be considered acceptable as the resolution decreases. The values in the ratio criteria may be rounded to fewer significant figures reported by the NRC Reference Laboratory, unless such rounding will result in a narrowed category of acceptance.

RESOLUTION	RATIO = LICENSEE VALUE/NRC REFERENCE VALUE
	Agreement
<4	NO COMPARISON
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
200 -	0.85 - 1.18

Some discrepancies may result from the use of different equipment, techniques, and for some specific nuclides. These may be factored into the acceptance criteria and identified on the data sheet.

TABLE 2

U. S. NUCLEAR REGULATORY COMMISSION

REGION III

FACILITY: DUANE ARNOLD ENERGY CENTER

LIQUID RADWASTE SAMPLE SPLIT

FOR THE 2ND QUARTER 1992

NUCLIDE	NRC VAL.	NRC ERR.	LIC.VAL.	LIC.ERR.	RATIO	RESOL.	RESULT
Gross Beta	2.15E-5	1.10E-6	2.11E-5	---	0.981	19.5	A
H-3	1.96E-3	0.03E-3	2.02E-3	---	1.031	65.3	A
SR-89	3.00E-8	3.00E-8	9.00E-10	---	0.030	1.0	N
SR-90	1.30E-9	3.40E-9	4.60E-9	---	3.540	0.4	N

TEST RESULTS:

A=AGREEMENT
D=DISAGREEMENT
N=NO COMPARISON
*=CRITERIA RELAXED