U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-346/88008(DRSS)

Docket No. 50-346 License No. NPF-3

Licensee: Toledo Edison Company
Edison Plaza
300 Madison Avenue
Toledo, Ohio 43652

Facility Name: Davis-Besse Nuclear Power Station

Inspection At: Davis-Besse Nuclear Power Station, Oak Harbor, Ohio

Inspection Conducted: February 23-26 and March 7-11, 1988

Inspectors: D. E. Miller — 4-5-88 Date

W. B. Grant — 4-5-88 Date

R. B. Holtzman — 4/5/88 Date

Accompanying Inspectors: M. A. Kunowski

W. W. Ogg

Approved By: L. R. Greger, Chief
Facilities Radiation
Protection Section — 4-5-88 Date

Inspection Summary

Inspection on February 23-26 and March 7-11, 1988 (Report No. 50-346/88008(DRSS))
Areas Inspected: Special, announced team inspection of the operational radiation protection, solid radwaste management, and nonradiological chemistry programs including: radiological control organization, management controls, and qualifications (IP 83522); chemistry organization, management controls, and training (IP 83522, 83523); general orientation training (IP 83523); internal exposure controls (IP 83525); external exposure controls (IP 83524); control of radioactive materials and contamination (IP 83526); ALARA (IP 83728); solid radwaste (IP 84522); water quality (IP 79701); implementation of the chemistry program (IP 79701); chemistry QA/QC program (IP 79701); and nonradiological chemistry confirmatory measurements. Also reviewed were past open items, audits, an allegation, and planning and preparation for the extended scheduled outage.
Results: Extensive organizational and procedural changes resulting in increased program formality to accommodate significant staff increases are in various stages of completion. The changes have the potential to improve long-term licensee performance in the radiological controls area. Station internal and external doses and radwaste volumes remain very low. No violations or deviations were identified. One unresolved item was identified pertaining to the absorber thickness used in personal dosimetry devices.

DETAILS

1. Persons Contacted

T. Anderson, Maintenance Planning and Outage Management Supervisor
L. Bonker, Radiological Health Supervisor
R. Coad, Radiological Protection Supervisor
R. Edwards, Chemistry Specialist
D. Erickson, Radiological Control Superintendent
R. Flood, Assistant Plant Manager, Operations
L. Harder, Radiological Control Supervisor
D. Hennen, Chemistry General Foreman
G. Honma, Compliance Supervisor, Nuclear Licensing
S. Jain, Director, Independent Safety Engineering
J. Polyak, Radiological Assessment Manager
L. Ramsett, Quality Assurance Director
J. Scott-Wasilk, Director, Nuclear Health and Safety
L. Storz, Plant Manager
P. Strahm, Radwaste Supervisor
J. Sturdavant, Licensing Principal

P. Byron, NRC Senior Resident Inspector
L. Greger, NRC Region III, Chief, Facilities Radiation Protection Section

The above individuals attended the exit meeting on March 11, 1988. In addition to the above individuals, the inspectors contacted other licensee and contractor personnel during the team inspection.

2. General

This special team inspection began on February 23, 1988. Reviewed were the operational radiation protection, solid radwaste management, and nonradiological chemistry programs. Also reviewed were past open items, audits, an allegation concerning qualifications of a contractor radiation protection technician, and licensee planning and preparation for the scheduled extended refueling and maintenance outage. Several tours of licensee facilities were made to review posting, labeling, access and contamination controls, and to observe radiation protection aspects of work in progress. Special attention was given to programmatic areas where weaknesses were previously identified by the NRC and others. No significant problems were identified.

One purpose of the team inspection was to assess the impact of extensive organizational and programmatic changes which have taken place over the last two years; changes concerning procedure development and staffing increases are continuing. The organizational and staffing changes, particularly in radiological control operations, resulted in an organization that has not been challenged by the demands of an extensive refueling and maintenance outage such as the one scheduled this year. In recognition of this, the licensee has supplemented the radiological control operations and support organizations with sufficient contractor employees who have extensive outage experience.

The organizational structure, qualifications of personnel, management controls, proposed staffing levels, and upper management support appears adequate to establish and maintain quality radiation protection, radwaste, and chemistry programs.

Minor problems were identified with the content of some specific procedures and interfaces between procedures; the licensee committed to correct the problems. Corrective actions for previously identified concerns by the NRC and others appear to have been adequately implemented or are being addressed in a timely manner except for needed corrective alterations to the station vent effluent monitoring equipment. The corrective alterations to the monitoring system have been in the facility change request and engineering stages since 1984 with no current completion date established; the licensee committed during this inspection to complete the needed alterations, testing, and calibrations by December 31, 1988.

3. Licensee Action on Previous Inspection Findings and Open Items

(Open) Open Item (346/84-08-02): Energy response of PASS noble gas high range detector. As discussed in Inspection Report No. 50-346/87021(DRSS), a facility change request was initiated in October 1986 to implement a vendor detector enhancement modification, an onsite isotopic calibration, and other changes. No completion date had been established. The inspectors discussed with the licensee at the exit meeting the apparent slow progress made in making needed modifications.

(Open) Open Item (346/84-30-02): Stack sample return line. This matter is included in the facility change request referenced in Open Item 346/84-08-02 above.

(Closed) Open Item (50-346/86026-03): Licensee to make improvements in the inline chemistry monitoring capability by 1987. The licensee replaced and improved the previously inoperable inline monitors in the secondary system, including the conductivity monitors and the dissolved oxygen and sodium analyzers. New dual-range cation conductivity monitors and improved ion-exchange columns were added to the system at various feedwater sampling points to monitor the steam generators, which cannot be monitored directly because blowdown is not allowed above 15% power. The hydrazine analyzer was repaired and is now operable. Conductivity and sodium analyzers were added to determine the amounts and locations of hotwell cooling water inleakage. Corrosion monitors were added to the feedwater and condensate systems.

(Open) Open Item (50-346/86026-06): Licensee to revise REMP Surveillance Test Procedure ST 5099.033, "Radiological Environmental Monitoring Program," Revision 13, to assign responsibilities to the current REMP management. The procedure was changed satisfactorily to reflect the change of responsibilities of the Environmental Monitoring Supervisor in Revision 14, February 27, 1987, but Administrative Procedure AD 1843.00 has not been revised. A licensee representative noted that these two procedures are being reformatted and incorporated into new procedures. This item will remain open until procedure revisions are completed.

(Open) Open Item (50-346/87023-02): Analyze liquid split sample for gross beta, H-3, Sr-89, Sr-90, and Fe-55 and report the results to Region III. The comparison of the licensee results with those from the NRC Reference Laboratory (Radiological and Environmental Sciences Laboratory, RESL) are given in Table 1; the comparison criteria are listed in Attachment 1. The gross beta values were substantially higher than those of the NRC and those of Sr-89 and Sr-90 were too low for a comparison to be made. The Fe-55 activities were not determined by RESL. The licensee agreed to analyze a spiked sample supplied by RESL and submit the results to Region III. This item will remain open pending completion of the intercomparison.

(Closed) Open Item (50-346/87023-03): Licensee to correct the 1985-1987 effluent reports using an improved method to determine Cs-134 at or below the required technical specification LLD. The licensee modified the procedure for Cs-134 to determine the nuclide at or below the required LLD, and redetermined this nuclide in the effluent samples. Cs-134 was detected in seven samples. Only three were greater than the required LLD's, and all occurred during the third quarter 1987. The offsite dose due to the Cs-134 was estimated at 0.0014 and 0.0017 mrem to the whole body and liver, respectively. The results were included in the Davis-Besse "Effluent and Waste Disposal Semiannual Report," July 1 - December 31, 1987, Table 5.

(Closed) Open Item (50-346/87023-04): Licensee to calibrate new Detector 2 and recalibrate Detector 1. The inspector reviewed the calibration data for these detectors for each of the several geometries. The laboratory had made comparisons between the old and new calibrations for the older detector, and for the efficiencies between the two counters. The calibrations appeared to be satisfactory.

(Closed) Open Item (50-346/87023-05): Licensee to generate a new EBAR library before the next required EBAR determination. The inspector's review showed that the EBAR library had been revised to conform to the NRC values from NUREG/CR-1413, "A radionuclide decay data base-index and summary table," by D. C. Kocher, June 1980. Calculations on a gamma spectrum from an RCS sample using the revised table gave somewhat higher values of EBAR (0.85 Mev, 0.24% of LCO) than did the previous table (0.77 Mev, 0.21% of LCO).

(Open) Open Item (50-346/87021-01): Liquid radwaste release forms are not always complete. Procedures have been revised and are being reviewed by the licensee; the changes should assure form completion. This item remains open pending inspector review of completed procedure revisions.

(Open) Open Item (50-346/87021-02): Need more accurate quantifications of containment pressure relief releases. Procedure has been revised and is being reviewed by the licensee; the changes should improve quantification accuracy. This item remains open pending inspector review of completed procedure revisions.

4. Radiological Control Organization, Management Controls, and Qualifications (IP 83522)

The inspectors reviewed the licensee's organization and management controls for the radiation protection and radwaste programs including changes in the organizational structure and staffing, effectiveness of procedures and other management techniques used to implement these programs, and experience concerning self-identification and correction of program implementation weaknesses.

Organizational changes are discussed in Inspection Report No. 50-346/87021(DRSS). Since that August 1987 inspection, additional professional/technical and technician personnel have been hired. Staffing level in the Radiological Control (RC) Department is about 55 personnel with a budgeted staffing level of 66. Five persons are to begin employment in late March 1988. The licensee is actively recruiting qualified persons to fill the remaining open radiological control foreman, health physics serviceman, and radiological control tester (technician) positions.

The inspectors reviewed selected managerial and qualifications aspects of the department and found that:

- Formal job descriptions have been developed for supervisors and foremen, and annual performance appraisals are performed.

- No performance appraisal system is in place for technicians, but such a system is being considered. The inspectors discussed with the licensee the desirability of establishing such a system so that technicians receive feedback concerning their performance.

- The department's internal communications appears adequate. Communications include weekly meetings between departmental supervisors and technicians to discuss any matter pertinent to the department; individual attendees are encouraged to participate. Similar supervisory meetings are routinely held. During interviews with various department personnel, the inspectors learned of no significant existing communications problems.

- All supervisors and foremen meet or exceed the qualification requirements listed in ANSI N18.1-1971 for the positions they hold.

- The licensee's policies and procedures for classification of technicians are consistent with ANSI N18.1-1971 requirements. Also, credit for prior military nuclear experience is consistent with NRC's guidance concerning creditable military health physics experience.

- Supervisors Personnel Guidelines procedure SPG 6-9, "Radiological Control Deficiencies," included in the Nuclear Group Guideline/ Handbook, lists individual and supervisory responsibilities for following radiological control procedures and practices and prescribes progression of disciplinary actions to be taken against offenders.

- Through memoranda and directives, station management has instructed station and contractor first line supervisors to spend more time overseeing work performed in radiologically controlled areas to ensure good health physics practices are employed. Also, all station managers are encouraged to tour the plant to observe the physical condition of the plant and work practices. The RC department maintains a tour log at the RC foreman's desk in the access control area; station managers and supervisors and others are to log their tour findings/observations. The inspectors noted that log entries are made at least once per day, with most entries indicating that the problems are corrected or passed on to the appropriate department for action. The majority of the log entries are made by RC personnel.

- Eight contractor supervisors/foremen will act in various supervisory capacities during the outage; four of the eight will act as RC foremen and report to station RC foremen. Both contractor and station RC technicians will be assigned to report to contractor RC foremen; the technicians will work side-by-side without station or contractor distinction. This temporary organizational structure is designed to provide a climate where station RC technicians can gain commercial reactor refueling outage experience/knowledge from the contractor personnel.

- A consultant was hired to assist the radiological control supervisor in performance of RC aspects of outage planning and coordination.

The licensee's Radiological Awareness Reporting (RAR) system, described in Inspection Report No. 50-346/87021(DRSS), appears to be properly used to document radiological deficiencies, concerns, and suggestions. Followup of individual RARs appears good. The system appears to be working as designed.

The Radiological Assessor position, which previously was reportable to the Radiological Control Superintendent, has been changed to a Radiological Assessment Manager (RAM) position reporting to the Director, Independent Safety Engineering group which reports to the Vice President, Nuclear. Among the RAM's duties is independent assessment of all aspects of the RC department. The RAM currently has an office adjacent to the RC superintendent in the RC office area. Housing the RAM in this location does not give the appearance of independence, and could temper employee interactions with the RAM. This matter was discussed at the exit meeting, and will be further reviewed as part of a future routine inspection. (Open Item No. 346-88008-05)

Because of the large numbers of newly created/revised health physics procedures, minimal commercial refueling outage experience of RC technicians, and the extent of work to be performed during outage, the inspectors discussed with the licensee during the inspection and at the exit meeting the apparent need to provide enhanced supervisory review/oversight of radiological work and associated work precautions/surveys and paperwork during the outage.

The organizational structure, qualifications of personnel, management controls, proposed staffing levels, and upper management support appears adequate to establish and maintain quality radiation protection and radwaste management programs. No violations or deviations were identified.

5. Chemistry Management Controls, Organization, and Training (IP 83522, IP 83523)

Plant management has been reorganized since the previous inspection in this area, (Inspection Report No. 50-346/87023). The Chemistry Superintendent reports to the Assistant Plant Manager-Operations. He is supported by a General Foreman Chemistry, four foremen (laboratory), a Training Foreman, and four chemists. The laboratory work is done by 18 chemistry testers (technicians). Seven of the testers have bachelor or associate degrees; the others have Navy experience or experience at other nuclear plants. At least seven are qualified in accordance with ANSI N18-1-1971. The licensee's chemistry technician training program was accredited by INPO on December 9, 1987. The chemistry staff and testers appear to be well qualified, and the laboratory adequately staffed to do the analyses required for plant operation.

No violations or deviations were identified.

6. General Orientation Training (IP 83523)

The inspectors reviewed the General Employee Orientation (GOT)/Radiological Controls Training (RCT) program for all employees and contractors and the Technical Skills Training and Qualification Program for Health Physics Personnel including changes in responsibilities, policies, goals, and objectives.

The objective of General Orientation Training (GOT) is to ensure that all personnel who enter the protected area have sufficient knowledge to do so safely and in accordance with all applicable security, industrial safety, quality assurance, radiological controls, emergency planning procedures, and NRC requirements. The objective of Radiological Controls Training (RCT) is to ensure that personnel who enter Radiologically Controlled Areas (RCA) have sufficient knowledge to do so safely and in accordance with all applicable radiological controls procedures.

The inspectors reviewed GOT/RCT course outlines, lesson plans and examination results; instructor experience, background and training were also reviewed and discussed with the program manager; no problems were noted. An inspector attended a portion of the GOT and the RCT classes. The classrooms were of adequate size and well equipped. The class size was large due to the upcoming outage; however, it appeared that adequate individual attention was provided. In general, presentations were of good quality and students participated. An examination requiring a 70% passing grade was given after completion of the GOT and RCT sessions. No problems were noted.

The inspector reviewed course outlines, lesson plans, and qualification cards for the Technical Skills Training Program for Health Physics Personnel. The program objectives and instructor experience and qualifications were also reviewed and discussed with the program manager. There are three instructors for the training program; their education and experience appeared adequate. No problems were noted.

An inspector attended a portion of a week-long Plant Systems Related To Health Physics course which is part of the continuing training program for health physics personnel. Class size was small (6) which allowed for individual attention. Systems discussed included radwaste, fuel handling, containment purge, and the emergency ventilation systems; radiation monitors in each ventilation system and their intended function were included. The gaseous radwaste system, the Radiological Environmental Technical Specifications, and the Offsite Dose Calculation Manual were also discussed. In general, the presentations were of good quality and student participation was good. An examination requiring a 80% passing grade was given after completion of the course. No problems were noted.

No violations or deviations were identified.

7. Internal Exposure Control and Assessment (IP 83525)

The inspectors reviewed the licensee's internal exposure control and assessment programs, including: changes in facilities, equipment, and personnel; respiratory protection training; procedures affecting internal exposure control and personal assessment; determination whether engineering controls, respiratory protective equipment, and assessment of individual intakes meet regulatory requirements; planning and preparation for maintenance and refueling tasks including ALARA considerations; required records, reports, and notifications; effectiveness of management techniques used to implement these programs, and experience concerning self-identification and correction of program implementation weaknesses.

In response to station and contractor audits conducted in 1987, several programmatic changes were made including:

- Respiratory protection equipment cleaning methods were upgraded. A new washer/dryer unit and an additional dryer were purchased and made operational. Water temperature is now verified and recorded and is required to be between 100°F and 140°F prior to washing masks. As previously done after washing, masks are sanitized, inspected for defects, marked as acceptable or repaired/destroyed, and stored for reissue. Quality assurance records generated for inspection and testing of respiratory protection equipment are now kept on equipment history cards located in the respirator test and cleaning room. No problems were noted.

- Procedure DB-HP-00002, Revision 00, "Internal Exposure Control Program," now requires respirator particulate air filters to be tested and inspected prior to reissue to ensure they meet guidances for efficiency and breathing resistance specified in Section 10.1.1.2 of NUREG-0041. All respirator particulate air filters, new and used, are now tested on a TDA-100 Air Techniques Inc. test system.

- The licensee now formally documents the qualifications of personnel who have been trained in accordance with NUREG-0041 to repair, test, and calibrate respirators and respirator test equipment. The inspectors reviewed the training and qualifications records; no problems were noted.

- The licensee now formally documents that the air quality of distribution systems used as respirable air sources complies with regulatory guidances. The Station Service Air System, which is used to supply airline respiratory equipment, and the Eagle Air Compressor, which is used to fill self-contained breathing apparatus supply tanks, are sampled and analyzed quarterly; the air samples are analyzed in accordance with the Texas Research Institute National Life Support Air Quality Assurance Program. Both air sources exceed the minimum requirement for breathing air (Type 1, Grade D); they meet the preferred Grade E requirements. Records of the quarterly analyses are filed in the Radiological Control Area Book and with Records Management. No problems were noted.

A Respiratory Protection Permit (RPP) is required for entry into expected or known airborne radioactivity areas of greater than 0.25 MPC except those containing only noble gases. The licensee calculates MPC-hours and records those greater than 0.1 MPC-hours per entry.

The licensee's program for controlling internal exposures includes the use of protective clothing, respirators, and engineering controls. When engineering controls cannot be used, respiratory protection methods include increased air sampling frequency, limiting stay times, and/or the use of respirators. If the use of respirators would significantly increase external exposure, worker stress, or reduce job safety, internal exposure may be controlled by limiting exposure to 2 MPC-hours in a day or 10 MPC-hours in any seven consecutive days. The inspectors selectively reviewed the RPPs which were attached to active RWPs at the RCA entrance; no problems were noted.

Air sample data for the period July 1987 to date were reviewed. All air samples are counted on a Ge(Li) system. Routine grab air sampling frequency and extent appears adequate. Air samples are also collected to establish RWP requirements and during certain jobs to identify changing conditions. Air sample data is reviewed and evaluated by an RC foreman and an RC specialist or technologist to assure accuracy and completeness. No problems were noted.

Urine samples are collected and analyzed to evaluate personnel uptake of tritium when potential tritium exposure exists, such as when the refueling canal is filled with water; urine samples are collected from selected individuals every two weeks when the refueling canal is filled. Tritium urinalyses are also performed on a quarterly basis on a random segment of the station radiation worker population. The above urine samples are collected and analyzed to evaluate the effectiveness of the internal exposure control program. Records of tritium urinalyses performed during the last two quarters of 1987 were reviewed. None of the analyses showed intakes greater than 0.1% of the Maximum Permissible Body Burden for tritium. No problems were noted.

The inspectors selectively reviewed whole body counting results for the period September 1987 to date. No uptakes in excess of the 40 MPC-hour control measure were noted. Based on whole body counting results and tritium urinalyses, there is no indication of defects in the licensee's internal exposure control and assessment program.

The inspectors reviewed the annual efficiency and energy calibrations for the licensee's chair-type whole body counters. Daily checks of the WBC's were also reviewed. No problems were noted.

No violations or deviations were identified.

8. External Occupational Exposure Controls and Personal Dosimetry (IP 83524)

The inspectors reviewed the licensee's external exposure control and personal dosimetry programs, including: changes in facilities, equipment, personnel, and procedures; required records, reports and notifications; and effectiveness of management techniques used to implement correction of program implementation weaknesses.

The licensee's Radiological Health Supervisor is responsible for maintaining portable and fixed survey and sampling equipment, the personnel dosimetry program, and the radiation exposure record keeping system. Assisting are a staff health physicist responsible for instrumentation, a dosimetry records clerk, several clerks at the TLD and SRD distribution desk, and computer programmers.

a. Portable Survey Meters

The licensee's program for maintaining and calibrating survey meters has changed since described in Inspection Report No. 50-346/87021; implementing procedures have been rewritten and new equipment has been or will be purchased and used. Changes are discussed in the following paragraphs.

In response to a QA audit observation, the licensee verified the accuracy of decay-corrected activity values for the eight sources in the Eberline Model 1000B Multiple Source Gamma Calibrator; this calibrator is used to calibrate most of the survey meters used by the RC department. In addition, the licensee stated that the activity of two other sources, a nominal 1.2 curie cesium-137 source used to calibrate SRDs and electronic dosimeters, and a nominal 5 curie americium-241:Be source used to calibrate neutron survey meters, will be verified in the near future. The licensee purchased a new multi-source calibrator that, unlike the currently used unit, has a source of sufficient activity to calibrate the licensee's high-range survey meters on all scales and is designed such that recertification with a condenser R-meter can be readily accomplished. The new calibrator should be in use by mid-1988. The licensee has also purchased and soon will be using Bicron Model RSO-5/50 portable survey meters (ion chambers) for routine surveys. According to the licensee, this instrument is easier to repair and calibrate than currently used instruments. A licensee representative stated that most equipment repairs are now done inhouse by I&C personnel. Previously, equipment was sent to an out-of-state contractor for repair.

b. Personnel Dosimetry

TLDs and SRDs are issued at the new RCA entrance. SRDs are issued by clerks to each person who enters the RCA. The clerks enter in the computer the SRD serial number, the initial SRD reading, the individual's social security number, and the number of the RWP under which the person is entering the RCA. Each time a person exits the RCA, the person deposits the SRD at the desk. The desk clerk then reads the SRD and enters the reading into the individual's SRD dose record. When the computer system is inoperable, the desk clerks record SRD readings manually on sheets attached to the RWPs. The practice of recording dose for each entry is different from the method used at the old RCA control point. Previously, individuals entering the RCA on a general RWP were required to sign in on the first entry of the day and sign out only on the last egress of the day. The inspectors noted that the licensee's current implementing procedure for the RWP program, DB-HP-01901, Radiation Work Permits, Revision 11, dated December 14, 1987, describes the previously used method and not the new computerized or manual sign-in method. Licensee representatives stated that the procedure would be revised to accurately describe the current method.

The licensee developed a computer program that records and tracks SRD and TLD issuance and dose information. The program will be further developed to issue 10 CFR 20.407 and 20.408 personnel monitoring reports, and permit retrieval of dose information for ALARA purposes. The licensee expects the new system to be fully operational in 1989.

TLDs used for routine whole-body dose monitoring are collected and processed (by a vendor) monthly. Discussions with licensee representatives indicated that whole-body dose information recorded to satisfy 10 CFR 20.401(a) is based on two zones of the TLD badge providing 798 and 1000 mg/cm^2 thickness absorbers. Form NRC-5, referenced in Section 20.401(a), requires that eye protection with 700 mg/cm^2 thickness be provided to individuals if dose assignment is based on TLDs with 1000 mg/cm^2 absorbers. The licensee agreed to evaluate the plant's beta hazard, the eye protection provided, and their dose assignment methodology to determine the mathematical difference between whole-body dose assignment as is currently done and the dose assignment that is required by Form NRC-5. This evaluation will be reviewed during a future inspection (Unresolved Item 50-346/88008-01).

In response to a QA audit observation concerning need for more formality in certain records (from an audit conducted in March 1987), the RC department now issues an RAR when (Section 4) performing an evaluation to assign dose for possible unmonitored exposures such as when an SRD or TLD is lost or damaged. The evaluation is also now performed using flowcharts as described in a new procedure, DB-HP-01232, Evaluation of Damaged, Lost, Off-Scale and/or Aberrant Dosimetry. An NRC inspector reviewed an evaluation performed by the licensee in accordance with this procedure; no problems were noted.

c. Access Controls for High Radiation Areas (HRA) ≥ 1000 mrem/hr

The licensee controls access to plant areas where radiation levels ≥1000 mrem/hr may exist by controlling the keys necessary to unlock barricades to these areas. The administrative and physical access controls for these areas are described in procedure DB-HP-01109, High Radiation Area Access Control. In addition, management memo HPI-022-6, Control of High Radiation Keys, designates the management persons and RC foremen who are authorized to grant access to these areas. RC foremen are not authorized to grant access to the containment at power, the containment for initial entries after a trip, areas where high-level waste is being moved, and locked areas within containment; management approval is required for issuance of keys to these areas. For access to the reactor pit/incore area, one of four managers with a key to the area must accompany the entry. In addition, the shift supervisor and the assistant shift supervisor have access to a key that will allow entry to all locked HRAs and to the pit/incore area in case of emergency. The locked status of these areas is confirmed weekly by RC personnel, within ALARA constraints, according to procedure DB-HP-04003, Locked High Rad Area Boundary Verification, and more frequently by security personnel.

A review of the licensee's control and surveillance procedures and a discussion with licensee personnel indicate that the licensee has been successful in controlling access to HRAs. However, in response to a concern of an RC tester (RAR 88-23) and the NRC inspectors, the licensee agreed to instruct personnel that during entries to HRAs that are secured with padlocks, the padlock be either relocked or taken with those persons entering the area to prevent inadvertent locking of personnel in the HRA.

No deviations or violations of NRC requirements were identified. One unresolved item was identified.

9. Control of Radioactive Materials and Contamination (IP 83526)

The inspectors reviewed the licensee's program for control of radioactive materials and contamination, including: effectiveness of survey methods, practices, and procedures; effectiveness of methods of control of radioactive and contaminated materials; management techniques used to implement the program, and experience concerning self-identification and correction of program implementation weaknesses.

During RCA tours, the inspectors observed: performance of contamination surveys; work performed under radiation work permits; protective clothing use, handling, and cleaning; posting and labeling; frisking; hot particle detection methods; and tool decontamination, handling, and storage. The inspectors also reviewed contamination control procedures for adequacy, and survey records for procedural compliance. The inspectors noted that all completed routine and special surveys are reviewed by an RC foreman as well as by RC supervision for completeness and notation of any unusual conditions. No problems were noted.

The inspectors noted that laundered protective clothing (PC) had low contamination levels and a clean appearance. This apparently results from: discarding as radwaste all PCs worn in high contamination areas; discarding any bag of used PCs without opening the bag if the contact dose rate is greater than 20 mR/hr; not routinely issuing laundered PCs which have contamination levels above 2000 cpm when frisked with a pancake probe; changing the freon and filters in/on the dry cleaning machine on a frequent basis; and performing preventative maintenance on the dry cleaning machines. The licensee is scheduled to install an new automated laundry monitor in the near future; monitoring is now done by hand using GM tube pancake friskers. A continuous air sampler is run in the laundry room and grab air samples are collected shiftly when the laundry is in operation. No problems were noted.

Plant contaminated floor area within the RCA has been reduced. The extent ranged from a peak of 28% in past years to a minimum of 9% in March 1987. The goal is for the contaminated floor area within the RCA to be less than 12% during power operations and less than 20% during outages. In order to minimize surface and airborne contamination levels in the Auxiliary Building, the licensee recently identified components which were leaking radioactive liquids and/or gases and developed a plan for corrective maintenance/repair.

The licensee performed an extensive hot particle search during August/September 1987. Areas surveyed included: the personnel processing facility, maintenance tool room, turbine building, personnel shop facility, and refuse. No hot particles were found outside the RCA. Inside the RCA one hot particle (4000 dpm) was found in the tool crib, and six hot particles (maximum activity 11,000 dpm) were found in the laundry room.

Thirteen personal contamination events have been recorded to date in 1988 of which four were from hot particles. The maximum calculated skin dose was 120 mrem. The licensee uses detailed procedures for calculating skin dose for any plane source or hot particle contamination greater than 100 cpm. No problems were noted.

No violations or deviations were identified.

10. ALARA (IP 83728)

The Radiological Protection Supervisor functions as the station ALARA coordinator. He is assisted by a staff health physics specialist and, for the outage, three contract health physicists who have extensive nuclear plant experience.

The ALARA group is undertaking an extensive ALARA procedures rewrite. The inspectors reviewed recently developed or revised administrative and implementing procedures and discussed the changes with the Radiological Protection Supervisor who indicated that once the procedure rewrite is completed and the procedures are fully implemented, the ALARA program will be much more formal. If the requirements of these procedures and the objectives of the ALARA group are successfully implemented, the ALARA program should remain effective in maintaining low annual station person-rem total. For the period 1976-1987, the station's annual person-rem total has ranged from about 24 to 177 person-rem, one of the lowest in the country. In 1987 the person-rem total was 47.4. For 1988, the goal is 190 person-rem. According to the licensee, the large difference between the 1987 total and the 1988 goal is because of a 160 person-rem estimate for the just begun 6-month refuel/maintenance outage and previous pre-outage work.

Prior to institution of the extensive organizational changes, the licensee's ALARA program functioned effectively because of close oversight by persons with extensive plant specific experience. Because of the greatly increased staffing levels and extent of personnel changes, it became apparent that a more formalized ALARA program was needed. Listed below are several aspects of the licensee's more formal ALARA program now inplace or forthcoming which should maintain the effectiveness of the program.

- Proposed facility changes must now be formally reviewed by the ALARA group.

- A radiation protection person with 10 years experience at the station reviews maintenance work orders to determine the need for an RWP and ALARA review.

- Job history files are being developed.
- Annual exposure goals for work groups are being developed.
- A system that will provide a video record of most of the plant systems will be implemented and used for training and job planning.
- A design/systems engineer ALARA training program is being developed.
- Procedures for control and use of portable ventilation units are being developed.
- The person-rem threshold for required ALARA reviews of RWPs has been lowered from 3 to 1 person-rem.
- The planning foreman or ALARA group personnel attend job-planning meetings.
- The Radiological Control Superintendent is a member of the Station Review Board.
- The recently implemented computerized RWP/TLD-SRD dose tracking system will be modified to allow work group and job function dose tracking.
- Employment during the outage of three contract health physicists to work in the ALARA program and support, as needed, the radiological operations group. The contractors are to develop an ALARA report for the refueling outage to include lessons-learned.
- Availability of the RAR system for workers to express ALARA concerns.

No violations or deviations were identified.

11. Solid Radwaste (IP 84522)

The inspectors reviewed the licensee's solid radwaste management program, including: changes to equipment and procedures; processing, control, and storage of solid wastes; adequacy of required records, reports, and notifications; implementation of procedures to properly classify and characterize waste, prepare manifests, and mark packages; and experience concerning identification and correction of programmatic weaknesses.

An inspector toured solid radwaste handling and storage facilities with the Radwaste/Decon Supervisor; methods of handling, storage, and proposed changes were discussed during the tour and later interviews. The supervisor was aware of applicable regulations, and the licensee's procedures for applying regulatory and burial site requirements appeared current and comprehensive.

The inspectors toured the newly constructed Radwaste Building (RWB); the building was being equipped for full operation/storage. The building is designed to have a storage capacity of five years accumulation of radwaste packaged for transport. The building abuts the Reactor Building (RB) and access between the buildings can be made through a door and truckdoor in the RB trackway. The licensee plans to perform dry active waste sorting and packaging in the RWB; new sorting and packaging equipment is on order and is expected to arrive soon. The licensee plans to equip a small counting room in the RWB to support packaging operations, and to install a whole body frisker for personnel monitoring.

The licensee purchased and is installing/testing a new contaminated water cleanup system (Duratec liquid radwate demineralizer), a sluiceable system which the licensee believes will further reduce radwaste volume and minimize handling.

No solid radwaste shipments have been made during 1988. Five shipments with a total volume of about three thousand cubic feet were made during 1987. The shipments were made in conformance with regulatory and burial site requirements; no incidents were reported. The licensee's solid radwaste volume remains comparatively low. No problems were noted.

The inspector reviewed the results of a licensee audit of the vendor who performs radioisotopic assay of the licensee's waste streams in accordance with 10 CFR 61. There were no audit findings during this January 1988 audit.

No violations or deviations were identified.

12. Water Chemistry Control Program (IP 79701)

The inspector reviewed the water chemistry control program based on procedure PP 1101.04.29, "Operational Chemical Control Limits," Revision 29, June 16, 1987. This procedure is based on the EPRI Secondary Chemistry Guidelines, Revision 1, April 1985, the EPRI Primary Water Chemistry Guidelines, September 1986, the B&W Water Chemistry Manual BAW-1385, Revision 4, April 1985, and the technical specifications. The licensee's program appears to follow the various guidelines.

A licensee representative stated that the dissolved oxygen levels in the condensate discharge are consistently above the guidelines of 10 ppb. This is due to the necessity of bleeding air into the condenser to keep the pressure above a certain minimum to prevent steam-impingement vibration in the condenser. However, to prevent oxygen damage to the steam generators, a deaerator lowers feedwater oxygen levels to a few ppb before the feedwater reaches the steam generator.

The laboratory maintains trend charts with limiting conditions of the chemical parameters in the systems. They keep the parameters well within these limits except for secondary system pH which is required to be within the narrow limits of 9.3-9.6 pH units. This parameter represents the main cause of out-of-specification time, and is due again to the condenser air bleed which reduces the efficiency of ammonia removal from the steam condensate. The licensee is considering an engineering solution to control pH and also asking the plant vendor (B & W) to recommend higher pH and ammonia limits because the secondary system does not contain copper or copper alloys.

The licensee is considering various improvements to plant operations, including: in-line ion chromatography to monitor chloride, fluoride, sulfate, ammonia, hydrazine and organic acids; continuous data output from inline instrumentation, and an improved post-accident sampling system that could be used for routine sampling of reactor coolant. Resolution of the various problems and improvements in the systems will be followed in subsequent routine chemistry inspections.

No violations or deviations were identified.

13. Chemical Control Program (IP 79701)

The inspector reviewed the progress of the program to control the use of chemicals in the plant that may be safety hazards or present operational problems. The Industrial Hygiene and Safety Department has inventoried the chemicals in the plant and classified them for environmental and fire hazards. The procedures are expected to be completed by April 15, 1988. Training programs, but not necessarily the training itself, for the various affected groups is expected to be complete by May 23, 1988. To simplify the approval process, the chemicals may be approved for safety separately from plant compatibility, but these chemicals may not be brought into the plant without engineering approval. The progress of this program will be reviewed in subsequent routine chemistry inspections.

No violations or deviations were identified.

14. Implementation of the Chemistry Program (IP 79701)

The inspector reviewed chemistry programs including physical facilities and laboratory operations. The laboratories were somewhat crowded, benches were covered with instruments, and there was little room for sample preparation or for testers to do their paperwork. The inspector noted some concern that the chemistry offices were in the administration building which was a substantial distance from the laboratories. Housekeeping was adequate. Licensee representatives stated that they have plans to expand the laboratory area by conversion of the former radiation control access area to a laboratory.

The laboratory instrumentation has been upgraded by the recent addition of a two-unit Dionex Ion Chromatography (IC) with an automatic sample changer for improved sensitivity, accuracy, and versatility, and a Perkin-Elmer Atomic Absorption Spectrophotometer (AA) with a Zeeman Furnace attachment to replace an older unit. The licensee has two digital readout Spectronic 501 UV/vis spectrophotometers on hand to replace the older analog readout Spectronic 88 units.

The inspector observed several testers analyze the confirmatory measurements samples for boron by titration, metals by flame atomic absorption spectrophotometry, and fluoride, chloride and sulfate by IC. The testors were very knowledgeable about the work and followed the procedures; they appeared to do well in the analyses.

Overall, the laboratory appeared adequate to support operation of the plant, and appeared to be functioning satisfactorily.

No violations or deviations were identified.

15. Implementation of the QA/QC Program in the Chemistry Laboratory (IP 79701)

The inspector reviewed the nonradiological QA/QC program in the laboratory which is based on Administrative Procedures DB-CH-00010, "Chemistry Quality Control Program," Revision 00, September 21, 1987, and DB-CH-00011 (AD 1842.03), "Reagent Control," Revision 00, September 26, 1987. The laboratory maintains an instrument logbook and control charts for both performance and duplicate checks. The charts have 2-sigma control and 1.5-sigma warning limits; they are maintained for most of the analyses including fluoride, chloride, sulfate, hydrazine, lithium, magnesium, and silica. In many cases two controls were used, one near the lower and one near the upper end of the calibration range, e.g., silica at 10 and 100 ppb. The precision samples were run weekly with standards somewhat above the concentration of the lower level performance check standards. The laboratory uses multipoint instrument calibrations and regular performance checks.

The inspector related the following concerns to licensee representatives. Control limits were determined approximately yearly and many of the controls showed substantial drift in mean values. The limits should be recalculated at more frequent intervals, e.g., on a monthly or quarterly basis (after the collection of about 30-60 data points). Also, the performance check standards were not always from different vendors (different lots or different manufacturers) than the calibration standards. Licensee representatives agreed to calculate the chart parameters more frequently and to consider use of separate standard source.

The licensee appears to have good technician performance testing and interlaboratory comparison programs. Each month each tester analyzes several vendor supplied samples (a portion of a series) so that over each quarter of the year each tester does the required analysis series. The agreement criterion is set at ± 10% of the vendor's reported value. A good picture of laboratory performance is given by graphs of the results

of various analyses. The recoveries of all of the analyses over the year are plotted for each tester. The inspector noted that the calculations could be simplified and speeded up by using the actual concentration values, rather than "recoveries" based on vendor values (which arrived several weeks after the analyses) and to use laboratory means. The difference between the mean and vendor values would then be a bias to be considered separately from tester performance. Because of the high precision of the boron analyses, the acceptance limits should be much stricter, e.g. ±1%. Licensee representatives will consider these suggestions.

The licensee's QA/QC program has the basic elements of a satisfactory program, but it needs some adjustments to make the QC charts more useful tools to demonstrate the credibility of the laboratory results. This will be followed under Open Item No. 50-346/88008-02.

No violations or deviations were identified.

16. Nonradiological Confirmatory Measurements (IP 79701)

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 various technical specification and other regulatory and administrative requirements. These samples were prepared, standardized, and periodically reanalyzed (to check for stability) for the NRC by the Safety and Environmental Protection Division of Brookhaven National Laboratory (BNL). The samples were analyzed by the licensee using routine methods and equipment.

The samples were diluted by licensee personnel as necessary to bring the concentrations within the ranges normally analyzed by the laboratory, and run in triplicate in a manner similar to that of routine samples. The results are presented in Table 2, and the criteria for agreement in Attachment 2. These criteria for agreement are based on comparisons of the mean values and estimates of the standard deviations (s.d.) of the measurements. Consideration was given to the fact that the uncertainties (s.d.) in the licensee's results were not necessarily representative of the laboratory's because they were obtained by one analyst over a short period of time. Consequently, when the licensee s.d. was less than that of BNL, and a disagreement resulted, the BNL value was substituted for that of the licensee in calculating the s.d. of the ratio Z (S_Z in Attachment 2).

The licensee also prepared two samples to be split with BNL. To these were added analytes supplied by the inspectors. One sample of condensate water was spiked with the anions chloride and sulfate and another with copper and iron ions. The licensee will determine the concentrations of the analytes in each and the results will be sent to Region III for comparison with the values determined by BNL. This will be followed under Open Item No. 50-346/88008-03.

The licensee determined nine analytes at three concentrations each. Of the initial 27 analyses, 19 of the results (70%) were in agreement with those of BNL. The disagreements included the three fluoride, two sodium, the low concentrations iron and boron, and the middle hydrazine concentration results. The consistently low biases of the fluoride values appeared to be due to the fluoride peak starting in the water dip of the IC since calibration with different standards gave similar results. Thus, a slight shift in peak retention time due to differences in sample composition may cause large errors in baseline and consequently of peak-height estimation by the integrator. The chemist agreed to look into changing the analysis conditions to move the peak onto the flat part of the baseline. The initial sodium results had a low bias indicating a deficient calibration standard. A repeat analysis with a new standard brought the results into agreement ("Rerun"). The disagreement in the boron results appears to be due to the analyst using smaller than usual sample sizes necessitated by the small size of the low level BNL standard. The low level iron sample was in disagreement with a 90% bias and a large standard deviation which indicated contamination or problems with the analytical technique. The copper results had large biases, but because of the large s.d.'s the results were in agreement. These ions were analyzed by another laboratory in a fossil plant. The licensee plans to begin doing these analyses on the new AA in his laboratory in the near future. The middle hydrazine result was also in disagreement, partially because the precision of these measurements was very good. The low, fairly constant biases in all the hydrazine values indicates a possible calibration problem. This analysis should improve when the Spectronic 88 spectrophotometer is replaced by the digital readout Spectronic 501 presently being readied for use in the laboratory.

Progress in the improvements in the fluoride and sodium analyses and implementation of the iron and copper analyses in the licensee's laboratory will be followed in subsequent inspections under Open Item No. 50-346/88008-04.

No violations or deviations were identified.

17. Allegation Followup (AMS No. RIII-87-A-0152)

Discussed below is an allegation received in Region I and forwarded to Region III. The allegation was evaluated when received to determine need for immediate onsite followup; such need was not indicated. Further reviews were performed during this inspection.

Allegation: A contract junior health physics technician (identified by name) left a Region I nuclear station and became a senior health physics technician at Davis-Besse; the technician did not have sufficient experience to be a senior technician.

Discussion: Upon arrival of the named technician at Davis-Besse Nuclear Plant, the licensee classified him as a junior health physics technician after review of his resume, not as a senior as alleged. During the normal two-week site specific training provided to all incoming contract technicians, the technician did not pass a routine test designed to determine adequacy of technical knowledge. The technician therefore was not considered qualified and was not retained by Davis Besse.

During the inspector's review, it was noted that the technician's resume appeared to contain inaccurate information concerning certain experience durations and positions held. Had the technician passed the licensee's routine testing, the inaccuracies may have been identified by the licensee's performance of past experience verifications for randomly selected incoming contractor technicians.

Finding: The allegation that the individual was working as a senior health physics technician, a position for which he was not qualified, was not substantiated. However, the individual's employment was terminated for reasons not directly related to the allegation.

18. Exit Meeting

The inspectors met with licensee representatives (denoted in Section 1) at the conclusion of the inspection on March 11, 1988, to discuss the scope of the team inspection and the findings. The inspectors also discussed the likely informational content of the inspection report with regard to documents or processes reviewed by the inspectors during the inspection. The license did not identify any such documents/processes as proprietary. In response to certain matters discussed by the inspectors, the licensee:

a. Acknowledged the comment that the Radiological Assessment Manager's office appears to be inappropriately located in the radiological control office area. (Section 4)

b. Acknowledged the apparent need to provide enhanced supervisory review/oversight of radiological work and associated precautions/surveys and paperwork during the outage. (Section 4)

c. Stated that an evaluation of beta exposure protection and dose assignment would be performed. (Section 8)

d. Acknowledged the apparent need to make chemistry QC charts more useful as tools to demonstrate the credibility of laboratory results. (Section 15)

e. Stated that corrective modification, testing, and calibration of the normal and accident ranges of the reactor building vent effluent monitoring system would be completed by December 31, 1988. (Section 3)

Attachments:

1. Table 1, Confirmatory Measurements Program Results, 3rd Quarter 1987
2. Attachment 1, Criteria for Comparing Analytical Measurements (Radiological)
3. Table 2, Nonradiological Interlaboratory Test Results, March 7-11, 1988
4. Attachment 2, Criteria for Comparing Analytical Measurements (Nonradiological)

TABLE 1

U S NUCLEAR REGULATORY COMMISSION

OFFICE OF INSPECTION AND ENFORCEMENT

CONFIRMATORY MEASUREMENTS PROGRAM
FACILITY: DAVIS-BESSE
FOR THE 3 QUARTER OF 1987

		------NRC-------		----LICENSEE----		---LICENSEE:NRC----		
SAMPLE	ISOTOPE	RESULT	ERROR	RESULT	ERROR	RATIO	RES	T
L WASTE	GROSS B	2.2E-05	1.0E-06	5.1E-05	0.0E-01	2.3E 00	2.2E 01	D
	H-3	2.8E-02	7.0E-04	3.0E-02	0.0E-01	1.0E 00	4.0E 01	A
	SR-89	0.0E-01	8.0E-09	2.0E-08	0.0E-01	0.0E-01	0.0E-01	N
	SR-90	0.0E-01	3.0E-09	5.0E-09	0.0E-01	0.0E-01	0.0E-01	N

T TEST RESULTS:
A=AGREEMENT
D=DISAGREEMENT
*=CRITERIA RELAXED
N=NO COMPARISON

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	0.4 - 2.5
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

Nonradiological Interlaboratory Test Results
Davis-Besse Nuclear Power Plant
March 7-11, 1988

Analyte	Analysis Method[b]	Dilution, 1:x	NRC Y ± s.d.(n)	Licensee[a] X ± s.d.(n)	Ratio Z ± s.d.	Comparison[c] ± 2 s.d.
			Concentration, ppb			
F^-	SIP	2500	9.24 ± 0.20	7.66 ± 0.21	0.829 ± 0.029	D
		2500	17.4 ± 0.76	14.4 ± 0.19	0.828 ± 0.051	D*
		3333	25.0 ± 0.84	20.8 ± 0.84	0.832 ± 0.044	D*
Cl^-	IC	2500	9.64 ± 1.24	8.72 ± 0.82	0.905 ± 0.144	A
		2500	14.96 ± 0.48	15.2 ± 0.17	1.016 ± 0.035	A
		3333	24.2 ± 0.66	24.6 ± 1.54	1.019 ± 0.070	A
Sulfate	IC	2500	8.00 ± 0.36	8.11 ± 0.33	1.014 ± 0.062	A
		2500	16.40 ± 0.96	14.96 ± 0.34	0.912 ± 0.057	A
		3333	24.2 ± 0.90	22.7 ± 0.20	0.938 ± 0.036	A
Silica	Spec	1000	54.3 ± 5.6	51.3 ± 1.2	0.945 ± 0.100	A
		1000	109 ± 7	99.3 ± 1.2	0.911 ± 0.060	A
		1000	160 ± 5	151.3 ± 1.2	0.946 ± 0.030	A
Cu	AAS	1000	4.68 ± 0.24	6.94 ± 1.61	1.483 ± 0.352	A
		1000	9.66 ± 0.49	11.6 ± 1.5	1.201 ± 0.167	A
		1000	14.5 ± 0.6	17.9 ± 1.7	1.234 ± 0.128	A
Fe	AAS	1000	4.89 ± 0.35	9.28 ± 1.73	1.90 ± 0.38	D
		1000	9.55 ± 0.34	11.1 ± 1.3	1.162 ± 0.142	A
		1000	14.70 ± 0.42	15.7 ± 0.54	1.068 ± 0.048	A
Na	AAS	250	18.3 ± 2.0	13.7 ± 0.62	0.748 ± 0.115	D*
		250	36.9 ± 3.2	30.5 ± 1.5	0.826 ± 0.101	A*
		250	57.6 ± 3.2	71.5 ± 5.1	1.241 ± 0.112	D
Na (rerun)	AAS	250	18.3 ± 2.00	19.7 ± 3.8	1.076 ± 0.239	A
		250	36.9 ± 3.20	30.7 ± 1.5	0.832 ± 0.103	A*
		250	57.6 ± 3.20	60.0 ± 3.0	1.042 ± 0.078	A
Hydrazine	Spec	1000	22.3 ± 1.4	20.8 ± 0.3	0.933 ± 0.060	A
		1000	56.9 ± 0.7	51 ± 0.0	0.896 ± 0.016	D*
		1000	104 ± 1	100 ± 1.7	0.962 ± 0.019	D
			Concentration, ppm			
B	Titr	1	1000 ± 10	1031 ± 2	1.031 ± 0.015	D*
		1	3024 ± 46	3021 ± 9	0.999 ± 0.015	A
		1	4947 ± 61	4976 ± 7	1.006 ± 0.012	A

a. Value ± standard deviation (s.d.); n is number of BNL analyses. The number of licensee analyses is 3 unless otherwise noted.

b. Analytical methods:
- Titr - titration
- IC - Ion chromatography
- Spec - Spectrophotometric
- SIP - Specific ion probe
- AAS - Atomic Absorption Spectroscopy (furnace)

c.
- A = Agreement
- D = Disagreement
- A* or D* = Substituted the BNL uncertainty for licensee's uncertainty.

ATTACHMENT 2

Criteria for Comparing Analytical Measurements

This attachment provides criteria for comparing results of the capability tests. The acceptance limits are based on the uncertainty (standard deviation) of the ratio of the licensee's mean value (X) to the NRC mean value (Y), where

(1) $Z = X/Y$ is the ratio, and

(2) S_z is the uncertainty of the ratio determined from the propagation of the uncertainties of licensee's mean value, S_x, and of the NRC's mean value, S_y.[1] Thus,

$$\frac{S_z^2}{Z^2} = \frac{S_x^2}{X^2} + \frac{S_y^2}{Y^2}, \text{ so that}$$

$$S_z = Z \bullet \left(\frac{S_x^2}{X^2} + \frac{S_y^2}{Y^2}\right)^{\frac{1}{2}}$$

The results are considered to be in agreement when the bias in the ratio (absolute value of difference between unity and the ratio) is less than or equal to twice the uncertainty in the ratio, i.e.

$$|1-Z| \leq 2 \bullet S_z .$$

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1. National Council on Radiation Protection and Measurements, A Handbook of Radioactivity Measurements Procedures, NCRP Report No. 58, Second Edition, 1985, Pages 322-326 (see Page 324).

4/6/87