UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SEP 29 1993

MEMORANDUM FOR: Robert M. Bernero, Director
Office of Nuclear Materials Safety
and Safeguards

FROM: Charles E. Norelius

SUBJECT: MEETING TO PLAN NPI INSPECTION

On September 28, 1993, I and others of the NRC Staff met with representatives of the State of Maryland to plan for NRC assistance in a State inspection of Neutron Products, Incorporated (NPI). Other NRC participants were Bob Bores, Section Chief, RI; Craig Gordon, State Agreements Officer, RI; and Wayne Slawinski, Radiation Specialist, RIII. Maryland participants were Carl Trump, Program Administrator, Radioactive Materials Compliance, Ray Manley, Tom Fergeson and Alan Jacobson. Ray Manley will be leading the team inspection at NPI.

Inspection Plan

The State requested NRC assistance to assess: 1) pathway analysis to determine unmonitored release paths of material from the facili*:; 2) regulatory and health physics implications from such releases; and 3, recommendations on any engineering controls to limit releases. Based on our discussions, it was decided to conduct a team assessment with "inside" and "outside" components. Both team components will have State and NRC participants.

The in-plant inspection will address the basic processes in which Cobalt 60 is used, primarily the hot cell operation. This will consider release paths from the process into the air, water and solid waste streams. A special attempt will be made to determine any unmonitored releases. The inspection will include a fire protection assessment to review possible radiological consequences from any fire that may occur; one focus of this aspect will be to review the waste storage area in which about 750 curies of cobalt 60 is stored in a variety of containers ranging from High Integrity Containers to plastic bags.

The outside team activities will center around the use of the Region I radiological measurements van. They will perform confirmatory measurements of licensee samples and will assess licensee methods of collection and analysis. Independent measurements will also be taken of surface and airborne contamination, with the locations to be determined during the inspection. The sanitary sewer disposal methods and pathway will be pursued to determine if there has been any reconstitution of materials in the process. Personal property surveys will be conducted if time permits; many of these have already been conducted by the State and the licensee.

ENCLOSURE 1

There will also be an ARMS overflight survey of the plant area and any additional areas that may be designated as a result of the review of the sanitary sewer system into which the material is discharged. This is being arranged by AEOD under an existing contract.

Dates and Logistics

The inspection is to be conducted October 18-22, 1993. The ARMS flight will be conducted as soon after that as can be arranged. It is important to the state to have all of the information from the survey completed before the end of the year, as information from the inspection and overflight may be useful to them as part of their ongoing litigation against NPI. A trial date with NPI has been set for January 4, 1994.

I will be providing the State with the names of the NRC participants before the end of this week. The inspection team will consist of 6-7 members. Craig Rogers will be handling the logistics of the NRC participants; the current plan is to have the team stay in Frederick, Md., during the inspection. Craig will also distribute to the participants copies of the Maryland license covering the hot cell and any related facility information.

We provided the State with inspection plans, an inspection report directed toward release pathways and offsite surveys, and a fire protection assessment, all related tc AMS, for their consideration in planning and documenting the NPI inspection.

I will continue to keep in touch with the State and coordinate the efforts of NRC participants in this inspection. Please let me know if there are questions you wish to discuss.

Charles E. Norelius

Charles E. Norelius

cc: C. J. Paperiello, IMNS
S. Schwartz, OSP
R. Bores, RI
C. Gordon, ASO, RI
W. Slawinski, RIII

Ne tron Products, Inc.
Assi Inspection to Maryland

Inspection Summary

Inspection on October 18-22, and November 1-2,1993

Areas Reviewed: Special, announced safety inspection to assess the overall adequacy of Neutron Products, Inc. (NPI) radwaste management and effluent control program, contamination controls, and the licensee's ability to monitor effluent streams and analyze samples of various types. An operational fire protection safety inspection was also conducted. Additionally, subsequent to the onsite inspection, an aerial survey of the plant area and the release point of liquid waste into the sanitary sewer system was performed.

Results: The external radiation levels in the hot cell were relatively low, and the contamination levels within the LAA were also relatively low. Airborne releases from the hot cell and liquid releases to the sanitary sewer system appear to be well within regulatory limits. The licensee's monitoring program and method of sample analysis was found to be adequate for airborne releases from the hot cell. However, some questions were raised as to the adequacy of the samples for sewer system releases.

Several concerns were identified which reflect a need for further licensee evaluation or program improvement. Solid radwaste storage is the most significant safety concern in that it: 1) contributes to high external doses on site as well as at the fence line; 2) appears to be a substantial source of contamination in the "courtyard" area; and 3) raises potential safety concerns when viewed from a fire protection perspective. The contamination control program, while having less safety significance, is poor with windblown and liquid runoff resulting in the ongoing identification of contamination in the unrestricted area, resulting in soil concentrations exceeding license condition limits. The program for evaluation of internal exposures is weak, although no instances of excessive exposures were identified. RSO attention to and knowledge of the program is limited. Poor worker health physics practices were also observed. These items collectively represent a significant weakness in management control over several program areas.

The aerial survey showed no contamination outside of about a 1000-foot radius around the plant. Within that radius, but outside the plant boundary, the direct radiation from the plant masked the system's ability to distinguish any contamination. A survey of the location where liquid waste is dumped into the sanitary sewer did not identify any contamination.

The inspection also showed that considerable effort will be required by the licensee to implement the requirements in NRC's revised 10 CFR 20, at such time as these are adopted by the State. Areas of concern include assessment of dose to members of the public, internal dose evaluation, and releases to the sanitary sewer system.

DETAILS

Solid Radwaste

The licensee generates relatively large volumes and quantities of solid radwaste during its cobalt-60 melt campaigns and subsequent hot cell cleanups. Approximately 1,000 curies of radwaste are generated annually from these operations. Both finished and unfinished cobalt-60 sources and certain other wastes are encapsulated and stored in the facility's main pool. Cloth, paper and plastic wastes resulting primarily from hot cell cleanup activities are bagged or drummed and stored in the dry solid radwaste storage building along with dewatered resins, contaminated filters and other miscellaneous solid radwastes.

The licensee occasionally ships solid radwaste to a contractor for compaction and subsequent transfer to a burial site. However, the shipments are infrequent and generally do not comprise large quantities. In July 1992 through August 1993, the licensee shipped 100 millicuries in 300 cubic feet of solid radwaste to its contractor. The licensee allows large quantities of solid radwaste to accumulate in its dry storage area (radwaste building) and has not significantly reduced its waste inventory for several years. The dry solid radwaste area currently houses approximately 750 curies of cobalt-60 contaminated wastes comprising a volume of over 2,200 cubic feet.

Inspector observation of the solid radwaste storage building revealed several concerns in addition to the large accumulation of wastes. Specifically, numerous plastic bags filled with solid radwaste were stacked atop one another, some of which had torn open. These bagged wastes were neither properly contained or shielded. Radiation levels measured by the inspectors at the entry doors to the waste storage building were 200-300 mrem/hour. Radiation levels within the storage building were, according to the licensee, in excess of 1 rem/hour. Similarly, some of the 55-gallon waste filled drums were uncovered and unsealed. These poor housekeeping and health physics practices create unnecessarily high radiation levels in the local area and at the restricted area fenceline, contribute to the contamination control problems experienced by the licensee, and appear to be contrary to ALARA principles.

Liquid Effluents to the Sanitary Sewer System

Liquid radwaste is generated primarily from LAA floor mopping, protective clothing laundering, use of the decontamination showers and sinks and rainwater runoff through the LAA's contaminated courtyard. With the exception of rainwater runoff, liquid radwaste is collected in an underground wastewater collection tank, pumped from the collection tank into a tanker truck on at least a weekly basis, and subsequently transported and deposited into the municipal sanitary sewer system at the Muddy Branch station in Montgomery County, MD.

The licensee collects three waste water samples during the filling of each truck load at approximately one-third, two-thirds, and near full. The method of sample collection raises some questions as to the extent to which the samples are representative of the tank's contents. While the pumping action provides for some mixing, there is no other mechanism in the underground collection tank or tanker truck to ensure thorough mixing prior to sampling; further, the sample volume is small in comparison to the tanker's volume. In addition, the degree of insolubility of the cobalt 60 also raises questions as to the representativeness of the sample. While these are questions that need to be pursued, a review of the licensee's procedures and disposal records reduces any concern that these releases may not be meeting regulatory requirements.

The inspector reviewed the analytical logs for the sanitary sewage disposal for 1993 and noted that while there were some differences in activity between the three samples for each load, the variation was typically not very large, and that the licensee always used the most conservative (highest) value to calculate the Co-60 activity for the entire load. Furthermore, the licensee had been adding 3 standard deviations of the counting uncertainty to the highest value when doing the calculations as an additional conservatism. The inspector noted that the latter, while providing additional conservatism, and done according to the sample procedure, could not be justified scientifically.

The inspector reviewed the sewage disposal records from January 1985 through August 1993. During that interval, a total of less than 250 mCi of Co-60 was disposed to the sanitary sewer system; this value containing all of the conservatisms discussed above. The inspector noted no instance of exceeding allowable limits. The inspector's review of the data indicated that on some occasions the LLD of the analytical system approached the allowable limits.

The sewerage is processed at the Blue Plains treatment plant in Washington, D.C. Inspectors visited the treatment plant to review the process and to take samples to determine if there was any detectable cobalt. Four sludge samples were analyzed. These samples showed some short lived isotopes commonly used for medical treatments, but no cobalt 60 was detected. (See Table II.)

The licensee was advised that when the limits of new NRC 10 CFR 20 become effective, the analytical system and procedures as currently used will need to be reviewed to ensure adequate analytical sensitivity for the more restrictive limits. A further area which the licensee must address as related to the new 10 CFR 20 requirements relates to the issue of cobalt 60 solubility in the wastes. Based on preliminary information gathered during the inspection, it appears that the cobalt-60 wastes may be insoluble in whole or in part. For example, it was observed that cobalt-60 contaminants are readily removed through conventional filtration (floor mop water filtering). Also, inspector measurements revealed hot spots in the dry pond which may suggest particulate matter, although licensee evaluations have not identified discrete particles. Inspector measurements also revealed radiation levels of about 1.5 mR/hour at the surface of the tanker truck. These levels remained after the truck was unloaded, suggesting either particulate plate-out or sediment in the tank, or possibly cobalt retained in waste material due to insufficient cleaning of the tank during routine dumping. The insufficient cleaning is a violation of the licensee's procedure. In any case, the solubility question is a matter which needs to be evaluated by the licensee.

Liquid Effluents through the Dry Pond

The licensee has designed a rainwater/stormwater collection system consisting of ponds and water retention basins to control water runoff from the contaminated "courtyard" area. The courtyard is essentially an outdoor paved driveway sandwiched between the radwaste building and hot cell building. This area is subject to Co-60 contamination from the radwaste storage building, soil stored in large containers within the courtyard, and contamination which escapes from the hot cell area when the roll-up doors are open. Rainwater runoff which flows through the courtyard is channeled through a rock bed/sediment filtering system and into a "dry pond" located in an unrestricted area on the licensee's property. The licensee periodically monitors the activity in the deposited silt in the rock pit and removes the silt to radwaste storage drums. According to the licensee, its rock bed/sediment filtering system removes about 85 percent of the contaminants which pass through it. The licensee's estimates of the material removed from the rock pit is on the order of low tens of millicuries per year. The effluent from the rock pit mixes down stream with runoff from some clean roof drains and from the near side of the public road. This then enters the dry pond, which like the rock pit allows the sediment carrying Co-60 contamination to deposit.

During periods of moderate to heavy rain, the hold-up time in the dry pond is relatively short and the liquid is released through a small spillway and eventually makes its way to the nearby railroad bed and can flow to a creek approximately one-half mile away. During a moderate rainfall during the inspection, the liquid effluent into and out of the dry pond was analyzed by the NRC. No activity was seen in these samples above the LLD (about 2E-6 μCi/ml). Nevertheless, dry pond and other soil samples just outside of the licensee's property show concentrations of cobalt 60 which routinely exceed the 8 picocurie/gram cobalt-60 license limit for unrestricted areas. This problem was confirmed by samples taken during this inspection. The highest activity sample showed 410 pCi/gm and was found just outside of the dry pond on the railroad property. (See Table II.) Also, ongoing measurements by the State have shown that TLD measured radiation doses in the dry pond continue to exceed the 500 mrem/year license limit, which likely results from a combination of sky shine from the stored waste and operational uses and from the contamination in that area.

The licensee currently has no routine monitoring of the Co-60 as it is being released through the dry pond pathway, which is a continuing violation of survey requirements. Estimates of the released quantities have been made based on the amount of activity found in the deposited silt, but this evaluation lacks rigor as an analytical tool. Estimates by the inspector based on the amount of soil contamination found outside the dry pond indicates less than one millicurie per year leaves the site through the dry pond. This estimate indicates that the liquids leaving the site have average Co-60 concentrations of a few percent of the allowable release concentrations or less.

A sample taken during the inspection from an onsite environmental sampling well showed no detectable activity.

Airborne Effluents

Airborne effluents are generated during various hot cell operations, cleanup activities and work in the radwaste building. According to the licensee, its LAA/hot cell area ventilation system was designed to maintain air flow negative with respect to surrounding (non-LAA) areas. Normal air flow was designed to be from unrestricted areas to the cleaner areas of the LAA, into the front face and back side of the hot cell and up through the cell's HEPA filtration system. Air is subsequently exhausted to the environment through the stack located on the roof of the facility.

No LAA/hot cell ventilation system, building ventilation flow diagrams or engineering drawings/blueprints were available for inspector review. Consequently, the inspectors were unable to review the ventilation system design for comparison with as-built configurations. The inspection team, however, conducted ventilation system walkdowns and air flow smoke tests in the LAA in an effort to evaluate airborne release pathways and determine air flow directions. The smoke tests revealed the air flow through most of the LAA/hot cell area to be relatively static, with no definitive negative pressure except through the back (personnel access door) of the hot cell and at a "pass box window" between the clean area (offices) and the LAA. Air did not appear to flow into penetrations in the front face of the hot cell as designed.

The inspectors toured the facility and examined potential airborne radioactive release pathways. The only confirmed release point that was identified by the licensee was through the hot cell ventilation system. The air flow through this system is approximately 800 cubic feet per minute (cfm), through a pre-filter, two HEPAs in series, then through a final full flow filter (similar to the pre-filter) of the furnace filter type. The primary HEPA filter bank is dioctyl phthalate (DOP) tested by the licensee upon filter change-out. The DOP test procedures/methods were reviewed by the inspectors and found to be adequate. DOP test results show the filtration system efficiency to be greater than 99.97 percent for particles with a diameter of one micron or greater.

The licensee's hot cell stack exhaust effluent is sampled continuously by a mini-flow (1 cfm) sampler just prior to the final, full flow filter. The sampling system consists of a single (0.375-inch diameter) inlet nozzle positioned in the center of the (11-inch diameter) stack exhaust duct. Licensee air flow measurements taken across the stack showed considerable velocity gradient variation in the vicinity of the sampling probe. This was likely due to the transition (bend) that exists in the exhaust duct just upstream of the sampling probe. The licensee was unable to install its sampling probe at the ANSI N13.1-1969 recommended five to ten diameters (55-110 inches) downstream from any transition or elbows due to the physical characteristics of its ventilation system. As a result, the ratio of the actual sampling probe inlet velocity to duct (stack) velocity yields a slightly anisokinetic sampling system. This somewhat anisokinetic system can result in an underestimate of the release concentrations for large particle sizes (greater than four microns in diameter). However, since the HEPA filtration system effectively filters (traps) airborne particulates with a diameter in excess of one micron, the licensee's sampling system is adequate and nearly isokinetic for these small particulates.

The filter paper on the mini-flow sampler is changed and analyzed at least weekly. However, the stack effluent is not continuously monitored with a radiation detection system to alert the licensee to elevated releases. An enhancement to this system would be a continuous stack effluent monitoring and alarm system. In designing such a system, consideration would have to be given to the ability to detect appropriate radiation levels effectively in a high background area, the capability to monitor the system remotely so that high levels may be evaluated for appropriate action, and the desirability of any automatic change in the air flow system should a high release rate be identified.

The licensee also periodically analyzes the final full-flow filter in the exhaust stack. The inspector reviewed the results of a nine-month study performed by the licensee in 1990 of the effluents released from the hot cell ventilation system. In the study the full-flow and the mini-flow filters were analyzed. The data indicated that the activity for the mini-flow system filters was less than the lower limits of detection (LLD) of the counting system for each sample. The inspector noted that for those samples with positive net counts, the maximum was only about 5% greater that background, values which could have been due to counting uncertainties alone. (The licensee reports those values less than background as ">0" so a true statistical assessment could not be done.)

For the full-flow filters (which see about 800 times the air flow of the mini-filters) during this time, net positive counts were reported for each sampling period, although not all of these values were above the LLD for the counting system. The maximum value for any sampling period was for a 2-day sample during a melting/cleanup campaign, and that value was less than 1% of the maximum permitted annual average concentration during the two-day period. Most values during the study ranged from 0.01 to 0.1% of the annual average value. Although the efficiency of the full-flow filter for the small particulates is not known, it appears to be quite effective. Even if the efficiency is only 5%, the maximum release concentration for Co-60 would only be 5% of that permitted on an annual average basis. NRC measurements during this inspection indicate the activity on this filter is primarily Co-60 and not natural radon daughter activity. Based on an analysis of the filtering and the monitoring systems, the inspector concluded that releases through the hot cell ventilation system were well within the licensee's requirements.

(See Table I for the NRC measurements on this system during the inspection.)

During the first half of 1993, the licensee attempted to sample the effluent of each of the stacks that are not thought to be connected to the LAA, to ensure that there were not unmonitored releases through some unknown pathway, through one of these stacks. The licensee's sampling plan was well thought out and was implemented by use of a portable high volume air sampler held into the outlet of each stack for about a 10-minute period. None of the counting results were greater than the LLD of the analytical equipment. Although the sensitivity of the analysis was not particularly good, the results indicate that no significant releases were occurring via these stacks.

The preceding paragraphs show that the releases from the hot cell ventilation system were well controlled and adequately monitored. However, the inspection identified other areas of the airborne effluent control program which were not similarly monitored and controlled. The next section of the report shows that the failure to control contamination into and from the courtyard contributes to both waterborne (as previously described) and airborne effluent releases. Neither of these courtyard release pathways are adequately controlled.

Contamination Controls

The hot cell area, courtyard and adjacent radwaste building are all part of the LAA and are contaminated to varying degrees. Protective clothing (coveralls and shoe covers) and personnel dosimetry are required for entry into all areas of the LAA including the courtyard. Smearable contamination levels in the LAA hot cell area were within acceptable limits. Routine floor mopping and daily smear surveys have improved the contamination conditions in the LAA. At the time of this inspection, smears showed contamination to be relatively low (500-1000 dpm/100 sq. cm.). Of course, these levels vary depending on work within the LAA. The inspectors observed some workers crossing from areas of higher contamination to those of lesser contamination without respecting step-off-pad demarcation lines. Many workers in the LAA hot cell area also failed to use gloves to prevent hand contamination and coveralls were not always worn in a manner to prevent skin contamination of the chest and neck. A cavalier attitude toward contamination control appeared to be prevalent with many of the licensee's workers in the LAA. In part, this may be due to the LAA being much larger than needed, leading workers to conclude, due to past experience, that some areas are not really contaminated even though they are in the LAA.

The courtyard directly communicates with the hot cell area. Three large overhead (garage door type) and one standard size manway door exist in the LAA/hot cell area, all leading to the courtyard area outside the building. These doors are routinely opened to allow personnel, equipment, shipment casks and other materials into and out of the LAA's hot cell area. In addition, one or more of the large doors are occasionally left open for several hours per day for temperature control during certain times of the year. Smoke tests conducted by the inspectors showed that the LAA's hot cell area does not exhibit significant negative pressure, and that air flows from the hot cell area into the courtyard with an overhead door open. Consequently, the probability of contamination escaping the hot cell area into the courtyard is high when the doors are open.

Similar problems exist with the radwaste building contamination controls. The radwaste building has two large overhead doors which remain open during activities in the waste building. The radwaste building is not equipped with a ventilation system to maintain it under negative pressure or otherwise control or filter airborne radioactivity which may be generated during work in the area. Furthermore, the doors to the radwaste building are left open during waste packaging/processing operations. During these operations, airborne contaminants are generated and can readily escape through the open doors into the courtyard. It is noted, however, that during the last radwaste shipment, the contractor used a "tent" around the work area as a means of limiting the spread of contamination. Continuation of this practice should reduce the spread of contamination from such operations.

Leaves collected in the courtyard by the inspectors were analyzed in the NRC's mobile lab and showed a cobalt-60 concentration of about 2E-2 μCi/gram. This sample demonstrates the contamination problem that exists in the courtyard.

Once contamination enters the courtyard, it either settles in the courtyard, is blown off site or flows to the dry pond and/or off site by rainwater runoff. Surveys of a neighbor's property during the inspection showed six areas of minor contamination which was likely deposited by windblown materials. This is typical of prior survey findings by the State and the licensee.

Establishing a contaminated area that is exposed to the environment and allowing potentially highly contaminated indoor areas to directly communicate with outdoor areas are poor health physics designs. The failure to implement appropriate controls to eliminate unknown quantities of contamination in outdoor, uncontrolled areas is a significant programmatic weakness. Several options for reducing contamination were discussed with the licensee during the inspection: enclosing the courtyard to shelter it from the elements and equipping it with a dedicated ventilation system to maintain it under negative pressure and prevent uncontrolled/unmonitored release of contaminants to the environment; establishment of an airlock system for any contaminated area that communicates with clean areas; modifications to the existing hot cell ventilation system to increase negative pressure in the LAA; reduction in the size of the LAA; use of portable filtered ventilation systems during cell cleanup and other jobs which may create airborne radioactivity; enhanced administrative controls to prevent personnel and equipment tracking and include limitations and controls on overhead door opening; and enclosing work areas in tent type structures and using portable HEPA filtered ventilation systems within the structure.

An overflight survey was conducted during the period of November 1-12, 1993 by EG&G under a contractual arrangement with the NRC. The survey involved low level (150 feet) flights with a helicopter containing highly sensitive detection equipment over a four square mile area surrounding the plant, and separately over the Muddy Branch dumping station where the licensee dumps its liquid wastes into the sanitary sewer system. The purpose of this survey was to determine if there was any significant contamination in these areas. Preliminary results of this survey showed that the external levels of radiation from the plant combined with the highly sensitive equipment resulted in the masking of any contamination determination within about a 1000-foot radius of the plant. Beyond that distance, no contamination was detected by this survey. A final report of this survey will be issued by the end of February 1994.

Internal Personnel Exposures

The licensee collects nasal smears from workers upon removal of respiratory protection equipment worn during hot cell cleanup activities. During the review of the nasal smear results, the inspector noted that several personnel nasal wipes had contamination levels of several hundred to a couple thousand disintegrations/minute (dpm). The licensee stated that the nasal contamination appeared to result from the removal of supplied air hoods following work in decontaminating the hot cell. The licensee described the undressing steps used and indicated that the hoods were taped to the outer set of coveralls, necessitating the removal of the hoods prior to this set of coveralls. The licensee believes that the contaminations occurred during the removal of the hood itself and the outer set of contaminated coveralls. The inspector discussed alternatives to reduce intakes, including the taping of the hood to the inner set of coveralls and then sealing the outer set of coveralls to the hood, such that the outer set of coveralls (those most contaminated) could be removed prior to removal of the supplied air hoods. The licensee representative indicated that this would be evaluated.

The licensee stated that individuals with high nasal smears were asked to blow their noses until activity could not be detected on the wipes. "Nasal wipes" were taken such that the contamination could have been external to the nasal passages (i.e., from the face or exterior of the nose) rather than from the nasal passages themselves. The inspector discussed ways of determining the location of the contamination and the importance of doing this for the assessment of exposures.

The inspector discussed with the licensee the means of determining internal exposures. The licensee stated that on an annual basis, a contractor is brought to the site area to perform whole body analyses of employees who worked in the LAA. The whole body counting had not yet been done for 1993. The inspector reviewed past records of whole body counts and the evaluations performed of the exposures. Only a few instances of significant (but well within the allowable limits) exposures were identified. In these instances, a HP consultant was utilized to assess the exposures. The inspector noted no problems in these evaluations.

The inspector discussed with the licensee plans for evaluation of internal exposures and the summing of them with external exposures to obtain the Total Effective Dose Equivalent (TEDE) which will be required when the State adopts the revised 10 CFR Part 20 regulations. The licensee stated that this area had not yet been developed. The licensee does not routinely evaluate internal exposures between their annual whole body counting program. Licensee representatives stated that there was little need to do any since most intakes were due to ingestion of material. The licensee indicated that when the portal monitor detected activity above the alarm levels and it didn't appear to be external contamination, the individual was provided laxatives and sent home. In each case, the licensee stated that upon return to work the following day the activity was gone. Therefore, the licensee concluded that the activity was due to ingestion and was quickly removed from the body through the digestive tract and no internal assessment had been necessary. The inspector questioned the licensee's assumption that the activity could have been due to ingestion, since scientific studies indicate that the peak elimination of Co-60 through the digestion system occurs approximately 36 hours after ingestion. Therefore, it is unlikely that the indicated activity could have been due to an actual intake. (The peak removal of Co-60 from the body due to inhalation occurs about 40 to 60 hours after intake.) The inspector concluded that in the above instances in which the licensee had suspected ingestion of Co-60, the individuals were either externally contaminated, such that removal from the skin was achieved by the next day, or the monitor gave a false positive signal due to increase in background or other reason. This area should receive additional attention.

Radioanalysis of Samples

The inspector toured the radioanalytical laboratory facilities and the instrumentation in use. The licensee uses a NaI (Tl) detector in a shield with a scaler for all analyses. The inspector noted that the instrument was located within the LAA and instrument background ranged from about 1100 to 1500 cpm, depending on the work activities taking place in and near the nearby hot cell facility. The high and changeable background limits the certainty of the analyses when sample activities are low.

The inspector noted that the licensee typically counted background for ten minutes each morning and then spot checked background several times during the day with one-minute counts. Most samples, however, were counted for only one minute. The inspector discussed with the licensee the use of longer count times (e.g., at least 10 minutes) for samples with activities near background and also that for such samples the uncertainty is minimized when the sample count time is approximately the same as the background count time. The inspector also discussed the determination of the lower limits of detection (LLD) and how the LLD is used in evaluating whether activity is actually present in the sample. The licensee stated that these areas would be evaluated.

The inspector noted that no uncertainties were reported with any samples and that sample results less than background were reported as "<0" rather than as a negative result. The inspector discussed the statistical meaning of negative values when average and total activity was being determined and that reporting a one standard deviation counting uncertainty with each result was common industry practice, enabling the data user to immediately see the analytical significance of the results. The licensee stated that these areas would also be evaluated.

The inspector noted that the licensee utilized good counting procedures, plotting daily counts of a standard to ensure counter stability and proper functioning. The licensee representative was aware of actions to be taken when the standard counts fell outside the criteria for operations. The inspector also noted that the licensee took sample backgrounds appropriately, i.e., with blank media for the same geometry as the sample.

As verified by the NRC measurements on the same media or samples, for samples with activity sufficiently high, such that the laboratory background did not interfere, the licensee's results were in excellent agreement with those of the NRC. This confirms that the licensee's calibrations for those media (liquids and particulate filters) were performed correctly and accurately.

In summary, the inspector found that the laboratory analyst was knowledgeable of the analytical procedures and followed them. The procedures were of good quality. Data were logged accurately and consistently. The counting instrument was properly calibrated and could effectively measure the higher activity samples. The room backgrounds were high, however, and prevented accurate analyses of low activity samples. Techniques were discussed for improving these analyses and evaluating the analytical uncertainties.

Management Control and Oversight

The inspection team reviewed the licensee's management control and oversight for its radwaste effluent and contamination control programs, including techniques to implement the program and ability to self-identify and correct weaknesses.

The inspection disclosed senior management (company president) to be knowledgeable and involved in its effluent and contamination control programs, and aware of problems/concerns identified through self-disclosure and regulatory agency inspections. However, licensee management has been ineffective in resolving these problems in an adequate and timely manner. For example, the storage of high volumes of waste onsite in a manner which causes high external radiation levels and contamination remains a significant problem. Further, the licensee and the State of Maryland continue to identify off site contamination resulting primarily from known or suspected uncontrolled release points in its courtyard and dry pond areas. Similarly, according to prior findings by the State, levels of radiation in unrestricted areas (dry pond) continue to exceed the 500 mrem calendar year regulatory limit. Although causes of these problems have been identified in whole or in part, the licensee's attempts toward problem resolution have been unsuccessful.

The inspection team concluded that the current radiation safety officer (RSO) is not knowledgeable or adequately involved in the day-to-day radiation protection program, devoting the majority of his time to non-RSO duties. The RSO indicated that he typically frequents the Limited Access Area (LAA) only a few times per month. The lack of an active and involved RSO may contribute to the untimely resolution of problems.

Independent Measurements

During this part of the inspection, liquid, particulate filter and soil samples were analyzed by the licensee and the NRC for the purpose of intercomparison. The samples were actual split samples with the exception of the particulate filter samples. In these cases the samples could not be split and the same samples were analyzed by the licensee and the NRC. The samples were analyzed by the licensee using routine methods and equipment and by the NRC Region I Mobile Radiological Measurements Laboratory. Joint analyses of actual samples were used to verify the licensee's capability to measure radioactivity in samples with respect to regulatory requirements. In addition, various liquid, particulate filter and soil samples were taken by NRC and State personnel and analyzed by the NRC Region I Mobile Radiological Measurements Laboratory for the purpose of obtaining independent data with respect to site operations.

The comparisons of the split sample results indicated that all of the measurements were in agreement under the criteria for comparing results. (See Attachment 1 to Table I.) The subject sample results are presented in Table I. Other sample results are presented in Table II.

Fire Protection

The inspector toured the entire facility, including the Limited Access Area (LAA), the radioactive waste storage area, the two irradiators, the machine shop, and the manufacturing areas for non-radioactive products. The objective was to assess the risk of release of radioactive materials or contamination from the LAA and the waste storage area due to accidental fires originating both inside and outside of those areas.

The Limited Access Area is isolated from the remainder of the facility by at least 8" thick concrete block walls, except for controlled access doorways and an underwater connection between a pool in the LAA and an adjoining irradiator pool. The perimeter walls of this area are judged to be effective against propagation of fires from outside the area, given the light fire loading of the immediate vicinities outside. The fire loading in the LAA, where a hot cell is located can be characterized as light overall. A small electric furnace is used for melting radioactive metal in the hot cell, and this operation is continuously supervised. The risk of fire and damage to the HEPA filter elements arising from this operation is judged to be very small. There appears to be some risk from possible welding or cutting operations in the general area outside the hot cell, for which the inspector would advise due caution and adherence to the guidelines of industry codes, such as the

National Fire Protection Association code NFPA 51B, Cutting and Welding Processes. Removal is recommended from the area of all unnecessary combustibles, such as wooden pallets, as soon as their function is over.

The waste storage area comprises two adjoining rooms separated by an 8-foot high concrete-block partition wall, with a plywood divider on top. The perimeter walls of the area are constructed of concrete blocks, except for two roll-up doors opening into a yard. There are a few penetrations in the wall of one of the rooms with relatively small openings for the structural and moving parts of a conveyor system in an adjoining area. The risk of fire propagation from outside the area into it is minimal. The contents of the rooms include, as viewed from outside, approximately 50 large polyethylene bags full of, the inspector was told, contaminated clothing and several dozen apparently sealed 55-gallon drums containing unknown materials. Because of the level of radiation, no detailed examination of the contents was made. The fire loading in the area is judged to be moderate. The risk of a fire starting in the area is small, unless flammable liquids or self-ignitible substances, such as oily rags, have been stored in the area, which the facility operators assured the inspector they have not. There are no fire detection, suppression, or alarm systems in the facility. Therefore, a safety concern exists in this area, because a fire may release a substantial part of the waste inventory off site before it can be detected and controlled. Minimizing the fire load in the rooms is recommended. The plywood divider between the rooms should be replaced by a noncombustible wall. Short of removal to a disposal site, storage of the combustible waste in sealed steel drums is recommended. This would considerably minimize the risk of fire.

The NPI facility has approximately 200,000 gallons of water stored in underfloor tanks which can be used for fighting fires, and a fire department-compatible connection exists. The facility does not have any other installed protective systems, such as sprinklers, fire detectors, or an alarm system. A few portable fire extinguishers are provided, but these are too few in number. The inspector reviewed an inspection report by the Montgomery County, Maryland, Fire and Rescue Service, which listed 32 items of deficiency. It is noted that the County did not inspect the LAA or the radioactive waste storage area. This inspector can endorse all of the corrective measures noted by the County. In particular, the County advises immediate measures to store small containers of flammable liquids in approved flammable liquid cabinets, install emergency lighting, especially in the basement manufacturing areas, and provide portable fire extinguishers of appropriate type and capacity, distributed throughout the facility in accordance with NFPA 10, Portable Fire Extinguishers.

TABLE I
Neutron Products Capability Test Results

SAMPLE	ISOTOPE	NRC VALUE	LICENSEE VALUE	COMPARISON
		Results in microCuries per milliliter		
Main Pool Water 1600 hrs 10/19/93	Co-60	(1.042±0.008)E-3	(1.0±?)E-3	Agreement
Mini Exhaust (Isokinetic smpl pt) 0800 hrs 10/21/93	Co-60	<3E-13	(8.9±?)E-13	No Comparison
		Results in total microCuries		
Smear Wipe #23 1500 hrs 10/19/93	Co-60	(4.64±0.09)E-2	(4.80±?)E-2	Agreement
		Results in microCuries per gram		
Discharge #1 Soil 1410 hrs 10/19/93	Co-60	(1.75±0.05)E-5	(1.63±?)E-5	Agreement
Culvert Soil 1400 hrs 10/19/93	Co-60	(1.264±0.004)E-3	(1.15±?)E-3	Agreement

Note: NRC uncertainties are ± 1s counting uncertainties

ATTACHMENT 1 TO TABLE I

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 the program.

In these criteria, the judgement limits are variable in relation to the comparison of the NRC Reference Laboratory's value to its associated 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 must be considered acceptable as the resolution decreases.

Resolution[1]	Ratio for Comparison[2]
<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

1. Resolution = (NRC Reference Value/1 standard deviation counting uncertainty)

2. Ratio = (Licensee Value/NRC Reference Value)

TABLE II

Neutron Products Sample Results

SAMPLE	ISOTOPE	RESULT
	Results in microCuries per milliliter	
Waste Water #2 1500 hrs 10/19/93	Co-60	(5.0±0.6)E-6
Waste Water 1600 hrs 10/19/93	Co-60	(3.7±0.6)E-6
Catch Basin Inlet 1020 hrs 10/20/93	Co-60	(1.0±0.5)E-6
Catch Basin Outlet 1025 hrs 10/20/93	Co-60	(6±4)E-7
Dry Pond Inlet 0830 hrs 10/20/93	Co-60	(3±5)E-7
Dry Pond Outlet 0830 hrs 10/20/93	Co-60	<1.2E-6
Building H Sewage 1200 hrs 10/20/93	Co-60	<1E-6
Well #4 1200 hrs 10/20/93	Co-60	<1E-6
Hot Cell Filter 0800 hrs 10/21/93	Co-60	(1.28±0.04)E-13 (25%)

TABLE II - continued

Neutron Products Sample Results

Results in total microCuries

SAMPLE	ISOTOPE	RESULT
Smear-Wipe #14 1500 hrs 10/19/93	Co-60	(1.5±0.4)E-4
Hot Cell Particulate Filter After HEPA 10/20/93	Co-60	<2E-4
Smear-Wipe Bay Door Floor 1500 hrs 10/19/93	Co-60	(2.4±0.4)E-3 (15%)
Smear-Wipe Hot Cell Vent Exhaust 1500 hrs 10/19/93	Co-60	(1.8±0.4)E-3 (15%)
Smear-Wipe hot Cell Vent Bypass 1500 hrs 10/19/93	Co-60	(2±3)E-4
Soil Spot MR-23 1200 hrs 10/21/93	Co-60	(5.84±0.04)E-1(10%)
Smear-Wipe Post HEPA 1200 hrs 10/21/93	Co-60	<1E-3

TABLE II - continued

Neutron Products Sample Results

SAMPLE	ISOTOPE	RESULT
Results in microCuries per gram (wet weight)		
Dry Pond Soil 1355 hrs 10/19/93	Co-60	(3.04±0.02)E-4 (15%)
Discharge #2 Soil 1415 hrs 10/19/93	Co-60	(8.5±0.3)E-6 (15%)
Railroad Property Soil 1500 hrs 10/19/93	Co-60	(4.10±0.02)E-4 (15%)
North Dry Pond Soil 1500 hrs 10/19/93	Co-60	(6.3±1.2)E-7 (15%)
Railroad Spur by Pipe Soil 1500 hrs 10/19/93	Co-60	(1.271±0.012)E-4 (15%)
Creek Soil 1500 hrs 10/19/93	Co-60	(9.7±1.3)E-7 (15%)
Court Yard Fence 1500 hrs 10/19/93	Co-60	(8.03±0.11)E-5 (15%)
Gravel from Beneath Hot Cell Exhaust on Roof 1500 hrs 10/19/93	Co-60	(3.77±0.05)E-5 (15%)
DC Sewage Treatment Plant - Pretreatment #3 1200 hrs 10/21/93	Cr-51 I-131 Tc-99m	(6±3)E-7 (6.44±0.16)E-6 (25%) (9.4±0.2)E-6 (25%)

TABLE II - continued

Neutron Products Sample Results

SAMPLE	ISOTOPE	RESULT
Results in microCuries per gram (wet weight)		
DC Sewage Treatment Plant-Pretreatment #4 1200 hrs 10/21/93	Cr-51	(9±4)E-7
	I-131	(6.24±0.15)E-6 (25%)
	Tc-99m	(9.3±1.5)E-6 (25%)
DC Sewage Treatment Plant-Post Treatment#1 1200 hrs 10/21/93	I-131	(8.9±0.2)E-6 (25%)
	Tc-99m	(9.2±0.8)E-7 (25%)
DC Sewage Treatment Plant-Post Treatment#2 1200 hrs 10/21/93	I-131	(8.7±0.2)E-6 (25%)
	Tc-99m	(9.2±1.0)E-7 (25%)

Note: Results are reported as: result ± 1s counting uncertainty. Estimates of systematic uncertainty are reported in parentheses, if appropriate