THE PERRY NUCLEAR POWER PLANT

RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

POR 1986

INCLUDING

PREOPERATIONAL DATA

FROM

1981 TO 1985

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EXECUTIVE SUMMARY

This report is a summary of the PNPP Radiological Environmental Monitoring Program for 1986. This report includes a review of the results reported in 1986, as well as a comparison with results from the preoperational period 1981 to 1985. This report also includes results from the 1986 Land Use Survey and the EPA Cross-Check Intercomparison Program.

A total of 1409 environmental samples were collected and analyzed in 1986. These samples were collected and analyzed in accordance with the Perry Nuclear Power Plant (PNPP) Technical Specifications. On two separate occassions, the vendor laboratory had identified non-compliance with the PNPP Technical Specifications for the requirements on lower limits of detections. The situations and their respective corrective actions are described in this report.

During 1986, PNPP Unit 1 received approval for 5% power on March 18, 1986 and reached initial criticality on June 6, 1986. The unit reached another milestone on November 13, 1986 when it received the license for full power.

The achievement of initial criticality occurred during the same time period as the Chernobyl incident in the Soviet Union. The incident at Chernobyl released significant quantities of radioactive material into the atmosphere. This release of radioactive material was detected in Northeast Ohio during the period May 5th thru June 11th. The radioactivity was detected in air and milk in all locations including the control locations.

Results from other samples showed no significant activity other than naturally occurring radionuclides and fission products deposited from nuclear fallout which were similar to those observed during the preoperational period.

PERRY POWER PLANT
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
1986 ANNUAL REPORT

I. INTRODUCTION

The Perry Power Plant is a twin unit BWR plant with a capacity to generate 1205 MWe per unit. The main condenser circulating water is cooled by a closed-loop natural draft cooling tower system. The plant is located on Lake Erie, on approximately 1100 acres about thirty-five (35) miles northeast of Cleveland, Ohio.

PNPP Unit 1 acheived initial criticality on June 6, 1986. Unit 1 received approval for 5% power on March 18, 1986 and approval for full power on November 13, 1986. The construction of Unit 2 is on indefinite hold. During construction of Unit 1, data was being collected for the Perry Radiological Environmental Monitoring Program (REMP).

The objective of the preoperational Radiological Environmental Monitoring Program was to measure background radiation and radioactivity levels around a twenty-five mile radius of the Perry Nuclear Power Plant prior to operation.

In addition to collecting environmental data, the preoperational period provided the opportunity to evaluate procedures, equipment and techniques, as well as to provide experience to personnel.

The objective of this program was conducted in compliance with USNRC Regulatory Guide 4.1 "Programs For Monitoring Radioactivity In The Environs Of Nuclear Power Plant" Revision 1, April 1975, the USNRC Branch Technical Position on Radiological Environmental Monitoring, Revision 1, November 1979 and the PNPP Technical Specifications.

During the operational period, the data collected and recorded will be compared to the preoperational data to determine the radiation and/or radioactivity level, if any that might be deposited into or might impact the local environment from the Perry station. This program will be extended to cover testing, commercial operations and decommissioning of the Perry Power Plant.

During 1986, Unit 1 produced 236.4 megawatt-hours of electricity and was operational for 1429.6 hours.Operation at any significant power level occurred in late December.

As of December 1986, the Perry Operational Radiological

Environmental Monitoring Program consisted of seven air stations, four water stations, four milk stations, twenty-nine TLD (Thermoluminescent Dosimeter) stations, four sediment stations, two fish stations, three snow stations, and eight soil stations. The food section was divided into three sections with the following number of stations; food products-four stations, silage/feed-five stations, and vegetation-five stations.

The TLD stations, one through twenty-four, and the four sediment and two fish sample stations were placed into operation in 1981. In 1982, samples were collected for air, water, milk, and food products/silage. The program was augmented in 1985 to include snow and soil. Although snow and soil samples are not required by the NRC Branch Technical Position on Radiological Environmental Monitoring Revision 1 or the PNPP Technical Specifications for Radiological Environmental Monitoring, the two media have been added to the program to expand the monitoring of exposure pathways.

The location of each sampling station within a twenty-five mile radius of the Perry Plant is shown in Figures 1, 2, and 3. Figure 1 shows all sampling stations within the two mile radius of the plant. Figure 2 shows all sample stations approximately two miles to eight miles of the plant and Figure 3 shows all control stations greater than ten miles from the plant.

Table 1 identifies each sample station by number, the distance from the plant site and direction. A description of its location and the media pathway found in that particular sample station are also found in Table 1.

II. PROGRAM CHANGES

There were several program changes in 1986. The majority of the changes occurred in the milk medium. The Manley residence (Location 30) and the Hoffer residence (Location 31) returned to the program in February and April, respectively. Each resident removed their milk-producing animals (goats) from milking in late fall of 1985 to dry. This is a normal husbandry practice. The Manley residence and the Hoffer residence removed their goats from milking again in October and November of 1986 to repeat the drying cycle.

There were several additions to the milk sampling in 1986. In April, the Zoldak residence (Location 47) participated in the program, but in October they removed their goats from milking for drying. The Zoldaks anticipate returning to the program in the spring of 1987.

Other new participants in the milk sampling program were the Rettger's residence (Location 51) in September, the Pollock's residence (Location 52) in December, and the Waites'

residence (Location 29) in December. The Waites' residence did participate in the program prior to 1985.

These new milk sampling locations will support compliance with the PNPP Technical Specifications when all participants return to the program in the spring.

Other changes to the program were the addition of a new air sampling station (Location 7) on Jan. 15th, the addition of Location 47 and Location 51 for feed and silage in September, the addition of Location 49 and Location 50 for food products in August, and the addition of vegetation sampling (grass and leaves) at Locations 6, 7, 35, 44 and 48 in July.

The vegetation samples are being collected to supplement the milk sampling so the radioiodine pathway is covered when the milking of goats is suspended each year. This is being performed in accordance with the PNPP Technical Specification on Radiological Environmental Monitoring.

In 1986, the following mechanical failures or vandalism occurred:

STATION	MEDIA	DATE	PROBLEM
35	Air	1/22/86-1/29/86	Electrical malfunction
28	Water	1/27/86-2/24/86	75% capacity-flooding
26	Water	6/23/86-7/28/86	75% capacity-flooding
8	TLD	7/01/86-10/02/86	Missing-Vandalism
19	TLD	7/01/86-10/02/86	Missing-Vandalism
8	TLD	12/31/85-10/02/86	Missing-Vandalism
12	TLD	12/31/85-10/02/86	Missing-Vandalism
19	TLD	12/31/85-10/02/86	Missing-Vandalism

The air sampler was repaired and calibrated, and returned to service on 1/29/86. During 1986, only one weekly sample was missed due to malfunctioning equipment.

The water samplers were inspected and the tygon tubing was replaced prior to returning the water sampler back to service for the month of March collection.

The Ashtabula Generating Station built a stand in the Screen/Intake house for the water sampler. This should eliminate losing the monthly water collection.

Each TLD found missing during the quarterly exchange was replaced with a new TLD for the next quarterly field cycle. A sufficient number of TLDs have been collected and reported from these locations since 1981 to provide adequate results for trend analysis. The impact of these missing TLDs during 1986 is insignificant.

III. SAMPLING METHODS AND PROCEDURES

To derive meaningful and useful data from the program, sampling methods and procedures have been developed which provide samples representative of potential pathways for the area. During the pre-operational phase of the program, samples were collected and analyzed not only to obtain background radiological levels, but at the same time to acquire experience with the sampling methodology and procedures.

Since initial criticality, the methods described herein meet the intent of the procedures used in the PNPP Radiological Environmental Monitoring Program. The selection of the locations comply with the PNPP Technical Specifications Section 12, Table 3.12.1-1.

1. DIRECT RADIATION

Environmental thermoluminsecent dosimeters (TLDs) were used to determine the direct (ambient) radiation levels at twenty-nine locations as described in Table 1. Environmental TLDs were located in two rings around the station as well as along the site boundary. The inner ring measured direct radiation within a one-mile radius around the plant, whereas, the outer ring measured direct radiation at the approximate distance of four to five miles from the station. The environmental TLDs at the site boundary measured direct radiation at the site boundary (The site boundary ranges from 0.42 miles in the NE sector to 0.82 miles in the SSE sector.)

A control TLD is placed in two locations approximately ten miles in the two least prevalent directions of the plant.

The area around the station is divided into 16 radial sectors, each of which is 22-1/2 degrees. Environmental TLDs were placed in each sector except those sectors which radiate from the site directly out over the lake without intersecting any unrestricted areas over land.

Each environmental TLD was made up of calcium sulfate with dysprosium impurities. Each location had one field environmental TLD, one emergency environmental TLD, and one annual environmental TLD. The field environmental TLD and the emergency environmental were collected quarterly, whereas, the annual environmental TLD was collected once a year.

The field environmental TLD is the primary environmental TLD used for measuring direct radiation dose and the results are included in this report. However, because the emergency environmental TLDs are intended to be used only under emergency conditions and because they may be pulled from

their locations at intermittant times during the year, the results of the emergency environmental TLDs are not included in this report.

This report also includes the annual environmental TLD results.

Control badges were used during transportation to correct for any direct radiation not received during the field cycle. Control badges were kept in a lead pig when not in use. All environmental TLDs were packaged at the site and were shipped by commercial freight to the vendor radiological laboratory for analysis.

2. FISH

Fish samples were collected semi-annually from two locations. One in the immediate vicinity of the plant discharge is the indicator location and an offshore location near Mentor-On-The-Lake is the control location.

A passive collection technique was used for fish collection. An experimental gill net, with a mesh ranging from approximately 1.0 to 2.5 inches to maximize catches in useful size ranges, was set in the evening and removed the following morning. A scientific collecting permit has been obtained from the Ohio Department of Natural Resources to permit sampling.

Available edible species were filleted at the time of collection. The edible protions were packed in dry ice and shipped to the vendor laboratory for analysis by gamma spectrometry.

3. SEDIMENT

Sediment samples were collected semi-annually from four locations. Two samples were collected at the same locations where fish samples were collected. The other sediment sample locations were offshore in the vicinities of Fairport Harbor and Redbird.

Samples were collected with a Petite Ponar Grab Sampler in about 30 feet of water. The samples were then transferred to a plastic container. Approximately one kilogram was collected and frozen from each sample location and shipped to the vendor laboratory for analysis.

4. AIR

Air samples (particulate and iodine) were collected weekly at seven locations. There were six air sample locations operating within a four-mile radius of the plant. The seventh location was a control location located in the least

predominant wind direction at a distance greater than ten miles from the plant.

The air samples were collected on a low volume air sampler (Research Appliance Company Model No. 209088-2). The air samplers run continuously and generally sample approximately 10,000 cubic feet of air a week. The total air volume was measured by a dry gas meter and the time was registered by a time totalizer. The samples were packaged and shipped to the vendor laboratory for analysis.

All air samplers were calibrated and had maintenance checks every six months or after repair.

5. WATER

Water samples were collected monthly at four locations, of which, one location was a control location (Ashtabula Generating Station). Two locations (Painesville and Green Rd. in Madison) are drinking water facilities. The other facilities, (Perry Plant Intake and the Ashtabula control location) extract surface water from Lake Erie for industrial use.

The Perry Plant Intake sample location and the Ashtabula sample location obtain water samples via a Horizon Interval Sampler, which collects a small volume of water at short intervals, nominally an one and one half minute sample every fifteen minutes. The other two water locations use an interval timer to control a solenoid valve on a pressurized sampling line. This sampling unit collects a one minute sample of water from the raw water sample line every hour.

The samples were composited in a five gallon container. Each month, at each location, two one-gallon samples and one 125-milliliter sample were removed from the five gallon container. The remaining sample volume in the five gallon container was disposed of back into the lake. The two one-gallon samples were treated with ten milliliters of nitric acid to prevent plate-out on the sample container. The 125-milliliter sample was not treated with nitric acid, since it is analyzed only for tritium, and it does not plate-out on the container.

All samples were then packaged and shipped to the vendor laboratory for analysis.

6. MILK

During 1986, the number of milk locations had varied from one sample location to as many as five sample locations. The control location (Greig's Farm, 10.2 miles south of the plant) continued to provide samples throughout 1986. The owners of the farm had indicated that they may be terminating

the dairy business by the end of 1986. In anticipation of this termination, a second control location was put into service in September. The second control location is approximately 9.2 miles south of the plant. This is the Rettger residence. The Hofer residence, the Manley residence and the Zoldak residence provided milk samples for the majority of 1986, however, during the winter seasons the goats were not milked and were allowed to dry until the next birth period. This appears to be a normal husbandry practice in raising goats.

Milk samples were collected monthly during the non-grazing season (October 15-April 15) and twice a month during the grazing season. Milk samples were normally collected from a batch tank at the dairy farm. The owners who supply goat milk samples were given two one-gallon containers and the filled containers were collected several days later, since goats require several days to produce two gallons.

All milk samples were treated with eighty milliliters of formalin to preserve the milk. The samples were then packaged and shipped to the vendor laboratory for analysis.

7. VEGETATION

Samples of grass and leaves were collected monthly, when available to supplement milk sampling. These samples were collected at five locations. The control location (Location 6) is in the least prevalent wind direction.

At each grass sample location, grass was clipped from on area approximately 24 square feet in area. However, due to the moisture content of the grass, the grass samples weighed from 1100 grams to 4400 grams. Samples were taken at the highest D/Q sector, the highest D/Q sector with milk-producing animals, or both.

Leaves were sampled at or very near the same locations as grass samples. Leaves are taken from one particular specie (the Staghorn Sumac or Rhus typhina L.) that is abundant in the area. A minimum of 500 grams is collected each month when available.

8. FEED SILAGE/FOOD PRODUCTS

The feed silage/food product samples were collected once a year during the harvest season (Late August or early September). The food products were collected from locally grown gardens and roadside vendors near the plant. One location (Location 50) is a control location located approximately 11 miles south of the plant. Every effort was made to collect broad-leaf vegetation (cabbage, lettuce, etc.) if possible. However, if broad-leaf vegetation was not available, other food products were collected for samples.

Feed/silage samples were collected from each milk sample location.

All samples were packaged and shipped to the vendor laboratory for analysis.

9. SOIL

Soil samples were taken quarterly at eight locations, of which one sample was a control sample located eleven miles SSW at the Concord Service Center. The other soil samples were located in two rings around the station. There were three soil samples in the inner ring within a mile of the plant. Another three soil samples were collected in an outer ring approximately five miles from the plant. The eighth soil sample was located near a community in the ENE sector. This sector is one of the three highest D/Q (Dispersion value) sectors. The highest D/Q sector covers a small sparsely populated area which eventually continues out over the lake.

A garden trowel was used to remove the soil from a twelve inch by twelve inch area approximately one inch deep. The soil was placed in a one-liter plastic container at each location. The samples were then packaged and shipped to the vendor laboratory for sample analysis.

10. SNOW

Snow samples were collected monthly at three locations when available. Snow samples were generally collected within a short time frame after a fresh snowfall when more than several inches have accumulated.

Snow samples were collected east of the plant and west of the plant. The third snow sample was collected at a control location eleven miles SSW at the Concord Service Center. (These snow sample locations are subject to change based on experience gained from collecting and analyzing snow samples.)

A large rectangular scoop was used to remove the snow. Only several inches from the surface of the snow were removed and placed in a four-liter container. A sufficient amount of snow was removed and packed into the container until 1000 grams had been collected in the container. A spring scale is used to weigh each container. Once a sufficient amount of snow has been collected, the area was measured and documented on the collection field form. When the snow melts, the liquid contents (1000 ml) is transferred to a one-liter container.

All samples were then packaged and shipped to the vendor laboratory for analysis.

IV. DISCUSSION AND RESULTS

A summary of the results for each sample medium is provided in the Radiological Environmental Monitoring Program Summary Table 2. The average values recorded in Table 2 reflect the results for each sample medium in Appendix A.

A tabulation of results for each sample medium for each year prior to 1986 is provided in Appendix B.

The 1986 results recorded in Table 2 are discussed below for each sample medium and the results are compared with historical values to reflect any possible trends.

1. DIRECT RADIATION

During 1986, there were 116 environmental field TLDs placed in the surrounding environment. Only three quarterly environmental field TLDs and two annual environmental field TLDs were found to be missing at the time of exchange.

The annual average value for all TLDS in 1986 was 20.30 mR/Std Qtr. +/- 2.68 mR/Std Qtr. or 0.22 mR/day +/- 0.03 mR/day. This is equivalent to an annual exposure of 81.2 mR per year. The annual average value for all indicator locations in 1986 was 20.43 mR/Std Qtr. +/- 2.70 mR/Std Qtr. or 0.22 mR/day +/- 0.03 mR/day. The annual average values for indicator locations for previous years were as follow:

1985	0.23 mR/day
1984	0.21 mR/day
1983	0.22 mR/day
1982	0.20 mR/day
1981	0.19 mR/day

These values are in good agreement with the 1986 annual average value for all indicator locations.

The annual average value for all control locations was 18.64 mR/Std Qtr. +/- 1.75 mR/Std Qtr. or 0.20 mR/day +/- 0.02 mR/day. The control locations which are located approximately 10 miles in the least prevailing direction of the plant have consistently reported lower results.

The TLD results ranged from 13.50 mR/Std Qtr. to 30.10 mR/Std Qtr. (0.15 mR/day-0.33 mR/day). The location with the highest annual average value was location No. 18 located approximately 5.0 miles south of the plant. This value was 28.15 mR/Std Qtr. +/- 1.45 mR/Std Qtr. or 0.31 mR/day +/- 0.02 mR/day. This location has consistently been ranked the location with the highest annual mean value every year since 1981, with the exception of 1985. During 1985, location No. 16 was identified as the location with the highest annual mean value and location No. 18 was ranked second.

A review of all the results by location showed that locations 16, 17 and 18 have measured exposures slightly higher than other locations. These locations are found approximately 5.0 miles in the SE, SSE, and S direction of the plant, respectively.

The slightly increased exposures in these areas were suspected of being influenced by the composition of the soil. A further explanation of this topic can be found in the sub-section on Soil in the Results and Discussion Section.

The annual TLDs were not analyzed by the vendor laboratory, with the exception of three badges. The badges after being left in the field for approximately 365 days were damaged by water. A review of the situation showed that many plastic bags that contained each TLD were punctured as a consequence of the method of deployment. The vendor laboratory will purchase heavier plastic bags and double seal each plastic bag. A section of the bag will be available to allow personnel to hang these bags in the field.

2. AIR

A total of 362 samples were collected in 1986 for each air particulate and air iodine medium. Air particulate filters and air iodine cartridges were analyzed for gross beta and by gamma spectrometry weekly, respectively. Each air particulate filter was composited by location and analyzed quarterly by gamma spectrometry.

The annual average gross beta activity for all locations was 28.02 E-03 pCi/cu.m. +/- 33.17 E-3 pCi/cu. m. The annual average gross beta activities for all indicator locations and control location(s) were 27.98 E-03 pCi/cu.m. +/- 32.98 E-03 pCi/cu.m and 28.25 E-3 pCi/cu.m +/- 39.24 E-3 pCi/cu.m., respectively.

These values are higher than previous results reported for gross beta in air particulate.

This increase in activity was attributed to the Chernobyl fallout detected during the period May 5, 1986 thru June 11, 1986. The average gross beta activity during this period for all locations was 110.77 E-3 pCi/cu.m. +/- 58.34 E-3 pCi/cu.m. This is an increase of approximately a factor of 6 above normal activity levels reported for this medium.

A review of the air particulate gross beta results, less the activity recorded during the aforementioned period, shows that the annual average values are in good agreement with previous historical results. The results for indicator locations are as follows:

1986	19.15 E-3 pCi/cu.m.
1985	20.26 E-3 pCi/cu.m.
1984	19.00 E-3 pCi/cu.m.
1983	19.00 E-3 pCi/cu.m.
1982	21.00 E-3 pCi/cu.m.

Gross beta results for air particulates ranged from 3.0 E-3 pCi/cu.m to 207 E-3 pCi/cu.m. in 1986. The location with the highest annual mean value was location No. 5. This location measured an annual average value of 29.37 E-3 pCi/cu.m. +/- 35.36 E-3 pCi/cu.m. This location is approximately 0.6 miles SW from the plant. The activity at this location, less the activity contributed from Chernobyl, was 20.06 E-3 pCi/cu.m. +/- 6.76 E-3 pCi/cu.m. This value is in good agreement with previous results reported for this location. This location has been reported as the location with the highest annual mean value since 1982.

Iodine was also detected in measureable quantities during the period May 5, 1986 thru June 4, 1986. The average value for air iodine for all locations in 1986 was 0.11 pCi/cu.m. +/ 0.07 pCi/cu.m. The air iodine activity ranged from 0.04 pCi/cu.m. to 0.26 pCi/cu.m. for all locations. The location with the highest annual mean activity was location 4 located 0.7 miles in the S sector.

Other reported values, prior to and after the aforementioned period, showed iodine activity to be equal to or less than the lower limit of detection (0.04 pCi/cu.m.).

The nuclide Be-7 was detected in all air samples. The annual average activity was 78.21 E-3 pCi/cu.m. +/- 14.89 E-3 pCi/cu.m. for all locations. The activity for this nuclide ranged from 50 E-3 pCi/cu.m. to 110 E-3 pCi/cu.m. in 1986. The annual average activities for indicator locations and control locations were 79.17 E-3 pCi/cu.m. +/- 15.79 E-3 pCi/cu.m. and 72.50 E-3 pCi/cu.m. +/- 4.33 E-3 pCi/cu.m., respectively.

The annual average indicator activity is in good agreement with previous historical results as shown below:

1986	79.17 E-03 pCi/cu.m.
1985	81.45 E-03 pCi/cu.m.
1984	75.00 E-03 pCi/cu.m.
1983	54.00 E-03 pCi/cu.m.
1982	53.25 E-03 pCi/cu.m.

The National Council on Radiation Protections and Measurements (Reference 1) has reported the atmospheric distribution and transport of cosmogenic radionuclides, including Be-7, in the environment.

It is important to note that the nuclide Be-7 is a naturally-occurring cosmogenic radionuclide.

The nuclides Cs-134 and Cs-137 were reported as the lower limit of detection.

3. WATER

A total of 48 water samples were collected and analyzed for gross beta activity and by gamma spectrometry in 1986. During each quarter, strontium analyses were performed on water samples. A total of 16 water samples were composited in 1986 and analyzed for tritium.

The annual average gross beta activity for water for all locations was 6.90 pCi/L +/- 3.52 pCi/L. The geometric mean and geometric standard deviation for these same water samples was 5.90 pCi/L +/- 1.78. This method takes into consideration the results reported as less than the lower limit of detection and eliminates bias.

The annual average gross beta activities for water at indicator and control locations were 6.90 pCi/L +/- 3.67 pCi/L and 6.90 pCi/L +/- 3.05 pCi/L, respectively. The historical trends for indicator locations are depicted below:

1986	6.90 pCi/L
1985	6.55 pCi/L
1984	3.80 pCi/L
1983	4.20 pCi/L
1982	4.30 pCi/L

The results reported for indicator locations in 1986 and 1985 are in good agreement with each other, but are statistically different from results reported for indicator locations in 1984, 1983 and 1982. This difference appears to be distinqished between two laboratories. NUS Laboratory performed gross beta analysis from 1982 to the third quarter of 1984. International Technology/Radiological Science Laboratory (formerly Gulf Nuclear/Applied Science Laboratory) performed gross beta analysis from the fourth quarter of 1984 to present. It is possible that this difference in mean values can be attributed to the nature of each laboratory's ability to count samples (ie. counting time, lower limit of detection, equipment etc.)

The gross beta activity for all locations ranged from 1.64 pCi/L to 21.68 pCi/L. The location with the highest annual mean in 1986 was location No. 34, which is located at the Perry Intake. The activity was recorded as 7.48 pCi/L +/- 5.01 pCi/L.

Water samples analyzed for tritium and strontium showed no positive activity. All results were reported as the lower

limit of detection.

Water samples analyzed by gamma spectrometry showed no positive activity except for one water sample collected from location No. 28 on 12/22/86 and one water sample collected from location No. 37 on 11/24/86. The results of these analyses showed positive activity for K-40 (197 pCi/L +/- 178 pCi/L) and Ra-226 (60.90 pCi/L +/- 39.30 pCi/L),respectively. These nuclides are naturally occurring. All other results were reported as the lower limit of detection.

4. MILK

During 1986, a total of 68 samples were collected and analyzed for iodine by chemical separation and gross beta measurement, and by gamma spectrometry. A total of 11 samples from the 68 samples were analyzed for strontium.

The nuclide I-131 was detected at all milk locations during the period 05/12/86 to 06/23/86. The average iodine concentration for all locations was 7.63 pCi/L +/- 8.68 pCi/L. The average iodine concentration for indicator locations and control locations were 10.05 pCi/L +/- 9.66 pCi/L and 2.8 pCi/L +/- 2.12 pCi/L, respectively.

The iodine concentration during the period 05/12/86 thru 06/23/86 ranged from 1.10 pCi/L to 31.50 pCi/L. Location No. 47 was identified as the location with the highest mean average with a concentration of 18.70 pCi/L. However, this location had only one sample with positive activity.

The detection of iodine 131 in milk supports the detection of iodine in air, as well significant increases in gross beta activity in air particulate during the same period of time. This increase in activity can be attributed to the fallout from Chernobyl. The detection of positive activity in these media at all locations, including control locations, supports this contention. All other milk samples analyzed for iodine showed no activity and the results were reported as the lower limit of detection. Thus, if the results from the Chernobyl fallout period are removed, the iodine concentration for the indicator locations was less than or equal to 0.8 pCi/L.

Milk samples analyzed for iodine between the period 08/25/86 thru 10/27/86 were reported as positive activity. The vendor laboratory investigated this matter further and concluded that the results were not iodine. This is because the beta activity did not decay with the I-131 half-life. The activity was not high enough to permit meaningful gamma spectrometry on the separated sample and, the laboratory could not determine the source of this activity, since several milk owners (primarily goat milk owners) were in the process of drying their goats for the winter. No additional samples could be analyzed for this unknown nuclide. The vendor

laboratory performed an extensive washing of glassware and continued to detect positive activity in the separation process for iodine in milk. A review of the PNPP gaseous releases during the same period showed no iodine activity being released from the plant. PNPP personnel will continue to monitor this situation in the future.

Milk samples are also analyzed by gamma spectrometry. The primary nuclide detected in this process in all samples was K-40. The annual average concentration of K-40 in milk in all locations was 1648.51 pCi/L +/- 267.77 pCi/L.

The annual average concentrations of K-40 in indicator locations and control locations were 1762.05 pCi/L +/- 233.90 pCi/L and 1440.38 pCi/L +/- 189.48 pCi/L, respectively. The historical trend for all indicator locations including the results in 1986 are shown below:

1986	1762.05 pCi/L
1985	1636.00 pCi/L
1984	1600.00 pCi/L
1983	1600.00 pCi/L

(Although milk samples were collected in 1982, these milk samples were collected at a control location.)

A review of the results from the indicator locations shows that the trend is stable.

The results between the indicator locations and the control locations actually reflects the difference in K-40 activity between cow milk and goat milk. Cow milk is collected from control locations 33 and 51. Whereas, goat milk is collected at all indicator locations. The nuclide K-40 is a naturally occurring radionuclide in the environment.

All other radionuclides analyzed by gamma spectrometry were reported as the lower limit of detection, with the exception of the nuclide Cs-137. This nuclide was reported as 19 pCi/L +/- 11 pCi/L at location No. 31 in the June 9th sample. This nuclide was not reported in any other sample during 1986. The nuclide Cs-137 has been detected in several milk samples during 1983, 1984, and 1985. It can not be determined if the positive activity of Cs-137 detected in 1986 is contributed from the Chernobyl accident.

The nuclide Sr-90 was also detected in two milk samples in 1986. Location No. 31 and location No. 51 both detected 1.20 pCi/L +/- 0.30 pCi/L. All other samples showed no positive activity of strontium 89 and strontium 90 and the results were reported as the lower limit of detection.

The Handbook of Environmental Radiation edited by A.W. Klement (Reference 2) shows that strontium has been detected

in the environment. The radionuclide strontium can come from nuclear weapon fallout, as well as nuclear power plants and fuel reprocessing plants.

In 1986, PNPP has released to the environment via stack effluent, approximately 11.26 E-7 Curies of the radionuclide Sr-89/Sr-90. All of this release came in the third and fourth quarter of 1986. This release had no significant impact on the environment.

5. SNOW

A total of 9 samples of snow were collected in 1986. Each sample was analyzed for gross beta activity, tritium and by gamma spectrometry.

These snow samples were collected during the winter months. The average gross beta activity for all locations was 8.74 pCi/L +/- 2.76 pCi/L. This gross beta activity for all locations was slightly lower than the gross beta activity for all locations in 1985 which was 10.01 pCi/L +/- 7.21 pCi/L.

The average gross beta activities for indicator locations and control locations were 8.08 pCi/L +/- 2.97 pCi/L and 10.08 pCi/L +/- 1.50 pCi/L, respectively.

The results from samples analyzed by gamma spectrometry were reported as the lower limit of detection.

Only two samples, out of nine samples detected tritium above the lower limit of detection. Location No. 1 and Location No. 6 each reported a value of 2523 pCi/L. All other results were reported as the lower limit of detection.

In 1986, PNPP released 1.5 Curies of tritium to the environment via controlled atmospheric discharges. This entire inventory was monitored in the 4th quarter of 1986.

Although tritium has been detected in several snow samples, the National Council on Radiation Protection and Measurements (Reference 3) describes several sources of tritium and its physical transport in the environment.

6. FISH

A total of 22 samples of fish were collected and analyzed by gamma spectrometry. This comprised of ten species of fish. Only the naturally occurring nuclide K-40 was detected in each sample. The major species collected each year, along with other species, have been Freshwater Drum, Walleye and Yellow Perch. These species are major recreational and commercial species.

The annual average concentration for K-40 for all locations

was 3562.27 pCi/Kg +/- 503.11 pCi/Kg. The annual average concentrations for all indicator locations and control locations were 3620.71 +/- 580.02 pCi/Kg and 3460 pCi/Kg +/- 301.50 pCi/Kg, respectively. A comparison of the annual average concentration for K-40 for indicator locations by year is depicted below:

1986	3620.71 pCi/Kg
1985	4601.00 pCi/Kg
1984	2900.00 pCi/Kg
1983	4200.00 pCi/Kg
1982	3600.00 pCi/Kg
1981	5100.00 pCi/Kg

These indicator locations have been identified as the locations with the highest mean every year except 1984. The control location was identified as the location with the highest mean in 1984.

All other nuclides analyzed by gamma spectrometry were reported as the lower limit of detection. It is important to note that Cs-137 has been detected in some species of fish in previous years but not in 1986.

7. SEDIMENT

There were eight sediment samples collected in 1986. These samples were collected during the same collection period as fish. Each sample was analyzed by gamma spectrometry and for strontium.

The majority of the results indicate the presence of naturally occurring nuclides. The most predominate nuclides are K-40 and Ra-226. These nuclides have been detected in most samples every year since 1981. Other naturally occuring nuclides that have been detected are Ra-228, Th-232, Th-234, Pb-214, Rn-220 and Be-7.

The annual average concentrations for K-40 and Ra-226 for all locations were 13499 pCi/Kg +/- 4121 pCi/Kg and 831 pCi/Kg +/- 274 pCi/Kg, respectively.

The annual average concentrations for K-40 in indicator locations and control locations in 1986 were 11765 pCi/Kg +/- 3259 pCi/Kg and 18700 pCi/Kg +/- 100 pCi/Kg, respectively.

For Ra-226, the annual average concentration in indicator locations and control locations were 763 pCi/Kg +/- 314 pCi/Kg and 967 pCi/Kg +/- 23 pCi/Kg, respectively. A historical perspective of the annual average concentration for K-40 and Ra-226 in indicator locations are provided below:

	K-40	RA-226

1986	11765 pCi/Kg	763 pCi/Kg
1985	12936 pCi/Kg	936 pCi/Kg
1984	13000 pCi/Kg	1100 pCi/Kg
1983	13000 pCi/Kg	860 pCi/Kg
1982	12000 pCi/Kg	1400 pCi/Kg
1981	18000 pCi/Kg	1100 pCi/Kg

It appears that the trend is stable since 1982. The result for K-40 in 1981 was higher than normal.

Other radionuclides that have been detected in sediment samples are Co-60 and Cs-137. These radionuclides are activation products and fission products,respectively. The nuclide Cs-137 has been detected in most sediment samples since 1981. The nuclide Co-60 has been detected in some samples during 1986, 1985 and 1981. However, the nuclide Co-60 was not detected in any samples from 1982 to 1984.

The annual average concentration of Cs-137 and Co-60 in sediment samples from all locations during 1986 was 321.5 pCi/Kg +/- 221.35 pCi/Kg and 84.25 pCi/Kg +/- 24.28 pCi/Kg, respectively.

The annual average concentrations of Cs-137 in sediment samples in 1986 from indicator locations and control locations were 223 pCi/Kg +/- 130 pCi/Kg and 617 pCi/Kg +/- 170 pCi/Kg, respectively. The control location was also the location with the highest mean. Since 1981, the annual average concentration of Cs-137 in sediment ranged from 24 pCi/kg in 1981 to 787 pCi/kg in 1986. The average concentration of Cs-137 in sediment since 1981 is 254 pCi/Kg +/- 176 pCi/Kg (n=35). This value appears to be in good agreement with the results for all locations in 1986.

The historical trend for the nuclide Cs-137 in indicator locations is listed below:

1986	223 pCi/Kg
1985	195 pCi/Kg
1984	64 pCi/Kg
1983	220 pCi/Kg
1982	350 pCi/Kg
1981	270 pCi/Kg

A review of the aforementioned results show no significant trend. The presence of the nuclide Cs-137 in sediment has been through nuclear fallout.(Reference 4) A review of the results indicate that Chernobyl did not make any significant contribution to the sediment.

The annual average concentrations of Co-60 in sediment for indicator locations and control locations during 1986 were 74 pCi/Kg +/- 24.28 pCi/Kg and 115 pCi/Kg +/- 0 pCi/Kg (Only one control sample was detected with Co-60), respectively. The

average concentration of Co-60 detected in sediment since 1981 is 112.44 pCi/Kg +/- 39.31 pCi/Kg (n=9).

It has not been determined how the nuclide Co-60 is present in the sediment. The PNPP Semi-Annual Radioactive Effluent Release Reports for 1986 shows no liquid releases of the radionuclides Cs-137 and Co-60 to the environment.

The results for strontium 89 and strontium 90 in sediment were reported as the lower limit of detection.

8. SOIL

A total of 32 soil samples were collected and analyzed for strontium and by gamma spectrometry in 1986. Again, like sediment, the majority of the radionuclides detected in soil samples were naturally occuring. The most predominant radionuclides were K-40 and Ra-226. Other naturally occurring radionuclides detected in soil were Be-7, Ra-228, Rn-220 and Th-234.

The annual average concentration of K-40 and Ra-226 in soil in 1986 for all locations were 12327 pCi/Kg +/- 3086 pCi/Kg and 772 pCi/Kg +/- 294 pCi/Kg, respectively.

The annual average concentrations of K-40 in soil for indicator locations and control locations in 1986 were 11910 pCi/Kg +/- 3072 pCi/Kg and 15250 pCi/Kg +/- 593 pCi/Kg, respectively. These values agree well with the annual average concentration for indicator locations and control locations reported in 1985. These values were 11806 pCi/Kg +/- 2726 pCi/Kg and 16580 pCi/Kg +/- 1276 pCi/Kg, respectively.

The annual average concentrations of Ra-226 in soil for indicator locations and control locations in 1986 were 687 pCi/Kg +/- 182 pCi/Kg and 1370 pCi/Kg +/- 226 pCi/Kg, respectively. Comparison of these values with the annual average concentration of Ra-226 in 1985 show similar agreement. These results were 748 pCi/Kg +/- 277 pCi/Kg and 1195 pCi/Kg +/- 145 pCi/Kg, respectively.

The nuclide Ra-228 had an annual average concentration of 841 pCi/Kg +/- 321 pCi/Kg for all locations in 1986. The annual average concentrations from indicator locations and control locations were 785 pCi/Kg +/- 314 pCi/Kg and 1173 pCi/Kg +/- 47 pCi/Kg, respectively.

The nuclide Cs-137 was detected in most samples in 1986. The annual average concentration for all locations was 569 pCi/Kg +/- 551 pCi/Kg.

The annual average concentrations from indicator locations and control locations were 521 pCi/Kg +/- 560 pCi/Kg and 882 pCi/Kg +/- 348 pCi/Kg, respectively. Some radionuclides found

in soil samples that were analyzed by gamma spectrometry were reported as the lower limit of detection. A geometric mean and standard deviation were determined from the results. The geometric mean and the standard deviation of Cs-137 in soil for all locations was 380 pCi/Kg +/- 2.37.

A review of the results show that Location No. 18 is consistently higher in potassium concentration and radium concentration than most other locations. This location is five miles south of the plant. The high activity found in the soil at this location tends to support the high TLD reading also found in this area. The Soil Survey maps of Lake County (Reference 5) show that Location No. 18 is situated along a unique soil region which runs along the Grand River. Several additional samples taken in different locations in this region during the 4th quarter soil collection tend to support the assumption that this unique region is higher than normal in potassium and radium concentrations than in other areas.

The results from this special collection are as follows:

LOCATION	CS-137	K-40	RA-226	RA-228
Mason's Landing	1190	15600	897	1230
Indian Point	1590	19600	1100	1360
Baker Rd.	1240	15700	991	1020
Hidden Valley	1110	19200	1050	1410

(NOTE: ALL UNITS ARE EXPRESSED IN PCI/KG)

A comparison of these results show that the potassium and radium results agree well with the potassium and radium results for Location No. 18 taken during the same time period. This area contributes an appreciable environmental background exposure level to TLDs located in this area that is consistently higher than other TLDs located in other areas around the plant.

The results from strontium 89 and strontium 90 analyses were reported as the lower limit of detection.

9. FOOD PRODUCTS/FEED&SILAGE

A total of 12 different types of food products (produce) were collected from several different growers around the plant. Also, nine feed and hay samples were collected from each milk sample location. These samples are collected annually. An attempt is made to collect broad leaf vegetation when collecting produce. Each sample is analyzed by gamma spectrometry.

The most predominant nuclide found in each produce sample was

the naturally occuring nuclide K-40. The average concentration for all locations was 3327 pCi/Kg +/- 1417 pCi/Kg. The activity ranged from 1740 pCi/Kg to 6530 pCi/Kg. The average concentrations for all indicator locations and the control location were 3233 pCi/Kg +/- 1453 pCi/Kg and 3607 pCi/Kg +/- 1265 pCi/Kg, respectively.

A review of the historical trend for K-40 concentration in indicator locations shows an increasing trend as depicted below:

1986	3233 pCi/Kg
1985	2788 pCi/Kg
1984	2100 pCi/Kg
1983	2100 pCi/Kg
1982	1900 pCi/Kg

A substantial increase can be observed between the results given prior to 1985 as compared to the results given in 1985 and 1986. This difference in results may be related to the change in vendor laboratories between these two time periods. It is possible that each vendor laboratory may have had different counting geometries and counting time, as well as fluctuating background counts.

The nuclide Cs-137 was detected in one sample in 1986. This nuclide was observed in lettuce from location No. 49. Since Cs-137 had not been detected previously in these types of samples, it can not be determined if the detection of Cs-137 in lettuce was the result of cross contamination at the vendor laboratory, or a concentration buildup of this nuclide in this area from the Chernobyl fallout. A review of the PNPP effluent report shows no releases of the nuclide Cs-137.

The nuclides I-131 and Cs-134 were reported as the lower limit of detection.

The major radionuclide detected in feed and hay samples was the naturally occuring nuclide K-40. This nuclide was detected in each sample. The average concentration for all locations in 1986 was 10869 pCi/Kg +/- 4960 pCi/Kg. The average concentrations for all indicator locations and control locations were 10693 pCi/Kg +/- 4113 pCi/Kg and 11220 pCi/Kg +/- 6309 pCi/Kg, respectively.

The previous results for feed and hay for indicator locations are shown below:

1986	10693 pCi/Kg
1985	7318 pCi/Kg
1984	8600 pCi/Kg
1983	7800 pCi/Kg
1982	4900 pCi/Kg (Control location only)

It appears that the results for K-40 for indicator locations are satisfactory between 1983 and 1985. The K-40 results for indicator locations in 1986 were slightly higher than normal and the K-40 results for indicator locations in 1982 were slightly lower than normal.

Other naturally occuring radionuclides detected with positive activity were Ra-226, Be-7 and Rn-220. These nuclides were detected in only a few samples.

The nuclides Cs-134, Cs-137, and I-131 were reported as the lower limit of detection.

10. VEGETATION

Vegetation samples include grass and leaves. These samples were collected in conjunction with the food product (produce) samples and supplement the collection of milk samples. A total of 49 samples were collected and analyzed by gamma spectrometry in 1986.

The two naturally occuring nuclides that were detected in vegetation samples were K-40 and Be-7. The annual average activities for K-40 and Be-7 for all locations were 5134 pCi/Kg +/- 1816 pCi/Kg and 2923 pCi/Kg +/- 2126 pCi/Kg, respectively. This value compared well with the annual average activity for K-40 and Be-7 for all locations in 1985. These 1985 values were 4273 pCi/Kg +/- 1828 pCi/Kg and 2306 pCi/Kg +/- 755 pCi/Kg, respectively.

The annual average activities for indicator and control locations in 1986 for K-40 were 5174 pCi/Kg +/- 1761 pCi/Kg and 4978 pCi/Kg +/- 2011 pCi/Kg, respectively.

The annual average activities for indicator and control locations in 1986 for Be-7 were 2889 pCi/Kg +/- 2075 pCi/Kg and 3056 pCi/Kg +/- 2310 pCi/Kg, respectively.

There was no positive activity above the detection limit for the nuclides Cs-134, Cs-137, I-131 and Co-60. All results were reported as the lower limit of detection.

The lower limit of detection had exceeded the PNPP Technical Specifications on several occasions. A further explanation is provided later in this report.

V. LOWER LIMIT OF DETECTION

Several problems have been identified by the vendor laboratory in 1986 in the reporting of the lower limit of detection.

These problems were identified in the analysis of food products (particularly vegetation and on one occasion with

produce), water, snow and milk samples.

It was determined in the review of the laboratory results by the new laboratory director that some vegetation samples did not have a sufficient aliquot to analyze the sample at the pre-determined counting time and meet the lower limit of detection values as defined in the PNPP Technical Specifications. To maintain proper lower limit of detection requirements, the Laboratory Director has instructed personnel to increase counting time to compensate for insufficient aliquots.

Several milk, water, and snow samples that were analyzed by gamma spectrometry did not meet the lower limit of detection requirments. This problem was most predominant with the nuclide La-140. This problem was most critical when samples were collected and shipped just prior to a long weekend where a Monday holiday followed the weekend.

Further investigation of this matter, showed that personnel had not compensated for optimum counting time, including fluctuating background and decaying of short lived nuclides, such as La-140.

The vendor laboratory has taken corrective action to develop new "a priori" lower limits of detection analysis method for milk and water. These new analysis methods will compensate for fluctuating background, short-lived nuclides and delayed samples due to shipment, and assure that the lower limit of detection values are met.

VI. LAND USE CENSUS

Tne 1986 Land Use Survey was conducted during the period June 2nd through June 4th. The closest garden (greater than 50 square meters, producing broad leaf vegetation) and residence in each radial sector were determined and all dairy animals within five miles of the site were also identified. In addition, control milk sampling locations were verified. The control locations are outside of the 5 mile radius.

The garden identified in the survey with the highest D/Q value (Deposition rate expressed in M^{-2}) was the residence located at 3199 Parmly Rd in the SSE sector approximately 0.9 miles from the plant. This garden was also identified in the 1985 Land Use Survey. The other gardens identified in this survey by sector and distance are shown in Table 3.

The nearest residence was founded at 4385 Lockwood Rd approximately 0.8 miles NE of the plant. This residence was not identified in the 1985 survey. The residence identified in the 1985 survey was unoccupied in 1986. A decision was made to identify the next closest residence. Table 4 shows the nearest residences depicted by sector and distance.

The milk-producing animal locations with the highest D/Q value were found at 3291 Parmly Rd. This location is approximately 1.0 mile SSE of the plant. This location was also identified in the 1985 survey. The other milk-producing animal locations are shown in Table 5.

A review of the number of locations with milk-producing animals decreased by two locations. Generally, most of the owners within the five-mile radius of the plant are raising goats. Dairy cows are generally found outside the five-mile radius and to the south and east of the plant. This area is more rural and suitable for farming. A large metropolitan area is to the west of the plant.

During January and February of 1986, a special dairy survey was conducted to find milk-producing animals beyond the five-mile radius of the plant. In 1985, all participants in the milk sampling program stopped milking their animals for the winter. This resulted in no milk samples during the winter season. An attempt was made to contact and solicit participation of other owners identified from the 1985 land use survey. The result of this task ended with no participants. Therefore, a decision was made to expand the search for milk-producing animals beyond the five-mile radius of the plant. The results of this special dairy survey are listed in Table 6.

Control locations (approximately 9 miles or more from the plant) for milk-producing animals were verified and the results are listed in Table 7. One of the two control locations, 8187 Callow Rd. had been a regular milk sampling station since 1982. It was learned during this survey that the owner will be terminating dairy production at the end of 1986 as part of the U.S. Government Buyout Program.

VII. EPA CROSS-CHECK INTERCOMPARISON PROGRAM

The results of all EPA samples analyzed by the vendor laboratory are shown in Table 8. This table shows the number of samples, the date, the sample medium, type of analysis, the EPA results and the vendor laboratory results.

The vendor laboratory exceeded the EPA normalized deviation for known-values on eleven occassions. In each of the eleven cases, only two intercomparison samples were in agreement with the EPA normalized deviation for the grand average. This indicates that the majority of the other participants in the EPA Intercomparison Survey did not meet EPA known-value and its expected laboratory precision.

The remaining results were within the EPA control limits.

VIII. CONCLUSION

The operation of the PNPP Radiological Environmental Monitoring Program is being conducted in compliance with the PNPP Technical Specifications with the exception of certain lower limit of detection cases.

During 1986, several sample media detected the presence of radioactivity above normal levels. This increase in radioactivity was contributed to the incident in the Soviet Union. The accident at Chernobyl contributed a significant amount of radioactivity to the atmosphere that was transported world wide. The release from this incident was detected in Northeast Ohio.

The detection of radioactivity from the Chernobyl accident occurred during the same period when Perry achieved initial criticality. A review of plant effluent reports show no releases of radioactivity to environment during that period correlating to the radionuclides identified in the PNPP Radiological Environmental Monitoring.

A review of data collected in 1986, less the data collected during the Chernobyl event, showed that results compared very well with previous historical pre-operational results.

Therefore, it can be concluded that Perry did not have an impact on the environment during 1986.

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