Report to Washington Department of Ecology
Northwest Washington Region

Release and Independent Actions
for
Mercury Contaminated Natural Gas Meter Houses

Prepared by Northwest Pipeline Corporation
Salt Lake City, Utah
June 21, 1991

Circumstances of the Release and the Discovery

Mercury meters which contain elemental mercury, have been used by the natural gas industry since the 1920's to monitor fluctuations in gas pressure and to calculate volumes of gas delivery. These meters, typically housed in small enclosures, or meter houses (typical meter houses are < 16'x 24'), are routinely maintained and serviced. Accidental releases may have occurred over a period of years at sites across the country.

Accidental releases of mercury may have occurred due to vandalism, overpressure releases or leaks during operation, and spillage during maintenance operations. In addition to the mercury meters, mercury manometers used for calibration have also been a potential source for accidental release of mercury. Many of the meter houses have dirt/gravel floors and the accidentally released mercury has accumulated in the floors over the years.

Mercury meters have been in service at Northwest Pipeline Corporation (NWP) facilities for the past 30 years. NWP first started looking at the use of mercury manometers and meters as an employee safety issue. Employees were being exposed to mercury vapor when handling mercury pots and during calibrations. NWP also recognized that an additional potential source for exposure to mercury vapor at levels in excess of OSHA standards was the mercury that may have accumulated in the soils over the years.

In order to eliminate this employee safety hazard from the work place, NWP decided to remove all mercury meters and manometers as soon as possible and remove mercury contaminated soils. The primary driving force for the cleanup was compliance with the more stringent OSHA regulations which will become effective 12/31/92. In addition, EPA will ban disposal of mercury waste in landfills after 5/8/92, after which expensive waste treatment will be required. Therefore, NWP is pushing to complete this project prior to the 5/8/92 mercury land ban date.

NWP initiated the process by determining every location where mercury meters had been installed or where mercury manometers had been used. The sites identified in the Nortwest Region of the Washington Department of Ecology are listed in Table 1. The mercury meters in service at that time were targeted for replacement with dri-flow meters that don't utilize mercury.

All of the sites identified were placed on a pre-cleanup sampling list. NWP then contracted with MH Services, Inc. to conduct mercury vapor and soil sampling at all mainline meter locations prior to the start of the cleanup project. The purpose of the sampling was to determine which sites needed to be placed on the soil remediation list.

The site characterization sampling involved the determination of both mercury vapor levels and mercury presence in the soil. A Bacharach MV-2 (MV-2) was utilized to determine the level of

Table 2. **Mercury Cleanup Site - Soil Cleanup Completion Information**

SITE NAME	EPA ID #	DATE SITE COMPLETED	# OF DRUM FILLED	# OF SAMPLES	SAMPLE #1[1]	SAMPLE #2[1]
BELLINGHAM I M/S	WAD988479028	11-Feb-91	7	2	0.35	53.00
COVINGTON M/S	WAD988475638	05-Oct-90	2	1	92.00	
ENUMCLAW M/S	WAD988479085	13-Feb-91	3	1	1.00	
ISSAQUAH M/S	WAD988479093	12-Feb-91	4	1	0.20	
NORTH SEATTLE M/S	WAD988478962	12-Feb-91	2	2	47.00	1.10
NORTH TACOMA M/S	WAD988479002	14-Feb-91	4	1	1.10	
SEDRO WOOLEY M/S	WAD988478988	10-Oct-90	3	1	31.00	
SNOHOMISH C/S	WAD000642165	06-Oct-90	1	1	74.00	
SNOHOMISH M/S	WAD988479226	06-Oct-90	1	1	37.00	
SOUTH SEATTLE M/S	WAD988475646	05-Oct-90	4	1	2.40	

[1] All samples are total Mercury results given in mg/kg (ppm).

mercury vapor in the meter house. The X-Met 880 (X-ray fluorescence analyzer, see Appendix A) was used to screen the soil/gravel floor within the building to determine the total Mercury concentration in the soil. MH Services' sampling methodology and conclusions are discussed in their final report found in Appendix B and the results of the sampling for each site listed in Table 1 may be found in Appendix C.

Cleanup Action and Monitoring

The results of the pre-cleanup sampling conducted by MH Services, Inc. were evaluated using the following criteria to select contaminated sites requiring soil cleanup. The site was considered for cleanup, if:

1) Mercury vapor levels detected at ground level exceeded 0.05 mg/m^3; or

2) there was visible mercury present; or

3) the X-MET 880 detected mercury contaminated soil in the medium range or above (with no interference noted) and either mercury vapor or visible mercury was also detected. Low and trace contamination levels were considered non-conclusive because low and trace levels were detected in several background samples. The presence of mercury vapor or visible mercury usually correlated with the X-MET readings. This provided confidence with the model and indicated that there was no interference which might give a false, high reading.

In addition, if a site was known to have a concrete floor it was eliminated from the site cleanup list. The reason for this was that free Mercury that had been spilled on the floors had been cleaned up and the cleanup project was directed at removing contaminated soils.

NWP determined, based on these criteria, that ten (10) out of the seventeen (17) sites within the Nortwest Washington Region required soil cleanup.

NWP contracted with U.S. Pollution Control, Inc.'s, Remedial Services Division (USPCI) to cleanup mercury contaminated soils and provide transportation and disposal of soil and debris from the meter stations. Prior to any soil cleanup at the sites all mercury containing instrumentation was removed from service in order to ensure that sites would not be recontaminated after the soil remediation had been completed.

USPCI hand excavated gravel and soil from the contaminated sites. The material to be removed included first the layer of gravel from all locations identified in the pre-cleanup sampling reports as being contaminated. Then all soil that was visibly contaminated was removed. And finally, through the use of a Jerome 411 Mercury Vapor Analyzer (Jerome) all contaminated soil was removed until the vapor readings were less than .005 mg/m^3. Empty (clean) mercury meters, contaminated personal protective equipment, and other debris were combined with the gravel and soil, and placed in properly labeled drums for disposal as hazardous waste (D009) at USPCI's Grassy Mountain Facility near Clive, UT.

Note: There was one (1) site with a concrete floor where the remediation contractor removed contaminated soil from outside the building. The site was the North Seattle Meter Station.

Upon completion of site cleanup, based upon the Jerome mercury vapor readings, soil samples were collected for laboratory analysis of Total Mercury. When the cleanup project was initiated the method for collecting cleanup verification samples was to collect samples from the five areas with the highest vapor readings and composite them for a single sample from the site. This method was replaced with a sampling grid methodology on 10/18/90. The procedure for setting up the sample grid and sample collection is outlined in Appendix D.

Information regarding the site cleanup and cleanup verification sampling results is found in Table 2.

Table 1. **All Mercury Meter and Manometer Sites in Northwest Region of Washington Deptment of Ecology**

SITE NAME	COUNTY	TWNSHP	RANGE	SECTION	QUARTER	QTR-QTR
BELLINGHAM I M/S	WHATCOM	38N	3E	10	SE	SW
BELLINGHAM II M/S	WHATCOM	40N	4E	11	SE	SW
COVINGTON M/S	KING	22N	6E	31	NE	NW
ENUMCLAW M/S	KING	21N	5E	27	NW	NE
ISSAQUAH M/S	KING	24N	6E	21	NE	SW
LYNDEN M/S	WHATCOM	40N	4E	27	SW	NE
MOUNT VERNON C/S	SKAGIT	34N	5E	19	NW	
MOUNT VERNON M/S	SKAGIT	34N	5E	18	SE	SW
NORTH BEND M/S	KING	24N	6E	11	SW	NW
NORTH SEATTLE M/S	SNOHOMISH	27N	6E	17	SW	NE
NORTH TACOMA M/S	KING	20N	5E	7	NW	SW
OAK HARBOR M/S	SNOHOMISH	32N	3E	23	SE	SE
REDMOND M/S	KING	25N	6E	9	SE	NE
SEDRO WOOLEY M/S	SKAGIT	35N	5E	18	SE	NW
SNOHOMISH C/S	SNOHOMISH	27N	6E	32	NE	
SNOHOMISH M/S	SNOHOMISH	28N	6E	16	SW	SE
SOUTH SEATTLE M/S	KING	23N	5E	19	SW	

APPENDIX A.

Description of X-Met 880 X-ray Fluorescence Analyzer

X-MET XRF analyzers

X-MET MEETS THE NEED

With "just in time" manufacturing and statistical process control becoming dominant forces in the production environment, the need for fast, reliable quality control has never been more critical to success and profit. With this shift in analytical needs, traditional analytical instruments in central quality control laboratories may not meet the time constraints now required by production. Over the past 10 years Outokumpu has been meeting the need for product site testing with portable and benchtop X-ray fluorescence analyzers. Now Outokumpu continues these commitments with the introduction of the new X-MET 880 and 820: Easy-to-use X-ray fluorescence analyzers that are tough enough to withstand the hostile environment of the production area.

RANGE OF USES

Because no two users have the exact same analytical requirements, X-MET has been designed to allow the user to have total flexibility in configuring and programming his/her instrument. The versatility incorporated into each instrument has always been one of the strongest features of the X-MET product line.

WHAT IS X-RAY FLUORESCENCE SPECTROSCOPY?

X-ray fluorescence spectroscopy (XRF) is an analytical technique which allows for both qualitative and quantitative analysis of a sample's elemental composition. In XRF analysis, primary X-rays illuminate a sample. These X-rays cause the sample to emit characteristic X-rays from the elements contained in the sample. From the energy, or wavelength, of these fluorescent X-rays a qualitative analysis can be made. From the number of X-rays at a given energy a quantitative analysis is possible. With X-MET you can perform both types of analyses.

X-MET APPROACH TO X-RAY FLUORESCENCE ANALYSIS

Production of fluorescence X-rays

The X-MET instruments use radioisotopes, such as Fe-55, Cm-244, Cd-109 and Am-241 for the production of primary X-rays. Each source emits unique primary X-rays which cause a range of elements to produce fluorescent X-rays. The chart on pages 8 and 9 show which sources are best used for the analysis of each range of elements.

Detection of fluorescence X-rays

The heart of any XRF instrument is the detector and the energy resolution it offers. X-MET analyzers utilize room temperature, gas filled proportional counters for detecting of X-rays. Their rugged construction and wide operational temperature range make them ideal for small benchtop and portable analyzers. The X-MET detectors offer the best resolution commercially available in gas filled proportional detectors. This will guarantee you excellent handling of spectral overlaps.

Non-helium purged probes for light element detection

The major cost in operating most benchtop XRF analyzers is the helium purge required for the conventional light element probes. Since

X-rays from elements below Ti are severly absorbed in air, a helium purge is used to eliminate the air in the space between the sample and detector.

Outokumpu's solution is the light element probe, which minimizes the distance, and thus the air, between the sample and detector. This simple solution gives you the same performance as a helium purged instrument, without the cost of helium.

Fully interactive software

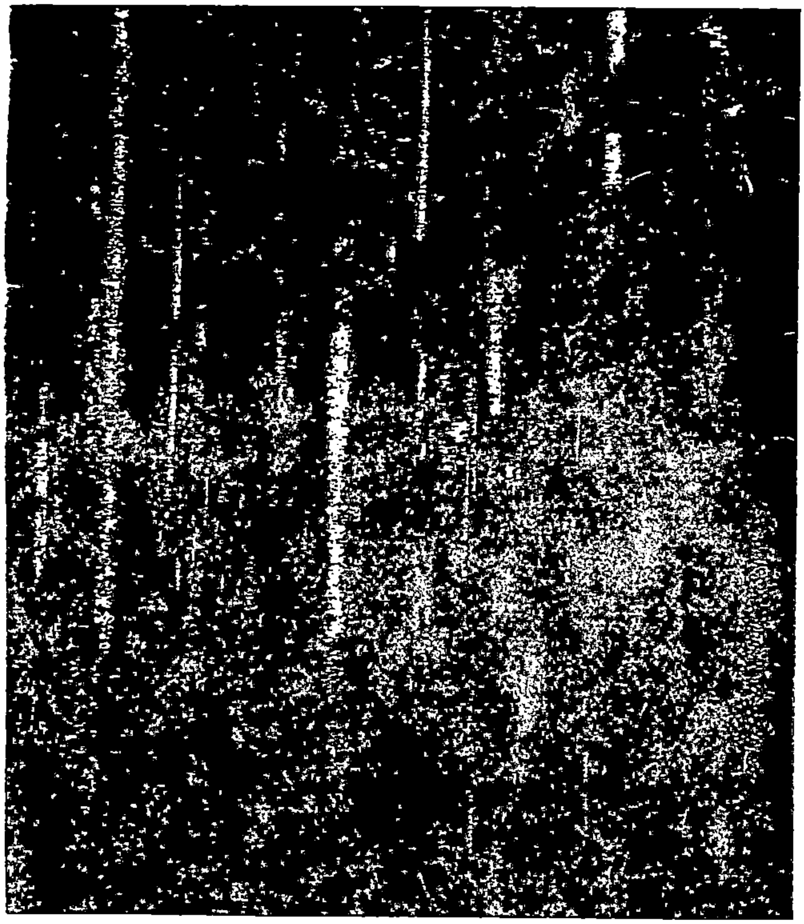
When more than one element is present in a sample, interelement effects exist and the key to proper analysis via XRF is the ability to handle these effects. X-MET lets you make these corrections with its interactive software. Up to 10 measurement windows can be set in the 256 channel multichannel analyzer spectrum of measured samples. Each window, including one for backscatter, monitors a different element and thus interelement effect. The multivariable regression model uses the intensities in these measurement windows to eliminate the interelement effects in the derived calibration curve. With such sophisticated modelling capabilities at your fingertips, you are insured accurate and precise analysis, even in a complex sample matrix.

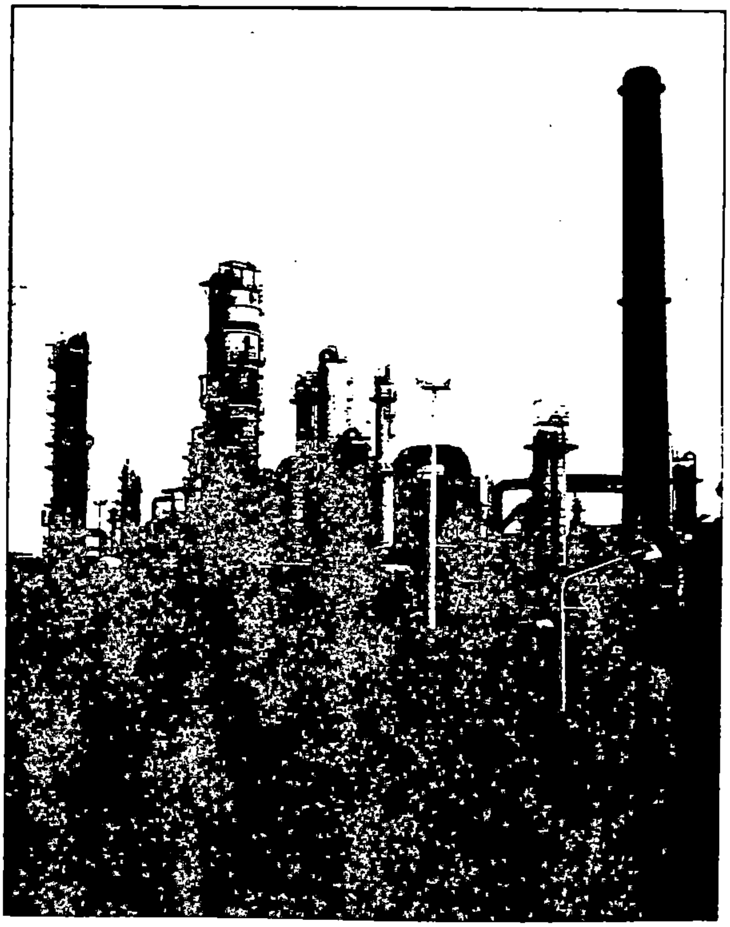
All parameters used for quantitative analysis and reference spectra for identification are stored in battery-backed up memory. The X-MET 880 stores up to 32 multielemental models and up to 400 user-measured reference spectra. All software for instrument utilization is resident in EPROM memory, thus allowing the X-MET instruments to work in stand alone mode.

Automatic instrument stabilization

The stability of the X-MET is automatically guaranteed. X-MET software performs gain control to keep the spectrum stable in the energy scale. It also automatically corrects intensity variations caused by source decay.

These automatic normalization routines are performed between measurement cycles of the probe. So they not only insure accurate analyses day after day, but also allow you to have maximum usable analysis time.





X-MET 880

X-MET 880

- Portable XRF analyzer
- On-the-spot analysis and identification
- Several probe types for analysis of liquids, slurries, powders and solids. Also a dual source surface probe for in-situ analysis.
- Automatic multiprobe switch box
- Flow through cell for on-line applications
- Internal storage for up to 32 multielement models
- Learning mode for alloy identification with 400-spectra reference library
- Built-in keyboard and LCD display with backlight
- Built-in battery for 10 hours of field use

The X-MET 880 is a modular portable XRF analyzer composed of an electronics unit and a variety of probe types. This allows the user to configure the system to meet his or her exact analytical requirements. The X-MET 880 is designed to be used flexibly as either a field portable or laboratory benchtop analyzer. The instrument has a 10 hour built-in battery pack for continuous field use. A keyboard facilitates access to the internal software functions without a separate terminal. The hermetically sealed electronics unit and probe meet the environmental specification IP55 and allows the instrument to stand the most adverse weather conditions.

PROBES FOR X-MET 880

A variety of powders and liquids can be analyzed with the sample probes. Large solid samples are measured using the special surface probes.

ALLOY IDENTIFICATION

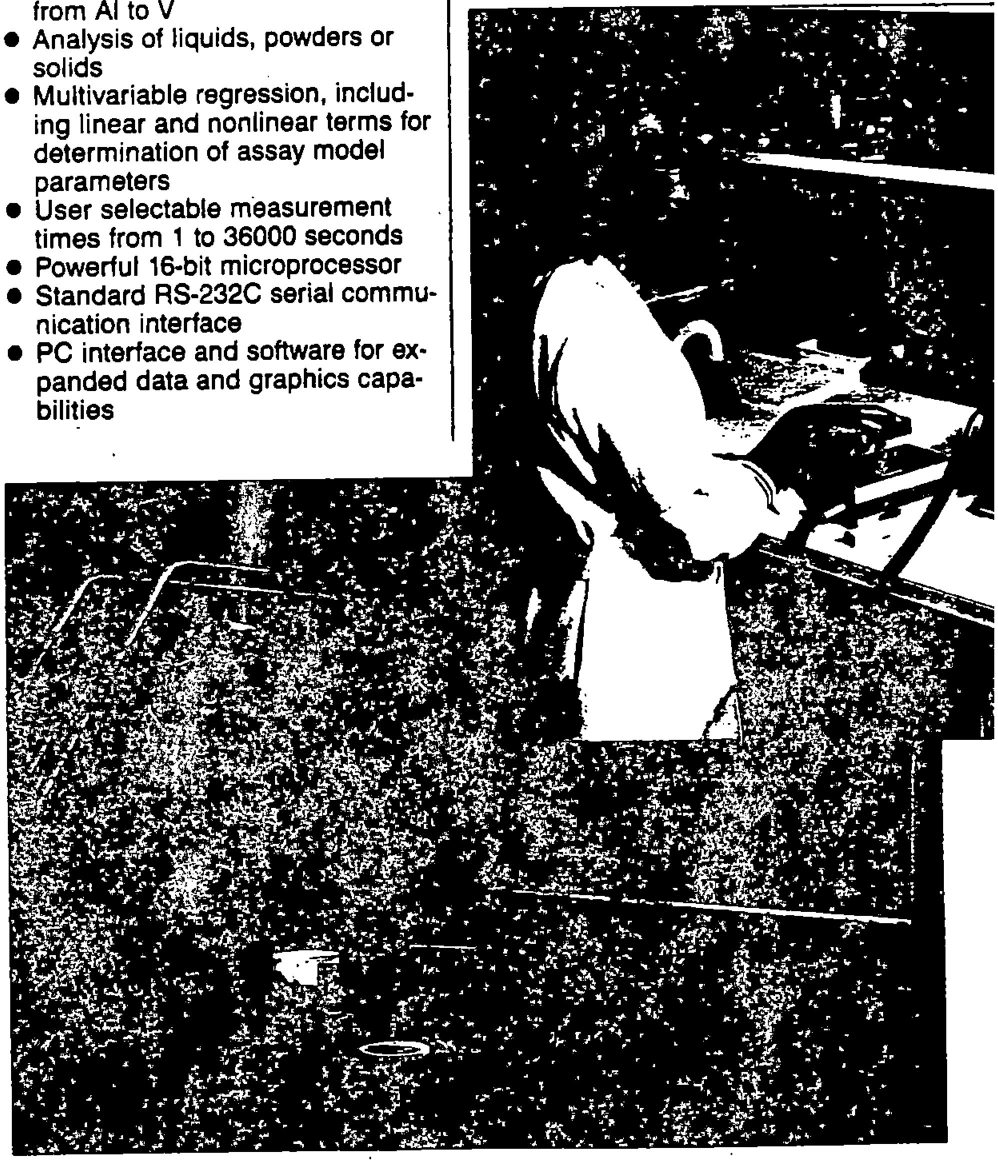
Up to 400 alloys can be measured and the results stored in the X-MET 880's memory. When measuring an unknown alloy, the X-MET 880 compares its spectrum with those stored in the memory and determines which one gives the best correspondence. If the correspondence is adequate the X-MET 880 will display the name of the appropriate alloy. When the correspondence is only approximate, the names of one or two possible matches will be shown. The X-MET 880 will also tell you if the unknown alloy corresponds to none of the stored ones.

STANDARD X-MET FEATURES

- Matched sources and detectors for optimum analysis of elements from Al to U
- Simultaneous analysis of up to 6 elements in each program
- Interelement correction for up to 10 elements
- Non-helium purged light element probe for analysis of elements from Al to V
- Analysis of liquids, powders or solids
- Multivariable regression, including linear and nonlinear terms for determination of assay model parameters
- User selectable measurement times from 1 to 36000 seconds
- Powerful 16-bit microprocessor
- Standard RS-232C serial communication interface
- PC interface and software for expanded data and graphics capabilities

AUTOMATIC MULTIPROBE OPERATION

A new electronic switch box allows the user to connect up to six probes to one electronics unit. The switch box can be programmed with up to fifty steps. Each step recalls the proper analysis model and, at the same time, selects the associated probe. This capability allows the user to control the occurrence and order of analysis. In the continuous analysis mode, the X-MET repeats the sequence continuously.
RS-232C/RS-422C communications and 0—5 V analog output connectors are provided.



Typical X-MET Applications

X-MET analyzers have been field tested for over 10 years in a variety of analytical applications. The following list describes some typical X-MET application areas.

Sorting, identification and analysis of metals

Multi-element analysis of ferrous and non-ferrous metals, iron and low/high alloy steel; cobalt, nickel, titanium based alloys; aluminium alloys, brasses, bronzes. All the above in many forms such as plates, welds, pipes, wires, slags, powders, dusts, sludges, etc.

Mining and minerals

- Metallic and non-metallic minerals, e.g. Ag, Pb, Zn, Cu, Ni, Fe, Mn, Cr, Mo in ores
- Fe, TiO_2, $CaCO_3$, K_2O, Al_2O_3, SiO_2 in clays
- Sn, Ag, S in slag
- CaO, P_2O_5, SiO_2, Al_2O_3 in phosphate rock
- Si, S, Ca, Ti, Al, Fe in bauxite ores
- Cu, Pb, Zn, Fe in flotation plant samples
- Si, Fe in iron concentrate
- Ti, Zr, Fe, Pb in sand

Pulp and paper

- Inorganic fillers in paper
- Coating weight measurement of TiO_2, $CaCO_3$ and clay
- Si coating on paper

Petroleum

- Sulphur in oil
- Lead in gasoline
- Lubrication oil additives
- Cutting oil additives
- Wear metals in lubrication oils

Chemicals and catalysts

- CaO, P_2O_5 in phosphoric acid plants
- V, Ca, P, Mo, Ni and Co in HDS catalysts
- Inorganic catalysts Al, Cl, Mo in process streams
- Fe and Ni in organometallics
- Ca, Cl, Cu, Br in organic solutions
- Pb in paint
- TiO_2 and clay pigments in paint
- Metal pigments in printing inks
- Sb, Zn, Br, P, Cl flame retardants in plastics
- Ti, Cl, I, Br in plastics
- SiO_2 filler in plastic
- Sn in PVC pipes
- Ag in photographic emulsions
- Formulation control in detergents

Plating baths

- Au in gold plating baths
- Cu in copper plating baths
- Ag in silver plating baths
- Ni, K, Co in plating baths

Films and coatings

- Ru, Ir, Ta, Pt on electrodes
- Ag on photographic film
- Ni and other metals in films
- Zinc phosphate coating on steel
- Aluminium coating on steel
- Epoxy coating on aluminium
- Si coating on plastic films

Environmental

- Hazardous materials (e.g. Pb, As, Cr, Cd) in waste sludge
- On-site analysis of contaminated soils and ground water
- PCB in transformer oil
- S in coal

APPENDIX B.

MH Services Final Report

Final Report for Mercury Investigation

Prepared by MH Services For
Northwest Pipeline Corporation

October 12, 1990

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1.0 INTRODUCTION

MH Services, Inc. provided Northwest Pipeline Corporation a proposal for the sampling of mercury vapor and mercury contaminated soil at approximately 200 sites along Northwest's mainline. The purpose was to outline the schedule and activities associated with this undertaking. MH Services, Inc. was subsequently awarded a contract to implement the work plan which had been outlined in said proposal. The following is a summary of the actions and findings which resulted from this work.

2.0 SCOPE OF WORK

2.1 PROPOSED SCOPE OF WORK

The initial work plan called for utilizing a Bacharach MV-2 and an X-Met 880 for field measurements. The plan called for measuring the level of mercury vapor in mainline meter buildings by entering the building and sampling the ambient air with the MV-2. Then, after "airing out" the meter building, a second sampling would be carried out to determine what effect the venting of the building had on mercury vapor levels. Following vapor measurement the X-Met 880 was to be used for "screening" the soil and/or gravel floor within the building. The original plan called for analysis of two indiscriminate points directly under the location of the mercury meters. Additionally, two points at a depth of one foot would also be analyzed. These would also be directly under the mercury meters. Further assessment of the building's interior would include "screening" samples from each of the building's corners. The plan called for recording all data generated from the aforementioned.

2.2 VARIATIONS IN SCOPE

While the Bacharach MV-2 and X-Met 880 were utilized as originally proposed, alterations to the original scope of work were necessitated by field conditions. Because of procedures associated with Northwest's "hot work permits", meter buildings had to be checked for the potential of a combustible atmosphere. In most cases, the meter buildings were "aired out" prior to entering and performing vapor measurements with the MV-2. This usually involved opening all windows and doors in order to vent what gas may have been present. Because of this, the vapor measurements were directed more towards the floor of the buildings and in the proximity of suspected mercury contamination. The measurements recorded and presented in the field reports then, reflect near surface analysis of mercury vapor (unless otherwise noted).

The X-Met 880 was used as originally proposed with the exception that the number of sample points increased in an effort to better define the extent of contamination. As an example, when the analysis of a sample point at a one foot depth showed a presence of mercury, samples were taken at depths below that point in an effort to define the depth of contamination. Thus, in most cases there were approximately 50% more sample points than originally proposed.

Additionally, twenty three site locations were added to the original list of meter buildings. These additional sites were located along Pacific Gas Transmission's mainline which extends from the Idaho panhandle to southern Oregon. As a result, work on the Northwest mainline was interrupted so that the PGT sites could be assessed.

There were numerous sites (PGT & NWP) which had a concrete floor. In these cases, mercury vapor was the primary focus of analysis as the X-Met 880 was not calibrated for concrete surfaces. The MV-2 was used to measure mercury vapor in side the buildings and the X-Met 880 was used outside and at the perimeter of the building. In this way, it could be determined if mercury had migrated in some manner outside of the building. Findings are presented in the field reports.

3.0 PROJECT STAFF

MH Services, Inc. assigned Mr. Mark Harvey to begin the field program as outlined. Mr. Harvey is a degreed Geologist with varied experience in both the environmental business and oil and gas industry. Mr. Harvey initiated field activities and worked until July 21, 1990, having completed assessment of seventy seven sites. After that date, another Geologist, Mr. Jim Struhs, was assigned to complete the project. Mr. Harvey and Mr. Struhs worked together the week of July 16, 1990 in order to facilitate a smooth transition. Mr. Struhs completed the project on August 22, 1990.

4.0 HEALTH & SAFETY

Personnel assigned to the project were 40 hour OSHA trained as required under 29 CFR 1910.120. Personnel were familiar with all requirements as well as personal protective equipment needed for this assignment. There were no on site injuries or accidents during the course of this action.

5.0 FIELD SAMPLING / ANALYSIS

5.1 VAPOR ANALYSIS

Utilizing a Bacharach MV-2 mercury vapor detector, vapor levels were measured at all sites. Because of the field conditions previously mentioned, vapor measurements were taken at or near floor level after the building had been aired. Consequently, there was no way of quantifying what effect, if any, venting the building had on mercury vapor levels. Moreover, due to the spatial variation in mercury vapors detected,it was difficult to establish accurate peak, average, and low level measurements. As an example, it was common to find a trace to greater than 1.0 mg/m3 within a three square foot area. The Bacharach was used more to assist in pinpointing and confirming mercury contamination than it was to measure mercury vapor in the breathing zone. Thus, in most cases, the field reports lack peak, average, and low level readings.

5.2 SOIL ANALYSIS

The X-Met 880 was used as a "screening" tool to try and determine if mercury contamination was present. While not able to give an accurate concentration, the X-Met provided a rough order of magnitude analysis of mercury contamination. From this information, the areal extent and depth of contamination could be reasonably ascertained. Numerous models were set up to try and maintain a certain level of reliability. This involved taking background soil samples and spiking with a known mercury level of a standard matrix. When results from the X-Met were suspected of being inaccurate, and/or when the soil type changed significantly, the field Geologist would set up a new model accordingly. Due to the large geographic region covered, the corresponding variations in soil characteristics, and an effort to minimize costs, more accurate results were not possible.

6.0 CONCLUSIONS AND RECOMMENDATIONS

As this field assessment was to provide information with which to make an informed decision about which sites required remediation or additional assessment,it was successful. As mentioned earlier, the large geographic region covered presented unique problems when trying to utilize the X-Met. The X-Met can and has been used successfully to obtain much more accurate analytical information. However this requires setting up calibration standards for the soil (or matrix) of interest. In this case probably ten to fifteen different sets of standards would have been required to get more than rough order of magnitude analysis. This would have contributed significantly to the cost of this assessment with a higher level of detail the only result. The basis for making a determination about remediation might have been better substantiated, but the end result would likely be the same.

Due to the conditions previously mentioned in this report, mercury vapor levels in the breathing zone could not be measured accurately. It should be noted that measurements in the breathing zone showed no detection of mercury vapor, except when visible mercury or other areas where there was significant vapor near the surface were disturbed. Mercury vapor measurements approached or exceeded the permissible exposure limit (PEL) of 0.05 mg/m3 TWA in these cases. These cases are referenced in the field reports provided earlier.

Generally, mercury contamination was localized directly under the meters. However, as mentioned in the field reports, variations in contamination patterns existed. There were cases where a much greater area was contaminated. In part it was attributed to construction activities within the buildings and the practice of raking the gravel floors.

It appeared that in most cases visible mercury could be found when X-Met readings were high and there was corresponding vapor detection. Thus, it seems reasonable to use two of three indicators (X-met, vapor, visual) as a basis for remediation and/or further assessment.

7.0 PROJECT LIMITATIONS

MH Services, Inc. conducted this assessment in accordance with generally accepted environmental science procedures. It is provided specifically for the use of Northwest Pipeline Corporation and their agents. The information provided to Norhtwest Pipeline was obtained and prepared based on site conditions as they existed at the time of this assessment. Should site use or conditions change, the information may no longer be valid.

APPENDIX C.

Field Reports -
MH Services Site Investigation

SERVICES, INC. 1717 S. 8th ST. • COLORADO SPRINGS, CO 80906 PHONE: 719-632-5613 • FAX: 719-578-1050

July 23, 1990

Mr. Dave Loff
Northwest Pipeline Corp.
295 Chipeta Way
Salt Lake City, Utah 84158

Dear Dave,

As a way to offer clarification on abbreviations used on field reports, I have listed the following:

NR: Nearest reference
ND: No detection
BS: Below surface
SP: Sample point
NGM: No good match
GM: Good match
PM: Possible match

As for X-Met readings, I can give you a range which I can reasonably say is valid. As you and Lori are both aware, without specific calibration standards for specific soil types, I cannot achieve any more accuracy with the models being used. While different soil types greatly affect the reliability of the readings, I am confident that the five models being used can be examined for correlations and that interpretation of those readings can yield the following:

ND - No detection to 100ppm
Trace - 75ppm to 400ppm
Low - 250ppm to 750ppm
Medium - 750ppm to 3500ppm
High - 2500ppm to 7500ppm
Very High - 7500ppm to 15,000ppm
High-Visual - > 10,000ppm

Understand that there is really no sharp dividing line between readings, it is the best fit of the spectrum and amplitude of the peak which the X-Met examines.

What may be a "HIGH" with one soil type, could be a "MEDIUM" with another. I believe this is evident from the ranges provided.

If you have questions or need additional information please feel free to contact me.

Sincerely,

Mark Harvey
MH Services, Inc.

gm/MBH

APPENDIX D.

Mercury Site Cleanup
Remediation Confirmation Sampling Procedure

MAINLINE MERCURY CLEANUP CONFIRMATION SAMPLING PROCEDURE

Upon completion of site cleanup, based on Mercury vapor readings, a sample grid was laid out and composite samples collected for laboratory analysis of total Mercury. The procedure for setting up the sample grid and sample collection is outlined below.

A. Sample Grid

The sample grid was setup on 18" centers with the starting point being directly under the "#1 Recorder". From the starting point, the grid was laid out on 18" centers, running parallel and perpendicular to the face of the "#1 Recorder". A sample was collected from each point that fell within the excavated area.

For the two sites with concrete floors that were cleaned up after 10/18/90, Goldendale Compressor Station and Prosser Meter Station, USPCI set sample points around the perimeter of the meter buildings. The points were set six (6) inches from the outside of the building and 18 inches apart.

B. Sample Collection

Each sample for laboratory analysis was a composite sample of no more than five (5) points per composite. After the grid was laid out, the sampler would decide which contiguous sample points to group for each composite. The sampler would group them so there would be as few composite as necessary, no more than five points per composite,and so that each composite would have approximately the same number of points. For example, if there were 11 points within the excavated area, three (3) composites would be required. The points would be divided up so there would be four (4) points in two of the composites and three (3) points in the other composite.

At each sample point a level 8 ounce (one cup) scoop was collected and placed in a hard plastic container with a smooth interior surface. Once each sample point of a composite had been sampled, a tight lid was placed on the container and the container shaken vigorously in order to mix the composite sample. Then, two 8 ounce jars were filled with the mix, one to be sent to the laboratory and one for Northwest Pipeline. The two jars were labeled identically with a three letter site designation and a two or three digit sequence number (i.e., the second composite collected at John Day Dam meter station was marked JDA-002).

The remaining sample material was placed back in the excavation and the plastic container, measuring cup, and digging trowel wiped clean with a moist cloth to prevent potential contamination of the next composite sample. If the hard plastic container became etched through repeated use and could not be cleaned, it was replaced with a similar container.

This procedure was followed until all points within the grid had been sampled. For any composite sample containing 3 or fewer points, equal amounts of material were collected from each point to ensure that when the composite was split that there would be enough material for both the lab sample and NWP's sample.