Department of Energy

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NOV 04 2003

Mr. James A. Saric, Remedial Project Manager
United States Environmental Protection Agency
Region V, SR-6J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

DOE-0022-04

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

LEAK LOCATION TESTING RESULTS FOR ON-SITE DISPOSAL FACILITY CELL 6 PRIMARY GEOMEMBRANE LINER AND REQUEST TO START IMPACTED MATERIAL PLACEMENT

Reference: Memorandum, K. Badu-Tweneboah and D. Phillips to U. Kumthekar and C. Van Arsdale, "Preliminary Evaluation of Potential Problem with Extrudate Welding Rods," dated September 23, 2003

The purpose of this letter is to inform you that the construction and subsequent leak location survey of the On-Site Disposal Facility (OSDF) Cell 6 has been successfully completed. Two leak tests have been conducted on the Cell 6 primary HDPE liner. The additional leak test was requested by the United States Environmental Protection Agency (USEPA) and Ohio Environmental Protection Agency (OEPA) due to a suspected quality problem associated with a batch of welding rods used in portions of the primary HDPE liner and the subsequent decision to only selectively fix these extrusion-welded locations (reference). This letter also summarizes the final leak location survey conducted after placement of the drainage layer and repair of three identified leak locations. With the completion of this test, Cell 6 is ready for impacted material placement pending regulatory approvals of the attached two test reports.

During installation of the Cell 6 primary geomembrane liner, our Construction Quality Control Consultant, GeoSyntec Consultants Inc., noticed that an unusually large number of extrusion-welded destructive seams were failing in both field tests and laboratory tests. The specimens were typically failing in the peel mode; the average peel strengths were adequate but the ASTM D 6392 break code indicated failure in adhesion or through the fillet weld.

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Initially, it was suspected that the problem was either due to the welder or the welding equipment (i.e., extrusion welding gun). But similar results were obtained with different welders and different extrusion welding guns. Examination of trial welds after grinding part of the extrudate revealed the presence of small voids that indicated that continuous bonding of the parent material with the extrudate was not being achieved. However, there were no holes in the seams that would allow leakage through the liner. Typically, these small voids or holes are due to the presence of moisture and/or dirt on the welding rod or geomembrane being welded. But after careful inspection of the welding rods and trial seams, it was suspected that the potential problem was with the welding rod. This was confirmed when air pockets or tiny holes were observed trapped in the plastic after slicing into the welding rod. It appears that as the rod was being fabricated (i.e., extruded through the machine), air voids were caused by the vaporization of free water within the plastic. It is possible that the quick cooling of the rod caused the air voids to be trapped and thereby, producing a second-quality rod. The presence of additional free water or the resulting voids then prevented bonding of the extrudate to the parent material during welding which could have resulted in the seam failing in adhesion or through the fillet weld.

On September 11, 2003, Fluor Fernald, Inc. requested an additional 45 reels of new welding rods with backup certification to replace the other rods on site. We received reels of the new welding rods on Friday, September 12, 2003 and Monday, September 15, 2003. Fluor Fernald received the backup certification on September 17, 2003. Examination of the new rods and trial welds did not reveal the presence of the tiny holes in the rods or worm holes in the weld. Also, destructive samples completed with the welding rods passed in the field and laboratory with no signs of failure in adhesion or through the fillet.

Since the welding rod problems were discovered only on the primary geomembrane, GeoSyntec Consultants recommended to Fluor Fernald, via a September 23, 2003 memorandum (referenced), to repair suspect extrusion seams except for small seams that seams included patches at destructive test locations, T-seams and patches for small holes, tears, etc., which were small in dimension and were located on the bottom (two percent slopes) or on the 4H:1V side slopes of the cell. This recommendation was based on the fact that repairing these seams was not necessary, and would even be detrimental. Repairs were made to the relatively long (seven feet or greater) capped seams, and seams at locations with potential stress concentrations, such as the tie-in to the liner penetration boxes, grade breaks, steep slopes, and toe of slopes.

On September 26, 2003, a conference call was held among representatives of Fluor Fernald, USEPA, and OEPA to discuss the next step based on the data and recommendations presented. The USEPA and OEPA jointly requested an additional leak location test to be performed on the primary geomembrane liner after placement of the overlying geotextile cushion and granular drainage layers.

This leak location survey was performed on October 15-17, 2003 by the same company that performed the previous survey on the bare geomembrane, as required by the project specifications. Three leaks were found on the primary geomembrane liner. The first leak was an approximately 1 1/2-inch long cut. The second leak was approximately ¼-inch cut on a scuff mark. Both leaks were located near the tie-in with Cell 5. The third leak was a hole less than 1/16-inch diameter that was located near the middle of the cell floor. The hole and cuts locations were uncovered with the help of laborers; repaired and nondestructively tested (using the vacuum-box method) by the geosynthetic installer; and retested with the leak location survey equipment after placement of the geotextile cushion and granular drainage layers. Details on the leak location procedures, leaks, and retesting after the repairs are presented in the enclosed survey report.

Based on the construction quality assurance performed on the geomembrane liner, including the leak location testing on the bare geomembrane (Attachment 1) and after placement of the drainage layer (Attachment 2), the cell is ready to be completed and certified.

As requested by the USEPA and OEPA, the enclosed leak test reports need to be submitted for review and approval prior to initiation of impacted material placement in Cell 6.

If you have any questions or need further information, please contact Johnny Reising at (513) 648-3139.

Sincerely,

Glenn Griffiths

Glenn Griffiths
Acting Director

FCP:Reising

Enclosures: As Stated

cc w/enclosures:
J. Reising, OH/FCP
D. Pfister, OH/FCP
T. Schneider, OEPA-Dayton (three copies of enclosures)
G. Jablonowski, USEPA-V, SR-6J
M. Cullerton, Tetra Tech
F. Bell, ATSDR
M. Shupe, HSI GeoTrans
R. Vandegrift, ODH
AR Coordinator, Fluor Fernald, Inc./MS78

cc w/o enclosures:
R. Greenberg, EM-31/CLOV
N. Hallein, EM-31/CLOV
K. Johnson, OH/FCP
R. Abitz, Fluor Fernald, Inc./MS64
K. Badu-Tweneboah, GeoSyntec, MS38
T. Beasley, Fluor Fernald, Inc./MS60
J. Chiou, Fluor Fernald, Inc./MS64
T. Hagen, Fluor Fernald, Inc./MS1
K. Harbin, Fluor Fernald, Inc./MS60
W. Hooper, Fluor Fernald, Inc./MS64
U. Kumthekar, Fluor Fernald, Inc./MS64
D. Powell, Fluor Fernald, Inc./MS64
T. Poff, Fluor Fernald, Inc./MS65-2
M. Stumbo, Fluor Fernald, Inc./MS60
C. Van Arsdale, Fluor Fernald, Inc./MS64
W. Zebick, Fluor Fernald, Inc./MS60
ECDC, Fluor Fernald, Inc./MS52-7

LEAK LOCATION SERVICES, INC. 5136
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September 26, 2003

Mr. Chuck Van Arsdale
Fluor Fernald, Inc.
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Cincinnati, OH 45253-8704

Fax: (513) 648-4528

Subject: Report for "Leak Location Survey of the DOE On-Site Disposal Facility Landfill Cell 6 Primary HDPE Liner Located Near Hamilton, Ohio"; Contract No. PHIV3 Revision 0

Dear Mr. Van Arsdale:

Leak Location Services, Inc. conducted an electrical leak location survey of the On-Site Disposal Facility (OSDF) landfill cell 6 Primary HDPE liner located at the DOE facility near Hamilton, Ohio. The newly constructed landfill cell 6 is approximately 7 acres and is double-composite lined with an 80-mil textured HDPE geomembrane liner and a geosynthetic clay liner (GCL). The electrical leak detection testing was performed on the bare cell geomembrane prior to placement of the geotextile cushion and subsequent upper protective soil layers. This report describes the results of the final leak location survey conducted on approximately 304,920 sq. ft of the bare HDPE landfill cell 6.

I. SURVEY RESULTS

A. Survey of Primary Geomembrane

On September10, 2003 through September 12, 2003 Martin Morales and Bryan Bergemann of Leak Location Services, Inc. conducted an electrical leak location survey of the On-Site Disposal Facility (OSDF) landfill cell 6 bare Primary HDPE liner. Six leaks were located on the landfill cell 6 bare Primary HDPE Liner. Figure 1 shows the area that was surveyed by the LLSI field crew and the location of the leaks. Table 1 lists the locations and descriptions of the leaks. The LLSI personnel retested the leaks that were repaired to verify that there were no additional leaks present near the repairs. The water puddle squeegee method was used to test the bare Primary HDPE liner.

B. Survey of Cap Strips

On September 24, 2003 Martin Morales of Leak Location Services, Inc. retested nine Cap Strips of the On-Site Disposal Facility (OSDF) landfill cell 6 bare Primary HDPE. The shaded areas on figure 1 represent the nine Cap Strips that were retested by the LLSI personnel. No leaks were found on the areas that were retested. The water puddle squeegee method was used to retest the shaded areas of the landfill cell 6 bare Primary HDPE.

II. CALIBRATION OF EQUIPMENT

The leak location survey equipment was tested for proper operation and functionality at the beginning and end of each day and routinely tested the equipment operation during the course of the work day. This test consisted of passing the squeegee sensor over a known hole in the primary liner to test operation and functionality of the equipment. In addition, a second test was performed to check the calibration of the equipment by placing a 0.0625 inch-diameter hole on a test pad placed on earth ground outside the testing area. These tests were documented and witnessed by a representative of the CQA engineer. The testing was performed in accordance with Fluor Fernald's Technical Specifications, Construction Quality Assurance Plan, Construction Drawings, and approved Electrical Leak Detection testing work plan.

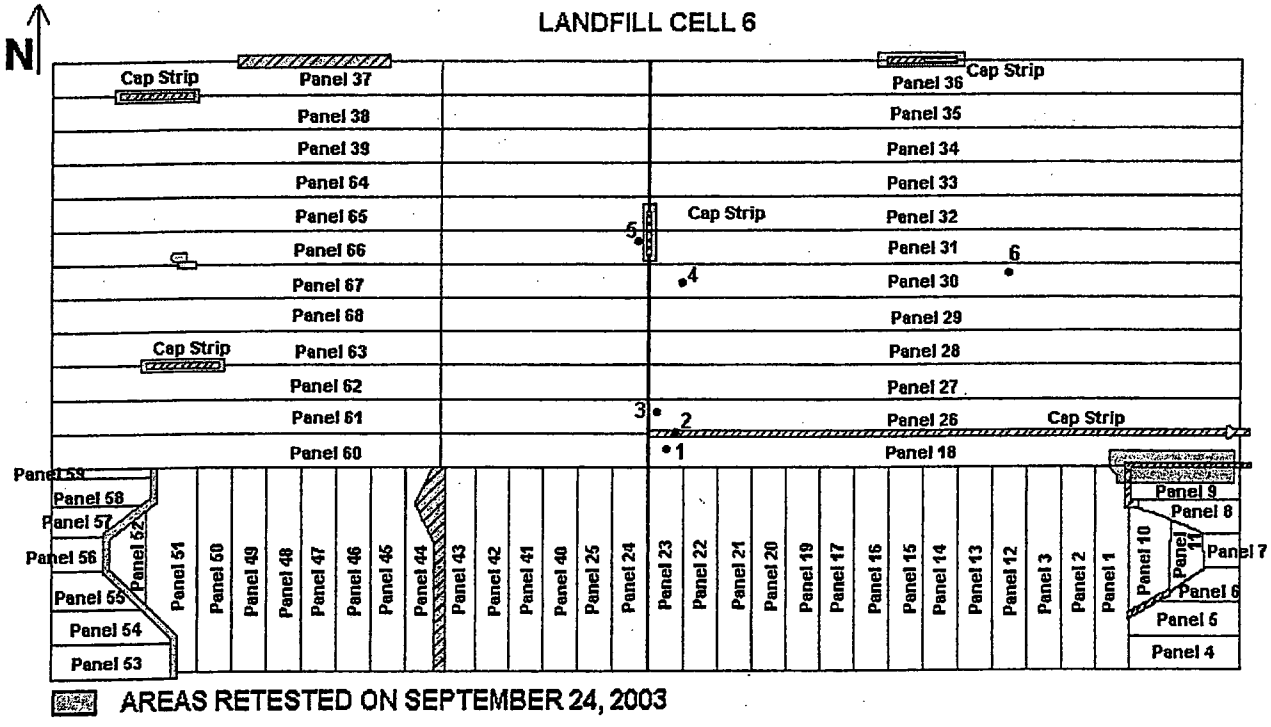

FIGURE 1. APPROXIMATE LOCATION OF LEAKS LOCATED IN LANDFILL CELL 6

TABLE 1. LOCATIONS AND DESCRIPTIONS OF THE LEAKS

Leak Number	Location	Description
1	Located on panel 18 near RP40	Pin Hole
2	Located on center of cap between panels 26 and 18	Pin Hole
3	Located on panel 26 near R204	Pin Hole
4	Located on panel 30 near RP235 and RP236	Pin Hole
5	Located between panels 65 and 66 near the center weld	Pin Hole
6	Located on panel 30 near RP87	½" long cut

III. LEAK LOCATION PROCEDURES

A. General

The water puddle test for bare liners was used to test the On-Site Disposal Facility landfill Cell 6. This method detects electrical current flowing through holes in the geomembrane liner that are filled with water or other earth materials. A water puddle test sensor was used to systematically spread the water over the top surface of the liner and a low voltage leak power supply was used to energize the water with electrical current. The low voltage leak power supply is connected to an electrode placed in leak detection soil drainage layer located below the primary liner and the water puddle sensor head. When a hole in the liner is encountered water will fill the hole or contact the soils in the hole and electrical current will flow between the electrode located above and below the primary liner. The change in electrical current is monitored using an LLSI leak that converts the increase in the current to an audible tone indication.

B. Water Puddle Leak Detection Sensitivity

LLSI has redesigned the leak detection electronics to obtain a higher leak detection sensitivity while utilizing a lower excitation voltage. In addition, we have incorporated the self-contained excitation power supply within the hand-held leak detection electronics. This modification eliminated the requirements of using a gasoline-powered portable motor generator to supply 120 volt A.C. power to an external stand-alone leak location power supply.

When conducting an electrical leak location survey the measured electrical signal of a leak located in the geomembrane is directly proportional to the excitation voltage and the sensitivity of the detector electronics. Therefore, the excitation voltage can be decreased if the sensitivity of the detector electronics is increased. This can be achieved without lowering leak detection performance.

The previous excitation voltage that was used at the Fluor Fernald site was 30 volts D.C. with a leak detector sensitivity of 50 microamperes or greater for a full scale reading (600,000 volts per ampere or less). The system was redesigned to operate using a self-contained power supply producing an excitation voltage of 18 volts with the a full scale detector sensitivity range of 23 to 2.25 microamperes (780,000 to 8,000,000 volts per ampere). The detector setting for the leak detection survey at the Fluor Fernald site was adjusted to 6 microamperes for full scale (3,000,000 volts per ampere).

The redesigned leak location system electronics has an increased sensitivity range that is 1.3 to 13.3 greater than the previous system electronics. However, the leak location survey that was currently being conducted of the landfill cell 6 located at the Fluor Fernald site were using a detection sensitivity that is adjusted to five times the sensitivity of the previous surveys conducted by LLSI at the same site. This sensitivity may have to be occasionally readjusted to reduce nuisance background noise, but in no case will the detection sensitivity be less than the detection sensitivity used on previous surveys.

C. Liner Wrinkles

The electrical leak location method detects electrical paths through the geomembrane material. This electrical conduction path is provided by soil, water or other electrical conductors bridging the geomembrane material and contacting the earth materials placed above and below the geomembrane. If the geomembrane is not in complete contact with the supporting earth materials then an electrical conduction path may not exist and leaks may not be detected.

Typically geomembranes are covered with earth materials such as water or soil. The weight of these materials helps to hold the geomembrane against the supporting sub-grade. In addition, the cover material keeps the geomembrane from exposure to the sun which helps to limit excessive wrinkling of the geomembrane material due to thermal expansion. However, a bare geomembrane does not have the advantage of the cover materials to help limit the wrinkling due to thermal expansion of the geomembrane material.

Bare liner water puddle surveys are conducted when the liner material is completely contacting the underlying geosynthetic clay liner (gcl). When wrinkles were, encountered measures are taken to ensure the liner is laying flat against the supporting material. These measures include:

- Using additional personnel to walk in front of the squeegee; and
- Surveying during the cooler time of the day.

Therefore, bare liner surveys are conducted during the cooler hours of the day or very early morning hours when the liner material is tight and in complete contact with the supporting sub-grade. In the areas where there were wrinkles in the liner of landfill cell 6, Fluor Fernald provided additional personnel to walk in front of and along the side of the squeegee to insure the liner was in complete contact with underlying geosynthetic clay liner (gcl).

If there are any questions regarding the leak location survey or this report, please contact us at (210) 408-1241. We appreciate the opportunity to have been of service once again to the Fluor Fernald, Inc on this project.

Very truly yours,

Herman Flores
Project Manager

Approved:

Daren L. Laine
President

LEAK LOCATION SERVICES, INC.

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October 28, 2003

Fluor Fernald, Inc.
P.O. Box 538704
Cincinnati, OH 45253-8704

Attention: Chuck Van Arsdale

Fax: (513) 648-4528

Subject: Final Report for "Leak Location Survey of the DOE On-Site Disposal Facility Landfill Cell 6 Primary HDPE Liner Located Near Hamilton, Ohio"; LLSI Project 381A

Dear Mr. Van Arsdale:

On October 14-17, 2003, Martin Morales and Edgar Barraza of Leak Location Services, Inc. conducted an electrical leak location survey of the On-Site Disposal Facility (OSDF) landfill Cell 6 Primary HDPE geomembrane liner located at the DOE facility near Hamilton, Ohio. The newly constructed landfill Cell 6 is approximately 7 acres and is double-composite lined with an 80-mil textured HDPE geomembrane liner and a geosynthetic clay liner (GCL). The electrical leak location testing was performed after placement of the geotextile cushion and 1-foot thick granular drainage layer. The bare geomembrane was previously surveyed for leaks on September10-12, 2003, and nine cap strips were retested on September 24, 2003. A separate report was issued for this work. This report describes the results of the final leak location survey for Cell 6 primary liner after placement of the geotextile cushion and granular drainage layer.

I. CALIBRATION OF EQUIPMENT

A performance test was used to determine the survey line spacing, evaluate leak location sensitivity for the survey, and verify proper equipment operation. A 0.25-inch artificial test leak was used. An artificial leak is an electrical simulation of an actual leak through the geomembrane. The artificial leak consists of a metal electrode with the same surface area as the leak that is required to be located. The artificial leak was connected to an insulated wire and placed on top of the geotextile cushion located above the geomembrane. The area surrounding the artificial leak was wetted with water and then covered with 12 inches of LCS granular drainage material. The opposite end of the insulated wire connected to the artificial leak was placed in contact with the primary GCL.

A line of data was recorded directly over the artificial test leak with the artificial leak disconnected and the power supply turned on to measure and quantify the background noise level (BN). This data was plotted on the computer to determine the background noise, which is defined

as the difference between the maximum and minimum measured voltage with the artificial leak disconnected.

The artificial leak was then connected and leak location measurements were made and recorded along closely-spaced parallel lines in the vicinity of the artificial leak and centered over the artificial leak. This data is the leak signal plus noise (S + N).

The recorded leak location data was examined to determine the peak-to-peak leak signal plus noise to background noise ratio R = (S +N)/BN. for each of the recorded data lines. The two farthest lateral lines of data with an R value greater than 3.0 were noted. The distance between these lines is the survey line spacing needed to detect the 0.25 inch diameter artificial leak. The leak location survey was performed so that the survey line spacing does not exceed the survey line spacing needed to detect the 0.25 inch diameter artificial leak.

II. LEAK LOCATION PROCEDURES

A high voltage isolated DC power supply was used to impress a voltage across the liner using one electrode placed in the cover material located on top of the primary liner and a second ground electrode placed in contact with the geosynthetic clay liner underneath the primary HDPE geomembrane. The geomembrane liner provides an electrical barrier between the electrodes except where there are holes in the geomembrane liner. Electrical current flowing through water, sand, or soil in the holes in the geomembrane liner produces localized anomalous areas of high current density near the holes. The electrical leak location method is to measure electrical potentials on the surface of the soil to locate these areas of high current density.

The leak location survey was conducted by making point-by-point potential measurements on the moist surface of the earth materials with half-cell electrodes. The measurements were collected and stored in a portable digital data acquisition system. A dipole electrode handle was used to space the half-cell electrodes 2.5 feet apart and allow an easy means to move the electrodes. The dipole measurements were made approximately every 2.5 feet along numbered survey lines that were spaced approximately 5 feet apart. Strings were laid 10 feet apart on the soil and the survey technician alternated taking data along the string and midway between the strings.

The data was collected using a portable digital data acquisition system using software for leak location data acquisition. The system recorded the data as well as the line number and position of each measurement. The data from the data acquisition system was downloaded in the field to a notebook computer for storage, display, plotting, and analysis.

A computer program was used to display the lines of adjacent data in a raster plot. This data was inspected for characteristic bipolar leak signals. When a leak signal was observed, its line number and position were noted. Manual measurements were made at the corresponding position on the LCS granular drainage material to further localize the position of the leak.

The leaks were excavated and repaired by the geosynthetic installer contractor. The leak location survey was repeated on the two closest survey lines for a distance extending 20 feet before and after the leak to determine if additional leaks were present.

III. SURVEY RESULTS

Three leaks were located in the Cell 6 primary geomembrane liner. Figure 1 shows the area that was surveyed by the LLSI field crew and the location of the leaks. Table 1 lists the locations and descriptions of the leaks. The LLSI personnel retested the leaks after they were repaired to verify that there were no additional leaks present near the repairs.

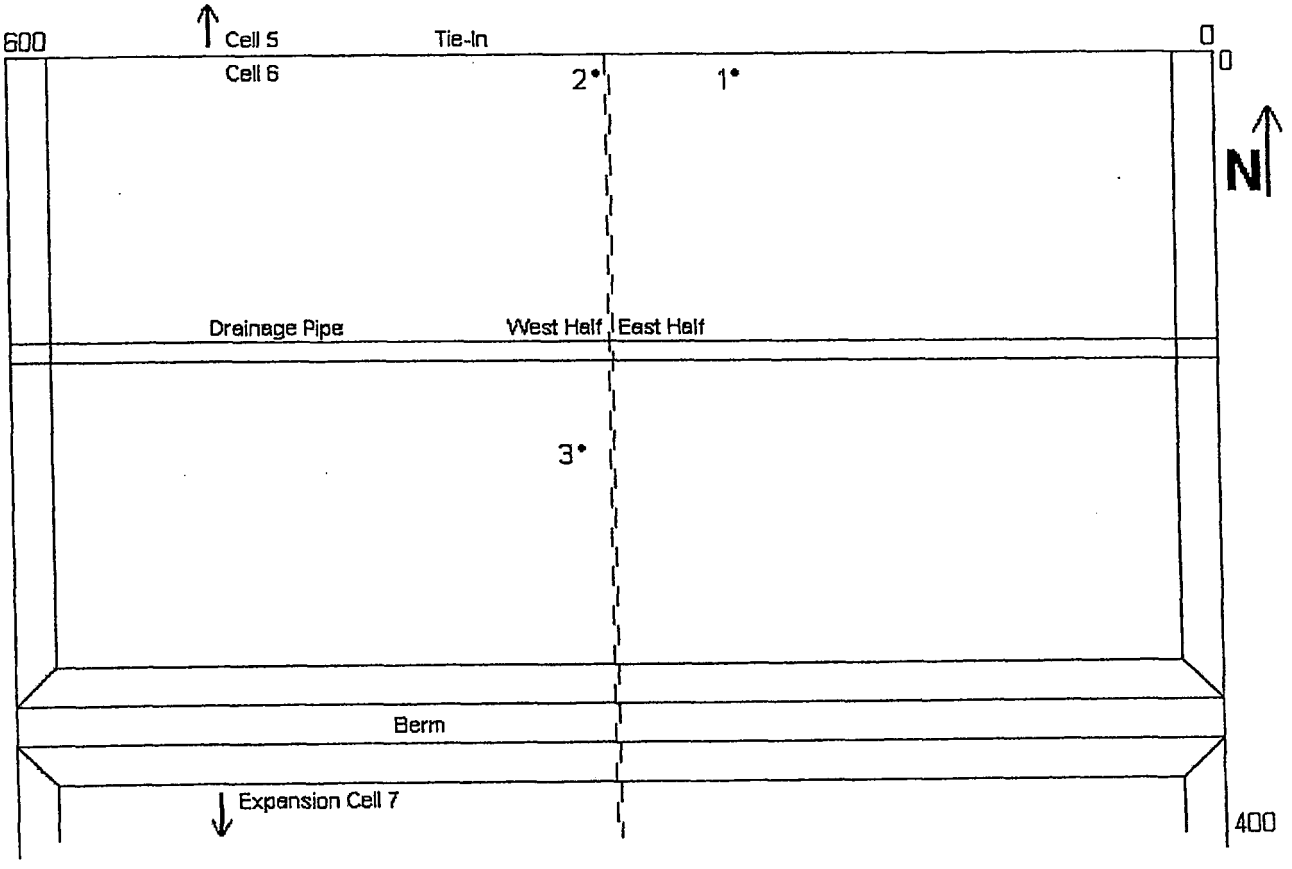

FIGURE 1. APPROXIMATE LOCATIONS OF LEAKS IN CELL 6

Table 1. Locations and Descriptions of Leaks in Cell 6

Leak	Location	Description
1	Line 10 @ 236 feet (10 feet south, 236 feet west of northeast corner)	1 1/2" Cut
2	Line 10 @ 305 feet (10 feet south, 305 feet west of northeast corner)	1/4" Cut on scuff mark
3	Line 200 @ 315 feet (200 feet south, 315 feet west of northeast corner)	Hole less than 1/16" diameter

If there are any questions regarding the leak location survey or this report, please contact us at (210) 408-1241. We appreciate the opportunity to have been of service once again to Fluor Fernald, Inc. on this project.

Very truly yours,

Robert M. Stephens III
Project Manager

Approved by:

Glenn T. Darilek
Principal Engineer