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ILLIOPOLIS, ILLINOIS

VOLUME III

Draft Final Report



GCA CORPORATION
Technology Division

213 Burlington Road
Bedford, Mass. 01730

BOR 007711

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Division of Stationary Source Enforcement
Washington, D.C. 20460

Contract No. 68-01-6316
Technical Service Area 1
Task No. 14

EPA Project Officer

John Busik
Division of Stationary Source
Enforcement
401 M Street, S.W.
Washington, D.C. 20460

EPA Task Officer

George Czerniak
Air Enforcement Branch
U.S. EPA, Region V
230 South Dearborn Street
Chicago, Illinois 60604

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TECHNICAL ASSISTANCE TO REGION V FOR EVALUATING ADHERENCE
TO APPROVED VINYL CHLORIDE LEAK DETECTION AND ELIMINATION PROGRAMS

Prepared by

Marc Grant
Robert R. Hall

August 1981

GCA CORPORATION
GCA/TECHNOLOGY DIVISION
Bedford, Massachusetts

BOR 007712

DISCLAIMER

This Draft Final Report was furnished to the Environmental Protection Agency by the GCA Corporation, GCA/Technology Division, Bedford, Massachusetts 01730, in partial fulfillment of Contract No. 68-01-6316, Technical Service Area No. 1, Task Order 14. The opinions, findings, and conclusions expressed are those of the authors and not necessarily those of the Environmental Protection Agency or the cooperating agencies. Mention of company or product names is not to be considered as an endorsement by the Environmental Protection Agency.

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ABSTRACT

Federal emission standards for the hazardous air pollutant vinyl chloride, promulgated 21 October 1976, require that plants which produce polyvinyl chloride implement an EPA-approved vinyl chloride leak detection and elimination program. The Borden Chemical plant at Illiopolis, Illinois, a division of Borden Inc., instituted such a program by December 1978.

The results of a review of Borden's implementation of the approved leak detection and elimination program at this plant are presented in this report.

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SECTION 1

SUMMARY

National emission standards for the hazardous pollutant vinyl chloride were promulgated 21 October 1976.¹ Pursuant to Section 61.65(b)(8) of this regulation, the Borden Chemical polyvinyl chloride plant at Illiopolis, Illinois, obtained EPA approval of a vinyl chloride leak detection and elimination program. The original program was reviewed by GCA/Technology Division in execution of a contract to provide technical assistance to the Environmental Protection Agency Region V (Contract No. 68-01-4143, TSA 1, Task No. 16). GCA cited several deficiencies in their review of the original program.² Borden's leak detection program as submitted on 8 May 1978 and amended on 27 September,³ 10 November,⁴ and 1 December 1978⁵ was approved by the EPA in December 1978.

The vinyl chloride regulation lists six requirements of an adequate leak detection and elimination program under §61.65(b)(8). These can be summarized as follows:

1. a reliable and accurate vinyl chloride area monitoring system,
2. a reliable and accurate portable hydrocarbon detector,
3. an acceptable calibration and maintenance schedule for the area monitoring system and the portable hydrocarbon detector,
4. an acceptable number and location of monitoring points and acceptable frequency of monitoring,
5. an acceptable plan of action to be taken when a leak is detected, and
6. a definition of a leak which is acceptable when compared to the background concentration in the plant.

In addition, the regulation requires, in §61.72(a)(1) and (2), that plants maintain records of information about leaks for at least 2 years.

Borden's implementation of their approved vinyl chloride leak detection and elimination program is generally adequate for the regulation. Borden's few deficiencies with respect to the VC regulation involve their calibration gas standards, their outdoor leak definition, and their recordkeeping

practices. Regarding the first of these, the company must obtain a calibration gas cylinder standard which is affixed the manufacturer's recommended maximum shelf life so that the concentration does not change greater than +5 percent from the certified value. Borden's present cylinders lack this information. Regarding their outdoor leak definition, Borden should employ their background measurement data in an evaluation of the present 5 ppm definition, as agreed to in their approved program and as specified in the VC regulation. It is suggested that outdoor measurements be reported as the number of excursions above 5 ppm, 2 ppm and 1 ppm, for each outdoor point, to facilitate evaluation of leak definitions. Finally, regarding their recordkeeping practices, Borden should institute a procedure to record corrective action on leak elimination when performed during a routine leak patrol.

SECTION 2

LEAK DETECTION AND ELIMINATION PROGRAM

INTRODUCTION

Representatives of GCA/Technology Division visited the Borden Chemical polyvinyl chloride plant at Illiopolis, Illinois, on 30 June 1981 for the purpose of reviewing the plant's implementation of the company's approved vinyl chloride leak detection and elimination program. Mr. Bill Gerson was the primary Borden representative, although other plant and corporate personnel also participated in the inspection and discussions. Mr. Rich Ruthe of EPA Region V was present to observe the technical aspects of GCA's review procedures.

The Borden Chemical plant is located in a rural area outside Illiopolis and about 20 miles east of Springfield, Illinois. This facility has been producing polyvinyl chloride (PVC) since 1959 and currently has two polymerization buildings, a monomer recovery building, and some outdoor monomer unloading and storage equipment in vinyl chloride service. Building PVC1 (company designation), also known as "A" building, includes production of paste and suspension PVC resins. Building PVC2 ("B" building) includes only suspension resin production. At the time of this inspection the plant was not producing PVC resins due to annual maintenance operations. The temporary shutdown did not effect the company's implementation of their leak detection and elimination program, though a lower incidence of leaks might be expected for the shutdown period.

AREA MONITORING SYSTEM

The first requirement of an acceptable leak detection and elimination program is the inclusion of a reliable and accurate vinyl chloride monitoring system (§61.65(b)(8)(i)):

"(8) ...Approval of a program will be granted by the Administrator provided he finds:

(i) It includes a reliable and accurate vinyl chloride monitoring system for detection of major leaks and identification of the general area of the plant where a leak is located..."

Borden presently employs three 16-stream Bendix gas chromatographs in their vinyl chloride area monitoring system, designated GC1, GC2, and GC3.

These units feature continuous purging of each sample stream and an analysis time of about 90 seconds/sample, as described in Borden's approved program. Equipment specifications, including sensitivity and method of analysis, have not changed from the approved program.

Borden has added a Hewlett-Packard computer and a computer terminal to their approved area monitoring system. This equipment, installed in the trailer which houses GC1 and GC3, has been used to coordinate the records of continuous vinyl chloride measurements. The system provides (printed at the terminal) 8-hour and daily summaries of the maximum, minimum, and time-weighted average (TWA) concentration of VCM for each sampling stream. It also computes and prints the monthly TWA levels for each stream. The system can supply the immediate status of any of the three sampling networks--including calibration data--in response to a typed command at the computer terminal. The continuous monitoring data, no longer recorded in strip chart form, is stored on cassette tape at the terminal. Any measured level of VCM in excess of the alarm level at that point is recorded by the printer. Alarm-levels are presently set at 1 ppm VCM for all indoor monitoring points and 5 ppm VCM for all outdoor monitoring points, excluding OSHA and EPA emission monitoring probes (see Monitoring Points section). Audible and (except for outdoor alarms) visual signals are activated by each excursion.

The newest gas chromatograph (GC3) employs a sampling network featuring stainless steel sample lines, rather than the plastic tubing used in the other two networks. Plant personnel stated that portions of the other two networks are being upgraded to stainless steel lines as the necessary funds become available. The lines are particularly valuable for the GC3 system; virtually all of the sample points are located outside, hence are more subject to degradation by sunlight and thermal effects than the predominantly protected points in the other two systems. One of the plastic lines located on the roof of building PVC2 was found to be quite brittle during the plant inspection, snapping cleanly apart when flexed. This sample line was for an OSHA monitoring point.

Borden's monitoring network features a number of split sampling points: for each sample stream a single "header line" connects the gas chromatograph with a manifold from which 2 to 9 sample lines branch out. Borden checks the header line integrity once per month and the sampling line integrity once per quarter by depressurizing each and observing any air flow into the lines. The gas chromatographs are protected from dust damage by a particulate filter in each stream header. A company contact reports that there is no time schedule for replacement of these filters, but that the rotameters at the Bendix units are checked at least once per day to verify proper flow in each sample stream. The filters are replaced when the rotameter indicates low flow, which reportedly occurs every 3 to 6 months.

Borden's area monitoring system is adequate for the vinyl chloride regulation. The Hewlett-Packard computer system is clearly superior to the old strip chart records in terms of data organization, and it is a good addition to Borden's approved program. The ongoing installation of stainless

steel sample lines is further increasing the reliability of the monitoring network. The present check frequencies of line integrities and sample flow should ensure adequately against leaks or pluggage in any of the sampling network. Continuous operation of the Bendix monitoring systems was observed during the inspection, and this equipment appears to be in good working condition.

PORTABLE LEAK DETECTION

The second requirement of an acceptable leak detection and elimination program is the inclusion of a portable hydrocarbon detector (§61.65(b)(8)(ii)):

"(8) ...Approval of a program will be granted by the Administrator provided he finds:

(ii) It includes a reliable and accurate portable hydrocarbon detector to be used routinely to find small leaks and to pinpoint the major leaks indicated by the vinyl chloride monitoring system..."

Borden currently employs four Century System Organic Vapor Analyzers (OVA's) as portable hydrocarbon detectors. Three more OVA's are employed to determine reactor opening losses, and are available as backups in the event that maintenance must be performed on the four leak detectors. The portable detectors are normally calibrated at 50 ppm, while the reactor opening loss test instruments are calibrated at 2000 ppm VCM. Borden's approved leak detection program specifies the use of five OVA's and one HNu as portable leak detectors. The reduction to four OVA's seems acceptable in light of the availability of the three OVA's used for reactor opening loss tests as backup instruments. Since the company has scheduled its routine detection patrols on different shifts for each section of the plant (see below), it is likely that only one OVA would be in use at any one time. The presence of three backups calibrated at the same concentration, and three more backups that could be recalibrated to the portable detector leak definition, is adequate. Borden does not presently employ the HNu instrument for portable detection since they have experienced problems correlating this device's output with the OVA units.

X A copy of Borden's approved program of routine leak patrols including equipment and frequencies of inspection is included in the Appendix to this report. In their plan potential leak points in each of the four areas in vinyl chloride service and some general areas where fugitive emissions could gather are checked daily. In addition, a comprehensive leak check on each reactor in vinyl chloride service is performed weekly. Routine check reporting forms were inspected to verify these frequencies. The forms include the equipment checked, date, time, and concentration of VCM at that point. The weekly check forms are color-coded to facilitate identification of the area where the reactor is located. The location and frequencies of routine patrols are acceptable for this plant. The routine patrols appear to be well-organized and a good feature is the assignment of a specific patrol area to each of three shift technicians. The records associated with this task are also well-maintained and organized.

CALIBRATION AND MAINTENANCE

The third requirement for an adequate leak detection and elimination program is the provision for an acceptable calibration and maintenance schedule (§61.65(b)(8)(iii):

(8) ...Approval of a program will be granted by the Administrator provided he finds:

(iii) It provides for an acceptable calibration and maintenance schedule for the vinyl chloride monitoring system and portable hydrocarbon detector..."

Each Bendix gas chromatograph is calibrated once per day automatically using a nominal 1 ppm standard provided and certified by Matheson Gas Company. The gas supplier has not affixed to each gas cylinder a recommended maximum shelf life for the certified concentration, as required by §61.65(b)(8)(iii)(B) of the vinyl chloride regulation. Borden should obtain the required certification from Matheson or switch to a gas supplier that can provide this certification. The potential problem of a gas cylinder outlasting its certified shelf life was discussed with Borden personnel, since one gas cylinder (used to calibrate GC2) is consumed twice as slowly as the other (used to calibrate GC1 and GC3). The plant representatives stated that either of two remedies could be adopted; ordering a smaller gas cylinder for GC2, or switching two of the current-size cylinders between the two chromatograph locations so that they are exhausted simultaneously and within the recommended shelf life.

Bendix systems GC2 and GC3 monitor with 2 different leak definitions, since these units sample both indoor and outdoor points (see Monitoring Points and Definition of a Leak sections). The use of a single calibration gas standard of a concentration equal to the lower of the two leak definitions should be acceptable considering the minor difference (4 ppm) between the two levels.

The OVA portable detectors are calibrated at least weekly using a nominal 50 ppm standard, also supplied by Matheson Gas Company. This gas cylinder suffered the same deficiency as mentioned above, bearing no indication of the manufacturer's recommended maximum shelf life. The calibration frequency was verified by inspection of a log book into which each calibration date is entered.

The portable leak detectors are ordinarily maintained in-house by Borden personnel. The company reports that some service must be performed by the manufacturer and the instruments are occasionally shipped to Century Systems for maintenance. There are an adequate number of backup units (see Portable Leak Detector section) to allow for maintenance out-of-house, and the present OVA service procedures are deemed adequate.

No service contract is presently in effect with Bendix; the gas chromatographs are also maintained in-house. Considering the Bendix

reputation for reliability, and Borden's good experience with this equipment, in-house maintenance procedures are probably adequate. Borden presently has a service contract with Hewlett-Packard by which the computer system is serviced quarterly and in immediate response to a maintenance request. Plant personnel report that the system has performed excellently with no significant downtime in the previous 13 months. Borden reports that they have a number of spare components and will soon have a complete changeout of the computer system, further reducing the potential for a significant service delay.

MONITORING POINTS

Section 61.65(b)(8)(iv) of the vinyl chloride regulation requires that the number and location of monitoring points for the area monitor, and the frequency of monitoring be acceptable to the EPA:

"(8) ...Approval of a program will be granted by the Administrator provided he finds:

(iv) The location and number of points to be monitored and the frequency of monitoring provided for in the program are acceptable when they are compared with the number of pieces of equipment in vinyl chloride service and the size and physical layout of the plant."

Borden's vinyl chloride monitoring network has not been altered from the system described in their approved leak detection and elimination program. A list of monitoring points and locations as presented in their approved program is included in Table 1. Note that seven of the thirty-eight streams are solely OSHA monitoring areas, and one is an EPA emission monitoring stream. The first digit of each stream number indicates which chromatograph performs the analysis, and a column has been added to show which points are located outside. Since the monitoring network is unchanged and the plant has not undergone any major changes in the amount or type of equipment in vinyl chloride service, the present system is still deemed adequate.

PLAN OF ACTION

The leak detection and elimination program must contain an adequate plan of action in order to be deemed acceptable (§61.65(b)(8)(v)):

"(8) ...Approval of a program will be granted by the Administrator provided he finds:

(v) It contains an acceptable plan of action to be taken when a leak is detected."

Borden's plan of action to be taken when a leak is detected features good lines of responsibility and good recordkeeping practices. A quick response to the area monitoring alarms is assured by the presence of the leak detector operator at the computer terminal when he is not on a routine leak patrol. A form is used to record pertinent information for each detected leak (see Recordkeeping section), whether found on a routine patrol or pinpointed from an area monitoring system alarm. A second form is used daily to account for

TABLE 1. MONITORING POINTS

Stream no.	Has outside points	Number sample points	Location and description
1-1		5	Top PVC1 slurry blend tank
1-2		2	1st floor paste blow down tanks and WW tank
1-3		2	1st floor recovery bldg--seal water pumps
1-4		4	2nd floor recovery bldg--compressors and vac pumps
1-5		7	2nd floor Mod #4 R _{xr}
1-6		9	2nd floor Mod #5 R _{xr}
1-7*	X	1	Heating and ventilating
1-8		9	2nd floor paste R _{xr} 3201-02-03-04
1-9*		3	Paste drying and bagging
1-11		7	2nd floor Mod #1 R _{xr}
1-12		7	2nd floor Mod #2 R _{xr}
1-13		7	2nd floor Mod #3 R _{xr}
1-14*		2	PVC1 dryer
1-15		8	1st floor Mod #4, 5, 6
1-16		8	1st floor Mod #1, 2, 3
2-1	X	2	VCM weigh tank and charge pump
2-2	X	5	Outside S. 3 RMVC hold tanks, yard tank and WW tank
2-3		2	Above stripper feed tanks
2-4	X	3	Skid stripper column
2-9		7	1st floor lower reactor room
2-10		9	2nd floor upper reactor room
2-11*		2	1st floor lower chemical prep area
2-12*		2	2nd floor upper chemical prep area
2-13*	X	3	Heating and ventilating
2-14*		3	Dryers
3-1	X	8	Outside East paste VCM scale tanks and conad pumps
3-2		2	Above paste blow down tanks
3-3	X	2	Outside above F-357 and 3370 RVCM hold tanks
3-4	X	3	PVC1 skid stripper column
3-5	X	4	East MVC tank car unloading stations
3-6	X	5	Gas holder and WW tank and pump
3-7**	X	1	Incinerator stack
3-8	X	4	Gas holder KO tank, WW transfer tank, RVCM and vent condensers
3-9	X	5	3 MVC spheres--2 bullet WW tanks
3-10	X	5	5 MVC unloading compressors
3-11	X	6	In and out pump house--all MVC feed pumps
3-12	X	3	WW stripper, incinerator KO tank and burner
3-13	X	4	West MVC unloading stations

* = OSHA monitoring stream

** = EPA emission monitoring stream

the actions taken to eliminate area monitoring system alarms. The shift foreman is notified of any detected leaks, and his response to eliminate these depends on the apparent severity of the leak. There are basically three levels of response described in Borden's approved program. From a review of the repair records it appears that corrective measures are often instituted immediately, and generally occur within the guidelines of the approved program.

DEFINITION OF A LEAK

The last requirement of an adequate leak detection and elimination program is the inclusion of a leak definition which is acceptable to the EPA (§61.65(b)(vi)):

"(8) ...Approval of a program will be granted by the Administrator provided he finds:

(vi) It contains a definition of a leak which is acceptable when compared with the background concentrations of vinyl chloride in the areas of the plant to be monitored by the vinyl chloride monitoring system. Measurements of background concentrations of vinyl chloride in the areas of the plant to be monitored by the vinyl chloride monitoring system are to be included with the description of the program. The definition of leak for a given plant may vary among the different areas within the plant and is also to change over time as background concentrations in the plant are reduced."

Borden has not changed the leak definitions--5 ppm for outdoor points and 1 ppm for indoor points--nor the alarm levels outlined in their approved leak detection and elimination program. As part of their approved program Borden agreed to collect background measurements of VCM concentrations in outdoor areas and use this data either to support the approved leak definition of 5 ppm or to propose a replacement. The company maintains monthly graphs of daily TWA vinyl chloride concentration versus the date, for each sampling stream. This data is generally adequate to indicate background levels of VCM in each area, but it is difficult to ascertain from this data alone what effect a change in the leak definition would have on the number of detected leaks. It is suggested that Borden compile data on the number of measured excursions over various VCM levels (i.e., 5 ppm, 2 ppm, and 1 ppm) in order to facilitate future evaluations of their leak definitions. This data could be collected in place of the monthly plots of daily TWA VCM concentrations for each stream: the latter is less useful in that a high TWA value does not indicate whether there are high background levels or merely a few high excursions over a low background level.

Borden should employ their current background measurement data in a determination of the propriety of the outdoor leak definition, as originally agreed in their approved program and as required by the vinyl chloride regulation. From a review of portions of this data it appears that the present outdoor leak definition is excessively high. Observation of several monthly graphs for a recent period showed common outdoor background levels

approaching the detection limit of the gas chromatograph, less than .5 ppm VCM. From a review of the computer hardcopy it appears that only about four of the fourteen outdoor leak monitoring points would have any appreciable increase (more than 5 leaks/week) in the number of detected leaks if the leak definition were lowered to 1 ppm VCM (probably points 2-2, 2-4, 3-10, and 3-11).

RECORDKEEPING

Section 61.71 of the vinyl chloride regulation requires that a polyvinyl chloride plant shall retain records of leak detection and elimination:

"(a) The owner or operator of any source to which this subpart applies shall retain the following information at the source and make it available for inspection by the Administrator for a minimum of two years;

(1) A record of the leaks detected by the vinyl chloride monitoring system, as required by §61.65(b)(8), including the concentrations of vinyl chloride as measured, analyzed, and recorded by the vinyl chloride detector, the location of each measurement and the date and approximate time of each measurement.

(2) A record of the leaks detected during routine monitoring with the portable hydrocarbon detector and the action taken to repair the leaks, as required by §61.65(b)(8), including a brief statement explaining the location and cause of each leak detected with the portable hydrocarbon detector, the date and time of the leak, and any action taken to eliminate that leak..."

XX
The area monitoring records at Borden include the cassette tapes of continuous monitoring data and the computer printouts of 8-hour and daily summaries and alarm levels. An "Alarm I.D." form, tabulated by hand from the computer hardcopy, characterizes the cause and remedy of each excursion on a daily basis. The computer summarizes and alarm explanation form, while not specifically required by the vinyl chloride regulation, are a valuable addition to Borden's approved program. The former facilitates presentation of trend data while the latter helps insure that action is taken on all detected leaks. As mentioned in the previous section, certain records of background concentrations of VCM are also maintained, to satisfy the requirements of §61.65(b)(8)(vi) of the vinyl chloride regulation.

Information gathered during routine monitoring with the portable leak detector is recorded on a check form as described in a previous section. For all detected leaks, a "Leak Sheet" form is filled out unless the situation is corrected immediately and has not caused an area monitoring alarm. The leak form includes all of the information required in the regulation. The check form does not necessarily include a description of the action taken to eliminate a leak, yet the check form constitutes the only record of a leak if the problem is fixed immediately and a leak form is not filled out. In order to comply with the regulation, Borden must make a provision for recording the corrective action taken when a leak form is not filled out. One possible

procedure would be to record this information directly on the routine check form. this procedure was suggested to plant personnel during the inspection, and they indicate that they could easily implement the procedure as part of the formal recordkeeping practices.

REFERENCES

1. National Emission Standard for Hazardous Air Pollutants--Standard for Vinyl Chloride. Federal Register, Volume 41, No. 205. October 21, 1976.
2. Borden Corporation--Volume VII, Draft Final Report submitted by GCA/Technology Division to U.S. Environmental Protection Agency, Region V. July 1978.
3. Letter from Mr. W. Bailey Barton (Borden Inc.) to Mr. David Kee (EPA) September 27, 1978.
4. Letter from Mr. W. Bailey Barton (Borden Inc.) to Mr. Bruce Varner (EPA) November 10, 1978.
5. EPA Telephone Memo. Call from Mr. Bruce Varner (EPA) to Mr. Jack Kirby (Borden Chemical) December 1, 1978.

APPENDIX A

STANDARD OPERATING PROCEDURES FOR ROUTINE DETECTION PATROL

Safety Technicians will be required to make following patrols as described:

1. Every shift technician will make bottom valve leak check and record findings on form provided.
2. Shift technician who is working 0730-1530 shift will check tank farm area on daily basis. Specific areas include pump houses, MVC unloading compressors, MVC transfer pumps, MVC unloading stations and MVC storage vessels. Record valves on form provided.
3. Shift technician who is working 1530-2330 shift will make plant tour and monitor all equipment having double mechanical seals. Pressures and glycerine levels will be recorded on form provided. In addition to the above on this tour, MVC scale cuno filters, recovery systems in Paste area and manhole seal on blend tanks will be checked.
4. Shift technician who is working 2330-0730 shift will make a complete tour of Plant #2, recovery building and gas holder area. Specific areas in Plant #2 will include MVC charge pump and filters, lower reactor room, reactor bottom discharge area, VE-3111 LP K.O. tank, south outside yard K.O. tank, WW tank, and #3 recovered MVC holding tanks. Skid stripper at grade level, dryer room, lower chemical prep room, skid stripper at centrifuge level, upper chemical prep room, upper reactor room, reactor manheads manual vents, rupture disc, recovery systems and vacuum pumps. Roof area over reactor room, top of reactor condensers, reactor exhausters, inline exhauster and related duct work.

Recovery building areas will include 1st and 2nd levels of building, yard K.O. tank, gas holder, WW tanks and pump houses.



GCA CORPORATION
Technology Division

213 Burlington Road
Bedford, Massachusetts 01730
Telephone: 617-275-6444

BOR 007729