INDUSTRIAL HYGIENE REPORTS

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UNION CARBIDE INTERNAL CORRESPONDENCE

CHEMICALS AND PLASTICS

P. O. BOX 471, TEXAS CITY, TEXAS 77590

TO (NAME)
COMPANY
LOCATION

DATE December 18, 1967

COPY TO See list.

SUBJECT Sandblasting

Gentlemen:

Recent industrial hygiene studies of sandblasting operations at two of our Gulf Coast plants caused great concern for the health of the operators. Dust counts were determined within the breathing zone inside the abrasive-blasting hoods. Further study of the respirator equipment was conducted to explain the high dust counts found.

Silicosis is a disease characterized by nodular fibrosis of the tissue of the lungs. It is caused by breathing free-crystalline silica dust (SiO_2)--of which sand is almost 100%. The duration of exposure. size, composition and concentration of particles are factors related to the development of the disease.

A properly installed, properly worn and properly maintained air-supplied abrasive-blasting hood will offer complete protection from silicosis for the operator. The following recommendations are designed to provide clean, respirable and comfortable air with no more than one million particles of silica dust per cubic foot of air in the 0.3 to 5 micron size.

This matter should be given prompt consideration. If I can be of further help, please do not hesitate to contact me.

Very truly yours,

D. E. Deese

D. E. Deese
Industrial Hygienist
Gulf Coast Area

DED:bb
Attachments

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RECOMMENDATIONS FOR SANDBLASTING OPERATIONS

1. Respirators

   a. A supplied-air abrasive-blasting hood (Type CE) is essential respiratory protection for sandblast operators. Each operator should be assigned his own hood.

   b. Only a U. S. Bureau of Mines approved hood should be used for sandblasting work. Any unit not marked "B. M. ", followed by the approval number, should not be accepted. (See the attached list of hoods that are approved.)

   c. The neck drawstrings should be kept snug. If the operator becomes aware of sand penetration inside the hood, a Dustfoe respirator should be used additionally for the remainder of the job. Corrective measures should be taken immediately.

   d. A rack or other device from which to suspend hoods should be provided at the sandblasting shed. The purpose is to prevent contamination of hoods with sand from the ground or shelving.

   e. At the end of each day, hoods should be cleaned with a vacuum device so that all accumulated sand may be removed. Defective parts should be replaced then. At least once a week hoods should be cleaned with soap and water.

   f. This type respirator is not to be used in atmospheres that are immediately dangerous to life or from which the wearer cannot escape without the aid of the respirator.

2. Air Hose

   a. Each hood requires a minimum air supply of 6 cu. ft. per minute to prevent dust from entering.

   b. It is a serious mistake to provide valves by which the wearer can adjust his air supply to less than this minimum safe amount. The air supply should be engineered to deliver into the hood the correct amount of air as measured by a suitable air-flow metering device. The flow should then be checked periodically to see that the flow does not fall below this minimum.

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c. A minimum of ½" I. D. air hose is required for adequate air delivery with low pressure systems. The maximum air hose length should never exceed 250 ft. The length may be further limited by the pressure developed by the compressor. (See Graphs: Nos. 1, 2, and 3.)

d. Quick connect fittings should be provided to allow the operator to disconnect the hood rapidly in the event of an emergency.

e. A trap and filter should be in the delivery line to remove rust, oil mist, dust, and water condensate.

3. Air Compressor

a. A source of clean, comfortable, respirable air is required for sandblasting hoods. This means air that is free of carbon monoxide, oil mist, water condensate, rust, silica dust and other harmful contaminants. Plant air should not be used for this purpose.

b. Three types of compressors are available--oilless centrifugal, rotary, and reciprocal. They are listed in order of preference. The low pressure capacity of the first, however, limits the conditions under which it can be used effectively. Internally oiled compressors require filtration of oil mist with activated charcoal cartridges such as the Bullard air purifier. Temperature activated controls are further necessary to prevent overheating and the subsequent "carbon flashing" of oil to form carbon monoxide. The compressor should automatically shut down or sound an alarm.

c. The Acme Model 4107 "three-man" compressor should be limited to the following conditions: Only two hoods should be used at a time. These should be connected by no more than 100-ft. lengths of ½" I.D. air hose. Three-eighths inch I.D. hose will not deliver 6 CFM from this compressor. (See Graphs.) A pressure gauge should be attached to the compressor manifold to indicate the proper operating pressure as shown on Graph No. 1. (One hood at 9 3/4 psi; two hoods at 8.0 psi.) This gauge is particularly important where the compressor is driven by an air-motor with variable torque. It was found that plant air pressure will not adequately drive the air-motor where the feed line to the motor has been reduced to less than the originally equipped pipe size. These portable compressors are best suited for field use.

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d. The compressor air intake should be located in an area of clean air. This means upwind from the sandblasting area. High dust concentrations have been shown to exist many feet downwind. Compressor air-intake filters are designed to protect only the compressor and have very low efficiency in the microscopic range of respirable dust. Where portable compressors are used, the location of the compressor upwind in clean air should be the responsibility of one individual.

4. Air Conditioning

a. Heat stress is a very real problem on the Gulf Coast because of high temperature and humidity. A sandblasting hood adds to the problem by further limiting the rate of skin evaporation. Two methods are available to cool air for sandblast hoods: (1) the Vortex tube for high pressure systems (60 to 100 psi) and (2) the compressed refrigerant cycle unit such as has been devised for the Texas City plant. (See attached diagrams.)

5. Sandblast Shed Location

Discretion should be exercised in permanently locating sandblasting sheds. Since dust may be airborne some distance downwind, workmen and machinery in nearby areas may be exposed to adverse concentrations.

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TYPE CE: ABRASIVE-BLASTING HELMETS, HOODS, OR MASKS

The type CE supplied-air respirator (abrasive-blasting helmet, hood, or mask) is approved for respiratory protection during abrasive blasting in atmospheres that are not immediately harmful or from which the wearer can escape without the aid of the respirator.

1. Pangborn type DD-4 blast helmet. Approval BM-1908, issued to Pangborn Corporation, Hagerstown, Maryland 21740, July 15, 1938, under schedule 19A.

2. Sly "Purair" helmet. Approval BM-1911, issued to W. W. Sly Manufacturing Company, 4735 Train Avenue, Cleveland, Ohio 44102, July 16, 1938, under schedule 19A, and July 11, 1957, under schedule 19B.

3. Willson Nos. 31 and 33 abrasive-blasting helmets. Approval BM-1914, issued to Willson Products, Inc., Willson Products Division, P. O. Box 622, Reading, Pennsylvania 19603, March 10, 1939, under schedule 19A.

4. Pangborn type DF-2 blast helmet. Approval BM-1915, issued to Pangborn Corporation, March 23, 1939, under schedule 19A.

5. METCO air-line respirator. Extension of approval BM-1920, issued to Metallizing Engineering Company, Inc., 1101 Prospect Avenue, Westbury, New York 11590, December 8, 1948, under schedule 19A.

6. Willson No. 52 lightweight abrasive-blasting helmet. Approval BM-1923, issued to Willson Products, Inc., July 19, 1949, under schedule 19A.

7. M-S-A® "Blastfoe" abrasive helmets. Approval BM-1926, issued to Mine Safety Appliances Company, 201 North Braddock Avenue, Pittsburgh, Pennsylvania 15208, May 9, 1951, under schedule 19A.

8. Cesco Nos. 603-RH, 603-RS, and 603-RG abrasive blasting hoods. Approval BM-19B-35, issued to Chicago Eye Shield Company, (Cesco Safety Products, Inc.,) 2727 West Roscoe Street, Chicago, Illinois 66018, January 9, 1962, under schedule 19B.

9. M-S-A® "Flexi-Flo" abrasive masks with lightweight or heavyweight hoods. Approval BM-19B-38, issued to Mine Safety Appliances Company, May 7, 1962, under schedule 19B.

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Type CE: Abrasive-Blasting Helmets, Hoods, or Masks - continued

10. M-S-A® "Hyperflo" abrasive masks with lightweight or heavyweight hoods. Approval BM-19B-38A, issued to Mine Safety Appliances Company, June 14, 1962, under schedule 19B.

11. Bullard No. 37-V abrasive blasting helmet. Approval BM-19B-39, issued to E. D. Bullard Company, 2680 Bridgeway, Sausalito, California 94965, April 24, 1962, under schedule 19B.

12. Bullard No. 37-LD lightweight abrasive blasting helmet. Approval BM-19B-40, issued to E. D. Bullard Company, April 30, 1962, under schedule 19B.

13. M-S-A® "Flexi-Flo" abrasive mask. Approval BM-19B-41, issued to Mine Safety Appliances Company, March 5, 1964, under schedule 19B.

14. M-S-A® "Hyperflo" abrasive mask. Approval BM-19B-41A, issued to Mine Safety Appliances Company, March 5, 1964, under schedule 19B.

15. Pulmosan HA-99 hood. Approval BM-19B-44, issued to Pulmosan Safety Equipment Corporation, 644 Pacific Street, Brooklyn, New York 12217, January 20, 1965, under schedule 19B.

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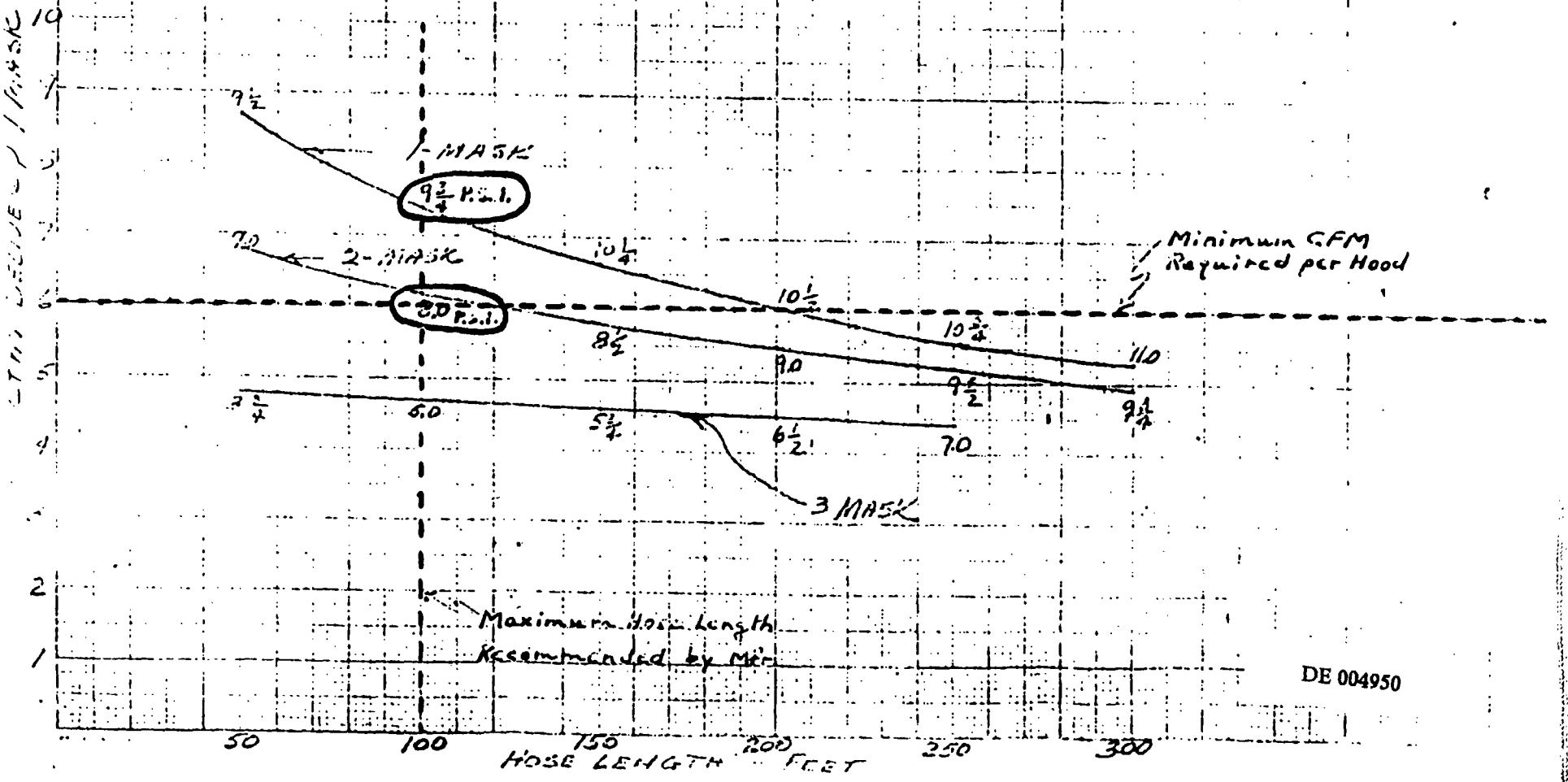
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GRAPH #1

1-19-61

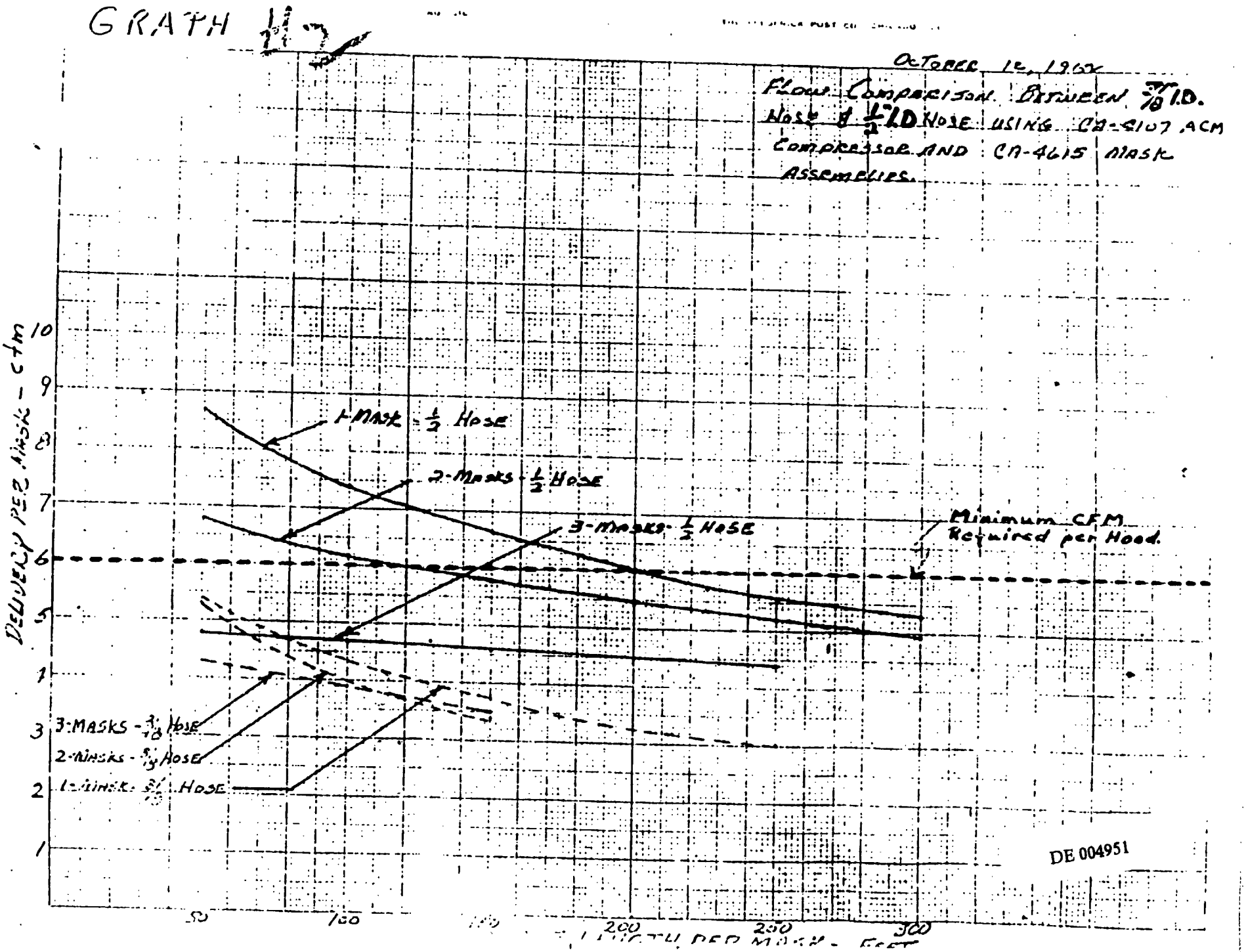
PERFORMANCE CURVES FOR ACME CA 4107 THREE MAN. COMP...
USING ½" I.D. HOSE
NUMBERS ON CURVES GIVE ... PRESSURE AT THE COMPR... DURING OPERATION.



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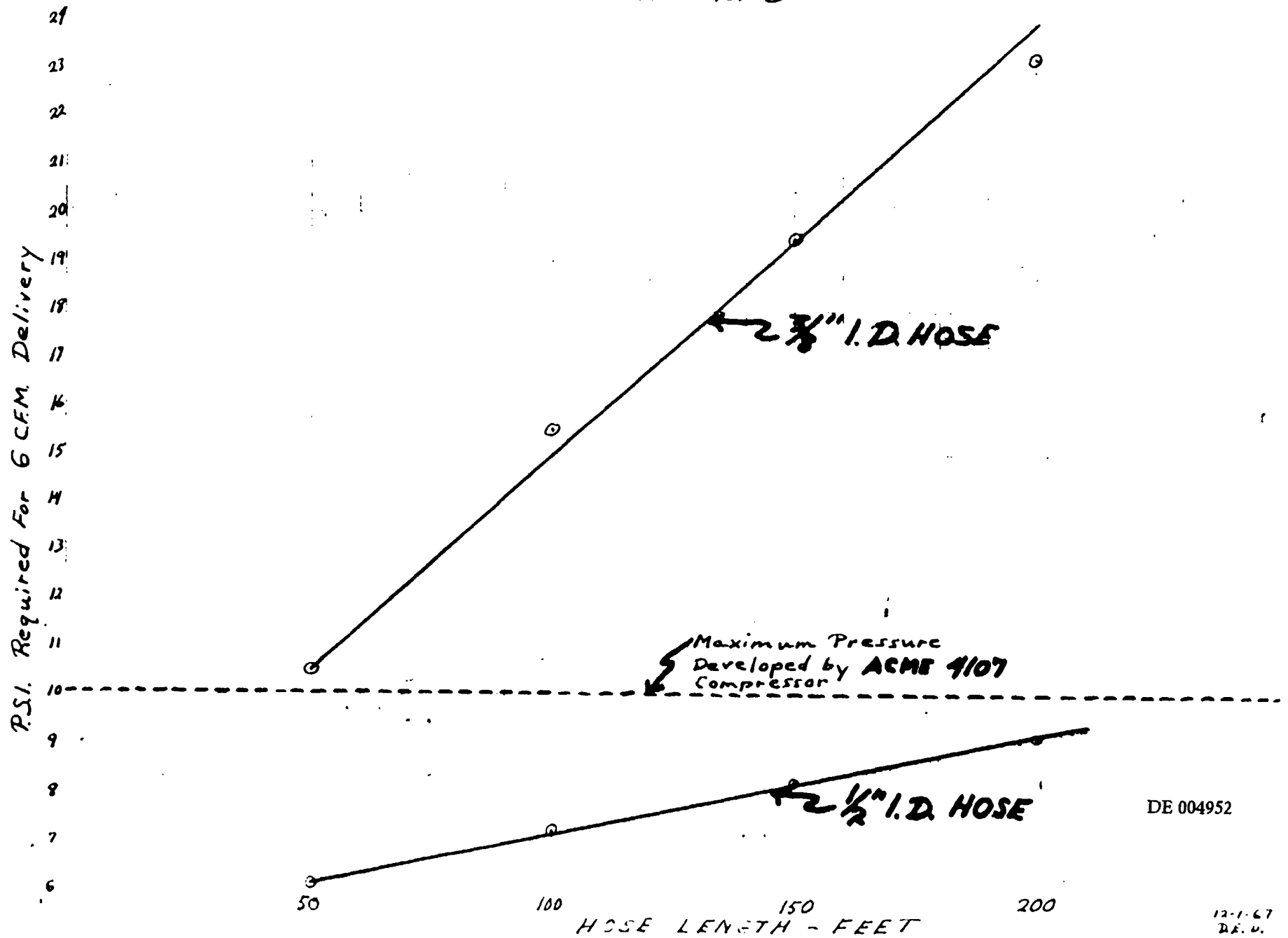
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GRAPH No. 3



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MEMORANDUM

To: General Managers
Operations Managers
R & D Managers
Technology Managers

Date: March 13, 1964

cc: Marketing Managers
R & D Group Leaders
See Attached List

I am sending to each of you a copy of the attached memorandum "Toxicology of Chemical Products - Responsibilities and Procedures" which was prepared by the Technology Managers, Messrs. Dunn, Hoaglin and Powell, working in conjunction with the Labeling Committee and Mellon Institute Fellowship Administration. This memorandum describes the responsibilities and the procedures to be followed in order to provide for the safe handling of our chemical products both by ourselves and by others. It starts with repetitive small laboratory-scale preparations of chemical products and follows through plant-scale operation. Steps are described which are taken to meet labeling requirements and shipping regulations as well as to qualify under the Food and Drug laws.

As a result of changes which arose due to the new Business Organization, it was necessary to redefine areas of responsibility. It is because of this that the Officers of the Chemicals Division gave the Business Departments, more specifically the Technology Managers, the major responsibility for obtaining and applying the necessary toxicological information. The responsibility of others is also described. Particular attention should be paid by Operations Managers to the statements on page 3 relating to changes in the manufacture of products going into foods, drugs or cosmetics.

For convenient use the memorandum is organized in reference form. The provisions will go into effect at once.

JLM:nnp

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TOXICOLOGY OF CHEMICAL PRODUCTS

RESPONSIBILITIES AND PROCEDURES

It is a long-standing Union Carbide policy to know the toxicological hazards involved in the handling and reasonably foreseeable uses of each of its chemical products. For the past 26 years the Mellon Institute Chemical Hygiene Fellowship,[1] under the guidance of Drs. Smyth and Carpenter and now located at Bushy Run, Pennsylvania, has been providing toxicological information for the Chemicals Division to be used in various ways. In cooperation with Dr. Dernehl of the Industrial Medicine and Toxicology Department,[1] information and advice are provided for the safe handling, storage and shipping of chemicals in laboratory and plant operations as well as for the guidance of fabricators and the ultimate consumers.

These toxicological data are also used by the Labeling Committee[1] to provide labels with adequate warning for the handling and use of all of our products. Finally, these data may be used to obtain Food and Drug clearance for those products that are used or come in contact with foods, drugs or cosmetics. These clearances are obtained by the combined efforts of Dr. C. E. Colwell and Mr. E. R. Weidlein, Jr. of the R & D Department (Tarrytown), Dr. Smyth, and Mr. G. T. Scriba of the Law Department,[1] who make all of our contacts in Washington.

The toxicity tests usually begin with the conventional range-finding tests which provide pertinent basic information at minimal cost. The time normally required (30-90 days) is due mainly to a backlog of work rather than to that required for the actual experimental work. For many compounds this amount of information is adequate. However, more precise and extensive tests may be recommended by Drs. Smyth or Dernehl depending upon the applications anticipated. These will involve different kinds of animals, repeated applications and combinations of these. A description of these tests is listed beginning on page 9.

For clarity, it is useful to consider toxicological information in two categories. The first is toxicological information relative to handling hazards. This commonly consists

[1] See page 8.

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of acute toxicity studies, sometimes referred to as range-finding or screening tests. On occasion more detailed studies are necessary. The second is chronic toxicological information relevant usually only to food, drug, cosmetic and similar uses where the problem relates to prolonged human exposure to small doses. By food, drug and cosmetic uses we mean not only the direct employment of our chemicals as ingredients in such products but also indirect applications, for example, when used in packaging materials, or as food machinery lubricants, coatings and the like. In these instances they may foreseeably get into such products.

In the past it has been the responsibility of the Group Leader or project controller to initiate the range-finding tests on new products, and it is expected that this will continue. Much of the responsibility for justifying further work, as products matured, was in the hands of the Product Managers in the old organization. With the advent of the new Business Organization much of the impetus was lost while the need for pursuing this effort became more important than ever. It is because of this that the Officers gave the Business Departments, and more specifically the Technology Managers, the major responsibility for obtaining and applying toxicological information. This was to insure compliance with regulatory requirements pertaining to products marketed in the various business areas.

The memorandum that follows is organized as reference material for the benefit of those who need to know the responsibilities and procedures to follow in obtaining and using toxicological information.

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I Requests for Range-Finding Studies and Clearance for Handling Chemicals

It is essential that appropriate screening (range-finding) data be obtained for all of the chemicals we make or use, with the possible exception of those prepared once or twice in the laboratory. This is to protect our laboratory and plant personnel, our customers, cargo handlers and all those who conceivably could come into contact with the chemicals.

New Compounds - Initiation of requests for range-finding tests on samples of new chemicals will ordinarily be the responsibility of the R & D Manager or Group Leader, whoever initiated the work. One can request these studies by filling out the attached form and submitting it as indicated. The form should be filled out no matter how meager the available data. As stated on the form the request should be addressed to Dr. C. P. Carpenter with copies, including the pink form, to Dr. C. E. Colwell, Dr. C. U. Dernehl, the Technology Manager and the line Assistant Director. Data required for making out the experimental label are indicated on the request form. In case of doubt Dr. Smyth or Dr. Carpenter should be consulted.

The request for range-finding tests should precede the preparation of any new chemicals in repeated laboratory runs, in larger than laboratory runs or in anticipation of sampling to a prospective customer. In most cases, adequate time should be available to obtain the screening results in a routine manner; however, in those instances where there is urgency, these data can be obtained in two weeks. Furthermore, in cases of extreme urgency, Dr. Smyth and Dr. Carpenter can, by virtue of their extensive experience, give an opinion on the toxicological hazards of a new chemical. The obtaining of such an opinion is the least action that must be taken before larger-scale manufacture is undertaken, and this should only be done when circumstances prevent obtaining the screening data in time. (Prior to shipment of any samples review the instructions found in box of the attached form.)

Consideration for Commercialization - This may represent several stages such as 1) extended laboratory studies, 2) supply of market development samples, 3) work leading to product introduction. This is definitely under the jurisdiction of a Technology Manager who will be responsible for reviewing the

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preliminary toxicity work. If the work has not been done he will immediately request that a sample be sent and that the work be initiated. Copies of the request will also be sent to those indicated in the second paragraph above. The same request form will be used but it is important that most of the information required to fill out the form be available or be obtained. It is not only important to this effort but for other reasons as well that complete physical property data be obtained at this stage.

After reviewing the preliminary toxicity data, the Technology Manager then anticipates the need for further study in support of market application. At this time:

a) He consults with Dr. Colwell concerning the need for further study, based upon the proposed application, and assignment of priority of the work in the Chemical Hygiene schedule.

b) The Chemical Hygiene Fellowship and the Industrial Medicine and Toxicology Department will determine the specific studies to be made.

c) Several of the recommended studies may be started simultaneously to save time. The Technology Manager also decides whether the market potential justifies the effort, and may discontinue several of the long-range tests at a later date if plans for commercialization are changed.

At this time or at a later stage of market development, Dr. Colwell, on the basis of his knowledge of applications and products coming under the Food and Drug Administration surveillance, will advise the Technology Manager concerning the full scope of studies required to meet statutory regulations. The Technology Manager then judges whether the potential of the product justifies the effort. When a contact must be made with the Food and Drug Administration, this will be done by Dr. Colwell and Mr. Scriba (Law Department). They may enlist the help of such experts as the situation requires.

Decision to Manufacture - When the decision has been made to manufacture a new product, toxicity studies will either be complete or in progress. The results should be reviewed by the Technology Manager with respect to larger scale of operation anticipated. Particularly important at this stage is the potential exposure of personnel to large quantities of material over extended periods. Some of the important considerations are:

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a) Safety of manufacturing operations
b) Protection of shipping personnel
c) Handling by customers
d) Carcinogenicity
e) Clearance for use in foods and in food packaging materials.

Dr. Carpenter and Dr. Dernehl (for the Labeling Committee) should be advised of the new status and a new label provided if necessary.

If Food and Drug clearance is required but has not been obtained, the procedure indicated above should be initiated at this time. In support of this it may be necessary to set up special methods of analysis to help meet clearance requirements, e.g., residue analyses on agricultural chemicals, and to establish the necessary specifications, e.g., to meet a U.S.P. grade for those products going into drugs. All of this of course is the responsibility of the Technology Manager.

New Applications - Occasionally established products will find applications in new markets which will require new information. This may include additional toxicity studies, information relating to Food and Drug clearance, special analytical procedures and specifications, and the like. This also is the responsibility of the Technology Manager in accordance with the foregoing.

Change in Manufacturing Operations or Formulations - The Operations Manager who has responsibility for the manufacture of a given product should report proposed changes in formulations or in established operating procedures to Technology Managers concerned. The Technology Manager with Dr. Colwell should review the effect of these changes in terms of changes in toxicity values or clearances by Food and Drug Administration and make recommendations accordingly. Substitution of even trace amounts of an inhibitor or additive, or a change in by-products resulting from a different reaction procedure or catalyst can invalidate the results of feeding tests on the parent product or affect guarantees given to customers. Where food, drug, pesticide or cosmetic applications are involved, changes in procedure should be employed only after their effects on the end use have been determined and approved by the Technology Manager. This applies to minor as well as major changes in the formulation of proprietary products.

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II Labeling and Shipment of Chemicals

As a policy we will not ship production lots or samples of chemicals without precautionary labels. Precautionary labeling is based upon toxicity and physical properties of a chemical. As indicated in the foregoing, physical properties such as flash points and volatility should always be provided. As a matter of practice the Labeling Committee will write the text of a precautionary label for each chemical upon completion of the range-finding tests. Samples of this label are shown on page 12. This label will be used in the shipment of samples until a more specific label is written.

Provisions covering the shipment of samples are contained in ICC Tariff Regulation No. 15. To aid in complying with ICC Regulations all information relating to Class B poisons is collected and compiled by Mr. R. B. Broadwater (Building 770). The responsibility for complying with these regulations rests with the Shipping Department on matters relating to shipping containers and with the Transportation Department on types of transportation. Questions arising concerning either of these matters should be referred to the respective department.*

New Compounds - In view of the precautions ordinarily observed in preparing small samples in the laboratory, for use within the Division or for screening as an agricultural chemical, no toxicological data are normally required. In the few cases where it is necessary to send out a new sample before toxicity data are known, an experimental label should be used with precautionary wording provided by Dr. Dernehl[1] or, if necessary, by consultation with Dr. Carpenter. A sample of this label is shown on page 12. An experimental label is not considered acceptable for shipping samples other than first lots. By the time second shipments are made or if repeated laboratory experiments are planned, toxicity studies should have been ordered and preliminary screening completed. Final labels should have been written. This is the responsibility of the R & D Manager or Group Leader, whoever initiated the work.

*In South Charleston
A. D. Haddix - Shipping
J. A. Willis - Transportation
In Tarrytown
E. J. Dolan - Shipping and Transportation

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Development or Sales Development Samples - By the time products reach this stage adequate toxicology data should be in hand and suitable labels written (if not, see page 1). It is the responsibility of the Technology Manager or Assistant Director (if not under control of a Business Area) to notify Mr. R. J. Allen and Dr. Dernehl, and see that adequate labels are provided for shipments.

Commercial Shipments - The Technology Manager will have seen to proper notification of the Labeling Committee who will undertake proper action. (See page 2.)

Special Sample Shipments

a) To chemical and drug firms, universities, special laboratories - These are chemicals which are usually shipped or exchanged under contract or special agreement. It is assumed, however, that regulations covering the shipment of normal samples apply to special samples. In instances when we do not have toxicity data and the customer has, we should obtain his information and supply it to Dr. Carpenter and Dr. Dernehl. This will be the responsibility of the Technology Manager who will also see that good judgment prevails where written procedures are inadequate.

b) To foreign countries - The same regulations which govern domestic shipments of chemicals should apply to shipments abroad. It should be recognized as good practice to print a warning label in the native language when this is possible.

III Requests from the Sales Personnel

Requests from the field sales force for toxicological information, involving customer activities, are of two types: 1) those requesting information or opinions based on established data and 2) those requiring experimental work. All requests will be sent to Dr. Dernehl. In the case of requests for additional work, the Technology Manager may participate in decisions as to the type, extent or whether the work should be done.

IV Requests from the Plant

Responsibility for safety in plant manufacturing operations rests primarily with Production Department line supervision. All requests for assistance from the Chemical Hygiene Laboratory should originate in the plant Medical Department, and copies should be sent to the Industrial Medicine and Toxicology Department and to the Operations and Technology Managers.

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V Dissemination of Toxicological Information

The work by the Chemical Hygiene Fellowship is reported by the following means: Monthly Progress Reports, Quarterly Reports and Special Reports. Special Reports are written for individual compounds and contain the detailed results which are of especial value to those requiring this information. The interpretation of toxicological information is to be made by either the Industrial Medicine and Toxicology Department or the Chemical Hygiene Fellowship. Recommended distribution lists for the R & D Department are given below.

Complete files of abstracts of previously issued reports are available at several locations.* Dr. Best and Mr. N. H. Ketcham are available at the Technical Center to assist those who wish to refer to these records. Mr. Ketcham and his Industrial Hygiene personnel also provide a valuable service, upon request, of monitoring safety conditions associated with experimental and plant operations.

The Technology Manager will see to the dissemination of toxicological data to customers, outside agencies, universities and the like by means of Division literature. Where this information is not adequate or is limited Drs. Dernehl or Carpenter should be consulted.

The R & D Manager or Group Leader** with the advice of the local Medical Director will transmit toxicological information to people within the Division as required to aid in the following safeguards. The text must be approved by Dr. Dernehl.

a) Safe practices in the laboratory and development operations.
b) Design of pilot plants.
c) Safe practices in plant operation.
d) Design or modification of plant equipment.

*Research & Development Library, Bldg. 701
E. M. Best, Jr., M.D., 511 (Bldg. 791)
Mr. N. H. Ketcham, 511 (Bldg. 770)
C. U. Dernehl, M.D., NYO-4
R. E. Joyner, M.D., 515
E. Q. Hull, M.D., 514
R. J. Sexton, M.D., 512
Mr. E. R. Weidlein, Jr., TNY
Dr. L. Shechter, Bound Brook
K. S. Lane, M.D., NYO-4

**In Advance Research Projects

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Distribution of Chemical Hygiene Reports*

U.C. Chemicals Division Special Report Mailing List (Except Ag. Chemicals)	U.C. Chemicals Division Special & Monthly Reports Mailing List Agricultural Chemicals	U.C. Chemicals Division Monthly, Quarterly and Annual Reports Mailing List
1 - J. W. Biddle	1 - F. Johnston	1 - J. W. Biddle
1 - F. Johnston	1 - R. L. Bateman	1 - F. Johnston
2 - R. L. Bateman		2 - R. L. Bateman
Medical	**Medical**	**Medical**
4 - C. U. Dernehl	4 - C. U. Dernehl	4 - C. U. Dernehl
1 - R. E. Joyner	1 - R. E. Joyner	1 - R. E. Joyner
1 - E. Q. Hull	1 - E. Q. Hull	1 - E. Q. Hull
1 - E. M. Best, Jr.	1 - E. M. Best, Jr.	1 - E. M. Best, Jr.
1 - R. J. Sexton	1 - R. J. Sexton	1 - R. J. Sexton
Production		
1 - R. C. Hieronymus		
1 - L. N. Dickinson		
R & D		**R & D**
2 - E. R. Weidlein, Jr.	1 - J. B. Harry	2 - E. R. Weidlein, Jr.
1 - S. M. Livengood	1 - R. H. Wellman	1 - S. M. Livengood
1 - C. A. Carter	2 - H. H. Moorefield	1 - C. A. Carter
1 - R. I. Hoaglin	1 - R. C. Back	1 - R. I. Hoaglin
1 - H. R. Guest	1 - J. T. Dunn	1 - H. R. Guest
1 - R. E. Leech	1 - H. R. Guest	1 - R. E. Leech
1 - A. E. Montagna	1 - J. T. Adams	1 - A. E. Montagna
1 - G. M. Powell	1 - D. L. Heywood	1 - G. M. Powell
1 - W. N. Stoops	1 - H. E. Johnson	1 - W. N. Stoops
1 - S. W. Tinsley, Jr.	1 - H. A. Stansbury	1 - S. W. Tinsley, Jr.
1 - A. T. Walter	2 - E. R. Weidlein, Jr.	1 - A. T. Walter
1 - R. M. Berg		1 - R. M. Berg
1 - H. W. Schulz		1 - H. W. Schulz
1 - J. T. Dunn		1 - J. T. Dunn
4 - R & D Library	4 - R & D Library	4 - R & D Library

** ** It is recommended that full distribution be shown on all reports. List the names of the specific Technology Manager and special recipients on each request form.

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VI Personnel and Location

Chemicals Division, Research and Development Department

1. Chemical Hygiene Fellowship - Bushy Run Laboratories
   Mailing Address: Mellon Institute
   4400 Fifth Avenue
   Pittsburgh 13, Pennsylvania

   Telephone: Area Code 412 327-1020
   Henry F. Smyth, Jr., Ph.D. Administrative Fellow
   Charles P. Carpenter, Ph.D. Assistant Administrative Fellow

2. Tarrytown Laboratories - Telephone: Area Code 914 592-9300
   Dr. C. E. Colwell - Extension 262
   Mr. E. R. Weidlein, Jr. - Extension 231

3. Labeling Committee - Union Carbide Corporation
   Chemicals Division
   270 Park Avenue
   New York 17, New York

   Mr. R. J. Allen, Chairman - Distribution Department
   Mr. G. T. Scriba or Mr. Ashley Cole - Law Department
   Dr. C. U. Dernehl - Industrial Medicine & Toxicology Department
   Dr. C. E. Colwell or Mr. E. R. Weidlein, Jr. - Tarrytown
   Mr. T. E. Willoughby - Distribution Department

Union Carbide Corporation

1. Law Department - 270 Park Avenue
   Mr. G. T. Scriba - Extension 4881
   Mr. Ashley Cole - Extension 6468

2. Industrial Medicine & Toxicology Department - 270 Park Avenue
   Dr. C. U. Dernehl - Extension 4785

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VII Types of Toxicological Tests

A considerable part of the work of Fellowship 4274 consists of standardized studies aimed to meet the requirements of the U.S. Food and Drug Administration. The table presented below lists our best estimate of the costs of such studies. Fixed prices are quoted for the first four only. For other studies there is shown the most likely cost, and the range of uncertainty. Until a study is completed it will not be possible to determine where in the range will lie the actual cost of the specific study. The cost of nonstandardized studies such as defining metabolic pathways can be estimated only in terms of a monthly rate. Such studies are research. In metabolic studies one must identify the substances formed in the body, then devise new analytical methods for their quantification. Obviously, the time required for such research cannot be predicted.

Study Name	Purpose for Which Designed	Cost Range
Range-Finding Tests Predictions 1-2 weeks Final Report 4-8 weeks	See body and protocol section of any of the current range-finding reports. Peroral, skin penetration, inhalation, irritation of eye and skin (rat and mouse). For additional species the cost would increase progressively with the size of the animal used. (Guinea pig 2X; rabbit or cat 4X; monkey or dog 30X the rat or mouse costs.) It follows that the larger species must be used sparingly and judiciously and whole range-finding tests are not commonly done on large animals.	$ 400.00*
90-Day Feeding to Rats or Dogs	To determine levels for 2-year feeding study or for temporary tolerance at F&DA.	$5,500.00

*The costs of most of the tests are charged directly to individual projects; however, the charges for all range-finding tests are spread over all projects.

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Study Name	Purpose for Which Designed	Cost Range
2-Year Feeding to Rats or Dogs	To establish F&DA tolerance for use as incidental or intentional food additive or for residues of pesticides.	$50,000.00 Early termination billed at actual cost for work done.
Sensitization, Modified Landsteiner Guinea Pig Test	Not to determine direct skin irritation but to determine whether as a result of repeated application followed by a suitable incubation period the body will react to a minuscule challenge dose in greatly magnified manner, i.e., from an initial no reaction to an inflammatory final reaction in form of red, raised wheal.	$ 500.00
Pharmacology Stage 1	Limited screening. Preliminary cardiovascular, over symptomatology, simple testing.	$600 ± $200
Stage 2	Pharmacological evaluation. Secondary evaluation of leads obtained in Stage 1, not complete but staying with major system which appears to be affected.	$1,800 ± $600 Price includes Stage 1
Stage 3	Pharmacological Profile. Further investigations on all major systems for mechanism of action, antidotal studies.	$4,000 ± $1,000 Price includes Stages 1 and 2
Stage 4	Pharmacological-Biochemical Correlates of Action. For more specialized chemicals to examine degree of pharmacologic effect with a known "biochemical lesion" e.g., Behavior versus Cholinesterase Inhibition.	$2,250 ± $750 Stage 4 only

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Study Name	Purpose for Which Designed	Cost Range
Pharmacology Stage 5	Interaction Studies. Combination studies with psychotherapeutic, depressant, stimulant, antihypertensive and diuretic agents.	$800 ± $200 per drug class to a maximum for these 5 drug classes of
	Total	$4,000 ± $1,000
90-Day Inhalation 3 Levels and Control 1 Species	To establish baseline for Threshold Limit Value.	$8,000 ± $1,500
90-Day Inunction to Rabbits	To establish safe level for cosmetic uses or potential harm from repeated skin application as for naphthols of SEVIN process.	$7,500 ± $1,000
3-Generation Studies on Rats - 1 Compound	To determine effect on fertility, life span, etc.	$3,000 ± $1,500 Minimal cost if integral with 2-year study
Cancer Studies	Feeding mice 80 weeks.	$2,000 ± $400
	Skin painting mice 24 months.	$1,500 ± $300
	Subcutaneous Injection of mice - 22 weeks.	$300 ± $100
	Proof to F&DA that a suspicious material is not a carcinogen. (Proving a negative.)	ca. $162,000 (avg.)

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DANGER!

FLAMMABLE

MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED

PROLONGED OR REPEATED BREATHING OF VAPOR HARMFUL

Keep away from heat, sparks, and fire.

Do not leave container open.

Use with adequate ventilation.

Methanol Liq. (Methyl Alcohol)
CCC-1743D

POISON

CANNOT BE MADE NON-POISONOUS
ANTIDOTES

(First Aid) if swallowed: Give a tablespoonful of salt in a glass of warm water and repeat until vomit fluid is clear. Give two teaspoonfuls of baking soda in a glass of water. Have patient lie down and keep warm. Cover eyes to exclude light. CALL A PHYSICIAN.

MADE IN U. S. A.

FOR INDUSTRIAL USE ONLY

UNION CARBIDE CHEMICALS | UNION CARBIDE CORPORATION CHEMICALS DIVISION NEW YORK, N.Y. 10017 • OFFICES IN PRINCIPAL CITIES



WARNING! ABSORPTION THROUGH SKIN MAY BE HARMFUL
LIQUID CAUSES SKIN IRRITATION

Avoid contact of liquid with skin or clothing.

Avoid prolonged or repeated breathing of vapor.

Keep away from heat, sparks, and fire.

Do not leave container open.

Use with adequate ventilation.

In case of contact with skin, immediately flush with plenty of water for at least 15 minutes. Remove contaminated clothing and shoes at once. Wash thoroughly before re-use.

CCC-2768

MADE IN U.S.A.

FOR INDUSTRIAL USE ONLY

UNION CARBIDE CHEMICALS | UNION CARBIDE CORPORATION CHEMICALS DIVISION NEW YORK, N.Y. 10017 • OFFICES IN PRINCIPAL CITIES

Precautionary Labels

FOR EXPERIMENTAL USE ONLY

CAUTION!—The chemical, physical, and physiological properties of this material are not fully known, and its handling or use may be hazardous. Use due care.

Known hazards are_____

_____

_____

CCC-2139E Other hazards may exist. There is no express or implied warranty. MADE IN U.S.A.

FOR INDUSTRIAL USE ONLY

UNION CARBIDE CHEMICALS | UNION CARBIDE CORPORATION CHEMICALS DIVISION NEW YORK, N.Y. 10017 • OFFICES IN PRINCIPAL CITIES

Experimental Label

DE 004987

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NOTE: Under Union Carbide policy no product is shipped until the shipping department is advised of the Precautionary Labeling Committee's instructions on warning labeling. Use this form to initiate Precautionary Labeling Committee action. In an emergency use Experimental Label on any sample which must be shipped before Precautionary Labeling Committee action. Use this label only after obtaining advice from Dr. Dernehl at New York on the warning to be typed on it.

Request for: TOXICITY STUDIES
PRECAUTIONARY LABELING

To: Dr. C. P. Carpenter
Mellon Institute
4400 Fifth Avenue
Pittsburgh 13, Pa.

From: Name _____
Dept. _____
Location _____

Copies to: Dr. C. U. Dernehl, New York
Dr. C. E. Colwell, Tech. Serv.

The Mellon Institute Fellowship is requested to make toxicity studies, if necessary, and the Precautionary Labeling Committee to specify suitable precautionary labeling. Please advise plant shipping departments and the writer.

PRODUCT NAME FOR LABEL: _____

A.C.S. NOMENCLATURE: _____

STRUCTURAL FORMULA OR COMPOSITION OF MIXTURES: _____

SAMPLE QUANTITY REQUIRED:
(Underline amount shipped)

if toxicity is estimated to be in the range of:
allyl alcohol — 2 oz. or more
glycol ether — 8 oz. or more
polyglycol — 16 oz.

PHYSICAL CHARACTERISTICS: (Give all which are known)

Gas _____ Liquid _____ Low M.P. Solid _____ Powder _____

Molecular wt. _____ Vapor Pressure:

Sp. Gr. _____ (3 temp. between 15° and 150°C)

Melting Point _____ _____mm at _____°C

Boiling Point _____ _____mm at _____°C

Flash Point (Tag Open Cup) _____ _____mm at _____°C

	SOLUBILITY (Per cent?)	STABILITY (How long?)	DECOMPOSES (Light? air? temperature?)
Water			
Acetone			
Vegetable Oil			
Propylene Glycol			
Dimethyl Phthalate			
Aliphatic Hydrocarbon			

PROSPECTIVE USES AS AN INGREDIENT: (Circle) *In food* *In drugs* *In cosmetics* *In food packaging* *In drug packaging* *In cosmetic packaging* *In a pesticide* *In animal feed* *In other products as follows:*

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FOR PRECAUTIONARY LABEL COMMITTEE ACTION

Name of Product:

Signal Word:

Poison:

Statements of Hazard:

Precautionary statements:

Handling and Storage Instructions:

First Aid and Antidote:

Directions for use:

As printed on standard form: FOR INDUSTRIAL USE ONLY

Special directions:

INDUSTRIAL MEDICINE AND
TOXICOLOGY DEPARTMENT

Does Label meet requirements of:	Yes	No
New York City of C of A		
Federal Food, Drug and Cosmetics Act		
Federal Insecticide, Fungicide and Rodenticide Act		
M.C.A. Manual		
California Regulations		
Other State Regulations		

APPROVED BY LABEL COMMITTEE

Secretary of Label Committee

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WFM
RM - File

INTERNAL CORRESPONDENCE

UNION CARBIDE CORPORATION

CHEMICALS UNION CARBIDE DIVISION

P. O. BOX 186
PORT LAVACA, TEXAS 77979

To (Name) Mr. A. P. Moss
Company
Location New York Office

Date January 8, 1964
Originating Dept.
Answering letter date

Copy to Mr. H. E. Allspach
Mr. H. B. Coons ←

Subject Texas Area Industrial Hygienist

Dear Mr. Moss:

The Seadrift Plant has some industrial hygiene problems at the present time. These problems consist of noise in the compressor areas and the intensifier oil building, and the build-up of cobalt concentration in the personnel working at the Oxo Unit. Additional problems will be encountered in the Styrene Unit. Therefore, I believe that the Seadrift Plant could use effectively an industrial hygienist on a part-time basis.

I believe that this hygienist should work from a centralized group to cover all problems in the Texas area. I further believe that he should work closely with Dr. Joyner on the solution of all problems in the area plants. If Dr. Joyner is assigned these problems on an area basis, we may be relieved from a full-time doctor at Seadrift and Brownsville for many years.

In the corrosion work at the Seadrift and Brownsville Plants, we have used the services of the corrosion group at Texas City. I visualize that the same procedure could be used to fully utilize the services of an industrial hygienist at the Texas area plants.

As pointed out in Mr. Allspach's letter, the place to start a program of industrial hygiene is in the Engineering phase of the project. As our industrial hygienist became familiar with the technical aspects of the problems, he could be used as a consultant to the Engineering Department on the design of new units in the same manner as we assign an operating man to work on the design of new units.

Very truly yours,

R. P. Barry

R. P. Barry/mk

DE 004990

C. & C. C. C.
RECEIVED
JAN 10 1964
H. B. COONS

UNION CARBIDE CORPORATION

CHEMICALS DIVISION

INTERNAL CORRESPONDENCE

DE 004991

UNION CARBIDE

Mr. A. P. Moss

New York Office

January 6, 1964

Mr. H. E. Allspach
Mr. R. P. Barry

Texas Area Industrial Hygienist

Dear Mr. Moss:

The number of industrial hygiene problems at Brownsville (except for noise) are, as Mr. Ketchum says, minor. We do have a noise problem in the oxygen plant and in the utilities unit. At present we require employees to wear ear plugs. We plan to improve these areas and to keep a close check on the hearing ability of the people who work in them.

It is my feeling that with the purchase of an instrument to measure noise levels, we can develop a program which can be executed here. We can keep the records necessary to comply with the California law, as suggested by Mr. Ketchum.

From the standpoint of the Brownsville Plant we see little need for an industrial hygienist in the Texas area.

Very truly yours,

H B Coons

H. B. Coons

HBC:mr

DE 004992

UNION CARBIDE INTERNAL CORRESPONDENCE

UNION CARBIDE CHEMICALS COMPANY • P. O. BOX 471, TEXAS CITY, TEXAS

To (Name) Mr. A. P. Moss
Company 32nd Floor
Location NEW YORK OFFICE

Date January 2, 1964

Copy to Mr. R. P. Barry
Mr. H. B. Coons

Subject Texas Area Industrial Hygienist

Dear Mr. Moss:

We recognize here at Texas City the presence of many industrial hygiene problems which need solution. Certainly a full-time hygienist in the area or in the plant would be helpful in solving some of these problems.

In reading Mr. Ketcham's letter of December 17, and in recalling conversations with him and Dr. Joyner at the time of his visit in October, I am impressed with the number of problems which fall in the category of noise, heat, and ventilation. These problems exist because of decisions made at the time these facilities were engineered and designed. We have struggled to find practical solutions to these problems and I am pessimistic about finding them. Meanwhile we are getting into a sizable building program in this plant, and I am hopeful that industrial hygiene factors are being given adequate consideration in the design stage. Similarly we are doing some modernizing of existing units in which industrial hygiene factors should be considered.

If the industrial hygiene effort is to be limited, I would rather see it applied in the design stages in the Engineering and Design Departments than in the plants, and we could continue to call upon existing personnel for consultation visits as we have been doing rather than locate an industrial hygienist in this area. Even with one industrial hygienist located in the Texas area, he could be resident on only one plant of the three and must necessarily serve on a consulting basis to the other two plants.

DE 004993

C. & C. C. C.
RECEIVED
JAN 3 1964
H. B. COONS

In summary, while I am not adverse to locating an industrial hygienist in the Texas Area, I believe that increased efforts should be made first in the design and engineering stages of both new units and units being modernized so as to prevent problems rather than solve them.

Sincerely yours,

H. E. Allspach

HEA/dmh

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UC 149-2

UNION CARBIDE

INTERNAL CORRESPONDENCE

UNION CARBIDE CHEMICALS COMPANY • 270 PARK AVENUE, NEW YORK 17, NEW YORK

To (Name) Mr. H. E. Allspach
Company ✓Mr. R. P. Barry
Location Mr. H. B. Coons

Date December 24, 1963

Originating Dept. Works Manager's Dept.

Answering letter date

Copy to

Subject Texas Area Industrial Hygienist

Gentlemen:

The attached letter from Mr. Ketcham on the subject matter is self-explanatory. For some time he and Dr. Dernehl have been urging us to add people in this category to our plants.

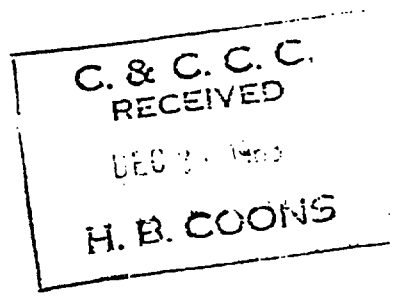
I will appreciate your counsel on this matter.

Very truly yours,

APMoss/etw

Encl.

DE 004996



DE 004997

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UNION CARBIDE

INTERNAL CORRESPONDENCE

UNION CARBIDE CHEMICALS COMPANY • SOUTH CHARLESTON 3, WEST VIRGINIA

To (Name) Mr. A. P. Moss
Company 32nd Floor
Location New York Office

Date December 17, 1963
Originating Dept. Research and Development
Answering letter date

Copy to Mr. R. M. Berg
C. U. Dernehl, M. D.
Dr. F. Johnston
Dr. J. L. Marsh

Subject Texas Area Industrial Hygienist

Dear Mr. Moss:

Early this Fall I spent two consecutive weeks at the three Texas Plants with the primary objective of evaluating a suspected need for greatly increased industrial hygiene services at these locations. At each plant I discussed the needs with the plant manager and outlined a course of action which included a proposal for hiring an industrial hygienist. The managers were generally cognizant of the health problems and agreed there was considerable merit in the proposal. Dr. R. E. Joyner, Medical Director of the Texas City Plant, was also consulted and is in agreement with the plan. This letter and attached memorandum summarize my conversations with the plant managers and Dr. Joyner and is a specific request for your approval for the Texas Plants to hire an experienced professional industrial hygienist who will apportion his time between the three locations. The services of this man can be expected to result in major monetary savings, to improve our medico-legal position with respect to the impairment of hearing of our employees, and to make major contributions to the solutions to many of the health problems.

After you have had an opportunity to consider this proposal and the information in this letter and memorandum, I will appreciate a chance to discuss the subject with you, as there are some aspects which warrant further clarification.

The health problems at the three plants can be divided into two broad categories; namely, (1) noise exposure and (2) other problems including compliance with state regulations for the handling of radioisotopes, ventilation problems, heat control efforts, and air contamination.

My observations and conclusions concerning the noise problems were discussed in detail with each of the plant managers. At both the Texas City and Seadrift Plants, impairment of hearing attributable to industrial noise has been demonstrated. The situation is particularly serious as impairment of hearing in some relatively young men has progressed with disturbing rapidity. The Brownsville Plant has not reported impairment

DE 004998

of hearing to date, but this may be expected as the existence of a severe hazard has been defined.

Very large expenditures of money may be required to cope with the noise problems at each of the three plants. Some major expenditures have already been made and some notable reductions in noise exposures have resulted. Unfortunately, these efforts to date have had to be made without a clear-cut criterion for judging how much and what kind of correction was needed. It has been especially difficult to distinguish between noise exposure reductions which should be assigned mandatory status and those which would be desirable but not necessarily essential. Accordingly, I attempted to acquaint each of the three plant managers with the provisions and general philosophy of a noise control law passed by the State of California early in 1963. This law is extremely lenient, but it does for the first time provide a basis for distinguishing between mandatory and optional corrective action. I proposed that each plant voluntarily attempt to "live with" this California law in anticipation of the time when the State of Texas would have similar legislation. The advantages to the plants and to the Chemicals Division of following this course of action are explained in the attached memorandum, Part A.

A large number of other industrial hygiene problems in the Texas area plants were identified during this two-week survey. This was not a surprise, and very little was observed that was not already known. This was, however, the first time an effort has been made to formally record the volume and variety of the problems. As expected, the largest volume of such needs occur at the Texas City Plant. A list of 45 examples existing at the Texas City Plant is included in Part B of the attached memorandum.

The rapidly growing volume of work with radioisotopes in sealed sources is worthy of special comment. The safety aspects and the procedures for compliance with Texas State regulations have been handled capably to date by plant personnel at all three locations. Experience at other locations, however, shows conclusively that the safety and compliance aspects will require the services of an industrial hygienist to sustain the somewhat routine but mandatory procedures over extended periods of time.

Ventilation problems, efforts at heat control, and air contamination problems also occur frequently and need the services of an industrial hygienist.

There is, in my opinion, no doubt but that the serious nature and the volume of health problems at the Texas area plants require the full-time services of a professional industrial hygienist. The present level of effort being made to define and correct the problems is not adequate. Provision of full-time industrial hygiene service at the Texas Plants is most logical in view of the favorable experience at the Institute and South Charleston Plants and the Technical Center, where industrial hygienists are employed by the medical departments. The demonstrated value of the service and the overwhelming volume of work requested of the industrial hygienists

DE 004999

at these locations virtually assures the success of the program at the Texas Plants. The cost of the industrial hygienist's services will be negligible in comparison with the potential savings he can be expected to produce on the noise problems alone. His contributions on other problems, from which additional major savings can be expected, make the need for his work even more apparent.

The industrial hygienist should report to Dr. R. E. Joyner, Medical Director of the Texas City Plant. This would accomplish a second highly desirable objective; namely, that of providing for over-all medical supervision of the work, including review and interpretation of the results of audiometric tests being conducted at all three locations. The time and the cost of the industrial hygienist's services should be apportioned between the three plants.

An experienced industrial hygienist of the caliber needed for this assignment will be difficult to find. The definition of an industrial hygienist, as described by the American Industrial Hygiene Association, is marked on the first page of the management brochure enclosed. I urge prompt approval of this proposal so efforts can be initiated immediately to locate a qualified man. This may take a year or more to do. In the meantime I will, of course, continue to give the three Texas Plants as much personal attention as I can.

Very truly yours,

N. H. Ketcham

N. H. Ketcham
Industrial Hygiene Consultant

NHK/dww
Attachments

DE 005000

M E M O R A N D U M

Part A: Noise Problems, Texas Area Plants

The existence of noise exposure sufficient to cause hearing impairment of employees working in the Seadrift and Texas City Plants has been a matter of concern for many years. The relatively recent acquisition of the Brownsville Plant added another location with a serious noise problem. The virtual certainty that some employees would suffer impairment of hearing has been known. Nonetheless, it has been extremely difficult to balance the medical and legal risks against the cost and effort needed for corrective action. In some of the work areas involved, the cost of eliminating the problem by engineering means has appeared to be prohibitive. The plants have been in the unfortunate position of having no realistic guidline for determining what degree of noise exposure reduction "must" be provided regardless of cost or effort, and to what extent corrective action "should" be undertaken. This has been a problem for many industries having serious noise problems.

In recognition of the need for a realistic criterion, the State of California solicited the assistance of qualified experts to define regulations which could be administered by state law. The experts selected for this assignment included good representation from industry as well as from government agencies. With this expert help, the State of California drafted and enacted into law a safety order covering the control of industrial noise exposure. This law will undoubtedly serve as a pattern which other states will follow. It can be anticipated that the State of Texas will be among those enacting this type of legislation in the near future. In general the law can be characterized as being extremely lenient, but is is written so that it can be tightened up as experience is gained in administering it.

The California law is deceptively simple. It adopts a philosophy which has been used successfully for the control of radiation exposure. The employer must be able to produce records defining the noise exposure history of every employee from his hiring date to termination (or to the date when the information is needed). This need for information and records describing the individual employee's exposure is not spelled out in the California noise regulation, but is is clear that employers cannot operate under the law without such records. Briefly, under a California-type noise control law, the company has the following responsibilities:

1. Over-all noise measurements and octave band frequency analyses must be made in locations where excessive noise exposure is possible. Such measurements would have to be repeated whenever any changes in equipment or operating procedures alter the noise condition.

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2. The time during which employees work in the noisy area must be known.

3. In work areas where the noise exposure is excessive (as defined by the regulation), the company must either correct the exposure by engineering means or be able to show that this approach is not feasible.

4. In those areas where the exposure is excessive and cannot be corrected by engineering means, employees must be required to use ear protection devices.

5. In the event of any legal action, such as the filing of compensation claims by the employees, the company must be able to produce documentation showing compliance with (1) through (4) above, which is in effect a record of the employee's noise exposure history.

For three reasons it is important that our Texas area plants initiate efforts to comply with the California law on a voluntary basis. The first reason is that voluntary compliance would give us a basis for a practical evaluation of the cost of compliance with this type law while there is still time to make individual decisions carefully, rather than have to do so hurriedly under duress. It must be emphasized that the cost of making major reductions of noise can be extremely expensive. Also, large sums of money can be spent unwisely with the result that little effective reduction of employee noise exposure is accomplished. The second reason is that experience gained through voluntary efforts to comply with a California-type law will enable us to anticipate the specific effect of similar legislation proposed for the State of Texas. Without such experience, it would be virtually impossible to judge the ultimate cost or other effects such a law would have on the Texas Plants. Third, the California law is so lenient that voluntary compliance would carry no risk of taking more action than would be reasonable.

None of our three Texas Plants is now in a position to do the work which would be required to comply with a law of the type described. In order to do this the services of an industrial hygienist (who would apportion his time between the three plants) would be required. The cost of this service would be negligible in comparison with the potential costs of eliminating the present hazards to the hearing of the employees. The industrial hygienist could not do all the implied work himself, but he would provide necessary guidance in setting up the programs and he would coordinate the resulting efforts. He would be personally responsible for making the noise measurements in the plants and for assuring that they were properly recorded. He would watch the progress of the work, review the findings, and report them in a manner to define what would be required to accomplish the needed reduction of noise exposure.

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It is recommended that the industrial hygienist work under the supervision of Dr. R. E. Joyner, Medical Director at the Texas City Plant. This would accomplish another desirable objective in that Dr. Joyner would provide medical supervision of the work, including review and interpretation of the results of the audiometric tests being conducted at the three plants.

Part B: Other Industrial Hygiene Problems, Texas Area Plants

Texas City Plant

During a four-day period (October 2, 7, 8, and 9), a survey was made of the Texas City Plant to assess the volume of industrial hygiene work, in addition to the noise problems. The survey consisted of observation of plant locations and discussions with the supervisors. The survey was made by Mr. N. H. Ketcham following an itinerary outlined by Dr. R. E. Joyner. At the conclusion of the four-day survey, a list of 45 problems which required, or would benefit from, industrial hygiene service was compiled. The complete list is attached. Selected items included on the list were discussed with Mr. H. E. Allspach at the conclusion of the survey.

The Texas City Plant is beginning to utilize instrumentation containing radioactive sources and is now procuring them at a rapid rate. Plans are also being considered for having plant personnel do non-destructive testing using radiography, which is now being done by an outside contractor. The entry of the Texas City Plant into these fields is highly desirable but must be accompanied by suitable administrative control to comply with State regulations. Our experience at other locations shows that the services of an industrial hygienist are essential to sustain compliance with the licenses over extended periods of time.

Seadrift Plant

In 1961 the Seadrift Plant developed data showing an appreciable excretion of cobalt in the urine of Oxo process personnel. Further study of this finding would have been desirable but was not undertaken as there had been no evidence of acute illness of the men. The possibility of adverse effects from chronic (continuing) exposure has not been ruled out.

Close medical and industrial hygiene supervision of personnel who will be assigned to the new Styrene Unit is essential, at least until the extent of exposure to benzene and cracking residues has been evaluated.

The Seadrift Plant is complying with the State requirements for the use of a moderate number of radioactive sources. An industrial hygienist would relieve plant personnel of some of these continuing responsibilities.

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Numerous relatively minor potential health problems exist at the Seadrift Plant and would benefit from the attention of an industrial hygienist, if such a service were available locally.

Brownsville Plant

At the present time the Brownsville Plant has only minor industrial hygiene problems other than noise. The use of radioactive materials will probably remain very small for the foreseeable future.

There is a possibility that contemplated activities at this plant, such as propane oxidation studies, might introduce some problems not now present.

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Texas City Plant

Continuing Industrial Hygiene Needs

1. Noise exposure evaluations -- engineering corrections -- personnel protection.
2. Radiation safety -- compliance with regulations.
3. Ventilation design consultation.
4. Periodic performance testing and inspection of ventilation systems.
5. Community air pollution investigations.
6. Review of plans for new construction -- phenol-formaldehyde plastic unit -- n-alkanes unit -- ethylenimine unit.
7. Heat exposure evaluations and correction.
8. Lighting problems -- evaluation -- correction
9. Vessel and tank entry -- pre-entry safety tests.

Specific Problems as of October 10, 1963

1. Complaints of airborne irritant at sheetmetal shop (dripolene?).
2. Illnesses due to removal of tube bundles at maintenance shop.
3. Fumes from salt pot at valve shop.
4. Cutting oil fumes at machine shop.
5. Evaluate dust inhalation at present insulation fabrication shop.
6. Design ventilation for new insulation fabrication shop.
7. Design paint spray facilities for new paint shop.
8. Evaluate need for local exhaust ventilation in carpenter shop.
9. Evaluate exposure to dust from outdoor sandblasting.
10. Evaluate exposure to welding fumes (winter conditions) north and south shops.
11. Carbide Seadrift - ventilation and pre-entry testing.
12. Air sampling for mercury vapor in instrument shop.
13. Lime dust at shipping department.

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14. Vessel entry test - use of Humble Oil Company rapid analysis for cobalt.

15. Barge entry test for acrylonitrile - test detector tubes used.

16. Nitrous acid fume at Oxo Unit - evaluate inhalation exposure.

17. Silver catalyst loss and personnel exposure.

18. Smith-Douglas Company fumes.

19. Acid plant fumes (SO_2).

20. Disaster planning - radiation and other emergencies.

21. Investigate feasibility of scrubbing acetaldehyde vent, Building 111.

22. Test (and then replace) ring-type exhaust hoods at catalyst unit.

23. Evaluate benzene exposure - plantwide.

24. Compare suitability of single tube benzene test with mixed reagent kit.

25. Ventilation for heat relief, Compressor Building 139.

26. Chlorinated hydrocarbon inhalation, Building 110 - air sampling.

27 Mercury catalyst loss and personnel exposure.

28. Mercury contamination of water -- National Institutes of Health.

29. Formic acid from Brownsville - evaluate inhalation exposure.

30. Improve carbon monoxide sampling system for alarm (Oxo Unit).

31. Air sampling for cobalt - chronic inhalation - Oxo Unit.

32. Investigate cobalt exposure at filter press - Oxo Unit.

33. Mercury contamination of ground near Dowtherm furnace.

34. Vapors from drum washing at shipping building.

35. Air sampling for miscellaneous esters - Building 24.

36. Heat control at oxide units.

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UC 149 2

INTERNAL CORRESPONDENCE

UNION CARBIDE CHEMICALS COMPANY • P. O. BOX 1551, BROWNSVILLE, TEXAS

To (Name) Mr. W. H. Ketcham
Company Research and Development
Location Technical Center

Date August 14, 1963

Originating Dept.

Answering letter date

Copy to C. U. Dernehl, M.D.

Subject Chemicals Company Six-Month Industrial Hygiene Summary Report

Dear Mr. Ketcham:

The only industrial hygiene activities we have to report for the Brownsville Plant for the first six months of 1963, was the periodic audiometric testing of employees working in high noise areas.

A comparative review of each employee's audiograms indicate that to date, none of these employees tested, have suffered any depreciable hearing loss.

Mr. Warren is on vacation and asked that I pass this information on to you.

Very truly yours,

F. M. Murphy

DE 005007

UC 149-2

UNION CARBIDE

INTERNAL CORRESPONDENCE

UNION CARBIDE CHEMICALS COMPANY

SOUTH CHARLESTON 3, WEST VIRGINIA

To (Name) Mr. W. E. Warren
Company
Location Brownsville Plant

Date July 19, 1963
Originating Dept. Research and Development
Answering letter date

Copy to Mr. R. M. Berg
C. U. Dernehl, M. D.

Subject Chemicals Company
Six-Month Industrial
Hygiene Summary Report

Dear Mr. Warren:

A summary report of industrial hygiene activities in the Chemicals Company for the first six months of this year is now being prepared. Information from the Brownsville Plant which you would like to have included should reach me by August 20.

Very truly yours,

N. H. Ketcham

N. H. Ketcham

NHK/rth

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JUL 22 1963
INDUSTRIAL RELATIONS

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UC 149-2

UNION CARBIDE INTERNAL CORRESPONDENCE

UNION CARBIDE CHEMICALS COMPANY • P. O. BOX 1551, BROWNSVILLE, TEXAS

To (Name) Mr. N. H. Ketcham
Company Research and Development
Location Technical Center

Date February 12, 1963
Originating Dept.
Answering letter date

Copy to C. U. Dernehl, M. D.
Mr. R. G. Wilson

Subject Chemicals Company Six-Month Industrial Hygiene Summary Report

Dear Newt:

The only subject activity which took place at Brownsville during the period July 1 - December 31, 1962, was the periodic audiometric testing of employees working in high noise areas. A cursory review of profiles indicate that none of the employees tested have suffered any hearing loss.

Following is the information about our radiation sources which you requested.

Location of Source:	The measuring cell and compensating cell are located in the butane oxidation unit.
Date Installed:	June 27, 1962
Manufacturer's Name and Type of Source Housing:	Ohmart Corporation, Model HM-S. The compensating cell is Model RTSN-3
Kind of Radioisotope:	Cesium 137
Amount of Radioisotope:	750 millicuries in the measuring cell and 0.100 millicuries in the compensating cell.
Required Leak Test Frequency:	Measuring cell at intervals not to exceed 6 months. Compensating cell at intervals not to exceed 3 years.
Date of Last Leak Test:	February 11, 1963

The above information was obtained from Mr. R. G. Wilson, our instrument engineer, who is responsible for the radiation source. According to Mr. Wilson, we have experienced no problems in the licensing procedure or

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in the radiation protection program. He states, however, that our license does not correctly describe the size sources that we have installed in our system. Our license calls for 500 mc in the measuring cell, while we actually have 750 mc. The license calls for 200 mc in our compensating cell, while we actually have 0.100 mc. The actual license procedure was handled by the Special Instrument Division and not by this location.

Mr. Wilson has assured us that future leak tests will be performed within the prescribed time limits.

Very truly yours,

W. E. Warren

WEW/f

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UC 149 2

UNION CARBIDE INTERNAL CORRESPONDENCE

UNION CARBIDE CHEMICALS COMPANY SOUTH CHARLESTON 3, WEST VIRGINIA

To (Name) Mr. W. E. Warren
Company
Location Brownsville Plant

Date January 31, 1963
Originating Dept. Research and Development
Answering letter date

Copy to Mr. R. M. Berg
C. U. Dernehl, M. D.

Subject Chemicals Company Six-Month Industrial Hygiene Summary Report

Dear Mr. Warren:

We are starting to work on a summary report of industrial hygiene activities in the Chemicals Company for the six-month period, July 1 - December 31, 1962. Information from the Brownsville Plant which you would like to have included should reach me by February 15.

In addition to the usual industrial hygiene information, please supply a table giving the following for each of your radiation sources subject to licensing by the State of Texas (previously the AEC).

Location of Source:
Date Installed:
Manufacturer's Name and
Type of Source Housing:
Kind of Radioisotope:
Amount of Radioisotope:
Required Leak Test Frequency:
Date of Last Leak Test:

Please include information about any problems you have encountered in radiation protection or your licensing procedure.

Very truly yours,

N. H. Ketcham

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MAY 6 1963
INDUSTRIAL RELATIONS

INDUSTRIAL HYGIENE SUMMARY REPORT

Period July 1 - December 31, 1962

Brief descriptions of selected Company activities requiring or benefiting from industrial hygiene services are contained in this report. It is not a complete report of work done, as such a compilation would be impractically voluminous. By selectively summarizing the reported progress, an effort has been made to show the nature of the industrial hygiene services being provided, and to illustrate the role they play in today's diversified and competitive chemical production industry.

Successful pilot-scale production of a boron-containing rocket fuel and laboratory-scale work with a beryllium-containing propellant ---- need for a method of sampling air for a miticide of unusually great toxicity ---- completion of the monumental task of evaluating employee noise exposure in the entire South Charleston Plant ---- evaluation of the hazard to personnel and the potential public liability, and the community air pollution aspects of burning chemical residue at the South Charleston City Dump ---- these are subjects mentioned in the report.

A trend toward increased state control of certain environmental hazards is clearly evident. During this reporting period, the States of New York and Texas joined California in assuming responsibility for licensing and supervising the use of radioactive materials. New York State took over this responsibility from the Atomic Energy Commission on October 15, 1962. Texas and the AEC approved an agreement on December 27, 1962 to take effect March 1, 1963. California's legislation became effective September 1, 1962. State control is in some respects more stringent than AEC control. The states include radium and X-ray producing electronic equipment in their licensing and usage regulations, whereas the AEC did not. The states may be expected to inspect with greater frequency than the AEC is able to do.

A table identifying the encapsulated radiation sources in the possession of all Chemicals Company locations which are subject to AEC or state licensing and control is attached to this report. This is the first time a complete Company-wide compilation has been reported.

The State of California Department of Industrial Relations has completed plans to regulate noise levels in factories. If this is the start of a trend to be picked up by other states, some of our Chemicals Company locations will be vitally affected.

Submitted by:

N. H. Ketcham

N. H. Ketcham
Industrial Hygiene Consultant

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TECHNICAL CENTER

This information was taken from Summary Reports for the 3rd and 4th quarters of 1962, prepared by Mr. Fred Williams, Technical Center Industrial Hygienist.

ROCKET PROPELLANTS Extensive efforts were required to cope with the potential health hazards associated with production of liquid rocket fuel. Contracted amounts of a propellant containing boron were produced without any serious exposure of personnel to boron hydride, a highly toxic by-product. Air sampling was done with Mine Safety Appliances Company hand-operated Boranes-in-Air Detectors.

Laboratory-scale production of another liquid fuel containing beryllium has been monitored closely. Equipment has been purchased for the extensive air sampling and surface inspections required to detect beryllium contamination when this work goes into larger-scale production in Building 709, early in 1963. Building 709 will undergo major rebuilding in preparation for housing the beryllium work.

Production of solid propellant has not been accompanied by any unusual health problems to date.

AGRICULTURAL CHEMICALS Occupancy of a new Agricultural Chemicals Laboratory, Building 728, has eliminated numerous hazards which resulted from inadequate space and facilities in the previous location, Building 709. Special precautionary efforts, including air sampling, were taken during the blending of methyl parathion. Careful advance planning is being made in anticipation of work with Compound 21149, an unusually toxic miticide.

Mr. Williams visited the Agricultural Research Station, Clayton, North Carolina, to become familiar with that part of the program and to initiate an industrial hygiene service for that location. Ventilation facilities and radiation protection were discussed specifically.

WASTE BURNING - SOUTH CHARLESTON CITY DUMP Intensive observations were made of the burning procedures required to dispose of chemical residues originating from Technical Center operations. This revealed serious hazards to Company personnel, potential public liability, and community air and water pollution problems threatening to result in legal actions. In cooperation with others, this problem was brought into focus and arrangements were made to have alternative methods of disposal evaluated.

RADIOACTIVE MATERIALS The use of radioactive materials continues to grow, thus requiring increasing effort to provide the relatively routine, but time-consuming, activity necessary for compliance with AEC requirements. At present, the Technical Center has 34 encapsulated sources licensed by the AEC and requiring periodic surveys. There are also 65 radium sources which must be kept under close supervision. In addition, during this report period Carbon^{14}, Tritium, and Gold^{189} were handled in unencapsulated form.

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TECHNICAL CENTER (Continued)

PERCHLORIC ACID EXPLOSIONS IN DURCO BLOWERS — Perchloric acid explosions have occurred in Durco Blowers resulting in injuries from the shrapnel-like parts of the fragmented blower. (This happened in AEC facilities.) For this reason, the Duriron Company has given us written notice that their blowers are not to be used in such service. A Duriron representative personally placed stickers with this warning on two hoods and blowers in Building 770 which had been designed for perchloric acid use.

HOT WATER MADE FROM STEAM WITH MIXING VALVES — Use of mixing valves to make hot water from steam and cold water has raised some questions about potential health problems. Additives in the steam, such as K-Gel, phosphates, soda ash, and Remox invariably preclude use of the resulting mixture for making hot drinks. The presence of some amine-type corrosion inhibitors in the steam could in some instances cause problems even when the hot water is used only for showers or lavoratories.

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SOUTH CHARLESTON PLANT

This information was taken from a summary report for the 2nd half of 1962 by Mr. B.L. Murray, Plant Industrial Hygienist.

PLANT-WIDE NOISE SURVEY This monumental project of identifying plant locations that offer a potential hazard to hearing has been essentially completed except for formal reporting. In addition, in some locations where a hazard has been identified, further work needs to be done to reliably define the degree of risk. Two hundred and eighty-five units have been found to offer no noise hazard, and the responsible supervisors have been so advised. Work on this project has been in progress intermittently for five years.

During this six-month reporting period noise reduction engineering projects were completed at five locations, with gratifying results. The equipment and locations benefiting from this work were: Raymond Mills, Building 152-4; Air Conditioner, Building 152-2; B-4 Pump, Building 152; Micro Atomizers, Building 190; and Key Punch and Verifier Machines, Building 82-2.

Nine additional locations at which noise reduction is needed are now being given engineering study. Two of these are of special interest as they involve noise resulting from high-pressure water cleaning and from sandblasting.

PACKAGING AND LOADING STATIONS Drum filling, solids packaging, and car or truck filling operations are characteristically accompanied by health or discomfort problems. For this reason all such locations were surveyed and the health hazard or nuisance potential of the chemicals being handled were rated. The locations were: 13 tank car spots, 18 drumming stations, 1 canning station, 3 barge docks, and 4 cylinder filling locations.

COMPILATIONS OF TOXICITY AND SAFE HANDLING DATA Condensed information of this nature descriptive of seven products was supplied at the request of production supervisors. This is a service which is well received and is growing rapidly, as it seems to supply a real need on the part of production supervision. Assembling the information is in some instances quite time-consuming.

RESIDUE BURNING AT SOUTH CHARLESTON CITY DUMP The use by the Plant of the subject dump was observed on several occasions and air and water samples were taken. In cooperation with others, the need for improved disposal procedures was established. At the request of Mr. R. C. Hieronymus, representatives from the South Charleston and Institute Plants and the Technical Center have been given responsibility for further defining the problem and for evaluating alternative methods of residue disposal.

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SOUTH CHARLESTON PLANT (Continued)

VENTILATION OF WELDING SHOP Continued air sampling for welding fume has led to recognition of the need for increased ventilation as a means of improving employee comfort in the working environment. The ventilation engineering work is now in progress.

LEAD FUME Lead concentrations in air resulting from melting lead at the Maintenance Department Salvage Unit have been found to exceed the Threshold Limit Value at times. This study continues.

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INSTITUTE PLANT

This information was taken from a summary report for the 2nd half of 1962, by Mr. R. E. Peele, Institute Plant Industrial Hygienist.

WASTE DISPOSAL AND SALVAGE OPERATIONS Complaints of respiratory irritation from smoke caused by burning residue from equipment in the salvage area were investigated. Problems associated with a number of other cleaning techniques used in the maintenance salvage area were also recognized.

The proposed use of the Fluorocarbons Unit limestone leaching pit for disposal of an HCl waste stream containing phosgene from the future Tolylenediisocyanate Unit was studied in cooperation with other interested persons. The proposed use was questioned as the breakthrough of phosgene to the air above the pit grating was demonstrated. Earlier studies had shown that normal operation of the leaching pit resulted in potentially hazardous concentrations of carbon monoxide within a few inches of the grating.

Undesirable working conditions resulting from removing slag from the floor of the aqueous waste incinerator were observed.

COMMUNITY AIR POLLUTION Numerous complaints of eye irritation (resembling that associated with Los Angeles smog) were investigated during a 7-day period in which temperature inversions and little or no winds were present for major portions of the day and night.

A complaint from the Ordnance Park Area of St. Albans about excessive fallout of flyash was studied. The flyash was submitted to chemical, X-ray spectrographic, and emission spectrographis analysis for identification purposes. Fallout data collected by the plant during the past three years was evaluated and the results submitted to the Plant Manager.

Although the Institute Plant does not now burn residue at the South Charleston City Dump, closely related problems do exist. Accordingly, considerable effort was made to evaluate these problems in the light of increasing public awareness of air pollution caused by open-pit and other inadequate methods of burning wastes and residues.

"SEVIN" UNIT BULK STORAGE AND CO SYNTHESIS Several illnesses resulted from efforts to manually unload bulk storage hoppers containing SEVIN. Air samples were taken for ethylene oxide, toluene, and SEVIN dust as part of the Medical Department's effort to identify the specific cause of the illnesses.

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A comparison of the effectiveness of two types of respiratory protective devices as protection from inhalation of SEVIN dust was made in cooperation with the Research and Development Department's Industrial Hygiene Laboratory.

A potentially serious exposure to carbon monoxide occurred at the SEVIN Unit synthesis gas area. The cause was found to have resulted from escape of carbon monoxide from a compressor being repaired. Ventilation was inadequate and is being corrected. Efforts to facilitate prompt installation of a MSA continuous CO analyzer are being made.

INTERFERENCE IN CO ANALYSES USING NBS DETECTOR TUBES — Experience at the Gas Separation Unit showed that ethylene and propylene interfere in the analysis of carbon monoxide with detector tubes containing National Bureau of Standards indicator (palladous sulfate and ammonium molybdate). Ethylene and propylene result in an erroneously high reading which cannot be distinguished from that due to carbon monoxide. Selection of a more suitable type of tube is in progress.

NOISE REDUCTION — Corrective actions have been taken to reduce the noise hazard in several locations. These include installation of mufflers on the converter exhaust stacks at the Acetone Unit, use of quieter inspirators on one burner at the #1 Dowtherm Unit, relocation outdoors of welding machines at the Welding Shop, installation of noise reduction devices on the Wulff Furnace in the Gas Separation Area, and reduction of noise exposure of personnel operating IBM equipment. Much of this successful noise reduction work was done with the assistance of the Vibration and Acoustics Group of the Special Instrumentation Department.

LIGHTING — A thorough survey of the lighting conditions in the Maintenance Welding Shop was made and recommendations were submitted.

INSULATION DUST — Studies of the amount of airborne dust resulting from fabrication (mainly sawing) of competitive insulating materials continued. Considerable interest in this work has been shown by Johns-Manville, one of the suppliers.

RADIATION PROTECTION — Study of an X-ray spectrograph located in the Works Laboratory showed need for additional shielding, which was installed.

INDUSTRIAL HYGIENE AND TOXICOLOGY INDOCTRINATION FOR NEW EMPLOYEES — A formal presentation for new technical employees was given with R. J. Sexton, M. D., Plant Medical Director, to acquaint the personnel with these subjects.

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TEXAS CITY PLANT

This information was taken from a letter report prepared by R. E. Joyner, M. D., Plant Medical Director

COBALT - OXO AREA Evidence of possibly excessive cobalt absorption by laborers cleaning filter presses used in the Oxo Area was observed. Approximately 35 urinary cobalt determinations were performed as part of the monitoring procedures in effect. The exact source of the cobalt or route of entry into the body has not as yet been definitely established.

ETHYLENE OXIDE STUDY A study of exposure to ethylene oxide has been concluded successfully. Clinical information and the measurements of ethylene oxide concentrations in the air in working environments are being evaluated. This work is a valuable contribution to the medical knowledge of low-level chronic exposure to ethylene oxide and is being prepared for publication.

ENTRY TO BARGE COMPARTMENTS The Plant Laboratories reported the use of Kitagawa Detector Tubes (No. 128b) for checking the acrylonitrile content of the air in barge compartments prior to entry during the latter stages of the cleaning process. The test is judged to be suitable for the purpose and is much cheaper and faster than traditional chemical tests.

TRACING PIPELINES WITH RADIUM Radium sources were used successfully to trace pipelines, using a technique initially explored by the Nucleonics Group of the Special Instrumentation Department, Olefins Company.

MERCURY VAPOR A Beckman Mercury Vapor Meter, Model 23, has been purchased and is being used successfully in identifying locations with comparatively high concentrations of airborne mercury. The exposure of personnel does not appear to be excessive, but continued observation is indicated.

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NIAGARA FALLS PLANT

This information was taken from a letter from Mr. D. M. Rupert.

HYDROXYETHYL CELLULOSE PLANT Two especially noteworthy improvements were made in the working conditions at the hydroxyethyl cellulose plant. Exhaust ventilation equipment was installed to capture and remove large amounts of isopropanol vapor escaping into the operating area from nominally "vapor-tight" equipment. Efforts to stop the leakage had been unsuccessful.

Installation of an exhaust system and bag collector resulted in substantial savings from the recovery of hydroxyethyl cellulose from a dumping operation. In addition, an unpleasant working condition and an explosion hazard were eliminated.

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RESEARCH AND DEVELOPMENT DEPARTMENT

TECHNICAL SERVICE LABORATORY, TARRYTOWN, NEW YORK

This information was taken from a letter report from Mr. W. B. Leighton.

CUSTOMER SERVICES Toxicology Studies Sheets prepared by the UCC Industrial Medicine and Toxicology Department are included regularly with standard storage facility specification and design reports supplied in response to customer requests.

Reports on the determination of low concentrations of ethylene oxide and ethyl acrylate in air were prepared for release to customers. The reports and procedures were based on work done by the Industrial Hygiene Laboratory of the Research and Development Department.

TOLYLENE DIISOCYANATE Successful control of TDI vapor from foaming operations to meet the stringent Threshold Limit Value of 0.02 ppm was reported. Air sampling was done with a Mine Safety Appliances Company TDI Detector with the results verified by comparison with another colorimetric method.

The local exhaust hooding of the foam machine has been found adequate to meet the 0.02 ppm limit. Extreme care to avoid even minor spillage, and closed transfer of TDI from drums to feed vessels, has been found necessary. An Oberdorfer gear pump is used with negligible TDI leakage at 20-30 psig. The stuffing box is extra deep with the inner half occupied by a carbon sleeve bearing and the outer half containing conventional graphited asbestos packing.

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RESEARCH AND DEVELOPMENT DEPARTMENT
INDUSTRIAL HYGIENE LABORATORY, TECHNICAL CENTER

Mr. N. H. Ketcham

Work done in support of Plant and Technical Center programs included the following projects.

"SEVIN" DUST IN AIR — Investigated methods for removing SEVIN dust from air, for air sampling purposes and for evaluation of respiratory protective devices. Evaluated the effect of the partial pressure of SEVIN vapor on the collection efficiency of cloth or paper filters, at the suggestion of the Chemical Hygiene Fellowship. Vapor was found to be a negligible factor.

METHYL "CELLOSOLVE" IN AIR — Investigated the suitability of commercial combustible gas indicators (Davis M-6 and MSA Model 2) for detecting combustible concentrations of methyl CELLOSOLVE in air. Done for Bryton Chemical Company at the request of the Technical Service Laboratory. Report 92E-F26.

1-NAPHTHOL IN AIR — Determined the collection efficiency of the method of sampling in use at the Institute Plant.

HYDROQUINONE IN AIR — Evaluated a published procedure and recommended it for use at the Institute Plant.

RADIATION MEASUREMENTS — Radiation counting of leak test swabs, calibration of survey instruments, water monitoring, and other procedures to comply with AEC and State requirements were done as requested in support of the Technical Center and the plant radiation safety programs.

ETHYL ACRYLATE IN AIR — Screened available candidates and selected a commercially-available detector tube suitable for the semi-quantitative estimation of ethyl acrylate in air. Prepared a calibration curve for use of the test, at the request of the New Chemicals Marketing Department. Report 92E-F25.

PHOSGENE IN AIR — Assisted Dr. R. L. Meeker's Group in preparation of known concentrations of phosgene in air for their investigation of the use of electron capture gas chromatography for trace analysis of phosgene in air.

BERYLLIUM ANALYSIS — Evaluated and recommended a published microcolorimetric procedure for use at the Technical Center. Ran analyses of samples collected by Mr. Fred Williams.

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METHYL PARATHION IN AIR Evaluated and recommended a published procedure for use in the Technical Center. Analyses were run on air samples collected by Mr. Fred Williams.

OZONE IN AIR Evaluated and recommended a published procedure for use at the Technical Center. Ran analyses on air samples collected by Mr. Fred Williams.

TOLYLENE DIISOCYANATE IN AIR Evaluated and recommended a published procedure for use at the Technical Center. Ran analyses on air samples collected by Mr. Fred Williams.

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PUBLICATIONS AND PROFESSIONAL ACTIVITIES

Publications

Best, E. M., and Murray, B. L., Observations on Workers Exposed to SEVIN Insecticide: A Preliminary Report, J. Occ. Med., 4, p. 507-517, October, 1962.

Bolton, N. E., Cavender, J. D., and Stack, V. T., Determination of Manganese in Biological Specimens, Am. Ind. Hyg. Assoc. J., 23, p. 319-326, July-August, 1962.

Other

N. H. Ketcham spoke on the subject "Noise Criteria" at the Tennessee Valley Industrial Hygiene Conference, Gatlinburg, Tennessee, October 12-13, 1962.

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TABLE I

LICENSED ENCAPSULATED RADIATION SOURCES
Inventory as of December 31, 1962 (not including radium)

Manufacturer's Name and Type of Housing	Kind of Isotope	No. of Sources	Amount in Each Source* (millicuries)	Total Amount* (millicuries)	Required Frequency for leak Test	Responsible Agency
			BROWNSVILLE PLANT			
Ohmart HM-8	Cs 137	1	750	750	6 mos.	Texas
			INSTITUTE PLANT			
Ind. Nucleonics BB-0041	Cs 137	1	150	150	3 yrs.	AEC
Ind. Nucleonics BBS-10051	Cs 137	1	50	50	3 yrs.	AEC
Ind. Nucleonics BBS-10073	Sr 90	1	1000	1000	6 mos.	AEC
Ind. Nucleonics BB-0041	Cs 137	1	200	200	3 yrs.	AEC
			SEADRIFT PLANT			
Ohmart SHRM	Cs 137	1	125	125	3 yrs.	Texas
Ohmart SHRM	Cs 137	6	150	900	3 yrs.	Texas
Ohmart SHRD	Cs 137	2	300	600	3 yrs.	Texas
E. K. Cole SKS 101/233	Co 60	1	0.03	0.03	6 mos.	Texas
Ohmart HM-8	Cs 137	2	750	1500	3 yrs.	Texas
U. S. Nuclear Source G 223	Co 60	1	1	1	3 yrs.	Texas
			SOUTH CHARLESTON PLANT			
Ohmart SHRM	Cs 137	11	100	1100	3 yrs.	AEC
Ohmart SHRM	Cs 137	2	50	100	3 yrs.	AEC
Ind. Nucleonics LS-101	Cs 137	1	25	25	6 mos.	AEC
Jordan Meter	Sr 90	1	0.003	0.003	6 mos.	AEC

(Continued)

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TABLE I (Continued)

Manufacturer's Name and Type of Housing	Kind of Isotope	No. of Sources	Amount in Each Source* (millicuries)	Total Amount* (millicuries)	Required Frequency for Leak Test	Responsible Agency
			TECHNICAL CENTER			
Ohmart SHRH	Cs 137	2	200	400	3 yrs.	AEC
Ohmart SHRM	Cs 137	1	20	20	3 yrs.	AEC
Ohmart SHRM	Cs 137	5	150	750	3 yrs.	AEC
Ohmart SHRM	Cs 137	2	200	400	3 yrs.	AEC
Ohmart SHRH-A	Cs 137	3	1000	3000	3 yrs.	AEC
Ohmart SHRM-P	Cs 137	4	20	80	3 yrs.	AEC
Ohmart SHRM-P	Cs 137	3	50	150	3 yrs.	AEC
Ohmart SHRM-P	Cs 137	1	100	100	3 yrs.	AEC
Ohmart HM-8	Cs 137	1	500	500	6 mos.	AEC
Ohmart ASR-3	Cs 137	1	500	500	6 mos.	AEC
Nuclear Chicago Model 506	Cs 137	1	1750	1750	6 mos.	AEC
Ohmart SHRD (2 gauge)	Cs 137	1	500	500	6 mos.	AEC
Ohmart ASR-3	Cs 137	1	450	450	6 mos.	AEC
AECL KCP-1 and C-129	Co 60	1	39 pencils up to 250 curies ea.	Approx. 1600 curies	6 mos. (water)	AEC
Tracerlab R-31	Co 60	1	1.1	1.1	6 mos.	AEC
Jordan Meter	Sr 90	1	0.003	0.003	6 mos.	AEC
Ind. Nucleonics C-5	Sr 90	1	20	20	6 mos.	AEC
Ind. Nucleonics DH-3	Sr 90	1	500	500	6 mos.	AEC
Chromatograph Det.	Sr 90	1	10	10	6 mos.	AEC
Chromatograph Det.	Sr 90	2	20	40	6 mos.	AEC

NOTE: Tritium foil sources held by the Technical Center are not included in this table.

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(Continued)

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TABLE I (Continued)

Manufacturer's Name and Type of Housing	Kind of Isotope	No. of Sources	Amount in Each Source* (millicuries)	Total Amount* (millicuries)	Required Frequency for Leak Test	Responsible Agency
			TORRANCE PLANT			
Ohmart SHRM	Cs 137	12	50	600	6 mos.	California
			WHITING PLANT			
Ohmart SHRM	Cs 137	1	80	80	3 yrs.	AEC
Ohmart SHRM	Cs 137	1	100	100	3 yrs.	AEC
Ohmart SHRM	Cs 137	2	50	100	3 yrs.	AEC
Ohmart SHRM	Cs 137	4	100	400	3 yrs.	AEC
Ohmart SHRM	Cs 137	8	50	400	3 yrs.	AEC
Ohmart SHRM	Cs 137	10	50	500	3 yrs.	AEC
Grand Total Number of Sources		105				

*Amount of activity at time of purchase.
No decay correction made.

NOTE: All of the above encapsulated sources were purchased originally under license agreements with the AEC. Radium sources have not been subject to licensing by the AEC but are included in the new State regulations. Information on approximately 80 radium sources in the Company's possession will be given in a future Summary Report.

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SOIL SURVEY
AND
SAMPLING

DE 004868

UNION CARBIDE CORPORATION
CENTRAL RESEARCH AND ENGINEERING TECHNOLOGY
HEALTH, SAFETY & ENVIRONMENTAL TECHNOLOGY
SOUTH CHARLESTON, WEST VIRGINIA

M E M O R A N D U M

TO: B. R. Adler, Danbury E3
Belia Cortez, Brownsville
J. B. Evans, Danbury K4
R. W. Lasher, Danbury K4
M. A. Tapp - Clear Lake City

FROM: S. G. Gilbert

DATE: July 8, 1988

CC: A. C. Booth
A. H. Cheely
P. R. Kavasmaneck

RE: Proposal - Brownsville, Texas Plant Site Survey for Soil and Ground Water Conditions

We are pleased to submit this proposal for environmental technology services, per your request. The services include a survey for soil and ground water conditions at the site of the Solvents and Coatings Materials (S & CM) Division plant in Brownsville, Texas. J. B. Evans is respectfully requested to authorize or comment on this proposal by July 18, 1988.

The survey provides S & CM with an indication of the subsurface contamination at the production, distribution, maintenance, and certain waste management areas at the plant. The survey will:

- indicate with reasonable certainty if contamination exists at each of the specific sites in the plant.
- where contaminants are found, determine the concentration of selected contaminants in the soil samples.
- provide an initial assessment of the potential risks posed by each site by comparing the collected information against health and environmental effects and standards for the detected compounds.
- recommend future work necessary for a thorough assessment of health and environmental risks posed by uncontrolled development of the site.

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For a thorough assessment of future health risks posed by uncontrolled development of the site, additional information such as:

- maximum contaminant concentration
- depth and areal extent of contamination
- identification of all compounds posing health hazards

would be needed. For a thorough assessment of potential risks to the environment (principally ground and surface water), the following information would probably be needed in addition to that identified as health risk factors:

- ground water quality
- in-situ biodegradation rates for the contaminants of concern
- determination of direction and rate of ground water flow

None of this additional work is included in the above cost and schedule, but it could be a second phase of work, if necessary. We would expect to work closely with S & CM representatives when developing the scope of the second phase.

Details of the survey are to be developed and documented in a detailed work plan to be submitted to S & CM for discussion and approval in advance of major expenditures. In the development of the work plan, it may become evident that some aspects of the survey could be made more effective or efficient than as described in this proposal. We intend to capitalize on these opportunities, with the changes highlighted for your review and acceptance. Examples of possible opportunities include the determination that less sensitive analytical tests are required, and the use of in-house laboratory resources.

Major elements of the work include:
- preparation of detailed work plan
- preparation of work safety and health plan
- on-site soil and ground water sampling
- soil and ground water analysis
- data interpretation
- preparation of report

Based upon the attached scope of work, we estimate the cost for the initial site assessment to be in the range of $240,000 to $410,000, depending upon the level of detail in the survey, and the investigation requirements, as determined on a site-by-site basis. The elapsed time estimated to be 22 weeks from release to perform the work to delivery of the final report is estimated to be 22 weeks.

We understand that this program is a significant expenditure, and have taken measures to control cost. For example, the analytical costs have been substantially reduced by the use of reliable but non-protocol methods. The number of soil samples have been held to a minimum consistent with the overall study objectives.

DE 004870

Further trimming of this study by reducing the number of sites evaluated or by using less effective analytical techniques would be inefficient. The results of a trimmed study would be much more difficult to defend on a technical basis. The fixed costs of the study (sample collection, safety program, administration, etc.) would not be substantially reduced by the trimmed survey. An abbreviated first phase will result in a second phase which is less well planned, more time-consuming, and more costly. We believe we have struck a good balance between cost and quality, consistent with S & CM objectives.

Note that our plan includes the disposal by S & CM Division of all wastes generated as a result of this survey.

A detailed scope of work is attached. We propose to use NUS Inc., (Houston Office) to conduct the on-site soil and ground water work, and to prepare draft reports. NUS is recommended since they are familiar with the facility and facility personnel. If schedule and manpower limitations permit, the analytical portion of this work may be shifted to UCC laboratories at the South Charleston Technical Center. The final determination of laboratory will be made in the preparation of the detailed work plan. We also propose to use NUS laboratories. We are planning on limited on-site support to be provided by S & CM, primarily for site safety activities.

Please contact me with your questions regarding this proposal at (304) 747-5326. We look forward to performing this interesting assignment for Solvents and Coatings Materials Division.

S. G. Gilbert, Jr., P. E.

SGG0607
07/08/88
Enclosure

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SCOPE OF WORK

Brownsville, Texas Plant Site Survey

for

Soil and Ground Water Conditions

Central Research and Engineering Technology

Environmental Engineering Skill Center

South Charleston West Virginia

July 8, 1988

Survey Objectives

In support of a transfer of the property lease, the Brownsville, Texas manufacturing site will be evaluated for soil contamination. The survey will focus on sites where soil or ground water contamination is suspected; sites where there is no indication of a release will not be surveyed. An initial assessment of the environmental and health risks posed by future uncontrolled use of the site will be provided, based upon the available data. The survey will not determine the areal extent, depth, or complete description of contaminants for each release. Recommendations for further investigation will be provided, if such investigation appears warranted.

Technical Approach

Areas where soil contamination has potentially occurred will be identified from historical information and visual inspection. A minimum number of samples will be taken at each potentially contaminated site to determine if contamination has in fact occurred and is persistent, and to preliminarily characterize the contamination. The collected field data will be compared against available information on compound fate, and environmental and health effects to make an initial assessment for each specific site.

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Environmental Fate and Effects and Health Effects Survey

An initial literature review will be performed to determine the levels of concern for the compounds likely to be present. The review will include the collection of readily available data, including:

- biodegradability
- vapor pressure
- solubility
- density
- established safe levels in water, air, soil (where available)
- environmental effects
- odor threshold
- health affects from exposure

Understanding the levels of sensitivity for specific compounds in advance of the field survey provides the following benefits: First, the information is needed to make intelligent management decisions about the study and its findings. Second, the analytical techniques may be tailored to the specific need, and analytical costs are controlled. Finally, much of the information should be collected anyway at this time for the site investigation safety and health plan.

Selection of Survey Areas

A plant history will be developed from available documents, interviews with past and present employees, aerial photographs, and on-site reconnaisance. Collection of the aerial photographs is under way.

Sample locations within individual sites will be selected to represent the most likely and highest contaminated areas, based upon the available historical information and visual inspection.

Detailed Work Plan

A written plan for performance of the field and laboratory work will be prepared. The plan will assure that there is thorough understanding of work assignments and schedule among the project participants. The plan will be provided to S & CM for comment. Preparation of the plan also includes procurement arrangements, peer review, and scheduling.

Work Safety and Health Plan

A site safety and health plan is needed to assure protection of UCC employees, contract employees, the public, and is required by Central Research and Engineering Technology policy.

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The plan will include the following sections:

- Responsibility
- Systems Analysis
- Training Requirements
- Personnel Protective Equipment
- Medical Surveillance
- Identification of Safety and Health Hazards on Site
- Site Control Measures
- Decontamination Procedures
- Standard Operating Procedures
- Contingency Plan
- Underground Utility Identification Procedure

A prestartup safety meeting will be conducted at the job site, with contract technical and drilling employees in attendance.

Analytical Methods

A screening test will be used for soil samples collected where the probable contaminants, if any, would be low molecular weight acids and alcohols. The analytical methods are described in the attached proposal prepared by NUS. Use of the Technical Center laboratory resources instead of NUS will be reconsidered when the project schedule and requirements are more firmly established. UCC labs will be used if the needed manpower and equipment are available, and if the change is cost-effective.

In preparation of the detailed work plan, the environmental fate and effects information and health information will be compared to the analytical sensitivities of the analyses. If wide disparities exist, revisions to the analytical methods will be considered. This will assure the required information is acquired at minimum cost.

An appropriate number of trip blanks and sample duplicates will be included in the program for quality assurance/quality control.

Selected soil samples (approximately 1 in 10 samples) will be analyzed for volatile and semivolatile organics, and heavy metals. This will determine if constituents have been missed by the analytical techniques used on most of the samples. If critical constituents are detected at levels which are of concern in these selected samples, they may be added to the analytical protocols used in subsequent work. Also, areas where contaminants not detected by the indicators but from site history may be present will be targeted. For example, the garage and construction stores areas should be analyzed for a more complete suite of compounds. The laboratory chemist will be provided with a list of compounds potentially handled in past site industial activities for use in the review of the analytical data.

On-Site Soil and Ground Water Sampling

The program intent is to determine with reasonable certainty if the proposed sampling sites have contamination remaining from past industrial activity. The principal method of evaluation of each site will be by sampling and analyzing soil samples. For a solid waste landfill area, the presence or absence of ground water contamination is to be determined.

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Analysis of selected near-surface soil samples is a sensitive and specific indicator of site contamination. The soil samples will be taken at locations where leakage or dumping of materials is most likely to have occurred. Ground water samples will be utilized to determine area-wide effects of solid waste landfills.

Preliminary surveys indicate soil contamination may have occurred at the sites shown in Tables 1, 2, and 3. Table 1 lists the sites proposed for soil contamination investigation. Table 2 lists the sites proposed for ground water contamination investigation. Sites included in Table 3 are being addressed separately and are not included in this work plan. The sites in these tables are subject to revision as additional historical information is collected and assimilated.

A summary of the sites to be surveyed for soil contamination, with ranges of soil samples per site, is provided in Table 4. Ranges of soil samples are provided to indicate the magnitude of sampling required for each group of sites. The number of samples will be made more specific for each site as the overall study objectives become more sharply focused, and detailed histories, visual inspections, underground utility locations, and other factors are collected and considered. The detailed work plan will be more specific about the number and location of samples per site; final determination of sample locations will be by the on-site hydrogeologist supervising the soil sampling.

For the sites proposed for ground water monitoring, five wells are included in this preliminary plan for the combined area of all the sites. For this large area, monitor wells at each corner, plus a location in the middle of the site is proposed. This is a reasonable minimum number of sample locations for evaluating if ground water contamination has occurred. Additional wells may be required in the future to fully define ground water conditions, if contamination is indicated.

For the iron oxide catalyst piles, several representative samples of waste material will be excavated and analyzed for volatile and semivolatile organics, and heavy metals to determine if there is potential for ground water contamination from the waste. The samples will be collected from deep within the piles to minimize the effects of weathering.

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TABLE 1

SITES TO BE EVALUATED FOR POSSIBLE SOIL CONTAMINATION

Zone	Description	Size	Evidence of Release
26	Waste Acid Lines and Energy Systems Boilers		
		Medium	Known and suspected spills
26	Fuel Unloading	Small	Likely spills
46	Garage	Small	Suspected oil and fuel spills
16	Construction Stores	Small	Construction Fuel storage and suspected Fuel spills
48	Sandblasting/Painting	Medium	Spent sandblasting sand containing heavy metals, and paint solvents
68	Fire Training Pit	Large	Known fuels and wastes burned on the ground
76	Drum Cleaning	Small	Visible signs of release
44-45	Amoco Pond	Very Large	No vegetation, past use for wastewater disposal
24	#6 Oil Storage Tanks	Very Large	Oil service, large quantities of material, no direct evidence of a release
12-13	Chemical Storage Tanks	Very Large	Recorded spills, visible releases, likely spill area
42	Stores Drum Storage	Small	Drummed materials stored outside
52,53,62,72,73,82	Process Area	Very Large	Visible spill evidence, known spills, known operating practices
58,68	Refinery Site for Carthage Hydrocol (Gas Oxidation)		
		Very Large	Typical operating practices of the 1950's
82	Amoco Ground Burner	Small	Suspected spills
92	UCC Ground Burner	Small	Suspected spills
76	Old oil skimmer pits	Small	Suspected spills
	45	Water Separator	Small Wastewater unit
82,92	North Wastewater Pond	Very Large	Wastewater unit

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TABLE 2

SITES TO BE EVALUATED FOR POSSIBLE GROUND WATER CONTAMINATION

Zone	Description	Size	Evidence of Release
78	Scrap Pile*	Large	Suspected releases from visible cans, drums, etc.
78	Trash Pile*	Large	Suspected releases from visible cans, drums, etc.
96,98	Garbage*	Large	Suspected releases from visible cans, drums, etc.
86,98	Perlite*	Large	Known disposal of insulation
86	Concrete Rubble*	Large	Visible concrete, suspect chemical dumping
98	Insulating Asbestos*	Large	Notations on drawing
82,92,45,88	Catalyst	Very Large	Iron Oxide catalysts were either buried or deposited at these locations

(* indicates to be investigated as one large site)

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TABLE 3

SITES NOT INCLUDED IN SURVEY

Zone	Description	Size	Reason Not Included
38	Linde Unit	Medium	Future status not determined
56,66	Salvage Yard	Large	Site reportedly contained only clean materials
86,96	Catalyst Ball Mill Residue	Large	Addressed as SWMU unit
76	Incinerator	Medium	Addressed as RCRA unit
46	Fuel Tanks at Garage	Small	Has been removed with no apparent release
65	Tank 3326	Medium	Addressed as RCRA unit
26	#2 Fuel Oil Tank	Medium	Site reportedly used only once with no release during this use
12	Building 127 Bulk Stores	Small	No evidence of release
32	Tank 3210	Small	Addressed as RCRA unit
42	Tank 4267	Small	Addressed as RCRA unit
52	Tank 5207	Small	Addressed as RCRA unit
52	Tank 5216	Small	Addressed as RCRA unit
53	Tank 5211	Medium	Addressed as RCRA unit
	RX-1 Caustic Tank	Small	Addressed as RCRA unit
	RX-2 Caustic Tank	Small	Addressed as RCRA unit
86	Mixed Acid/Residue Oil	?	Addressed with Catalyst Ball Mill Residue
46	Unleaded Gasoline Tank	Small	Tank and release have been removed
-	100 Acre Wastewater Evaporation Ponds	Very Large	(4) Addressed separately
	Q-107 Recovery Sump	Small	Addressed as UST
	Q-110 Recovery Oil Separator Sump	Small	Addressed as UST
	Q-114 Final Oil Separator Sump	Small	Addressed as UST
	Q-133 Pumphouse Oil Separator Sump	Small	Addressed as UST

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TABLE 4

SUMMARY - SITE GROUPS AND ESTIMATED SOIL SAMPLES
(SOIL SAMPLING SITES)

Group (by size)	Sites/ Group	Sample Locations/ site (range)	Soil Samples/ site (range)	Total (range)
Small	9	1-3	2-6	18-54
Medium	2	3-5	6-10	12-20
Large	1	4-10	8-20	8-20
Very Large	6	5-15	10-30	60-180
Grand Totals	18			98-274

TABLE 5

WIDE-RANGE ESTIMATE - DEEP BORINGS AND SOIL SAMPLES

Group (by size)	Sites/ Group	Avg Deep Borings/ site	Avg Soil Samples/ site	Total Samples
Small	9	1	2	18
Medium	2	2	4	8
Large	1	3	6	6
Very Large	6	4	8	48
Grand Totals	18			80*

(* Wide range estimate of +/- 40% quality results in range of 48 to 112 soil samples for analysis from deep boring program)

For the soil borings, locations where soil contamination is most probable will be determined from historical information and visual inspection. The field geologist may determine on the site that additional samples are warranted. At each of these locations, two initial soil samples will be collected at selected depths. The first sample will be collected near the surface (approximately 6 inches deep) and the second sample will be collected at 2 feet. Soil sampling at these shallow depths allows the use of hand tools for sampling.

Use of hand tools for shallow soil sampling reduces cost, and the soil samples may be collected more quickly. It is unlikely that significant contamination will be missed by taking only shallow soil samples, given the sensitivity of the analytical tests employed. Each soil sample will be visually examined, pH measured, and head space of sample container checked with a portable gas analyzer at the time of sampling.

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Where significant, field-detectable levels of contaminants are found in either of the two soil samples, follow-up sampling will be performed with a drilling rig to determine the depth of contamination at that location. Deeper samples provide a more clear picture of the overall contamination at the site. All drilling will be conducted after the surficial samples are taken to allow careful planning and efficiency. The total number of borings is estimated to range between 24 and 56; the total number of soil samples to be analyzed is estimated to range between 48 and 80. Table 5 provides details for these estimated ranges.

It is expected that EPA protocol sample holding times will be met.

For the sites where ground water samples are to be collected, monitor wells will be constructed. Standard well construction techniques for permanent landfill ground water monitoring will be employed. The wells will be completed through the first saturated conductive zone. The elevations of the casing tops will be surveyed to permit measurement of the potentiometric levels with respect to sea level. Ground water samples will be collected by dedicated bailers for each well. Field measurements of water temperature, pH, static water level, and observations of ground water color and odor will be recorded.

A written sampling plan will be followed for this work. Chain of custody procedures for the samples will be followed. The samples will be shipped by express carrier or transported by UCC personnel to the laboratory. The samples will be iced during transport.

It is assumed for budget and scheduling purposes that work may be conducted with standard personnel protective equipment (Level D). If low level contamination of organic solvents and organic acids are encountered in the drilling and sampling program, impermeable coveralls, respirators, and rubber gloves (Level C) would be required and the field portion of the work would require additional time at greater cost. If high levels of contamination are encountered, requiring self-contained breathing air (Level B), the on-site activities at that boring site will be suspended and S & CM management will consulted. The work safety and health plan will include Levels B, C, and D work.

Data Interpretation

The collected soil boring logs, aerial photos, analytical results, and field observations will be evaluated as a whole for determination of the risk of uncontrolled development of the site and potential environmental harm.

The interpretation will be performed by NUS and UCC geologists and environmental engineers. UCC CRET professionals will perform peer review.

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Preparation of Final Report

Draft and final reports will be issued. The reports will include:

executive summary
data interpretation
figures of site showing locations of samples and soil stratigraphy
recommendations for future work, if any

The raw data will be provided in an Appendix. The final report will be issued as UCC Business Confidential, with a restricted distribution approved in advance by S & CM. Meetings for one day each are planned to review the draft and final reports with S & CM management.

Project Personnel

This project will be managed by S. G. (Jerry) Gilbert. Jerry has 12 years Union Carbide experience in environmental engineering, including site contaminant studies, hydrogeological evaluations, and site surveys. Jerry is a registered engineer, and holds a M.S. in Civil Engineering.

The environmental program leader for the Brownsville Plant is A. C. Booth. Alan will stay apprised of the project activities and provide advice and guidance on an as-needed basis. Alan holds an M.S. degree in Civil Engineering, is a registered engineer in Texas, and has 11 years experience in the UCC environmental engineering skill center.

Other project personnel will be selected from the staff of NUS, Inc. This consultant is in the second year of a two year national contract with Union Carbide for environmental engineering services, and has performed soil contamination studies at the Brownsville Plant.

Project Schedule and Cost

The total elapsed time for the study is estimated to be 21 weeks.

The activities are planned on the following schedule:

Detailed Work Plan and Safety/Health Plan	4 weeks
On-Site Soil and Ground Water Sampling	4
Soil and Ground water Analysis	8
Data Interpretation and Draft Report Preparation	4
Final Report Preparation	2
Total Time	22 weeks

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The total project cost is estimated to range between $240,000 and $410,000, depending upon the number of soil samples required at each site. This estimate includes the following assumptions:

25% contingencies for weather and unanticipated difficulties.
Work in Level D. Contamination at the site could increase costs due to slower work progress.
Soil and ground water analyses completed by the contract laboratory in 8 weeks.
Disposal of wastes generated during the study by S & CM.

Elements of the estimated project cost are:

Work Element	Minimum	Maximum
Site History, Detailed Work Plan, Safety and Health Plan, Environmental Fate and Effects and Health Effects Survey	$30,000	$30,000
Well Construction and Soil Sampling	35,000	57,000
Analytical Services	93,000	210,000
Data Evaluation and Report	32,000	32,000
Contingencies	50,000	81,000
Total	$ 240,000	$ 410,000

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