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PRELIMINARY SITE VISIT REPORT

CHERRY POINT REFINERY

CONTROL TECHNOLOGY ASSESSMENT OF PETROLEUM REFINERY OPERATIONS

Contract No. 210-81-7102

April 1982

Submitted to:

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1.0 INTRODUCTION

This preliminary survey report documents a one-day visit by Radian Corporation and NIOSH to Atlantic Richfield Company's (ARCO's) Cherry Point Refinery near Ferndale, Washington. The purpose of the visit was to review control technology strategies used by the refinery in controlling worker exposure to potentially toxic chemical agents and harmful physical agents. Two processing areas were the focus of this visit:

- o Naphtha Reforming
- o Oil-water separation

The preliminary site visit was conducted on November 17, 1981 as part of a NIOSH-sponsored control technology assessment program conducted by Radian.

The information in this report will provide the basis for selecting control technology strategies for Phase III of the NIOSH program, the in-depth study phase. A summary report prepared by Radian when all preliminary site visits have been completed will describe findings of the preliminary site visits and will recommend control technologies and refineries for in-depth analysis.

Results of the program's in-depth study phase will be distributed to the refining industry and related industries (i.e. chemical or steel manufacturing). Distribution of information describing good examples of controls may enable individual industries to more readily and economically apply the controls.

On November 17, 1981 three Radian employees and the program's NIOSH project officer visited the Cherry Point Refinery. Meetings were held with the following ARCO personnel:

Eric LeBrocq, Jr. - Manager, Occupational & Environmental Health, ARCO Petroleum Products Company
Ralph Powell - Cherry Point Refinery Safety Manager
Doris Wunsch - Refinery Industrial Hygienist
Ray Snover - Refinery Maintenance Manager
Chuck Taul - Refinery Engineering Department
Fielding Formway - Refinery Manager
Les Smith - Refinery Operations Manager

All ARCO personnel contacted during the visit were very responsive and informative. NIOSH greatly appreciates their participation in the program.

ARCO's Cherry Point refinery which began operation in 1972 as a new "grass roots" facility, can process up to 120,000 barrels per stream day (BPSD) of Alaskan North Slope crude. The refinery has some of the latest in refining technology as well as having active health and safety programs. These programs, summarized below and discussed in more detail in Sections 4 and 5 of this report, may be of interest for study in Phase III of the control technology assessment program.

Cherry Point's industrial hygiene program has the following elements, which comply with Atlantic Richfield's corporate Assess and Control Exposures (ACE) program:

- Identification of all hazardous chemical and physical agents by workplace

- o Employee exposure assessment
  - Exposure task evaluation
  - Determination of degree of exposure

- o Control of unacceptable exposures
- o Training and information
- o Medical surveillance program
- o Documentation and recordkeeping system

In addition to implementing ARCO's corporate ACE program, Cherry Point has a number of preventive maintenance programs which also serve to reduce worker exposure. Programs conducted in the naphtha reforming area include:

- o Computer program that calculates desired stress to be appled to exchanger head bolts to prevent leaks.
- o Pump and valve inspection/maintenance program that reduces fugitive emission and major equipment failures.
- o Acoustical testing to locate material stress/ corrosion points while equipment is in service.

Cherry Point has installed area H_2S monitors located at the sulfur recovery unit and the plant API separator. A new 10-monitor system being installed at the sulfur recovery unit will be connected to a microprocessor that will estimate leak concentration, duration, and direction.

2.0 PLANT DESCRIPTION

The ARCO Cherry Point Refinery is located on approximately 430 acres near Ferndale, Washington. ARCO began operating the Cherry Point facility in 1972. The refinery is one of the few "grass roots" complexes constructed in the United States since 1968. The refinery was designed to run Alaskan North Slope crude brought in through port facilities located adjacent to the refinery on the Georgia Straits (Puget Sound). However, until the completion of the Alaska pipeline, Canadian and other foreign crudes were processed at Cherry Point. Refinery crude through-put capacity is about 120,000 barrels per stream day (BPSD). Figure 2-1 is a simplified block flow diagram of refinery operations.

Crude offloaded from ships is pipelined about one mile to the refinery from the port facility. In an atmospheric distillation tower (Crude Unit) and a vacuum distillation tower (Vacuum Unit), crude is distilled into six major streams: light hydrocarbons, naphtha, stove oil, diesel, gas oil, and resid. Light hydrocarbons from the crude tower overhead are processed at a gas plant into plant fuel gas and butane. Naphtha from the Crude Unit is hydrotreated for the removal of sulfur and nitrogen before reforming. The hydrotreated naphtha is then catalytically reformed to increase the octane before gasoline blending.

A stove oil cut from the crude distillation tower is chemically treated and sold as stove oil or jet fuel. The diesel cut from the Crude Unit is either hydrotreated for sulfur removal at the Diesel Hydrodesulfurization (HDS) Unit or chemically treated and sold as fuels. Stove oil from the Coker Unit is also hydrotreated for sulfur removal at the Diesel

HDS Unit and is sold as diesel fuels.

Gas oil from the Vacuum Unit and Coker Unit is catalytically cracked to lighter products in the Hydrocracker Unit. This high temperature-pressure unit produces gasoline blend stocks, naphthas which are reformed to a high octane gasoline blend stock and jet fuels. Hydrogen requirements for the Hydrocracker Unit are provided by the Hydrogen Unit and the Naphtha Reformer Unit. The Diesel HDS Unit and Naphtha HDS Unit hydrogen requirements are also provided by the Reformer and Hydrogen Units.

Hydrogen sulfide (H_2S) from sour gas streams and stripped from sour water streams is recovered using diethanol-amine (DEA) and converted to sulfur at a Claus plant. Plant waste waters are treated for oil recovery at an API separator; are biologically treated by a trickling filter; and are clarified using a clarifier and clarification ponds. The treated water is discharged or reused in the refinery. Biological and oily sludges generated in the refinery are land farmed at the refinery.

ARCO's Cherry Point refinery has about 385 employees of which approximately 80 are maintenance personnel. Additionally, the refinery uses about 55 contract maintenance personnel except during major turnarounds, when a maximum of about 200 contract maintenance workers are employed. Operating personnel work twelve-hour shifts with four shift groups rotating through the week. Maintenance crews work ten-hour shifts four days a week.

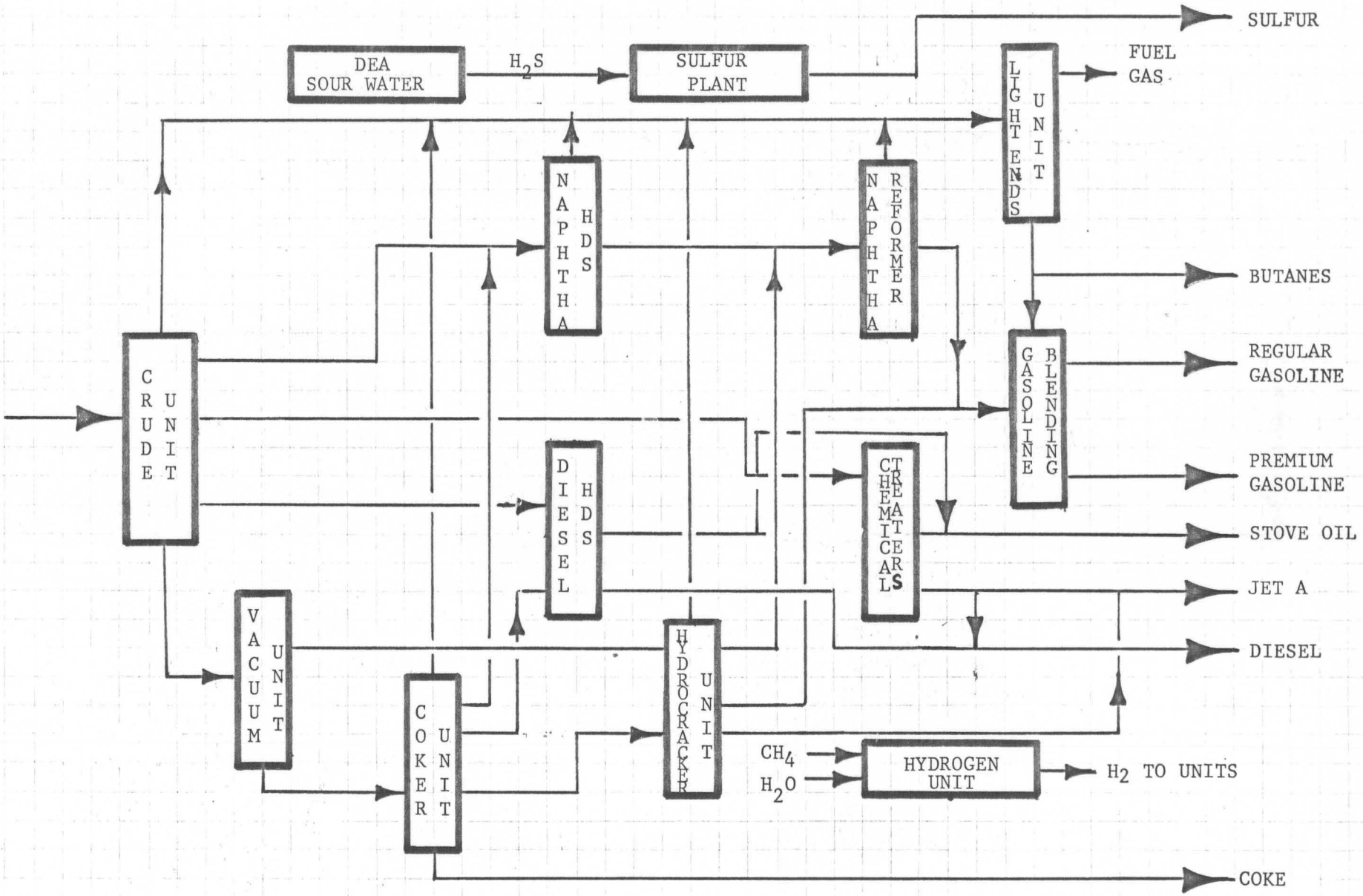


FIGURE 2-1 CHERRY POINT REFINERY FLOW DIAGRAM

3.0 PROCESS DESCRIPTIONS

Two refinery processing areas were the primary interest of the preliminary visit conducted at the Cherry Point refinery:

- o Naphtha reforming
- o Oil-water separation

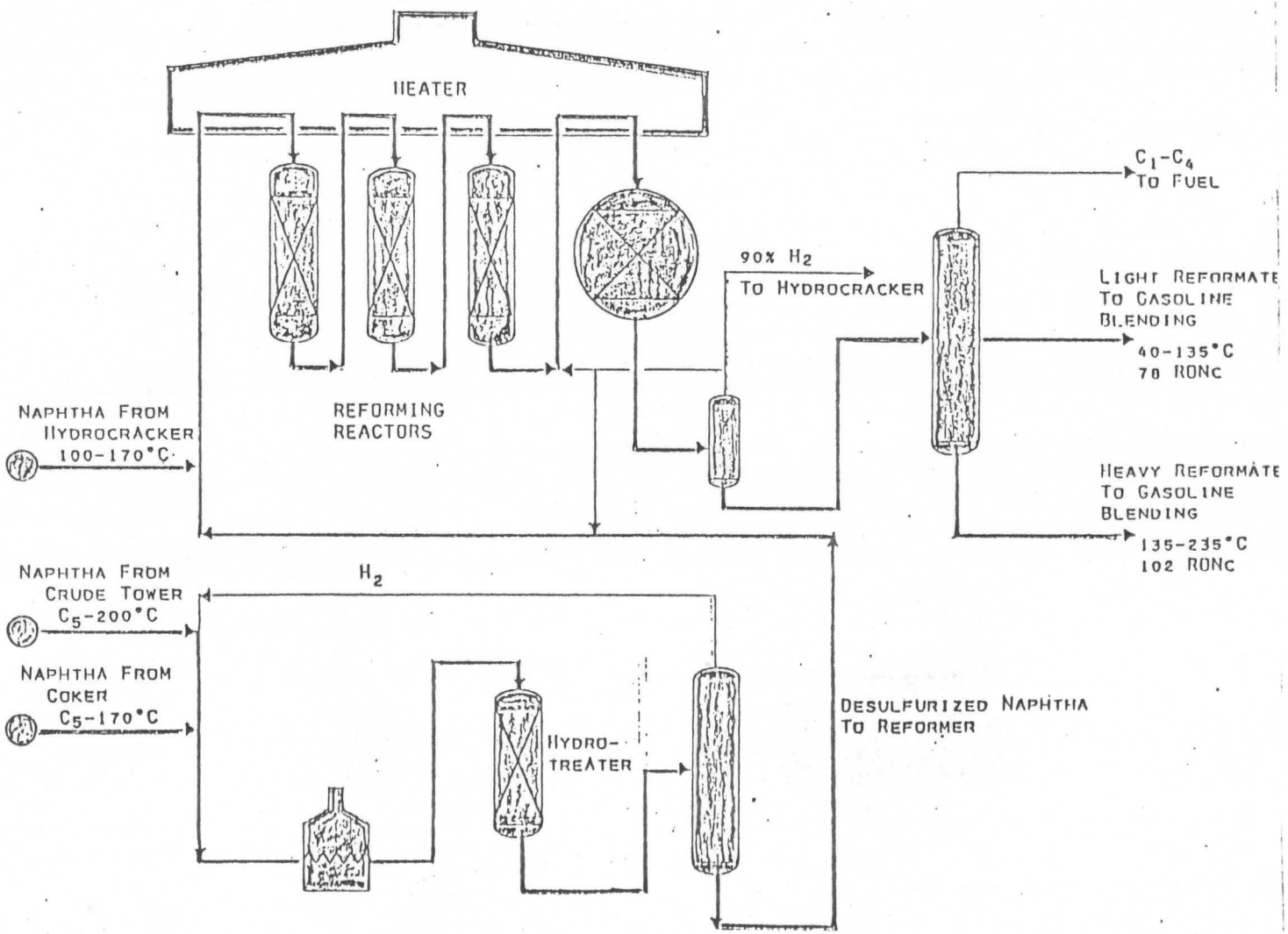
Brief descriptions of each of these processing areas follow.

3.1 Naphtha Reforming

This unit upgrades low octane naphthas into high octane gasoline components producing about 36,500 BPD of reformate having an octane of 90 to 98 Research Octane Number Clear (RONC). Two major processing areas as shown on Figure 3-1 are associated with this unit: hydrodesulfurization (HDS) and reforming.

The HDS Unit hydrogenates naphtha feed streams to the reformer removing sulfur, nitrogen and metallic impurities (reforming catalyst poisons). The Reforming Unit takes the hydrogenated naphtha from the HDS Unit and naphthas from the Hydrocracking Unit. These feeds are sent through a series of heaters and reactors where they are dehydrocyclized, aromaticized, isomerized, and cracked to form a high octane gasoline blend stock. Hydrogen and light hydrocarbons are separated from the light and heavy reformate product streams and used by other refinery processing units.

FIGURE 3-1 NAPHTHA HYDRODESULFURIZATION AND REFORMING UNITS



3.2 Waste Water Treating

The waste water system at the Cherry Point refinery is designed to separate oil from water, reduce pollutants by biological treating, and clarify the final water product. Figure 3-2 is a schematic diagram of the Cherry Point water treatment system (oil-water separation facilities are shaded).

Refinery process waters and ship ballast oily water are processed through a conventional API separator for solids removal and oil recovery. Recovered oil is pumped to a recovered oil tank and subsequently reprocessed in the refinery. An H_2S monitor is located in the API separator area to warn operators should a process upset send high levels of sour water to the API separator.

Only solids are disposed of in a land farm operated on the refinery property. The land farm consists of five small diked plots of soil in which the oily solids are tilled. The relatively mild temperatures and high rainfall of the Cherry Point area provide excellent conditions for biodegradation of the oily wastes.

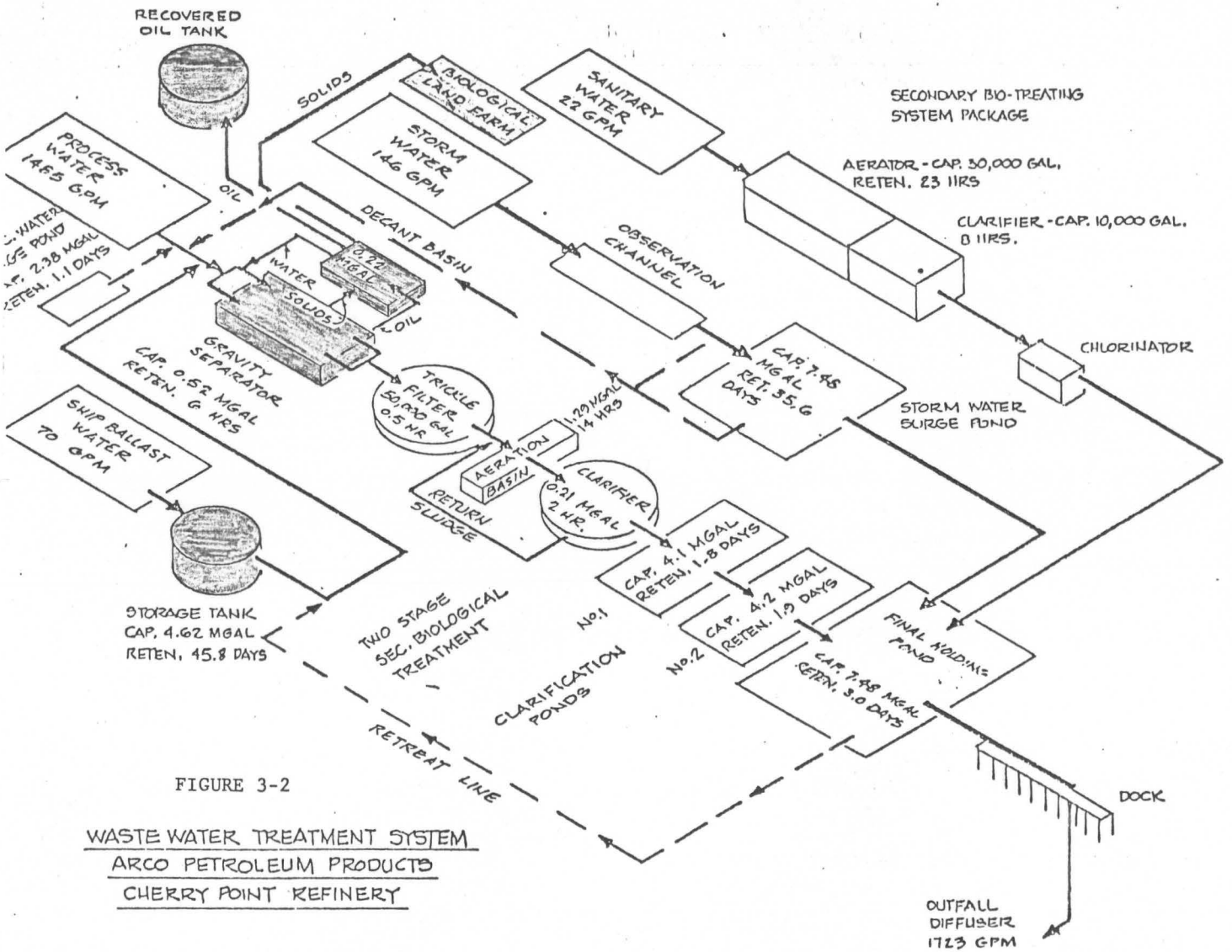


FIGURE 3-2

WASTE WATER TREATMENT SYSTEM
ARCO PETROLEUM PRODUCTS
CHERRY POINT REFINERY

4.0 GENERAL HEALTH AND SAFETY PROGRAMS

This section briefly describes the health and safety programs implemented throughout the Cherry Point refinery. A more complete description of the refinery's overall program has been appended to this report.

4.1 Health Programs

Atlantic Richfield has an extensive corporate industrial hygiene program called ACE "assess and control exposures to hazardous chemical and physical agents" at each of its refineries. The Cherry Point refinery employs a full-time industrial hygienist who works closely with the refinery's safety department and corporate industrial hygiene staff to implement the ACE program. The ACE program as described by ARCO is summarized below:

> " This program applies to hazardous agents regulated by legally promulgated health standards and is designed to control exposure at or below the permissible exposure limits prescribed by federal or state regulations and to meet other provisions of such standards.
>
> In addition, the program requires that exposures to nonregulated hazardous agents be assessed, controlled and recorded. This later step is a voluntary action on the part of the Company to determine that exposures to nonregulated hazardous agents are consistent with good industrial hygiene practice.
>
> Potential exposures from which employees are protected through the use of personal protective equipment will also be identified, assessed and documented.
>
> Documentation of the data derived from the assessment of all hazardous agents shall be

maintained in a form which complies with legal requirements and provides the information required to support a comprehensive occupational health program for all employees.

The program shall include the following elements:

Identification of all hazardous chemical and physical agents by workplace

Employee exposure assessment
- o Exposure task evaluation
- o Determination of degree of exposure

Control of unacceptable exposures

Training and information

Medical surveillance program

Documentation and recordkeeping system

ACE requires the identification, assessment and control of exposures to hazardous chemical and physical agents which employees may experience under normal operating conditions and during planned maintenance and shutdowns. It provides for the documentation of task oriented observations and monitoring activities."

One ongoing program implemented at corporate and refinery levels is identification of hazardous chemicals and physical agents through the maintenance of Material Safety Data Sheets for all compounds used or produced in each ARCO refinery. The Cherry Point refinery has aggressively implemented a Material Safety Data Sheet program following corporate policy.

Personal monitoring of routine operator procedures and major maintenance operations has been conducted for hydrocarbon exposure to benzene, toluene, xylene, and C_5-C_8 alkanes. 3M-type passive dosimeters are used for 10 and 12 hour shift monitoring and charcoal tubes/pumps are used for short

term monitoring (less than 1 hour). If sampling indicates high exposure levels, modifications in operating procedures or equipment are made. For example, if high levels of H_2S are suspected, respiratory protective equipment would be required. All sampling results are presented to and discussed with monitored employees and their supervisors.

Cherry Point management considers training and employee attitude to be the most important factors in reducing employee exposure. The refinery's safety and industrial hygiene staff conducts annual training programs in hearing conservation, respirator usage, and chemical handling. The refinery medical staff consists of two contract physicians and a full-time physician's assistant who provide annual medical examinations for all employees.

4.2 Safety Programs

The Cherry Point refinery has an extensive safety program. This program includes training, good maintenance practices and computer applications at certain processing areas.

New refinery employees are provided extensive safety training during their first month of employment. Safety meetings that include training classes, discussions of problems and drills are held monthly for operating and maintenance personnel. Maintenance groups also have weekly meetings and most maintenance engineers spend time as members of the safety department. Contract maintenance personnel are required to attend safety meetings on plant procedures before they can work in the refinery.

Employees in the refinery's maintenance and operations departments comprise most of the facility's emergency response

teams (fire, spills, etc.). Approximately 40 refinery employees have been trained as emergency medical technicians (EMT's).

All employees are issued Nomex® coveralls upon employment. Employees must wear the fire-resistant coveralls at all times while inside the refining complex. At least one fire or emergency drill is conducted each month for all operating employees.

5.0 DESCRIPTIONS OF CONTROL STRATEGIES

For each of the three process areas studied, the following control strategies are described:

- o Engineering controls
- o Monitoring
- o Personal protective equipment
- o Work practices

Engineering controls are process equipment items (such as special seals on pumps and compressors or pressurized control rooms) which limit employee exposure. Monitoring strategies include personnel monitoring and ambient monitoring. Personnel protective equipment includes such items as gloves, suits, or respirators. Work practices include any procedures which reduce the potential for worker exposure, such as work permit programs.

5.1 Naphtha Reformer

Cherry Point's reforming unit is divided into two general processing areas: naphtha hydrotreating and naphtha reforming. The unit is operated to improve the feedstock octane for gasoline product blending. Benzene, toluene, and xylene products are not recovered for sale. In this unit, workers may be potentially exposed to: heat, noise, hydrocarbons, hydrogen sulfide (H_2S), ammonia (NH_3) and other hazardous gases.

Engineering Controls

As is the case in most refinery processes, naphtha reforming units contain gases, liquids and solids inside closed

pieces of equipment (pipes, vessels, or pumps). Most worker exposures to toxic substances occur due to process leaks (fugitive emissions), during sample collection, during release of process waters to open sewers, or during equipment maintenance.

At Cherry Point, as at most new "grass roots" refineries, all refinery units are operated/monitored from a central control room. This arrangement has reduced the number of employees required to operate the refinery. In addition, Cherry Point's use of computers for control/monitoring has resulted in smoother operations and less process upsets. Operator functions in Cherry Point's Naphtha Reforming Unit area include: sample collection, equipment inspections and minor equipment maintenance/tuning.

Liquid sample taps located in the reformer/hydro-treating area are open tap-type with drains to a closed sewer system. The closed refinery sewer system prevents venting of hydrocarbon vapors in processing areas and along the sewer line. This reduces employee exposure to hydrocarbons, H_2S, and NH_3 as well as reduces potential for fire and explosions.

Cherry Point uses a computer model which calculates the desired stress to be used in tightening exchanger head bolts. Overstressing of the bolts can cause hydrocarbon leaks if exchanger head warpage occurs. Understressing or tightening of bolts also can cause leaks due to formation of a poor gasket seal. If flange and exchanger head leaks do occur, steam rings are used to keep the hydrocarbons smothered in steam (a common practice on high pressure and temperature units). Heat sensitive paint is applied to vessels where high temperature streams are contained. Paint color change indicates temperatures

above desired levels.

The Cherry Point refinery has daily pump inspections to check for seal leaks, oil levels and vibration. When a pump is noted to have excessive vibration, corrective maintenance is performed. Cherry Point's inspection/maintenance program has resulted in a pump seal failure rate 13.5 times less than the industry average. Valves are also monitored for steam and hydrocarbon leaks. Draeger tubes and soap solution (Snoop ®) are used by unit personnel to detect hydrocarbon leaks from valves and an outside contractor is employed periodically to plug identified leaks by injecting a special material around the valve stem or leak point. Valves which continue to leak are removed from service and repaired.

Another technique used by the Cherry Point refinery to improve equipment reliability is acoustical testing. This non-destructive testing technique allows for the examination of stress/corrosion cracking in vessels and large lines during equipment operation. Although the technique is no substitute for regular internal inspections, it can be used to detect problems that occur between inspection periods as well as to identify problems which can not be detected by visual inspections.

Presently the refinery uses dimethylsulfide for sulfiding new/regenerated hydrotreater catalyst. Previously, carbon disulfide was used, but safety/health concerns prompted a change to dimethylsulfide.

Monitoring and Personal Protective Equipment

Personal monitoring of operating and maintenance

employees is an integral part of the ARCO ACE program in place at Cherry Point. Ten and twelve hour monitoring is typically conducted using 3M-type passive dosimeters. Short term sampling to measure exposures in a specific job (i.e. sample collection) is conducted using pumps and charcoal tubes. Sampling results are discussed with the employees sampled and their supervisors. If high levels of certain compounds are measured, the employee job functions and his execution of those functions are examined. Depending on the situation, equipment and/or procedural changes are made to reduce exposure levels. No continuous area monitoring is conducted at the Reforming Unit.

No special personal protective gear is used at this unit other than the mandatory safety helmet, glasses and Nomex® coveralls required for all inplant employees. All employees must have an annual respirator fit test and be trained in proper use of respiratory protective equipment.

Work Practices

Normal refining industry practices are used throughout the refinery for operating and maintenance functions. Work permits are required before maintenance may be performed. Members of the safety staff must inspect vessels before confined space entry permits are issued.

The Reforming Unit is shut down for regeneration every 6 to 12 months. The hydrotreater catalyst is replaced every 1-2 years with vessel internal inspections made at least every two years.

5.2 Waste Water Treating

As described earlier the processing areas of interest

deal with oil-water separation facilities:

- o Ballast water tank
- o API separator
- o Recovered oil tank

Potential worker exposures are primarily to hydrocarbons, H_2S and NH_3. Exposures to these compounds would result from fugitive emissions during maintenance activities or operating inspections.

Engineering Controls

Oily process waters and oily water skimmed from ship ballast waters are segregated from other refinery water streams and conveyed to the API separator in closed systems (sewers or pipelines). The separator forebay is covered but does not have an air tight seal. The ballast water tank has a cone roof and the recovered oil tank has a cone roof with internal floating roof.

Monitoring and Personal Protective Equipment

Personal monitoring similar to that conducted at the Reforming Unit (using passive dosimeters and charcoal tubes and pumps) is conducted on operating/maintenance personnel. An area H_2S monitor is located near the API separator forebay to warn of H_2S levels greater than 10 ppm. High H_2S levels would only occur during a refinery unit upset such as the sour water stripper. All refinery sour water normally goes to the sour water stripper for treatment (H_2S and NH_3 removal).

No special personal protective gear is worn by the

area operator. However, if maintenance is conducted inside the separator, rain gear, gloves, boots and respirator are required. Maintenance typically is required once every six months inside the separator.

Work Practices

Operator time at the API separator is minimal and consists of equipment and skimmer inspection. The waste water treatment operator rotates positions with the Crude Unit and chemical treater positions. An operator typically spends only one week in five in the water treating area.

6.0 CONCLUSIONS AND RECOMMENDATIONS

ARCO's Cherry Point refinery has a very active industrial hygiene program which is built around the company's ACE program. This program stresses: the identification of chemical and physical hazards, the assessment of individual employee exposures, the control of unacceptable exposures, training of employees, medical surveillance and documentation and record-keeping. A full time industrial hygienist is employed at the refinery to conduct the program with support from the company industrial hygiene staff.

In addition to this outstanding program, the Cherry Point refinery is involved in a number of preventive maintenance programs which should be successful in reducing employee exposures. Programs include: a computer program to calculate acceptable bolt tightening stresses, pump inspection/maintenance, and valve inspection maintenance programs. These programs and the ACE program at Cherry Point could be of interest for indepth study with approximately one week onsite at the refinery by a Radian industrial hygienist required to conduct the indepth study.

6.1 Naphtha Reformer

The Cherry Point Naphtha Hydrotreating/Reforming Unit is operated to improve the gasoline blending pool octane. A number of interesting control techniques were noted during the preliminary visit:

- Closed oil-water sewer with sample points directly piped to the sewer.
- Use of computer program to calculate correct bolt tightening stress, thus preventing hydrocarbon leaks due to exchanger head warpage or poor gasket sealing.

- o Pump inspections for seal leaks, oil levels and vibration which has resulted in a much lower pump seal failure rate than industry average
- o Valve inspections for steam and hydrocarbon leaks with monthly leak repair using injection of special material into leaks.
- o Use of temperature sensitive paints on vessels to indicate higher than desired temperatures.
- o Use of acoustical testing for locating stress/ corrosion cracking while vessel is in service and to aid in visual inspections.

These programs either reduce worker exposure to hydrocarbons by preventing fugitive emissions or by reducing the possibility of major equipment failures (pump seals, vessels, lines).

6.2 Waste Water Separators

The Cherry Point refinery utilizes a conventional API separator for oil-water separation. Worker exposures to hydrocarbons are reduced through the use of a cover over the separator. An area H_2S monitor is located at the API separator to warn of a process upset which has released sour water to the waste water treatment plant. Except for the H_2S monitor, this unit is typical of the other refineries visited.

APPENDIX

GUIDELINES

FOR

THE

ACE PROGRAM

July 1, 1981

ATLANTIC RICHFIELD COMPANY

OCCUPATIONAL SAFETY AND HEALTH POLICY

ASSESS AND CONTROL EXPOSURE TO HAZARDOUS CHEMICAL AND PHYSICAL AGENTS (ACE)

Each company shall implement a continuing, systematic program to evaluate, control and record the degree of employee exposure to hazardous chemical and physical agents both regulated and nonregulated.

This policy cancels and supersedes the policy Prevention of Occupational Overexposure to Hazardous Chemical and Physical Agents.

(February 27, 1980)

ACE PROGRAM SUMMARY

This program applies to hazardous agents regulated by legally promulgated health standards and is designed to control exposure at or below the permissible exposure limits prescribed by federal or state regulations and to meet other provisions of such standards.

In addition, the program requires that exposures to nonregulated hazardous agents be assessed, controlled and recorded. This later step is a voluntary action on the part of the Company to determine that exposures to nonregulated hazardous agents are consistent with good industrial hygiene practice.

Potential exposures from which employees are protected through the use of personal protective equipment will also be identified, assessed and documented.

Documentation of the data derived from the assessment of all hazardous agents shall be maintained in a form which complies with legal requirements and provides the information required to support a comprehensive occupational health program for all employees.

The program shall include the following elements:

Identification of all hazardous chemical and physical agents by workplace

Employee Exposure Assessment
- Exposure Task Evaluation
- Determination of degree of exposure

Control of unacceptable exposures

Training and information

Medical surveillance program

Documentation and recordkeeping system

ACE requires the identification, assessment and control of exposures to hazardous chemical and physical agents which employees may experience under normal operating conditions and during planned maintenance and shutdowns. It provides for the documentation of task oriented observations and monitoring activities.

GUIDELINES FOR IMPLEMENTATION OF ACE PROGRAM

- The ACE program shall be implemented at all Atlantic Richfield Company facilities where employees may be exposed to hazardous chemical and physical agents.

- It encompasses all types of work at each facility including operations, maintenance and laboratory work.

- It is the intent of the Atlantic Richfield Company to see that contractors' employees are afforded the same degree of protection as is furnished for its own employees under the same or similar conditions. Contract language should reflect this intent and arrangements should be made with the contractor to insure that the contractual stipulations are fulfilled.

July 1, 1981

OBJECTIVES

The primary objective of the ACE program is to insure that no employee suffers adverse health effects which result from occupational exposures to hazardous chemical and physical agents.

The ACE Policy and Program initiates a comprehensive industrial hygiene program for the Corporation.

It is the responsibility of each operating company to identify the resources necessary to institute ACE. This includes assignment of personnel with adequate education, training and experience to competently manage and implement the program.

The secondary objective of ACE is to provide a structured means of documenting the companies' efforts to identify, assess and control occupational exposures. This documentation will provide:

- A means of monitoring progress toward a healthier workplace environment on a regular basis as required by the Atlantic Richfield OSH Policy
- Exposure information to medical personnel for diagnostic work and epidemiological studies
- A bank of data concerning employee exposure to comply with standards and facilitate response to proposed governmental regulations and other external and internal inquiries

The companies will input significant employee exposure data to the Industrial Hygiene Module of The Occupational and Environmental Health Information System (TOEHIS). This effort will facilitate the analysis and dissemination of the data generated by ACE.

ELEMENTS OF THE ACE PROGRAM

Program Element 1 — IDENTIFICATION OF ALL HAZARDOUS CHEMICAL AND PHYSICAL AGENTS IN THE WORKPLACE

A collaborative program should be established among operating and maintenance supervisors and industrial hygiene representatives to identify and continually maintain a list of all hazardous chemical and physical agents used, stored or otherwise present in each workplace within a facility. While all of the chemical and physical agents in a workplace may be inventoried, the intent of the ACE Program is to control employee exposure to only the hazardous agents on the list.

Chemical or physical agents are those organic or inorganic chemical substances or biological agents, such as virus, bacteria, fungus, etc. or physical agents, i.e., noise, heat, cold, vibration, radiation, pressure, etc. which workers will encounter in their occupational environment.

Hazardous chemical and physical agents are those agents which have been identified as having intrinsic properties capable of producing adverse effects at some known level on the health and safety of the worker.

This list of agents, coupled with basic toxicology data, will generally give the evaluator the information necessary to identify the potential hazard associated with a particular chemical or physical agent and to set priorities for the assessment step which follows.

An occupational exposure occurs when an employee contacts through any route of entry (inhalation, ingestion, skin contact or absorption) a chemical or physical agent while performing tasks associated with the job or to which the employee may be directly exposed in the workplace.

An unacceptable exposure occurs:

(a) when an employee is exposed to a substance at a concentration above the permissible exposure limit established by government regulations; or

(b) when in the judgment of qualified health professionals an occupational exposure may cause an adverse health effect to employees.

Program Element 2 EMPLOYEE EXPOSURE ASSESSMENT

A list of tasks for each job classification at each workplace should be developed by the hygiene representative (the "evaluator") in cooperation with the appropriate supervisor and/or employee. The brief task descriptions include identification of the agents to which the employees in a particular job classification are potentially exposed.

The assessment of exposure may include two phases:

1. Exposure Task Evaluation (ETE)

2. Determination of Degree of Exposure (DDE)

The Exposure Task Evaluation is an initial appraisal of an exposure situation where the evaluator determines if a task presents a low or high potential for causing an unacceptable exposure.

The evaluator should determine who, how, how often and for how long workers are exposed to the hazardous agents identified as being present at each workplace. This information, coupled with data on the toxicity of the agent, should be used by the evaluator to identify potentially unacceptable exposures. However, some agents have little or conflicting toxicity data which will require consultation with a qualified industrial hygienist or toxicologist. From this information, a plan for further evaluation and control should be developed and priorities established for its timely implementation. Records should be maintained which describe any control measures instituted to reduce exposure levels.

The ETE should cover the complete list of hazardous chemical and physical agents to which employees in each job classification are routinely exposed and provide some detail concerning each exposure task. This information will often furnish enough significant exposure data to the Medical Department to facilitate meaningful health effective studies.

The ETE provides management with the information necessary to establish priorities for arranging for additional medical surveillance and monitoring or for installing more effective control systems, such as ventilation or personal protective equipment.

The second phase of Employee Exposure Assessment is the Determination of Degree of Exposure (DDE) by monitoring. The DDE completes the exposure profile by determining how much of an agent an employee is exposed to for a particular period of time. More specifically, the DDE is a quantitative measurement of an employee's exposure.

These measurements may be made with dosimeters or monitoring instruments which measure airborne concentrations of contaminants at the individual's breathing zone. They may be biological monitoring results which measure the absorption of a substance or agent by body systems, e.g., the level of an agent in the blood, urine, etc.

This phase is important since compliance with government standards is based on comparisons of these types of measurements with government established Permissible Exposure Limits (PEL).

A PEL is usually expressed as a concentration of an agent in air to which employees may be exposed for a specified time period. Occupational exposure to any chemical or physical agents currently covered by standards must be controlled at or below the PEL. Occupational exposure to agents not having a PEL will require the health professional to make sound judgments based on good industrial hygiene and toxicology practices. Some agents may require closer examination so that consideration may be given to the development of a Company Occupational Exposure Level (COEL) to control exposure.

Program Element 3 CONTROL OF UNACCEPTABLE EXPOSURES

It is the general intent of the ACE Policy to furnish workplaces free from recognized hazards which are likely to cause death or illness. Whenever feasible, chemical and physical agents capable of producing an unacceptable exposure shall be prevented from being dispersed into the workplace environment by engineering controls or the substitution of less hazardous agents. Whenever these controls are not feasible or while they are being evaluated or instituted, unacceptable employee exposure to airborne contaminants shall be controlled primarily by work practices or administrative procedures and, secondarily, by personal protective equipment. All control systems must be periodically evaluated to assure their continued effectiveness.

Studies should be conducted to determine the feasibility of controlling an unacceptable exposure through engineering controls. Priority should be given to situations which require employees to use respiratory equipment. Any study which determines that engineering controls are infeasible for a particular situation shall be documented and retained.

Written procedures should be developed and maintained for any controls in the workplace which limit employee exposure to hazardous chemical or physical agents. These written procedures may take the form of operating manuals for equipment, work practices, or instructions covering the proper use and care of personal protective equipment. Employees should be trained initially and retrained periodically to insure they understand the importance of the control systems in the workplace and know how to use them.

Program Element 4 TRAINING AND INFORMATION

All employees, including new or relocated employees, whose work involves potential exposure to hazardous chemical or physical agents shall be at least annually, or more frequently as required:

- Trained in the proper use and maintenance of any equipment which controls employee exposure to hazardous chemical and physical agents.
- Trained in the work procedures, spill/leak or other emergency procedures, and correct use of personal protective equipment relative to the specific chemical or physical agents to which they may be exposed.
- Informed of the nature of the hazards which they may encounter in their workplaces utilizing Material Safety Data Sheets or equivalent data.
- Advised of the signs and symptoms of over-exposure and instructed to promptly report any such symptoms to his/her supervisor.

Detailed records, including name, date, job title of attendees and a description of the subjects covered shall be maintained of all training related to the recognition and control of health hazards.

Exposure records shall be made available to employees and third parties as required by law and Company policy.

Program Element 5 MEDICAL SURVEILLANCE PROGRAM

Medical surveillance are those physical examinations, body function tests or biological monitoring performed by the Medical Department on employees to assist in determining the degree of exposure or the health effects which may result from exposure to a chemical or physical agent.

The person responsible for ACE implementation will assist in determining who should be included in a medical surveillance program. Exposure records will be furnished to the Medical Department to aid the physicians in determining which medical surveillance programs would be most appropriate. Medical surveillance results which may identify signs or symptoms of employee exposure will be communicated to the ACE coordinator for further assessment in the workplace.

Medical surveillance shall be conducted as required by law or as determined by the Company's Medical Director. All medical surveillance shall be conducted at Company expense.

Medical and exposure records shall be made available to employees and third parties as required by law and the Company Policy on Access to Employee Medical and Exposure Records.

Program Element 6 DOCUMENTATION AND RECORDKEEPING SYSTEM

Proper documentation, maintenance and retention of records is a necessary adjunct to any comprehensive occupational health program. Like medical records, industrial hygiene data may acquire increased significance 20 or 30 years after it is generated.

Provisions shall be made to document exposure data, as well as any support information necessary to interpret the monitoring results or verify their integrity. The legal retention time for most of these records is 30 years.

An Industrial Hygiene Module (IHM) is being developed within the TOEHIS computer network to maintain, correlate and disseminate information concerning employee exposure in the workplace. Computer system programs are being developed to permit the correlation of the exposure data with the employee health records. The IHM will facilitate the orderly gathering of information for responses to inquiries by management, employees and regulators.