

✓ THE ACTUAL CONTRIBUTION OF ASBESTOS FIBER EXPOSURE
DURING GASKET REMOVAL FROM PIPE FLANGES ABOARD SHIP

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NOVEMBER 1983
BELLEVUE, WASHINGTON

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ABSTRACT

Early studies in the 1960's and 1970's rightfully ignored hard-pressed encapsulated gaskets in evaluation of high level exposures occurring aboard ship and in shops to include the emphasis on control programs for those sources (15,16) because of their low level contributions. In 1978, studies directed specifically toward asbestos gasket materials used in Naval shipyards (34) concluded that simple control measures were sufficient to maintain exposures less than the Federal standard of 2 fibers/cc. Many of the exposures reported were less than .01 fibers/cc.

Other studies (31,32) showed that the values in the 1978 PSNS gasket report were elevated because they included spurious contamination from other sources and that actual contributions from GARLOCK gaskets were substantially lower. This investigative research was able to demonstrate that removal of asbestos gaskets, specifically GARLOCK gaskets, from pipe flanges aboard ship produces fractional and negligible contributions to the occupational exposure of workers. The values averaged .03 fibers/cc for flanges disassembled aboard ship, and .02 fibers/cc for flanges cut from the ships and disassembled in remote asbestos-free locations.

These values are in the same range as ambient pollution levels of airborne asbestos fibers in industrial areas (1,31,32,33) and at ambient levels experienced by city dwellers on dry summer days, for which there is no significant impact on their health (9,10,17).

DISCLAIMER

The author is solely responsible for the contents and conclusions in this investigative research report which may not necessarily reflect the official opinion of the contributors, the U.S. Department of Navy, or U.S. Department of Labor.

ACKNOWLEDGEMENTS AND CONTRIBUTORS

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HISTORY

Asbestos is one of the most plentiful, useful, cheap, and strong industrial minerals. Consequently, and because of its high thermal stability, resistance to corrosion and strength it appears in more than 3000 manufactured goods in the United States. At least 30,000,000 tons have been used in construction and manufacturing since the year 1900, exposing millions of Americans to asbestos in industry and non-occupationally in cities. Even today large numbers of the population are exposed to substantial asbestos fiber levels in the air in cities, near industrial complexes, from soil high in asbestos content, and from drinking water (1,2,3,4,5,6,7) Therefore, most Americans receive at least some regular low-level exposure to asbestos in their lifetime (8,9,10).

Until about 1964 (11,12) when the real evidence appeared to shape thinking about occupational exposure to asbestos, high level exposures were allowed because standards were based on the etiology of asbestosis, a lung disease, not cancer. Many of the exposures were excessive and uncontrolled based on known work practices, poor control programs and elevated allowable standards at that time. However, little attention was given to the actual exposure of the general population in cities or nearby industrial complexes. There is evidence to show that some ambient levels of contamination in cities may exceed those found in industrial applications (1,2,6,13). But there is little evidence that these continuing ambient asbestos fiber exposures to the general population gives rise to significant identified asbestos-related disease (2,9,10).

However, workers in construction, shipyards, steam plants, mining, and milling, received, and may still receive, elevated exposures to asbestos from a variety of sources and processes. For example, from 1958 to 1973 about 500,000 tons of asbestos was sprayed inside high-rise buildings for fire proofing in the United States (2,6,7). About 4,500,000 men and women were employed in U.S. Naval and private shipyards during World War II, stabilizing to about 200,000 after 1945 and for the next 30 years. During this period, thousands of tons of asbestos products were installed on or removed from vessels during construction, overhaul, or demolition (17,18,19,20). Standards were elevated (14,15,16,17,18,19,20) and controls were few thus allowing elevated occupational exposure. The long lapse time from exposure to the onset of asbestos, or asbestos related cancers, creates significant difficulty in attempting to establish a dose response relationship (17,21). The disease incidence today is likely from decades past when few measurements of asbestos exposure were made, exposures were high and controls few (17,21,22,23,24).

Earlier studies (15,16) showed that major exposures aboard ship were produced by the high volumes of magnesia block insulation containing 15% long fiber asbestos, asbestos cements, or other soft asbestos products. At that time, the allowable exposure was 5 million particles per cubic foot of air as recommended by the American Conference of Industrial Hygienists. This was roughly equivalent to 50 asbestos fibers/cc greater than 5 micrometers in length (19) from 1946 to 1968.

As the allowable exposure levels were reduced, more attention was given to

lower and lower exposure levels from these products. Unfortunately, the exposure levels of workers were measured in contaminated atmospheres with little regard to the actual contributions of individual products. Therefore, much of this earlier data that names a specific product type or process is skewed upward by atmospheric contamination in the work area, contaminated work clothing, and airborne contributions from nearby operations.

As technology and preventive work practices are developed to meet lower allowable standards of exposure, the contributions of individual products becomes increasingly important (25,26,27,28,29,30).

Asbestos gaskets are a typically encapsulated, or hard pressed product that produces little free asbestos fibers from handling or use. Their contribution was largely ignored by those developing early programs (Marr, Mangold) because of the fractional and negligible contribution to the combined occupational exposure of asbestos workers.

The extremely low level contribution from the processing of gaskets is obscured by the high background levels from other asbestos products, and their residual contamination (31,32,33) produced by their handling and use.

II

BACKGROUND

In 1978, the Department of the Navy commissioned a study to determine the occupational exposure of asbestos gasket materials, their use and processes at Puget Sound Naval shipyard (34). The study concludes that the encapsulated nature of the gaskets, their handling, and application produces only low level release of asbestos fibers. Even the simplest of general housekeeping controls, ventilation, or work practices are sufficient to maintain exposure levels below the current Federal standard for any eight hour day on a time-weighted basis of 2 asbestos fibers per cubic centimeter, greater than 5 micro meters in length, (35,36,37) or the proposed Federal standard of .5 fibers/cc, became a Federal Emergency Temporary Standard on November 4, 1983 in 29 FR Vol 48, No 215, Friday November 4, 1983.

Although the 1978 PSNS report (34) does achieve the intended purpose to determine the exposure to any and all asbestos in the breathing zone of workers processing asbestos gaskets it does not determine the actual contribution from the gaskets alone. The 1978 PSNS report is unique because there are only a few such reports that attempt to evaluate the contribution of various types of asbestos gaskets to the occupational exposure according to state-of-the-art work practices conducted in a large shipyard by a highly mobile work force. The data shows only a small contribution by gasket materials to the overall occupational exposures of asbestos workers. None-the-less, the data includes atmospheric asbestos pollution, workplace contamination, redispersion of fallen fibers, the effects of asbestos-laden clothing, and reflects some intermittent peak

exposures of unit operations rather than an eight hour time-weighted average upon which the Federal standard of 2f/cc is based. Few attempts were made to address sources of contamination, therefore they are included in the results. Because the airborne concentrations reported in the 1978 PSNS (34) report are extremely low, often .01 f/cc or less, the potential for contamination in work areas used for other asbestos operations is certain and would be expected to substantially skew reported values upward (31,32,33). Tiny asbestos fibers, once airborne, are likely to remain airborne indefinitely under such conditions of turbulence (1,13, 27,28,29,38,39,40). Also, short sample periods ranging from 6 to 132 minutes evident in the PSNS report imposed an arbitrary upper limit of precision on the counting technique which also skewed results upward.

Therefore, the 1978 PSNS report reflects the contribution of gasket materials and any contamination of asbestos from the atmosphere, redispersion, asbestos laden clothing, or nearby processes.

Although the 1978 PSNS gasket report is an important work, a redefinition was needed to show the actual contribution of gasket materials to the occupational exposure of those processing them because the PSNS values are overstated and do not reflect actual eight hour time-weighted averages for comparison to the Federal standard.

III

INTRODUCTION

Because of the shortcomings mentioned in the 1978 PSNS report and earlier data that mentioned product types like gaskets without factoring the contribution of contamination, a series of investigative research projects were commissioned by GARLOCK, INC. to measure the actual contribution of GARLOCK gasket materials to the occupational exposure of workers in industrial settings and based on the eight hour time-weighted average other studies compared those results to non-occupationally exposed city dwellers for direct comparison (1,21,22,31,32,33).

The first investigative research project (31) repeated the work of Beckett (34) in the 1978 PSNS study to demonstrate the effects of several sources of contamination and to make proper comparison to the Federal standard. The results averaged .02 fibers/cc. The abstract of that report states,

"Hard-pressed or encapsulated asbestos gasket materials manufactured by GARLOCK release only small amounts of fibers during handling, processing or removal in industrial operations. A recent Department of the Navy study confirmed that the total occupational exposures related to gasket materials are at the minimum risk levels compared to current Federal standards.

This study, commissioned by GARLOCK INC. shows that work area contamination - i.e., ambient pollution from other sources in industrial areas, asbestos-laden clothing, and general atmospheric pollution - far exceeds any contributions from such gasket materials and makes emission from gaskets insignificant by comparison.

When these nongasket sources of contamination are minimized, the actual occupational exposure of the gasket materials is in the range of the levels of exposure expected in downtown city streets on dry summer days experienced by the public.

The breathing zone concentrations of asbestos fibers from GARLOCK, Styles 7021, 900/7735 and 605 gasket materials prepared as they were

in the 1940-1970's are near the lower limit of detection. To the extent they are measureable, the values average 1/100th of the current allowable exposure of two fibers per cubic centimeter greater than five micrometers in length as determined by phase contrast microscopy and based on an eight-hour time-weighted average work day.

The actual contribution of the GARLOCK asbestos gasket materials described and evaluated in work environments constitute a negligible exposure and risk to workers. The occupational exposures, are often lower than contamination levels of industrial work areas where asbestos is processed, or the exposure to the general population living near those industrial areas, or in downtown city streets on dry summer days."

A second study (32) determined the actual release of asbestos fibers from GARLOCK spiral wound, braided, and encapsulated gaskets in a contamination-free enclosure using state of the art applications of the GARLOCK product types. Results average .004 fibers/cc. The abstract from this study states,

"Spiral wound, braided, or encapsulated asbestos materials manufactured by GARLOCK release negligible amounts of asbestos fibers during storage, handling, installation and removal.

This study commissioned by GARLOCK INC. shows that when these gasket materials are handled and processed in a contamination-free environment the fibers released to the work atmosphere is 1/500th of the current allowable exposure of 2 fibers/cubic centimeter, greater than 5 um in the diameter for an eight hour time-weighted average work day. The measured release of fibers is less than the levels of exposures experienced daily by city dwellers and many times less than that experienced in downtown city streets on dry summer days.

The ambient release of asbestos fibers from other sources in industrial areas, asbestos-laden clothing, and general atmospheric pollution provide the major occupational exposure to workers, and far exceeds any contribution from these types of gasket materials. Therefore, the actual contribution of these GARLOCK asbestos gaskets constitute a negligible exposure and risk to workers. The amount of fibers released is so low that it is easily obscured by other asbestos products, or contamination sources, and borders on the lower limit of detection by phase contrast microscopy."

A third investigative research project (33) commissioned by GARLOCK INC. was designed to collect air samples in the cities of San Francisco, Vallejo, and

Oakland California in the same manner as airborne asbestos exposures are collected in the work place to form a direct comparison of exposure of those using gaskets, and those non-occupationally exposed in cities.

The abstract of the third project states,

"The ambient asbestos fiber levels in Vallejo, Oakland, and San Francisco, California during five days in February 1983 averaged .02 asbestos fibers/cubic centimeter of air, greater than 5 micrometers in diameter on an eight hour time weighted average as determined by phase contrast microscopy at 400X.

This data compares to previous findings of .02 asbestos fibers/cc in Seattle and Bremerton, Washington, and Portland, Oregon in July and August 1982.

Previous studies show that GARLOCK INC asbestos gasket materials and spiral wound gaskets produce less than .02 asbestos fibers/cc during processing. This is in the same range as the eight hour daily exposure to city dwellers for which there is no significant impact on their health."

Similar investigative research projects were conducted in the State of Virginia in cities and near shipyard industrial complexes (45). The results compare to the earlier studies that show that the GARLOCK encapsulated gaskets produced less than .02 fibers/cc during processing which is in the same range as the eight hour daytime exposure to city dwellers for which there is no significant impact on their health (9,10,25).

The following table compares the actual exposure from GARLOCK gasket materials averaging .02 fibers/cc to previous and current daily allowable occupational exposure levels (41,42,43,44).

<u>Date</u>	<u>Daily Allowable Exposure Level</u>	<u>Source</u>	<u>Gasket Exposure as a Fraction of the Std.</u>
1946-1969	5mppcf or 50/fibers/cc	(ACGIH TLV)	1/2500th
1969-1972	12/fibers/cc	(ACGIH TLV)	1/600th
1972-1976	5/fibers/cc	(OSHA Standard)	1/250th
1976-present	2/fibers/cc	(OSHA Standard)	1/100th
November 1983	.5 fibers/cc	(OSHA Standard)	1/25th

In order to complete these series of investigative research more information was needed to determine the actual exposure from the removal of gaskets from flanges, especially aboard ships.

The first study (31) established the actual exposure expected from handling, cutting, installation and removal of GARLOCK Style 7021 encapsulated gasket materials. The assembly and disassembly process conducted in an asbestos contamination-free environment did not exceed .02 fibers/cc. This validation of previous evaluations of GARLOCK asbestos gasket materials and the finding of lower values than in the 1978 PSNS report (34) was because extra care was given to the potential sources of contamination, and sample times reflected eight hour exposures.

Still, a need existed to determine the actual exposure of GARLOCK asbestos gaskets that had been in use for years in ship's piping flanges. A search was conducted for just such conditions.

IV

METHODS OF INVESTIGATION

The 1978 PSNS Gasket Report (34) Table X reported that hand scraping of gaskets from flanges in the absence of ventilation or other controls resulted in values of less than .05 fibers/cc, >5 μ m in length.

Table XI of the PSNS report (34) shows that removal of the gasket materials by hand scraping or wire brushing of the flange to remove residual asbestos resulting in values ranging from less than .03 to .39 fibers/cc, averaging .12 fibers/cc for 22 samples.

While these values are reasonably low compared to the Federal standard of 2f/cc, the above values likely reflect contamination of asbestos from a variety of sources aboard ship. No attempt was made in the PSNS report to factor these sources of contamination.

A design experiment (49,50) was conceived that would locate flanges aboard a ship in repair, or salvage and repeat the disassembly process of flanges containing asbestos gaskets under stress for long periods. The disassembly and removal would be under controlled conditions to,

- (1) factor general atmospheric pollution;
- (2) consider redispersion of fallen asbestos dust in the work area;
- (3) identify sources of asbestos dust from adjacent operations; if any;
- (4) avoid contaminated work clothing contributions, which can be substantial;

- (5) develop an eight hour TWA exposure pattern so it may be directly related to the Federal standard of 2f/cc;
- (6) avoid large errors introduced mathematically into the phase contrast microscopy counting technique by short sample times;
- (7) use NIOSH Analytical method P/CAM 239 for counting asbestos fibers by phase contrast microscopy at 400X as specified by the Federal standard.

Two ships were located that fit the needs of the designed investigative research to determine the actual airborne asbestos fiber contribution from asbestos gaskets removed from flanges after years of service.

The U.S.N. GYPSIE, ARSD-I, is a U.S. Navy bow lifter converted to a salvage vessel and currently undergoing removal of piping. It was built in 1944, mothballed in 1945, and stored in the reserve fleet in Astoria, Oregon. It was purchased in 1948 by private industry interests. It is considered an LST type hull commonly mass produced during World War II, measuring 214' feet in length.

This vessel was selected because,

- (a) most of the asbestos lagging and magnesia block insulation had been removed years ago, thus reducing this major potential source of contamination;
- (b) partial salvage had begun that centered on pipe removal by flange disassembly.
- (c) sufficient flanges were available to provide eight hour TWA comparison to the Federal standard.

The U.S.N. GYPSIE is shown in photographs I, II, and III of Appendix A.

The second vessel under salvage suitable for evaluation of flange removal was another LST type hull of World War II vintage called the OFFSHORE I. It measures 214 feet in length. It was converted from an LST to serve as a sea going barge. The piping between the first and second deck was intact

and apparently never altered since it was built except for removal of the magnesia block insulation. It is shown beached for salvage in photographs IV, V and VI, of Appendix B.

These two vessels were ideal because they contained flanges that apparently had never been opened during the life of the ship, which could be nearly 40 years. Many of the flanges required an oxygen-acetylene torch to cut the bolts which had been frozen by age and corrosion.

V

FINDINGS

A. U.S.N. GYPSIE

Various sizes of asbestos gaskets were selected for removal during the salvage phase so that 20 asbestos gaskets were removed over five days. Four flanges were disassembled per eight hour work day. The work days were selected when a full eight hour TWA sample could be collected and were projected over a three month period because the disassembly was conducted during slack work periods.

Air samples were collected in the breathing zone of each workman removing flanges containing asbestos gaskets. Also, environmental samples were collected in nearby locations to measure asbestos contamination. Workers wore clean clothing on each day of sampling to minimize the effects of soiled clothing which has been previously shown to produce significant contamination and obscure low results (31,32,46,47,48).

Workers were instructed to save all GARLOCK products positively identified to include any scraping from the flange. Nine of the twenty flanges removed contained GARLOCK flange gaskets. Their location is identified in the skematic of the U.S.N. GYPSIE in Appendix C.

Table I shows the concentrations of airborne asbestos fibers collected in the breathing zone during the disassembly of flanges during salvage of the U.S.N. GYPSIE. Exposures ranged from .01 to .08f/cc, averaging .03f/cc for the

twenty samples collected in sets of four on each of five separate days selected over a three month period. Because the activity aboard the ship was low and nearly all other asbestos materials had been removed in years past, the environmental background samples did not exceed .005f/cc which approached the eight hour TWA lower limit of detection of .002f/cc. Few fibers from other sources were airborne, which increases the credibility of this evaluation. Secondly, the GARLOCK and other gasket material had obviously been in place for many years ranging in estimates from 10 to 40 years.

TABLE I
U.S.N. GYPSIE
PORTLAND, OREGON

DISASSEMBLY OF FLANGES ABOARD THE USN GYPSIE, ARSD-1, UNDER SALVAGE

DAY	SAMPLE # FOR EACH FLANGE DISASSEMBLY	ASBESTOS FIBERS/CC, GREATER THAN 5 UM IN LENGTH BASED ON AN 8 HOUR TWA, BY PHASE CONTRAST MICROSCOPY AT 400 X (1)	ENVIRONMENTAL BACKGROUND, F/CC (1)
1	1	.02	.005
	2	.01	
	3	.03	
	4	.04	
2	5	.04	.005
	6	.01	
	7	.01	
	8	.08	
3	9	.01	.002
	10	.05	
	11	.07	
	12	.01	
4	13	.01	.005
	14	.05	
	15	.04	
	16	.02	
5	17	.02	.005
	18	.01	
	19	.02	
	20	.04	
20 FLANGES		$\bar{X} = .03$	NEGLECTIBLE

(1) NIOSH ANALYTICAL METHOD FOR PHASE CONTRAST MICROSCOPY, P-CAM 239

These values are substantially less than those reported in the 1978 PSNS report which averaged .12f/cc. The effects of contamination are substantial when magnesia block, asbestos cloth, or other soft asbestos products are present and would account for the higher levels in the PSNS report (34). Marr (14) and Mangold (15,16) reported such elevated levels in 1965 to 1970. Photographs VII and VIII, of Appendix D shows the typical volume of asbestos materials compared to the small volume of asbestos as gaskets in flanges aboard a typical large naval vessel.

Also, a Naval shipyard using the best state of the art during an aircraft carrier overhaul in December 1978 reported airborne asbestos fiber levels ranging from .01 to 23 fibers/cc in 19 locations aboard ship. Such levels shown in Appendix G would easily obscure or skew upward evaluations of any flange gasket removals (31,32), and would account for the higher values reported in the 1978 PSNS report.

Therefore, this investigative research project is unique because:

- (a) it locates gasket material that has been in place for 10 to 40 years in ships piping.
- (b) the sampling required was ideal in that other asbestos materials were absent or remained undisturbed.
- (c) actual GARLOCK flange gasket material could be evaluated.
- (d) it demonstrates the effects of contamination from other sources during a flange gasket removal during a ship overhaul.
- (e) the actual GARLOCK gaskets, and the scrapings could be saved for examinations.

In order to test the data in Table I, five small flanges were cut from the U.S.N. GYPSIE and removed to a remote residential site for disassembly.

Table II shows that the airborne concentration of asbestos fibers in the

breathing zone of the worker performing flange disassembly averaged .02f/cc. This confirms the data in Table I. The environmental background samples were negligible. The lower limit of detection was .002f/cc, which represents one fiber per 100 microscope fields counted for an eight hour sample or 960 liters of air.

TABLE II
U.S.N. GYPSIE
ARSD-1

Small flanges removed and disassembled in asbestos free environment.

<u>A FIVE FLANGE DISASSEMBLY</u>	<u>AIRBORNE ASBESTOS FIBERS IN THE BREATHING ZONE DURING AN 8 HR TWA WORK DAY EXPRESSED AS f/cc, 5um IN LENGTH</u>	<u>ENVIRONMENTAL BACKGROUND</u>
1 > BREATHING ZONE	.02	
2 > DUPLICATES	.02	
3 > DUPLICATE		.002
4 > BACKGROUND		.002

Note: Five flanges were each disassembled on a fresh piece of plastic to avoid cross contamination.

Photographs IX, X, XI and XII of Appendix E show the flange disassembly process at a remote asbestos - free location to substantiate findings aboard the ship, U.S.N. GYPSIE.

B. OFF SHORE I, an LST hull beached for salvage in Portland, Oregon

Thirty (30) piping flanges located between the first deck and second deck were removed by cutting with an oxygen-acetylene torch. The flanges remained intact and were removed to a remote asbestos-free residential site for processing

Each flange was placed on a clean piece of polyethylene plastic and disassembled as necessary. The flanges were so corroded and bolts frozen that a oxygen-acetylene torch was often used to cut the bolts. Other bolts were removed with an electric impact wrench, or hand tools.

The flanges were then broken apart, the gasket removed, and the flange surfaces scraped with a putty knife which is typical shipboard procedure.

Six flanges were disassembled during each eight hour work day over a five day period. This arrangement was selected because the workman could only disassemble about six flanges in eight hours.

Duplicate air samples were collected in the breathing zone of the worker during each eight hour work day in order to relate exposures to the Federal standard of 2 asbestos f/cc, greater than five micrometers in length, during an eight hour time - weighted average work day.

Duplicate eight hour environmental samples were collected during each work day to determine the ambient asbestos fiber contamination, if any.

Table III shows the concentrations of airborne asbestos fibers in the breathing zone of the worker disassembling the 30 flanges taken from the OFFSHORE I. Duplicate samples ranged from .01 to .05 asbestos fibers/cc, averaging .02 fibers/cc for thirty flanges processed in sets of six over five separate days. Since the flanges were processed under strictly controlled conditions to prevent contamination, and the environmental background concentrations were negligible (.003f/cc) which approached the lower limit of detection, the values reflect the actual release of asbestos fibers from the encapsulated gasket materials removed from the ships flanges. It is reasonable to believe that the flanges had never been parted during the life of the OFF SHORE I, and therefore represent expected asbestos fiber production levels of asbestos gaskets after many years in service.

Photographs XIII, XIV, XV, XVI, XVII, of Appendix F, show typical flanges, and disassembly at a remote asbestos-free location. The heavily corroded and frozen condition of the flanges reflect their age, and abuse aboard the OFF SHORE I.

Photographs numbered one through nine in Appendix H represent GARLOCK gaskets removed from flanges aboard the U.S.N. GYPSIE, ARSD-I. The 10th gasket was fashioned from asbestos cloth probably by the ship's crew.

The gasket marked (A), represents the typical gasket removed from flanges taken from the OFF SHORE I.

TABLE III
OFFSHORE-I
LST HULL UNDER - SALVAGE
PORTLAND, OREGON

Day	Eight Hour Air Sample @ 2.L/Min Duplicate Samples	Flanges Processed Per Day	Asbestos fibers/cubic centimeter of air, greater than 5 micrometers in length based on an 8 hour TWA, by Phase Contrast Microscopy at 400 X (1)	Environmental Background
1	1	1	.03	
	2	2	.02	
		3		
	1B	4		.002
	2B	5		.004
		6		
2	3	7	.05	
	4	8	.02	
		9		
	3B	10		.002
	4B	11		.004
		12		
3	5	13	.01	
	6	14	.01	
	5B	15		.003
	6B	16		.004
		17		
		18		
4	7	19	.03	
	8	20	.02	
	7B	21		
	8B	22		.002
		23		
		24		
5	9	26	.01	
	10	27	.03	
		28		
	9B	29		.004
	10B	30		.002
5 days	10 Flange Samples	30 flanges	Average breathing Zone Exposure $\bar{x}$ = .023	Average environmental
	10 Environmental Background Samples			Background $\bar{x}$ = .003
			21	

(1) NIOSH Method P ÷ CAM 239

VI

CONCLUSIONS

Early studies (14,15,16) in the 1960's and 1970's largely ignored the low level contributions of asbestos gasket materials to the overall exposure of workers handling asbestos products aboard ship and attendant shop processes. During those periods, high level exposures were recorded and control measures were directed toward the control of these elevated exposures. Also, when such asbestos fiber levels were elevated, little attention was given to background contamination, and the sampling, and counting errors because of their negligible effect. The negligible contribution of gaskets were justifiably ignored.

In 1978, the Department of the Navy commissioned a study of asbestos gasket exposure at Puget Sound Naval Shipyard (34), that concluded that even the simplest of general housekeeping controls or work practices are sufficient to maintain occupational exposure below the current Federal standard for an eight hour TWA work day of two fiber/cc, greater than 5 micrometers in diameter. In fact, many of the exposures were found to be less than .01f/cc.

Although the 1978 PSNS report achieved the intended purpose to determine any and all asbestos in the breathing zone of workers, it did not determine the actual contribution from gaskets alone. Any contamination present was included therefore, the values reported were skewed upward.

In 1982, Mangold (31) determined the actual contribution of GARLOCK asbestos gasket materials to the occupational exposure of asbestos workers. The values

were substantially lower than reported in the PSNS report and averaged .02f/cc. Careful attention was given to avoid other sources of contamination. The 1982 report (31) established that atmospheric, workplace, clothing, and redispersion are important and significant sources of contamination when considering low level contributions from the GARLOCK gasket materials. In fact, the report evaluated the exposure to city dwellers on summer days and found exposures as high as those expected from gasket materials in industrial settings (1,3,4,5, 6,7,21,22,23,24,31,32,33).

This investigative research is unique because two vessels were located that were under partial demolition. The asbestos lagging had been removed years previously, activity in the ship was low, and piping removal afforded the opportunity to evaluate the actual contribution of gasket materials to the breathing zone of workers during flange disassembly. This study corroborates earlier work that simulated such removals (31).

The occupational exposure of workers engaged in flange disassembly aboard ship averaged .03 fibers/cc, greater than five micrometers in length. Flanges cut from the two ships and disassembled at remote asbestos-free locations produced an eight hour time-weighted average exposure of .02 fibers/cc, which compare.

These values are in the same range as found in cities on dry summer days by Lemoine (1) and Mangold (31,33) and earlier by others (4,6,7,21,22,23,24).

The study refutes the notion that GARLOCK and other similar gasket materials

go through a major deterioration with age and use, and therefore release substantial asbestos fiber concentrations. Most of the gaskets removed from flanges from both ships built about 1944 were well preserved and intact. In most cases, the manufacture's name could be clearly seen on the gaskets removed attesting to the low level degradation of the hardpressed encapsulated gasket materials, some which have been in the flanges up to 40 years.

The actual contribution of the gasket materials to the occupational exposure to workers engaged in the disassembly of pipe flanges aboard ship is negligible, and is in the range of ambient pollution levels of airborne asbestos fibers in industrial areas, and often at ambient levels experienced by city dwellers on dry summer days, for which there is no significant impact on their health.

VII

REFERENCES

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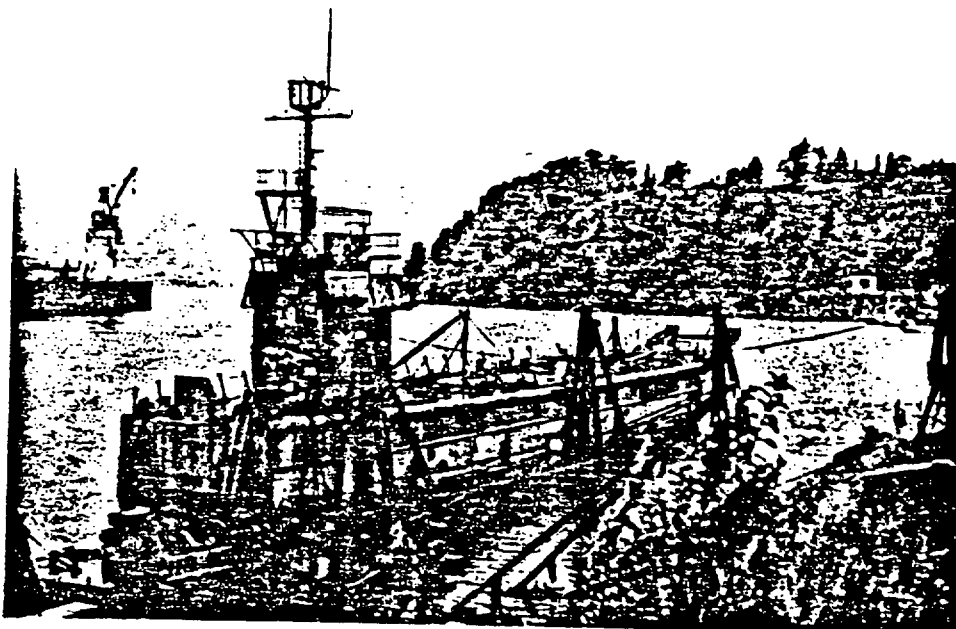
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VIII
APPENDICES

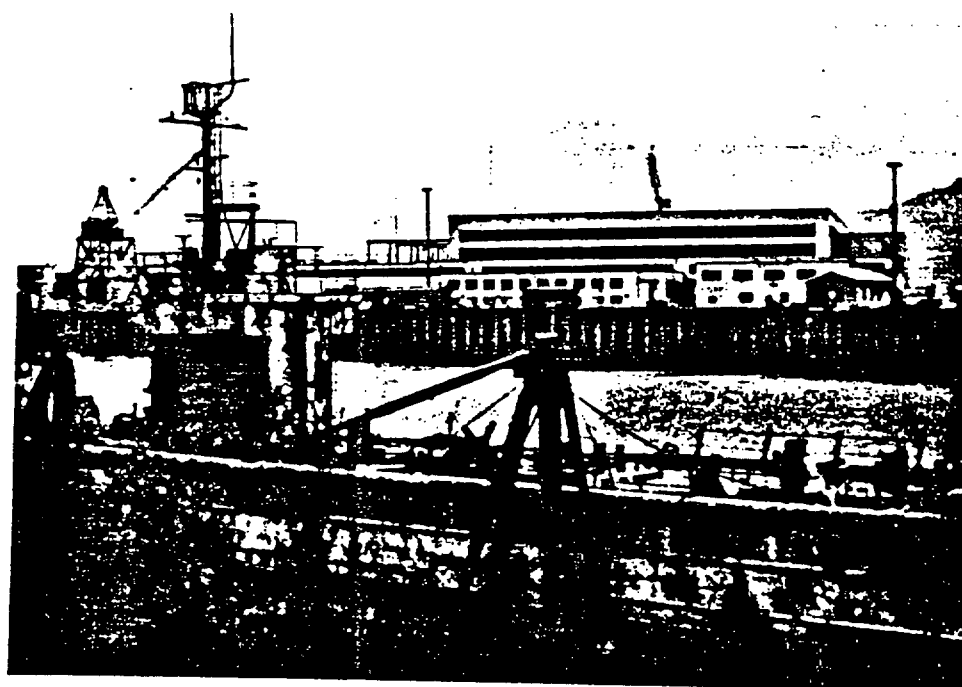
- A. Photographs of U.S.N. GYPSIE
Built 1944, decommissioned 1945
- B. Photographs of OFF SHORE - I
W.W.II Vintage (Circa 1944-45)
- C. Diagram of locations of (GARLOCK) gaskets found in flanges
disassembled on the U.S.N. GYPSIE
- D. Photographs VII and VIII represent of the Volume of Asbestos products
used in ships compared to asbestos gaskets in flanges.
- E. Photographs IX, X, XI, XII, represent a typical small flange from U.S.N.
GYPSIE disassembled in an asbestos-free environment.
- F. Typical flanges from the OFF SHORE - I disassembled in an asbestos-free
environment. Some of the gaskets easily reflect the life of the ship.
Few LST's were manufactured after 1945.
- G. Process data from pre-overhaul of the U.S.S. Enterprize (CVN-65) in
December 1978 reflecting high level airborne asbestos levels during
rip-out, removal, or after processing of asbestos. State of art
methods were used except for wetting down techniques.
(This document is public knowledge originating from the asbestos
litigations discovery process)
- H. Photographs of nine GARLOCK asbestos gaskets, and one home made gasket
from the U.S.N. GYPSIE. Photographs of typical gaskets removed from
the OFF SHORE - I.

APPENDIX A

USN GYPSIE, ARSD - I, built 1944, decommissioned 1945



I



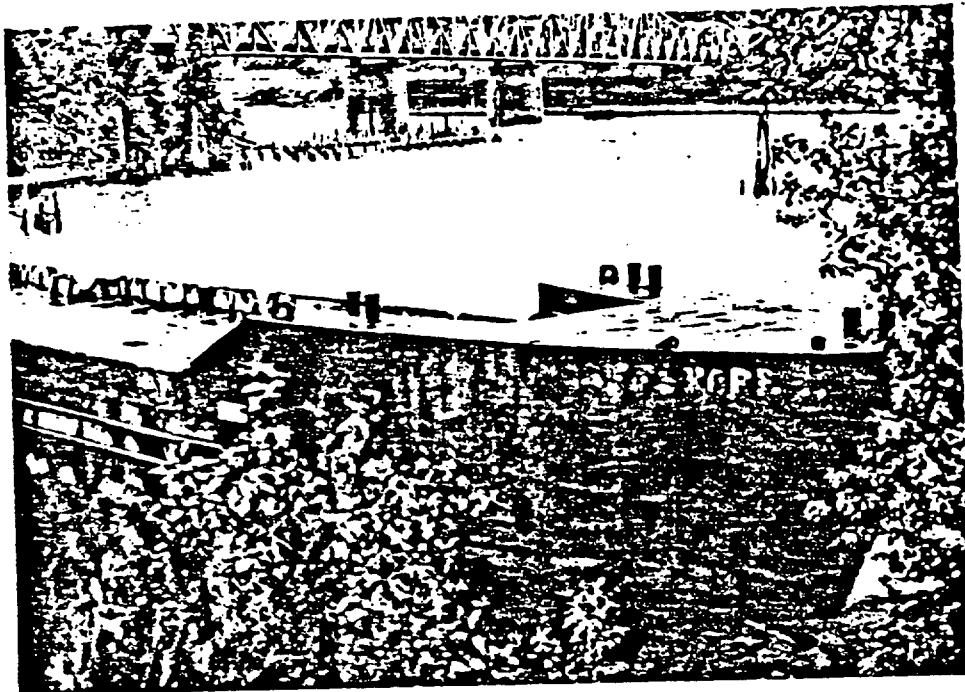
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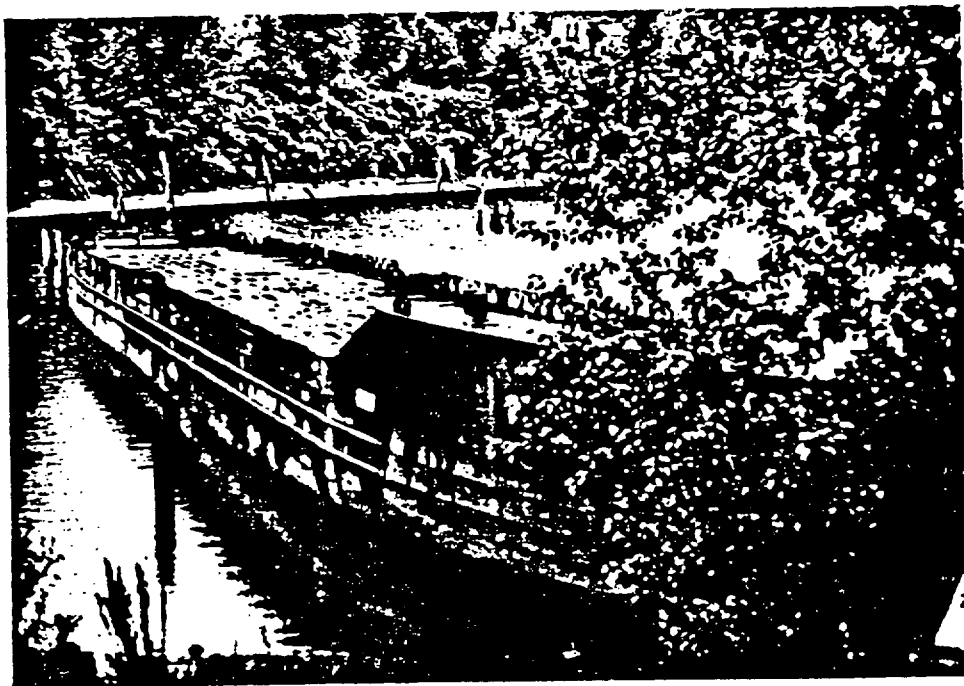
III

APPENDIX B

OFF SHORE - I, WW II VINTAGE (CIRCA 1944 - 1945)



IV



V



VI

APPENDIX C

USN GYPSIE
(ARSD - I)

GARLOCK INC GASKETS FOUND AT VARIOUS LOCATIONS DURING
PIPING DISASSEMBLY ABOARD THE USN GYPSIE (ARSD - I)

- 1 Visual Inspection Port of Volume Tank
- 2 Ships Air Volume Tank
- 3 Boiler Piping Gasket
- 4 Fire Water System
- 5 Boiler Feed Line to Fresh Water Maker
- 6 Small Steam Line
- 7 Steam Line
- 8 Fresh Water Supply
- 9 Ships Tank Flange Gasket

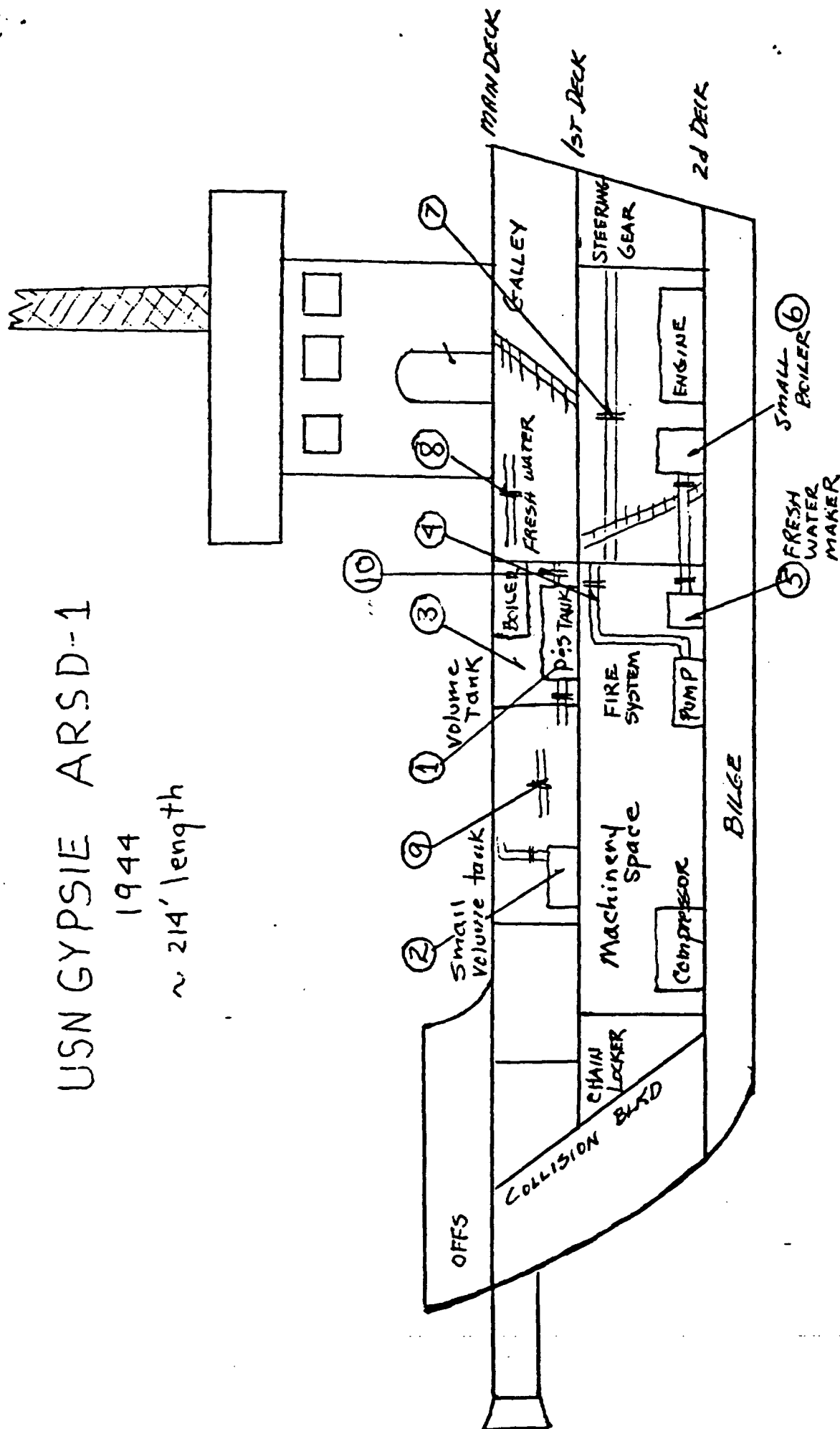
UNKNOWN ORIGIN ASBESTOS GASKET

- 10 Flange Gasket From Clean Air Inlet Line
(unknown source probably prepared by ship's force
from two layers of asbestos cloth)

USN GYPSIE ARSD-1

1944

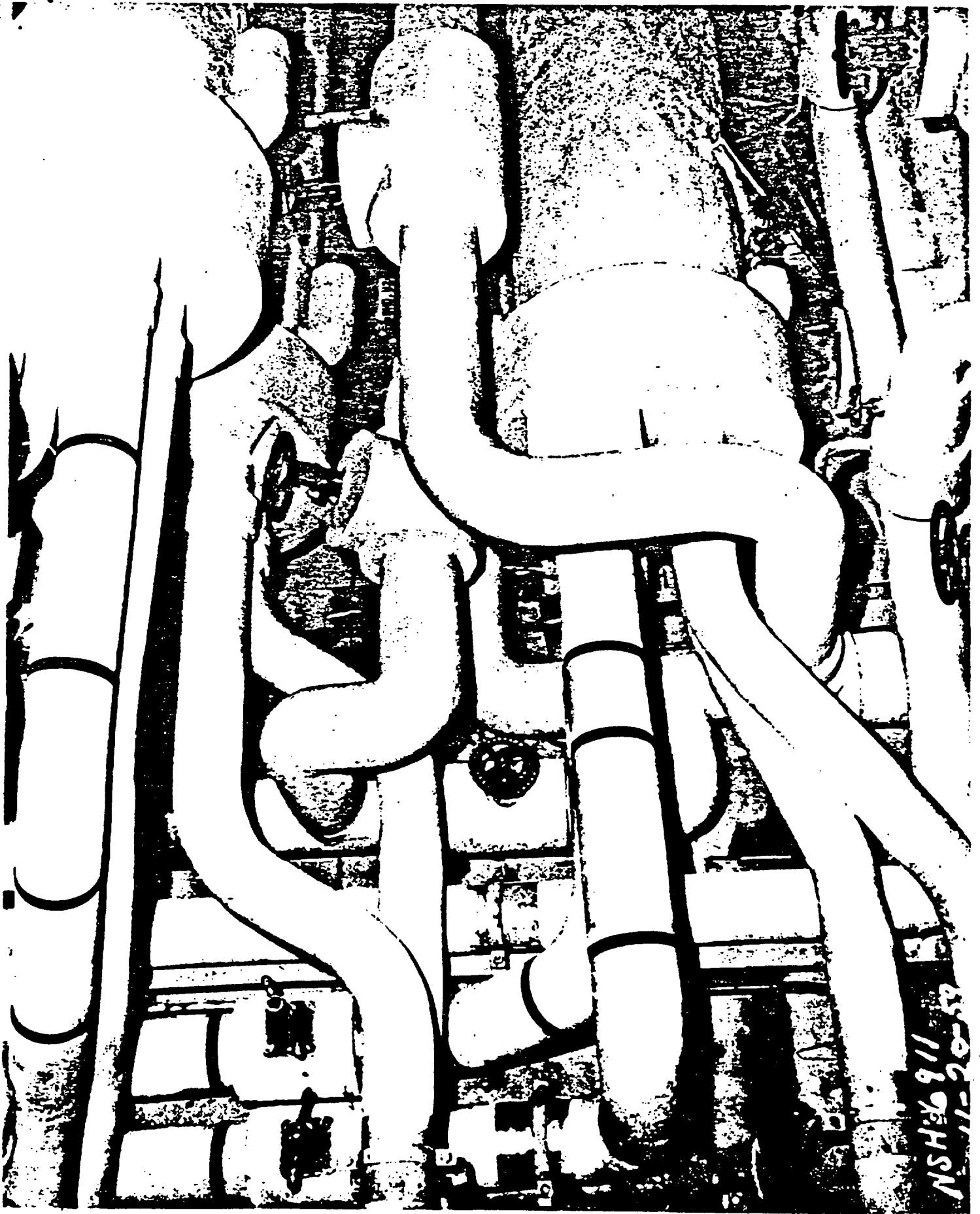
~ 214' length

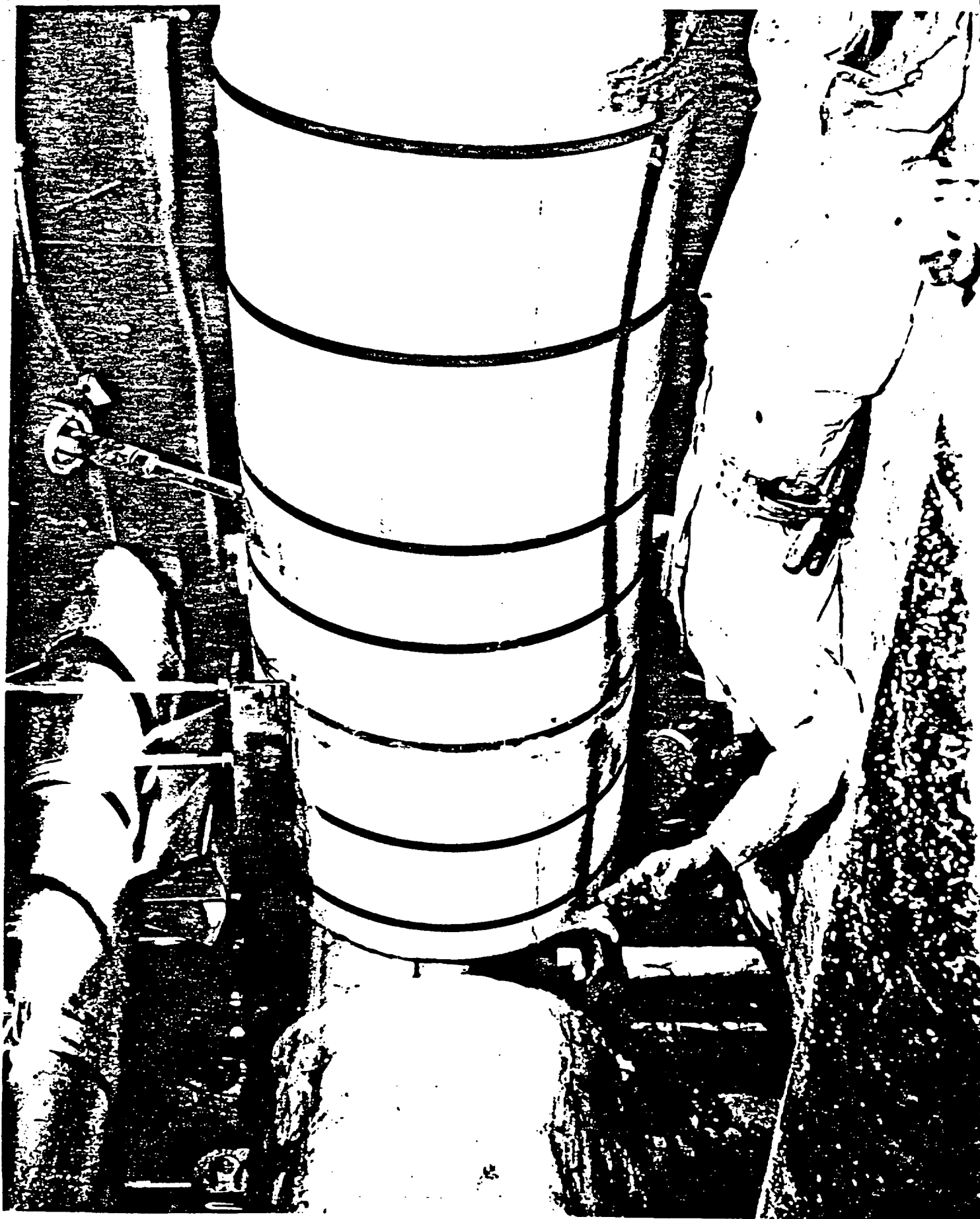


Approximate scale
1" = 25'
11/83 CAM

APPENDIX D

ASBESTOS LAGGING ON PIPING OF A LARGE NAVAL VESSEL (1959 and 1968 respectively)



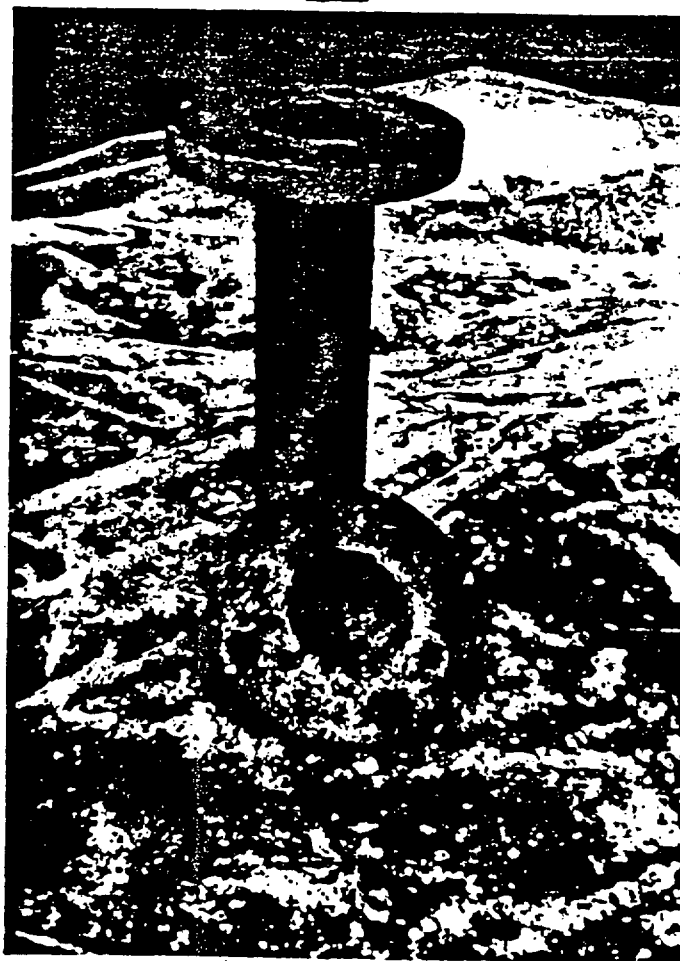


APPENDIX E

SEQUENCE OF DISASSEMBLY OF FLANGES REMOVED FROM THE USN GYPSIE
AND DISASSEMBLED IN AN ASBESTOS-FREE ENVIRONMENT



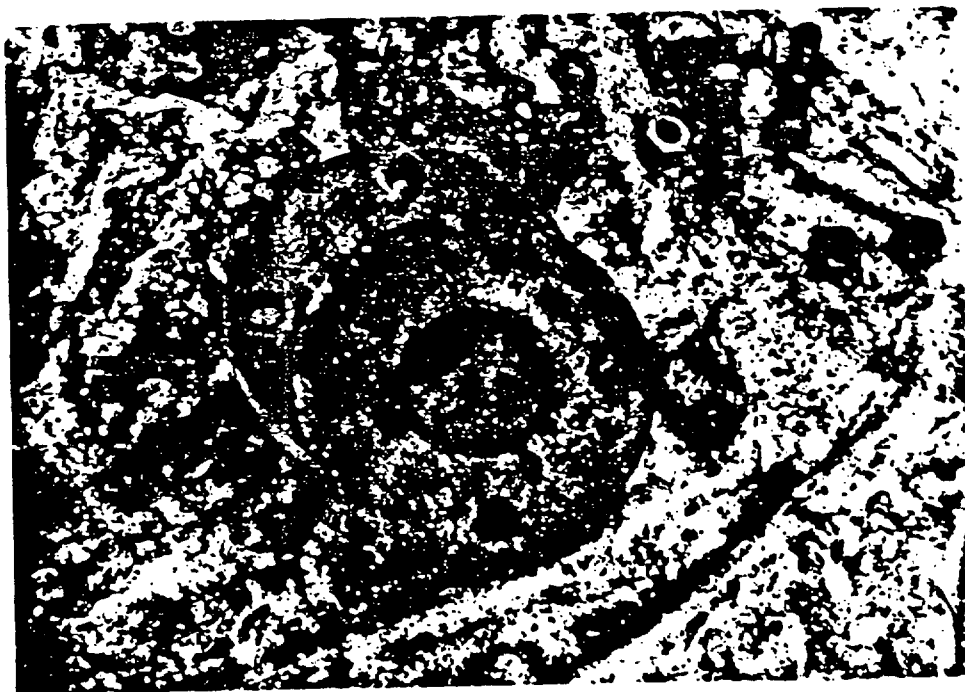
IX



X



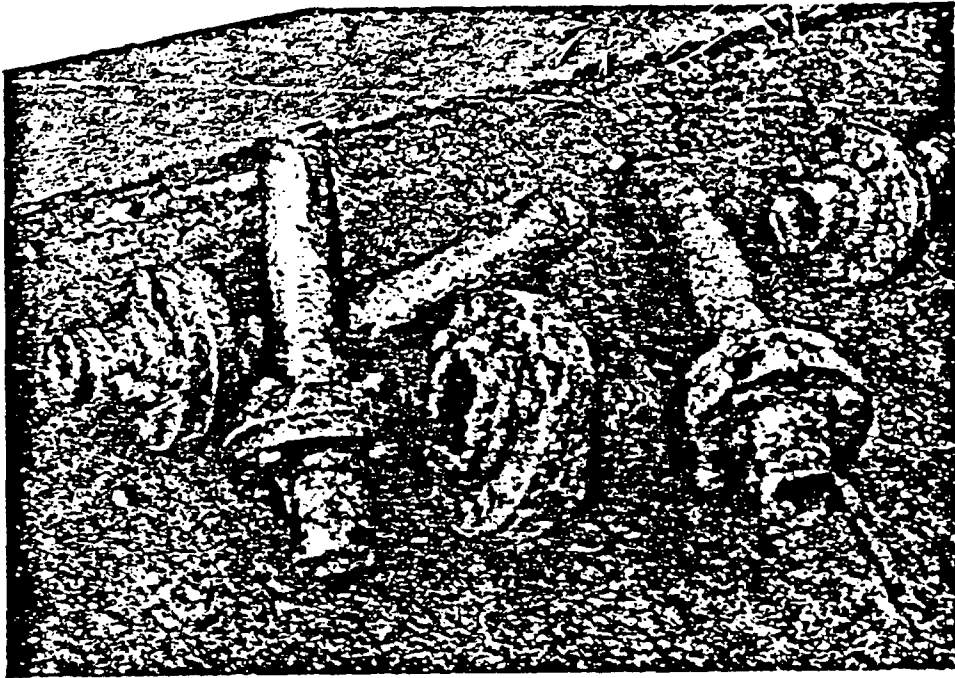
XI



XII

APPENDIX F

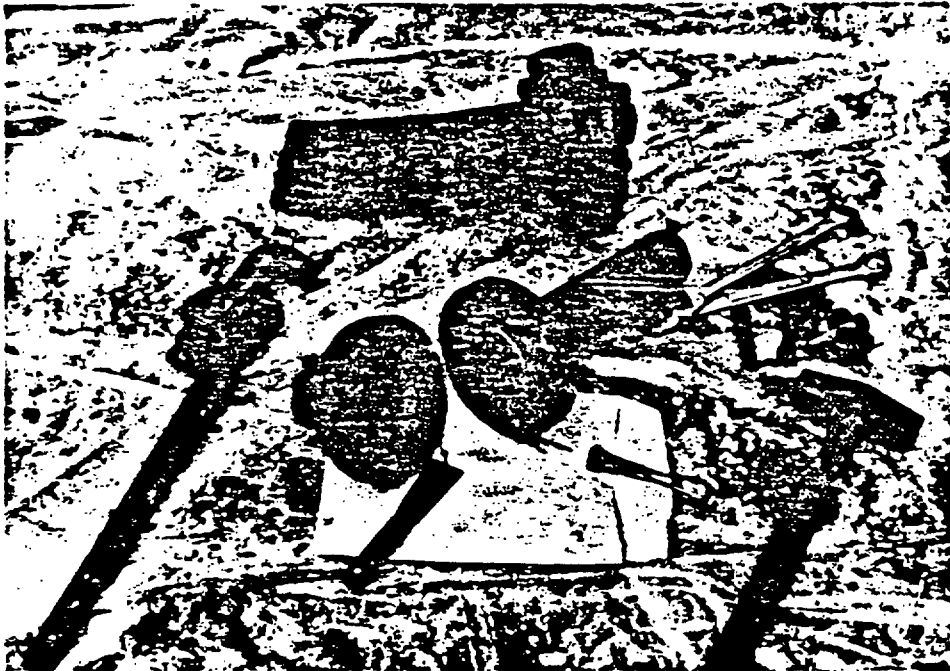
FLANGES FROM THE OFF SHORE -I DISASSEMBLED IN A REMOTE ASBESTOS-FREE ENVIRONMENT. SOME OF THE GASKETS EASILY REFLECT THE LIFE OF THE SHIP. FEW LST'S WERE MANUFACTURED AFTER 1945.



XIII



XIV



XV



XVI



VIII

APPENDIX G

PROCESS DATA FROM PREOVERHAUL OF THE USS ENTERPRISE (CVN-65) IN DECEMBER 1978 REFLECTING HIGH LEVEL AIRBORNE ASBESTOS LEVELS DURING RIP-OUT, REMOVAL, OR AFTER PROCESSING ASBESTOS MATERIALS. STATE OF THE ART METHODS WERE USED EXCEPT FOR WETTING DOWN TECHNIQUES. (This document is public knowledge originating from the asbestos litigation discovery process.)

The data demonstrates that under the best state of the art methods in use would easily obscure measurement of low level emissions of hard pressed, or encapsulated products like gaskets. The levels are often several orders of magnitude greater than expected from the handling, or removal of gasket materials aboard ship during a rip-out, or installation of asbestos pipe lagging and other asbestos materials.



DEPARTMENT OF THE NAVY
PUGET SOUND NAVAL SHIPYARD
BREMERTON WASHINGTON 98314

IN REPLY REFER TO
160.1:JJ:mr
12532
26 September 1979

Mr. Patrick G. Toomey
President
Bremerton Metal Trades Council
P. O. Box 448
Bremerton, Washington 98310

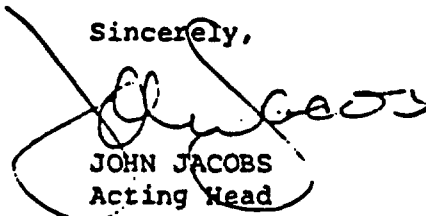
Dear Mr. Toomey:

This is in response to your request of 7 September 1979 for air samples and results taken from 18-21 December 1978, on the USS ENTERPRISE while it was underway.

You should be aware that the period in question was during the pre-overhaul operations of the CVN-65 at Alameda, California, and not while the ship was underway; the total period was 15-22 December 1978; there were ninety samples collected; and the samples were analyzed on site by the airborne fiber count method using phase contrast microscopy. Furthermore, both Puget Sound Naval Shipyard and Mare Island Naval Shipyard had employees performing rip-out operations and the enclosed data reveals both the results of PSNS and MINS worker operations.

Lastly, a Naval Regional Medical Center, Bremerton, Industrial Hygienist was provided during the period for the purpose of: analyzing breathing air; collecting and analyzing airborne asbestos samples; approving asbestos precautionary measures initiated by PSNS Shop 56 workers as stipulated in OPNAVINST 6260.1A and NAVSEA Technical Manual, Chapter 635, Thermal Insulation; to act as liaison between Ship's Force personnel and PSNS workers with regard to compliance with the above-referenced documents; and to provide general industrial hygiene consultative services.

Sincerely,


JOHN JACOBS
Acting Head

Employee Management Relations

Enclosures

Copy to:
NAVSHIPYDPUGET Codes:
160(2), 956
NIMC 430

<u>Process</u>	<u>No. Samples</u>	<u>Range (fibers/cc)</u>	<u>Ave (fibers/cc)</u>
(A) Ripout #1 MMR, in area of Mare Island workers (one deck below control point)	5	8.91-22.47	13.93
(B) Ripout #1 MMR, in area of PSNS workers, adjacent to Mare Island workers (one deck below control point)	7	3.00-13.64	6.70
(C) Ripout #1 MMR, in area of PSNS workers (two decks below control point)	6	1.66-2.21	1.96
(D) Trash removal route, within #1 MMR, within first 24 hrs after initiation of ripout	9	0.41-8.46	3.88
(E) Trash removal route, within #1 MMR, second 24 hr period	6	0.74-2.42	1.60
(F) Trash removal route, within #1 MMR, third 24 hr period	15	0.78-4.83	2.13
(G) Trash removal route, outside #1 MMR	6	< 0.01-0.06	0.02
(H) During clean-up process within #1 MMR	6	0.01-0.54	0.23
(I) Four hrs after final clean-up process	6	0.06-0.12	0.09
(J) EOS Room first 24 hr period	3	0.66-1.50	1.01
second 24 hr period	3	0.02-0.06	0.05

<u>Process</u>	<u>No. Samples</u>	<u>Range (fibers/cc)</u>	<u>Ave (fibers/cc)</u>
(K) Inside control point enclosure			
first 24 hr period	3	3.03-8.46	6.23
second 24 hr period	2	2.10-2.42	2.26
third 24 hr period	3	0.78-1.76	1.22
(L) Area outside control point enclosure			
first 24 hr period	3	0.41-1.91	1.12
second 24 hr period	2	1.33-2.01	1.67
(M) Passageway leading to control point			
first 24 hr period	3	3.44-5.76	4.30
second 24 hr period	2	0.74-0.99	0.87
third 24 hr period	6	1.60-4.11	2.35
third 24 hr period, during trash bag removed	6	1.32-4.83	2.36
(N) Environmental sampling during ripout, one deck below control point	12	3.00-22.47	9.71
(O) Environmental sampling during ripout, two decks below control point	6	1.66-2.21	1.96
(P) Breathing zone personal samples, Mare Island workers, during ripout	3	14.74-18.20	16.35
(Q) Breathing zone personal samples, PSNS workers, during ripout	3	3.37-4.32	3.76
(R) Breathing zone personal samples, PSNS workers, during ripout and clean-up	6	0.23-1.89	0.94
(S) Spaces adjacent to #1 SCR on deck two	6	0.01-0.16	0.05

APPENDIX H

Nine Garlock gaskets disassembled aboard the USN GYPSIE (1 thru 9)

One asbestos cloth gasket removed from a flange aboard the USN GYPSIE (#10)

One asbestos gasket representative of those removed from the OFFSHORE-I (# A)

