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Department of Energy  
Oak Ridge Operations  
P.O. Box 2001  
Oak Ridge, Tennessee 37831 - 8650

707512

August 30, 1989

Mr. Steve Berry  
6917 Resolute Road  
Knoxville, TN 37918

Dear Mr. Berry:

ORGDP CENTRIFUGE WORKERS STUDY

Martin Marietta Energy Systems, Inc., (Energy Systems) requested Oak Ridge Associated Universities (ORAU) to perform a telephone survey of former centrifuge workers who had exposure to epoxy resin. The results of this study are documented in a report which I have attached. Also included are an ORAU press release and a fact sheet describing significant findings in the study.

The study showed that there was a statistical increase in centrifuge workers having developed bladder cancer. The Study results did not identify a specific agent or exposure that could be labeled as the causative factor for the increase in bladder cancer incidence. Since this initial ORAU study, in which they reviewed the health of 300 out of 900 centrifuge workers, Energy Systems is requesting that ORAU expand their study to include the other workers and will be providing current and former Energy Systems employees with medical screening. I will keep you informed of the results of these further studies, and I am available to discuss with you any concerns you have regarding the study.

Sincerely,

James C. Hall  
Assistant Manager for  
Enriching Operations

Enclosures:

- 1. Fact Sheet
- 2. News Release
- 3. Health Study of ORGDP Centrifuge Workers, Executive Summary

REPOSITORY Oak Ridge Operations Office (ORO)

COLLECTION Energy Programs Div. ER-11

BOX No. Active Records Gathered for Human Radiation Exp. Pjt.

FOLDER \_\_\_\_\_

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bcc: P. G. Sewell, NE-30, GTN  
Dr. Donna Cragle, ORAU  
J. L. Foutch, CC-10, ORO  
J. T. Alexander, M-4, ORO  
~~Karen Atchley, ER-12, ORO~~

54866-A  
~~3811~~ ORAU

DOE Site Rep:

Steve Berry - Boeing; home address: 6917 Resolute Road  
Knoxville, TN 37918

Robert Brown - AiResearch; address: Office of AM SPRO, DOE/OR

Harlie Lunke - AiResearch; address: 20 Argonne Plaza, No. 196, Oak Ridge, TN

John Rothrock - Goodyear/AiResearch; address:

Director, Quality & Reliability Division,  
U. S. DOE, Oak Ridge

Jerry Fan Fossen, Engineering Division, USDOE/OR

Dr. Raymond I. Greenberg

DP-133.2, Room A-325-GTN

U. S. DOE

19901 Germantown Road

Germantown, MD 20585

Letters to Messes. Berry, Lunke, and Greenberg sent  
certified mail, return receipt requested; those with  
DOE/ORO addresses hand delivered.

bcc: Dr. Donna Cragle, ORAU  
P. G. Sewell, DOE/GTN

CONCURRENCE
RTG. SYMBO EO-20
INITIALS/SIG.
DATE
RTG. SYMBO CC-10
INITIALS/SIG. Foutch
DATE
RTG. SYMBO ER-12
INITIALS/SIG. K. Atchley
DATE KSA 8/3/89
RTG. SYMBO M-4
INITIALS/SIG. Alexandre
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## Department of Energy

Oak Ridge Operations  
P. O. Box 2001  
Oak Ridge, Tennessee 37831-8650

August 30, 1989

Mr. J. P. Douglas  
MS X11018  
Hercules Aerospace  
Bucchus Works  
Magna, UT 84044

Gentlemen:

### CENTRIFUGE WORKERS HEALTH STUDY

A study of the health histories of workers at the Oak Ridge Gaseous Diffusion Plant who were associated with the Centrifuge Program has been under way since the latter part of 1987. The study, conducted by the Oak Ridge Associated Universities (ORAU), is now complete, and an Executive Summary is attached. The study will be submitted for a peer review. A key element of the study was to determine the possible effects of exposure to four substances used as epoxy resin systems that have shown some carcinogenic potential in animal tests: 4,4-Methylenedianiline (MDA), M-Phenylenediamine (MPDA), bis(2,3)-Epoxypropyl ether (BECPE), and Diglycidyl Ether of Bisphenol A (DGEBA). Participants in the study were about 300 presently employed and former centrifuge workers from among those who had the greatest potential exposure to these materials during the life of the Centrifuge Program (the late 1960s to the mid-1980s). An equal number of employees, chosen because they had not worked on the Centrifuge Program, served as a "control group."

The study identified five cases of bladder cancer among the centrifuge workers, with none reported by the members of the control group. "None of the five workers had any job that required routine, 'hands-on' work with any of the epoxy resin material," the ORAU study states. "Three of the bladder cancer cases had frequent opportunity to pass through T-Lab although they were not routinely assigned to that area and did not come into direct contact with materials used there. At this time it is not possible to identify one specific agent or process that could be labeled as the causative factor for these bladder cancers."

The results of this study should be shared with your former employees who were involved with the centrifuge activities where there was a possibility of exposure to epoxy resins. Please have each employee acknowledge receipt of the notification and advise me when these notifications have been made and acknowledged. Additional studies will

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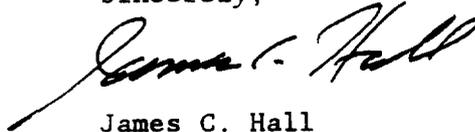
Mr. J. P. Douglas

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be conducted and the results provided to you. Martin Marietta Energy Systems will request ORAU to expand their study to include all past employees in the centrifuge program at the Oak Ridge Gaseous Diffusion Plant (ORGDP). They are also providing current and past employees additional medical surveillance.

Please refer any questions you have concerning this study to Dr. Donna Cragle, ORAU, (615) 576-2866.

Sincerely,



James C. Hall  
Assistant Manager for  
Enriching Operations

Enclosures:

1. Fact Sheet
2. News Release
3. Health Study of ORGDP Centrifuge  
Workers, Executive Summary

1021580

bcc: P. G. Sewell, NE-30, GTN  
Dr. Donna Cragle, ORAU  
J. L. Foutch, CC-10, ORO  
J. T. Alexander, M-4, ORO  
Karen Atchley, ER-12, ORO

COMPANIES WITH ACCESS TO RESIN

University of Virginia

The University of Virginia  
Mr. D. W. Jennings  
Office of Sponsored Programs  
P. O. Box 9003  
Charlottesville, VA 22906

Goodyear Aerospace - Wingfoot Lake  
- Akron Facility

(GAC has been sold to Loral Systems)  
Mr. David Seeman  
Loral Systems Group  
Department 961, Plant D  
1210 Massillon Road  
Akron, Ohio 44315

AiResearch - Torrance, CA  
- Sepuveda Blvd. Plant  
- Ohio

Mr. Donad J. Barsumian  
Allied Signal Aerospace Company  
AiResearch Los Angeles Division  
2525 West 190th Street  
Torrance CA 90509

Boeing - Seattle facility  
- Oak Ridge facility

Boeing Tennessee, Inc.  
ATTN: Doane Averill  
Director, Business Management  
P. O. Box 851  
Oak Ridge, TN 37831-0851

Exxon Nuclear - Ballston Spa, NY  
(files were retired 5/85)

Advanced Nuclear Fuels  
600 108th Avenue, N. E.  
Post Office Box 90777  
Bellevue, Washington 98009

Louisiana Manufacturing Plant  
Contract DE-AC050810R20809

Union Carbide Corporation  
Old Ridgebury Road  
Danbury, Connecticut 06811

Union Carbide; Columbia, S. C.  
(This Division has been sold, believed  
to be a subcontract to MMES)

Hercules - Utah

J. P. Douglas  
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**FACT SHEET**  
ORGDP Centrifuge Workers' Study  
August 25, 1989

**WHY WAS THE STUDY DONE?** In response to concerns expressed by representatives of the Oil, Chemical, and Atomic Workers Union (OCAWU) at ORGDP that nine cancer cases had been reported among gas centrifuge workers at ORGDP.

**WHO DID THE STUDY?** Oak Ridge Associated Universities' Center for Epidemiologic Research, for Martin Marietta Energy Systems.

**ON WHAT INFORMATION WAS THE STUDY BASED?** Workers' potential for exposure to four materials that were suspected animal carcinogens and that were used in the centrifuge process--4,4-Methylenedianiline, m-Phenylenediamine, bis(2,3-Epoxypropyl)ether, and Diglycidyl Ether of Bisphenol A and exposure to solvents. Exposure potential was determined from department numbers, job titles, and lists of medically monitored workers involved in the centrifuge process.

**WHAT WORKERS WERE INCLUDED IN THE STUDY?** Personnel from 10 designated centrifuge departments: the Resident Development Maintenance Department in charge of centrifuge maintenance; and the Chemical Operations Administration who cleaned up following centrifuge malfunctions, or "wrecks" (referred to as "wreck workers.") The study population was defined as persons in these areas of all races and sexes who had worked at ORGDP during the period of operation of the centrifuge process from the late 1960s to the mid 1980s.

**HOW WERE WORKERS IDENTIFIED FOR INCLUSION IN THE STUDY?** Workers with the largest numbers of days at risk of exposure to the centrifuge process (based on employment history) were identified for interviews. In addition, some wreck cleanup workers were chosen for interviews, bringing the total number of study subjects to 300. An equivalent number of ORGDP workers who had never worked in the centrifuge process were chosen as comparisons.

**HOW WERE INTERVIEWS CONDUCTED?** 610 workers were interviewed by phone.

**WHAT KINDS OF DISEASES DID THE STUDY COVER?** Animal studies previously indicated epoxy resin exposure as a potential factor in cancers of the liver, kidney, lung, small intestine, and bladder, as well as leukemias, reticulum cell sarcoma, lymphoma, and skin tumors. Questions were asked to determine the effects of resin exposure on fertility. Questions related to solvent exposure included occurrence of blurred vision, dizziness, tremors, irregular heartbeat, insomnia, persistent cough, wheezing, numbness or tingling of limbs, ringing of the ears, dark colored urine and difficulty swallowing.

**WHAT WERE THE RESULTS OF THE STUDY?** No difference in fertility rates. Centrifuge workers reported 12 incidences of cancer; 7 in the controls. The wreck workers reported one case of cancer (of the lung) while the wreck comparisons reported two (one prostate; one vocal cord). Other worker cancers were bladder, 5 (controls 0); breast, 1 (1); kidney, 1 (0); lung, 1 (0); lymphoma, 2 (1); melanoma, 1 (0); prostate, 1 (1).

**WERE ANY INCREASES IN DISEASE OR SYMPTOMS STATISTICALLY SIGNIFICANT?** The rate of bladder cancer in the centrifuge workers was 7 times greater than expected in the general population. Others were skin rashes, dizziness, insomnia, numb/tingling limbs, and kidney stones. Wreck workers experienced a stomach ulcer rate more than six-and-a-half times that of the control.

**WHAT WAS THE ROLE OF MANAGEMENT & LABOR IN THE STUDY?** Management and labor representatives participated in all phases of the study. The OCAWU scientific consultant, Dr. Miller, reviewed and accepted the study protocol and interview questionnaire as did Energy Systems.

**WILL THE RESULTS OF THE STUDY BE PUBLISHED?** Yes, there will be an ORAU technical report and a shorter version of the study results prepared for publication in a peer reviewed journal.

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# News Release



Oak Ridge Associated Universities  
Post Office Box 117  
Oak Ridge, Tennessee 37831-0117

FY89-38  
August 25, 1989  
FOR RELEASE AFTER 11 a.m. EDT

For more information:  
Susan Barnes  
(615) 576-3152

## HEALTH STATUS STUDY INDICATES ILLNESS INCREASE

A study on the health status of workers in the gas centrifuge process at the Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tenn., has indicated an increased rate of bladder cancer among the 263 centrifuge process workers included in the study.

The study, conducted by the Center for Epidemiologic Research at Oak Ridge Associated Universities, found five cases of bladder cancer in centrifuge process workers, while no cases were found in a control group of persons with similar demographic and work histories at the plant who had no exposure to the centrifuge process. The study results did not identify a specific agent or exposure that could be labeled as the causative factor for the increase in bladder cancer incidence.

Workers are being notified of the study results, and a meeting is scheduled for early September for ORAU researchers to present the detailed results. Study results will be prepared for publication in a peer-reviewed journal.

Follow-up medical monitoring is being planned by Martin Marietta Energy Systems medical personnel. Martin Marietta operates the plant under contract to the U.S. Department of Energy.

The study will be expanded to include all former centrifuge process workers.

Compared to rates for the disease in the general population, as estimated from national statistics, the centrifuge workers in

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the study group showed a sevenfold increase in the occurrence of bladder cancer (1.38 cases per 1000 person-years when 0.18 were expected for a group of the same age). Overall, epidemiologists found 12 cancer cases among the centrifuge process workers and seven in the comparison group.

The study, conducted by ORAU epidemiologists between August 1988 and April 1989, was undertaken at the request of Martin Marietta Energy Systems after the Oil, Chemical, and Atomic Workers Union at the Oak Ridge plant expressed concern about the number of centrifuge workers who had developed cancer.

The centrifuge process was developed at ORGDP during the mid-1960s but was abandoned by DOE in the mid-1980s as a method of enriching uranium for nuclear fuel. Special materials used in the centrifuge process included four epoxy resin systems with the chemical components 4,4-Methylenedianiline, m-Phenylenediamine, bis(2,3-Epoxypropyl)ether, and Diglycidyl Ether of Bisphenol A. Also, solvent exposure was an industrial hygiene concern.

Studies on laboratory animals have indicated a possible link between these chemicals and certain types of cancer, liver disease and reduced fertility. ORAU epidemiologists also inquired about illnesses that had been linked in laboratory studies to solvents used in the centrifuge process.

No evidence was found among the centrifuge process workers of liver disease or reduced fertility rates.

Statistically significant increases in rates for illnesses previously linked to epoxy resin or to solvent exposure included transient skin rashes, dizziness, and numb or tingling limbs. The study also revealed an unexpected increase in the occurrence of kidney stones. In addition, the workers involved in cleaning up centrifuge failures experienced an increase in stomach ulcers.

According to lead epidemiologist Dr. Donna Cragle of ORAU, further analysis showed that none of the five workers who had developed bladder cancer had any job that required routine,

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"hands-on" work with any of the epoxy resin materials.

In conducting the study, ORAU epidemiologists interviewed personnel from 10 designated centrifuge departments at the plant, as well as the Resident Development Maintenance Department in charge of centrifuge maintenance and the Chemical Operations Administration who cleaned up following centrifuge failures. Through telephone interviews, researchers obtained demographic data and specific medical histories, educational and occupational histories, and information on tobacco and alcohol use.

Using department numbers, job titles, and lists of names of medically monitored workers involved in the centrifuge process supplied to ORAU by the plant Health, Safety and Environmental Division, epidemiologists identified more than 500 centrifuge workers who were determined to have very likely been routinely exposed to the centrifuge process.

From that number, 263 workers with the largest numbers of days at risk of exposure were identified for interviews. In addition, 38 cleanup workers were interviewed. The total number of centrifuge process workers and comparison workers interviewed was 610.

Centrifuge process workers were matched with the comparison group according to date of birth, race, sex, date of hire, and presence at the plant on the day the process worker began working in the centrifuge area.

ORAU, a consortium of colleges and universities and a DOE contractor, began conducting health and mortality studies on workers employed by DOE contractors or DOE's predecessor agencies in 1977. ORAU maintains a registry of work histories and identifying data for all Oak Ridge plant workers as part of that study.

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HEALTH STUDY OF ORGDP CENTRIFUGE WORKERS  
EXECUTIVE SUMMARY

Prepared by Oak Ridge Associated Universities  
Medical Sciences Division  
Center for Epidemiologic Research  
August 15, 1989

Early in 1987, officials of the Oil, Chemical, and Atomic Workers Union (OCAWU) approached the management of Martin Marietta Energy Systems (MMES), the Department of Energy (DOE) contractor in charge of operations at Oak Ridge Gaseous Diffusion Plant (ORGDP), with concerns about the health of group of employees who had worked in the gas centrifuge process. The union leadership had become aware of at least nine cases of cancer among these workers. Some of the other former centrifuge workers were concerned that they were at increased risk of developing cancer. The union leadership requested that MMES review the information that had been obtained to determine if MMES agreed that further study was necessary.

In June 1987, MMES management requested the assistance of Oak Ridge Associated Universities (ORAU) in developing a special study to evaluate the health status of this group or cohort of employees. ORAU agreed to develop a plan (protocol) that would describe the type of study that might be done to examine the health of the cohort of centrifuge workers in terms of illness experience and cause of death. A protocol was written and MMES decided to sponsor ORAU to conduct the study. ORAU involved representatives of MMES and ORGDP management and the OCAWU in all phases of the study.

ORAU maintains computerized work history, vital status, and identifying data for all Oak Ridge workers as part of their work mission for the Department of Energy (DOE) to maintain health surveillance on

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populations of workers at active and defunct DOE sites. Use of these existing data systems expedited the start of the study.

In order to develop exposure criteria, the Health, Safety and Environmental Division at ORGDP supplied ORAU with department numbers, job titles, and lists consisting of names of workers who were medically monitored because of their association with the centrifuge process. The names of contact persons familiar with the centrifuge process and information regarding materials used were also furnished.

There were 10 designated centrifuge departments, however, personnel from several other departments were involved in various aspects of the centrifuge process. The Resident Development Maintenance Department was in charge of centrifuge maintenance and the Chemical Operations Administration was in charge of cleaning up following centrifuge malfunctions or "wrecks". Many craft personnel, including refrigeration mechanics, laborers, janitors, and carpenters, who worked in the centrifuge areas were from other ORGDP maintenance departments. However, organization charts along with department numbers for this group were not available so it was impossible to identify them for inclusion in the study.

The only unique job title for the centrifuge area was the hourly worker title of "component assembler". The other job titles were those used throughout ORGDP for hourly, weekly, and monthly employees. Since it was not possible to identify the study cohort on the basis of job title alone, a method was devised which combined job title and department code.

Lists maintained by the Medical Department identified employees who were under medical surveillance due to their potential for exposure to 4,4-Methylenedianiline (MDA), m-Phenylenediamine (MPDA),

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bis(2,3-Epoxypropyl)ether (BECPE), and Diglycidyl Ether of Bisphenol A (DGEBA), the substances which made up the resin systems used in the centrifuge process. Since these substances were suspected of being carcinogenic in animals, MMES and OCAWU were particularly concerned about the effects that exposure to them might have had on the centrifuge workers. The potential for exposure to high levels of solvents was also of concern.

In order to determine whether the centrifuge workers were different with respect to mortality (cause of death), the original study protocol called for the comparison of mortality among the centrifuge cohort with mortality in the general U.S. population and with a comparison group of other ORGDP workers. However, after the group of all centrifuge workers was identified from the ORAU data base (irrespective of level of exposure) it was determined that there was not a sufficient number of deaths in this group to do a meaningful mortality study. Although no formal statistical analysis could be performed, the causes of death are enumerated in the full version of this report.

ORAU defined the study population as all race/sex groups of employees who worked at ORGDP in centrifuge departments during the period of operation of the centrifuge process, that is the late 1960s to the mid 1980s. Also, workers in the Resident Development Maintenance Department and "wreck cleanup workers" in the Chemical Operations Administration would be included. There was some debate about whether the "wreck cleanup workers" should be part of the study population since they were exposed to a fully cured, and presumable inert, physical form of the substances of interest. After further discussion between ORAU, MMES, and OCAWU, it was agreed that their exposures were important and these workers should be included.

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Representatives from OCAWU and MMES, who are knowledgeable about the centrifuge process and the manner in which process materials were handled, ranked process job titles for the centrifuge departments in one of the following exposure categories:

- 0 - Job titles whose responsibilities and lack of access to materials and certain processes provide minimal or no likelihood of exposure to industrial types or quantities of toxic materials.
- 1 - Job titles with responsibilities which would ordinarily be expected to provide opportunity for at least intermittent exposure to industrial types and quantities of toxic materials.
- 2 - Job titles with responsibilities which would very likely provide routine exposure to industrial types and quantities of toxic materials.

A list of more than 500 centrifuge workers who ever worked in a job that was categorized as a level 2 job was compiled. The list was sorted according to the number of days of exposure in category 2 or routine exposure centrifuge process jobs. Two hundred and fifty-one workers with the greatest number of days of exposure were chosen to be interviewed. It was decided that 49 wreck cleanup workers should also be interviewed. This brought the total number of study subjects to 300. An equivalent number of workers who never worked in the departments of interest but were employed at the plant during the period of time that the centrifuge process was operational were chosen as a comparison group. These comparison workers were individually matched to the centrifuge workers according to date of birth, race, sex, date of facility hire, and presence at ORGDP on the day that the exposed worker began working in the centrifuge process.

A questionnaire was developed to collect specific demographic data and information concerning the participant's medical history, including the

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incidence of several types of cancer, educational and occupational history and information on tobacco and alcohol use. The questionnaire was reviewed by representatives of the MMES medical staff, MMES management, OCAWU representatives, and the OCAWU scientific consultant.

An Application for the Use of Humans as Experimental Subjects was submitted to and approved by the ORAU/ORNL Committee on Human Studies as is required by the National Institutes of Health and DOE for all studies involving humans. Along with the application, copies of the following documents were required: an overall study protocol, a protocol for contacting study subjects, the contact letter from OCAWU and MMES, the contact letter from ORAU, an information statement concerning the Privacy Act of 1974 which was included with the contact letter from ORAU, the study participation card and the proposed questionnaire.

The morbidity (or illness) phase of the investigation utilized telephone interviews with workers in the more highly exposed category and an equal number of matched controls from the ORGDP population. This phase addressed the question of whether the centrifuge workers had a similar incidence of cancer and attempted to determine whether the exposures had any effect on fertility. Cancers of specific interest prior to the start of the study (based on the scientific literature) included: liver cancer, kidney cancer, lung cancer, leukemias, reticulum cell sarcoma, lymphoma, skin tumors, cancer of the small intestine, and bladder cancer. Questions related to solvent exposure effects included the occurrence of blurred vision, dizziness, tremors, irregular heartbeat, insomnia, persistent cough, wheezing, numbness or tingling of limbs, ringing of the ears, dark colored urine and difficulty swallowing.

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Following the approval of the questionnaire by the Committee on Human Studies, two contact letters were mailed to each of the potential study participants. The first letter was a joint letter of support for the study from MMES and OCAWU. A few days later, ORAU followed-up with an additional letter requesting the worker's participation. Individuals agreeing to participate in the study were asked to sign a consent form stating that they understood the purpose of the study and the procedures involved. In the event that a centrifuge worker chosen to be interviewed refused to participate in the study, we contacted the next person on a list of centrifuge workers which had been sorted by length of employment in the high exposure areas. In all circumstances, the rights of the study subjects and potential study subjects were protected and their privacy was maintained.

Interviews began in August 1988 and 610 interviews were completed by April, 1989. The interview group comprised 263 centrifuge workers (CW), 271 centrifuge comparison workers (CCW), 38 'wreck' workers (WW), and 38 'wreck' comparison workers (WCW).

The exposed and comparison workers proved to be closely matched with a median year of birth of 1944 for the CW, CCW, WW, and WCW groups. The median year of hire at ORGDP was 1974 from the CW and CCW groups with a range from 1944 to 1980. The median year of hire at ORGDP for the WW and WCW groups was 1971 with a range from 1944 to 1976.

The groups showed no difference for the following demographic variables: religious background, marital status, military service, current employment status, tobacco history (including cigarettes, pipe, cigars, chewing tobacco, and snuff), and alcohol consumption history. The CCW

group had more education than the CW group with 33.6% of the group having a college education or greater compared to 17.5% for the CW group.

There did not appear to be any difference between the groups with regard to the questions related to fertility. The groups had similar distributions with respect to number of children born before entering the centrifuge program and after first exposure to the program. The number of miscarriages experienced before and after the centrifuge work experience were similar for exposed and comparison workers. Also, there was no difference in the number of stillbirths between the groups. The number of workers reporting experiencing trouble conceiving was similar between the exposed and comparison groups.

Incidence rates for all symptoms or specific diseases were calculated in each group from the date of first work in the centrifuge process until the end of the study. Each comparison worker was assigned the date of entry of the centrifuge worker to whom he/she was matched. All diseases or symptoms reported before this 'centrifuge date' were disregarded since it would be impossible for the disease or symptom to be related to an exposure that had not yet occurred.

The total number of cancers reported in each group after the beginning of work in the centrifuge process, by cancer type, is displayed in Table 1.

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Table 1. Incident Cancers in the Study Groups

Cancer	Centrifuge Worker	Centrifuge Comparison Worker	Wreck Worker	Wreck Comparison Worker
Bladder	5	0	0	0
Breast	1	1	0	0
Chest cavity	0	1	0	0
Colon	0	2	0	0
Kidney	1	0	0	0
Lung	1	0	1	0
Lung/liver	0	1	0	0
Lymphoma	2	1	0	0
Melanoma	1	0	0	0
Prostate	1	1	0	1
Vocal cord	0	0	0	1
TOTAL	12	7	1	2

A total of 12 cancers was reported by centrifuge workers versus 7 reported by centrifuge comparison workers. One cancer was reported by a wreck worker versus 2 in the wreck comparison group. The difference in total cancer incidence between the exposed and the comparison groups was not statistically significant.

Looking at the cancers on a site by site basis, the largest difference between the groups appears to be the incidence of bladder cancer. Five bladder cancers were reported in the CW group and none in the CCW group. The rate in the CW group is 1.38 per 1000 person years. The rate in the CCW group cannot be calculated because there were no reported cases. Using available statistics for age specific bladder cancer incidence rates in the general population, an expected rate for bladder cancer in the CCW group was calculated to be 0.18 per 1000 person years. Thus, the CW have greater than a seven-fold increase in risk for developing bladder cancer compared to the general population.



the CW did not appear until 1986 and after, which makes it less likely that this particular symptom was truly related to the centrifuge process since the process was virtually discontinued by that time.

Skin rashes have long been noted to be a symptom related to exposure to epoxy resin systems. The finding of a 4-fold increase is not, therefore, unexpected. The other symptoms that are increased in the CW are those that are related to high solvent exposure. These include blurred vision, dizziness, and numb and tingling limbs. Therefore, since solvent exposure was also a concern at the outset of this study, an increase in these symptoms could also serve as a confirmation of these exposures.

The finding of an increase in kidney stones in the CW group was unexpected and at this time has not been correlated with any specific centrifuge materials. More in depth analysis of the job titles and duties of these workers may reveal a biologically plausible mechanism which would explain this increase.

The bladder cancer increase needed further examination and characterization. Bladder cancer was one of the cancers of interest identified at the beginning of the study based on results of animals exposed to one of the materials utilized in the centrifuge program.

Examination of personal characteristics of the 5 workers with bladder cancer revealed that they were all smokers at one time; smoking is a known risk factor for bladder cancer, conferring a 2-fold increase in risk to present smokers. There does not appear to be any common previous exposure to known bladder carcinogens with the exception of one individual who was briefly employed in the rubber industry more than 30 years before his bladder cancer was diagnosed.

With the permission of the individuals concerned, we sought and have received histologic confirmation from hospital medical records for all of the primary bladder cancer cases.

Other factors found to be significantly correlated to the development of bladder cancer in this study included: previous military service (N=5), diabetes (N=2), and work with trichloroethylene before employment at ORGDP (N=4). These factors are not known to be risk factors for bladder cancer.

Each of the 5 bladder cancer cases agreed to be interviewed in order to determine exact job duties and plant areas of work. The interviews were conducted between August 4, 1989 and August 10, 1989. None of the five workers had any job that required routine, 'hands-on' work with any of the epoxy resin materials (MDA, MPDA, BECPE, or DGEBA). Three of the bladder cancer cases had the opportunity to pass through T-Lab although they were not routinely assigned to that area and did not come in direct contact with materials used there. Three of the workers helped with decontamination and cleanup following centrifuge malfunctions. Four workers were in close proximity to centrifuge operation areas during the time of centrifuge malfunctions.

At this time it is not possible to identify one specific agent or process that could be labeled as the causative factor for these bladder cancers.

This work was sponsored by Martin Marietta Energy Systems and performed by Oak Ridge Associated Universities under Contract No. DE-AC05-76OR00033 between the Department of Energy, Office of Energy Research and Oak Ridge Associated Universities.

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