

FINAL SURVEY REPORT:
ERGONOMICS INTERVENTIONS
FOR SHIP CONSTRUCTION PROCESSES
at
NORTHROP GRUMMAN SHIP SYSTEMS
INGALLS OPERATIONS SHIPYARD,
Pascagoula, Mississippi

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health
Division of Applied Research and Technology
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PLANT SURVEYED:	Ingalls Shipbuilding shipyard, 1000 Access Road, Pascagoula, Mississippi 39567.
SIC CODE:	3731
SURVEY DATE:	March 20-21, 2000
SURVEY CONDUCTED BY:	Stephen D. Hudock, NIOSH; Steven J. Wurzelbacher, NIOSH; Karl V. Siegfried, MEMIC; Kevin McSweeney, ABS
EMPLOYER REPRESENTATIVES CONTACTED:	as of 3/2000: Gerald St. Pé, Chief Operating Officer, Litton Ship Systems; W. Patrick Keene, President, Litton Ingalls Shipbuilding; Tim Hammerstone, Safety Engineer, Litton Ingalls Shipbuilding; Ulises Chavez, Industrial Hygienist, Litton Ingalls Shipbuilding
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Mention of company names and/or products does not constitute endorsement by the Centers for Disease Control and Prevention (CDC).

ABSTRACT

A pre-intervention quantitative risk factor analysis was performed at various shops and locations within the Ingalls shipyard in Pascagoula, Mississippi as a method to identify and quantify risk factors that workers may be exposed to in the course of their normal work duties. Several operations were identified for further analysis including: abrasive blasting, hatch assembly, pipe welding, subassembly grinding, and on-board cable pulling. The application of exposure assessment techniques provided a quantitative analysis of the risk factors associated with the individual tasks. Possible engineering interventions to address these risk factors for each task were suggested in a previous report. This report documents the subsequent actions taken to address the implementation of these interventions.

I. INTRODUCTION

IA. BACKGROUND FOR CONTROL TECHNOLOGY STUDIES

The National Institute for Occupational Safety and Health (NIOSH) is the primary Federal agency in occupational safety and health research. Since 1976, NIOSH has conducted a number of assessments of health hazard control technology on the basis of industry, common industrial process, or specific control techniques. The objective of each of these studies had been to document and evaluate effective control techniques for potential health hazards in the industry or process of interest, and to create a more general awareness of the need for or availability of an effective system of hazard control measures. Initially, a series of walk-through surveys are conducted to select plants or processes with effective and potentially transferable control technology concepts or techniques. Next, in-depth surveys are conducted to determine both the control parameters and the effectiveness of these controls. The reports from these in-depth surveys are then used as a basis for preparing technical reports and journal articles on effective hazard control measures. Ultimately, the information from these research activities will build a database of publicly available information on hazard control techniques for use by health professionals who are responsible for preventing occupational illness and injury.

IB. BACKGROUND FOR THIS STUDY

The background for this study is reported in “Preliminary Survey Report: Pre-Intervention Quantitative Risk Factor Analysis for Ship Construction Processes at Litton Ingalls Shipbuilding Shipyard, Pascagoula, Mississippi,” document number EPHB 229-15a by Hudock et al, 2000 and in “Interim Survey Report: Recommendations for Ergonomics Interventions for Ship Construction Processes at Litton Ingalls Shipbuilding Shipyard, Pascagoula, Mississippi,” document number EPHB 229-15b by Hudock and Wurzelbacher, 2001. Both of these reports are available at <http://www.cdc.gov/niosh/ergship/reports.html>.

IC. BACKGROUND FOR THIS SURVEY

The Ingalls shipbuilding facility was selected for a number of reasons. It was decided that the project should look at a variety of yards based on product, processes and location. Ingalls is one of the nation’s leading full service systems companies for the design, engineering, construction and life cycle support of major military and commercial vessels. Ingalls builds, repairs and overhauls military vessels including AEGIS class guided missile destroyers and multipurpose amphibious assault ships. Ingalls is also a primary contractor for the U.S. Coast Guard’s recapitalization effort, Project DEEPWATER, which involves the manufacture or refitting of about 90 vessels. Ingalls shipbuilding facility is considered to be a large shipyard.

II. PLANT AND PROCESS DESCRIPTION

IIA. INTRODUCTION

Plant Description: The Ingalls Operations shipyard is located on the Gulf of Mexico in Pascagoula, Mississippi. The shipyard consists of two neighboring facilities. The primary, or West Bank, facility encompasses 600 acres, including five major module assembly areas or lines. In 1988, approximately 181,000 square feet of the yard's slab area was brought under roof to facilitate pre-outfitting operations. Vessels are launched from a drydock that is about 850 feet in length and 174 feet wide.

Corporate Ties: The Ingalls shipbuilding operation is a component of Northrup Grumman Ship Systems that in turn is a subsidiary of Northrup Grumman Corporation.

Products: Ingalls shipyard is under contract to the U.S. Navy to deliver AEGIS class guided missile destroyers and amphibious transport dock ships. Additionally, the shipyard is a major contractor to the Coast Guard for new surface vessels.

Age of Plant: Ingalls original, or East Bank, facility has been in operation since 1938. The main, or West Bank, facility was opened in 1970 and has undergone a major capital expenditure program to upgrade facilities.

Number of Employees, etc: As of the date of the survey, the Ingalls facility employed a total of 10,200 workers. Of this number, 6,823 were considered production workers.

IIB. PROCESS DESCRIPTION

IIB1. Abrasive Blasting in Steelyard Process

Steel structures are blasted by employees utilizing specialized blast guns which propel steel shot or silica sand at an item at up to 100 psi, thus removing all foreign debris and pitting the steel which provides for better adherence of the paint coating to the steel. Blasters are completely covered with protective clothing including positive pressure respirators. Moderate force must be exerted to hold blast nozzle as the energy created by the steel shot or sand being propelled at a high velocity raises the nozzle.

IIB2. Shipboard Cable Pulling Process

Multiple lines of cable varying in length, size and weight are pulled by hand throughout areas of the ship. The larger cable pulls are performed by workers in groups numbering as high as 20. The size of the crew is largely dependent on the size, length, routing and final location of cable. The cable ranges in size from thin fiber optic cable to large diameter cable weighing over seven pounds per foot. Cable runs are located overhead, along bulkheads, and below deck plate level.

Installing cable requires the workers to assume a variety of postures. The awkward postures combined with the heavy exertions associated with the handling of the cable can result in musculoskeletal discomfort or injury.

IIB3. Shop Pipe Welding Process

A certain amount of assembly of piping systems is conducted in the shop area of the shipyard prior to pre-outfitting the unit on land. Pipe positioning units are provided to allow the welder to position the pipe in whichever attitude is necessary to make the weld easiest to complete.

IIB4. Panel Line Grinding Process

In the panel line, horizontal and vertical stiffeners are welded to steel plate to create subassemblies. This requires the worker to use a variety of tools including welding units, pneumatic grinders and needle guns. A complete seam weld is placed to secure the stiffener to the plate. Then grinders or needle guns are used to smooth out the weld and any weld splatter. Once the subassemblies are completed, they are combined into blocks or units.

IIB5. Manhole and Hatch Assembly Process

There are approximately three thousand manhole or hatch covers made for every vessel produced by the Ingalls shipyard. Every manhole cover must be attached to its base by bolts or studs. These studs are attached to each plate in a process called stud welding. An attachment on the stud welding gun holds the stud in the nose of the gun and an electric current is passed to the stud. The fluxed end of the stud is placed in contact with the steel plate. The stud is automatically retracted from the plate surface producing an arc. At the end of an automatically timed period, the molten end of the stud is forced against the molten metal pool on the plate resulting in the stud being securely welded to the plate. A typical manhole cover has approximately 26 studs attached to it. A worker can complete about 15 to 20 covers in a day, each worker welding about 400 to 500 studs to hatch covers each day. The stud gun weighs approximately 12 pounds.

III. CONTROL TECHNOLOGY

Possible interventions and control technologies are mentioned briefly here. A more detailed report of possible interventions has already been completed (Hudock and Wurzelbacher, 2001).

IIIA. POSSIBLE INTERVENTIONS FOR ABRASIVE BLASTERS IN THE BEACH BLAST AREA

Possible interventions for the abrasive blasters in the beach blast area include adjustable racks to hold the materials to be blasted at approximately knee to waist height. This would reduce the amount of back flexion required for the job. Racks that allow certain work pieces to be hung

would also reduce the amount of material handling that the abrasive blaster is required to perform in order to blast all sides of the material. No known action was taken by the shipyard to address this possible intervention.

IIIB. POSSIBLE INTERVENTIONS FOR SHIPBOARD CABLE PULLERS

A possible intervention for the shipboard cable pullers was the introduction of a semi-automated cable pulling system. These systems typically use a cable-pulling winch (capstan), double braided low stretch ropes, pulleys, and Teflon sheets to reduce cable friction. The ropes are attached to the end of the cable and capstan pulls at a range of speeds and in a wide range of positions. Most capstans are self-contained and allow for easy transport and set-up shipboard. The capstan pulling system may be able to be coupled with portable inline pullers that are also commercially available. Preliminary testing with similar systems aboard Navy vessels “indicate a potential for reducing cable pulling time and costs by as much as 50% with no personnel injuries” (NAVOSH website, 2000). Some interest was expressed in this intervention by members of one of the union locals, but no firm plans are known to exist to implement this intervention at any Ingalls facility.

IIIC. POSSIBLE INTERVENTIONS FOR PIPE WELDERS IN PIPE SHOP

Possible interventions for pipe welders using positioners mainly include training to optimally set the weld positioner to provide a work height that both reduces back flexion and still enables flat welding to be performed. Administrative controls are not an intended type of intervention for this project and, therefore, this particular intervention was not pursued further.

IIID. POSSIBLE INTERVENTIONS FOR GRINDERS IN THE PANEL LINE ASSEMBLY AREA

Possible interventions for grinders in the panel line assembly area include adjustable lift tables with jig tops to elevate the various subassemblies prior to grinding and needle gun operations to minimize back flexion. Process changes (e.g. weldable primer, more efficient and clean welding processes) to reduce the amount of required grinding may also be explored, but would probably require permission from the vessel’s intended owner whom, for this shipyard, is most often the U.S. Navy. Any change to Navy policy would require significant effort to enact. Therefore, the process change intervention was not implemented. No known action was taken at the shipyard to implement the intervention to supply adjustable lift tables for grinders in the panel line assembly area.

IIIE. POSSIBLE INTERVENTIONS FOR MANHOLE ASSEMBLERS IN THE EAST SIDE FABRICATION SHOP

Possible interventions for the manhole assembler in the east side fabrication shop include an adjustable lift table to set the work height of the manhole above the waist to reduce back flexion

during assembly operations. A similar arrangement may also be used to store the manhole covers prior to stud welding so that the hatch is lifted from a height that minimizes back flexion. Training in proper lifting techniques and in the setting of currently available adjustable equipment to optimal working heights may also be useful. No known action was taken at the shipyard to implement this intervention.

IV. CONCLUSIONS

Five work processes at Ingalls shipyard were surveyed to determine the presence of risk factors associated with musculoskeletal disorders. These processes included abrasive blasting in the beach blast area, shipboard cable pulling, pipe welding in the pipe shop, panel line grinding, and manhole assembly in the east side fabrication shop. In each process, certain work elements were found to be associated with one or more factors, including excessive force, constrained or awkward postures, contact stresses, vibration, and repetitive motions. However, participation in each phase of this project was voluntary and the shipyard chose not to implement any of the suggested interventions at this time.

It is suggested that further action can be taken to mitigate the exposure to musculoskeletal risk factors within each of the identified tasks. The implementation of ergonomic interventions has been found to reduce the amount and severity of musculoskeletal disorders within the working population in various industries.

Each of the interventions proposed in this document are to be considered preliminary concepts. Full engineering analyses by the participating shipyard are expected prior to the implementation of any particular suggested intervention concept to determine feasibility, both financial and engineering, as well as to identify potential safety considerations.

V. REFERENCES

- Hudock, S. D., S. J. Wurzelbacher, K. Siegfried, and K. McSweeney. 2001a. Preliminary Survey Report: Pre-Intervention Quantitative Risk Factor Analysis for Ship Construction Processes at Litton Ingalls Shipbuilding Shipyard, Pascagoula, Mississippi. DHHS, PHS, CDC, NIOSH, Cincinnati, Ohio, Report # EPHB 229-15a, August 2001, 138 pp. Available at <http://www.cdc.gov/niosh/ergship/reports.html>.
- Hudock, S. D., and S. J. Wurzelbacher. 2001b. Interim Survey Report: Recommendations for Ergonomics Interventions for Ship Construction Processes at Litton Ingalls Shipbuilding Shipyard, Pascagoula, Mississippi. DHHS, PHS, CDC, NIOSH, Cincinnati, Ohio, Report # EPHB 229-15b, August 2001, 25 pp. Available at <http://www.cdc.gov/niosh/ergship/reports.html>.

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