

FINAL REPORT



BENEFIT ANALYSIS OF SPC PANEL SP-7 PROJECTS

and

**EVALUATION OF SPC PANEL SP-7
MANAGEMENT AND ADMINISTRATION**



Prepared by
Robinson-Page-McDonough and Associates, Inc.
Post Office Box 9
Greenland, New Hampshire 03840
(603) 436-7762

For
NATIONAL STEEL AND SHIPBUILDING COMPANY
Harbor Drive and 28th Street
Post Office Box 85278
San Diego, California 92186-5278

In Behalf Of
SNAME SPC PANEL SP-7

WELDING

Under the
NATIONAL SHIPBUILDING RESEARCH PROGRAM



October 1993

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PREFACE

The National Shipbuilding Research Program has been sponsored during the past 20 years by the Maritime Administration United States Department of Transportation and by the United States Navy toward improving productivity in shipbuilding. The Program is operated through several Panels of the SNAME Ship Production Committee. During 1988 a survey was conducted in behalf of SPC Panel SP-3 on Surface Preparation and Coatings to determine (1) the benefit value that had accrued from the research projects sponsored by that Panel during the previous 15 years, and (2) how the management and administration of the Panel itself - meetings, discussions, activities - was seen by the using community. The report of this survey (NSRP 0303, July 1989) was well received. It was therefore decided to conduct a similar survey for each of the other active SPC Panels.

The survey of SPC Panel SP-7 on Welding is reported herein. The purpose of this survey was (1) to determine the type of project most beneficial in the past, and therefore most likely to yield the largest benefit in the future, and (2) to determine how the direction of Panel SP-7 itself might be improved.

The Task was conducted by Rodney A. Robinson, Vice President of Robinson-Page-McDonough and Associates, Inc. Personal interviews were conducted with several representative members of the shipyard Welding community to gain the necessary information. Conclusions and recommendations based on analysis of the findings are included in the report. The work, under NASSCO Purchase Order No. MU171117-D, began in October 1991 and was completed in October 1993.

EXECUTIVE SUMMARY

This Task has investigated the benefits derived from the projects sponsored during the past 20 years by SNAME Ship Production Committee Panel SP-7 on Welding under the National Shipbuilding Research Program. It has found that those projects that have supported direct shipyard applications and hands-on considerations, along with shipyard training activities, have yielded the most value in the shipyard community. Projects that have provided important reference information have also been beneficial.

This Task has also assessed the opinion of the shipyard using community on the administration and management of Panel SP-7 itself. It has found that the practices currently in effect have been well received, and should be continued with only minor improvements. In regard to NSRP matters in general, however, the survey has revealed major concern about the length and uncertainty of the project funding cycle. It also points out difficulties in achieving and maintaining faithful communications among Panel SP-7 participants and the members of the ECB (Executive Control Board of the Ship Production Committee of SNAME). These deficiencies should be examined and treated promptly, as the future success of the NSRP may well depend on it.

The portion of the NSRP within which Panel SP-7 is active takes on additional importance as efforts unfold to prepare our shipyard community for entry into the international commercial market. Welding considerations for Navy ships are quite different from those associated with commercial ships. The technology of construction materials, functional operating requirements, procedural training and qualifications for welders, contractual and technical testing and inspection considerations, and the unrelenting demands for lower fabrication costs and shorter construction cycles places the welding arena in a whole new light. The need for dealing with these issues is even now on our doorstep. Their timely resolution can greatly assist in achieving for our shipyard industry a favorable competitive posture in the international commercial marketplace. We are fortunate that SPC Panel SP-7 is active, available, well focused, strongly supported by dedicated professionals, and intellectually able to address these challenges.

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FINAL REPORT



BENEFIT ANALYSIS OF SPC PANEL SP-7 PROJECTS

and

EVALUATION OF SPC PANEL SP-7 MANAGEMENT AND ADMINISTRATION

BACKGROUND

General Discussion

This Project was designed: (1) to investigate the benefits that may have resulted from SPC Panel SP-7 Welding projects carried out over the past 20 years of Panel operations; and (2) to evaluate how the management of Panel SP-7 itself is currently viewed by the using community. The aim was to focus on what type of project has been most helpful in the past, and may therefore be presumed to yield the most benefits in the future, and also to explore how the activities associated with Panel SP-7 might be improved.

This Project would consist of interviews with members of the shipyard Welding community to gain information on these matters. The interviews would be on-site and face-to-face, to yield the most meaningful results. Analysis of findings would be published for principal consumption by SP-7 Panel Members toward their action on panel operations and projects in the future.

This project was a direct follow-on to a similar project conducted in 1989 in behalf of SPC Panel SP-3 to (1) explore the benefits that may have resulted from the projects sponsored by that Panel during the previous 15 years, and (2) to evaluate how the management of Panel SP-3 itself was seen by the using community. The report on that project (NSRP 0303, July 1989) was well received, prompting the development of this current project, which consists of the same kind of analyses for all other SPC Panels, as well as an update on the projects of Panel SP-3 since the original report. The report presented herein covers the area of SPC Panel SP-7 on Welding.

Overview

Information on both aspects of this effort was gained through personal and anonymous interviews with 13 members of the Welding community from 9 different shipyard locations. 13 specific and detailed responses to the questionnaire were gathered, and have been used to formulate the detailed sections of this report. The period of interviews extended from April 1992 through June 1993.

Several questions were designed to explore both aspects of this survey. The worksheets for gathering information on the benefits of individual projects are contained in Appendix A. The worksheets associated with Panel SP-7 direction are contained in Appendix B.

A detailed discussion of the findings is presented below. Those associated with the benefit analysis of panel projects begin on this page. Those associated with panel management begin on page 37. Conclusions reached from the findings are on pages 48 and 49. The recommendations drawn from these conclusions are on page 50.

BENEFIT ANALYSIS OF PROJECTS SPONSORED BY SPC PANEL SP-7

General Discussion

This section contains information on all of the SP-7 projects investigated, including a description of each project, the pertinent information surrounding that project, and an analysis of the benefit value gained from that project to date. The NSRP Number is that assigned to each report *in* the NSRP Bibliography of Publications 1973-1992, published (now annually) by the University of Michigan for the National Shipbuilding Research Program. The projects investigated are those listed in this specific publication (1973-1992). The analysis portion has been drawn from the comments offered by those interviewed, and is intended to provide a general indication of how the project has been received by the shipyard industry. It also indirectly provides the feelings of those interviewed on whether that particular type of effort should be sponsored by SP-7 in the future, since those projects with the higher benefit value might better receive the more favorable consideration. Appendix A was the worksheet used during the interviews.

The display below is intended to provide a rapid *visual* idea of the relative benefit value that has been gained from the SP-7 sponsored projects that were investigated. While these ratings are surely subjective, they represent the general opinions of those interviewed, which constitute a good cross-section of the shipyard industry in the Welding area. As such, these opinions reflect the overall industry attitude surrounding these projects, which should be of interest to SP-7 panel members during consideration of what projects to sponsor in the future. The number of *'s against each project report indicates the amount of benefit gained from it to date. The more *'s, the larger the benefit value gained.

<u>Report No.</u>	<u>Benefit Value</u>	<u>Report No.</u>	<u>Benefit Value</u>
NSRP 0039	* * * *	NSRP 0173	* * * *
NSRP 0040	* * * * *	NSRP 0182	* *
NSRP 0041	* * * * *	NSRP 0183	* *
NSRP 0044	* *	NSRP 0184	* * *
NSRP 0048	* * * *	NSRP 0195	* * * * * *
NSRP 0051	* *	NSRP 0209	* * - *
NSRP 0054	* * * * * *	NSRP 0211	* *
NSRP 0062	* * * *	NSRP 0215	* * * * *
NSRP 0063	*	NSRP 0220	* * * * * * * * *
NSRP 0072	* * * *	NSRP 0241	* * * * * * * *
NSRP 0080	* *	NSRP 0253	* * * *
NSRP 0083	*	NSRP 0257	* * *
NSRP 0085	* * *	NSRP 0261	* * * * *
NSRP 0086	* * * * *	NSRP 0262	* * * *
NSRP 0095	*	NSRP 0291	* * * * *
NSRP 0099	* * *	NSRP 0292	* * * * * *
NSRP 0110	* * * * * * *	NSRP 0297	* * * * * * *
NSRP 0112	*	NSRP 0299	* * * * * * *
NSRP 0113	* * * *	NSRP 0314	* * * * * *
NSRP 0118	* * *	NSRP 0326	* * * * * *
NSRP 0121	*	NSRP 0336	* * * * * * *
NSRP 0145	* * * *	NSRP 0338	* * * * * * * *
NSRP 0166	* * * * * *	NSRP 0339	* * * * * * * * *
NSRP 0168	* * * * * * * * *	NSRP 0343	* * * * *

Detailed Discussion of Individual Projects

Each of the individual projects investigated are discussed below in the chronological order in which they were carried out. Included is: NSRP Number; Benefit Value Rating (*'s); *TITLE*; *AUTHOR*; *DATE*; *COST*(where available); *ABSTRACT* and *BENEFIT ANALYSIS*.

NOTE: Appendix C is an abbreviated listing of these same projects (NSRP Number; *TITLE* *AUTHOR*; *DATE*; *COST*) arranged according to the benefit value (number of *'s) assigned to each project highest to lowest. Appendix C is included as an aid to understanding which types of projects were found to be of most (and least) interest and value to the using community, based on user comments received during this survey.

NSRP 0039 * * * *

TITLE: One Side Welding - Flux Development and Study of Multiple Arc Behavior.

AUTHOR: Linde Division of Union Carbide Corporation. Tarrytown, New York, for Bethlehem Steel, Sparrows Point.

DATE: 1974

COST: (Not available)

ABSTRACT: One side welding in thicknesses up to 3/4 inch had been successfully performed at the time this study was performed but there were no available American and European fluxes which could accommodate the higher currents and larger molten pool necessary for one pass welding of thicker plates. In addition to the flux problem the proper control of arc behavior with separately powered multiple arcs was also a significant problem. This publication indicates that a one side welding flux and a set of operating parameters were both successfully accomplished. The report contains information relative to flux composition, base material type and thickness, number, type and size of weld wires, type of current for each wire, volts, amps, travel speed and the mechanical properties of the welds achieved with the various combinations of fluxes and welding parameters. (126 P.)

BENEFIT ANALYSIS: MIXED VALUE. 54% of those interviewed were not familiar with this report and had no interest in this material. 38% of those interviewed were familiar with this report, and one person said that he was going to read it now. Comments indicated that this technique was tried in several shipyards with mixed results. As one person put it, this idea "did not achieve backing for shipbuilding". He went on to say that "3M still markets it but not for shipyard use". Although one of the earlier reports, this material seems to have been helpful to the shipyard community, at least as background information.

NSRP 0040 * * * * *

TITLE: Development of Extended Length Continuous Wire Feed System.

AUTHOR: Hobart Brothers, Troy, for Bethlehem Steel, Sparrows Point.

DATE: May 1974

COST: (Not available)

ABSTRACT: The objective of this project was to develop a semi-automated welding system with appropriate hardware to permit an operator to weld over 200 feet away from the source of both power and electrode with a gun and cable light enough to provide flexibility comparable to that of manual welding with stick electrode. The publication claims to have accomplished the objective, based on field tests made by Hobart Brothers Company and Bethlehem Steel's Sparrows Point Shipyard. (128 p.)

BENEFIT ANALYSIS: MIXED VALUE. 62% of those interviewed were not familiar with this report and had no interest in this material. The rest of those interviewed were familiar with this report. Representatives from two different shipyards indicated actual use of equipment based on this process. Others said that this: "did not work very well"; "had no application because the equipment became too large and bulky for shipyards"; and "had problems with the early wire feeders". It appears that this research was helpful to the welding industry, even though it was of mixed advantage to shipyards.

NSRP 0041 * * * * *

TITLE: Development of a Portable AC/DC Welding Power Supply Module.

AUTHOR: Celesco Industries, Inc., for Bethlehem Steel, Sparrows Point.

DATE: June 1974

COST: (Not available)

ABSTRACT: This publication describes the development of an AC/DC power supply capable of the following: supply 250 amps of welding current for AC-SMAW welding within that power requirement provide a minimum DC welding current of 250 amperes of parallel connected with other modules to provide up to 1000 amperes DC for SMAW and SAW, and the primary module or combination of the primary module to be designed to support shipyard production welding. This program was partially successful. (75 p.)

BENEFIT ANALYSIS: MIXED VALUE. 85% of those interviewed were not familiar with this report and had no interest in this material. Comments by the rest of those interviewed suggest that this project “was the driving force for inverters - the big thing out there now”. Although not successful at the time due to unacceptable arc characteristics, “today every shipyard has machines based on this initial try”. One person commented that “SP-7 is still trying to get a good unit as evidenced by it being priority #5 in the current crop of abstracts”.

NSRP 0044 * *

TITLE: Applicability of Laser Welding to Ship Production, Volume 1.

AUTHOR: United Aircraft Research Laboratories, for Bethlehem Steel, Sparrows Point.

DATE: August 1974

COST: (Not available)

ABSTRACT: The objective of this project was to determine the present state of the art concerning laser applications to welding and curing processes with a view toward adapting this new technology to shipyard production operations. The results of this feasibility study appear to warrant further investigation of the laser welding parameters in greater depth. Destructive and nondestructive tests and analysis of the results clearly indicate that laser welding can meet shipbuilding specifications. (51 p.)

BENEFIT ANALYSIS: LOW VALUE. 62% of those interviewed were not familiar with this report and had no interest in this material. The remaining 38% commented that “this was not cost-effective for shipyards”; “this was worthwhile, but not of much benefit”; “other disciplines (burning, fitting) limit the application before it gets to the welding process”; and “this was a good definition of constraints and problems”.

NSRP 0048 * * * *

TITLE: Toughness Evaluation of Electrogas and Electroslag Weldments.

AUTHOR: American Bureau of Shipping, for Bethlehem Steel, Sparrows Point.

DATE: March 1975

COST: (Not available)

ABSTRACT: These high deposition, more uniform and better appearing welds are achieved primarily by higher heat input and slower travel speed and at substantially lower cost than shielded metal arc welding. Unfortunately, these same attributes adversely affect the toughness properties of the weld and the heat affected zone (HAZ). The primary objective of the program was to develop a basis for relaxing some of the then current limitations on the applicability of these processes to commercial shipbuilding. Results of the program indicate several areas of information which should prove helpful in developing technology to extend the use of these processes in commercial shipbuilding. The information contained in this publication is pertinent and applicable today in commercial shipbuilding. (130 p. approx.)

BENEFIT ANALYSIS: MIXED VALUE. 46% of those interviewed were not familiar with this report and had no interest in this material. Two people were reading the report now, in light of renewed interest in commercial shipbuilding for the international commercial market. Comments by those familiar with the report were "we used electroslag back then, but not now"; "if this process had been widely used, my shipyard would have been supported by this information"; "we had some use of this on tankers in the mid-80's"; and "who knows what impact the international commercial market might have here".

NSRP 0051 * *

TITLE: Applicability of Firecracker Welding to Ship Production.

AUTHOR: Battelle-Columbus Laboratories, for Bethlehem Steel, Sparrows Point.

DATE: July 1975

COST: (Not available)

ABSTRACT: The objective of this project was to develop the procedures, facility requirements, consumables and general specifications for the application of firecracker welding to shipyard fabrication. Based on a list of fifteen constraints regarding the results of this study, firecracker welding is considered a workable procedure for use in shipyards. (120 p.)

BENEFIT ANALYSIS: LOW VALUE. 85% of those interviewed were not familiar with this report and had no interest in this material. The remaining 15% were familiar with the report contents, but no instances of application were cited. One person said that this was an "old process that has been abandoned". Another said that this information "did not go anywhere, but was worthwhile research and development because it was the forerunner of present practices". A third person said that this process was used in Japan but not in the United States. He added that it was only for commercial ships, and that it had no Navy application.

NSRP 0054 * * * * *

TITLE: Plasma Processes of Cutting and Welding.

AUTHOR: Linde Division of Union Carbide Corporation, Tarrytown, New York for
Bethlehem Steel, Sparrows Point.

DATE: February 1976

COST: (Not available)

ABSTRACT: This program was concerned with applying to the shipbuilding industry the latest technology in high speed shape cutting machines, plasma welding and plasma cutting. The following objectives have been accomplished as set forth in the original proposal: establish cutting conditions for alloys and thicknesses representative of an ABS steel ship; calculate cutting costs based on cutting conditions, known consumable usage rates, and representative labor costs; compare plasma cutting costs to those for standard and high speed oxy-gas cutting nozzles on a cost-per-foot basis; visit several shipyards to determine potential plasma cutting and welding applications, and investigate the mechanism of dross formation in plasma cutting of mild steel; and establish general guidelines for reducing dross formation by studying the influence of plate chemistry, surface condition and process parameters. This report presents the results of those investigations. (83 p.)

BENEFIT ANALYSIS: MIXED VALUE. 62% of those interviewed had no knowledge of this report and no interest in this material. 31% were familiar with this research, which one person called "a rudimentary study of the process which provided good information". Another said that his shipyard "does plasma cutting expensively, which could be an outgrowth of this research". This was "a new idea in 1976". Now plasma cutting is used extensively throughout the shipyard community, although one shipyard representative said that "we still cannot bevel". No specific instances of plasma welding were cited, however.

NSRP 0062 * * * *

TITLE: Development of an A11 Position Automatic Welding Machine.

AUTHOR: M. T. Gilliland Company, for Bethlehem Steel, Sparrows Point.

DATE: December 1976

COST: (Not available)

ABSTRACT: The objective of this project was to develop a welding machine capable of making continuous fully automatic welds on traverse butt joints economically any place on the shell of a ship. The objective was accomplished by the development of a machine capable of propelling and controlling the welding heads. This publication describes this machine. (88 p.)

BENEFIT ANALYSIS: MIXED VALUE. 54% of those interviewed were not familiar with this report and had no interest in this material. 31% were familiar with this material, but intended no application of the findings. One shipyard representative said that this equipment "was designed for commercial ships, and was used in several shipyards successfully". Two other shipyard representatives were less enthusiastic, however. One said "we have two units, but they do not work well". The other said "it depends on the quality of the weld preparation and fitup to be economical". Three people pointed out that the M. T. Gilliland Company uses this technique, and that this research produced good reference information. One person said that "by 1976 we had machine welding equipment that was capable of producing continuous butts", adding that "Gilliland power supplies were used".

NSRP 0063 *

TITLE: High Metal Deposition Per Ampere.

AUTHOR: Linde Division of Union Carbide Corporation for Bethlehem Steel, Sparrows Point.

DATE: 1977

COST: (Not available)

ABSTRACT: The objective of this program was to evaluate a number of commercially available "high metal deposition per ampere" welding materials and processes. In addition to the evaluation of commercially available processes, several experimental high deposition efficiency electrodes were evaluated. All materials and processes are being considered for their potential use in shipyards. The effective utilization of these systems/materials is the key to their successful application for specific weld joints. (38 p.)

BENEFIT ANALYSIS: LOW VALUE. 69% of those interviewed were not familiar with this report and had no interest in this material. 23% were familiar with this research, but intended no application of the findings. One person said that he had just requested a copy of the report. One person said that this report was "a fundamental study", adding that "some shipyards have used it, but we have not". Another shipyard representative said that this research "looked beyond the additives of powder". No specific instances of application were cited, however.

NSRP 0072 * * * *

TITLE: High Metal Deposition Welding, Volume I and II (Expanded version of NSRP 0063).

AUTHOR: TAPCO International, for Bethlehem Steel, Sparrows Point.

DATE: December 1978

COST: (Not available)

ABSTRACT: The objective of this project was to develop a machine capable of utilizing the process of automatically dispensing iron powder in a butt weld joint welded from one side with ceramic backing. The machine must be able to pass through a 10 x 4 inch opening. The objective was accomplished and this publication describes the development of the machine and the welding procedure developed for the machine. (51 p.)

BENEFIT ANALYSIS: MIXED VALUE. 62% of those interviewed were not familiar with this report and had no interest in this material. 31% were familiar with the report, and half of them cited specific applications in their shipyards. One other person had just requested a copy of the report. This research was directed at commercial ship applications, since "it was not for high yield steels".

NSRP 0080 **

TITLE: Dynamic Tear Test Correlation with Explosion Bulge Test at the Same Temperature.

AUTHOR: American Bureau of Shipping, for Bethlehem Steel, Sparrows Point.

DATE: January 1979

COST: (Not available)

ABSTRACT: Dynamic Tear Test (DT) performance of weldments was compared to explosion bulge test performance at the same temperature. The applicable sections in the report "Toughness Evaluation of Electrogas and Electroslag Weldments" were revised to include the additional data and analysis for a further toughness estimate. (33 p.)

BENEFIT ANALYSIS: LOW VALUE. 69% of those interviewed had no knowledge of this report and no interest in this material. 23% were familiar with this research but intended no application of the findings. One person said "I am getting it now". One person said that this was a test program to compare two different tests, but that the results were inconclusive. Another person said that this was a follow-on to the electroslag evaluation (NSRP 0048), but specifically "for the military side".

NSRP 0083 *

TITLE: Investigation of Welding Processes for Low Temperature Applications.

AUTHOR: American Bureau of Shipping, for Bethlehem Steel, Sparrows Point.

DATE: January 1979

COST: (Not available)

ABSTRACT: The primary objective of this project was to evaluate and determine the lower temperature limits of satisfactory explosion bulge performance of the Manual Metal Arc (MMA) and Submerged Arc (SAW) weldments of Grade CS and EH 36 material with a view toward determining their usefulness for low temperature service applications. (28 P.)

BENEFIT ANALYSIS: LOW VALUE. 77% of those interviewed had no knowledge of this report and no interest in this material. The remaining 23% were familiar with the report, but no applications of the results were cited. One person said that this was a fundamental study for ABS construction which provided data for higher productivity processes. Another person called this “groundwork for the LNG’s”.

NSRP 0085 * * *

TITLE: Applications of Plasma Arc to Bevel Cutting.

AUTHOR: Hypertherm, Inc., for Bethlehem Steel, Sparrows Point.

DATE: 1979

COST: (Not available)

ABSTRACT: This report describes the plasma process for bevel cutting including the following: types and use of equipment, techniques for square cutting, single, double and triple torch beveling, environmental considerations, and economics. (62 p.)

BENEFIT ANALYSIS: LOW VALUE. 54% of those interviewed were not familiar with this report and had no interest in this material. Two people said that they would get the report and read it now. The remaining 31% offered several comments on this material, as follows: “We do lots of plasma arc beveling, but we have done it independently of 0085”; “We do this at our shipyard, but I don’t know of any convention for it”; “Hypertherm is the ‘leading edge’ company for plasma arc on heavy equipment”; “We have done some work with Hypertherm, but there is no connection to this report”; “This is a follow-on to an earlier plasma study, but we still have no bevel capability and do cutting only”. It appears that this report captured the pertinent information available at that time, but that direct application of this material took place independently of the report itself.

NSRP 0086

* * * * *

TITLE: Mechanized Gas Metal Arc Welding of Light Plate.

AUTHOR: M. T. Gilliland Company, for Bethlehem Steel, Sparrows Point.

DATE: February 1979

COST: (Not available)

ABSTRACT: The objective of this project was to develop a prototype mechanized gas metal arc welding machine complete with motorized carriage, torch holders and related accessories to consistently and reliably weld butts and fillet welds on mild steel and aluminum sheets ranging from 0.119" to 0.188" and plates ranging from 0.188" to 0.625". This report describes the machine's specifications, design, operational tests, and the results of those tests. (49 p.)

BENEFIT ANALYSIS: MIXED VALUE. 69% of those interviewed were not familiar with this report and had no interest in this material. One person said that he would get the report and read it now. The remaining 23% were familiar with the report, and cited implementation of this capability at several shipyards. This research was to develop "another portable machine" for light plate. One shipyard representative said that they do not use Gilliland equipment for light plate, while another shipyard representative cited extensive use of it. Two others said that they simply had no application for this equipment.

NSRP 0095 *

TITLE: Applicability of Laser Welding to Ship Production, Volume II.

AUTHOR: United Aircraft Research Laboratories, for Bethlehem Steel, Sparrows Point.

DATE: December 1979

COST: (Not available)

ABSTRACT: This report describes an experimental laser welding investigation which was conducted on ship steel and was directed toward evaluation of practical aspects of laser welding in a shipyard environment. This was a follow on program to previous flat position laser welding tests carried out under optimum joint cleanliness and fitup conditions. In this program welds were formed with non-perfect fitup between plasma cut surfaces and between surfaces deliberately mismatched to provide a varying joint gap, and under out of position welding conditions. (25 p.)

BENEFIT ANALYSIS: LOW VALUE. 69% of those interviewed were not familiar with this report and had no interest in this material. The remaining 31% were familiar with the report but their comments were not supportive of it. One said that "this was not very useful, except for a negative result". Four people tied it to NSRP 0044 as a "revisit" of laser welding, with one person adding that "it defined problems".

NSRP 0099 * * *

TITLE: Property and Productivity Improvements in Electroslag and Electrogas Welding.

AUTHOR: Material Sciences Northwest Inc., for Bethlehem Steel, Sparrows Point.

DATE: January 1980

COST: (Not available)

ABSTRACT: This report describes automatic vertical welding in the electroslag and electrogas modes with the addition of powdered metal filler. Flux-cored and metal powder cored electrodes are evaluated in both modes. Also weldment mechanical properties for procedures employing metal powder filler are given. (96 p.)

BENEFIT ANALYSIS: LOW VALUE. 69% of those interviewed were not familiar with this report and had no interest in this material. One person said that he would look at it now. This was "a fundamental material study that produced some data for commercial ship processes". No specific instances of application were cited, but representatives from two different shipyards thought that they might have had some application of it. The shipyards doing military work simply had no application for this information.



NSRP 0110 * * * * *

TITLE: Ceramic Weld Backing Evaluation.

AUTHOR: Offshore Power Systems, for Bethlehem Steel, Sparrows Point.

DATE: June 1980

COST: (Not available)

ABSTRACT: The objective of this program was to establish if ceramic tiles backing in flux cored arc welding (FCAW) and submerged arc welding (SAW) butt weld applications could provide visually acceptable weldments such as welded back side contours requiring no cosmetic grinding repair, and volumetrically acceptable weldments requiring no grinding and welding repair. (104 p.)

BENEFIT ANALYSIS: HIGH VALUE. Although 54% of those interviewed had no knowledge of this report and no interest in this material, the rest found this research quite useful. One person said that "this was the best project in 20 years for ceramic weld backing". Another said that "this was a basic study that is still referenced in the literature, an excellent piece of work". He added that "now everybody is implementing ceramic backing". This information was "used as a reference for an article in the Welding Journal in 1980". Representatives from three different shipyards said that they were successful with ceramic backing before this report was published, with one person adding "there was no need for it because we were successful in doing it already". This rather parochial comment was the only negative one offered, however.

NSRP 0112 *

TITLE: The Development of a Composite Consumable Insert for Submerged Arc Welding.

AUTHOR: IIT Research Institute, for Bethlehem Steel, Sparrows Point

DATE: August 1980

COST: (Not available)

ABSTRACT: The objective was to develop a joint design and modified submerged arc welding process that would enable full penetration welding from one side. The modified process would eliminate that need for repositioning of the plate. The concept devised was to develop a flux filled composite wire structure that could be used as a preplaced insert or backing strip to support the molten puddle during welding and enable formation of a sound root area reinforcement. As a backing strip, the composite could be easily removed after welding by light grinding. (17 p.)

BENEFIT ANALYSIS: LOW VALUE. 77% of those interviewed were not familiar with this report and had no interest in this material. The rest did not cite any application of this information. One person said that this research "involved a different concept with small scale tests", adding that "no shipyard has implemented it in the real world".



NSRP 0113 * * * *

TITLE: Extension of E7024 Electrode Application in Shipbuilding.

AUTHOR: American Bureau of Shipping, for Bethlehem Steel, Sparrows Point.

DATE: August 1980

COST: (Not available)

ABSTRACT: The primary objective of this project was to determine the extent to which use of AWS type E7024 electrodes could be broadened in regard to fillet welding applications with particular emphasis on single pass fillet welding. The secondary objective was to determine the extent to which use of AWS E7024 electrodes could be broadened in regard to unlimited use for fillet and butt welding in Grades A, B, D, DS, AH and DH steels. (39 p.)

BENEFIT ANALYSIS: MIXED VALUE. 77% of those interviewed were not familiar with this report and had no interest in this material. Only one shipyard representative cited current use of this electrode. Comments on this report were interesting, however. One person said "We should let the (academic) research people investigate (this area) with the filler metal people". Another said that this project was done "to satisfy questions in interfacing with ABS for higher productivity on commercial ships". A third person said that "ABS put this out", adding that "they already knew the outcome". He went on to say that "They did not like E7024 in strength applications, and this project was an attempt to change their minds".

NSRP 0118 * * *

TITLE: Self-Shielded Flux-Cored Wire Evaluation

AUTHOR: Offshore Power Systems, for Bethlehem Steel, Sparrows Point.

DATE: December 1980

COST: (Not available)

ABSTRACT: The primary objectives of this project were to evaluate the state-of-the-art adaptability of gasless flux cored wire to the shipyard environment and to evaluate the deposited weld metal mechanical and toughness properties. A secondary objective was to provide a measure of process cost evaluation via a deposition rate comparison between gasless and flux cored wires and E7108 electrodes in flat and vertical positions. (95 p.)

BENEFIT ANALYSIS: LOW VALUE. 69% of those interviewed had no knowledge of this report and no interest in this material. Two people said that they would get the report and read it now, with one of them saying "we do this now, and this would be a good paper to review the process". Comments by those familiar with the report were "we have this, but not in response to O 118"; "this did not have the mechanical properties required for shipyard application"; "fume generation makes it of no interest"; and "this is the early stages of a new welding process that already has some uses".

NSRP 0121 *

TITLE: Proceedings of First Conference on Fitness-For-Service in Shipbuilding.

AUTHOR: Leslie W. Sandor, ed.

DATE: January 1981

COST: (Not available)

ABSTRACT: This report contains the proceedings of the conference on Fitness-for-Service in Shipbuilding sponsored by SP-7. The purpose of the conference was to generate U. S. shipbuilding policy on New Weld Acceptance Standards. Included are synopses of the 14 speakers' addresses to the conference, conclusions and recommendations, and a list of conference delegates. (62 p.)

BENEFIT ANALYSIS: LOW VALUE. 38% of those interviewed were familiar with this report, with one other person saying that he would get the report and read it now. Comments offered were as follows: "industry has been slow to respond ...". "no regulatory bodies are looking at it"; this is good information, but the regulatory agencies do not want to take the risk"; "lots of work was done to develop better weld acceptance standards which ABS might allow some day, but not the Navy". One person indicated that he was an anchor/presenter at the conference, while another person said "I would have liked to attend".

NSRP 0145 * * * *

TITLE: SMAW Ceramic Weld Backing Evaluation - Final Report.

AUTHOR: Offshore Power Systems, for Newport News Shipbuilding.

DATE: March 1982

COST: \$54,300.

ABSTRACT: Representative ceramic weld backing systems were evaluated with several SMAW process variations to determine their efficacy to produce volumetrically sound root beads and visually acceptable back bead weld contours not requiring consequent back side welding or repair. Ceramic tile backing was found to bring the use of open root low hydrogen SMAW within the realm of practicality. Operator training and/or retraining was found to be especially critical. Special technique considerations were necessary to assure soundness in restart areas. Chevron porosity and piping was much less frequent than in FCAW. Ceramic tile backing was additionally found promising with cellostic type (i.e., E6010) electrodes. Promising joint designs, parameters and techniques were identified for SMAW over ceramic backing. (56 p.) (Project identified as 7-80-5.)

BENEFIT ANALYSIS: MIXED VALUE. 54% of those interviewed were not familiar with this report and had no interest in this material. Comments by those familiar with this report were mixed. One shipyard representative said "this is used heavily at our shipyard", while another said "this is not the best way to do it". Other comments were "this project tried to extend ceramic to SMAW, but did not achieve the objective . . . some equipment was developed, but it still never got there"; "we had already investigated this area . . . it was so critical that we could not apply it"; "this could not meet Navy requirements"; "it is limited in application . . . we tried it on aluminum with poor results"; "specific shipyards asked for this project which answered some questions, but no shipyards have used it"; "this project worked with the electrode manufacturer on craters near welds . . . some hot start equipment was developed". It appears from the wide variety of comments that industry reception of this research was indeed mixed.

NSRP 0166 * * * * *

TITLE: Acceptance Standards for Nondestructive Test Not Required by Classification -
Phase L

AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.

DATE: March 1983

COST: (Not available)

ABSTRACT: The objective of Phase I of the project was to determine the quality of welds in existing ships that had proven satisfactory and use this information as a basis for developing appropriate guidance for nondestructive testing criteria for locations outside classification requirements. The quality of submerged arc (SAW) deck welds in 18 ships built between 1943 and 1973 were evaluated by ultrasonic inspections. Their relationship to an existing ABS Rule and a tentative guideline were determined. (20 p.)

BENEFIT ANALYSIS: MIXED VALUE. Although 62% of those interviewed were not familiar with this report and had no interest in this material, this project appears to have provided an information resource not available previously. Representatives from two different shipyards cited substantial application of this material, while another indicated limited application of it. One person said that the ABS NDT book resulted from this research. Clearly, this project established a database of information for researchers that has been useful in setting acceptance standards for ABS work.

NSRP 0168

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TITLE: Visual Reference Standards for Weld Surface Conditions, Phase I.

AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.

DATE: April 1983

COST: \$30,000.

ABSTRACT: Samples were produced illustrating three types of weld surface conditions at three levels of severity in butt and fillet welds. The samples can be related to existing descriptive acceptance standards used in the marine industry, and could form the basis for a guide for the evaluation of weld surface conditions which could be applicable to various structural and pressure vessel requirements of the marine industry. The use of such illustrations, replicated as plastic models, could reduce the frequency of making physical measurements of weld surface conditions, and also reduce the subjective considerations in evaluating weld surfaces. This phase of the project covers the conditions of cluster porosity, scattered porosity, and undercut. (31 p.) (Project identified as 7-80-3.)

BENEFIT ANALYSIS: HIGH VALUE. Only 15% of those interviewed were not familiar with this report and had no interest in this material. The rest gave this project high marks, with one person commenting that it is "perhaps the best project that SP-7 ever did". Other comments were quite extensive, and praised the educational value of this material, as follows: "This provided for pre-weld, in-process, and post-weld inspection training"; "We used the photographs even before the replicas arrived"; "Used in training extensively"; "This is an excellent report done by an ABS person . . . it has three levels of samples . . . they will not use it for acceptance standards, not even for accept/reject so its usefulness is limited"; "This project was 7 years in development . . . if the Navy would buy the ones that have the least acceptable product, then we would be in better shape financially"; "This is worthwhile, but the introduction of it to regulatory bodies and customers is an uphill battle". Clearly, this report has been well received, even though its application appears limited to training matters.

NSRP 0173 * * * *

TITLE: Study Mission to Japan - Trip Report.

AUTHOR: Bruno L. Alia Benjamin C. Howser, C. L. Null, and R. K. Richie.

DATE: July 1983

COST: \$20,604.

ABSTRACT: This report presents the observations of four members of the SNAME/SPC Welding Panel SP-7 during a study mission to Japan to investigate welding and welding technology in Japanese shipyards. (77 p.) (Project identified as 7-SP-4.)

BENEFIT ANALYSIS: MIXED VALUE. 46% of those interviewed had no knowledge of this report and no interest in this material. Another 46% were familiar with the report but did not cite any application of the material except as reference information. One person indicated that the material had been applied substantially in his shipyard. Comments were mixed, however, and ranged from "Little use to real shipyard applications" to "Extremely valuable report as a benchmarking effort . . . discussions of it in SP-7 meetings were excellent".

NSRP 0182 **

TITLE: Unimation "Apprentice" Welding Robot for Shipyard Application.

AUTHOR: Todd Pacific Shipyards Corporation, Los Angeles Division,
for Newport News Shipbuilding and Dry Dock.

DATE: December 1983

COST: \$105,000.

ABSTRACT: The overall objective of this study was to evaluate the applicability of the portable Unimation Apprentice Welding Robot for the shipbuilding industry. This evaluation was then to serve as a guide for introducing this technology into shipbuilding with an expected increase in productivity. The anticipated result was to have a base of information which shipbuilders might use to further the application of flexible welding automation in shipbuilding. Unfortunately, because of events discussed in this report the planned progress to meet the objectives experienced setbacks. The SP-7 Panel therefore thought it best to cancel this study before the objectives could be reached. (42 p.) (Project identified as 7-80-1.)

BENEFIT ANALYSIS: LOW VALUE. 46% of those interviewed had no knowledge of this report and no interest in this material. One other person said he was going to read it now. Another 46% were familiar with the report but only person cited limited application of the material in his shipyard. Comments were generally negative, but also suggested some benefit had been derived from this research. "This was a 'bust', but we did learn from it". "We looked at the same robot, but it never panned out". "This was the first robot in American shipbuilding . . . it showed what could/could not be done . . . good lessons were learned from it".

NSRP 0183 * *

TITLE: Cincinnati Milacron T3 Robot for Shipbuilding Welding.

AUTHOR: Todd Pacific Shipyard Corporation, Los Angeles Division,
for Newport News Shipbuilding and Dry Dock.

DATE: January 1984

COST: \$54,000.

ABSTRACT: The purpose of this report is to aid in the formulation of laboratory programs reflecting customer's needs, and effectively communicate the considerations/issues to appropriate levels of management. This report documents the rationale for strong/weak points, deficiency notices, and offers what is believed to be an improvement in reference to operational performance of the robot and its work station (compliance with functional requirements), and degree of usefulness of the arc welding robot system in the shipbuilding industry. (79 p.) (Project identified as 7-SP-3.)

BENEFIT ANALYSIS: LOW VALUE. 54% of those interviewed were not familiar with this report and had no interest in this material. One other person said he was going to read it now. The remaining 38% were familiar with the report, but only one shipyard representative cited application of the material. Comments were generally negative, as with NSRP 0182 above, but one person seemed to place this research in its proper context. He commented: "This was the second step in robotics technology . . . one shipyard bought it and used it . . . today many shipyards have robots, ours included".

NSRP 0184 * * *

TITLE: Out-Of-Position Welding of 5000 Series Aluminum Alloys Using
Pulse GMAW Power Sources.

AUTHOR: Todd Pacific Shipyard Corporation, Seattle Division,
for Newport News Shipbuilding and Dry Dock.

DATE: January 1984

COST: \$100,000.

ABSTRACT: This report describes the weld test work conducted during the development of welding procedure qualification data welding techniques and welding procedure specification relative to full penetration one-side, out-of-position manual pulsed gas metal arc butt welding of 5000 series aluminum alloy sheets and plates for maritime fabrication. (332 p.) (Project identified as 7-82-5.)

BENEFIT ANALYSIS: LOW VALUE. 69% of those interviewed had no knowledge of this report and no interest in this material. Representatives from two different shipyards cited use of this material for procedural development. A third shipyard representative indicated extensive welding of aluminum, but "without 0184". This was a comprehensive study of this area that produced "lots of answers on how to weld aluminum".

TITLE: Study of Fitting and Fairing Aids of U.S. Shipyards.

AUTHOR: Todd Pacific Shipyard Corporation, Los Angeles Division,
for Newport News Shipbuilding.

DATE: August 1984

COST: \$100,000.

ABSTRACT: *This document* is an attempt to list and categorize fitting and fairing aids used in the U.S. shipbuilding industry. It also provides implementation rationale for a select group of aids which are considered highly effective. This document was written for shop and area managers, foremen, and engineers interested in methods and devices for handling, fitting, and fairing problems developed by their counterparts throughout the industry. The need for greater accuracy, and the reduction for the need of these methods, must be emphasized. Fitting and fairing must be performed to increase production and this can be achieved through the use of fitting to support welding, and by avoiding dependence on welding to compensate for inaccurate fitting. (55 p.) (Project identified as 7-80-4.)

BENEFIT ANALYSIS: MIXED VALUE. 62% of those interviewed were familiar with this report. Application of at least some of this information was cited by representatives from five different shipyards. Comments were generally positive, such as: “moderately valuable”; “used some at our shipyard”; “very beneficial, used by our fitting department for fitting/fairing methods”; “we have not adopted all of it, but some parts are useful and have been incorporated into our shipfitting aids handbook”. This was “a survey study of what tools were being used, and which were effective/not effective . . . for reference information only”. The high percentage of “users”, however, suggests that this research was valuable.

NSRP 0209 * * *

TITLE: Higher Strength Steels Specially Processed for High Heat Input Welding.

AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.

DATE: February 1985

COST: \$34,500.

ABSTRACT: A study was completed to test improved heat affected zone (HAZ) toughness characteristics of ABS Grade EH36 steel plates welded with electroslag high heat input welding processes. It was found that ABS Grade EH36 steel plates specially formulated and produced with advanced metallurgical techniques have significantly greater resistance to weld heat affected zone degradation than conventional EH36 steel plates. Welds made in ABS Grade EH36 steel with electroslag welding at high heat input rates retained adequate toughness in the heat affected zone at -4 degrees F (-20 degrees C). Similar welds in conventional EH36 steel exhibited excessive HAZ toughness loss. These conclusions were confirmed on the basis of Charpy V-notch and large scale explosion bulge testing. In view of their superior resistance to HAZ degradation, ABS Grade EH36 steels should be useful for applications where HAZ degradation is of concern, such as for ABS, Coast Guard, and International Maritime Organization (IMO) weld requirements for Liquefied Natural Gas Carriers. (53 p.) (Project identified as 7-SP-5.)

BENEFIT ANALYSIS: LOW VALUE. 46% of those interviewed were not familiar with this report and had no interest in this material. One other person said he was reading it now. From the 46% who were familiar with this report, only one cited limited use of this information. Comments revealed that this research was "interesting", but seems to have quite limited application potential. As one person put it "This project provided a look at ABS grades of steels to see what happens . . . commercial applications . . . data for ABS". This general feeling prompted one other person to say "People doing this type of investigation should do the research and stay in touch but until we are ready to implement it is not NSRP stuff".

NSRP 0211 **

TITLE: Evaluation of an Automatic Seam Tracking/Adaptive Control Welding System
for Shipyard Applications - Phase 1 Report.

AUTHOR: General Dynamics, Electric Boat Division, for Newport News Shipbuilding.

DATE: February 1985

COST: \$70,000.

ABSTRACT: An automatic seam tracking/adaptive control welding system, the M-1000, was evaluated by weld testing, using the vertical position high heat input pulsed gas metal arc welding process. During the course of the evaluation period numerous hardware and software modifications were made by the machine designer/builder, CRC Automatic Welding, in response to Electric Boat suggestions. Significant improvements were made in bead shape and size, and in the automatic selection of the type of bead required and in the parameters to use as a function of the prevailing groove technology. It was concluded that the through-the-arc concept of seam tracking/adaptive control used by the M-1000 was a viable technology and potential savings in welding time may be possible if the M-1000 could be made competitive with current mechanized systems in terms of weld quality and bead size deposited. (82 p.) (Project identified as 7-82-3.)

BENEFIT ANALYSIS: LOW VALUE. 54% of those interviewed were not familiar with this report and had no interest in this material. The remaining 46% were familiar with this research, but no application of the findings was cited except at GD/EB. It appears that this project was developed for a specific military application. The research produced “major problems, but gave a *good* assessment of potential . . . it was too expensive, however”. One person commented that this research was valuable, because “how to apply this in commercial work is active now . . . there is a BMP for seam tracking and adaptive control . . . now it is being considered for one-sided welding”. Another person commented that this looked at “how to weld where fits are inconsistent . . . it found that tools available on the market do not suit the needs . . . and they still don’t”. A third person said “you don’t know until you try it . . . we had to do a related study on tip life and tip selection due to the problems encountered . . . but it is valuable as reference information for use in related initiatives”.

NSRP 0215 * * * * *

TITLE: Acceptance Standards for Nondestructive Test Not Required by Classification (Phase II).

AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.

DATE: June 1985 *COST:* \$46,500.

ABSTRACT: The objective of Phase II was to determine the quality of manual welds made in the vertical position and additional automatic submerged arc welds made in the flat position, in ships that had proven satisfactory in service, and compare these results with those obtained in Phase I (automatic submerged arc welds made in the flat position). To accomplish this, ultrasonic examinations were made of side shell weld intersections in twenty ships built during the 1943-1976 period. (16 p.) (Project identified as 7-SP-2.)

BENEFIT ANALYSIS: MIXED VALUE. Although 69% of those interviewed had no knowledge of this report and no interest in this material, half of the rest cited substantial application of this material in their shipyards. This was "a look at old welds not inspected earlier to provide data for research people". One person commented that "this became a book", while another said that "ABS was the main beneficiary". This project provided basic research information which at least two shipyards have found valuable.

NSRP 0220 * * * * *

TITLE: Visual Reference Standards for Weld Surface Conditions (Phase II).

AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.

DATE: August 1985 *COST:* \$71,000. (Phase II)

ABSTRACT: Samples were produced illustrating three types of weld surface condition. Roughness and irregular contour samples were produced at three severity levels in butt and fillet welds; re-entrant angle samples of butt and fillet welds were produced illustrating various angles around 90 degrees. The samples could form the basis for a guide for the description and evaluation of weld surface conditions which could be applicable to various structural and pressure vessel applications. The use of such illustrations, replicated as plastic models, could reduce the frequency of making physical measurements of weld surface conditions, and also reduce subjective considerations in evaluating weld surface conditions. (19 p.) (Project identified as 7-SP-1 and 7-84-11 (Phase II).)

BENEFIT ANALYSIS: HIGH VALUE. 69% of those interviewed were familiar with this report. Representatives from six different shipyards indicated extensive use of this information with another shipyard planning application of it now. One shipyard representative found it "not needed", and another had "no application for it". Overall, however, this material has been heavily and broadly applied, along with NSRP 0168 above and NSRP 0338 below. This was "a very, very good project".

NSRP 0241 * * * * *

TITLE: Investigation of Tubular Electrodes Designed for Submerged Arc Welding Applications, Final Report.'

AUTHOR: Newport News Shipbuilding.

DATE: July 1985

COST: \$110,000.

ABSTRACT: The primary objective of this project was to evaluate the operating characteristics of flux core and metal core electrodes designed for use with the Submerged Arc Welding Process. The purpose is to describe the methods used to weld the test samples and to present the results of the physical and metallurgical tests performed in this research and development program. It covers the investigation of the operating characteristics of tubular welding electrodes designed for Submerged Arc Welding applications. Efforts were directed toward comparing the relative merits of tubular submerged arc welding electrodes as compared to solid submerged arc welding electrodes. (250 p.) (Project identified as 7-83- 1.)

BENEFIT ANALYSIS: HIGH VALUE. 46% of those interviewed were not familiar with this report and had no interest in this material. The rest were familiar with the report however, and representatives from four different shipyards cited application of this material. Comments were quite supportive of this research, even from those who do not use tubular electrodes. One person said "We have no implementation yet . . . tubular electrodes do get usage in SAW, but none are available for high strength steels . . . we are still thinking about implementing it". Another said: "others have used and benefited, but not us . . . if we go back to big tankers, we would use it". Another said "This was a fundamental study of tubular electrode instead of solid wire . . . all shipyards use it". Another said: "the whole industry uses it . . . it has become a standard . . . we can get both metal core and flux core". Clearly, this research has been well received, and "might go someplace someday . . . metal core wire may be promising in the future".

NSRP 0253 * * * *

TITLE: Automatic Submerged Arc Welding With Metal Powder Additions to Increase Productivity and Maintain Quality.

AUTHOR: Newport News Shipbuilding.

DATE: June 1986

COST: \$70,000.

ABSTRACT: The focus of this report is directed toward the evaluation, testing, and qualification of Automatic Submerged Arc Welding (SAW-AU) with metal powder additions for shipyard use. The project consisted of both carbon steel and HY-80 test weldments using one-sided double-bevel, and fillet joint designs at several heat inputs and powder-to-wire ratios. It was concluded that controlled metal powder additions are indeed a production concept that can reduce shipbuilding costs through increased deposition rates and reduced consumables costs, while at the same time maintaining or improving quality. (149 p.) (Project identified as 7-83-2.)

BENEFIT ANALYSIS: MIXED VALUE. 54% of those interviewed were not familiar with this report and had no interest in this material. The rest were familiar with the report, but only one shipyard representative cited application of the findings. Comments were supportive of this research, but cited difficulties with the process, such as: "it is tough to maintain quality . . . any fluctuation of electric power produces problems in the weldment"; "this was valuable as a perspective on application"; "there were many problems with this process . . . complications"; "we found that the twin-wire process provides better control with the same deposition rate".

NSRP 0257 * * *

TITLE: Consumable Guide Electroslag Welding of 4 to 24 Inch Thick Carbon Steel Castings.

AUTHOR: Newport News Shipbuilding.

DATE: August 1986

COST: \$100,000.

ABSTRACT: The focus of this project was directed toward the development, testing and qualification of consumable guide electroslag welding of carbon steel castings from 4 to 24 inches in thickness. Consumable guide electroslag welding is a high deposition rate welding process that is ideally suited for use on thick members. This process has increased resistance to hot cracking, porosity, and underbead cracking, and results in minimal angle distortion. Joint preparation and fitup requirements are simplified and result in high quality weld deposits. Nondestructive testing included magnetic particle and radiographic inspection. Destructive testing included tensiles, Charpy V-notch impacts, and side bends. It is concluded that the use of consumable guide electroslag welding is an efficient process for joining thick carbon steel castings when postweld heat treatment can be used to achieve acceptable mechanical properties. (160 p.) (Project identified as 7-82-2.)

BENEFIT ANALYSIS: LOW VALUE. 62% of those interviewed had no knowledge of this report and no interest in this material. The rest were familiar with the report, but only one shipyard representative cited application of the findings - and that was on a limited scale. The other shipyards indicated no application needs for this type of high deposition welding on heavy members. One person commented that this technique might be of interest in future bridge building efforts.

NSRP 0261 * * * * *

TITLE: Evaluation of the Usability and Benefits of Twist Wire GMAW and FCAW
Narrow Gap Welding.

AUTHOR: Puget Sound Naval Shipyard.

DATE: March 1988

COST: \$75,000.

ABSTRACT: Butt welding of thick plates with narrow gap fit-ups in lieu of conventional U-groove and V-bevel angles is recognized as one approach to reducing the time and cost of welding in shipbuilding. The use of multiple twisted filler wires as electrodes is found to overcome some of the problems of lack of side wall fusion and slag entrapment associated with single wire arc welding of narrow gap butt welds. The main objectives of this project were to 1) identify known problems which have caused other narrow gap processes to be nonproductive, as well as new problems unique to the twist wire processor the shipbuilding industry; 2) identify the welding conditions that cause these problems so that the operating range which provides defect free welds can be identified; and 3) evaluate whether this range will be adequate to provide cost-effective welds in the non-optimum conditions found in the shipbuilding industry. (78 p.)

BENEFIT ANALYSIS: MIXED VALUE. 69% of those interviewed were familiar with this report, but only one shipyard cited application of the findings. Comments were mixed, however, as follows: “excellent process” and “saved us much money” on the positive side; “too many conditions to watch in order to make this happen . . . a change in current would produce lack of fusion on the sidewalls . . . too ‘pie-in-the-sky’ for us” and “must be flat down-hand welding . . . not enough applications to cost/justify this process” on the negative side. The shipyard where this process was used successfully had to make their own consumables, as there was not a big enough market for the vendor community to be interested in supplying them Overall this research was valuable, but the application of it has been quite limited.

TITLE: Evacuation of High Strength Steels Produced by Advanced Metallurgical Processes.

AUTHOR: American Bureau of Shipping.

DATE: September 1987

COST: \$90,000.

ABSTRACT: Newly developed high-strength steels produced by advanced steelmaking techniques and thermomechanical processing are shown to have toughness and weldability superior to those of conventionally heat-treated, quenched and tempered steels. The above was confirmed by small-scale toughness testing and by controlled thermal severity testing to determine heat-affected zone cracking susceptibility. Small-scale testing of shielded metal arc weldments was also conducted. In view of their superior toughness and weldability, these newly developed high-strength steels should be useful for applications such as low-temperature ship service, offshore structure service especially in harsh environments, and as a potential replacement for HY80/100 steels. (54 p.) (Project identified as 7-SP-6.)

BENEFIT ANALYSIS: MIXED VALUE. 54% of those interviewed were not familiar with this report and had no interest in this material. The rest were familiar with the report, but only one shipyard cited specific application of the findings. This research is known to be of interest to the American Petroleum Institute, and the U. S. Navy is known to be following up on this information. These steels are “lower in cost, and the supply base is more able to produce these high strength steels with better information on their properties and cost”. Another person said “this project was to evaluate a new class of steels . . . the Navy now has a multi-million dollar program on-going to get (these steels) introduced into U. S. shipyards”. It appears that this research has provided valuable insight into future opportunities involving these new steels. However, one shipyard representative commented: “this kind of effort should be kept in the research community until shipyards can use it. . . vendors should find this kind of research”.

NSRP 0291 * * * * *

TITLE: Tracking System for Automatic Welding-Phase H Improvement of Contact Tip Life for Through-the-Arc Welding System.

AUTHOR: Ingalls Shipbuilding.

DATE: February 1989

COST: \$196,000.

ABSTRACT: In Phase I of this project (NSRP 0211), an automatic seam tracking/adaptive control welding system was evaluated and weld-tested using the high-heat, pulsed gas metal arc welding process. Phase I concluded with the finding that thru-the-arc seam tracking, with computer control and adjustment of welding parameters, was a viable technology. Potential savings in welding time would be possible if further development of hardware and computer software were achieved to more fully realize the potential of the system. Needed improvement in consistency of system response to changing conditions in the weld were recognized. The primary focus of Phase II was the development of weld head contact tips, which could function over longer periods of continuous welding without need for replacement due to wear. The results of this testing are the subject of this report. (29 p.) (Project identified as 7-83-3, 7-84-05, and 7-84-09.)

BENEFIT ANALYSIS: MIXED VALUE. 54% of those interviewed were not familiar with this report and had no interest in this material. The rest were familiar with the report but only one shipyard cited "substantial application" of the findings. This was "a small project to fix bugs in tips . . . it did not solve them all . . . there was no rush to apply the findings". Another person said: "this was a tip improvement effort . . . useful life is still too short to be viable in a shipyard". A third person said that he was "not convinced that this tip is better", adding that this project "cost too much money . . . it could not be cost justified" and also "laser tracking systems promise much better performance". One other person said "a better tip is being used now, but I don't know how this report might have helped in the resolution of the problems".

NSRP 0292 * * * * *

TITLE: Evaluation of the Benefits of HSLA Steels.

AUTHOR: Ingalls Shipbuilding.

DATE: March 1989

COST: \$95,000.

ABSTRACT: *The* need for ships and oil well drilling equipment to operate in the extremes of polar climates has given emphasis to the need for high toughness, weldable steels. Important weight savings become available where designs currently use normalized, medium strength, low alloy steels. Significant cost savings become available if the new steels permit higher production weight welding in heavy fabrication. One of the objectives of this study was to procure plate sections of ASTM A710 steel in yield strength levels of 80 KSI and also ASTM A710 modified in chemistry to yield strengths of 100 KSI minimum yields. Plates over 5 inches thick in both strength levels were procured and welding was performed to evaluate producibility for shipbuilding and marine structures. Effects of high heat welding *on* heat affected zones toughness was of primary interest. (179 p.) (Project identified as 7-82- 1.)

BENEFIT ANALYSIS: MIXED VALUE. 62% of those interviewed were familiar with this report. Four different shipyards cited application of the findings, and two more were considering application in the near future. Comments on this research were all favorable, such as: “we all have it now, because of this report”; “this was to evaluate HSLA steels for shipbuilding applications . . . they are being used for replacements of HY steels”; “this was a basic steel investigation . . . this technology now is used in Navy ship construction”; and “cost/benefit leads the way . . . we save \$ 1/2M/yr in utility costs alone with HSLA-100 (not HSLA-80 as in this report)”.

NSRP 0297 * * * * *

TITLE: Evaluation of the Fillet Weld Shear Strength of Flux Cored Arc Welding Electrodes.

AUTHOR: Ingalls Shipbuilding, Inc.

DATE: July 1990

COST: \$50,000.

ABSTRACT: This paper presents results of a research project conducted by the Welding Engineering Department at Ingalls Shipbuilding. The primary effort of this project was directed toward the development of shear strength data for flux cored arc (FCAW) welding electrodes. The current welding design document for U. S. Navy construction, MIL-STD-1628, does not include fillet weld shear strength values for this widely used process. Presently, the equivalent shielded metal arc (SMAW) welding electrode values are used for design purposes. (52 p.) (Project identified as 7-SP-8.)

BENEFIT ANALYSIS: HIGH VALUE. 62% of those interviewed were familiar with this report. Five different shipyards cited application of the findings, which now “have been folded into the MIL-STD”. This project investigated “fundamental strength data for popular flux cored electrodes for which the designers needed information to use in designing ships”. This was considered by one shipyard representative as “good information to supplement existing information on fillet welds . . . we use it a lot”. Another person said “this is good background information.. helpful”. A third person said “I’m not sure of the outcome here . . . it probably did not turn out as intended”. A fourth person commented that “the Navy says this is excellent . . . now they can evaluate using this report . . . it saves money”. Overall, this research clearly has been valuable to the shipyard industry.

NSRP 0299 * * * * *

TITLE: Flame Bending of Pipe for Alignment Control.

AUTHOR: Ingalls Shipbuilding, Inc.

DATE: March 1990

COST: \$72,000.

ABSTRACT: The principles of flame straightening, long in use on plate structures in shipbuilding, have been applied to the problem of precision alignment of fluid system piping in shipbuilding and overhaul. Reduction of residual stresses by elimination of mechanically applied stresses to pipes for alignment prior to welding or bolting in place is a desirable objective. (165 p.) (Project identified as 7-84-8.)

BENEFIT ANALYSIS: HIGH VALUE. 62% of those interviewed were familiar with this report. Two different shipyards cited constant on-going application of the findings, and two others were considering the information now. One person commented that the "Author" should be Puget Sound Naval Shipyard, rather than Ingalls Shipbuilding, Inc., adding that this project led to NSRP 0336 (below) which was done by Puget Sound Naval Shipyard. This person went on to say that his shipyard "has saved \$1.5M via flame bending, using this technique on periscope tubes which might be off 1-1/2", and on the 14' long shaft sleeves for Trident submarines which can be flame shrunk to the proper dimensions". Both shipyard representative commented that this project has "extremely exciting potential", with other shipyards being trained in the technique by Puget Sound Naval Shipyard. He considers the process "promising for shipyards".

NSRP 0314 * * * * *

TITLE: Fabrication Accuracy Through Distortion Control In Shipbuilding.

AUTHORS: Ron Besselievre and Lee Norton.

DATE: September 1990

COST: (Not available)

ABSTRACT. The main objective of this project was to acquire and report empirical data on some of the distortion controls that are in use, but for which quantitative data is non-existent or difficult to find. (186p.)

BENEFIT ANALYSIS: MIXED VALUE. 54% of those interviewed were not familiar with this report and had no interest in this material. One person was going to look at it now. The rest were familiar with the material, and three different shipyards cited application of the findings. Comments were mixed, however, with one shipyard representative saying "this is a good report that fits our needs exactly", with another saying "nothing positive has happened in this area in 30 years". The Accuracy Control Departments in two different shipyards cited specific interest in this material.

NSRP 0326 * * * * *

TITLE: High Yield Strength Cast Steel with Improved Weldability.

AUTHOR: Robin K. Churchill and Jack H. Devletian

DATE: May 1991

COST: \$71,000.

ABSTRACT: A number of very low-carbon higher-nickel modifications of HY-80 and low carbon modifications of HY-130 were produced and cast into test blocks. Heat treatment studies were performed and mechanical properties were evaluated. Weldability tests were also performed. The experimental alloys appear to be capable of meeting the mechanical property requirements of HY-80 in section thicknesses up to at least 12 in. (55 p.) (Project identified as 7-84-12.)

BENEFIT ANALYSIS: MIXED VALUE. 62% of those interviewed were familiar with this report. Two different shipyards cited limited application of the findings, which are aligned with military shipwork only. This basic development of cast steels “has great potential, but has not been recognized by the industry as yet”. One person commented that funding limitations precluded finishing this project.

NSRP 0336 * * * * *

TITLE: Practical Guide for Flame Bending of Pipe.

AUTHOR: Frank Gatto

DATE: August 1991

COST: (Not available)

ABSTRACT: This report sets forth the technology of flame bending of pipes in a format which will serve as a guide for shipyards to use in training personnel and in developing procedures specific to their own requirements. The information contained in this report should enable shipyard personnel to reach the state-of-the-art and to implement this technology with minimal cost and risk of error. (99 p.)

BENEFIT ANALYSIS: HIGH VALUE. 85% of those interviewed were familiar with this report. Four different shipyards cited application of this material, and one other shipyard indicated that application was in the planning stage. This project is a follow-on to NSRP 0299 above. It provides a practical guide for use in training shipyard personnel in this process. All of the comments offered were positive and supportive of this research even from the shipyards where no need exists for it.

NSRP 0338 * * * * *

TITLE: Visual Reference Standards for Weld Surface Conditions and User's Guide for Weld Replicas Phase III.

AUTHOR: William Hanzalek, Dr. D.Y. Ku, and R.F. Waite.

DATE: September 1991

COST: (Not available)

ABSTRACT: *This* project was directed to the production of three dimensional sample illustrations of weld surface conditions, applicable to visual weld inspections. This phase addresses the manufacture of the plastic weld repliers distributed to the marine industry as reference standards for the evaluation of weld surface conditions. (27 p.)

BENEFIT ANALYSIS: HIGH VALUE. 62% of those interviewed were familiar with this report. Five different shipyards cited heavy and continuing application of this material, and one other shipyard indicated that application was in the planning stage. 400 sets of plastic replicas were made and distributed. All of the comments on this project were positive, even from the shipyards having only military shipwork where no specific application of the findings was cited. One person commented "it took 12 years to get there, but it has been good".

TITLE: Design and Planning Manual for Cost Effective Welding,

AUTHOR: Frank Gatto, Brian Lawlor, and Joyce McMillin.

DATE: October 1991

COST: (Not available)

ABSTRACT: The purpose of this manual is to assist in the successful construction of welded products by aiding individuals in selecting readily weldable materials, providing suitable weldment design, assessing available fabrication on resources, and managing the construction environment. Basic information is contained within this manual to aid individuals in making sound welding decisions. A basic approach for reviewing and accepting work by a fabricator is also provided, with common pitfalls highlighted. Information about welding design, welding metallurgy, welding processes, and nondestructive testing is also included. (446p)

BENEFIT ANALYSIS: HIGH VALUE. 92% of those interviewed were familiar with this manual. Representatives from eight different shipyards cited application of this material. Representatives from two other shipyards indicated that application of this material was currently in the planning stage. One person commented that this manual is “extremely beneficial . . . we use it for training in a course on introduction to welding”. Another person said “we use it every day”. Others cited use as “a good tool during training of craftsmen and designers”. A representative from the author shipyard (Puget Sound Naval Shipyard) is known to have participated extensively in organized training sessions, using this manual as the principal reference. Such training was conducted within the Shipyard for Planning and Estimating personnel and for Group Superintendents, at the Ship Repair Facility at Guam, and at several American Welding Society locations in the northwestern United States (Bremerton, Portland, Willamette, Tri City, Spokane, Seattle-Puget Sound). Clearly, this manual is a classic document that will have extensive usage throughout the entire shipyard industry for many years.



TITLE: Evaluation of Hitachi Zosen Portable Welding Robotics

AUTHOR: G. J. Blasko, D. J. Moniak, and B. C. Howser.

DATE: April 1992

COST: (Not available)

ABSTRACT: In December 1992, a team representing U. S. private and public shipyards and the David Taylor Research Center was sent to observe the Hitachi Zosen robots in operation and complete a technical assessment. The robots' excellent productivity improvement due to their potential for 50 to 70 percent arc time, high deposition rates, and ease of operation and set-up is seen. The technical observation is addressed in this report. (5lp.)

BENEFIT ANALYSIS: MIXED VALUE. 31% of those interviewed had no knowledge of this report and no interest in this material. The rest were familiar with the report, but only one shipyard cited limited application of the findings while two other shipyards indicated that application was in the planning stage. This project was called "extremely valuable, not from the point of view of implementation, but this report opened a lot of eyes . . . it shows where (our shipyards) have to go in commercial shipbuilding . . . the second phase will be to get one, bring it over here, and try it out ... robotics will surely be *used (in the future)*, but not necessarily portable ones". This sentiment was repeated by representatives from three other shipyards during the interviews. Panel SP-7 is now awaiting funding for Phase II, an actual robot trial in a selected shipyard.

MANAGEMENT OF SPC PANEL SP-7 ACTIVITIES

General Discussion

This section describes the opinions of those interviewed relative to the administration of SPC Panel SP-7 meetings, including such things as the use of pre-planned agenda, the actual format for a meeting, who should attend, how often a meeting should be held and under what circumstances (e.g., during the same time frame as the meeting of another SPC Panel, or an NSRP Symposium), what matters should/should not be discussed, how meeting minutes should be handled, and similar considerations that bear on the mechanics of the panel meeting itself. It also describes the thoughts of those interviewed on how the NSRP can be of more assistance to them, what projects should be prosecuted, and in general what message they would like to have transmitted back to Panel SP-7.

The discussions that produced these opinions were most gratifying for the questioner. Each person interviewed was quite willing to offer comments and a position on the matter at hand. A wealth of information was forthcoming, allowing a good overall assessment of each report and the several major aspects of Panel administration. The total group of persons interviewed constitute the core of Panel SP-7 as it is known today, and so their feelings are surely important to the future well-being of the Panel and its activities.

On the following 2 pages is a matrix showing SPC Panel SP-7 Meeting Attendees for the 10 most recent meetings. This matrix reveals which shipyards and other activities have been supporting SP-7 by having a representative in attendance at these meetings. The date and location of each meeting is indicated, along with the company affiliation of those in attendance. Note that 57% of these companies have had a representative at three at more of these meetings.

Attendee Affiliation	Date - Location									
	Apr '89 - Carderock, MD	Sep '89 - Golden, CO	Mar '90 - Bath, ME	Sep '90 - Napa, CA	Mar '91 - Appleton, WI	Sep '91 - State College, PA	Feb '92 - San Diego, CA	Aug '92 - Bremerton, WA	Jan '93 - Miami, FL	Jul '93 - Columbus, OH
A.W. Johnson & Associates							X		X	
ABS Americas	X	X	X	X	X	X	X	X	X	
American Welding Institute					X	X	X	X	X	
Atlantic Marine, Inc.					X	X			X	X
Avondale Industries, Inc.	X	X	X	X	X	X	X		X	X
B&W - CIM Systems			X	X	X					X
B&W - R&D										X
Bath iron Works	X		X	X	X	X	X	X	X	X
Bay Shipbuilding Corp.		X			X					
Bell Aerospace/Bell Halter (Textron)		X								
Bender Shipbuilding						X	X			X
Bethlehem Steel Corp.	X	X			X	X		X	X	
Board of Insp. & Surv. - USN	X									
Bonal Technologies			X							
Charleston NSY		X	X			X	X	X		
Colorado School of Mines		X		X		X	X	X	X	X
Cybo Robots										X
DTRC (NSWC - Annapolis)										X
DTRC (NSWC - Carderock)	X		X	X	X	X		X	X	X
Edison Welding Institute						X	X	X	X	X
ESCO Corp.		X	X		X	X		X	X	
Fraser's Boiler Service, Inc.		X					X	X		X
GD/EB Div	X	X	X	X	X			X	X	X
GDI					X					
Hydro Marine Systems									X	
Ingalls Shipbuilding Division		X	X	X	X	X	X	X	X	X
Lake Shore, Inc.						X	X	X	X	
Lehigh University							X	X		
Machinists, Inc.								X		
Mare Island NSY	X	X	X	X	X	X	X	X	X	X
Marinette Marine Corp.		X			X					
Maritime Administration		X								
Marsh Ceramics										X
Martin Marietta - Oak Ridge										X
IMcDermott, Inc.		X	X	X					X	X

Meeting Attendees
SPC Panel SP-7
Welding

Attendee Affiliation	Date - Location									
	Apr '89 - Carderock, MD	Sep '89 - Golden, CO	Mar '90 - Bath, ME	Sep '90 - Napa, CA	Mar '91 - Appleton, WI	X Sep '91 - State College, PA	X Feb '92 - San Diego, CA	Aug '92 - Bremerton, WA	Jan '93 - Miami, FL	Jul '93 - Columbus, OH
NASSCO	X	X				X	X	X	X	X
Nat'l Inst. for Stds & Tech		X								
NavSea	X	X		X	X			X	X	X
NCEMT								X	X	X
Newport News Shipbuilding	X	X	X	X	X	X	X	X	X	X
Norfolk NSY								X		
Ohio State University										X
Oregon Graduate Institute		X	X		X	X	X	X	X	X
Penn State - ARL		X	X	X	X	X	X	X	X	X
Peterson Builders, Inc.			X	X	X	X	X	X	X	X
Philadelphia NSY					X		X	X	X	X
N			X		X	X		X		
NS	X	X	X	X	X	X	X	X	X	X
M			X							
B		X								
TRW - Nelson Div.					X	X	X			
U.S.C.G. (Incl. Ship Structure Comm.)		X						X	X	X
Westinghouse	X									

Meeting Attendees
SPC Panel SP-7
Welding

Detailed Discussion of Findings

The responses are summarized under the headings of each question, following the order and language of the worksheet, Appendix B, that was used during the interviews.

PANEL MEETINGS AND ADMINISTRATION

How often do you attend?

69% of those interviewed regularly attend all of the meetings. The rest attend on an irregular basis.

Do/should others in your Company attend?

89% of those responding to this question said that they attend the meetings alone, and that they prefer to continue this practice. Only one person said that others should attend along with him.

Are the meetings of value to you?

All of those responding to this question answered in the affirmative. One person summed up the advantages of attendance this way: “We are able to feel the heartbeat of what is going on in U. S. shipyards . . . the real stuff . . . not what the periodicals say”.

How can the meetings be improved? In particular,

Increase/decrease number of meeting days?

38% felt that the present meeting arrangement of 2 day’s duration, two times per year, should be continued. 5 interviewees would add 1/2 to 1 more day to each meeting, while 1 other interviewee would add 2 days to each meeting. One person thought that 3 times per year would be better. It is interesting to find no hint that meeting duration’s or frequency should be shortened.

Continue/change meeting format?

While 69% said that no changes were needed, and 23% voiced no opinion, there was one specific comment on this matter, to the effect that too much time was being spent on administrative matters and finding problems.

Continue/change content of meeting?

Responses to this question indicated satisfaction with the present meeting content.

Broaden/restrict who should attend?

Those interviewed cited the present mix of attendees at Panel meetings as satisfactory, but three specific comments were offered, as follows:

1. More participation by small shipyards is needed, and less from salesmen.
2. The Panel function is primarily technology transfer, and secondarily research and development. We have a few too many R&D people. We have been infiltrated by people outside of the hands-on shipyard area. We need more hands-on people who apply technology, not just thinkers.
3. We need to treat all attendees as equals.

What should be added to the agenda?

Four specific suggestions were made in response to this question, as follows:

1. More on the application of ideas.
2. More tours of local industrial establishments.
3. More on cutting, forming, and fabrication issues.
4. Publish the agenda sooner.

What should be dropped from the agenda?

Only one specific suggestion was made here, to limit long discussions as they get boring.

Should meetings be held in conjunction with other organizations?

Those responding to this question were equally divided on this issue, but unanimously against joint panel meetings. Those favoring meetings with other organizations would also favor tours of local industrial establishments. One person favored a periodic “consolidated” meeting of the whole NSRP, but he was specifically opposed to joint meetings of two or three panels.

Are meeting minutes of value to you?

All of those responding to this question answered “Yes”. There were several comments that the minutes need to be published sooner, however.

How can the NSRP be of more assistance to your company?

This question prompted a series of comments which reflect some serious difficulties with the NSRP in general. These comments also illustrate concerns on the part of those interviewed for the future of the NSRP and the shipyard industry. These comments are presented below, as nearly verbatim as possible:

Ž We need money for our people to work in behalf of the NSRP within our own shipyard. Since we have no budget available, much that needs to be done is neglected. We also need money for people to attend meetings. In these down-sizing days our situation is desperate.

- SP-7 has suggested forming a “model shipyard” using a clean sheet of paper approach and the best knowledge of all Panels. The ECB could coordinate.
- More copies of the NSRP Newsletter would help.
- Every month there is an Engineering Duty Officer meeting (in the Naval Shipyard world) to stay abreast of current activities. Include the NSRP as a section of these meetings.
- We should get the (Naval Shipyard) Department Heads through NANTS (National Association of Naval Technical Supervisors) presentations, or a self-directed group, to publish and discuss NSRP activities.
- The projects done by our shipyard were used by our shipyard. This is an argument in favor of doing projects so that you get the benefit from them.

Ž Frame bending and thermal spray are two areas where much money has been saved. This information needs to be made known to senior people - over and over and over again - to support the interests of the NSRP. Others should learn from SP-7 the value of keeping this perspective fresh for local management. Stressing application of the findings will help to support the program. The NSRP is really more application development than it is pure research. Maybe we need to leave the SNAME umbrella and go to another organization for an application of findings focus, rather than pure research.

- We need to reduce the number of people needed to build a ship. We need to eliminate all delays in the production segment by much planning and preparation up front - just like the European shipyards are doing.
- Should all information that we develop be shared with the whole world? Why not keep it for our own use, such as by using a special information network for welding where we can selectively extract what is appropriate.
- The finding cycle takes too long,
- Performers need to fulfill their commitments.
- We have had dedicated attendees during no-finds times. We need to ensure that the faithful people stay involved.
- Reduce the time for funding of projects. We must move quickly and with low risk on our project finding. Right now our efforts are diluted by attempts to get ARPA money, and finds from other industries.

- Fix the funding cycle. Make the administration side as professional as the professions that are participating in it.
- We need more focus on small shipyards and their problems. The little shipyards should not be neglected, but should get “equal time” with the big boys.
- The whole NSRP is highly political, and has the “good buddy” system. You cannot sell a project to SP-7 without being a “good old boy”. Some people can sell, others cannot sell. You need both the project “inventor” and the project “seller” in order to get a project assigned to your shipyard. All of the good information in the abstract may enable others to attract the work. We should give the “inventor” the priority in getting the project . . . this area needs attention. We used to do this, but not now . . . money is so tight that you may have to play the game or else get nothing.
- The project cycle takes too long . . . you run out of gas before you get there. We also need help on finding to attend meetings, or else get a break on room costs, airline fares, meals, or such.
- We need to continue generating reference information, because you never know when it is going to be needed for some related purpose.
- A military atmosphere has been predominant lately. Throwing money at the problem will not do enough to enable the transition. Jones Act restrictions are OK with Navy work but not in the international commercial market.
- We need closer cooperation with the Ship Structure Committee to avoid duplication of effort.
- We need to deal with the problem of getting work and producing ships in this country for the international commercial market. We should not play “catch-up”, but should meet the problem head on.
- Get the electrode manufacturers back into the business of supplying what the shipyards need. They have not had enough volume to justify their involvement.

What Projects would you like to see carried out?

69% of those interviewed had specific comments on this question, as follows:

- We need to complete the weld-through primer study. The ECB wants it. It has become a political issue.
- 3-D accuracy control might be a joint panel project.

- More fundamental research projects, like casting material development. Our panel rates these projects highly, but funds do not get assigned. The ECB does not favor early stage R&D.
- We need lesson robotics . . . too much money has already been invested here.
- We have too many projects that are of interest only to the Navy, and not enough projects for commercial applications. The project on welding materials for HSLA steels was advanced to the ECB because of a Navy presence that prompted votes to “show support” . . . it did not make the ECB cutoff, however.
- We need a project on how to design, procure, set up, and operate a single-panel welding line.
- We need a major project to demonstrate thermal spray, and show how to put this capability into a shipyard. Thermal spray technology includes applying it cheaply, and not just establishing a thermal spray capability. We can protect a hull in the marine environment for 20 years, and perhaps for 30 to 40 years, while also reducing environmental problems . . . like bringing VOC’s down to zero . . . and eliminating hazardous waste.
- Find out how to relax ABS standards for work in the international commercial market.

Do you have on-going NSRP Projects?

Only one shipyard representative answered this question in the affirmative.

What problem areas would you like to see investigated?

This question was quite similar to the earlier one that asked “What Projects would you like to see carried out?”, but prompted a few rather different responses, as follows:

- We need to improve the quality of photographs in reports.
 - Our square butt welding project has been approved, but we have no money yet. Also, our thermal spray manual is awaiting funding.
 - How to use the big ideas, such as panel lines and line heating, on a smaller scale in the small shipyards.
 - On RO/RO ships, the platforms for loading vehicles has a gridwork of fillet welded cleats. This area might lend itself to a stud welded type of cleat, which would be more cost effective. This might not be a project for SP-7 alone, but is a problem needing a project.
- Ž We need training for welding processes. Pulse arc welding training did not get initiated by SP-7, but was supported by an earlier project report in this general area.

What message would you like transmitted to this Panel?

This question was added to the list so that the people being interviewed could have a direct voice back to the Panel, anonymously, on any point that they might wish to raise. Some comments were favorable, and some not so favorable, as follows:

- We should NOT setup a panel for management science. This is one group that does not need attention, because they have it all now.
- We need concurrent engineering, so as to eliminate delays and minimize the quantity of workers on the line. We should also get rid of middle management as much as possible.
- We need to look at the “ideal shipyard” if we intend to enter the international market. We cannot continue with business as usual and expect to attract business in this area.
- The support put forth by industry is way ahead of the results provided by the administration and finding of projects by DTRC, et al. The three-year queue and no money is killing us from the standpoint of keeping serious shipyard people participating in the NSRP.
- Keep the small and mid-size shipyards in focus. Also, be kind to non-welders who are in the attendance at Panel meetings.
- The goals of the NSRP are not the same as the goals of Codes 100/200/300 in Naval Shipyards and their counterparts in commercial shipyards. If they are the same, it is only by words and not by actions.

PROJECT REPORTS AND NSRP INFORMATION

Do you receive adequate information on NSRP Project Reports?

All of those responding to this question answered “Yes”.

Do you get the “Yellow Book” NSRP Bibliography of Publications?

Here 9 people answered “Yes”, and 2 people answered “No”.

Have you ever ordered a Report from the NSRP Library?

1/3 of those responding to this question said “Yes”, and 2/3 said “No”. One person complained about the time required to receive his order. It is clear that the procedure for obtaining project reports and training materials from the NSRP Library is working satisfactorily.

Is the NSRP Newsletter of value to you?

Only six out of 13 interviewees answered this question in the affirmative. Five answered in the negative. Most of these people saw the Newsletter only when it was routed to them by someone else. 50% of those interviewed asked to have their names added to the mailing list for the Newsletter, which is a favorable indication that they feel the Newsletter has the potential of being useful to them.

How can NSRP information be communicated more effectively?

Since it was apparent at the beginning of this Project that communications were a major weakness of the NSRP, this question was added to explore with those interviewed how improvements might be made. Responses to this question were as follows:

- We need a “bulletin board” arrangement for the NSRP library, allowing us to down-load information of interest via computer modern.
- A technology supermarket philosophy for the NSRP is better than the “must apply” concept which we have now by requiring so many shipyards to sign up to usage during ECB deliberations.
- Joint meetings at the working level will help.
- Multiple copies of the NSRP Newsletter would help in getting it distributed internally.
- We could require a short abstract on each project, like a “news flash”, to be used in shipyard newspapers. This requirement should be put right in the purchase order for the project.
- DTRC does not communicate with anybody. Last year the Panel Chairpersons were not even invited to present abstracts to the ECB. The blame belongs to the DTRC, and not the ECB. DTRC is the activity that puts out the invitations to attend ECB meetings . . . and the ECB is only a group of volunteers.
- One way is to improve the distribution of Quarterly Project Progress Reports.
- Another way is to prepare a panel “history” and pass it along to newer attendees. They can then get up to speed more easily. This should include an attendees list, panel charter, and similar items. This could also be used as a recruiting tool.
- Communications with the ECB could be improved by assigning an ECB person to each panel, and using that person as a window.

- There should be more presentations to the ECB by the Panel Chairpersons on what is being done today, and not just on projects being promoted. There should be more frequent ECB meetings, where the Chairpersons of 1 or 2 Panels are invited to discuss their areas. All Panels could be finished in the course of a year. The Chairpersons are not currently required to do anything for the ECB. The Program Managers are required to make reports to DTRC, but we never know what gets passed from DTRC to the ECB. The ECB members always say “we are too busy to read all of this stuff”. If we ask them, we might find that they would like to know what is going on.
- Note that DTRC is funded to run the NSRP. They are the source of the communications problem with the ECB.
- We should have an NSRP booth at ASNE, ASTM, SNAME Annual Meeting, etc., etc. Take our material and share it with people, such as a VCR loop tape on the NSRP, lots of brochures, and knowledgeable people to exchange ideas. We talk to ourselves, but we need to talk to others, also.
- We need more information at the worker level, such as a small and frequent newsletter which we would distribute to the workers themselves. We could add a section for publication in the local shipyard newspaper, like a “news release”. We could even extend this idea to community newspapers in areas where shipbuilding is a big part of the local industry.
- If we make the product successful, we will not have to worry about telling people about it . . . they will “come to your door”. Applied projects can do this for us . . . and matching finds may be the answer.
- Projects need to be notarized and accepted by the regulatory bodies as valuable and useful. If a project does not address their standards, they do not care about the NSRP. If a project is made a part of their regulations, then it will carry more weight and people will pay more attention to it. We should not work on guides, just rules.

Would you prefer to have a single point of contact within your company for information on meetings, availability of NSRP reports on projects, and other NSRP matters?

This question was included on the list to suggest the idea of a single point of contact to those who have not as yet tried it. It would also provide some feedback from those who have attempted this idea in their shipyard. Responses were all favorable.

What person in your company would best serve as this point of contact?

Responses to this question included an NSRP “User’s Group”, and the shipyard technical library.

CONCLUSIONS FROM THE FINDINGS

Analysis of the responses offered by those interviewed suggests the following conclusions on matters of interest to SPC Panel SP-7.

Those Associated with the Benefits derived from Project Reports

1. The projects yielding the most benefit value were those supporting direct shipyard applications and hands-on considerations, along with training activities.

Those Associated with the Suitability of Panel Meeting Administration

2. The present administration of Panel Meetings is quite satisfactory, and should be continued with only minor adjustments.

3. Several specific points are pertinent:

A. Meetings of at least 2 day's duration, two times per year, at varying locations, are favored. Meeting duration's might be lengthened by 1/2 to 1 day, but should not be shortened.

B. The present meeting format and content have been satisfactory and should be continued.

C. The present mix of attendees is satisfactory. However, the addition of more hands-on shipyard people and more representatives from small shipyards would ensure that the balance of attendee sentiment and actions will continue to be in the direction of shipyard interests.

D. Meeting agenda might be improved by providing for:

- Ž More attention to the application of ideas;
- Ž More tours of local industrial establishments;
- Ž More on cutting, forming, and fabrication issues;
- Ž Earlier publication of the agendas.

E. A meeting in conjunction with another SPC Panel is not favored. A meeting in the same location and time frame as a technical symposium, enabling attendance at both events, would be well received.

Those associated with the Administration of Project Reports and Information

4. Project reports generally have been available to the shipyard people who need them, and who are in a position to apply the findings.
5. The NSRP Bibliography of Publications has been available to those who need it.
6. The procedure for obtaining project reports and training materials from the NSRP Library has been working satisfactorily.
7. Distribution of the NSRP Newsletter is too narrow and restricted. Articles of broad shipyard interest should be made available for re-publication in local shipyard and community newspapers.
8. A single point of contact within a shipyard for obtaining information on NSRP matters would be helpful.

Those associated with NSRP matters in general

9. Panel meetings geared to various locations, and at minimum expense to the attendees, would allow more people to attend.
10. The finding cycle for projects has been too long and uncertain.
11. Better communications among panel participants and ECB members on NSRP matters are needed.
12. The NSRP Library should be computerized and automated in order to support more rapid retrieval of research information.
13. In summary, SPC Panel SP-7 is active, supported by a good group of shipyards and professional activities, and has been effective in providing meaningful contributions to the National Shipbuilding Research Program in behalf of the shipyard industry in general, and the Welding community in particular.

RECOMMENDATIONS FROM THE CONCLUSIONS

The following recommendations have been drawn from the conclusions.

Those Associated with Panel Projects

1. The voting members of Panel SP-7 should continue to weigh the potential for implementation of each proposed project, and to temper their decisions accordingly. Studies offering important reference information for use in future research efforts should also be supported.

Those Associated with Panel Meeting Administration

2. The present practices for Panel meetings should be continued, with only minor adjustments (see page 48 under Conclusions for a discussion of several pertinent points).

Those Associated with the Administration of Project Reports and Information

3. The distribution of project reports to shipyard people who are in a position to apply the findings should be continued and strengthened.

4. Extension of the NSRP Newsletter to a broader distribution, and the introduction of timely articles of interest to most readers, should be supported.

5. The idea of establishing of a single point of contact within each shipyard for NSRP information should be developed and implemented.

Those Associated with NSRP Matters in General

6. Panel meeting locations and expenses should be in line with maximizing attendance.

7. Steps to shorten and stabilize the finding cycle for projects should be supported.

8. Actions to computerize and automate the NSRP Library should be supported.

9. Communications among Panel participants and ECB members should be improved.

APPENDIX A

Project Benefit Analysis Worksheet

SPC Panel SP-7

SP-7 PROJECTS LISTING

NSRP	KEY	REMARKS
0039	One Side Welding - Flux Development and Study of Multiple Arc Behavior 1974	
0040	Development of Extended Length Continuous Wire Feed System 1974	
0041	Development of a Portable AC/DC Welding Power Supply Module 1974	
0044	Application of Laser Welding to Ship Production, Vol I 1974	
0048	Toughness Evaluation of Electrode and Electroslag Weldments 1975	
0051	Applicability of Firecracker Welding to Ship Production 1975	
0054	Plasma Processes of Cutting and Welding 1976	
0062	Development of an All Position Automatic Welding Machine 1976	

NSRP	SP-7	KEY	REMARKS
0063	High Metal Deposition Per Ampere 1977		
0072	High Metal Deposition Welding, Vol I and II (expanded version of NSRP 0063) 1978		
0080	Dynamic Tear Test Correlation with Explosion Bulge Test at the Same Temperature 1979		
0083	Investigation of Welding Processes for Low Temperature Applications 1979		
0085	Applications of Plasma Arc to Bevel Cutting 1979		
0086	Mechanized Gas Metal Arc Welding of Light Plate 1979		
0095	Applicability of Laser Welding to Ship Production, Vol II 1979		
0099	Property and Productivity Improvements in Electroslag and Electrogas Welding 1980		

NSRP	SP-7 KEY	REMARKS
0110	Ceramic Weld Backing Evaluation 1980	
0112	The Development of a Composite Consumable Insert for Submerged Arc Welding 1980	
0113	Extension of E7024 Electrode Application in Shipbuilding 1980	
0118	Self-Shielded Flux-Cored Wire Evaluation 1980	
0121	Proceedings of First Conference on Fitness-For-Service in Shipbuilding 1981	
0145	SMAW Ceramic Weld Backing Evaluation - Final Report 1982	
0166	Acceptance Standards for Nondestructive Test Not Required by Classification - Phase I 1983	
0168	Visual Reference Standards for Weld Surface Conditions, Phase I 1983	

NSRP	SP-7	KEY	REMARKS
0173	Study Mission to Japan - Trip Report (Alia/Howser/Null/Richie) 1983		
0182	Unimation "Apprentice" Welding Robot for Shipyard Application 1983		
0183	Cincinnati Milacron T3 Robot for Shipbuilding Welding 1984		
0184	Out-Of-Position Welding of 5000 Series Aluminum Alloys Using Pulse GMAW Power Sources 1984		
0195	Study of Fitting and Fairing Aids of U.S. Shipyards 1984		
0209	Higher Strength Steels Specially Processed for High Heat Input Welding 1985		
0211	Evaluation of an Automatic Seam Tracking/Adaptive Control Welding System for Shipyard Applications - Phase I Report 1985		
0215	Acceptance Standards for Nondestructive Test Not Required by Classification (Phase II) 1985		

NSRP	SP-7 KEY	REMARKS
0220	Visual Reference Standards for Weld Surface Conditions (Phase II) 1985	
0241	Investigation of Tubular Electrodes Designed for Submerged Arc Welding Applications - Final Report 1985	
0253	Automatic Submerged Arc Welding With Metal Powder Additions to Increase Productivity and Maintain Quality 1986	
0257	Consumable Guide Electroslag Welding of 4 to 24 Inch Thick Carbon Steel Castings 1986	
0261	Evaluation of the Usability and Benefits of Twist Wire GMAW and FCAW Narrow Gap Welding 1988	
0262	Evaluation of High Strength Steels Produced by Advanced Metallurgical Processes 1987	
0291	Tracking System for Automatic Welding - Phase II Improvement of Contact-Tip Life for Through-the-Arc Welding System 1989	
0292	Evaluation of the Benefits of HSLA Steels 1989	

NSRP	SP-7	KEY	REMARKS
0297	Evaluation of the Fillet Weld Shear Strength of Flux Cored Arc Welding Electrodes 1990		
0299	Flame Bending of Pipe for Alignment Control 1990		
0314	Fabrication Accuracy through Distortion Control in Shipbuilding Sep 1990		
0326	High Yield Strength Castings for Yard Capability Ott 1991		
0336	Practical Guide for Flame Bending of Pipe Aug 1991		
0338	Visual Reference Standards for Weld Surface Conditions (Phase II) and User's Guide		
0339	Design and Planning Manual for Cost Effective Welding Oct 1991		
0343	Evaluation of Hitachi Zosen Portable Welding Robots Apr 1992		

KEY	RATING DESCRIPTION
-----	--------------------

- | | |
|---|-----------------------------------------------------|
| 0 | No knowledge/ no interest |
| 1 | Interested; will look at information |
| 2 | Have information; considering it |
| 3 | Have studied information; no application intended |
| 4 | Information looks useful; application planned |
| 5 | Applied once no further application seen |
| 6 | Have applied on limited scale; may apply again |
| 7 | Have applied substantially; information useful |
| 8 | Constant application on-going; information valuable |
| 9 | Need more information; wider application |
-

RATING SYSTEM FOR NSRP PROJECTS EVALUATION

APPENDIX B

**SPC Panel Meeting
Management and Administration**

Questionnaire/Worksheet

NATIONAL SHIPBUILDING RESEARCH PROGRAM
 + + +
 PROJECT BENEFIT ANALYSIS
 and
 EVALUATION OF PANEL MEETINGS AND ADMINISTRATION
 + + +
 INTERVIEW QUESTIONNAIRE

Date _____

Shipyards Coded Identity _____

(Note: Shipyards identity will not be revealed in the published report.)

Shipyards/Company Name _____
 Location/Address _____

Persons Contacted _____		
Position/Title _____		
Mailing Address _____		
Telephone _____		
Panel Interest _____		

Shipyards/Company Size (#) _____ Production Workers (#) _____

Ship Types _____

New Construction (Y/N) _____ Repair (Y/N) _____ Union (Y/N) _____

Current Workload Size _____

Remarks _____

QUESTIONNAIRE

Panel SP-_____

Name_____Company_____Date_____

PANEL MEETINGS AND ADMINISTRATION

How often do you attend _____

Do/should others in your Company attend _____

Are the meetings of value to you _____

How can the meetings be improved _____

Increase/decrease number of meeting days _____

Continue/change meeting format _____

Continue/change content of meeting _____

Broaden/restrict who can attend _____

What should be added to the agenda _____

What should be dropped from the agenda _____

Should meeting be held in conjunction with other
organizations _____

Are meeting minutes of value to you _____

How can the NSRP be of more assistance to your company _____

What Projects would you like to see carried out _____

Do you have on-going NSRP Projects (identify) _____

What would you like to see investigated - problem areas _____

What message would you like transmitted to this Panel _____

PROJECT REPORTS AND NSRP INFORMATION

Do you receive adequate information on NSRP Project Reports _____

Do you get the 'Yellow Book' NSRP Bibliography of Publications _____

Have you ever ordered a Report from the NSRP Library _____

Is the NSRP Newsletter of value to you _____

How can NSRP information be communicated more effectively _____

Would you prefer to have a single point of contact within your company for information on meetings, availability of NSRP reports on projects, and other NSRP matters? _____

What person in your company would serve best as this point of contact? _____

APPENDIX C

**SPC Panel SP-7 Projects Listing
based on
Benefits Evaluation**

APPENDIX C

**SPC Panel SP-7 Projects Listing
based on
Benefits Evaluation**

This is an abbreviated listing of SPC Panel SP-7 projects, based on the benefit value (number of *'s) assigned to each project, highest to lowest. This listing is included as an aid to understanding which types of projects were found to be of most (and least) interest and value to the using community, based on the user comments received during this survey.

NSRP 0168 * * * * *
TITLE: Visual Reference Standards for Weld Surface Conditions, Phase I.
AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.
DATE: April 1983 *COST:* \$30,000.

NSRP 0220 * * * * *
TITLE: Visual Reference Standards for Weld Surface Conditions (Phase II).
AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.
DATE: August 1985 *COST:* \$71,000. (Phase II)

NSRP 0339 * * * * *
TITLE: Design and Planning Manual for Cost Effective Welding.
AUTHOR: Frank Gatto, Brian Lawlor, and Joyce McMillin.
DATE: October 1991 *COST:* (Not available)

NSRP 0241 * * * * *
TITLE: Investigation of Tubular Electrodes Designed for Submerged Arc Welding Applications,
Final Report.
AUTHOR: Newport News Shipbuilding.
DATE: July 1985 *COST:* \$110,000.

NSRP 0338 * * * * *
TITLE: Visual Reference Standards for Weld Surface Conditions and User's Guide for
Weld Replicas Phase III.
AUTHOR: William Hanzalek, Dr. D.Y. Ku, and R.F. Waite.
DATE: September 1991 *COST:* (Not available)

NSRP 0110 * * * * *

TITLE: Ceramic Weld Backing Evaluation.

AUTHOR: Offshore Power Systems, for Bethlehem Steel, Sparrows Point.

DATE: June 1980

COST: (Not available)

NSRP 0297 * * * * *

TITLE: Evaluation of the Fillet Weld Shear Strength of Flux Cored Arc Welding Electrodes.

AUTHOR: Ingalls Shipbuilding, Inc.

DATE: July 1990

COST: \$50,000.

NSRP 0299 * * * * *

TITLE: Flame Bending of Pipe for Alignment Control.

AUTHOR: Ingalls Shipbuilding, Inc.

DATE: March 1990

COST: \$72,000.

NSRP 0336 * * * * *

TITLE: Practical Guide for Flame Bending of pipe

AUTHOR: Frank Gatto

DATE: August 1991

COST: (Not available)

NSRP 0054 * * * * *

TITLE: Plasma Processes of Cutting and Welding.

AUTHOR: Linde Division of Union Carbide Corporation, Tarrytown New York for
Bethlehem Steel, Sparrows Point.

DATE: February 1976

COST: (Not available)

NSRP 0166 * * * * *

TITLE: Acceptance Standards for Nondestructive Test Not Required by Classification -
Phase L

AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.

DATE: March 1983

COST: (Not available)

NSRP 0195 * * * * *

TITLE: Study of Fitting and Fairing Aids of U.S. Shipyards.

AUTHOR: Todd Pacific Shipyard Corporation, Los Angeles Division,
for Newport News Shipbuilding.

DATE: August 1984

COST: \$100,000.

NSRP 0292 * * * * *

TITLE: Evaluation of the Benefits of HSLA Steels.

AUTHOR: Ingalls Shipbuilding.

DATE: March 1989

COST: \$95,000.

NSRP 0314 * * * * *
TITLE: Fabrication Accuracy Through Distortion Control In Shipbuilding.
AUTHORS: Ron Besselievre and Lee Norton.
DATE: September 1990 *COST:* (Not available)

NSRP 0326 * * * * *
TITLE: High Yield Strength Cast Steel with Improved Weldability.
AUTHOR: Robin K. Churchill and Jack H. Devletian
DATE: May 1991 *COST:* \$71,000.

NSRP 0040 * * * * *
TITLE: Development of Extended Length Continuous Wire Feed System.
AUTHOR: Hobart Brothers, Troy, for Bethlehem Steel, Sparrows Point.
DATE: May 1974 *COST:* (Not available)

NSRP 0041 * * * * *
TITLE: Development of a Portable AC/DC Welding Power Supply Module.
AUTHOR: Celesco Industries, Inc., for Bethlehem Steel, Sparrows Point.
DATE: June 1974 *COST:* (Not available)

NSRP 0086 * * * * *
TITLE: Mechanized Gas Metal Arc Welding of Light Plate.
AUTHOR: M. T. Gilliland Company, for Bethlehem Steel, Sparrows Point.
DATE: February 1979 *COST:* (Not available)

NSRP 0215 * * * * *
TITLE: Acceptance Standards for Nondestructive Test Not Required by Classification
(Phase II).
AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.
DATE: June 1985 *COST:* \$46,500.

NSRP 0261 * * * * *
TITLE: Evaluation of the Usability and Benefits of Twist Wire GMAW and FCAW
Narrow Gap Welding.
AUTHOR: Puget Sound Naval Shipyard.
DATE: March 1988 *COST:* \$75,000.

NSRP 0291 * * * * *
TITLE: Tracking System for Automatic Welding-Phase II Improvement of ContactTip Life
for Through-the-Arc Welding System.
AUTHOR: Ingalls Shipbuilding.
DATE: February 1989 *COST:* \$196,000.

NSRP 0343 * * * * *
TITLE: Evaluation of Hitachi Zosen Portable Welding Robotics
AUTHOR: G. J. Blasko, D. J. Moniak and B. C. Howser.
DATE: April 1992 *COST:* (Not available)

NSRP 0039 * * * * *
TITLE: One Side Welding - Flux Development and Study of Multiple Arc Behavior.
AUTHOR: Linde Division of Union Carbide Corporation. Tarrytown, New York for Bethlehem Steel, Sparrows Point.
DATE: 1974 *COST:* (Not available)

NSRP 0048 * * * * *
TITLE: Toughness Evaluation of Electroslag and Electrogas Weldments.
AUTHOR: American Bureau of Shipping, for Bethlehem Steel, Sparrows Point.
DATE: March 1975 *COST:* (Not available)

NSRP 0062 * * * * *
TITLE: Development of an All Position Automatic Welding Machine.
AUTHOR: M. T. Gilliland Company, for Bethlehem Steel, Sparrows Point.
DATE: December 1976 *COST:* (Not available)

NSRP 0072 * * * * *
TITLE: High Metal Deposition Welding, Volume I and II (Expanded version of NSRP 0063).
AUTHOR: TAPCO International, for Bethlehem Steel, Sparrows Point.
DATE: December 1978 *COST:* (Not available)

NSRP 0113 * * * * *
TITLE: Extension of E7024 Electrode Application in Shipbuilding.
AUTHOR: American Bureau of Shipping, for Bethlehem Steel, Sparrows Point.
DATE: August 1980 *COST:* (Not available)

NSRP 0145 * * * * *
TITLE: SMAW Ceramic Weld Backing Evacuation - Final Report.
AUTHOR: Offshore Power Systems, for Newport News Shipbuilding.
DATE: March 1982 *COST:* \$54,300.

NSRP 0173 * * * * *
TITLE: Study Mission to Japan - Trip Report.
AUTHOR: Bruno L. Alia, Benjamin C. Howser, C. L. Null, and R. K. Richie.
DATE: July 1983 *COST:* \$20,604.

NSRP 0253 * * * *

TITLE: Automatic Submerged Arc Welding With Metal Powder Additions to Increase Productivity and Maintain Quality.

AUTHOR: Newport News Shipbuilding.

DATE: June 1986

COST: \$70,000.

NSRP 0262 * * * *

TITLE: Evaluation of High Strength Steels Produced by Advanced Metallurgical Processes.

AUTHOR: American Bureau of Shipping.

DATE: September 1987

COST: \$90,000.

NSRP 0085 * * *

TITLE: Applications of Plasma Arc to Bevel Cutting.

AUTHOR: Hypertherm, Inc., for Bethlehem Steel, Sparrows Point.

DATE: 1979

COST: (Not available)

NSRP 0099 * * *

TITLE: Property and Productivity Improvements in Electroslag and Electrogas Welding.

AUTHOR: Material Sciences Northwest, Inc., for Bethlehem Steel, Sparrows Point.

DATE: January 1980

COST: (Not available)

NSRP 0118 * * *

TITLE: Self-Shielded Flux-Cored Wire Evaluation

AUTHOR: Offshore Power Systems, for Bethlehem Steel, Sparrows Point.

DATE: December 1980

COST: (Not available)

NSRP 0184 * * *

TITLE: Out-Of-Position Welding of 5000 Series Aluminum Alloys Using Pulse GMAW Power Sources.

AUTHOR: Todd Pacific Shipyard Corporation Seattle Division,
for Newport News Shipbuilding and Dry Dock.

DATE: January 1984

COST: \$100,000.

NSRP 0209 * * *

TITLE: Higher Strength Steels Specially Processed for High Heat Input Welding.

AUTHOR: American Bureau of Shipping, for Newport News Shipbuilding.

DATE: February 1985

COST: \$34,500.

NSRP 0257 * * *

TITLE: Consumable Guide Electroslag Welding of 4 to 24 Inch Thick Carbon Steel Castings.

AUTHOR: Newport News Shipbuilding.

DATE: August 1986

COST: \$100,000.

NSRP 0044 **

TITLE: Applicability of Laser Welding to Ship Production, Volume 1.

AUTHOR: United Aircraft Research Laboratories, for Bethlehem Steel, Sparrows Point.

DATE: August 1974

COST: (Not available)

NSRP 0051 **

TITLE: Applicability of Firecracker Welding to Ship Production.

AUTHOR: Battelle-Columbus Laboratories, for Bethlehem Steel, Sparrows Point.

DATE: July 1975

COST: (Not available)

NSRP 0080 **

TITLE: Dynamic Tear Test Correlation with Explosion Bulge Test at the Same Temperature.

AUTHOR: American Bureau of Shipping, for Bethlehem Steel, Sparrows Point.

DATE: January 1979

COST: (Not available)

NSRP 0182 **

TITLE: Unimation "Apprentice" Welding Robot for Shipyard Application.

AUTHOR: Todd Pacific Shipyards Corporation, Los Angeles Division,
for Newport News Shipbuilding and Dry Dock.

DATE: December 1983

COST: \$105,000.

NSRP 0183 **

TITLE: Cincinnati Milacron T3 Robot for Shipbuilding Welding.

AUTHOR: Todd Pacific Shipyard Corporation, Los Angeles Division,
for Newport News Shipbuilding and Dry Dock.

DATE: January 1984

COST: \$54,000.

NSRP 0211 **

**TITLE: Evaluation of an Automatic Seam Tracking/Adaptive Control Welding System
for Shipyard Applications - Phase 1 Report.**

AUTHOR: General Dynamics, Electric Boat Division, for Newport News Shipbuilding.

DATE: February 1985

COST: \$70,000.

NSRP 0063 *

TITLE: High Metal Deposition Per Ampere

AUTHOR: Linde Division of Union Carbide Corporation for Bethlehem Steel, Sparrows Point.

DATE: 1977

COST: (Not available)

NSRP 0083 *

TITLE: Investigation of Welding Processes for Low Temperature Applications.

AUTHOR: American Bureau of Shipping, for Bethlehem Steel, Sparrows Point.

DATE: January 1979

COST: (Not available)

NSRP 0095 *

TITLE: Applicability of Laser Welding to Ship Production, Volume II.

AUTHOR: United Aircraft Research Laboratories, for Bethlehem Steel, Sparrows Point.

DATE: December 1979

COST: (Not available)

NSRP 0112 *

TITLE: The Development of a Composite Consumable Insert for Submerged Arc Welding,

AUTHOR: IIT Research Institute, for Bethlehem Steel, Sparrows Point

DATE: August 1980

COST: (Not available)

NSRP 0121 *

TITLE: Proceedings of First Conference on Fitness-For-Service in Shipbuilding.

AUTHOR: Leslie W. Sandor, ed.

DATE: January 1981

COST: (Not available)



Additional copies of this report can be obtained from the National Shipbuilding Research Program Coordinator of the Bibliography of Publications and Microfiche Index. You can call or write to the address or phone number listed below.

NSRP Coordinator
The University of Michigan
Transportation Research Institute
Marine Systems Division
2901 Baxter Rd.
Ann Arbor, MI 48109-2150
Phone: (313) 763-2465
Fax: (313) 936-1081