

SPONSORED PROJECT TERMINATION SHEETDate 11/16/81

Project Title: New Design Combatant Ship RCS Evaluation

Project No: A-2839

Project Director: Ms. M. M. Horst

Sponsor: Litton Systems, Inc., Ingalls Ship Building Div., Pascagoula, MS

Effective Termination Date: 6/4/81Clearance of Accounting Charges: 6/4/81

Grant/Contract Closeout Actions Remaining:

- ☒ Final Invoice and Closing Documents  
☐ Final Fiscal Report  
☐ Final Report of Inventions  
☐ Govt. Property Inventory & Related Certificate  
☐ Classified Material Certificate  
☐ Other \_\_\_\_\_

Assigned to: RAIL/MAD (School/Laboratory)COPIES TO:

Administrative Coordinator  
Research Property Management  
Accounting  
Procurement/EES Supply Services

Research Security Services  
~~Reports Coordinator (OCA)~~  
Legal Services (OCA)  
Library

EES Public Relations (2)  
Computer Input  
Project File  
Other \_\_\_\_\_



## ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

25  
SR/43 364

17 March 1981

Ingalls Shipbuilding  
P. O. Box 149  
Pascagoula, MS 39567

Attention: William H. Cook  
M/S 1090-05

Subject: Monthly Progress Report 1-4 (Deliverable Nos. 1, 3, 5, and 7)  
on P. O. Number 51 - 19085 - 11 (GIT/EES Project A-2839)

Gentlemen:

This letter progress report summarizes efforts on the above referenced Purchase Order for the period November 1980 through February 1981. Although the Purchase Order was initially dated 11 November 1980, it was not signed by Georgia Tech until 12 January 1981, so work did not begin until that date.

Efforts in January and February were concentrated upon construction of the computer model for the LODEC design. Two new algorithms useful in model building were developed. One generates rows of triangular flat plate elements, such as those used to represent the hull, from rows of data points. The second algorithm performs general polynomial interpolation, which is useful in patching together model pieces which were constructed separately.

The LODEC ship model was completed except for small details around the stack and forward bridge windows. A meeting was held at Georgia Tech on 18 February with Bill Cook and Harry Cheyne of Ingalls to discuss these and other details of the LODEC design. Sample computer runs indicated that the rounded covering on the ship could not be modeled as a collection of flat triangular elements, as these would not provide accurate enough RCS predictions for a surface that was actually curved unless the plate size was very small, creating unacceptably large data files. Modeling the cover as a collection of truncated cone frusta was determined to be the best approach, but this requires geometrical theory of diffraction (GTD) equations to calculate RCS. These algorithms are not currently part of the ship RCS model, but can be implemented.

Monthly Progress Reports 1-4  
17 March 1981  
Page 2

During the next reporting period, the remaining details on the LODEC model will be finalized. Efforts to implement GTD equations for truncated cone frusta will begin.

Respectfully submitted,

Margaret M. Horst  
Project Director

SWC

Approved:

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M. T. Tuley, Associate Chief  
Modeling and Analysis Division



## ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

15 April 1981

Ingalls Shipbuilding  
P. O. Box 149  
Pascagoula, MS 39567

Attention: Mr. William H. Cook  
M/S 1090-05

Subject: Monthly Progress Report No. 5 (Deliverable No. 9) on  
P. O. No. 51-19085-11 (GIT/EES Project A-2839)

Gentlemen:

This letter progress report summarizes efforts on the above referenced purchase order during the month of March 1981.

The LODEC ship model representation was completed. Algorithms were implemented to approximate the curved LODEC cover by a collection of frustum slices. The new LODEC model with the cover composed of partial frusta has been constructed. In addition, useful software has been developed which makes model modifications and refinements much easier. With the new software, the number of frustum slices in the covering can be increased arbitrarily (by interpolation), a smoke stack of different dimensions can be easily constructed, and the entire covering can be approximated by an arbitrarily fine mesh of flat triangular elements. The ability to easily modify the model shape is an extremely useful feature in the design process.

The disadvantage of the choice of frustum slices is that the current RCS model, CROSS, does not have the capability of modeling partial frusta. CROSS may provide a reasonable approximation when there is a specular point on the partial frustum. However, the existing model could not handle the case when there is no specular point. Therefore, efforts have been made to add to CROSS the capability of predicting the RCS from a partial frustum in the special case which occurs in this application. In addition, it has been necessary to develop new software to create the collection of partial frusta which form the LODEC covering.

The necessary modifications to CROSS include the addition of a new scattering type (a partial frustum) and a subroutine(s) to calculate the cross section from the new type. The new subroutine must be able to (1) determine if there is a specular point on the partial frustum,



Monthly Progress Report No. 5  
GIT/EES Project A-2839  
15 April 1981  
Page 2

(2) determine if one or both of the edges are visible and if so, (3) calculate the RCS contribution from edge diffraction. These routines have been written, but they have not yet been debugged and tested. Another task to be completed is the modification of the file editor program to accomodate the new scatterer type. The form in which the data file is structured is also needed for reading the data in CROSS.

During the next reporting period, the edge diffraction routines will be completed and tested. Comparisons between predictions using the covering composed of frustum slices and that using triangles will be carried out. The RCS computer runs for the specified matrix of cases will be initiated.

Respectfully submitted,

Margaret M. Horst  
Project Director

SWC

Approved:

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M. T. Tuley, Associate Chief  
Modeling and Analysis Division



# ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

12 May 1981

Ingalls Shipbuilding  
P. O. Box 149  
Pascagoula, MS 39567

Attention: Mr. William H. Cook  
M/S 1090-05

Subject: Monthly Progress Report No. 6 (Deliverable No. 11)  
on P. O. No. 51-19085-11 (GIT/EES Project A-2839)

Gentlemen:

This letter progress report summarizes efforts on the above referenced purchase order during the month of April 1981.

Software routines to handle edge contributions to RCS were completed and tested. The LODEC model was completed and the matrix of RCS predictions was generated. Predictions were also generated for the FFG-7 to completed a similar matrix. Analysis of the predictions was initiated.

During the next reporting period, the analysis will be completed and the final report will be written.

Respectfully submitted,

Margaret M. Horst  
Project Director

SWC

Approved:

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M. T. Tuley, Associate Chief  
Modeling and Analysis Division



ENGINEERING EXPERIMENT STATION  
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

1 June 1981

Ingalls Shipbuilding  
P. O. Box 149  
Pascagoula, MS 39567

Attention: Mr. William H. Cook  
M/S 1090-05

Subject: Monthly Progress Report No. 7 (Deliverable No. 13) on  
P. O. No. 51-19085-11 (GIT/EES Project A-2839)

Gentlemen:

This letter progress report summarizes efforts on the above referenced purchase order during the month of May 1981.

The computer runs were completed and analysis of results was done. The major effort during the reporting period was the generation of the Final Technical Report on the project, to be delivered under separate cover. The report is presently undergoing internal review at Georgia Tech and will be submitted later this month.

Respectfully submitted,

Margaret M. Horst  
Project Director

SWC

Approved:

M. T. Tuley, Associate Chief  
Modeling and Analysis Division



ENGINEERING EXPERIMENT STATION  
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

17 March 1981

Ingalls Shipbuilding  
P. O. Box 149  
Pascagoula, MS 38567

Attention: William H. Cook  
M/S 1090-05

Subject: Monthly Time Records 1-4 (Deliverable Nos. 2,4,6, and 8) on  
P. O. No. 51-19085-11 (GIT/EES Project A-2839)

Gentlemen:

The Monthly Time Records on the above referenced Purchase Order for the period November 1980 through February 1981 are summarized below for your approval.

November, 1980

No charges weremade to the project.

December, 1980

No charges were made to the project.

January, 1981

<u>Name</u>	<u>SSN</u>	<u>Dates</u>	<u>No. of Hours</u>	<u>P.S. Charges</u>
*H. L. Bassett	434-44-7852	20,21	8.5	\$ 185.02
*M. M. Horst	416-66-2226	19,20	8.5	138.21
*J. W. Peifer	255-02-0926	12-30	108	1334.15
*R. B. Rakes	224-82-8367	19-23	34	386.09
P. S. TOTAL				\$2043.47

\* Hours calculated from percentage time sheets.

Monthly Time Records 1-4  
17 March 1981  
Page 2

February, 1981

<u>Name</u>	<u>SSN</u>	<u>Dates</u>	<u>No. of Hours</u>	<u>P.S. Charges</u>
*H. L. Bassett	434-44-7852	18-20	17	\$ 370.04
*D. E. Wrege	205-34-2181	4	4	70.62
*M. M. Horst	416-66-2226	9-11	17	276.42
*J. W. Peifer	255-02-0926	2-10, 16-24	108	1334.15
*E. F. Knott	381-28-1726	5,6	8.5	190.37
*D. I. Winters	420-88-8039	4	7	51.80
*W. F. Horne	241-88-0468	17,18	14	148.37
M. C. Boatwright	483-84-3574	13	1	6.10
K. D. Vaughn	252-98-8432	29,30,2-4		
		10-27	136	576.00
R. V. Duncan	266-96-6582	30	8	62.40
J. E. Meredith	290-50-7272	11, 18	12	89.22
S. W. Cuttino	257-90-2244	10, 11	10	53.44
			P. S. TOTAL	<u>\$3228.93</u>

\* Hours calculated from percentage time sheets.

Please sign your approval below and forward five (5) copies to C. H. Marecki, M/S 1090-52.

Respectfully submitted,

Margaret<sup>✓</sup> Horst  
Project Director

SWC

Approved:

M. T. Tuley, Associate Chief  
Modeling and Analysis Division

Approved

W. H. Cook



# ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

23 April 1981

Ingalls Shipbuilding  
P. O. Box 149  
Pascagoula, MS 39567

Attention: Mr. William H. Cook  
M/S 1090-05

Subject: Monthly Time Record No. 5 (Deliverable No. 10) on  
P. O. No. 51-19085-11 (GIT/EES Project A-2839)

Gentlemen:

The Monthly Time Record on the above reference purchase order for March 1981 is summarized below for your convenience.

## March, 1981

<u>Name</u>	<u>SSN</u>	<u>Dates</u>	<u>No. of hours</u>	<u>PS Charges</u>
*R. B. Rakes	224-82-8367	16, 17, 18, 25 26, 27	42.5	\$ 482.61
*M. M. Horst	416-66-2226	17, 18, 19	17	476.42
*J. W. Peifer	255-02-0926	2-6, 9-13, 16-20 23-27	144.5	1,800.04
S. W. Cuttino	257-90-2244	17, 18, 19	5.5	29.69
E. A. O'Brien	478-60-4488	2, 3, 4	12	78.00
F. P. Sheppard	260-86-3470	3, 6, 10, 13	29	131.95
M. C. Boatwright	483-84-3574	17	8	48.80
**K. D. Vaughn	252-98-8432	2/23-27, 3/3-6, 9-13, 16	120	720.00
R. V. Duncan	266-96-6582	9, 10, 11	20	156.00
A. R. Cobb	255-84-3513	3, 4, 12, 13	18	90.90
P. S. Total				\$3,814.41

\*Hours calculated from percentage time sheet.

\*\*Hours reported for this gentleman were incorrect for February. The February charges reflected 96 hours only. The 40 hours from 2/23-27 are included in the March total of \$720.

Monthly Time Record No. 5  
GIT/EES Project A-2839  
23 April 1981  
Page 2

Please sign your approval below and forward five (5) copies to  
C. H. Marecki, M/S 1090-52.

Respectfully submitted,

✓  
Margaret M. Horst  
Project Director

swc

Approved:

✓  
\_\_\_\_\_  
M. T. Tuley, Associate Chief  
Modeling and Analysis Division

Approved:

\_\_\_\_\_  
W. H. Cook  
Technical Monitor



# ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

22 May 1981

Ingalls Shipbuilding  
P. O. Box 149  
Pascagoula, MS 39567

Attention: William H. Cook  
M/S 1090 - 05

Subject: Monthly Time Record No. 6 (Deliverable No. 12) on  
P. O. No. 51-19085-11 (GIT/EES Project A-2839)

Gentlemen:

The Monthly Time Record on the above reference Purchase Order for the month of April 1981 is summarized below for your approval.

<u>Name</u>	<u>SSN</u>	<u>Dates</u>	<u>No. of Hours</u>	<u>PS Charges</u>
*H. L. Bassett	434-44-7852	20, 21	8.5	\$ 185.02
*R. B. Rakes	224-82-8367	13-17, 20-24	44	501.91
*M. M. Horst	416-66-2226	14, 22	8.5	138.20
*J. W. Peifer	255-02-0926	1-30	86	1058.85
*E. F. Knott	381-28-1726	9, 10, 13-16	23	514.00
M. Boatwright	483-84-3574	8	2	12.20
D. L. Rich	254-11-9653	2,3, 6-10, 14, 15	77	469.70
R. V. Duncan	266-96-6582	15, 16	16	124.80
S. W. Cuttino	257-90-2244	22, 23, 24	5.5	29.69
			TOTAL	\$ 3034.37

\*Hours calculated from percentage time sheets.

Please sign your approval below and forward five (5) copies to  
C. H. Marecki, M/S 1090-52.

Respectfully submitted,

Margaret M. Horst  
Project Director  
Approved:

Approved:

M. T. Tuley, Associate Chief  
Modeling and Analysis Division

William H. Cook





ENGINEERING EXPERIMENT STATION  
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

16 June 1981

Ingalls Shipbuilding  
P. O. Box 149  
Pascagoula, MS 39567

Attention: William H. Cook  
M/S 1090-05

Subject: Monthly Time Record No. 7 (Deliverable No. 14) on P. O. No.  
51-19085-011 (GIT/EES Project A-2839)

Gentlemen:

The Monthly Time Record on the above referenced Purchase Order for the month of May 1981 is summarized below for your approval.

<u>Name</u>	<u>SSN</u>	<u>Dates</u>	<u>No. of Hours</u>	<u>PS Charges</u>
E. A. O'Brien	478-60-4488	21,22	14	\$ 91.00
*R. B. Rakes	224-82-8367	14,15	13.5	154.44
*J. W. Peifer	255-02-0926	20,21	12	148.24
S. W. Cuttino	257-90-2244	4-15,22,24,29; 5-4,7,12-13	15	80.16
*C. S. Fuller	219-50-9815	27,28,29	17	126.00
*M. C. McGee	427-64-9189	27,28,29	17	287.12
			TOTAL	\$886.96

\*Hours calculated from percentage time sheet.

Please sign your approval below and forward five (5) copies to C. H. Marecki,  
M/S 1090-52.

Respectfully submitted,

Margaret M. Horst  
Project Director

Approved:

Approved:

M. T. Tuley Associate Chief  
Modeling and Analysis Division

W. H. Cook



# ENGINEERING EXPERIMENT STATION

GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

20 July 1981

Ingalls Shipbuilding  
P. O. Box 149  
Pascagoula, MS 39567

Attention: William H. Cook  
M/S 1090-05

Subject: Monthly Time Record No. 8 (Deliverable No. 16) on P. O. No.  
51-19085-011 (GIT/EES Project A-2839)

Gentlemen:

Remaining funds on the above referenced Purchase Order were expended in the month of May 1981. Therefore there is no Monthly Time Record for the month of June 1981.

Please forward five (5) copies of this letter to C. H. Marecki,  
M/S 1090-52.

Respectfully submitted,

Margaret M. Horst  
Project Director

SWC

Approved:

Approved:

M. T. Tuley, Associate Chief —  
Modeling and Analysis Division

\_\_\_\_\_  
W. H. Cook