



**GENERAL DYNAMICS**  
Electric Boat

***ManTech Design for Production (DfP)  
Supporting Virginia Cost Reduction***

***Mr. Barry Espeseth, Electric Boat***

**NSRP PDMT Panel Meeting  
*September 25, 2007***





## **DfP Issue / Problem Description**

- **Design decisions lack a robust process for integration and evaluation of the latest manufacturing methods.**
- **Knowledge of fabrication practices, standard and tools either do not exist or are not readily available to designers. This results in:**
  - **use of old/or obsolete methods,**
  - **data duplication,**
  - **many unique copies of the same basic parts**
  - **costly human interventions in the form of hand-offs.**
- **Delivery of design products to manufacturing involves hand offs and independent manual creation of non-configuration managed 3D isometric manufacturing aids.**



## **DfP Plan Objective**

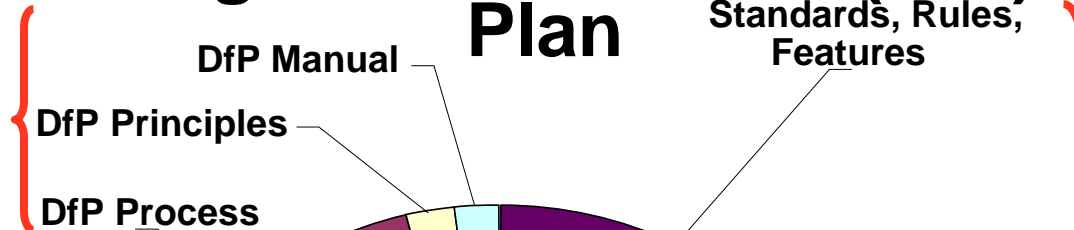
**Develop and demonstrate the Design for Production process for manufacturing and providing the design data seamlessly (on demand) to the shop floor to:**

- **reduce production costs**
- **eliminate post design disclosure manipulation of and changes to the design data**
- **eliminate duplication of efforts**
- **improve configuration management,**
- **infuse state of the art manufacturing & tooling methods into the design**



# Virginia Class Design for Production (DfP) Plan

**DfP-0 Process Establishment:  
Develop overall Virginia DfP Process  
(awarded 4/13)**



**DfP-3 Design Alts to Reduce Costs:  
Develop reqts and concept validation for capturing cost, rules and standards  
(award ECD 12/15)**

**Seamless Deliverables**

**DfP-2 Seamless Delivery Of Extended 3D Product Model:  
Develop reqts and concept validation of producing manufacturing workbooks directly from the 3D Model  
In lieu of 2d drawings  
(award ECD 11/15)**

**DfP-1 Knowledge Tools:  
Develop requirements & proof of concept database to house DfP features, rules, standards, and related cost data  
(award ECD 10/30)**



# Virginia Class Design for Production (DfP) Plan

- **DfP-0: Process Establishment**
  - Phase I: DfP Process Methodology Development
  - Phase II: Prototype Implementations
  - Final Report: Project results and “lessons learned”



### DfP Guiding Principles

Designs That Capture The Optimized Assembly/Installation Sequence Without Need For Post Design Activities

Designs That Are Construction Cost Based

DESIGN FOR PRODUCTION  
Seamlessly Enables Customers To Take Full Advantage Of Their Production Processes

Designs That Incorporate Enhanced Modular Construction, Inspection, and Test

Designs That Support Work Cell Product Families And The Associated Manufacturing Preferred Practices

Designs That Use Computerized Design Standards & Rules Based Requirements



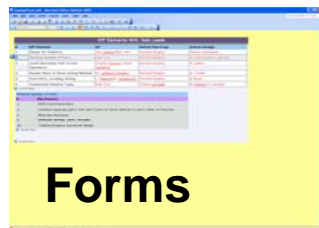
# Virginia Class Design for Production (DfP) Plan

- **DfP-1: Knowledge Tools**
  - Develop Process maps for each design discipline
  - Develop topic maps for designers to easily retrieve DfP rules & stds
  - Prototype software system to house, maintain and easily search DfP knowledge

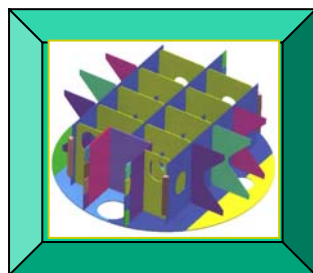


# DfP Knowledge Portal

**Authoring**



**Publish**



**Findability**



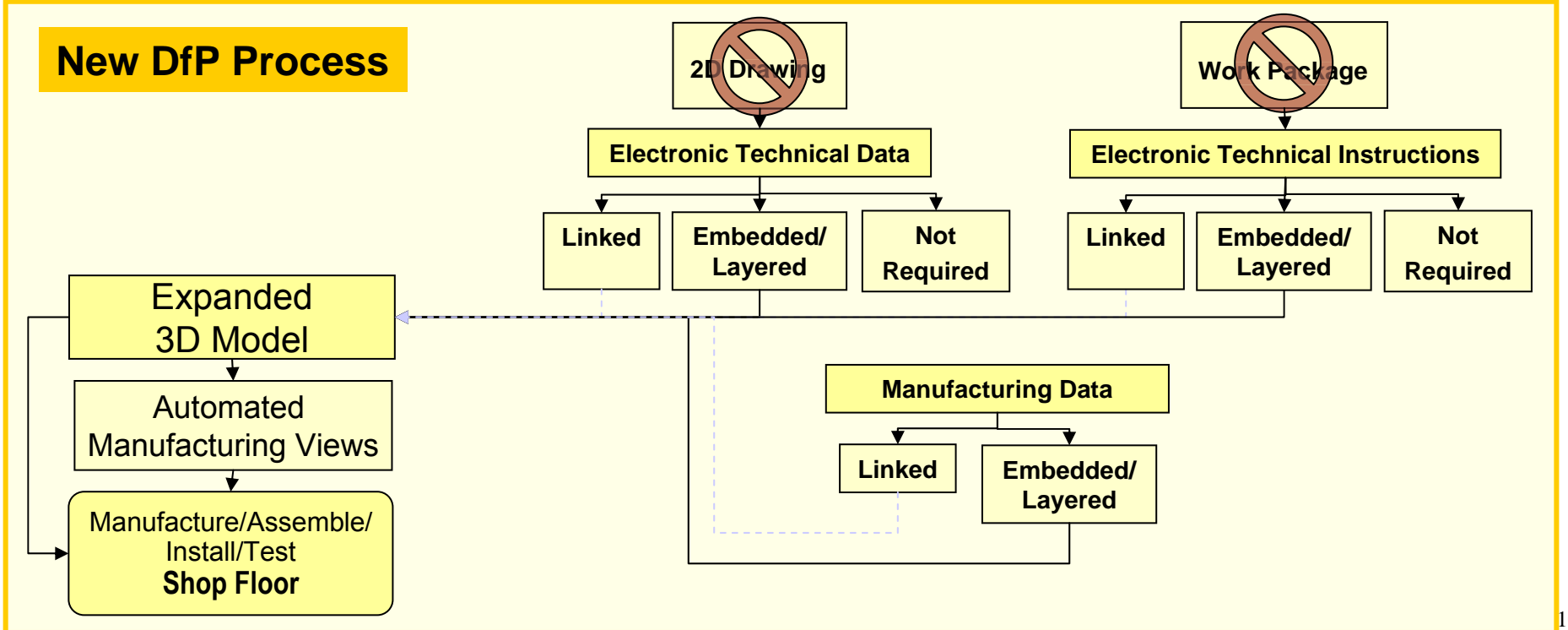
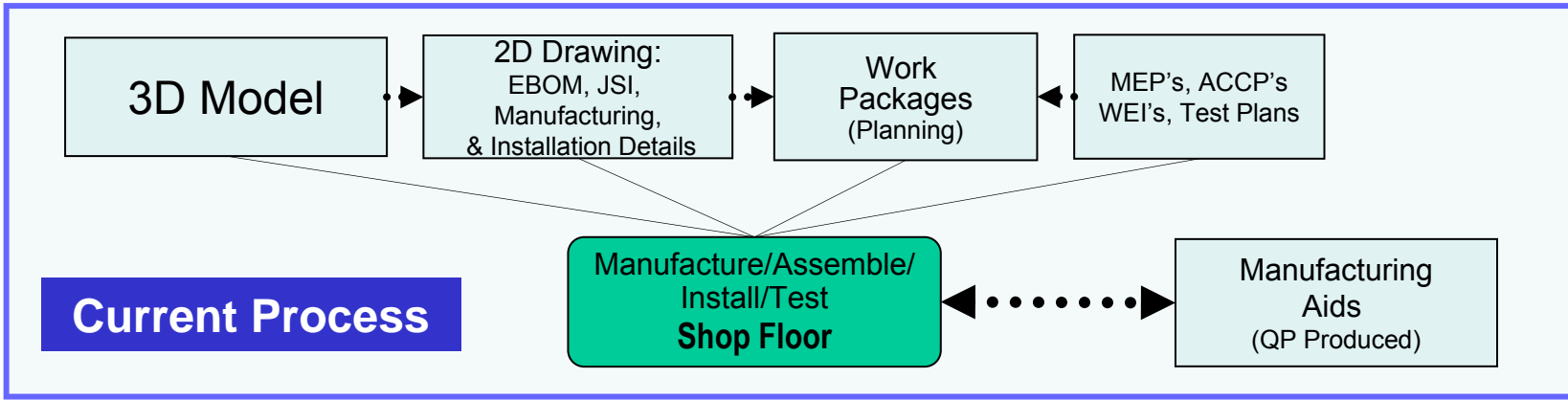


# Virginia Class Design for Production (DfP) Plan

- **DfP-2: Seamless Delivery of 3D Product Model**
  - Define requirements for expanded 3D product model
  - Develop methodologies to integrate design deliverables into work packages
  - Provide capability to provide design data into easily produced, configuration managed manufacturing aids



### Seamless Deliverables





## Seamless Deliverable of Design Data

### DfP

Seamlessly  
Enable Customers To  
Take Full Advantage Of  
Their Production  
Processes

- On CVN Module, Quonset Point successfully used Manufacturing Aid Workbook, saving manufacturing labor.
- Several opportunities for additional savings exist through the use of DfP concepts and Seamless Deliverables.

CVN PRODUCTION OBJECTIVE QUALITY EVIDENCE SHEET

**CVN Module Manufacturing Aid Workbook**

NSQ1/SSP FORM PRODUCTION OBJECTIVE QUALITY EVIDENCE SHEET

NSQ1 03.10 INITIAL VISUAL INSPECTION OF COMPLETED WELDS  
 NSQ1 03.0 NT / UT / RT  
 13.1 WELD CONSUMABLES, ISSUE AND CONTROL  
 13.16 FITUP AND WELDING OF STRUCTURES  
 NSQ1 13.17 REMOVAL OF WELDS, WELDED AREA  
 FABRICATION DAMAGE ON BASE METAL  
 21.01 IDENTIFICATION, MARKING AND CONTROL OF PRODUCTION MATERIAL  
 QA1-611.5 FINISH REQUIREMENTS FOR FLANG OR ARC CUT SURFACES  
 Y-1035 TEMPORARY ATTACHMENTS  
 NSQ1 23.29 MDT DOCUMENTATION PROCEDURE  
 NSQ1 23.38 WELD REPAIR DOCUMENTATION PROCEDURE

OPERATION	NAME	BADGE
Fit-up		N/A
BACKLOGUE		N/A
WT		
DIM. DATA		

MANUFACTURING AID  
 DOCUMENT  
 DS1301A-PROCESS B  
 RELEASE DATE: 3/27/03  
 CONTROL COPY:  DS1301A  
 DRAWING NO: DS1301A-1 REV: A  
 C/N: 1899 800  
 CVN70 1 1 of 54

PROPELLER APPROVED WELDING SYSTEM TILES



# Virginia Class Design for Production (DfP) Plan

- **DfP-3: Design Alternatives to Reduce Costs**
  - **For each manufacturing shop:**
    - **Determine current cost metrics and rules**
    - **Extract key design cost drivers for each design phase**
  - **Translate cost metrics into format usable by design (ie rules & stds)**
  - **Validate above process with a separate piping and structural system selection.**



# GENERAL DYNAMICS

## Electric Boat



### Qualitative Cost Trade-Off Matrix:

### Sheet Metal ITMP

### DfP Team Comments/Recommendations:

Element Metrics Design for Simplicity - Consider These to Get Lower Cost Designs	Weighting Factor	Baseline	New Design	
		Rating	Best	Worst
Minimize Number of Parts	3	10	2	2
Avoid Secondary Part to Part Ops	3	4	1	3
Reduce Piece to Piece Joining	3	8	1	8
Form Parts, Avoiding Joining	3	10	3	3
Standardize Material Types	3	2	2	2
Minimize the Need for Staging	3	--	--	--
Minimize Work Cell Transfers	3	3	3	3
Maximize Plate Marking	3	--	--	--
Minimize Lifting & Handling	3	--	--	--
Reduce Unnecessary Critical Alignment	3	--	--	--
Eliminate Hazardous Materials	3	--	--	--
Optimize the Use of Fixtures	3	--	--	--
Eliminate Special Tooling	3	8	1	1
Standardized Parts	3	2	1	1
Minimize Welding	3	--	--	--
Minimize Special Welding Reqs	3	3	1	1
Integrate Lifting into Part Design	3	--	--	--
Optimize Manufacturing Work Cell Ops	3	--	--	--
Optimize Outfitting and Assembly	3	--	--	--
Optimize for Test	3	--	--	--
Other -	3	--	--	--
Discipline Specific Worksheet Totals		0	0	0
<b>Weighted Total (Lowest is best)</b>		<b>150</b>	<b>45</b>	<b>72</b>
Process Steps		9	5	55.56%
Material Moves		--	--	--
Labor Hours		324	162	50.00%
Material Weight		--	--	--

Eliminated most parts  
 No fitup required  
 Welding of corners still req'd  
 Automated by forming  
 Reduced to one material type  
 No special tools needed  
 Standard thickness used  
 Standard corner weld used





# GENERAL DYNAMICS

Electric Boat

## DfP Standard Design



**GENERAL DYNAMICS**  
Electric Boat

**DRAFT**

**Design for Production (DfP)**  
Standard Design

Number: DFPD-S-0001  
Date: 2/13/07 Rev: A

**EB DFP**

Title: Manholes Fresh Water  
Applicable hulls: VIRGINIA

10 X Ø .813 THRU TEMPLATE LOCATION FROM ITEM 83 OR 87

171 USE WITH FRESHWATER SYSTEM

1.50 3.0

2X R10.5

2X R7.5

DETAIL 13-2B  
FLAT TYPE ASSY A101 AND A102  
SCALE: 1/4

6 OF ITEMS 3 AND 4

171 USE WITH FRESHWATER SYSTEM  
SEE PLAN 13-3F

53 (FOR A101)  
57 (FOR A102)  
SEE PLAN 9-7F

SEE PLAN 9-5F

PLAN 13-3F  
SCALE: 1/4  
(13-2B)

1 OR 5 3.0 1.50 15' 9' 2X R1.5 4X R1.5 2X R8.500 2X R7.5 2X R10.5 2X R8.500 2X R10.5 15P 2 PLACES

126 BOTTOM SIDE TO 80 THK MIN. IN VAY OF SC 2 OR 171 (GASKET SURFACE)

PLAN 9-7F (82)  
SCALE: 1/4  
(9-2E)

PLAN 9-5F (82)

VIEW 9-5H (9-5F)

16 X Ø .78 X 90° X 1.38W  
360 (10/40-30 ITEM 3)  
88 9 (R16) FULL THRO.  
STUD STANDOUT 1.8 (+ .0025)  
NOTE: THIS IS THE LOCATION FROM VIEW 1 OR 5.  
Ø 1.022(A)

**GENERAL DYNAMICS**  
Electric Boat

**DRAFT**

**Design for Production (DfP)**  
Standard Design

Number: DFPD-S-0001  
Date: 2/13/07 Rev: A

**EB DFP**

ITEM	QTY	NO	REV	COVER ASSEMBLY HANDLE	PLAN	DATE	BY	APP'D
1	1	00	01	COVER ASSEMBLY HANDLE <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
2	1	00	01	COVER HANDLE W/KEY <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
3	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
4	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
5	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
6	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
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29	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
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33	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
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39	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
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41	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
42	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
43	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
44	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
45	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
46	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
47	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
48	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
49	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
50	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
51	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
52	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
53	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
54	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
55	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
56	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
57	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
58	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
59	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
60	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
61	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
62	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
63	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
64	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
65	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
66	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
67	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
68	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
69	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
70	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
71	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
72	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
73	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
74	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
75	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
76	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
77	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
78	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
79	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
80	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
81	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
82	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
83	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
84	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
85	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
86	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
87	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
88	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
89	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
90	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
91	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
92	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
93	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
94	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
95	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
96	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
97	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
98	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
99	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ
100	1	00	01	FLAT 1/4" X 3/4" X 1/4" <td>PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td> </td>	PLAN <td>02/13/07</td> <td>WJ</td> <td>WJ</td>	02/13/07	WJ	WJ

MANHOLE COVERS OF ANY FRESHWATER SYSTEM WITH MANHOLES IN THE BELLE AREA SHALL HAVE COVER BASKETS COATED WITH PART NO. 9900. SEALANT WHITE COLOR WEL-A-BOND 5-1. STUDS USED TO HOLD THESE MANHOLE COVERS SHALL HAVE SETTING END LOOKED AND SEALED WITH PART NO. 9001. NLS-S-40153. TT-11. SH-N

FOR ADDITIONAL A1, A2, A3, A4, A5, A101, A102, A103 AND A104 THE MATERIAL FOR THE MANHOLE COVER AND LINER IS TO BE THE SAME AS THE MATERIAL TO WHICH IT IS INSTALLED.

STUDS REFERRED TO THIS NOTE ARE TO BE INSTALLED WITH ANEMERIC COATING TO MIL-S-20473 OR NAVY PART NO. 9039 AND INSPECTED IN ACCORDANCE WITH DDG-STD-13718 DATED NOVEMBER 1, 1977 AS MODIFIED BY THE WSH CLASS SHIP'S SPECIFICATIONS OR OTHER NAVSEA APPROVED PROCEDURE. SEE NOTE 7921.

THE BEATING OF THE MANHOLE COVER TO THE INSTALLED LINERS SHALL BE CHECKED WITH THE BASKETS INSTALLED AND COVERS DOGGED TIGHT. GAPS BETWEEN THE COVER AND THE SEAT SHALL NOT EXCEED .010 INCH AT THE INNER EDGE OF THE COVER. THE LINER SEAT MAY BE REMODELLED IF NECESSARY.

Engineering:	Dept	Engineering FPO:	Dept	Manufacturing Eng:	Dept
Design:	Dept	Manufacturing FPO:	Dept		

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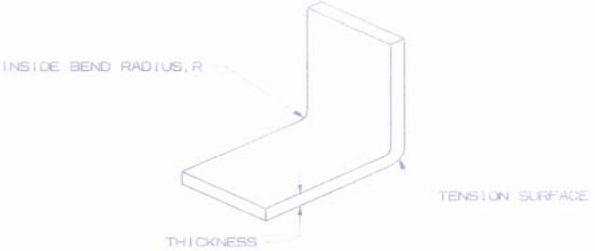


# GENERAL DYNAMICS

Electric Boat

## DfP Design Rule



<b>GENERAL DYNAMICS</b> Electric Boat		<b>DRAFT</b>			
	<b>Design for Production (DfP)</b>		<i>Number:</i> DFPR-R-0001		
	<b>Design Rule</b>		<i>Date:</i> 3/9/07 <i>Rev:</i> A		
<i>Title : Cold Formed Plates</i>			<i>Applicable hulls: All</i>		
Design rule for cold formed plates					
<b>Material Type Being Formed</b>	<b>Cold Forming Limitations</b>	<b>Corresponding Minimum Inside Bend Radius</b>	<b>Required NDT</b>	<b>Comments</b>	
OSS/HSS	See Comments	$R \geq 2T$	None	Plates formed to an inside bend radius less than 2T shall be hot formed	
HY-80/100	12% or Less Total Elongation	$R \geq 4T$	None	HY-80/100 shall not be formed to an inside bend radius less than 2T	
	Greater Than 12% Elongation	$4T > R \geq 2T$	MT Tension Surface		
HSLA-80	5 1/2 % Maximum	$R \geq 9T$	None	Minimum bend radius specified via EB letter 470-PJB/501697/5 6 for HSLA-80 material only	
					
Engineering:	Dept	Engineering FPO:	Dept	Manufacturing Eng:	Dept
Design:	Dept	Manufacturing FPO:	Dept	Page 1 of 1	



# Summary

**Virginia Cost Reduction Program is deploying  
“Design for Production” Projects with  
ONR and PEO 450 to implement changes  
to the existing design disclosure process  
to directly provide our customer  
substantial cost savings.**





**GENERAL DYNAMICS**  
Electric Boat



Questions?