COST COMPARISON

FEDERAL REGIONAL RESEARCH VESSEL

>500GT(ITC), >300GT(US)

VS.

CAPE HENLOPEN REPLACEMENT VESSEL

<500 GT(ITC), <300GT(US)

BAY MARINE, INC.
239 New Meadow Road
Barrington, RI 02806

401-245-6910
401-245-9630 (fax)
BayMarineInc@aol.com

JOB C197

REV -

January 24, 2003

CONTENTS

INTRODUCTION

Bay Marine, Inc. is currently under contract with the University of Delaware. We are in the midst of the bid design phase for the Cape Henlopen Replacement Vessel (CHRV). We are the lead consultant of the design team. We were contacted by UNOLS to do a study of the relative cost comparison between a Regional research vessel similar to the CHRV, but one that is larger than the CHRV and thus exceeds the key regulatory thresholds of 500GT(ITC) and 300GT(US). This vessel would meet the regional requirements of the FOFC report and would meet the Scientific Mission Requirements for the FOFC Regional R/V. (Draft Revision #6 – September 18, 2002).

FEDERAL REGIONAL RESEARCH VESSEL – PRINCIPAL CHARACTERISTICS

Length Overall	160 ft
Beam (Max)	37 ft
Depth	16 ft
Draft (Light)	10'-3"
Draft (Full)	11'-0"
Displacement (Light)	640 LT
Displacement (Full)	720 LT
Power	2 x 750 KW Schottel SRP 550M Z drives Diesel Electric
Total Installed KW	2500
Max Full load service speed	13.25 knots
Hull Material	Steel
Superstructure material (01 Deck and Above)	Aluminum
Crew	14
Science Party	18
Science Party (expanded)	26 (convertible lounge, berthing van)
Range	Not yet determined (8100 nm desired)
Endurance	Not yet determined (30 days desired)
Working Deck area (aft of portable vans)	1036 sf
Clear area – stbd side	50' L x 11'W (plus additional 38'Lx6'W)
Deck area/Scientist	57.5 sf/scientist
Dry Lab	620 sf
Wet Lab	420 sf
Labs (Total)	1040 sf
Lab area/Scientist	57.5 sf/scientist

CHRV – PRINCIPAL CHARACTERISTICS

Length Overall	138 ft
Beam (Max)	32 ft
Depth	14'-2"
Draft (Light)	8'-11"
Draft (Full)	9'-9"
Displacement (Light)	525 LT
Displacement (Full)	575 LT
Power	2 x 470 KW Schottel SRP 330M Z drives Diesel Electric
Total Installed KW	1600
Max Full load service speed	12.25 knots
Hull Material	Steel
Superstructure material (01 Deck and Above)	Aluminum
Crew	8
Science Party	14
Science Party (expanded)	22 (convertible lounge, berthing van)
Range	3500 nm
Endurance	21 days
Working Deck area (aft of portable vans)	800 sf
Clear area – stbd side	47' L x 7.5'W (plus additional 31'Lx4'W)
Deck area/Scientist	57 sf/scientist
Dry Lab	405 sf
Wet Lab	285 sf
Labs (Total)	690 sf
Lab area/Scientist	50 sf/scientist
Range	3500 nm
Endurance	21 days

DISCUSSION

The primary regulatory thresholds for a Oceanographic Research vessel are 300GT (US measure) and 500GT (ITC – International Tonnage Convention). When a vessel goes over 300GT(US), she must be inspected and certificated by the USCG under Subchapter U of 46CFR. When an R/V goes over 500GT(ITC), she falls under the regulations contained in the IMO (International Maritime Organization) Code of Safety for Special Purpose Ships. The SPS Code essentially delineates the portions of SOLAS that apply to research vessels. The SPS code varies according to several levels of "special personnel" carried aboard. Special personnel are defined as members of the science party. The cutoffs are 50 special personnel and 200 special personnel. Any regional vessel would fall below the 50 special personnel limit. In some areas, the SPS code modifies (usually easing) requirements of SOLAS.

500GT(ITC) is also an important cutoff in application of several areas of ABS (American Bureau of Shipping) Rules for Building and Classing Steel Vessels under 295 feet. These areas include Fire protection and rules for periodically unmanned machinery spaces and the requirements for automated, unattended machinery spaces (ACCU and ACBU notations to class).

In IMO regulations (SOLAS as modified by SPS code), USCG regulations and ABS Rules, 500GT is the threshold at which a vessel is required to have a double bottom. This is not to be confused with a double hull as now required in tank vessels.

The University of Delaware CHRV design is just under 500GT (ITC) and also just under 300GT(US). She will not have a double bottom. Her fuel is in wing tanks.

International tonnage is a fairly straightforward measure of the watertight, enclosed volume of the vessel. There are very few, if any ways to reduce a vessel's measured international tonnage. Of the possibilities – adding "non-tight" volume (open to sea at waterline – can normally flood) is an example. This is obviously not going to result in useable volume or payload carrying capability. As noted – the CHRV is just under the 500GT(ITC) threshold (492 tons). An addition of 5 feet at her transom would result in about 16 extra tons. This provides a feel for the relationship of length and volume. A vessel could be made longer – but she would have to be less beamy, and/or less deep, neither of which would be good for intact stability. The envelope can be changed in shape – but for all practical purposes – it is the same envelope.

US tonnage is also based on volume. However, as most of us know, US tonnage regulations allow for the use of various schemes to make volume essentially unavailable for the practical storage of cargo. The schemes rest on one of two premises. The first is breaking up space below deck into unusable volume by adding additional framing. The second is making volume above the main deck, by rule, "open to the weather" by use of tonnage openings. Space above the main deck can also be "framed out" as is done below deck. There are many variants of these two methods but they are similar. Some areas are not included in gross tonnage in the US system that are included in the international system. This includes heads, galleys and pilothouses.

The CHRV is framed longitudinally, with larger, transverse web frames on 4 foot centers and smaller framing running fore and aft (or longitudinal). By creating deep bulkheads at every other transverse web frame, a large amount of tonnage is taken out below deck. Tonnage openings are used to remove sufficient tonnage above deck.

FEDERAL REGIONAL SHIP

Based on the FOFC report, the size range for a regional ship is 130 to 180 feet in length. As explained above, a vessel of approximately 140 feet or more will be over 500GT(ITC). It is conceivable that such a vessel could still be designed such that her US GRT would be less than 300GT(US). Thus you would have a vessel required to meet all ABS rules for cargo vessels over 500GT, SOLAS as modified by the SPS Code and ISM – but the vessel would still not be inspected or certificated by the USCG under subchapter U. This could conceivably be done right up to the 180 foot size vessel, though the restrictions of additional framing and tonnage openings would increase as the vessel grew in size. For simplicity's sake, we assumed that UNOLS would comply with Subchapter U if the vessel went over 500GT(ITC). This report could be amended to include a variant vessel that was over 500GT(ITC) yet under 300GT(US).

IMPLICATIONS

USCG Inspection – 46CFR Subchapter U

There are many varied implications of becoming inspected and certificated under 46CFR Subchapter U. For the most part we will touch on the ones that have the largest cost impact (first cost or life cycle cost). One thing that must be understood is that the CHRV is being designed to comply with the majority of the requirements of Subchapter U. These requirements (that the CHRV will comply with) include Structural Fire protection, Electrical design, Marine Engineering design (Piping, machinery installation) and Arrangement (stairway size and inclination, cabin size, escapes), Structure and Stability and Subdivision. There are several minor areas that the CHRV will not comply with. The only one that comes to mind is the requirement for a vertical locker in each cabin (Arrangement issue). As the CHRV is ABS classed (as required by UNOLS/NSF operating agreement), many of the structural and marine engineering and electrical engineering requirements of Subchapter U are superseded by those of ABS.

Subchapter U requires that all officers have a single occupancy cabin. As we estimate that the Federal Regional ship would have 6 officers aboard, 3 additional cabins are required over an uninspected vessel with the same number of crew.

Subchapter U requires the addition of a "hospital" or sick bay with a shower, head and medical facilities as well as one berth for each 12 crew members (or portion thereof). Oddly, the number of beds is based only on the number of crew, not the whole complement aboard.

The University of Delaware operates the R/V Cape Henlopen with a two watch (6 on, 6 off) manning system. If the vessel were inspected, a 3 watch system would be required. This means that this vessel will require 14 crew as opposed to 8 on the CHRV. This means 3 additional double occupancy cabins for the additional 6 crew. Along with the single occupancy officer cabins – this means 6 more cabins are required for crew on the proposed Federal Regional ship vs. the CHRV.

The remainder of differences in the first cost of the vessel based on becoming USCG inspected are minor.

The additional crew obviously enter into the life cycle costs. These costs are listed in Appendix B.

ABS/SOLAS

By going over 500GT(ITC), the vessel must be built with a double bottom. This is required by USCG regulations in 46CFR Subchapter S, the SOLAS regulations as well as the ABS rules. Most in the research community are used to this type of arrangement and the cost is not extravagant. Double bottoms are required because of the potential protection they provide in the case of damage to the bottom of the vessel.

However, there are some operational advantages to having wing tanks. (Day tank not required, open bilges, less tank maintenance in small spaces, less issues with hot work in bilges) Also, although double bottom tanks are low weight in a vessel, their large surface area in plan view makes it more important to manage tank volumes/ullage as a ship full of slack double bottom tanks have an adverse on intact stability (free surface effect).

The three largest areas of cost impact from ABS/SOLAS when a vessel goes over 500GT(ITC) are increased requirements in the areas of Fire suppression and detection, Lifesaving and engine room automation.

LARGER VESSEL

Obviously, the biggest cost associated with going from a 138 foot vessel to a 160 foot vessel is in the increased size of the vessel itself as well as the machinery needed to propel the vessel and the potential for adding larger and more expensive deck equipment. The electronics and acquisition stay roughly the same for the larger vessel.

ARRANGEMENT

Although concept design drawings were not developed for the hypothetical 160' Federal Regional Ship, the basic real estate decisions were made on a conceptual basis to determine whether everything would fit and what the relative sizes would be. Essentially, because of increased manning requirements (due to 3 watch system and single officer cabins), 6 additional cabins are required for crew. 22 additional feet gives 4 cabins below deck (with additional required heads/lavs) and 4 cabins on the 01 deck. Six are required for the crew – leaving 2. Two cabins are double occupancy giving 4 additional scientist berths. (CHRV has 14 scientist berths + 4 = 18 scientist berths for Federal Regional Ship).

On the main deck, 8 feet is needed on one side for the "hospital". Four to six feet additional is needed in the mess area for the additional crew and scientists. We need 2 to 3 feet more for the laundry (sink required by Subchapter U). So, 8 feet port and starboard forward on the main deck gives all required "accommodation" additions. This leaves 14 feet on the main deck. With the additional crew and scientists, especially with more off duty personnel, it would behoove us to add 4 feet to the galley and the lounge/conference area (p/s). This leaves 10'. If we give 3 feet to the aft working deck and 7 feet to the labs we arrive at roughly the required 1000 sf for labs and 1000 sf working deck (aft of the vans). This takes into account the additional beam.

Obviously there are many ways to arrange a ship – and this can be discussed to a greater extent when concept design drawings are completed. However, it would appear we are "in the ballpark" with the major space constraints. One area not considered that could use additional space is the machinery spaces, winch spaces and Z drives aft. This may point to a slightly larger ship in the next iteration.

CONCLUSIONS

Appendix A shows the capital, first cost of the CHRV vs. a hypothetical 160' Federal Regional Research Vessel. The CHRV comes in at an estimated cost of $11.5 million. The 160' Federal Regional Vessel comes in at an estimated cost of $16.3 million. It must be stressed that both these figures are estimates only. While some of the figures are developed using actual prices from vendors (Z drives, generators, deck machinery, ABS fees are some examples), much of the estimate comes from empirical data in our files. Bay Marine did have a respected commercial shipyard do a cursory, gratis review of the figures for the CHRV. This gives some assurance of reasonable accuracy.

Appendix B shows the estimated life cycle costs for both vessels. This gives breakdowns of estimated manning, other life cycle costs as well as repair and overhaul costs over a 10 year period.
Over the long term, it would appear that the difference in the life cycle costs are more significant than the difference in first cost between a CHRV sized vessel and a larger regional ship.

Both vessels have similar deck and lab space on a per scientist basis.

If the day rate is normalized on a per scientist basis – the CHRV is $533/day ($7461/14) whereas the Federal Regional Ship is $689/scientist/day ($12,402/18)

REFERENCES

1. 46CFR, Subchapter U, §188-§196, Oceanographic Research Vessels (2001)
2. 46CFR, Subchaper S, §170-§174, Subdivision and Stability (2001)
3. ABS Rules for Building and Classing Steel Vessels, <295' (2001)
4. IMO Code of Safety for Special Purpose Ships (1984 – reprinted 1990)
5. IMO - SOLAS Consolidated Edition (2001)
6. IMO - MARPOL 73/78 Consolidated Edition, 1997
7. USCG Marine Safety Manual – Volume 3, Chapter 25
8. Regional Class Research Vessel – Science Mission Requirements – Draft Rev #6- 9/18/02
9. Charting the Future of the National Academic Research Fleet
10. Reponses to FIC survey – Comments as of March 26, 2001
11. Notes regarding implementation of the Code for Special Purpose Ships as it applies to Oceanographic Research Vessels 500 tons and greater – Capt. George Ireland – 15 May 2001

APPENDIX A

CONSTRUCTION COST ESTIMATE COMPARISON

FEDERAL REGIONAL SHIP VS. UDEL CAPE HENLOPEN REPLACEMENT VESSEL (CHRV)

CONSTRUCTION COST ESTIMATE

BID DESIGN 1/22/03

Item Description	COST	
	CHRV	Federal Regional Ship
HULL ONLY (Steel)	$1,800,000	$2,724,679
SUPERSTRUCTURE (Aluminum)	$925,000	$1,400,182
Double bottom (in lieu of wing tanks)	$0	$200,000
Rails/Mast	$25,000	$37,843
Paint/misc	$180,000	$271,800
Joinerwork	$175,000	$264,250
Furniture	$50,000	$75,500
Hull Outfit	$95,000	$143,450
Galley Outfit	$50,000	$62,500
Safety equipment	$40,000	$65,920
Pilothouse outfit	$10,000	$11,000
Pilothouse Electronics	$130,000	$143,000
DP system	$180,000	$180,000
Z drives (including installation and auxiliary)	$429,000	$1,040,000
Z drive motors (including installation and auxiliary)	$182,000	$441,212
Bow thruster	$120,000	$202,800

Generators (450 kw) - 3 each (including installation)	$300,300	$500,500
Generator (250 kw) - 1 each (including installation)	$59,800	$107,640
Emergency generator (including installation)	$24,213	$30,266
Elec control	$425,000	$718,250
Elec wiring	$100,000	$169,000
Elec components	$50,000	$84,500
Aux Machinery and Machinery Outfit	$395,000	$493,750
Fire suppression/detection	$75,000	$175,000
Periodically unattended vs. ACBU/ACCU	$10,000	$100,000
Additional Emissions control	$50,000	$84,500
E/R Isolation raft/isolators	$200,000	$338,000
Noise treatments	$489,000	$738,390
Windlasses/anchors (3 pt anchoring) (incl installation, fairleads)	$103,600	$156,820
Portable Intermediate Deck Winch	$85,000	$85,000
Small Portable Deck winches - 3 Units	$150,000	$150,000
CTD Traction Winch/wire/HPU	$160,000	$160,000
CTD Mo-Comp crane	$360,000	$360,000
Stbd side Mo-Comp crane	$150,000	$150,000
Trawl winches - 2 each	$190,000	$285,000
Portable davits/forward boom	$20,000	$20,000
Stern A-frame	$110,000	$165,000
Port Side frame	$60,000	$75,000
Aft deck HPU/fairleads	$140,000	$175,000
Main Aft Deck Crane	$225,000	$281,250
Foredeck crane	$40,000	$50,000
RIB/Rescue Boat	$20,000	$30,000

Rigid-Hull Utility Boat	$75,000	$75,000
Vans - 4 Units	$300,000	$300,000
LAN	$100,000	$125,000
Lab outfitting	$125,000	$187,500
Acquisition systems	$890,000	$890,000
Design - Naval Architect Fees	$460,000	$575,000
Noise Control Consultant	$225,000	$281,250
Documentation	$65,000	$130,000
ABS plan approval/survey	$95,484	$126,162
Administrative - Design Review, Artwork, Public Relations	$60,000	$75,000
Model testing	$95,000	$190,000
Acoustic trials, surveys, and modifications	$170,000	$212,500
Moving/handling/launching/trials/warrantee allowance	$131,386	$216,079
Performance bond, liability insurance, construction interest	$262,773	$432,157
ABS administration/inspector ovhd./contract administration(Yard)	$131,386	$216,079
TOTAL COST	**$11,568,942**	**$16,330,492**

Note: The CHRV costs presented here have been refined from those presented to NSF/ONR in December 2002

APPENDIX B

LIFE CYCLE COSTS

CAPE HENLOPEN (UDEL) REPLACEMENT VESSEL (138'x32'x14')

I. Salaries and Wages		
A. Ships Crew		
1. Salaries	$388,000	8.5 crew - 6-on/6-off. Self-Relieving
2. Fringe Benefits	$132,860	
Total	**$520,860**	
B. Shore Side Support Staff		
1. Salaries	$168,000	3.5 personnel ashore (ISM-like code)
2. Fringe Benefits	$54,300	
Total	**$222,300**	
II. Repair, Maintenance & Overhaul:		
A. Normal Maintenance and Repair	$60,000	20% increase over RVCH due to complexity and size
B. Major Overhaul	$89,000	See Major Overhaul
III. Other		
A. Fuel and Lube Oil	$148,000	Avg consumption of 39 gal/hr (575 kW)
B. Food	$64,800	Avg of 12 scientists & 6 crew=18 ppl @$20/day
C. Insurance	$30,000	
D. Stores and Minor Equipment	$45,000	10% increase over RVCH due to complexity & size
E. Travel		
Domestic	$12,000	Includes travel for training
Foreign	$0	
F. Shore Facilities Support	$35,000	10% Increase over RVCH due to enhanced comms
G. Miscellaneous	$16,000	Includes ABS fees and Training Tuition
H. Amortization	*$100,000*	Institutionally Owned vessel
Total	**$599,800**	
Total Direct Costs	**$1,342,960**	
Expected Operating Days	180	
Estimated Daily Rate	**$7,461**	

FEDERAL REGIONAL VESSEL (160' x 37' x 16')

I. Salaries and Wages		
A. Ships Crew		
1. Salaries	$783,605	14 crew - 4-on/8-off + occasional relief
2. Fringe Benefits	$369,233	
Total	$1,152,838	
B. Shore Side Support Staff		
1. Salaries	$191,250	4.0 personnel ashore (ISM/USCG)
2. Fringe Benefits	$69,675	
Total	$260,925	
II. Repair, Maintenance & Overhaul:		
A. Normal Maintenance and Repair	$90,600	CHRV x 1.51
B. Major Overhaul	$140,000	See Major Overhaul
III. Other		
A. Fuel and Lube Oil	$296,000	CHRV x 2.0
B. Food	$108,000	Avg of 16 scientists & 14 crew=30 ppl@$20/day
C. Insurance	$40,000	
D. Stores and Minor Equipment	$49,500	10% increase above CHRV
E. Travel		
Domestic	$24,000	CHRV x 2.0
Foreign	$0	
F. Shore Facilities Support	$38,500	10% increase above CHRV
G. Miscellaneous	$32,000	CHRV x 2.0
H. Amortization	$0	Federally Owned Vessel
Total	**$818,600**	
Total Direct Costs	**$2,232,363**	
Expected Operating Days	$180	
Estimated Daily Rate	**$12,402**	

CAPE HENLOPEN REPLACEMENT VESSEL

Crew:

Watch Rotation 6-on/6-off

Uninspected - Manning determined by Marine Operations (<300 GRT)

Voluntary ISM compliance or "ISM Like" Operations Procedures (<500 ITC)

Crew is self-relieving

	No.	Salary/Wages	Fringes	sub-Total Salary	sub-Total Fringes	
Captain**	1	$61,600	$18,480	$61,600	$18,480	
Chief Mate**	1	$53,900	$16,170	$53,900	$16,170	
Second Mate	1	*$45,000*	$18,000	$45,000	$18,000	
AB	0	$42,400	$16,960	$0	$0	
OS/Deckhand	1	$35,000	$14,000	$35,000	$14,000	On Deck and Galley
Chief Engineer**	1	$59,900	$17,970	$59,900	$17,970	
Assist Engineer/QMED	1	$43,600	$17,440	$43,600	$17,440	
Second Engineer	1	$35,800	$14,320	$35,800	$14,320	
Oiler/Wiper	0	*$30,000*	$12,000	$0	$0	
Cook	1	$38,200	$15,280	$38,200	$15,280	
Steward	0.5	$30,000	$2,400	$15,000	$1,200	Part Time Cook
	8.5			$388,000	$132,860	

Shore Side Support Staff

Marine Superintendent**	1	$65,000	$19,500	$65,000	$19,500	
Administrative Assistant	0.5	$40,000	$3,200	$20,000	$1,600	To administer voluntary ISM
Port Engineer	1	$45,000	$18,000	$45,000	$18,000	
Staff Assistant	1	$38,000	$15,200	$38,000	$15,200	
	3.5			$168,000	$54,300	

Notes

1. Wages for each position are based on the UNOLS "Regional" Ship Salary Survey conducted in 2001.
2. The average wages are increased annually by 3.0% to achieve the averages in 2003 dollars.

NEW FEDERAL "REGIONAL VESSEL

Crew:

Watch Rotation		4-on/8-off (Captain assumed to stand a watch)				
Inspected - Manning determined by USCG (>300 GRT)						
ISM Compliant (>500 ITC)						
	No.	Salary/Wages	Fringes	sub-Total Wages	sub-Total Fringes	
Captain**	1	$64,680	$19,404	$64,680	$19,404	5% Higher due to vessel size
Chief Mate**	1	$56,595	$16,979	$56,595	$16,979	5% Higher due to vessel size
Second Mate	1	$45,000	$18,000	$45,000	$18,000	
AB	3	$42,400	$16,960	$127,200	$50,880	
OS/Deckhand	2	$30,000	$12,000	$60,000	$24,000	
Relief Captain	*0.2*	*$55,000*	*$4,400*	*$11,000*	*$880*	*Relieves Captain*
Relief Mate	*0.4*	*$45,000*	*$3,600*	*$18,000*	*$1,440*	*Relieves both Chief Mate and 2nd Mate*
Relief AB	*1*	*$42,000*	*$3,360*	*$42,000*	*$3,360*	*Relieves both AB and OS*
Chief Engineer**	1	$62,900	$18,870	$81,770	$81,770	
Assist Engineer	1	$43,600	$17,440	$61,040	$61,040	
Second Engineer/QMED	1	$35,800	$14,320	$50,120	$50,120	
Oiler/Wiper	0	*$30,000*	$12,000	$42,000	$0	Assume to meet un-manned E/R requirements
Relief C.E..	*0.2*	*$50,000*	*$4,000*	*$10,000*	*$800*	
Relief Eng	*0.4*	*$40,000*	*$3,200*	*$16,000*	*$1,280*	
Relief Oiler/Wiper	*0*	*$30,000*	*$2,400*	*$0*	*$0*	
Cook	1	$38,200	$15,280	$38,200	$15,280	Steward's Dept is self-relieving w/help from OS
Steward	2	$30,000	$12,000	$60,000	$24,000	16 Scientists (Ave)
	14			**$783,605**	**$369,233**	

Shore Side Support Staff

Marine Superintendent**	1	$68,250	$20,475	$68,250	$20,475	5% Higher due to size of Operation
Administrative Assistant**	1	$40,000	$16,000	$40,000	$16,000	To administer ISM and USCG Inspection
Port Engineer	1	$45,000	$18,000	$45,000	$18,000	
Staff Assistant	1	$38,000	$15,200	$38,000	$15,200	
	4			**$191,250**	**$69,675**	

APPENDIX B-3
OVERHAUL/MAINTENANCE COSTS

		CHRV	Federal Regional Ship
Year 1	(No Major Overhaul Req'd)	0	0
Year 2	Routine Shipyard	$60,000	$80,000
Year 3	Generator Overhaul (1.5 units)	$65,000	$110,000
Year 4	Major Shipyard		
	Routine work	$60,000	$80,000
	Z-drive Overhaul (2 each)	$95,000	$155,000
	Drive Motor Overhaul	$50,000	$75,000
Year 5	Generator Overhaul (2 units)	$75,000	$145,000
	Total	$405,000	$645,000
	Yearly Major Overhaul Request	**$81,000**	**$129,000**
Year 6	Routine Shipyard	$60,000	$80,000
Year 7	Generator Overhaul (1.5 units)	$65,000	$110,000
Year 8	Major Shipyard		
	Routine work	$60,000	$80,000
	Z-drive Overhaul (2 each)	$95,000	$155,000
	Drive Motor Overhaul	$50,000	$75,000
	Bow Thruster Overhaul	$20,000	$30,000
Year 9	Generator Overhaul (2 units)	$75,000	$145,000
Year 10	Routine Shipyard	$60,000	$80,000
	Total	$485,000	$755,000
	Yearly Major Overhaul Request	**$97,000**	**$151,000**
	Average =	**$89,000**	**$140,000**

APPENDIX C

CHRV DRAWINGS: Will be available at FIC meeting