VESSEL LIFE CYCLE COST MODEL UPDATE 2010

Washington State Ferries

Contract Y-10268

TASK AD

September 14, 2010 Final Report

Performed by:

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Contents

About the Author

W. Greg Johnson, CAPT USCG (Ret.) is a 1972 graduate of the US Coast Guard Academy and in 1977 earned MSE degrees in both NA&ME and Mechanical Engineering from the University of Michigan. During his 28-year CG career he had 2 tours as Engineer afloat, 5 tours managing the shipyard repairs of CG ships and boats in the Pacific Region, and 6 years as the Program Manager for the design, construction, and life cycle support planning of the Coast Guard's newest Polar Research Icebreaker, USCGC HEALY. He retired from active duty Coast Guard in 2000, and during the last 10 years with John J. McMullen Associates and Alion Science and Technology Corporation, he has become well known for his expertise in the Life Cycle Maintenance and Supportability of ships and fleets of ships. Mr. Johnson also supported WSF in the 2008 and 2009 WSF LCCM Updates and Preservation Analysis.

Executive Summary

Washington State Ferries tasked Alion Science and Technology Corporation (Alion) to assist the Senior Port Engineer for Vessel Preservation to study the February 2010 draft update of the Vessel Life Cycle Cost Model (LCCM), the outcome of which will be used to develop a report to the state legislature in the December 2010 timeframe. Our report will be divided into the four sections each of which relate to the Scope of Work in our Task AD of Contract Y-10280.

Section 1 This section provides the results of our review of Vessel Preservation Engineering's February 2010 update to the LCCM. A list of the LCCM Vital and Non Vital Inventory Items are found in Appendix A. The review focused on the comments provided by the Capital Program Director of the WSF Program Development Office. We reviewed and analyzed the following in detail:

- The Updated Preservation Intervals across the five classes for Vital and Non Vital Systems
- The 165 Deferred or Extended Preservation items
- The differences between LCCM Cost Factors and the Cost Estimates in the 16 Year Work Plan.

Intervals : Appendix B contains two interval tables that detail the Life Cycle Intervals by vessel class, one table for Vital Systems and one for Non Vital Systems. In total, there were 139 Vital ship inventory items changed in the 2010 draft update, and 119 Non vital ship inventory items changed.

Within the Vital Systems there are 14 system intervals (39%) which are not consistent across the five classes. Within the Non Vital Systems, 17 system intervals (61%) are not consistent across the five classes. We worked with the Senior Preservation Engineer and identified the reasons for the differences. Those explanations are listed below each of the tables in Appendix B. We recommend that Preservation Engineering include the reasons for the differences in the LCCM so that in future reviews the rationale will be documented and it will assist in evaluating future changes.

In general, we recommend that the intervals across the vessel classes be the same, unless there is a distinct design or operational difference that would impact the system life cycle. If condition assessments across the class or fleet consistently indicate that the system interval is too short, then the interval should be increased.

In 2009, Preservation Engineering started a formal inspection process for LCCM Preservation Items, which involved the Staff Chief Engineer (SCE) for each vessel. While this was a good first step, we recommend standardizing the metrics for evaluating each Preservation Item, and standardizing the format of the report. More detail on this recommendation is in Section I of the report.

Deferred or Extended Preservation Items: Based on a report generated by the WSF Program Development Office, within the February 2010 Vessel LCCM Update, there were 165 preservation items that had been deferred or extended at least once. Appendix C lists these items by system.

Of the 40 Vital Items, 75% are on vessels soon due for retirement (19 on Hiyu or Estate), or scheduled for renovation (11 on Hyak). Preservation Engineering has reviewed the condition of the remaining 10

Vital Items and they are suitably scheduled in the 16 Year Work Plan. From this data, we feel WSF does a good job scheduling, budgeting and maintaining Vital Items per the LCCM.

The 125 Non Vital Items represent 18 systems and are listed in the report. We recommend that each of these 125 Non Vital Items is either scheduled for completion in 2011-13, or a note is made in the LCCM documenting the reason or justification for extension/deferral.

What stands out in this data presentation for Non Vital Items is that the vast majority have been consistently extended over the life of the ships listed, from 25-38 years. It appears that some of the Non Vital Items currently with an interval of less than 30 years could have their intervals increased to 15, 20 or up to 30 years. This opinion is especially valid if the condition of the system is monitored and routinely reported on by the Staff Chief Engineers, and then maintained with the extension in mind.

Examples are:

- Boilers: the fleet interval is 20 years. But the Jumbo Class has been extended to 38 years, and the Issaquah class from 25 to 30 years.
- HVAC systems and Controls: the fleet interval is 12 years with MKII's just increased to 20 years. But Hyak is at 43 years, Jumbos at 38 years, and five of six Issaquah class are at 28-30 years.
- Fresh Water Tanks: the fleet interval was just raised to 20 years. But Walla Walla is at 38 years and four of six Issaquah Class are at 28-30 years.

We recommend that Preservation Engineering review the list of extended Preservation Items and evaluate whether the intervals across the fleet can be increased and what maintenance practices if any need to be changed to accommodate the increase.

With all the constraints confronting Vessel Engineering to execute the preservation program, we feel that WSF does a good job scheduling, budgeting and completing Vital Items and Non Vital Items, extending those judiciously and putting more maintenance attention (as opposed to preservation attention) towards those items extended.

LCCM Cost Factors vs. 16 Year Work Plan estimates: The WSF Program Development Office provided a recent report on the February 2010 Vessel LCCM Draft Update, which focused on LCCM Cost Factors in comparison to cost estimates in the 16 Year Work Plan. In general terms there was concern in two areas:

1. Most LCCM Cost Factors were higher than the Work Plan cost estimates
2. Several LCCM cost factors were different within a class

With respect to the first concern (LCCM Cost Factors were higher than Work Plan Cost Estimates): The cost factor of a preservation item in the LCCM currently represents Preservation Engineering's best estimate of what it would cost to replace or preserve the entire system, worst case. The cost estimates in the 16 Year Work Plan represent the best estimate in actual scope and cost for that particular ship in the year that item is due, based on the current and projected condition of the system. In some cases the estimated cost is close (+/- 10%) to the LCCM cost factor because the system is well defined and the scope well bounded. The Comms/Nav/Lifesaving Systems, Propulsion Systems, Electrical Generating Systems and Security Systems fit into this category. However, the actual cost of Painting and Steel Preservation Systems and Piping Systems can and usually does differ from the worst case scenario. Secondly, there are State constraints and sometimes WSF management constraints on preservation costs per year or per vessel, which force Preservation Engineering to reduce the scope of a preservation item and even to defer items in order to fit within the budget constraints. These management budget constraints do not change the reality of what it costs to completely renew a system.

With respect to the second concern (LCCM Cost Factors Different within class): We concur. We worked with Vessel Preservation Engineers and recommend changes to 146 individual vessel cost factors, including 9 missing vessel items and cost factors. Those changes can be found in the far right hand column of Appendix D, LCCM Cost Factor Change Summary.

<u>Section 2</u> This section provides a description of a typical risk analysis methodology that, for each preservation item, assesses the probability of failure in the next three years vs. the impact of failure on the vessel's ability to sail. Combining the probability of failure with the impact of failure provided a measure of risk of lost service. The detailed process and sample risk tables for Tacoma are found in Section 2 and Appendix E.

Based on the risk analysis process done on Tacoma, we suggest that there is value in the exercise for the fleet. Once the probability and criticality (impact) factors were set, the tables designed, and due dates calculated, it took about one hour to do the risk analysis and compare the results to the draft 16 Year Work Plan. If the last done dates and the intervals can be electronically dumped into the tables, it should take about 24 man hours to update the risk tables for the fleet each biennium. If the risk analysis is done before the 16 Year Work Plan is started, the risk analysis will provide a method to ensure high risk items are scheduled and provide a method for choosing lower risk items to defer or extend if needed.

<u>Section 3</u> This section provides an analysis of constructability with respect to out of service time. Based on the planned period of performance and award price, we sought metrics that would show WSF uses that planned out of service time wisely. We looked at cost and schedule growth for the scheduled availabilities over the last three years, between March 2007 and March 2010. The data is in Appendix F.

The data shows that for dry dock availabilities if the estimated cost of work is around $250 thousand a week, the work can be accomplished within that period of performance. For dockside periods, that number would be around $170 thousand. In order to reduce the number of days extended from planned and thus improve out-of-service metrics, the cause for work growth needs to be more clearly identified and then WSF can determine whether changes in maintenance practices, policy or specification development can reduce the magnitude of contract extensions. We could not find clear, concise documentation in the Vessel Engineering Contract Files, or data base, for the reason or reasons the contracts were extended

Specific Recommendations relating to vessel availability summary data and helping to reduce out of service time:

- As part of the Availability Summary, include the Contract Award Start and End Dates. Right now the contract completion date at award is not visible. This will help calculate the contract extensions.
- As part of the Availability Summary, include for each line item the award price, total change order cost and final cost. There is a summary of Change Orders, and in addition a summary of the award Price, Change order price and final contract price is presented for the contract as a whole, but this same data also should be available by the contract line item. This will help make future adjustments to Preservation Cost Factors.
- Contract Line Item descriptions for Preservation Items should match the LCCM Preservation Item Description, or at least identify it to the LCCM Item making it easier to capture the final cost of each preservation item.
- Any change to the contract end date should be done by change order and the reasons for the contract extension clearly explained and traced to one or more work items. The Vessel Project Engineer and the Vessel Business Staff should review each contract extension and determine if changes can be made to prevent a similar extension in the future. Examples of internal management change could be in contract policy, pre contract inspections, or different approaches recurring work requirements.

Looking at constructability from a different standpoint, we analyzed Topside Painting and Passenger Space Renovations; they are high cost Preservation Items, they take a relatively long time to compete, and the intervals are relatively short. The analysis shows that they can be accomplished as scheduled by the LCCM, but the presentation highlights the risks based on the number of ships needing to be done each biennium, the availability of Puget Sound region shipyards, and cost implications.

Section 4. Having completed the previous three sections of this task, this section summarizes our recommendations relative to the budget implications of the revised vessel 16 Year Work Plan.

- In general, we recommend that the intervals across the classes be the same, unless there is a distinct design or operational difference that would impact the system life cycle.
- Look critically at inventory items that have consistently been extended and are still operational. Can the methods used to keep those systems operational be used in other classes of ships and increase the interval over the entire class or fleet?
- Work with Staff Chiefs to come up with an easy procedure for evaluating change orders and determine whether the scope could be better identified by inspection prior to the contract solicitation.
- Clearly document the specific reasons for contract extensions and evaluate how those reasons can be avoided in the future.
- Evaluate documentation and procedural changes that result in clearly capturing total preservation item costs.

1.0 Review and Update the Vessel Life Cycle Cost Model

The LCCM has been in practice for approximately 13 years and provides the basis of the Vessel Preservation Program by planning the replacement of individual vessel systems or components as they reach the end of their useful lives, with the goal of preserving the WSF Vessels in the safest, most reliable, and most efficient material condition for the least cost. WSF plans for each ferry to remain in service for 60 years. Prior to the philosophy of replacing systems as they each reach the end their individual service life, WSF had planned for a massive, 30-year mid life major renovation, which took the vessel out of service for a year, and in most cases the contracts were filled with risk of schedule slips and cost overruns. The LCCM method appears to reduce the risk, reduce the out of service time, and levels the year to year preservation costs.

In 1997, Washington State Ferries began developing a data base called the Life Cycle Cost Model (LCCM) to assist engineering and budget managers to plan for, budget and manage terminal and vessel preservation activities. There is a module specifically for Vessels and one for Terminals. Each preservation item for each vessel has an estimated cost, performance interval and date last renewed. From this information a schedule of performance in the out-years can be developed. The Life Cycle Cost Model (LCCM) consists of unique data base records for each ship and each subsystem. Among the data base elements, the following elements are included:

- LCCM Item Number (a unique number for each item on each vessel)
- Inventory Item Title
- Preservation Life Cycle Interval (Years of Service Life Expected
- Year Last Renewed
- Estimated Cost in the Baseline Year

In the 2010 draft LCCM Update there are 36 Vital preservation systems, which are considered vital to the ship being able to sail, and 28 Non Vital systems. A list of the Vital and Non Vital LCCM systems for vessels can be found in Appendix A. There are a few inventory systems not applicable to all of the five major vessel classes because of differing ship designs. For instance the Issaquah class has Controllable Pitch Propellers and propulsion reduction gears, and the other classes have fixed pitch propellers, propulsion generators, motors, and switchboards instead.

The review of the LCCM for this report focused on the comments provided by the Capital Program Director of the WSF Program Development Office. We reviewed and analyzed the following in detail:

- The Updated Preservation Intervals across the five classes for Vital and Non Vital Systems
- The 165 Deferred or extended Preservation Items
- The differences between LCCM Cost Factors and the Cost Estimates in the 16 Year Work Plan.

1.1 Preservation Life Cycle Intervals

Appendix B contains two interval tables for the five largest vessel classes that detail the Life Cycle Intervals by vessel class. There is one table for Vital Systems and one for Non Vital Systems. The cells highlighted in light blue indicate those intervals that were changed from the 2008 LCCM. In most cases the intervals were increased. In total, there were 139 Vital ship inventory item intervals changed, and 119 Non Vital ship inventory item intervals changed.

Within the Vital Systems there are 14 system intervals (39%) which are not consistent across the five classes. The item descriptions are highlighted in light green. Within the Non Vital Systems, 17 system intervals (61%) are not consistent across the five classes. We worked with the Senior Preservation Engineer and identified the reasons for the differences. Those explanations are listed below the tables in Appendix B. We recommend that Preservation Engineering include the reasons for the differences in the LCCM so that in future reviews the rational will be documented, and it will assist in evaluating future changes.

In the summer of 2009, the Staff Chief Engineer of each vessel was given their vessel's inventory of systems. They were tasked with evaluating the condition of each system, and drafting a report that listed the following:

- The overall condition of each system
- The relative amount of routine repairs needed to keep each system operational compared to a typical new or repaired system
- An evaluation of condition monitoring if any
- The availability of spare parts and general supportability of that system from the vendor community
- A professional opinion as to whether that system will last at least another two years past the schedule replacement year.

In the fall of 2009, meetings were held with the Staff Chief Engineer of each vessel class, the Senior Port Engineer for Preservation, the respective Preservation Project Engineer, and the Fleet Maintenance Port Engineer for the vessel class and input was received that justified extending many preservation items and in many cases increasing the intervals between conducting a preservation item. This was a good first start, but we recommend that for each item the Staff Chief Engineers are provided a standard or threshold metrics to use in evaluating whether each item is ready for preservation per the LCCM Schedule, or is in good condition and should be extended. The Staff Chief Engineers should be involved in developing these standards or threshold metrics. The inspection results and other input from each Staff Chief should be in similar format so that comparisons across the class and across the fleet can be made. Ideally, this inspection report should be done in the year prior to the next biennium budget submission and LCCM update.

In general, the intervals across the vessel classes should be the same, unless there is a distinct design or operational difference that would impact the system life cycle. As opposed to increasing the interval based on a one-time assessment of the condition, we recommend extending the scheduled completion date for that item to a future biennium on a case by case basis, and then make a comment in the LCCM on why the extension was made. This documentation will make future updates easier. If the condition assessments across the class or fleet indicate that the system interval is too short, we agree the interval should be increased.

1.2 Deferred or Extended Preservation Items

Based on a report generated by the WSF Program Development Office, within the February 2010 Vessel LCCM Update, there were 165 preservation items that had been deferred or extended, 48 of which were deferred or extended from 2.5 up to 5 times their life cycle interval. Appendix C lists these items by system. There are two interesting questions?

- Why were these items deferred or extended consistently?
- If they could be deferred or extended on these ships, why not across the fleet?

Preservation Engineering's answer to the first question was, "*In almost all of the cases these are Non Vital Items. Many are on vessels that were scheduled for retirement in the past [and] due to operational or financial reasons were kept active. Therefore these systems were maintained with operational funds but not renovated with capital funds and not renewed [per] the LCCM."*

To begin this section, we recommend consideration of using the term "Extended" instead of "Deferred". A "deferred item" has the connotation of one that is due by the LCCM and the condition warrants it being accomplished, but for management reasons the item is deferred. In the cases we saw in this report, the items did not require renewal and therefore we suggest using the term "extended". This term means that the item is (or was) due, but the condition was such that the item was not needed to be renewed and could be scheduled for another biennium. In some cases, with extra monitoring and maintenance, the item could be extended indefinitely, but with some added risk of failure. In all cases discussed here, the latter was the case. We will use the term "extended" henceforth. Per Appendix C, we sorted the 165 items by item description and the following details became evident:

Of the 165 items, <u>40 (24%) are Vital Items</u> and <u>125 (76%)</u> are Non Vital. So, ¾ of the extended items are of the Non Vital variety.

Of the 165 items, 44 are on Hiyu or ESstate due for retirement by 2014 and 26 are on Hyak due for Renovation (a three-ship total of 42%). 4 items are on Tillikum and Klahowya and 11 on other Super Class vessels all due to retire in 17-21 years (2027-2031). Taking all of these previously planned-to-be retired vessels into consideration, the total represents 52% of the 165 items.

<u>Looking at Vital Systems</u>, 15 of the 26 Vital Systems have one or more extended items. Of the 40 individual <u>Vital LCCM items</u>, 19 are on Hiyu or EState, and 11 are scheduled for Hyak's renovation. Altogether, the extended vital items of these three ships represent 75% of the total.

The other ten Vital Items are listed below. Preservation Engineering has evaluated the condition of them all and has scheduled all but two on the current 16 Year Work Plan: Tillikum's Reduction Gears, and Hyak's #2 end rudder are not scheduled because they are still is good operational condition. The remaining 10 Vital Items are:

Yakima	535	Bilge Piping	15	43 Years 2.9 Cycles
Yakima	537	Firemain Piping/Manifolds	15	43 Years 2.9 Cycles
Chelan	655	Hull Steel	20	25 Years 1.3 Cycles
Walla Walla	317	PA System	12	38 Years 3.2 Cycles
Kitsap	825	PA system	12	22 Years 1.8 Cycles
Klahowya	1079	PA system	12	21 Years 1.8 Cycles
Tillikum*	3934	Reduction Gears #1	20	51 Years 2.6 Cycles
Tillikum*	3935	Reduction Gears #2	20	51 Years 2.6 Cycles
Hyak *	421	Rudder Number Two End	20	43 Years 2.2 Cycles
Walla Walla	282	Sprinkler System	15	23 Years 1.5 Cycles

*Not scheduled per 16 year plan.

Looking at Non Vital Systems, 18 of the 26 Non Vital LCCM preservation systems have one or more items extended. The systems are listed below. The number in parentheses represents the number of ships deferred and the ships identified to the right along with a note of the number of years in operation compared to the LCCM interval of that system:

Bilge Painting (3)	Hyak, Kaleetan and Kittitas. Interval 10 years; lasting 43, 43, 30
Crews Quarters (6)	4 Issaquah, Hyak, EState: Interval 20; lasting 28 and more.
Galley (4)	4 Issaquah class; Interval 12: lasting 30
Boilers (18)	All classes but MKII; Interval 20; lasting 22-38
Heating Piping (3)	(Hyak, Hiyu, Estate) Walla Walla: Interval 20; lasting 38
HVAC/Controls (9)	2 Jumbo, 5 Issaquah (Hyak, Hiyu): Interval 12; lasting 28-43
Lighting Exterior (9)	Walla Walla, Yakama, 5 Issaquah (Hiyu): Interval 12; lasting 29-38
Machinery Space (8)	2 Jumbos, Kaleetan, 3 Issaquah, Hyak, EState: Interval 10; lasting 22-43
Passenger Spaces (2)	Hiyu and EState: Interval 12/13; lasting 22-26
Potable H2O Piping (5)	2 Jumbos, Interval 20; Hyak, Estate, Hiyu Interval 13; lasting 22-38
Potable H2O Tanks (6)	Walla Walla, 4 Issaquah, Hiyu; Interval 20; lasting 25-38

Salt H20 Piping (4)	3 Supers, Hiyu; Interval 10; lasting 43
Fresh H20 Flushing (4)	2 Issaquah, Hiyu, Estate: Interval 18; lasting 22-34
Sewage Piping (6)	Walla Walla, 3 Issaquah, Hiyu, EState: Interval 20, 15,10; lasting 22-38
Sewage Tanks (6)	Chelan (2), Issaquah, Walla Walla, Hiyu (2): Interval 20; lasting 25-38
Solariums (5)	Spokane, 4 Issaquah: Interval 20; lasting 25-30
Voids (7)	3 Supers, 3 Issaquah, EState: Interval 10; lasting 25-40
Wet Spaces (6)	3 Issaquah, Hyak, EState, Hiyu: Interval 12; lasting 22-43

Another way to slice the data is the number of extended Non Vital Items per group or class:

Hiyu and Evergreen State (Retire in 2014)	26	(Avg 13 per vessel)
Hyak (Renovation 2014)	13	
Tillikum	1	
Other Supers	9	(Avg 3 per vessel)
Issaquah Class	57	(Avg 9.2 per vessel)
Jumbo Class	19	(Avg 9.5 per vessel)
MKII	0	

We did not check to see if these 125 individual Non Vital Items are scheduled for completion in the 2010 or the 2011-13 work plan, but we recommend Preservation Engineering validate and document in the LCCM the reason for any extension or deferral , and whether additional maintenance attention should be warranted to keep those systems in operation.

What stands out in this data presentation for Non Vital Items being extended is that the vast majority have been consistently extended over the life of the ships listed, from 25-38 years. The obvious question is "What maintenance practices have Vessel Engineering done on these vessels to keep these systems operational, and can those maintenance practices be accomplished on the other ships of the fleet to extend their intervals?" We recommend that Preservation Engineering review those systems and determine whether or not maintenance practices can be changed throughout the fleet and Preservation intervals increased.

From the data reviewed, it appears that some of the items currently with an interval of less than 30 years could have their intervals extended to 15, 20 or up to 30 years. This opinion is especially valid if the condition of the system is monitored and routinely reported on by the Staff Chief Engineers, and then maintained with the extension in mind.

Examples are:

- Boilers: the fleet interval is 20 years. But the Jumbo Class is at 38 years, and the Issaquah class is from 25 to 30 years.
- HVAC systems and Controls: the fleet interval is 12 years with MKII's just increased to 20 years. But Hyak is at 43 years, Jumbos at 38 years, and five of six Issaquah class are at 28-30 years.
- Fresh Water Tanks: the fleet interval was just raised to 20 years. But Walla Walla is at 38 years and four of six Issaquah Class are at 28-30 years.

With all the constraints confronting Vessel Engineering to execute the preservation program, we feel that WSF Preservation Engineering does a good job scheduling, budgeting and completing Vital Items and Non Vital Items, extending those judiciously and putting more maintenance attention (as opposed to preservation attention) towards those items extended.

1.3 LCCM Cost Factors vs. 16 Year Work Plan Estimates

The WSF Program Development Office provided a recent report on the February 2010 Vessel LCCM Draft Update, which focused on LCCM Cost Factors in comparison to cost estimates in the 16 Year Work Plan. In general terms there was concern in two areas:

- Most LCCM Cost Factors were higher than the Work Plan cost estimates
- Several LCCM cost factors were different within a class

With respect to the first concern: The cost factor for of preservation item in the LCCM currently represents the best estimate of what it would cost to replace or preserve the entire system, worst case. The 16 Year Work Plan cost estimates represent the best estimate in actual scope and cost for that particular ship in the year that item is due based on the current and projected condition of the system. In some cases the estimated cost will be very close (+/- 10%) to the LCCM cost factor because the system is well defined and the scope well bounded. Most of the Comms/Nav/Lifesaving Systems, Propulsion Systems, Electrical Generating Systems and Security Systems fit into this category. However, the actual cost of Painting and Steel preservation Systems, and Piping Systems can and usually does significantly differ from the worst case scenario. Secondly, there are State constraints and sometimes WSF management constraints on preservation costs per year or per vessel which force Preservation Engineering to reduce the scope of a preservation item and even to defer items in order to fit within the budget constraints. These management budget constraints do not change the reality of what it costs to completely renew a system.

With respect to the second concern: Vessel Preservation Engineers recommended changes to the LCCM cost factors so that cost factors for Systems across each vessel class were consistent. We took the draft LCCM 2010 update and sorted the spreadsheet first by item name and then by class of vessel. With that spreadsheet format, it was easier to see the following:

- Variances in Cost Factors within each class
- Comparative Cost Factors between classes

From that data, we constructed Appendix D, a spreadsheet that identified the 18 inventory system cases where there was a significant difference between cost factors within a class or questionable differences across the fleet. In addition there were 9 inventory items where one or more vessels were missing from the data base. Working with the Senior Preservation Engineer, we analyzed the data and then recommended changes to 146 individual vessel cost factors, which included adding the 9 missing vessel items and cost factors.

Appendix D, The Cost Factor Summary spreadsheet, contains the details of the 146 updated cost factors. We won't duplicate that information in the report. The following attempts to explain the details of the appendix to help capture all the information directly from Appendix D, and assist in making changes to the existing LCCM cost factor information.

Each inventory system that had a cost factor that we questioned is included. For each system there is a bold heading at the top left of the listing.

First Column: Listed the vessels (or in some cases vessel class) where the cost factor was in question.

Second Column: Identified the inventory item.

Third Column: Identified the inventory category.

Fourth Column: Identified the 2010 Draft interval.

Fifth Column: Identified the 2010 Draft LCCM Cost Factor

Sixth and most important Column: Identified the recommended 2010 Updated LCCM Cost Factor

In red font below the vessel listings is a description of data that caused the cost factors to be in question. And directly underneath in black font, is the Senior Preservation Engineer/Alion recommended action to be taken.

With one exception, color highlighting has no legend. Color highlighting was used to separate visually the classes of vessels, or cost factors that were the same within a class. The exception is the highlight color "gold", which identified an inventory item that needs to be added to the data base. In addition, at the end of that gold row, you will see the phrase in red font, "ADD This ITEM."

In addition to updating the cost factors identified in Appendix D, we have two further recommendations.

(1) The Senior Preservation Port Engineer should work with the Operational electronics systems manager and conduct a review the electronics items for additional opportunities to update the cost factors. There are still some questions regarding the following systems:
    - Electronic Door Locks: cost factor differences across classes
    - Gyrocompass: minor cost factor differences across classes

- PA System: Intervals and cost factor differences across classes

(2) When creating the 16 Year Work Plan, Preservation Engineering recognizes that the cost factors are total cost estimates for the entire preservation item. In some cases the costs may be spread over two biennia. An individual preservation item may need to be split between two maintenance periods crossing biennia periods. And Funds may be requested in the biennium prior to installation for:
- Engineering and software design required prior to installation; e.g. the propulsion control and monitoring system.
- Long Lead Materials; e.g. Main propulsion generator sets, main motors

2.0 Risk Analysis: Preservation Needs vs. Risk of Lost Service

WSF desires a methodology to assess the risk of lost service by extending or deferring a specific preservation item. In this section we will provide a description of a typical risk analysis methodology that will enable WSF to assess each preservation item and its probability of failure in the next three years vs. the impact of failure on the vessel's ability to sail. Combining the probability of failure with the impact of failure provides a measure of risk of lost service. We will then provide an example of this analysis for M/V Tacoma.

2.1 Risk Analysis Process

One of the more accepted Risk Analysis tools is the Department of Defense acquisition risk model: RISK MANAGEMENT GUIDE FOR DOD ACQUISITION Sixth Edition (Version 1.0). Because this is a guide it is intended to be tailored to programmatic needs while providing a recognized framework to ensure the best risk management practices are used

Risk is a measure of future uncertainties in achieving program performance goals and objectives within defined cost, schedule, and performance constraints. The particular WSF Risk question at hand is, "What is the probability that a preservation item will fail, and if it does, what impact will it have on the ability of WSF to service all clients of the WSF System?" Having done this analysis, one can better decide whether or not to extend or defer an item based on the impact to providing service if the system fails.

The basic framework can be set up without regard to a specific vessel and time element. However, to be useful, the Preservation Items for each vessel will need to be evaluated every other year in order to support biennium budget decisions.

A typical full scale risk management process model includes the following key activities, performed on a periodic basis:

- Risk Identification
- Risk Assessment
- Risk Mitigation
- Risk Monitoring

The first step is to identify all known risks to the overall system; in this case they are risks of the ferry to be available for safe service and operation. The second step is to evaluate each risk item based on the probability of failure and the impact on the ferry being available for safe service and operation. Once evaluated based on probability of occurrence and impact of failure, if the Risk assessment is too high, you either want to eliminate the risk through better design or mitigate the risk via maintenance or monitoring. Finally, you will want to monitor the mitigation strategies to ensure they are successful.

For the purposes of this study, we recommend focusing on the first two steps of the risk management process, namely identification of the risk areas, and then assess their probability of occurrence and the consequences.

In the case of the WSF fleet, the risks areas are already identified as the Preservation Items within the LCCM.

Next, the initial assessment of risk is performed based on Probability of Failure (P_f) and Consequence of Failure (C_f). We recommend using a 5 x 5 risk assessment matrix as in Fig. 1.

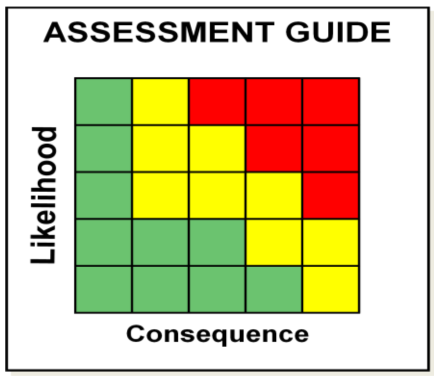


Figure 1 Risk Rating

We worked with the Preservation Engineer and defined the five probabilities (Likelihood) of failure and the five consequences of failure. The full table can be found in Appendix E. The five probabilities and consequences are:

Pf <u>The Probabilities of Failure in the next three years:</u>

1.0	Near Certainty	Beyond Life Cycle Interval AND supported by Condition Assessment
0.8	Likely	At Life Cycle Interval AND Supported by Condition Assessment
0.6	Possible	Due Date Less than 10% Life Cycle Interval
0.4	Unlikely	Due Date Less than 25% Life Cycle Interval
0.2	Very Unlikely	Due Date Less than 50% Life Cycle Interval

Cf <u>The consequence or Impact of Failure on Vessel Availability</u>

Assume this is a complete system failure, not a component failure that can be repaired with normal maintenance procedures and funding.

1.0	Catastrophic	Miss more than one week of service

0.8	Critical	Miss One Week to Repair
0.6	Moderate	Miss One Day to Repair
0.4	Marginal	Miss ½ Day to Repair
0.2	Minimal	Does not Affect Sailing

Risk ratings for (P_f) and (C_f) will be rated between 0.2 to 1.0 in five steps and each represents one of the five rows or columns in the risk matrix illustrated in Figure 1.

In applying the determined P_f (Probability) and C_f (Consequence) to Figure 1, the probability of failure is used to identify the "likelihood" of the risk and is reflected on the vertical axis while the consequence of failure is used to identify the impact of the risk to the program if it was to occur, and is reflected along the horizontal axis. In large acquisition projects, risk is assessed against performance, cost and schedule impacts. In the case of this task, WSF is mainly interested in the impact on performance. I.e. impact of losing the vessel to the operating schedule. So we will only evaluate the Performance Risk of the availability of the vessel to get underway safely and perform her mission.

There is some complication for items for which the scope is unknown until a maintenance period inspection. If the failure is identified by inspection during a routine dry dock or dockside maintenance period, and the repair can be made during the normal period of performance of that maintenance period, the impact does not affect the ship's sailing. Typical examples of this are rudders, propellers, shafting, and couplings that can only be properly inspected when the vessel is in dry dock. WSF's risk mitigation strategy for these items is to maintain spare components in its warehouse, so these items can be replaced expeditiously if found defective, and then repaired at a later date and returned to storage. Since these items would typically take months to manufacture new, this strategy aids greatly in keeping the delays to a minimum. Other examples not involving spares would be a paint failure in the fresh water tank or the sewage tank.

The blocks in Figure 1 shaded in red are the high probability and high consequence items and should have definite risk mitigation plans to reduce or eliminate the risk. Yellow shaded blocks have medium level of risk, and if possible should be mitigated or eliminated to green. In the case of Preservation Items, the easiest way to mitigate the risk is to do the preservation action before the failure occurs, or improve the preventive maintenance practices, which includes condition based maintenance, to extend the interval between accomplishing the preservation action.

2.2 Risk Analysis Example M/V Tacoma

Intuitively, WSF Preservation Engineers have already conducted a portion of this risk analysis in a basic way as proven by the division of LCCM Preservation Items into Vital and Non Vital Items. However going through the effort of rating the risks based on actual condition assessments at a given point in time will help with the decision making process of scheduling and budgeting a preservation item due in the next biennium or deciding to extend or defer the item.

As an example, we have done a sample analysis for Tacoma using existing data as of June 2010. The condition assessments were not available to us, so the Vital systems were assumed needed if due and we assumed the Non Vital systems could be extended if needed. The Vital and Non Vital tables are found on the second and third pages of Appendix E. The draft current Work Plan printed July 15, 2010, for year ‘10 and the next biennium ‘11-'13 was used to compare the outcome of the Risk Analysis to the actual Work Plan.

Each table contains a column for the estimated Pf and Cf based on the respective Pf or Cf table. The next column is the year due. If the item is due in 2010 or prior, the date is highlighted in gold. If the year due is 2011-13 the font is RED. Since our estimate of the probability of failure is a function of the relationship between the interval and due date, the fourth column contains the interval period. Using the Pf and Cf values we locate the cell on the Risk Matrix that is applicable—a red cell, a yellow cell or a green cell and highlight the appropriate cell in the fifth column applicable to the LCCM item in question.

A review of the Vital Items shows 11 red items, each one either past due (two of them) or are due in years 11-13. Each one of these should be scheduled and budgeted in 2010, or 2011-13. We took a look at the latest 16 Year Work Plan printed on July15, 2010 to see if the items due were on the schedule. The comparison can be found in the sixth column. The sixth column keys to the legend are: The block shaded Red means that the item is scheduled for 2010; A Red Font “B” means that it is budgeted for the 2011-2013 biennium; A black font “E” means that the item is extended, i.e. it is due, but the condition is such that it can be extended; a black font “D” means that the item is deferred, i.e. the item is due or past due, the condition is such that it should be done, but it is deferred, All deferrals should be justified by explanation in the LCCM and in the 16 Year work Plan.

- Of the 11 red Vital Items, all but three are budgeted in either year 10 coded with a red block or 11-13 coded with a red B.
- The Satellite Compass system and the Electronic Door Locks are both extended to 2019-21 and coded with an E. These are relatively new systems and the interval of 10 years and 6 years respectively may be suspect if the item can be extended out to 15+ and 10 years as scheduled.
- The Temporary Emergency Power System was not found on the Work Plan.

So it appears that for Tacoma the Preservation Engineers have made good management decisions for the Vital red-risk items, decisions which are in alignment with the risk analysis done for Tacoma.

Looking at the Non Vital Items, there are no Red items. The only Yellow item due and budgeted is Hull Paint. That item presented an interesting analysis. If the paint system fails, does it prevent the ship from sailing? Probably not. But is it wise to keep the ship in the water with the hull unprotected from the salt water environment? This would not be a wise business decision. Since that item is due (0.8 probability) and it technically doesn’t impact the ship sailing (0.2 Impact), the risk rating is Yellow. However, one could make a case that the impact on the vessel is more than whether the ship can sail or not; since WSF would take the ship out of service to correct a serious hull paint failure, one could argue that because the item is due, it should be Red. These are decisions the Preservation Engineers conducting the risk analysis can make. At any rate, Preservation Engineering has Hull Paint budgeted in the year due (2013) for good reason.

We note in comparing the Non Vital Risk assessment for Tacoma with the draft 16 Year Work Plan, the inspection and touch up painting of the potable water tanks and of the sewage tanks are being extended, i.e. they are due (really past due) and yet not scheduled until 2017-19. These two items are critical to being able to increase the tank steel replacement item intervals as recommended in the interval study in Section I. We suggest that these inspections and touch up paint items not be extended but scheduled for the next available dry dock. As such even though the criticality does not impact sailing, it does impact steel replacement and Cf could be higher. The same philosophy for these tanks should be applicable throughout the fleet.

Having gone through the risk analysis process with Tacoma, we suggest that there is value in the exercise. Once the probability and criticality (impact) factors were set, the tables designed, and due dates calculated, it took about one hour to do the risk analysis and compare the results to the draft 16 Year Work Plan. If the last due dates and intervals can be electronically dumped into the tables, it should take about 24 man hours to update the risk tables for the fleet each biennium. If the risk analysis is done before the 16 year plan is started, the risk analysis will provide a method to ensure high risk items are scheduled and provide a method for choosing lower risk items to extend or defer if needed.

3.0 Constructability vs. Out-Of-Service Time.

3.1 Analysis Of Contracts With Respect To On-time Completion

Planned out of service time for maintenance versus actual out of service time can be significant. There is always a question of how much work can get done in a fixed period of time, and it is not always an easy question to answer. Some metrics that generally shed some light on the subject are: dollars/week expended, planned vs. actual periods of performance, dollars spent and extensions granted based on engineering contract changes to both contract work and new work, and weather related delays. We set out to see what data were available from past scheduled commercial availabilities in order to see if there were any trends or correlation. Prior to looking for and gathering available data, Vessel Engineering indicated that a general rule of thumb in terms of cost/week was about $1 million/month or approximately $250 thousand/week. We looked at cost and schedule growth for the scheduled availabilities over the last three years, between March 2007 and March 2010. With that information, we hoped to ascertain whether projected workload for each vessel within the preservation plan could be accomplished in the projected time frames and can the metrics show that WSF uses the available out of service time wisely.

In reviewing the availability data from the Vessel Engineering Business staff the following data was readily available:

- Contract Start Date
- Contract Completion Date
- Contract Award Cost
- Contract Final Cost
- Contract change order forms but with little info other than a line item to charge and a cost for that change. The contract extensions did not contain enough detail to determine the cause.

In most contracts we found a Contract Summary Spreadsheet which captured each contract change, and whether the work was due to Growth, Design Problems, New Work, Regulatory Requirement after contract award, Government (or Owner) Furnished Equipment problems, Incorrect Specifications, Information purposes only, or Miscellaneous. A copy of one of these summaries can be found in Appendix G. As part of the report, each change is made against a contract line item number, and what funding group, i.e. Preservation, Maintenance, or Improvement. In order to relate final costs of Preservation Items to the LCCM Cost Factors, it would be most helpful to have a final contract cost for each Preservation Item; the costs can be directly compared if the scope of the LCCM Preservation Item is the same or similar to the scope in the contract package. In most cases the preservation item relates directly to one line item, but in some cases, like hull or topside painting, there may be more than one line item. We could not find the total cost of each preservations item clearly identified in the contract files or electronic documentation. It would also be helpful if the contract line item name for Preservation Items more closely matched the Preservation Item Description in the LCCM or at least the line item was clearly identified with a specific LCCM Item Description. Together, these two improvements would aide in clearly identifying those Preservation Items completed and the final cost.

Often times the solicitation start date was not the same as the award start date. We had to assume that the period of performance in the solicitation was the same as the period of performance for award. With that assumption we calculated the number of days the contract was extended or reduced if any.

With this data, we also were able to calculate: cost growth; schedule growth in dollars, days and percent; and overall cost per/week. A table of the data can be found in Appendix F.

The overall results are as follows:

There were 26 scheduled Dry Dock Availabilities

DD Data	
Average Period	44.7 Days
Average Extension	8.5 Days
Average % Growth	38.32%
Average $/Wk	$216,784

There were 8 dry dock contracts that were extended more than 2 weeks and three of them were 49, 24, and 21 days. There were 4 contracts extended between 1 and 2 weeks. There were 14 that were extended 1 week or less with 2 of those delivered on time and 4 delivered early. Based solely on contract files and change order documentation, we could not determine, with confidence, the reasons for the extensions.

The average cost per week for dry dock availabilities was $216,784 a week. Using a factor of 4.3 weeks/month the average cost was about $932,000 a month, very close to the $1 million a month rule of thumb WSF uses. The average percent of cost growth at 38% seemed high but the documentation showed that most of the cost growth was due to work on the underwater body, hull steel or within items where work requirements were hidden like tank coating preservation, or steel work and other preservation work in passenger, galley, or wet spaces after the deck underlayment was removed.

The cost growth for hull steel and interior hull preservation should be moving towards zero as the Hull Inspection / Steel Preservation Program gets better at identifying steel preservation needs and then preserving those areas by coating preparation and painting. This will reduce the need for steel renewal. Where steel renewal is required, those needs can be quantified through the Hull Inspection Program prior to the next dry dock contract and included as a definite item that contract, thus reducing unplanned out of service time and change order costs.

It is difficult to predict the need to repair rudders, shafts, and sea chests and other underwater body work until the ship is out of the water. In the 3 dry dock contracts those items had the highest cost growth over the last three years. We saw no cost growth caused directly to poor specifications.

We reviewed in depth the three dry dock contracts with the largest extensions to the delivery date and could not find direct and clear reference to why the contract delivery date was extended.

There were 13 Scheduled Dock Side Availabilities

DS Data	
Average Period	65.7 Days
Average Extension	4.5 Days
Average % Growth	17.94%
Average $/WK	$172,328

There were 2 Dock Side contracts extended more than 2 weeks with one of them 36 days and one of them at 24 days. There was 1 contract extended between 1 and 2 weeks (10 days). There were 10 contracts at 7 days or less with 7 of those 10 delivered on time or early. The dockside availabilities were more controlled with half of the 14 delivered on time or early. The 4.5 day average extension is a very good number. It was not surprising that the cost per week was lower for the dockside availabilities as opposed to dry dock availabilities because the cost of the dry dock did not come into play. The average cost growth was more reasonable for the dockside availabilities because the work is generally more able to be defined in the specifications. As in the case of the dry dock availabilities, we reviewed in depth the two contracts extended more than two weeks but could not find direct and clear reference to the fact that the contract delivery date was extend or why.

The data shows that for dry dock availabilities if the estimated cost of work is around $250 thousand a week, the work can be accomplished within that period of performance. For dockside periods, that number would be around $170 thousand.

Recommendations:

- As part of the Availability Summary of data, include the Contract Start and End Dates.
- As part of the Availability Summary include for each line item the award price, total change order cost and final cost. The award Price, Change order price and final contract price is calculated and presented for the contract as a whole, but it should be also available by the line item. This will help make future adjustments to Preservation Cost Factors.
- Contract Line Item descriptions for Preservation Items should match the LCCM Preservation Item Description. Or at least identify the contract line item to the LCCM Item, making it easier to capture the final cost of each preservation item.
- Any change to the contract end date should be done by change order, as is the practice, but the reasons for the contract extension should be clearly explained and tied to specific contract line items. The Vessel Project Engineers and the Vessel Business Staff should then review each contract extension and determine if changes can be made to prevent a similar extension in the future. Examples of internal management change could be in contract policy, pre contract inspections, or different approaches to recurring work requirements.

3.1 Constructability vs. LCCM Intervals

Looking at the various Preservation Items and their intervals, the question is whether each item can be accomplished per the model. The period of performance for vessel availabilities are usually controlled by one or two items called the critical path. We therefore looked at two of the items which historically require the longest time to complete: Topside Painting and Passenger Space Renovation, both Non Critical Items.

The worst case item is Topside Painting. This item requires at least three months and if there is cold/rainy weather or other work items that conflict with the painting preparation and application of the coating, it has taken longer. The other complication is that the preparation and painting of the freeboard and curtain plate must be done in dry dock for environmental reasons. This dry dock requirement further complicates the picture because at present, in Puget Sound, only Todd Shipyards can dry dock the Jumbo MK II and Jumbo class ferries. The LCCM interval for topside painting currently is 7 years. There have been cases where due to budget constraints a vessel has been extended to 10 years but the ship's exterior appearance reflected poorly on an otherwise well maintained vessel. For the five largest ferries in 14 years there will be 10 events. In terms of biennia, a notional schedule would be as follows

- Biennium 1: One Jumbo
- Biennium 2: Two Jumbos
- Biennium 3: One Jumbo
- Biennium 4: Two Jumbos
- Biennium 5: One Jumbo
- Biennium 6: Two Jumbos
- Biennium 7: One Jumbo and then it starts over.

From a dry dock perspective, each ship is required by the U.S. Coast Guard to be on dock twice every five years, so the painting events and dry dock periods need to be carefully planned and coordinated to ensure they match up in the 16 Year Work Plan. Again, this challenge is complicated further by the fact that Todd Pacific Shipyard is has the only dry dock in Puget Sound large enough to handle the five largest ferries, and Todd leases the dry dock from the government and must give priority to Navy and Coast Guard ships.

Looking at the entire current fleet of 20 ships, each with an interval of 7 years, three ships will be scheduled for top side painting for six biennia out of seven, one of seven will have two. Like for the largest five vessels, the challenge is to make sure a dry dock period is scheduled to match up with the topside painting event. Since the topside paint event is one of the most costly preservation items, the Senior Preservation Port Engineer also must try to even out the costs across the seven biennia. Eventually adding two ferries for the expected fleet total of 22 vessels will complicate the scheduling further.

Passenger Space Renovations is another frequent, high-cost item and one that takes 2-3 months to accomplish. The length of time is dependent on the condition of the deck underlayment and steel below the underlayment, as well as if there is other conflicting work or not. The LCCM interval is 12 years for all but Puyallup, which is 20 years. From a scheduling perspective it is a plus if you can do this item along with top side painting to reduce the out of service time of the vessel. However, since the intervals are not the same, this cannot always happen. For this item, 20 passenger space renovations will take place every 12 years. On average and if Puyallup is scheduled in the same 12 year period, four biennia will have three vessels scheduled for Passenger Space Renovations, and in two biennia there will be 4. Again, when the fleet expands to 22 ferries, there will be two more ships to schedule in the 12 year period.

Our analysis shows that these two critical path items can be accomplished as scheduled by the LCCM, but we have tried to highlight the challenges and constraints confronting Vessel Preservation Engineers and the risks based on the number of ships needing to be done each biennium, the availability of Puget Sound region shipyards, and cost implications.

4.0 Budget Implications of the Revised 16-Year Work Plan

Based on the analysis completed in the first three sections we recommend the following that may have positive impact on the revised 16-Year Work Plan:

- In general, we recommend that the intervals across the classes be the same, unless there is a distinct design or operational difference that would impact the system life cycle.
- Look critically at inventory items that have consistently been extended and are still operational. Can the methods used to keep those systems operational be used in other classes of ships and increase the interval over the entire class or fleet?

- Work with Staff Chief Engineers to come up with an easy procedure for evaluating change orders and determining whether the scope of that item could be identified better by inspection prior to the contract solicitation.
- Clearly document the specific reasons for contract extensions and evaluate how those reasons can be avoided in the future.
- Evaluate documentation and procedural changes that result in clearly capturing total preservation item costs.

Appendix A List of Vital and Non Vital Inventory Items

Appendix A - LCCM Preservation Items

F1A (Vital) Preservation Items (36 Total)

Structural Steel Replacement (2)
Auto Deck Corrosion
Hull

Piping Replacement (3)
Bilge Piping
Firemain Piping/Manifolds
Sprinkler System

Propulsion Systems (8)
CPP Hubs/Blades (Issaquah Class only)
Reduction Gears (Issaquah Class only)
MDE
Propulsion Generators/Alternators
Propulsion Motors
Propulsion Controls
Propulsion Switchboards
Rudders

Major Mechanical/Electrical Systems (3)
Aux Diesel Generator
Aux S/B/ Power Dist
Steering 1 and 2

Communications and Lifesaving Systems (15)
Auto Identification System
Davits 1 and 2
Draft Indicating System
General Alarm System
GPS
Gyro Compass
Interior Communications
Radars
Marine Escape Slides
PA System
Radar
Radios
Rescue Boats 1 and 2
Satellite Compass Sys
Temp Emergency Power

Security Systems (5)
A/C Data Center
All Cameras
Electronic Door Locks
Hirsh Hardware
Sensors and Alarms

F1B (Non-Vital) Preservation Items
(Total 28 Systems)

Structural Preservation Paint (7 items)

- Bilges
- Hull Paint
- Machinery Spaces
- Potable Water Tanks
- Sewage Tanks
- Topside
- Voids

Interior Preservation (3 items)

- Crews Quarters
- Galley
- Passenger Spaces

Steel Replacement (5 items)

- Potable Water
- Sewage
- Solariums
- Shelter Deck
- Wet Spaces

Piping Replacement (5 items)

- Heating
- Fresh Water Cooling
- Potable Water
- Salt Water
- Sewage / Soil

Major Mechanical / Electrical (8 items)

- Boilers Heating
- Oil Fired Hot Water Heaters (JMKII)
- Lighting Fixtures Exterior
- Lighting Fixtures Interior
- Elevators Freight and Passenger
- Sanitary Fresh Water Flushing
- Heat Recovery System
- HVAC Vents and Controls

Appendix B Intervals for Vital and Non Vital Inventory Item

Non Vital Preservation Item Interval 2010

Legend: Changes from 2008 LCCM

Item Description	Jumbo MK II		Jumbo		Super		Issaquah		Estate			
	2010		2010		2010		2010		2010			
Bilge Painting		20		10		10		10		10	Inventory Items Changed	
Crews	20P	12	20W	12 S		12		20	20	12 ES		12
Elevators		20		30		30		30		30		3
Fresh Water Cooling		15										
Galley Renovation	20P	12		12		12		12		12		1
Heat Recovery System		30										3
Boilers Heating				20		20		20		20		
Heating Piping		30		30		12		15		12		11
Hull Paint		8		8		8		8		8		
HVAC Vent/Control		20		12		12		12		12		3
Lighting Fixtures Interior		12		12		12		12		12		
Lighting Fixtures Exterior		12		12		12		12		12		
Machinery Space Painting		30		20		10		10	ES10	20		7
Oiled Fired Hot Water Heaters		20										
Passenger Rehab	20P	12		12		12		12		12		1
Potable Water Piping		30		20	15 E Y	12		20	20	12 ES		12
Potable Water Tanks Paint		10		10		10		10		10		
Potable Water Tanks Steel		30		20		20		20		20		18
Salt Water Piping		20		10		10		10		10		3
Sanitary Fresh Water Flushing		30		18		18		18		18		3
Sewage Piping		20		20		15		15	10ES	20		17
Sewage Tank Paint		5		5		5		5		5		
Sewage Tank Steel		30		20		20		20		20		3
Shelter Deck								20		20		
Solariums		30		20		20						3
Topside Paining		7		7		7		7		7		
Voids		15		10		10		10		10		3
Wet Spaces	20P	12	20S	12		12	12	10 CA,SE		12	Change Walla Walla to 20	16

Notes to 2010 LCCM Update Intervals Non Vital

Recommended Changes to 2010 Update
Preservation Engineering recommends changing Walla Walla from 12 to 20 to match Spokane

Inventory Item Intervals Changed **119**

2010 LCCM Update Notes to be added to Vessel data.

Bilge Painting	MKII 20, others 10: Quality of MKII's bilge painting prep and application were exceptional
Crew Quarters	Puyallup, Walla Walla, Issaquah Class 20 v 12 based on Staff Chief's Condition Report
	Puyallup also to match and renew Crew Qtrs, Passenger Spaces and Galley the same year @ 20.
	Puyallup has less wear & tear on Passenger spaces--they have fewer commuters & short ride on Kingston-Edmonds Route.
	Asbestos in Super Class--when renovated Hyak will move to 20
Elevators	Puyallup reduced to 20 because she has much more elevator use than any other ship. More Passengers and levels.
Galley	Puyallup increased to 20 based on less use (route) and Staff Chiefs Condition Report
Heating Piping	MKIIs have Cu piping and Staff Chief condition report
HVAC Vent/Controls	MKII 20 v 12 Modern Controls and Staff Chief condition report. Look at deferrals of Issaquah Class, Why those at least 20 years.
Machinery Space Painting	MKII, Super and Klahowya and Tillikum increased to 30, 20 , 20 and 20 based on Staff Chiefs Condition Report Don't change E State due to retirement
Paassenger Rehab	Puyallup's material quality and low commuter/tourist ratio, and short run
Potable Water Piping	Hyak, Kaleetan, and E State remain 12. MKII 30 (CuNi), Others 15 based on Staff Chiefs Condition Report
Water Tanks Steel	All vessels increased due to routine paint inspections. MKII 30 due to better paint application at construction. Others 20
Salt Water Piping	MKII increased to 20 yrs based on CuNi pipe and Staff Chief Condition Report
Sanitary Fresh Water Flushing	MKII increased to 30 - others remain at 18 due to having been salt water flushing early in their years.
Sewage Piping	All vessels increased due to conditon. Ships with 20 yrs are CuNi pipe.
Sewage Tank Steel	MKII used fresh water flushing from construction. Others started out with Salt Water Flushing.
Solariums	MKII increased to 30 - others remain at 20. MKIIs constructed of better materials
Voids	JMKII 15 v others remained at @10 due to quality of construction and paint systems.
Wet Spaces	All increased intervals due to better quality floor covering. Puyallup and Supers 20 based on Staff Chief Condition Reports. July Review recommends changing Walla Walla to 20 to match Spokane.

WSF LCCM 2010 Update Interval Comparison Vital Systems

Legend: Changes from 2008 LCCM

Item Description	MKII 2010	Jumbo 2010	Super 2010	Issaquah 2010	Estate 2010		Number of Inventory Items Changed
Auto Deck Corrosion Note 1	15	10	10	10	10		3
Hull Note 2	20	20	20	20	20		
Bilge Piping Note 3	30	20	15	20	20- ES15		13
Firemain Piping/Manifolds	20	15	15	15	30-ES15		7
Sprinkler System	30	15	15	15	30-ES15		5
CPP Hubs/Blades Issaquah				7			6
MDE 4/4/4/2/2	30	30	30	30	30		
Gens/Alternators Note 4	30	30	10 30 EL		30		
Motors 4/2/2/0/4	30	30	30		30		
Propulsion Controls Note 5	20	30	30	30	30		3
Reduction Gears				20	20		6
Rudder 1 and 2	20	20	20	20	20		4
Propulsion Switchboards	30	30	30		30		
Aux Diesel Generator Note 6/6a	30	30	20	20	30-ES 20		7
Aux S/B/ Power Dist	30	25	20	20	20		5
Steering 1 and 2	20	20	20	20	20		
Auto Identification System	10	10	10	10	10		
Davits 1 and 2 Note 7	30	30	30 -20EL	30	20	Change Elwah to 30	36
Draft Indicating System	6	6	6	6	6		
General Alarm System	30	30	30	30	30		
GPS 2/2/1	10	10	10	10	10		
Gyro Compass Note 8	15	15	15	15	15		
Internal Comms Note 9	30	30	30-EL20	30	30		
Landing Radars 2/1/1/1/1	10	10	10	10	10		
Marine Escape Slides 4	15	15	15	15	15		
PA System	20	12	12	12	12		3
Radar (4)	10	10	10	10	10		
Rescue Boats 1 and 2 Note 10	15	15	15	15	15		36
Satelite Compass Sys	10	10	10	10	10		
Temp Emer Power	15	30	30	30	30		3
VHF Radio	10	10	10	10	10		
AC Units (Datacenter)	10	10	10	10	10		
All Cameras	7	7	7	7	7		
Electronic Door (locks)	6	6	6	6	6	Change Elwah from 12 to 6	1
Hirsh Hardware Security	12	12	12	12	12	Change Rhoddie from 6 to 12	1
Sensors and Alarms	10	10	10	10	10		

Inventory Item Interval Changes **139**

Notes from 2010 Update

Recommneded Additional Changes
Davits: Change Elwha from 20 to 30 to match other Super Class
Electronic Doors: Change Elwha from 12 to 6 to match the rest of the fleet
Hirsh Hardware: Change Rhoddodendrun from 6 to 12 to mathc the rest of the fleet

Reasons for Differences 2010

Auto Deck Corrosion: MKII increased to 15 due to Zink Coating and paint quality from the outset
Bilge Piping increased to 30 and 20 on MKII and Jumbo based on type of materials and condition reports.
Firemain Piping increased to 30 and 20 yrs based on quality of materials and condition reports.
Sprinkler System increased to 30 yrs on MKII and Estate: stainless pipe and tubing
CPP/Hubs Issaquah's increased to 7 due to better seals and materials
Propulsion Gens/Alternaters: Yakima and Kaleetan have problems with rebuilt propulsion generators. See 2008 note 4
Propulsion Controls: MKII to 20 from 30 based on Vendor's estimate of hardware & software changes due to major component obsolescence.
Reduction Gears decreased from 30 to 20 due to bearing wear history.
Aux Diesel Gen Sets: Difference in Intervals due to different engine models and hours of usage. See 2008 notes 6 and 6a
Aux Switchboards/Distribuition: Difference between MKII (30), Jumbo (25) and others (20)due to technical quality of materials when built
Davits: Estate class has a different Davit model and of lower quality
Internal Comms: Elwha is 20 vice 30 due to condition and Staff Chief Condition Report
PA System: MKII 20 yrs vice 12 because the system is better quality as built. As others renewed, they may change to 20 as well.
Temp Emergency Power: MKII Class twice the use

Appendix C Deferred Inventory Items

Vessel	InvID	InvIDDescription	f1a or f1b	Year Last Renewed	Life Cycle	Years since last renewed	Preservation comment
Vital Items (Fia) in Red Font							
Non Vital Items (F1B in Black Font							
Hiyu	1409	Auto Deck	1a	1986	11	24 Years 2.2 Life Cycles	Retire
Evergreen State	994	Auxiliary Diesel Generator #1	1a	1988	20	22 Years 1.1 Life Cycles	Retire
Hyak	422	Auxiliary Diesel Generator #1		1988	20	22 Years 1.1 Life Cycles	2011
Hyak	1945	Auxiliary Diesel Generator #2		1988	20	22 Years 1.1 Life Cycles	2011
Evergreen State	995	Auxiliary Switchboard / pwr dist		1988	20	22 Years 1.1 Life Cycles	Retire
Hyak	423	Auxiliary Switchboard / pwr dist		1988	20	22 Years 1.1 Life Cycles	2011
Hyak	409	Bilge Piping	1a	1967	15	43 Years 2.9 Life Cycles	2011
Yakima	535	Bilge Piping		1967	15	43 Years 2.9 Life Cycles	
Hiyu	1413	Bilge Piping		1986	16	24 Years 1.5 Life Cycles	Retire
Evergreen State	980	Bilge Piping	10	1988	15	22 Years 1.5 Life Cycles	Retire
Hyak1	393	Bilges	1b	1967	10	43 Years 4.3 Life Cycles	2011
Kaleetan1	455	Bilges		1967	10	43 Years 4.3 Life Cycles	
Kittitas1	838	Bilges		1980	10	30 Years 3.0 Life Cycles	
Hyak2	400	Crew's quarters	1b	1967	12	43 Years 3.6 Life Cycles	2015
Evergreen State1	971	Crew's quarters		1988	12	22 Years 1.8 Life Cycles	Retire
Issaquah2	716	Crew's quarters		1980	20	30 Years 1.5 Life Cycles	
Kittitas3	844	Crew's quarters		1980	20	30 Years 1.5 Life Cycles	
Cathlamet4	589	Crew's quarters		1981	20	29 Years 1.5 Life Cycles	
Sealth5	908	Crew's quarters	9	1982	20	28 Years 1.4 Life Cycles	
Evergreen State	1022	Davits #1	1a	1988	20	22 Years 1.1 Life Cycles	Retire
Evergreen State	4041	Davits #2	12	1988	20	22 Years 1.1 Life Cycles	Retire
Hyak3	3932	Dumbwaiters	1b	1967	30	43 Years 1.4 Life Cycles	No other dumwaiters
Spokane1	4092	Dumbwaiters		1972	30	38 Years 1.3 Life Cycles	No other dumwaiters
Walla Walla2	4123	Dumbwaiters		1972	30	38 Years 1.3 Life Cycles	No other dumwaiters
Issaquah6	742	Elevators	1b 13	1980	30	30 Years 1.0 Life Cycles	
Hyak	411	Firemain Piping/Manifolds	1a	1967	15	43 Years 2.9 Life Cycles	2011
Yakima	537	Firemain Piping/Manifolds		1967	15	43 Years 2.9 Life Cycles	2019
Hiyu	1415	Firemain Piping/Manifolds		1976	16	34 Years 2.1 Life Cycles	Retire
Evergreen State	982	Firemain Piping/Manifolds	16	1988	15	22 Years 1.5 Life Cycles	Retire
Issaquah7	717	Galley	1b	1980	12	30 Years 2.5 Life Cycles	
Kittitas8	845	Galley		1980	12	30 Years 2.5 Life Cycles	
Cathlamet9	590	Galley		1981	12	29 Years 2.4 Life Cycles	
Sealth10	909	Galley		1982	12	28 Years 2.3 Life Cycles	
Evergreen State2	972	Galley		1988	12	22 Years 1.8 Life Cycles	Retire
Hyak4	443	General Alarm System		1967	30	43 Years 1.4 Life Cycles	2011
Issaquah11	747	Heating Boilers	1b	1980	20	30 Years 1.5 Life Cycles	
Kitsap12	811	Heating Boilers		1980	20	30 Years 1.5 Life Cycles	
Hiyu3	1431	Heating Boilers		1984	21	26 Years 1.2 Life Cycles	Retire
Spokane3	238	Heating Boilers #1		1972	20	38 Years 1.9 Life Cycles	
Walla Walla4	303	Heating Boilers #1		1972	20	38 Years 1.9 Life Cycles	
Kittitas13	875	Heating Boilers #1		1980	20	30 Years 1.5 Life Cycles	
Sealth14	939	Heating Boilers #1		1982	20	28 Years 1.4 Life Cycles	
Chelan15	683	Heating Boilers #1		1985	20	25 Years 1.3 Life Cycles	
Tillikum1	1130	Heating Boilers #1		1986	20	24 Years 1.2 Life Cycles	
Hyak5	430	Heating Boilers #1		1988	20	22 Years 1.1 Life Cycles	2015
Yakima2	556	Heating Boilers #1	30	1988	20	22 Years 1.1 Life Cycles	
Spokane5	4091	Heating Boilers #2		1972	20	38 Years 1.9 Life Cycles	
Walla Walla6	4122	Heating Boilers #2		1972	20	38 Years 1.9 Life Cycles	
Kittitas16	4078	Heating Boilers #2		1980	20	30 Years 1.5 Life Cycles	
Sealth17	4009	Heating Boilers #2		1982	20	28 Years 1.4 Life Cycles	
Chelan18	4020	Heating Boilers #2		1985	20	25 Years 1.3 Life Cycles	
Hyak6	4047	Heating Boilers #2		1988	20	22 Years 1.1 Life Cycles	2015
Yakima3	4145	Heating Boilers #2		1988	20	22 Years 1.1 Life Cycles	
Hyak7	412	Heating System Piping	1b	1967	12	43 Years 3.6 Life Cycles	2015
Hiyu4	1416	Heating System Piping		1981	12	29 Years 2.4 Life Cycles	
Walla Walla7	284	Heating System Piping		1972	20	38 Years 1.9 Life Cycles	
Evergreen State5	983	Heating System Piping	41	1988	12	22 Years 1.8 Life Cycles	Retire

Vessel	InvID	InvIDDescription	f1a or f1b	Year Last Renewed	Life Cycle	Years since last renewed	Preservation comment
Chelan	655	Hull	1a 17	1985	20	25 Years 1.3 Life Cycles	
Hyak8	427	HVAC Vent Systems / Controls	1b	1967	12	43 Years 3.6 Life Cycles	2011
Hiyu6	1429	HVAC Vent Systems / Controls		1967	13	43 Years 3.3 Life Cycles	Retire
Spokane8	235	HVAC Vent Systems / Controls		1972	12	38 Years 3.2 Life Cycles	
Walla Walla9	300	HVAC Vent Systems / Controls		1972	12	38 Years 3.2 Life Cycles	
Issaquah19	744	HVAC Vent Systems / Controls		1980	12	30 Years 2.5 Life Cycles	
Kitsap20	808	HVAC Vent Systems / Controls		1980	12	30 Years 2.5 Life Cycles	
Kittitas21	872	HVAC Vent Systems / Controls		1980	12	30 Years 2.5 Life Cycles	
Cathlamet22	617	HVAC Vent Systems / Controls		1981	12	29 Years 2.4 Life Cycles	
Sealth23	936	HVAC Vent Systems / Controls	50	1982	12	28 Years 2.3 Life Cycles	
Hyak	444	Interior Communications	1a 18	1967	30	43 Years 1.4 Life Cycles	2013
Hiyu7	1430	Lighting Fixtures	1b	1984	12	26 Years 2.2 Life Cycles	Retire
Walla Walla10	4121	Lighting Fixtures Exterior	1b	1972	12	38 Years 3.2 Life Cycles	
Cathlamet24	4014	Lighting Fixtures Exterior		1981	12	29 Years 2.4 Life Cycles	
Yakima4	4146	Lighting Fixtures Exterior		1982	12	28 Years 2.3 Life Cycles	
Issaquah25	745	Lighting Fixtures Interior		1980	12	30 Years 2.5 Life Cycles	
Kitsap26	809	Lighting Fixtures Interior		1980	12	30 Years 2.5 Life Cycles	
Kittitas27	873	Lighting Fixtures Interior		1980	12	30 Years 2.5 Life Cycles	
Cathlamet28	618	Lighting Fixtures Interior		1981	12	29 Years 2.4 Life Cycles	
Hyak9	392	Machinery Spaces	1b	1967	10	43 Years 4.3 Life Cycles	2013
Kaleetan5	454	Machinery Spaces	60	1967	10	43 Years 4.3 Life Cycles	
Issaquah29	709	Machinery Spaces		1980	10	30 Years 3.0 Life Cycles	
Kitsap30	772	Machinery Spaces		1980	10	30 Years 3.0 Life Cycles	
Chelan31	645	Machinery Spaces		1985	10	25 Years 2.5 Life Cycles	
Evergreen State8	964	Machinery Spaces		1988	10	22 Years 2.2 Life Cycles	Retire
Spokane11	200	Machinery Spaces		1972	20	38 Years 1.9 Life Cycles	
Walla Walla12	264	Machinery Spaces	66	1972	20	38 Years 1.9 Life Cycles	
Hyak	417	Motors #1	1a	1967	30	43 Years 1.4 Life Cycles	2010
Hyak	4052	Motors #4		1967	30	43 Years 1.4 Life Cycles	2310
Walla Walla	317	PA System	1a	1972	12	38 Years 3.2 Life Cycles	
Hyak	442	PA system		1985	12	25 Years 2.1 Life Cycles	2011
Evergreen State	1015	PA system		1988	12	22 Years 1.8 Life Cycles	Retire
Kitsap	825	PA system		1988	12	22 Years 1.8 Life Cycles	
Klahowya	1079	PA system	25	1989	12	21 Years 1.8 Life Cycles	
Hiyu9	1404	Passenger spaces	1b	1984	13	26 Years 2.0 Life Cycles	Retire
Evergreen State10	970	Passenger spaces		1988	12	22 Years 1.8 Life Cycles	Retire
Hyak10	414	Potable Water Piping	1b	1967	12	43 Years 3.6 Life Cycles	2011
Hiyu11	1418	Potable Water Piping	70	1981	13	29 Years 2.2 Life Cycles	Retire
Spokane13	221	Potable Water Piping		1972	20	38 Years 1.9 Life Cycles	
Walla Walla14	286	Potable Water Piping		1972	20	38 Years 1.9 Life Cycles	
Evergreen State12	985	Potable Water Piping		1988	12	22 Years 1.8 Life Cycles	Retire
Hiyu13	1402	Potable Water Tanks #1	1b	1984	11	26 Years 2.4 Life Cycles	Retire
Walla Walla15	1821	Potable Water Tanks #1		1972	20	38 Years 1.9 Life Cycles	
Hiyu14	1411	Potable Water Tanks #1		1976	21	34 Years 1.6 Life Cycles	Retire
Issaquah32	1828	Potable Water Tanks #1		1980	20	30 Years 1.5 Life Cycles	
Kittitas33	1830	Potable Water Tanks #1		1980	20	30 Years 1.5 Life Cycles	
Sealth34	1831	Potable Water Tanks #1		1982	20	28 Years 1.4 Life Cycles	
Chelan35	1827	Potable Water Tanks #1	80	1985	20	25 Years 1.3 Life Cycles	
Walla Walla16	1843	Potable Water Tanks #2		1972	20	38 Years 1.9 Life Cycles	
Hiyu15	4229	Potable Water Tanks #2		1976	21	34 Years 1.6 Life Cycles	Retire
Issaquah36	1850	Potable Water Tanks #2		1980	20	30 Years 1.5 Life Cycles	
Kittitas37	1852	Potable Water Tanks #2		1980	20	30 Years 1.5 Life Cycles	
Sealth38	1853	Potable Water Tanks #2		1982	20	28 Years 1.4 Life Cycles	
Chelan39	1849	Potable Water Tanks #2	86	1985	20	25 Years 1.3 Life Cycles	

Vessel	InvID	InvIDDescription	f1a or f1b	Year Last Renewed	Life Cycle	Years since last renewed	Preservation comment
Hyak	419	Propulsion Controls	1a	1967	30	43 Years 1.4 Life Cycles	2010
Evergreen State	3938	Reduction Gears #1	1a	1954	20	56 Years 2.8 Life Cycles	Retire
Tillikum	3934	Reduction Gears #1		1959	20	51 Years 2.6 Life Cycles	
Hiyu	1421	Reduction Gears #1		1967	31	43 Years 1.4 Life Cycles	Retire
Evergreen State	3939	Reduction Gears #2		1954	20	56 Years 2.8 Life Cycles	Retire
Tillikum	3935	Reduction Gears #2		1959	20	51 Years 2.6 Life Cycles	
Hiyu	1934	Reduction Gears #2		1967	31	43 Years 1.4 Life Cycles	Retire
Evergreen State	992	Rudder Number One End	1a	1988	20	22 Years 1.1 Life Cycles	Retire
Hyak	421	Rudder Number Two End	34	1967	20	43 Years 2.2 Life Cycles	
Hyak11	408	Saltwater Piping	1b	1967	10	43 Years 4.3 Life Cycles	2015
Kaleetan6	470	Saltwater Piping		1967	10	43 Years 4.3 Life Cycles	
Yakima7	534	Saltwater Piping		1967	10	43 Years 4.3 Life Cycles	
Hiyu16	1434	Sanitary Fresh Water Flushing	1b	1976	18	34 Years 1.9 Life Cycles	Retire
Cathlamet40	623	Sanitary Fresh Water Flushing		1981	18	29 Years 1.6 Life Cycles	
Chelan41	686	Sanitary Fresh Water Flushing		1985	18	25 Years 1.4 Life Cycles	
Evergreen State17	1006	Sanitary Fresh Water Flushing		1988	18	22 Years 1.2 Life Cycles	Retire
Hiyu18	1417	Sewage / Soil System Piping		1981	11	29 Years 2.6 Life Cycles	Retire
Evergreen State19	984	Sewage / Soil System Piping	95	1988	10	22 Years 2.2 Life Cycles	retire
Issaquah42	729	Sewage / Soil System Piping		1980	15	30 Years 2.0 Life Cycles	
Kitsap43	793	Sewage / Soil System Piping		1980	15	30 Years 2.0 Life Cycles	
Kittitas44	857	Sewage / Soil System Piping		1980	15	30 Years 2.0 Life Cycles	
Walla Walla17	285	Sewage / Soil System Piping		1972	20	38 Years 1.9 Life Cycles	
Hiyu20	1403	Sewage Tanks #1	1b	1984	5	26 Years 5.2 Life Cycles	Retire
Hiyu21	4230	Sewage Tanks #1		1976	20	34 Years 1.7 Life Cycles	Retire
Chelan45	659	Sewage Tanks #1		1985	20	25 Years 1.3 Life Cycles	
Walla Walla18	1865	Sewage Tanks #2		1972	20	38 Years 1.9 Life Cycles	Changed to 30 years
Issaquah46	1872	Sewage Tanks #2		1980	20	30 Years 1.5 Life Cycles	
Chelan47	1871	Sewage Tanks #2	105	1985	20	25 Years 1.3 Life Cycles	
Evergreen State22	975	Shelter Deck	1b	1988	20	22 Years 1.1 Life Cycles	Retire
Spokane19	211	Solariums	1b	1972	20	38 Years 1.9 Life Cycles	
Issaquah48	720	Solariums		1980	20	30 Years 1.5 Life Cycles	
Kitsap49	784	Solariums		1980	20	30 Years 1.5 Life Cycles	
Kittitas50	848	Solariums		1980	20	30 Years 1.5 Life Cycles	
Chelan51	656	Solariums	111	1985	20	25 Years 1.3 Life Cycles	
Hiyu	1414	Sprinkler System	1a	1981	16	29 Years 1.8 Life Cycles	Retire
Walla Walla	282	Sprinkler System		1987	15	23 Years 1.5 Life Cycles	
Evergreen State	981	Sprinkler System		1988	15	22 Years 1.5 Life Cycles	Retire
Evergreen State	996	Steering #1	1a	1988	20	22 Years 1.1 Life Cycles	Retire
Evergreen State	1898	Steering #2		1988	20	22 Years 1.1 Life Cycles	Retire
Hiyu23	1408	Superstructure	1b	1984	21	26 Years 1.2 Life Cycles	Retire
Hyak	418	Switchboards	1a 40	1967	30	43 Years 1.4 Life Cycles	2011
Hyak12	394	Voids	1b	1967	10	43 Years 4.3 Life Cycles	2011
Kaleetan8	456	Voids		1967	10	43 Years 4.3 Life Cycles	
Yakima9	520	Voids	115	1967	10	43 Years 4.3 Life Cycles	
Kitsap52	774	Voids		1980	10	30 Years 3.0 Life Cycles	
Cathlamet53	584	Voids		1981	10	29 Years 2.9 Life Cycles	
Chelan54	647	Voids		1985	10	25 Years 2.5 Life Cycles	
Evergreen State24	966	Voids		1988	10	22 Years 2.2 Life Cycles	Retire
Hyak13	406	Wet Spaces	1b	1967	12	43 Years 3.6 Life Cycles	2011
Issaquah55	722	Wet Spaces		1980	12	30 Years 2.5 Life Cycles	
Kitsap56	786	Wet Spaces		1980	12	30 Years 2.5 Life Cycles	
Kittitas57	850	Wet Spaces		1980	12	30 Years 2.5 Life Cycles	
Hiyu25	1410	Wet Spaces		1984	11	26 Years 2.4 Life Cycles	Retire
Evergreen State26	977	Wet Spaces	125	1988	12	22 Years 1.8 Life Cycles	Retire

Appendix D LCCM Cost Factor Change Summary

Vessel or Class	Inventory Item Name	Inventory Category	Int	2010 Draft LCCM Cost Factors	July 2010 Cost Factor Update
Auto Deck					
Spokane	**Auto Deck**	Steel Replacement	10	**$1,726,000**	
Walla Walla	**Auto Deck**	Steel Replacement	10	**$1,726,000**	
Tacoma	**Auto Deck**	Steel Replacement	15	**$1,599,716**	
Wenatchee	**Auto Deck**	Steel Replacement	15	**$1,599,716**	
Puyallup	**Auto Deck**	Steel Replacement	15	**$1,599,716**	
Suggest that Auto Desk Steel for MKII and Jumbo be the same estimate. If not, the MKIIs should be more.					
MKII auto decks were preserved with improved coating at construction. No changes.					
Davits					
Spokane	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$203,000	
Walla Walla	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$203,000	
Tacoma	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$300,000	$203,000
Wenatchee	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$203,000	
Puyallup	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$203,000	
Hyak	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$189,000	
Kaleetan	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$189,000	
Yakima	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$189,000	
Elwha	**Davits #1**	Comm/Nav/Lifesaving Equip	20	$189,000	
Issaquah	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$63,280	$189,000
Kittitas	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$63,280	$189,000
Kitsap	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$63,280	$189,000
Cathlamet	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$63,280	$189,000
Chelan	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$63,280	$189,000
Sealth	**Davits #1**	Comm/Nav/Lifesaving Equip	30	$63,280	$189,000
Evergreen Stat	**Davits #1**	Comm/Nav/Lifesaving Equip	20	$126,560	
Klahowya	**Davits #1**	Comm/Nav/Lifesaving Equip	20	$195,000	$189,000
Tillikum	**Davits #1**	Comm/Nav/Lifesaving Equip	20	$195,000	$189,000
Evergreen Stat	**Davits #2**	Comm/Nav/Lifesaving Equip	20	$126,560	
Klahowya	**Davits #2**	Comm/Nav/Lifesaving Equip	20	$72,772	$189,000
Tillikum	**Davits #2**	Comm/Nav/Lifesaving Equip	20	$72,772	$189,000
Davit Comment 1 2 MKIIs and the Jumbos @ 203K, Tacoma @ 300K. Suggest change Tacoma to 203K					
Davit Commnet 2 Issaquah Class @ 63,280 is significantly lower than all other classes					
Davit Comment 3 Same data for Davits #1 and #2 except for Klahowya and Tillicum--see comment 4					
Davit Commnet 4 E State #1 is much lower than K and T. #2 much Higher than K and T---Common Theme					
Davit Comment 5 Unless boat davits are different between classes, estimates should be the same					
Change Issaquah Class, Klahowya and Tillikum to match Supers. Tacoma to match other MKII					

Vessel or Class	Inventory Item Name	Inventory Category	Int	2010 Draft LCCM Cost Factors	July 2010 Cost Factor Update		
Electronic Door Locks							
Spokane	**Locks**	Security	6	$16,800			
Walla Walla	**Electronic Door**	Security	6	$11,500	$16,800		
Tacoma	**Electronic Door**	Security	6	$15,750	$16,800		
Wenatchee	**Electronic Door**	Security	6	$16,800			
Puyallup	**Electronic Door**	Security	6	$16,800			
Evergreen Stat	**Electronic Door Locks**	Security	6	$7,350			
Klahowya	**Electronic Door Locks**	Security	12	$7,350			
Tillikum	**Electronic Door Locks**	Security	6	$7,350			
Rhododendron	**Electronic Door Locks**	Security	6	$15,750	$7,350		
Logic says that Walla Walla and Tacoma should be the same as the other Jumbo's. Fewer Locks?							
Rhododendron estimate seems high at 2x the E State Class							
Klahowya interval should be 6							
Change Walla Walla to match other Jumbo/MKII. Rhododendron to match E State Class. Change Klahowya Interval to 6.							
Elevators							
Kaleetan	Elevators	Major Mech/Elec Systems	30	$2,296,833	$594,008		
Yakima	Elevators	Major Mech/Elec Systems	30	$2,296,833	$594,008		
Elwha	Elevators	Major Mech/Elec Systems	30	$594,008			
Hyak	Elevators	Major Mech/Elec Systems	30		$594,008	ADD This ITEM	
Elwha estimate is more than 3x less than K and Y. Hyak is missing.							
Compared to the Issaquah Class ($1.018M) , Kaleetan and Yakima estimate is more than twice as high.							
Change Kaleetan and Yakima to match Elwha							
Firemain							
Hyak	Firemain	Piping Replacement	15	$201,000			
Kaleetan	Firemain	Piping Replacement	15	$201,000			
Yakima	Firemain	Piping Replacement	15	$240,464	$201,000		
Elwha	Firemain	Piping Replacement	15	$201,000			
Yakima is 40K higher than other three Supers?							
Change Yakima to match other Supers.							
Gyro							
Evergreen Stat	Gyrocompass	Comm/Nav/Lifesaving Eq	15	$62,014	$64,000		
Klahowya	Gyrocompass	Comm/Nav/Lifesaving Equip	15	$244,000	$64,000		
Tillikum	Gyrocompass	Comm/Nav/Lifesaving Equip	15	$244,000	$64,000		
Estimates for other classes were between 49K and 53K. K and T seem way out of line, and even E State seems hi.							
A gyro seems to be a standard system, why shouldn't the extimate be the same across the fleet?							
Change the Estate Class to $64K.							

Vessel or Class	Inventory Item Name	Inventory Category	Int	2010 Draft LCCM Cost Factors	July 2010 Cost Factor Update
Heating Boilers					
Spokane	Heating Boilers #1	Major Mech/Elec Systems	20	$56,573	
Walla Walla	Heating Boilers #1	Major Mech/Elec Systems	20	$56,573	
Spokane	Heating Boilers #2	Major Mech/Elec Systems	20	$55,158	$56,573
Walla Walla	Heating Boilers #2	Major Mech/Elec Systems	20	$55,158	$56,573
#1 and #1 boilers should be the same for Spokane and Walla Walla.					
Change the #2 boiler cost factor to match #1 boiler cost factor.					
Hull Paint					
Spokane	Hull (Paint)	Structural Preservation (Paint)	8	$1,630,978	$715,000
Walla Walla	Hull (Paint)	Structural Preservation (Paint)	8	$1,630,978	$715,000
Jumbo MK II Cl	Hull (Paint)	Structural Preservation	8	$509,150	$765,000
Super Class	Hull (Paint)	Structural Preservation (Paint)	8	$509,150	$650,000
Issaquah Class	Hull (Paint)	Structural Preservation (Paint)	8	$339,434	$475,000
Evergreen Stat	Hull (Paint)	Structural Preservation (Paint)	8	$1,286,452	$410,000
Klahowya	Hull (Paint)	Structural Preservation (Paint)	8	$1,194,806	$410,000
Tillikum	Hull (Paint)	Structural Preservation (Paint)	8	$1,194,806	$410,000
Rhododendron	Hull (Paint)	Structural Preservation (Paint)	8	$616,071	$410,000
Hiyu	Hull (Paint)	Structural Preservation (Paint)	9	$402,229	$400,000
Comment 1 Logic says that hull paint estimates should be proportional to u/w hull surface area					
Comment 2 Jumbo's are MORE than 3x the estimate of the MKII's					
Comment 3 Estate Class are MORE than 2x the estimate of the MKII's and Estate is higher than K and T					
Comment 4 Rhododendron is 20% HIGHER than the MK II's					
Comment 5 Hiyu is 18% HIGHER than the Issaquah Class					
Unless there are other factors than surface area to blast and paint, these paint estimates should be adjusted.					
Change the cost factors as indicated in column L					

Vessel or Class	Inventory Item Name	Inventory Category	Int	2010 Draft LCCM Cost Factors	July 2010 Cost Factor Update
HVAC/Controls					
Jumbo	HVAC Vent Systems / Controls	Major Mechanical/Electrical Systems	12	$706,022	
Jumbo Mk II	HVAC Vent Systems / Controls	Major Mechanical/Electrical Systems	20	$884,225	
Hyak	HVAC Vent Systems / Controls	Major Mechanical/Electrical Systems	12	$1,188,017	$700,000
Kaleetan	HVAC Vent Systems / Controls	Major Mechanical/Electrical Systems	12	$1,018,300	$700,000
Yakima	HVAC Vent Systems / Controls	Major Mechanical/Electrical Systems	12	$1,018,300	$700,000
Elwha	HVAC Vent Systems / Controls	Major Mechanical/Electrical Systems	12	$1,188,017	$700,000

This is the first of many Supers where Hyak = Elwha which are Higher than Kaleetan=Yakima

If the estimates for Supers are ok, why are they about 30% higher than Jumbo and Jumbo Mk II?

Change the Supers to $700K

Vessel or Class	Inventory Item Name	Inventory Category	Int	2010 Draft LCCM Cost Factors	July 2010 Cost Factor Update
PA System					
Spokane	PA system	Comm/Nav/Lifesaving Equip	12	$117,700	$234,000
Walla Walla	PA System	Comm/Nav/Lifesaving Equip	12	$234,000	
Tacoma	PA system	Comm/Nav/Lifesaving Equip	20	$249,000	
Wenatchee	PA system	Comm/Nav/Lifesaving Equip	20	$249,000	
Puyallup	PA system	Comm/Nav/Lifesaving Equip	20	$249,000	
Hyak	PA system	Comm/Nav/Lifesaving Equip	12	$255,000	
Kaleetan	PA system	Comm/Nav/Lifesaving Equip	12	$255,000	
Yakima	PA system	Comm/Nav/Lifesaving Equip	12	$255,000	
Elwha	PA system	Comm/Nav/Lifesaving Equip	12	$255,000	
Issaquah	PA system	Comm/Nav/Lifesaving Equip	12	$156,000	
Kittitas	PA system	Comm/Nav/Lifesaving Equip	12	$156,000	
Kitsap	PA system	Comm/Nav/Lifesaving Equip	12	$156,000	
Cathlamet	PA system	Comm/Nav/Lifesaving Equip	12	$156,000	
Chelan	PA system	Comm/Nav/Lifesaving Equip	12	$156,000	
Sealth	PA system	Comm/Nav/Lifesaving Equip	12	$156,000	
Evergreen Stat	PA system	Comm/Nav/Lifesaving Equip	12	$126,560	$89,858
Klahowya	PA system	Comm/Nav/Lifesaving Equip	12	$89,858	
Tillikum	PA system	Comm/Nav/Lifesaving Equip	12	$89,858	
Rhododendron	PA system	Comm/Nav/Lifesaving Equip	12	$45,562	
Hiyu	PA system	Comm/Nav/Lifesaving Equip	13	$29,108	

It seems like the major pieces of hardware are the same, the difference may be # speakers?

Why is Spokane 1/2 the estimate of Walla Walla? Raise Spokane to $234K

Seems like the 3 largest classes should be the same or at least in order of largest boat to smallest.

E State is significantly higher than K and T (One of many cases to be summarized in Section III)

Change Spokane to match Walla Walla. E State to match others in class.

Vessel or Class	Inventory Item Name	Inventory Category	Int	2010 Draft LCCM Cost Factors	July 2010 Cost Factor Update
Passenger Spaces					
Jumbo Class 2	Passenger spaces	Passenger and Crew Spaces	12	$6,848,069	
MK II Class 3	Passenger spaces	Passenger and Crew Spaces	12	$9,079,843	
Hyak	Passenger spaces	Passenger and Crew Spaces	12	$8,399,561	
Kaleetan	Passenger spaces	Passenger and Crew Spaces	12	$7,989,678	
Yakima	Passenger spaces	Passenger and Crew Spaces	12	$8,426,434	
Elwha	Passenger spaces	Passenger and Crew Spaces	12	$9,275,017	
Issaquah Class	Passenger spaces	Passenger and Crew Spaces	12	$6,092,829	
Chelan	Passenger spaces	Passenger and Crew Spaces	12	$5,923,113	
Sealth	Passenger spaces	Passenger and Crew Spaces	12	$5,923,113	
The four Supers are all different					
Moreover each of the Super Class estimates is larger than the Jumbo Class and one is larger that the MK II class?					
Four Issaquah Class estimates are $6.092M. Sealth and Chelan @ $5.923M.					
I know Sealth has fewer seats and area, does Chelan also?					
Many variables: Seating Arrangements, potential toxic materials, underlayment, passenger numbers and type.					
	No changes this time.				
Potable Water Tanks Paint and Inspection					
Elwha	Potable Water Tanks	Paint	10	$392,045	
Evergreen Stat	Potable Water Tanks	Paint	10	$329,250	
Klahowya	Potable Water Tanks	Paint	10	$305,491	
Tillikum	Potable Water Tanks	Paint	10	$305,491	
Hiyu	Potable Water Tanks #1	Paint	11	$101,830	
The estimates for Elwha, and Estate Class are for both tanks together.					
Recommend making separate LCCM items for painting Tank 1 and Tank 2 for these 4 vessels and split the estimates in half.					
Hiyu does not have a line item for Potable Water Tank #2. Add that inventory Item with the same Cost Factor as #1					
In addition, the Jumbo Class vessels have slightly different cost factors, as do the Supers					
Therefore change the current Elwha and E State Class items to Potable Water Tank #1 and Add a #2 Tank					
Add an inventory Item for Hiyu Potable Water Tank #2					
Make the following Cost Factor Changes as indicated in Column L					
Jumbo	Potable Water Tank 1	Paint	10	$209,317 $207,903	$209,317
MKII	Potable Water Tank 1	Paint	10	No change	$240,432
Supers	Potable Water Tank 1	Paint	10	$196,588 $195,975	$196,588
E State Class	Potable Water Tank 1	Paint	10	From Above	$164,000
Hiyu	Potable Water Tank 1	Paint	10	No change	$101,830
Jumbo	Potable Water Tank 2	Paint	10	$209,317 $207,903	$209,317
MKII	Potable Water Tank 2	Paint	10	No change	$240,432
Supers	Potable Water Tank 2	Paint	10	$196,588 $195,975	$196,588
E State Class	Potable Water Tank 2	Paint	10	From Above	$164,000
Hiyu	Potable Water Tank 2	Paint	10		$101,830 ADD This ITEM 2

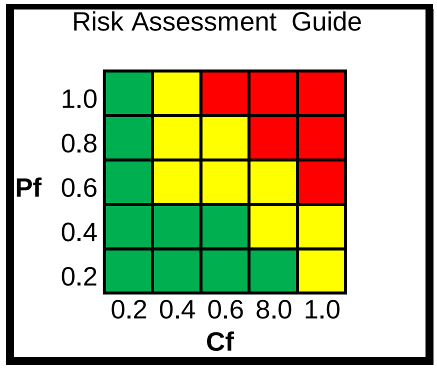
Vessel or Class	Inventory Item Name	Inventory Category	Int	2010 Draft LCCM Cost Factors	July 2010 Cost Factor Update	
Potable Water Tanks Steel Replacement						
Puyallup	Potable Water Tanks #2	Steel Replacement	30	$240,432	$921,561	
Puyallup's Potable Water Tank #1 Steel Replacement is missing. Cost Factors for other MKIIs is $921,561						
Yes, add the Puyallup Potable Water Tank #1 Steel Replacement to the LCCM but @ $921,561						
Yes, Change Puyallup Potable Water Tank #2 to $921,561 to Match other MKII's						
Puyallup	Potable Water Tank #:	Steel Replacement	30		$921,561	ADD This ITEM
Propulsion Controls						
Tacoma	Propulsion Controls	Propulsion System	20	$6,327,990		
Wenatchee	Propulsion Controls	Propulsion System	20	$6,327,990		
Puyallup	Propulsion Controls	Propulsion System	20	$6,327,990		
When you changed MKII interval from 30 to 20 years did you change the estimate?						
This Preservation Item Phylosophy is being negotiated with the OEM						
Radar						
All larger classe	Radar 1A	Comm/Nav/Lifesaving Equip	10	$48,000		
Evergreen Stat	Radar 1A	Comm/Nav/Lifesaving Equip	10	$44,296	$48,000	
Klahowya	Radar 1A	Comm/Nav/Lifesaving Equip	10	$52,000	$48,000	
Tillikum	Radar 1A	Comm/Nav/Lifesaving Equip	10	$52,000	$48,000	
Rhododendron	Radar 1A	Comm/Nav/Lifesaving Equip	10	$53,156	$48,000	
Hiyu	Radar 1A	Comm/Nav/Lifesaving Equip	10	$35,436	$48,000	
MKII, Jumbo, Super and issaquah classes have radar estiamte of $48K.						
Assuming all vessels have the same radar, estimates should be the same, unless significant interference difference.						
This applies to Radar 1A, 1B, 2A and 2B						
Make all Radar Cost Factors $48,000 RADAR 1A, 1B, 2a and 2B.						

Vessel or Class	Inventory Item Name	Inventory Category	Int	2010 Draft LCCM Cost Factors	July 2010 Cost Factor Update	
RESCUE BOATS						
MKII and Jumb	Rescue Boats #1	Comm/Nav/Lifesaving Eq	15	$141,000		
Puyallup	Rescue Boats #2	Comm/Nav/Lifesaving Equip	25	$197,222	Delete this 2nd #2 boat	
Puyallup	Rescue Boats #2	Comm/Nav/Lifesaving Equip	15	$141,000		
All MKII and Jumbo boat estimates are $141K with the execption of an EXTRA Puyallup Boat #2						
Recommend deleting the second Puyallup Rescue Boat #2 with estimate of $197,222.						
Evergreen Stat	Rescue Boats #1	Comm/Nav/Lifesaving Equip	10	$253,120		
Evergreen Stat	Rescue Boats #2	Comm/Nav/Lifesaving Equip	10	$253,120		
Supers and Issaquah class boat estimates are $88K and $82K respectively.						
Klahowya and Tillikum $84K.						
E state at $253,120 is so far out of line as to be suspect. Recommned changing E State to $84K						
Delete the second Puyallup #2 boat @ $197,222. Change all cost factors to align with Klahowya and Tillikum $84K						
MK II (3)	Resuce Boat #1	Comm/Nav/Lifesaving Equip	10	$141,000	$84,000	
Jumbo (2)	Resuce Boat #1	Comm/Nav/Lifesaving Equip	10	$141,000	$84,000	
Super (4)	Resuce Boat #1	Comm/Nav/Lifesaving Equip	10	$88,000	$84,000	
Issaquah Class	Resuce Boat #1	Comm/Nav/Lifesaving Equip	10	$82,000	$84,000	
Evergreen Stat	Resuce Boat #1	Comm/Nav/Lifesaving Equip	10	$253,120	$84,000	
Tillikum/Klahov	Resuce Boat #1	Comm/Nav/Lifesaving Equip	10	$84,000	$84,000	
MK II (3)	Resuce Boat #2	Comm/Nav/Lifesaving Equip	10	$141,000	$84,000	
Jumbo (2)	Resuce Boat #2	Comm/Nav/Lifesaving Equip	10	$141,000	$84,000	
Super (4)	Resuce Boat #2	Comm/Nav/Lifesaving Equip	10	$88,000	$84,000	
Issaquah Class	Resuce Boat #2	Comm/Nav/Lifesaving Equip	10	$82,000	$84,000	
Evergreen Stat	Resuce Boat #2	Comm/Nav/Lifesaving Equip	10	$253,120	$84,000	
Tillikum/Klahov	Resuce Boat #2	Comm/Nav/Lifesaving Equip	10	$84,000	$84,000	
SALT WATER PIPING						
There were no items for Salt Water Piping Replacement for Issaquah class or E State Class.						
There were firemain systems however.						
There is no salt water system on Issaquah or E State Classes						
Sanitary Fresh Water Systm						
Hyak is missing						
Add an inventory Item for Hyak						
Yes, Add the new item for Hyak						
Hyak	Sanitary Fresh Water Flushing	Major Mechanical/Electrical Systems	18		$220,632	ADD This ITEM

Vessel or Class	Inventory Item Name	Inventory Category	Int	2010 Draft LCCM Cost Factors	July 2010 Cost Factor Update	
Sensors and Alarms						
Kaleeten : Typo Estimate should be $6375 to match other Issaquah Class vise $6075						
Elwha, Issaquah, and Klahowya missing. Add them and use Cost Factors for their repsective Class.						
Yes. Change Kaleetan, and add the other three inventory items using Cost Factors for their respective Class.						
Kaleetan	Sensors and Alarms	Security	10	$6,075	$6,375	
Elwha	Sensors and Alarms	Security	10		$6,375	ADD This ITEM
Issaquah	Sensors and Alarms	Security	10		$6,925	ADD This ITEM
Klahowya	Sensors and Alarms	Security	10		$6,575	ADD This ITEM
Temp Emergency Power						
Issaquah and Sealth missing. Chelan does not match other Issaquah Class Factors						
Yes, Add Issaquah and Sealth at $221,480 per other Issaquah class. Change Chelan from $215,152 to $221,480 as well						
Cathlamet	Temp Emergency Power	Comm/Nav/Lifesaving Equip	30	$221,480		
Chelan	Temp Emergency Power	Comm/Nav/Lifesaving Equip	30	$215,152	$221,480	
Issaquah	Temp Emergency Power	Comm/Nav/Lifesaving Equip	30		$221,480	ADD This ITEM
Sealth	Temp Emergency Power	Comm/Nav/Lifesaving Equip	30		$221,480	ADD This ITEM
Topside Paint						
Other Issaquah	Topside	Structural Preservation (Paint)	7	$1,975,502		
Chelan	Topside	Structural Preservation (Paint)	7	$1,805,785	$1,975,502	
Sealth	Topside	Structural Preservation (Paint)	7	$1,805,785	$1,975,502	
Is not Chelan more like other Issaquah's than Seatlh?						
Yes, make Chelan the same as larger Issaquah Class						
Wet Spaces						
Hyak	Wet Spaces	Steel Replacement	12	$975,871	$500,000	
Kaleetan	Wet Spaces	Steel Replacement	12	$933,442	$500,000	
Yakima	Wet Spaces	Steel Replacement	12	$933,442	$500,000	
Elwha	Wet Spaces	Steel Replacement	12	$975,871	$500,000	
Issaquah Class	Wet Spaces	Steel Replacement	12	$402,229	$425,000	
Evergreen State	Wet Spaces	Steel Replacement	12	$539,699.00	$385,000	
Klahowya	Wet Spaces	Steel Replacement	12	$502,361.00	$385,000	
Tillikum	Wet Spaces	Steel Replacement	12	$502,361.00	$385,000	
Super Estimates are more than twice that of all other classes between $402K-$576K: does this make sense?						
E State Class compared to Issaquah at $402K is also high						
See Section II below for Systems where Super Class estimates are different like this one.						
Yes, change Supers to $500K, Issaquah Class to $425K, Estate Class to $385K						

Appendix E TACOMA Vital and Non Vital Risk Tables

RISK ASSESSMENT PROBABILITY
and CRITICALITY TABLES



Pf = Probability Factor
Cf = Consequence Factor

Pf	Probability of Failure in three years:	
1.0	Near Certainty	Beyond Life Cycle Interval And Based on Condition Assessment
0.8	Likely	At Life Cycle Interval And Based on Condition Assessment
0.6	Possilble	Due date less 10% of Life Cycle Interval
0.4	Unlikely	Due date less 25% of Life Cycle Interval
0.2	Very Unlikely	Due date less 50% or more of Life Cycle Interval

Cf	Impact on Vessel Availability Due to Failure	
1.0	Catestrophic	Miss More than One Week to Rrepair
0.8	Critical	Miss One Week to Repair
0.6	Moderate	Miss One Day to Repair
0.4	Marginal	Miss Half a Day to Repair
0.2	Minimal	Does Not Affect Sailing

NON VITAL Preservation Item Risk for 2011-13 **Tacoma**

Item Description	Pf		Cf		Due	**Int**	Risk		Comments
Bilge Painting	0.4	.	0.2		2018	20			
Crews	1		0.2		2010	12			
Elevators	0.2		0.2		2018	20			Assumes ADA rules don't prohibit sailing
Fresh Water Cooling	0.6		..8		2013	15		E	Due but Extended and not in the budget
Galley Renovation	1		0.2		2010	12			
Heat Recovery System	0.2		0.2		2028	30			
Boilers Heating									
Heating Piping	0.2		0.2		2028	30			
Hull Paint	0.8		0.2		2013	8		B	
HVAC Vent/Control	0.4		0.2		2018	20			
Lighting Fixtures Interior	1		0.2		2010	12			
Lighting Fixtures Exterior	1		0.04		2010	12			
Machinery Space Painting	0.2		0.2		2028	30			
Oiled Fired Hot Water Heaters	0.4		0.2		2018	20			
Passenger Rehab	0.8		0.2		2010	12			Pf Assumes condition warrants - Aesthetics only
Potable Water Piping	0.2		0.2		2028	30			
Potable Water Tanks Paint	1		0.2		2008	10		E	Scheduled '17-'19 Recommend next DD
Potable Water Tanks Steel	0.2		0.2		2028	30			Inspected then Corrected in DD
Salt Water Piping	0.4		0.6		2018	20			Monitor Pumps and piping when yellow
Sanitary Fresh Water Flushing	0.2		0.2		2028	30			
Sewage Piping	0.4		0.6		2018	20			Assmes not CuNI: Monitor Pumps & Pipe @ yellow
Sewage Tank Paint	1		0.2		2009	5		E	Scheduled '17-'19 Recommend next DD
Sewage Tank Steel	0.2		0.2		2028	30			Monitor condition @ every 5 year paint job.
Shelter Deck									
Solariums	0.2		0.2		2028	30			
Topside Paining	0.2		0.2		2015	7			
Voids (Paint)	0.6		0.2		2013	15		E	'17-'19
Wet Spaces	1		0.2		2010	12			Past Due, assessment warrants '10

Key		
	Budget 09-11	
	Extended (E) or Deferred (D)	D
	Budget 11-13	B
	Past Due	

VITAL Preservation Item Risk for 2011-13 Tacoma

Item Description	Pf	Cf	Due	Int	Risk		Comments
Auto Deck Corrosion	0.8	0.8	2013	15		B	
Hull	0.4	1	2018	20			
Bilge Piping	0.2	1	2028	30			
Firemain Piping/Manifolds	0.4	1	2018	20			
Sprinkler System	0.2	1	2028	30			
CPP Hubs/Blades Issaquah							
MDE 4/4/4/2/2	0.2	1	2028	30			
Gens/Alternators	0.2	1	2028	30			
Motors 4/2/2/0/4	0.2	1	2028	30			
Propulsion Controls	0.4	1	2018	20			
Reduction Gears							
Rudder 1 and 2	0.4	1	2018	20			
Propulsion Switchboards	0.2	1	2028	30			
Aux Diesel Generator	0.2	1	2028	30			
Aux S/B/ Power Dist	0.2	1	2028	30			
Steering 1 and 2	0.4	1	2018	20			
Auto Identification System	0.8	?	2013	10		B	
Davits 1 and 2	0.2	1	2028	30			
Draft Indicating System	0.8	1	2013	6		B	
General Alarm System	0.2	1	2028	30			
GPS 2/2/1	0.4	1	2017	10			
Gyro Compass	0.8	1	2013	15		B	
Internal Comms	0.2	0.4	2028	30			
Landing Radars 2/1/1/1/1	0.8	1	2012	10		B	
Marine Escape Slides 4	0.8	1	2012	15		B	
PA System	0.4	0.8	2018	20			
Radar (4) 3 in 2011- 1 in 15	0.8	1	2008	10		B	1 Radar of 4 Past due and scheduled '11-'13
Rescue Boats 1 and 2	0.8	1	2013	15		B	
Satelite Compass Sys	0.8	??	2013	10		E	Extended 19-21
Temp Emer Power	0.8	1	2013	15			Didn't see this listed
VHF Radio	0.8	1	2008	10			Past Due
AC Units (Datacenter)	0.4	0.8	2018	10			
All Cameras	0.6	0.8	2014	7			
Electronic Door (locks)	0.8	0.4	2013	6		E	Extended to 19-21
Hersh Hardware Security	0.2	0.2	2019	12			
Sensors and Alarms	0.4	1	2017	10			Didn't see this Listed

Keys

- Budget in 09-11
- Budget In 11-13 — B
- Extended (E) or Deferred (D) — E
- Past Due

Appendix F Constructability Data

Vessel Name		Start Date	End Date	Days	Contract Days	Delta Days	Weeks	Contract Cost	Final cost	% Change Orders	$/WK				
Dry Dock Availabilities															
Issaquah	DD	3/5/2007	5/14/2007	71	47	24	10.14	$ 1,224,032	$ 1,188,616	-3%	$ 117,187	Changed to DD per Browning 7/22			
Klickitat	DD	5/4/2007	6/20/2007	46	29	17	6.57	$ 344,520	$ 577,334	68%	$ 87,855				
Illahee	DD	5/16/2007	6/21/2007	36	26	10	5.14	$ 582,519	$ 684,194	17%	$ 133,038		Highest 49, 24, 24, 21 Days		
Kittitas	DD	5/21/2007	7/21/2007	62	54	8	8.86	$ 1,380,400	$ 1,447,110	5%	$ 163,383	8	14 days or above		
Klahowya	DD	10/15/2007	11/8/2007	25	19	6	3.57	$ 492,565	$ 679,307	38%	$ 190,206	4	8-13 days 1-2 weeks		
Hyak	DD	11/26/2007	2/8/2008	68	19	49	9.71	$ 527,373	$ 1,302,578	147%	$ 134,089	14	7 or less		
Chelan	DD	1/14/2008	2/5/2008	33	26	7	4.71	$ 363,167	$ 657,323	81%	$ 139,432		2 on time and 4 early		
Spokane	DD	2/4/2008	2/18/2008	15	12	3	2.14	$ 575,873	$ 762,109	32%	$ 355,651				
Kaleetan	DD	2/27/2008	3/21/2008	24	24	0	3.43					No cost data in record			
Tillakum	DD	4/28/2008	5/17/2008	20	19	1	2.86	$ 684,955	$ 954,944	39%	$ 334,230				
E State	DD	4/30/2008	6/9/2008	41	40	1	5.86	$ 1,183,807	$ 1,560,181	32%	$ 266,372				
Yakima	DD	5/19/2008	7/11/2008	54	68	-14	7.71	$ 1,454,273	$ 1,942,005	34%	$ 251,741				
Wenatchee	DD	7/23/2008	8/19/2008	28	28	0	4.00	$ 1,158,861	$ 1,195,940	3%	$ 298,985				
Sealth	DD	8/25/2008	10/24/2008	61	40	21	8.71	$ 1,352,465	$ 1,471,738	9%	$ 168,888		DD Data		
Elwha	DD	10/28/2008	12/23/2008	57	64	-7	8.14	$ 341,857	$ 803,915	135%	$ 98,726		Average Period		44.7
Puyallup	DD	11/29/2008	12/24/2008	26	28	-2	3.71	$ 1,047,734	$ 1,012,523	-3%	$ 272,602		Avg Extension		8.5
Hiyu	DD	12/1/2008	1/14/2009	45	26	19	6.43	$ 330,049	$ 521,599	58%	$ 81,138		Avg % Growth		38.32%
Kitsap	DD	1/5/2009	2/14/2009	41	26	15	5.86	$ 1,546,753	$ 1,801,486	16%	$ 307,571		Avg $/Wk		$ 216,784
Walla Walla	DD	2/9/2009	3/27/2009	47	33	14	6.71	$ 2,040,610	$ 2,490,948	22%	$ 370,992				
Cathlemet	DD	2/17/2009	3/27/2009	39	33	6	5.57	$ 895,167	$ 1,426,385	59%	$ 256,018				
Issaquah	DD	4/1/2009	5/1/2009	31	40	-9	4.43	$ 679,229	$ 903,416	33%	$ 203,997				
Kaleetan	DD	5/18/2009	6/24/2009	38	33	5	5.43	$ 1,283,709	$ 1,480,497	15%	$ 272,723				
Klahowya	DD	8/3/2009	11/2/2009	92	68	24	13.14	$ 1,998,682	$ 3,284,629	64%	$ 249,917				
Kittitas	DD	10/5/2009	11/16/2009	43	33	10	6.14	$ 1,290,269	$ 1,753,972	36%	$ 285,530				
Chelan	DD	1/4/2010	2/24/2010	52	50	2	7.43	$ 1,942,635	$ 1,996,152	3%	$ 268,713				
Elwha	DD	2/8/2010	4/16/2010	68	58	10	9.71	$ 919,775	$ 1,074,476	17%	$ 110,608				
				1163		220				958%	$ 5,419,595				

Vessel Name		Start Date	End Date	Days	Contract Days	Delta Days	Weeks	Contract Cost	Final cost	% Change Orders	$/WK				
Dockside Availabilities															
													DS Data		
Kaleetan	DS	4/23/2007	5/11/2007	19	19	0	2.71	$ 142,204	$ 149,581	5%	$ 55,109		Average Period		65.7
Tacoma	DS	7/23/2007	11/15/2007	115	91	24	16.43	$ 2,321,391	$ 2,541,592	9%	$ 154,706	TS Paint	Avg Ext		4.5
Issaquah	DS	7/23/2007	11/19/2007	120	110	10	17.14	$ 2,830,403	$ 2,967,931	5%	$ 173,129	TS Paint	Avg % Growth		17.94%
Hyak	DS	2/14/2008	3/14/2008	30	42	-12	4.29	$ 1,043,764	$ 1,045,505	0%	$ 243,951		Avg $/Wk		$ 172,328
Wenatchee	DS	3/24/2008	7/1/2008	100	103	-3	14.29	$ 2,285,131	$ 2,361,870	3%	$ 165,331	TS Paint			
Puyallup	DS	8/22/2008	11/29/2008	100	96	4	14.29	$ 2,999,880	$ 3,587,371	20%	$ 251,116				
Rhododendron	DS	1/12/2009	2/16/2009	36	32	4	5.14	$ 368,676	$ 571,683	55%	$ 111,161				
Elwha	DS	2/16/2009	3/6/2009	19	19	0	2.71	$ 216,039	$ 241,137	12%	$ 88,840				
Spokane	DS	4/6/2009	7/18/2009	104	109	-5	14.86	$ 3,524,114	$ 3,888,240	10%	$ 261,708	TS Paint	Galley	Pass	
E State	DS	4/27/2009	7/25/2009	90	54	36	12.86	$ 1,754,623	$ 1,939,887	11%	$ 150,880	TS Paint			
Walla Walla	DS	7/27/2009	9/4/2009	40	40	0	5.71	$ 743,676	$ 1,226,033	65%	$ 214,556		High 36, 24		
Tacoma	DS	10/5/2009	10/25/2009	21	21	0	3.00	$ 1,003,453	$ 1,300,969	19%	$ 273,905	2	14 days or more		
Elwha	DS	10/26/2009	12/24/2009	60	60	0	8.57	$ 690,074	$ 821,715	19%	$ 95,867	1	8 to 13 days		
				854		58				233%	$ 2,240,258	10	7 days or less		
												7	on time or early		

Appendix G Availability Change Order Summary

CPR #	Title	Description	Date Recv'd	Date Ans'd	Answer	Proposed Cost	Approved Cost	Item	Grp	Code	T& M To Date	Comp	Change Order
1	Piping Repair	Replace deteriorated piping in passenger deck overhead	5/17/10	5/24/10	Proceed at T&M	T&M			1	G	$25,811.28		
2	Navigation Upgrade	Install new navigation light system	5/19/10	5/24/10	Proceed at T&M	T&M			5	N	$35,636.96		
3	Cleaning Gear Locker Preservation	Preserve areas of corrosion	5/21/10	5/24/10	Proceed at T&M	T&M		18	2	G	$49,422.14		
4	Crane & Rigging Support	Provided Crane and Rigging Support for WSF Contractors	5/25/10	6/4/10	Proceed at T&M	T&M		2	2	G	$1,904.00		
5	Access Openings	Cut and Ring access openings in void frames	6/3/10	6/4/10	Proceed at $1,750.00	$3,500.00	$1,750.00	32	1	G			
6	Wiper Motor Interferences	Modify Gussets	6/4/10	6/4/10	Proceed, Provide fixed price			31	1	D		x	
6A	Wiper Motor Interferences	Modify Gussets	6/7/10	6/8/10	Proceed at $2,175.00	$3,264.00	$2,175.00	31	1	D			
7	Weld Fracture Repair	Repair fracured welds in vehicle ramps	6/7/10	6/8/10	Proceed at T&M	T&M		32	1	G	$1,457.95		
8	Grounding of passenger deck lights	Ground all new lights	6/7/10	6/8/10	Proceed at $5,466.00	$5,466.00	$5,466.00	3	2	S			
9	New Galley Refer Box	Replace existing non-working refer under serving counter with new unit	6/9/10	6/11/10	Proceed at $9,802.00	$9,802.00	$9,802.00	17	3	G			
10	High Speed Shaft Repair	Repiar high speed shaft	6/9/10	6/11/10	Proceed at $1,800.00	$1,800.00	$1,800.00		1	G			
11	Lighting Circuit Breakes	Repalce 3 existing circuit breakes	6/19/10	6/28/10	Proceed at $343.00	$343.00	$343.00	3	2	G			
12	EOS A-60 Insulation Installation	Install A-60 insulation in overhead of EOS	6/22/10	6/28/10	Proceed at $31,455.00	$31,455.00	$31,455.00		1	N			
					Total	$55,630.00	$52,791.00				**$114,232.33**		
					Total Approved and T&M to Date		$167,023.33						
	Original Contract Price	**$1,917,244.00**			**% Change**	2.90%	8.71%						
				Current Contract Price			**$2,084,267.33**						
				CRs Paid By Change Order			**$0.00**						
				CRs Remain to be Paid			**$167,023.33**						