U.S. Department of
Homeland Security

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Subj: Washington State Ferry Manning Review

Ref: (a) Assessing Risk in the Washington State Ferry System, (TIEMS Conference, 1998)
(b) A Risk Management Procedure for the Washington State Ferries (Risk Analysis, 2002)
(c) Washington State Ferries letter of July 23, 2012

Dear Mr. Moseley:

In response to the request in your letter of October 31, 2011, Coast Guard Sector Puget Sound commenced a review of the manning levels of the Jumbo Mark I, Super, Issaquah, and Evergreen State classes of ferries. After an extensive review process, we met with you and your staff on October 23, 2012 to address manning changes on the ferries as a result of this request; this letter documents the results of that meeting and notes future actions needed.

An analysis of the sufficiency of vessel manning levels can be summarized into assessing the crew's ability to perform normal duties of operation and maintenance, and their ability to perform emergency duties, such as firefighting, vessel evacuation, man overboard, and security threat response. Given the nature of WSF's operation, with non-continuous (less than 24 hour) daily operation within lakes, bays and sounds waters, deck crews performing shift work, shore side maintenance performed during night tie-ups, and continuous manning of the vessels' engine rooms, this manning analysis has accordingly centered on underway operation and emergency duties. Additional discussions detailed below also highlight the need to set minimum thresholds for firefighting and mass evacuation responsibilities regardless of passenger ridership levels.

The ability of a limited number of crewmen to properly perform operational and emergency duties is central to the success of WSF's Subchapter W Alternative Compliance Plan, and WSF's Alternative Security Plan. Performance expectations for executing a complex sequence of emergency duties must accordingly be carefully managed. WSF's Subchapter W Alternate Compliance Plan is well crafted and offered a significant improvement over previous WSF safety plans, with its added lifesaving, integrated response network and enhanced crew training, and it is reflective of a substantive investment by WSF in ensuring passenger safety. However, the plan relies on highly effective performances by each crewman, with little redundancy if a crewman is injured, distracted, or forced to perform more duties than envisioned, such as responding to a passenger with a heart attack during a vessel evacuation. This plan is especially demanding on the deck manning of WSF ferries, particularly given the high passenger counts carried, with up to 2500 passengers on the largest ferries.

Subj: Washington State Ferry Manning Review

My staff developed the following analysis of firefighting and abandon ship drills, which are the most crew intensive safety responses on WSF vessels. In accordance with this analysis, manning levels have been derived for each engineering and deck department for each class of ferry.

Fire Fighting. An underway fire is one of the most critical emergencies that can occur on passenger vessels. In considering a response to a fire, we reviewed a worst-case scenario where the fire is in a location where fixed firefighting extinguishing equipment is not installed and surrounding boundaries are enclosed within the superstructure. In this scenario, the vessel must be capable of continued navigation while responding with fire suppression equipment using basic fire-fighting techniques. The recommended minimum level of manning needed to effectively respond to an onboard fire emergency on a large multiple deck ferry is normally 12 crew members. This response team size will effectively set the minimum threshold for crewmembers onboard at any time while underway:

Bridge: 2 crew to operate the wheel house/communication/oversee firefighting efforts.
Engine Room: 2 crew to operate the vessel/machinery/firefighting equipment.
Fire Team: 1 crew as on scene coordinator and 4 crew in the fire teams (including on-scene coordination & fire hose team).
Boundary Team: 6 crew to set & maintain the fire boundary on all 6 sides as applicable; however, given that WSF vessels typically operate in close proximity to shore firefighting resources, this number can be reduced to 3.

Capability to continue vessel operations. In the case of a fire that does not completely incapacitate the vessel, it is critical for the crew to be able to maintain a minimum level of operations to both respond to the emergency and also potentially navigate the vessel to a safe harbor. This would require, at a minimum, 2 individuals on the bridge to navigate, make emergency calls, manage response resources, and accomplish other tasks, and 2 individuals in the engine room to respond to bridge orders, operate/monitor machinery such as the fire pumps, and assist in mechanically and electrically isolating the space on fire.

Use of fixed fire-fighting equipment. The use of fixed fire-fighting equipment may generally be a factor which would ultimately require less crew onboard to fight a fire, given that installed systems in enclosed spaces are typically more effective than a fire-hose response. WSF vessels have fixed fire-fighting systems on the car decks (water deluge) and in the engine spaces (fixed gas, and in some vessels high fog); these spaces are where a fire is more likely to occur because of the high flammability and heat hazards present. Noting that fixed systems are not in every space onboard, there is a potential for a fire to occur in a space without fixed firefighting, which would threaten up to 6 boundary spaces.

Fire-fighting techniques. All U.S. mariners are required to go through minimum training on marine fire-fighting. This training includes standardized methods of combating a fire, such as noted by the U.S. Maritime Administration:

a. Size-up: determining where the fire is, what type of fire, how to combat it, mechanically and electrically isolating the space, setting up communications, etc.
b. Ventilation: ventilating the space to either suffocate a fire, or get toxic air out of the space away from fire-fighters.
c. Setting boundaries: preventing the fire from extending beyond the space by surrounding the affected area on all six sides using hose lines or portable extinguishers. This also includes examining and protecting openings in the system where fire may spread.
d. Attack: this includes using fixed fire-fighting systems and/or a fire team.
e. Overhaul & re-flash: extinguishing hot spots and monitoring the space for fire re-flash. This often is done by the original fire-fighting team, but crew fatigue can become an issue in this step.

Abandon Ship: An abandon ship or mass evacuation scenario is the most challenging emergency scenario on a large passenger ferry. Vessels can sink quickly in some conditions and panicked passengers can offer serious challenges to a safe evacuation. The recent casualty that occurred on the LAMMA IV, a Lamma Island Hong Kong ferry, October 1, 2012 which led to 38 deaths and over 100 more injured, showed that fully effective passenger evacuation can be difficult to achieve, even while on a short voyage in a crowded waterway in warm water.

Similarly, evacuation was difficult to achieve when the auto passenger ferry ESTONIA capsized on September 28, 1994 in the Baltic, leading to nearly all of the 898 passengers perishing in less than 30 minutes. In the Joint Accident Investigation Commission report[1] the failed mass evacuation evolution can be summarized in noting that crew and passengers alike were not prepared for the casualty. The following lessons learned were noted:

- Alarms from the bridge were not timely, sometimes not understood, and sometimes not heard. As found in this study, a public address system was not a fully effective substitute for clear, live directions. More success was had by crew-members directing and organizing passengers.
- Some of the crew did not have clear responsibilities.
- Crew distributed life jackets but many passengers didn't understand how to put them on. While crew launched life-saving appliances, the action was slow and confused, showing inadequate training. As a result, the crew was unable to properly instruct the passengers.
- There was no order to the evacuation of passengers off the ship.
- Passenger behavior was erratic and detrimental to progress. If the crew had the time to respond (i.e. if the evacuation time was longer), the behavior of the passengers would have consumed many of the crew, making it difficult to evacuate passengers that were actively trying to escape.

Note: SOLAS requires passenger ships to completely evacuate all persons within 30 minutes of the master sounding the abandon ship alarm; Lifesaving Appliance Code VI 6.2.2.1.2.

Even during ferry accidents with no loss of life, crew performance is cited by the National Transportation Safety Board (NTSB) as a concern.[2]

[1] http://www.multi.fi/estonia/estorap.html#_Toc405839566
[2] NTSB report PB2011-916401

Subj: Washington State Ferry Manning Review

Based on the lessons learned with actual incidents, crew roles and duties for abandoning ship must be clear, concise and performed without delay or error, and therefore cannot be assigned without clear delineation of responsibilities. Each duty must be dedicated to facilitating passenger evacuation. As the muster leaders report to the assembly area to take passenger accountability, they are not physically able to also sweep decks, where they are likely to encounter passengers onboard that need special assistance or are otherwise nonresponsive. Additionally, two rescue boats are provided and must be launched to execute the passenger transport function of the mass evacuation evolution.

For these four vessel classes, the following crew members would be required in order to safely complete an evolution where the entire ferry complement had to be evacuated using the marine evacuation slides (Note: This does not address the minimum level of crew needed for firefighting):

Bridge: 2 personnel to maintain operations on the bridge,
Engine Room: 2 personnel to maintain operations in the engine room,
Rescue Boat: 2 personnel to launch and operate a rescue boat,
Muster Leaders: 2 personnel to man and lead two passenger mustering areas,
Embarkation: 2 personnel to launch and assist the loading of the Inflatable Buoyant Apparatus (IBAs),
Sweep Team:
- JUMBO MARK I Class and SUPER Class – 4 additional crew members; 2 to clear car decks (lower/upper) and 2 to clear upper passenger deck.
- ISSAQUAH Class – 2 additional crew members to clear the car decks (lower/upper); except SEALTH, where only one additional crew member is required, as SEALTH does not have an upper car deck.
- EVERGREEN STATE Class – 0 additional crew members.

SOLAS international voyage standards (such as those for ELWHA) require passenger vessel crews with duties related to the movement of persons to have crisis management training as part of their basic safety training. However, mariners assigned onboard domestic passenger vessels are not required to obtain advanced training in crowd control/management. To enable successful performance of these crew members involved in the evacuation duties, they will be required to have a minimum level of crisis training as a prerequisite; we understand WSF does already provide some crowd management training.

In addition to evaluating manning levels based on emergency drill performance, we also evaluated both engineering and deck manning based on the vessels' physical configurations and machinery plants, as described in the following discussion.

Engineering Manning. For the engineering positions, in considering underway operation, the Super Class ferries have four diesel driven propulsion generators, two ship's service generators, a vital systems generator, and an emergency generator. The Jumbo Mark II and Mark I class ferries have the same number of engines and propulsion generators, with the Jumbo Mark I having comparable horsepower (8,000 hp for the Super class, 8,500 hp for the Jumbo Mark I class). The provided COI and CBA engine room manning levels are relatively consistent for the

Subj: Washington State Ferry Manning Review

Jumbo Mark II and Jumbo Mark I classes, along with the CBA level manning for the Super classes: one chief engineer, one licensed engineer, one oiler, and one wiper.

In evaluating emergency operations, three of the four Super class ferries do not have pilot house control, necessitating that an engineer remain at the engine room console throughout an emergency, until an evacuation is ordered. Performance of emergency fire drills also demonstrated that on the Super class ferries the fire pumps can either not be started remotely, or require local attendance so that they do not become air bound, requiring that an engine room crewmember must attend the pump locally; this could be especially demanding if the engineering watertight doors are closed, requiring leaving the engineering control room and accessing the engine room via the car deck.

Additionally, the need for engine room personnel to assist in active firefighting precludes their availability to man the engine order telegraph, or to start and operate fire pumps. In the event of a deck fire, both the oiler and the wiper will be assisting on deck. With the chief engineer in contact with the bridge in the main control room, the fourth person is needed to operate any systems that cannot be operated remotely, such as some fire pumps and the fixed sprinkler systems. This person must also be capable of addressing issues that arise at these locations, such as a pump that has become air bound. In order to adequately fulfill these duties and responsibilities, the lowest level of qualification is a licensed engineer. Accordingly, unless the muster list for the Super class can be adjusted to enable the engineering crew's performance of the full range of their emergency duties, or pilothouse control and remote fire pump starting/operation are fully provided, the Super class COI engineering manning will require one chief engineer, one assistant engineer, one oiler and one wiper. Note: Although the ELWHA has pilot house control vice an engine order telegraph, the complexity of its engineering systems, as discussed above, would still require the same manning.

On the Issaquah class, the COI requires one chief engineer, one licensed engineer, and one oiler. On the Evergreen State class, the COI level manning notes one chief engineer, one oiler and one wiper; the CBA level manning substitutes an oiler for the wiper. Based on the revised muster lists provided for these classes, and the performances observed during quarterly drills, there is not a need at this time to change these classes' required level of engineering manning.

Licensed deck manning. The current deck manning levels of the Washington State Ferries present dissimilarities, both between the classes themselves, and between the COI required deck manning levels and the deck manning levels WSF has traditionally provided. Historically, the Jumbo Mark I class has required a second mate in contrast to no similar requirement on the Super class, despite the Super class having two enclosed decks accessible to passengers and a Texas deck (Jumbo Mark I class has one passenger deck and a Texas deck), less automation, no pilot house control (except ELWHA), and comparatively more obscured passenger deck sightlines. The elements of an extra passenger deck and obscured sightlines are especially concerning, as the success of the muster list vessel evacuation and firefighting duties depend on each crew member being able to effectively control a wide area and correspondingly large number of passengers in conjunction with firefighting or manning each of the four marine evacuation slides. Given the complexity of the Super class configuration and the attendant

difficulties in coordinating a passenger evacuation at full capacity or in fighting a significant vessel fire, it is appropriate to require a second mate position, substituted with a specially trained able seaman in place of the second mate (if a suitable training and qualification program can be developed and approved).

Based on the above analysis, I consider the following manning levels appropriate for the WSF ferry classes as noted:

COI manning levels for the Jumbo Mk I Class (2000 pax):

Previous COI Manning	New COI Manning Level
1 Master & 1st Class Pilot	1 Master & 1st Class Pilot
1 Mate & 1st Class Pilot	1 Mate & 1st Class Pilot
1 Licensed Mate	1 Licensed Mate
4 Able Seamen	4 Able Seamen
1 Ordinary Seaman	*2 Ordinary Seamen*
1 Watchman	1 Watchman
1 Chief Engineer	1 Chief Engineer
1 Assistant Engineer	1 Assistant Engineer
1 Wiper	1 Oiler
1 Watchman	1 Wiper

COI manning levels for the Super Class (1868-2000 pax)*:

Previous COI Manning	New COI Manning Level
1 Master & 1st Class Pilot	1 Master & 1st Class Pilot
1 Mate & 1st Class Pilot	1 Mate & 1st Class Pilot
	1 Licensed Mate
4 Able Seamen	4 Able Seamen
1 Ordinary Seaman	*2 Ordinary Seamen*
1 Watchman	1 Watchman
1 Chief Engineer	1 Chief Engineer
	1 Assistant Engineer
1 Oiler	1 Oiler
1 Wiper	1 Wiper

*Note: this does not include the ELWHA when operating on a SOLAS route, which requires both additional manning and a reduced passenger complement. These additional requirements would be altered in accordance with the new deck department manning. However, the addition as presented above of a licensed engineer does not offset one of those emergency evacuation personnel, as the licensed engineer will be in the engine room during emergencies.

Crew Reduction Alternatives. As noted above, these manning levels, and the scenarios used to generate them, assume the vessels are carrying their full COI capacity, and all decks are in use. As shown by reference (c), this is rarely the case, and it is possible to include conditions in each COI so that its manning may be temporarily reduced in low ridership conditions. The most viable option for WSF would involve passenger reductions, coupled with restricting passenger

access to some decks, such as upper passenger decks or upper car decks. My staff is ready to meet with yours on how we would implement COI and muster list changes to implement these alternatives; ultimately, the vessels' COIs would be amended to reflect that when a ferry operates on a certain route with a certain reduced passenger complement, the manning would be reduced, provided that the passengers' access to certain decks was restricted to enable the reduced crew to perform their emergency duties.

Passenger reduction: Each ferry class in question has 4 IBAs rated to carry 100 persons. Each IBA is authorized to carry up to 150% of the rated capacity, for a total of 150 each. With 4 IBAs, they are able to accommodate a total of 600 passengers. The additional ridership lifesaving quotas are met through a second ferry's lifesaving and the alternative compliance to Subchapter W authorization based on ridership less than the COI passenger total. Each IBA must be manned by a crew member with no other duties. However, the number of IBAs to be deployed may be reduced if the ferry achieves 100% lifesaving but carries less passengers than there are lifesaving appliances onboard. For example, each IBA accommodates 150 persons; if the ferry carries less than 450 persons it can achieve 100% lifesaving with only 3 IBAs, and therefore may reduce crew by 1; if the ferry carries less than 300 passengers it may reduce crew by 2. Note: the minimum level of crew needed to properly fight a fire on large multiple deck ferries is normally 12 crewmembers as stated above and therefore may not be authorized to carry less.

Restricted passenger access: To enable reduced crewing when fewer passengers are carried, passenger access to certain areas on the vessels such as the Texas deck, upper passenger deck, and upper car deck must be temporarily restricted. A crewmember would be responsible for fire patrols, but the time consuming duties of clearing and securing a space in the event of a fire, abandon ship, or security event would be eliminated. For example, securing the Texas deck on vessels from passenger access at the ladders (by a means of physical barriers or equivalent), or, on the Super class, closing off the upper passenger deck, or closing off upper car decks on vessels so equipped, will enable potential crew reductions for vessels operating with reduced passenger complements.

A sample reduced manning scale is provided below for the Super Class:

COI reduced passenger manning levels for the Super Class (up to 300 pax):

New COI Manning Level	Reduced Psgr Manning Level
1 Master & 1st Class Pilot	1 Master & 1st Class Pilot
1 Mate & 1st Class Pilot	1 Mate & 1st Class Pilot
1 Licensed Mate	1 Licensed Mate
4 Able Seamen	4 Able Seamen
2 Ordinary Seamen	*1 Ordinary Seaman*
1 Watchman	*(watchman deleted)*
1 Chief Engineer	1 Chief Engineer
1 Assistant Engineer	1 Assistant Engineer
1 Oiler	1 Oiler
1 Wiper	1 Wiper

16711
October 26, 2012

Subj: Washington State Ferry Manning Review

In our meeting on October 23, 2012, we agreed to further discuss manning levels on the ISSAQUAH class and EVERGREEN STATE class. To establish appropriate manning levels on these vessels, we will have to agree on how the emergency duties required of these vessel crews can be performed by lesser numbers of crew. In evaluating emergency manning, the potential areas for further reductions would be to evaluate feasibility of reductions in numbers of firefighting boundary setters and/or personnel performing passenger evacuation sweeps, in both cases needing to provide some form of equivalent achievement of these safety response measures.

I recognize this has been a lengthy and highly sensitive process to date. WSF staff has dedicated significant effort to resolving these issues, and I appreciate their dedication to ensuring the vessels are able to fully meet their operational and emergency duties. Once we complete this review and reset these manning levels, I view the engagement of our staffs as an ongoing process; as noted during our meeting on October 23, 2012, we will set up regular reviews to consider in partnership crew training, perform drills and exercises, and periodically evaluate muster list effectiveness, and whether manning levels should see potential increases occasioned by either increased duties or safety concerns, or reductions enabled by technology improvements or reduced operating needs.

The above changes are not an implication that WSF's safety record is substandard. WSF does have a strong safety record, but as noted in references (a) and (b), WSF operates a large fleet in a demanding and complex operating environment that mandates providing essential resources to further protect the ferries from the low probability but high consequence event of a ferry collision or sinking.

We will implement the manning changes to the Jumbo Mark I and Super Class ferries with revised Certificates of Inspection within 30 days. My point of contact for this review is Mr. John Dwyer, the Officer In Charge, Marine Inspection for Sector Puget Sound. He will contact your staff to set up a time frame to complete the evaluation of the Issaquah and Evergreen State classes; my goal is to have this evaluation completed by November 15, 2012.

Sincerely,

S J Ferguson

SCOTT J. FERGUSON
Captain, U.S. Coast Guard
Commander, Sector Puget Sound

Copy: Marine Engineers Beneficial Association
International Association of Masters, Mates, and Pilots
Inlandboatmen's Union of the Pacific