SHORT SEA TUG AND BARGE CONTAINER OPERATIONS

ALBERNI CANAL TO VANCOUVER

AND PUGET SOUND

AN ANALYSIS FROM A NAVIGATOR’S PERSPECTIVE

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1. The differences between ocean-going container ships and coastal barge operations, and the effects on operations.

It is essential to understand the differences between containership and tug and container barge operations to appreciate the issues that may arise along the proposed routes.

The advantages of a tug and barge operation are:

a) the ability to leave a barge at a terminal for unloading and loading and to use the tug for another barge or operation.

b) savings on wages as a tug has a much smaller crew than a containership.

c) savings on fuel as a tug has a much smaller engine or engines than an ocean-going ship.

d) more flexibility – a barge could easily be transferred to a smaller harbour tug or vice versa.

e) draft - a tug and barge requires substantially less water and can transit rivers and harbours where depth of water would be an issue for a large containership.

The disadvantages of a tug and barge container operations are:

a) speed – the average containership travels at 24 to 27 knots and new buildings are on the drawing boards that will have service speeds of 40 knots. Whether these ships will be built given the present cost of fuel is debatable. I also note that the new supersized containerships are designed for 16 knots At any rate, I know of tug and barge operations on the Alaska trade where speeds of 13 and 14 knots are the norm. Again, the present price of fuel may make operating these tug and barges at high speeds uneconomic. Containerships are constructed with very fine entry (bows) where most barges have square bows and once the square nosed barges reach their design hull speed, it takes large increases in tug horsepower to increase the barge speed by each knot. At present on the B.C. coast we have log barges with more or less rounded bows which do result in some speed efficiencies. Foss Marine on the Seattle – Alaska runs base their schedules on 11 knots. They are towing 10000 gross tonnes barge with 600 teu or more on deck and petroleum products in tanks below decks. I would think that the same barge with only containers (approx. 1000 teu's) would average 12 knots. The smaller tug and barge units would likely average 9 knots

b) Stability – containerships load containers below the main deck of the ship. Before the first containers are loaded, the hatches are removed and the containers are lowered into slots inside the hull and sit on the double bottoms of the ship. This gives the capability to load containers higher on deck. Without getting into ship stability theory, the desired condition of a container ship is to have a righting moment of force (otherwise the ship may capsize), without having the righting movement too large. Aboard ship this righting moment is called the GM. If too large, the righting moment would have the ship roll violently when encountering large waves or when making sharp turns and this could result in the barge capsizing or damaging cargo within the container (especially those containers at the top of the load). It could also result in container lashings being broken and containers being thrown overboard. On a containership, the righting moment is monitored and managed by a stability computer and it uses ballast tanks and container position management to keep the proper righting moment.

On the other hand, most conventional barges would load all of their containers on and above the main deck of the barge. This would result in a situation where the volume of the barge under the main deck is a void space with no weight. The centre of gravity of the load would be higher than the main deck. Should this barge be rolled by a large ocean wave, the void space would act as an upward buoyancy force and the center of gravity would act downward to one side and the barge could turn over. This situation would severely limit the height that one could stack the containers on the deck of a conventional barge, especially if the barge would be experiencing ocean waves. If dedicated container barges were to be designed, the ability to stow containers below decks and a ballast tank system would greatly enhance the efficiency and safety of the barge.

c) wind- Container ships and container barges by their very nature have large flat surfaces exposed to any existing wind but especially side winds (winds on the beam). A container ship can manage to transit a narrow channel with a strong side wind because the action to counteract the wind is taken by the ship itself. With his skill and experience, a pilot will steer a ship into the wind with sufficient correction to stay in the desired part of the channel. The ship will crab along, not going where it is steered but following a course which is the resultant of the direction and speed of the ship and the wind forces acting on the ship's hull and on deck containers. It would not require much extra channel width. With a tug and barge, the correction to counteract the effects of the wind must be taken by the tug. The tug must transit on the windward side of the channel and the barge will be blown downwind and follow the tug off to one side like a dog track. The amount of the dog track is dependent on a number of factors such as length of towline, amount of surface area exposed to the wind, strength of the wind, and the bollard pull of the tug (horsepower). The result can be that a tug and barge can occupy a large section of the channel or even be unable to use a narrow channel in certain wind conditions.

d) Tow line- It goes without saying that a tug and barge must be connected by a tow line so that the tug can tow the barge. Under normal conditions, the tow line is not an issue as long as the seas are fairly calm and the tug and barge are not moving in a seaway (waves). When the seas (waves) are large enough, the fact that the tug and the barge are two separate hulls and are moving in different directions can result in excessive forces being applied to the towline, the tug's towing winch, and the towline's connection to the barge. For example, the tug could be riding down a wave and picking up speed (surfing) while the barge is climbing a wave and almost being stopped. As a result, tremendous temporary forces may be experienced on the towline. The tug's Captain mitigates this situation by extending the length of the towline to create a catenery (sag) in the towline. As the towline is extended, its weight causes it to sink into the water.

When the excessive forces are experienced, the catenery acts like a spring and the towline will attempt to straighten out, but the weight of the towline will absorb the shock. The length of towline required to handle the sea conditions at the time is a judgement call by the captain and most modern larger tugs have tension gauges on the winch and automatic releases that pay out and retrieve towline when the forces get too great. The issue we are concerned about is the longer the towline is extended the deeper the water it requires to avoid catching up on the bottom, which would be a disaster for the tug and the tow.

e) Waves – The height of a wave is determined by several different factors:

i) the strength of the wind

ii) the duration of the wind (how long the wind has been blowing at that speed)

iii) the fetch of the wind (the distance of open water that the wind has been blowing over)

iv) the depth of water (as the wave encounters shallow water the height of the wave increases dramatically)

v) the period of the wave (period is the length of time from peak to peak in the wave pattern)

vi) opposing currents (when waves encounter tidal or ocean currents running against the wave pattern, the waves increase in height as the period of the wave decreases)

As the height of waves increase and the period of the wave decreases the resulting pitching and rolling of the barge may cause cargo damage, damage to the towing gear (possible parting of the towline), and reduction in speed (in extreme cases stopping the progress of the tug).

4. Describe and define issues of concern for tug and barge operations along the proposed routes and in particular container barges.

A tug and container barge departing the proposed new terminal in the Alberni Canal would have deep water for navigation and steep shorelines and hills for excellent protection from the wind. The first navigational issue would be the narrowing of the channel at San Jose Islet. The 16 metre shelf running to the north would limit the width of the channel for a containership and for a short distance (a quarter mile) this would prohibit a meeting between a container ship and a tug and barge unit. There is a deep water channel to the south of San Jose Islet that the tug and barge could use, that would allow the ship to transit the narrow part without large course alterations. The entire passage from the proposed terminal to Vancouver or Seattle/Tacoma is under the supervision of Canadian MCTS and/or Seattle VTS. From the terminal to Buoy "J" at the entrance to Juan de Fuca traffic is monitored and advised by Tofino Traffic. From buoy "J" to Seattle or Tacoma Seattle Traffic has the jurisdiction, and vessels bound for Vancouver switch to MCTS at Race Rocks and are monitored by them until they reach their Canadian port.

The next issue and certainly the most concerning for a tug Captain is the channel from abeam of Bamfield to clear of Cape Beale. This portion of the route presents all of the factors in building of wave height. This entrance to the open sea is susceptible to storms and weather fronts which normally travel across the Pacific in an easterly direction. The fetch to the West is all the way to Japan and there is a shallow ledge which goes out approximately 2 miles from Cape Beale Lighthouse. As well, on large ebb tides a substantial ebb current runs counter to the waves especially at Sea Pool Rocks. The shallow water in this area will prohibit the tug from extending its towline to deal with the large waves. Fortunately, there is an alternative. Twelve miles inland from Cape Beale there is a channel called Junction Passage. This channel is a deepwater passage to the northwest side of the Broken Group Islands and would allow the tug to use Imperial Eagle Channel. Imperial Eagle Channel provides a deep water exit to the open sea and would allow the tug to extend its towline for ocean towing, have less ebb tide current, and have no shallow water ledge to build larger waves. I personally used this route when towing log barges as an all weather passage to the open seas. Of somewhat concern is Tyler Rock which is located in midchannel of Junction Passage at the southern entrance.

The next area of concern would be the 30 miles of open ocean from Cape Beale to buoy J at the entrance to Juan de Fuca Strait. The tug and barge would be dealing with ocean weather conditions but with deep water and minimal currents. In my opinion, the larger tug with a 10000 tonne barge should not have to stop navigating except for hurricane force winds which only occur rarely. These units should be capable of handling 8 to 9 metre waves when using Imperial Eagle channel. The smaller units would be limited to 5 to 6 metre seas. Wave height is the deciding factor because wind speed is only one factor in determining the height of the waves (wind speed, duration, fetch, and water depth). The wave frequency does not become an issue when using Imperial Eagle channel because of the deep water. Mr. Lui's data will give us a better idea of the frequencies of these conditions.

As you approach buoy J a certain amount of ebb current may be experienced to increase the height of waves. As you transit into Juan de Fuca Strait, the ocean waves will subside and the prevailing winds and swells are coming from behind for an inbound vessel. Weather in Juan de Fuca Strait does not usually affect even smaller tug and barge units, however, SE gales and ebb currents can reduce the speed of inbounds, and westerly winds (prevailing) and flood currents can reduce the speed of outbound tugs. It is common for Juan de Fuca to experience 25 to 30 knot winds (both SE and Westerlies) in winter months, with 25 to 30 knot Westerlies in the summer months. These winds would not stop the tugs and container barges from making the passage, but when heading into these winds the larger tugs would have their speed reduced somewhat, and there would be more of an effect on the smaller tugs. There would be an opposite effect when experiencing a following wind. On a bad luck individual voyage the tug may experience substantial headwinds in Juan de Fuca Strait and countercurrents in Juan de Fuca and the Gulf Islands. On a good luck voyage, the tug could experience fair winds and currents all the way. I would think that over the long term it would even out. One concern in Juan de Fuca is the ever-increasing foreign- going traffic for Vancouver and Seattle-Tacoma can result in very busy traffic lanes. These lanes are monitored by shore based radar and AIS transmissions and slower traffic is required to give safe passage to overtaking vessels.

The transit from the Eastern end of Juan de Fuca to Georgia Strait and/or Seattle Tacoma would only present the issue of very strong currents in the Gulf Island area and in Puget Sound. Currents in sections of this area can reach 5 knots and can cause substantial reductions in speed. Over the long haul, this should average out as transits are made with currents running the same direction as the tug.

Georgia Strait does not present any issues for a tug and barge except on those very rare occasions with hurricane force winds.

Berthing at Roberts Bank can be a challenge in certain wind conditions, but there are high-powered assist tugs stationed there and container ships are seldom delayed by weather.

Tug and barges bound for New Westminster will have a significant challenge transiting the Fraser River from Sandheads to just past Steveston. This seven miles is in shallow water with both the Southeast and Northwest prevailing winds acting on the beam of the tug and tow. This narrow channel may require the use of assist tugs for this section of the river and at times may present lengthy delays. Sea conditions when winds are in excess of 30 knots may make impossible for assist tugs to connect to the barge off Sandheads (especially with large ebb tides and at freshet time) This is the area that would result in the biggest challenges for tugs and barges along the suggested routes.

5. Identify assumptions of vessel design and capacity used in the analysis and identify design or operational requirements that would enhance safety and reliability of service.

If we consider the large number of containers that may be unloaded at the terminal at one time, I would think that the barges required for the short-sea service would be as large as practicable. A 10,000 international gross tonne barge would require a tug with a minimum of 5000 horsepower. If the operation wishes to avoid Canadian pilotage fees, the total International Gross Tonnage of the tug and the barge combined, must not exceed 10,000 tonnes. With a 5000 horsepower tug being approximately 1000 tonnes, it would leave the maximum tonnage for the barge at 9,000 tonnes. My present research indicates that a 10000 International Gross Tonnage Barge would carry around 1000 teu.

I understand that meetings are currently underway between the Pacific Pilotage Authority and industry to seek a system where Canadian officers could navigate larger tugs and tows within compulsory pilotage waters.

The service could be provided with smaller tugs and barges, but with these routes, I would think a minimum size would be a 5000 tonne barge with a 2000 horsepower tug. With smaller units, reliability becomes an issue with more frequent weather delays.

6. Identify gaps in information, and or areas for additional research.

I am still waiting on answers to queries regarding frequencies of extreme wave and weather off Barkley Sound and TEU capacity of large container barges.

7. Identify the conditions that prohibit safe and reliable barge operations and estimate the hours or days that those conditions would limit navigation.

I will have a more accurate opinion after I receive the weather data from Mr. Hong Liu.

8. Identify other navigation related insurmountable issues or risks that would have to be addressed is subsequent research.

I do not know of any insurmountable issues or risks to be addressed. However, proper tugs and barges must be utilized with suitable GM’s (righting moments) and they must be towed with suitable horsepower to barge tonnage ratios.

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