Transit trips and fueling of Ferry "Raunefjord"

On October 25th, I left Bergen at 7 pm to ride the Fjord 1 ferry Raunefjord and to witness fueling operations. The Raunefjord is one of a class of 5 identical ferries operated by Fjord 1. Three of the ferries are on the Bergen to Stravanger route.

These ferries are 425 feet long, overall and have 12,360 KW of main propulsion power available from 4 LNG fueled SFE engines. These engines drive generators which power electric motors fitted to the top of 4 azimuthing propulsors with one at each of the 4 corners of the ferry.

I arrived at the terminal, South of Bergen, at 8 pm in enough time to see a sister ship to the Raunefjord arrive and discharge and load.

It was easy to count the 16 large Trucks and 40 cars in the waiting queue at the terminal so I decided to time the discharge / load cycle.

The ferry holds to the pier with the propulsors (no mooring lines) and approached at a good clip.

From the time the ferry stopped and the internal ferry ramp immediately descended, 45 cars and 4 large trucks drove off the ferry, 16 trucks and 45

cars drove on the ferry and the ramp closed and the ferry started to leave the terminal, was exactly 4 minutes flat. The record is evidently 100 on and 100 off in 5 minutes.

When I asked the crew of the Raunefjord why everything seemed in fast forward I was told that one of the three ferries on this route was currently in dry-dock for routine survey, so the remaining two ferries had to keep the schedule as best they could.

I had asked in advance if it would be permissible to ride in the engine room and was escorted there when boarding. The engine control room (ECR), located one deck below the wheelhouse and 5-6 decks above the machinery spaces, was occupied by the Chief Engineer and an engine cadet.

The 7 man crew consists of a watch standing Master and Chief Mate, two deck unlicensed, one Chief and First Assistant Engineer and one unlicensed engine crew.

The wheelhouse is occupied by one man at a central, aircraft type, control position. As the wheelhouse is amidships, the man at the conn merely rotates his chair 180 degrees to make the trip back.

Transits

I was impressed, as we came up to power on three of the 4 main engines (three are only needed to make speed, allowing one to be maintained underway), that there was no engine exhaust noise, nor any vibration. We came up to just under 20 knots for the crossing.

The 4 main SFE engines are each located, on centerline on the tank top, in individual steel enclosed rooms, one behind the other. Each room is constructed to DNV explosion proof rules (similar to WT bulkhead rules) and each room has on one side an explosion released hinged bulkhead that opens

in the event of explosion. The path of the expanding explosion gases is then led up a channel inside the outer shell to an explosion released panel on the side shell, well above the waterline. This arranged was required when these vessels were constructed, about 5 years ago, but is no longer required.
There are three diesel fueled generators of 400 KW each located in a separate machinery space. All voltage was 680 volts.
The two LNG fuel tanks and the cold boxes, separated from the LNG tank enclosures, are also located below deck on the tank top. The whole engine room fuel tank arrangement employs double walled piping and is arranged to the Emergency Shut Down (ESD) concept.
One is struck immediately as to how clean LNG fueled operation is, the machinery and fuel spaces were immaculate.
At the time of the crossings I made, the Chief Engineer, alone, was operating the plant from the control room; the unlicensed ER man was on a required sleep time as he would start the fueling operation, just after midnight.
During transits, with the Engine cadet left in the control room, the Chief showed me each engine, each fuel tank and each cold box. Leaving the engine cadet in the ECR might seem risky, however, not only is each of the 7 man crew equipped with a handie talkie permanently attached to them, but in conversations with the engine cadet it was clear he was entirely familiar with the operation of the entire plant. The engine cadet had finished all of his courses and was required to spend a few months sailing, before he could sit for his license. As he led me through the various screens, showing the operation, I was impressed that his education must have been more formidable than would have been the case in the US.

At one point, the Chief took me to the off line engine and removed the spark plug assembly and then the valve cover. The spark plugs cost $139 US each and are replaced every 1000 hours. An automated power management system indicates when spark plugs and all other maintenance issues are to be addressed. The engine opened had been running for about 20,000 hours, the lube oil looked like it had just been added, it was clear and appeared to have full viscosity.

Monitors in the control room can view all aspects of all machinery spaces and, when docking, can be turned to view the unload / load operation. There is no need to leave the ECR at any time; everything is controlled from the ECR.

The first two years of operation consisted of numerous problems with the propulsion thrusters, however, the last 3 years had been trouble fee. There had been no start up issues with the SFE engines.

Fueling

The last transit was completed at midnight and the Raunefjord departed the Bergen berth, made a full 180 degree turn just off the berth, and backed into the immediately adjacent fueling berth. This turning is necessary as the ferry fueling station is on one side of the vessel only. All possible LNG emitting devices are located on one side of the ferry all intakes on the other side. I was in the wheelhouse during this maneuver and it was impressive that one man, at a control position, could do the whole thing, unassisted.

We arrived at the fueling berth at 0015. The fueling berth consists of a permanent shore discharge facility which is hooked to the ferry by a 6 inch LNG hose. The shore tanks are located across the road leading to the ferry and are immediately adjacent to individual houses. These tanks are filled up

several times during the week by LNG trucks. The site arrangement and required approvals for the LNG facility was the responsibility of the LNG supplier.

Shore tanks being refueled by tanker truck

The Raunefjord has two 125 M3 LNG fuel tanks. Fjord 1 has detailed procedures for all operations and fueling, not only has a written procedure, but also has a sequential check off list that is used by the Chief Engineer in the ECR to control the process. Each step must be recorded, hard copy, with the time given and initialed. The Chief Engineer is the designated fueling officer and had to take a rest period on the last transits before fueling. The first assistant ran the ECR during that rest period.

The unlicensed engine room man is located at the fueling station and must repeat each order before he takes action, that order is confirmed by the Chief Engineer and logged as the unlicensed engine room man carries out the task.

The first operation consisted of electrically bonding (grounding) the ferry to the shore station. At the same time the Chief Engineer started shutting down the 4 gas fueled main engines, one at a time. Each engine shut down had to be complete before he next shut down was started. When all engines had been shut down (the ferry was then operating on one diesel generator) the unlicensed engine room man then started a procedure of proving each LNG valve operable and tight. The method was to open and shut LNG block valves, one at a time (there are two in tandem at each location) with a purge of nitrogen. The nitrogen comes from a flat of 12 nitrogen cylinders. A certain time period is observed during which the pressure on the other side of the valve is monitored. If any LNG has leaked into the pipe, then the pressure will increase as the pipe warms up.

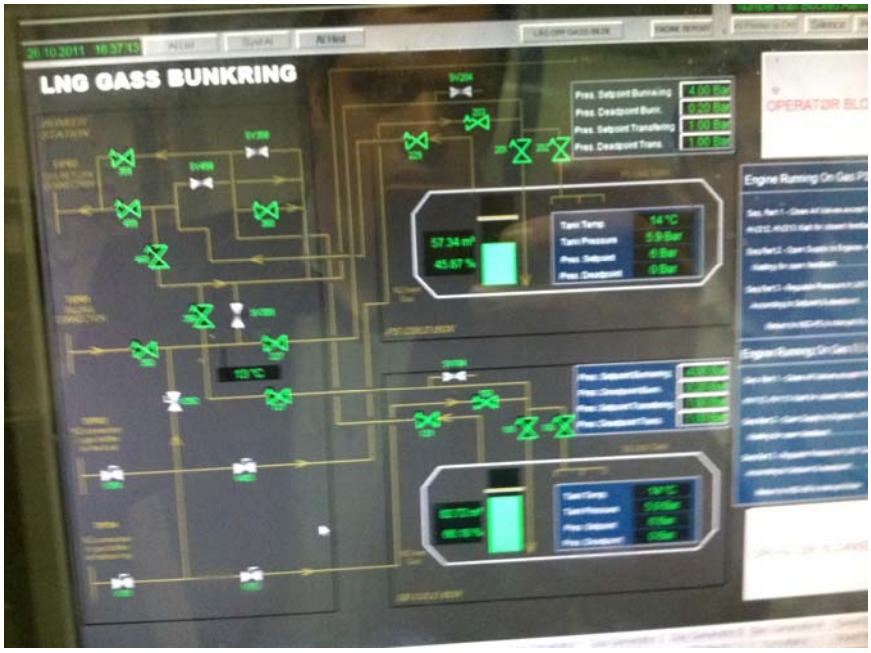
The entire process of valve checking (which included operation of all nitrogen valves), hooking up of the LNG hose and related operations took 45 minutes, we were ready to start loading LNG at 0100.

There were no shore personnel associated with the operation and a automated control console at the shore station monitored shore LNG tank conditions and remotely operated shore LNG tank valves. Most impressive was an embedded screen check off list that required keying in that certain things had been done before one could move to the next step.

The unlicensed engine room man had attended the LNG training, required of the whole crew, but had received additional training in the fueling operation.

The first tank filled was nearly empty and took 45 minutes to fill. It was necessary to purge again in between tank fillings which took about 30 minutes. We started filling the second tank at 0215 and as that tank was

37% full, it did not take as long as the first tank. We finished loading that tank at 0300.



Bunkering control screen

The shut down process mimicked the start up process in reverse with purges, disconnection and the sequential start up of the LNG fueled engines after everything had been disconnected from the shore fueling station.
We departed the fueling dock at 0400, the fueling operation had taken just under 4 hours.

Security and other issues

The fixed shore facility and LNG storage tank facility, across the road, are surrounded by high walls and fitted with personnel and truck access gates that were locked the entire time we were at the fueling berth.
As the ferry berths alongside, there is no ramp or other access to the ferry from shore other than a very small personnel ramp between the ferry fuel station and the shore manifold. Thus, no storing, spare parts loading or other activity took place during the fueling.

The ferry bunker station is located at the end of the ferry where there is no deck above; it is open to the atmosphere, if the gas tight door to the fueling station is left open. This door has an explosion proof lock and is locked at all times, except for fueling. The small personnel gangway forms a closed gas tight side port, when closed, and thus the fueling station is gas tight at all times except for fueling. Sensors can detect gas in the room. At the time of fueling no regulatory body observed the fueling, there was no one there except for the 2 members of the ship's crew involved.