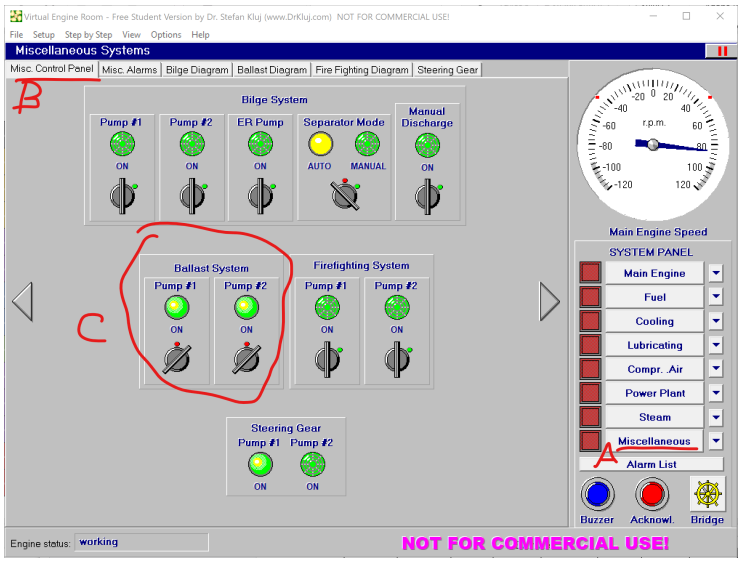
Lab 3 Outline - Water Systems

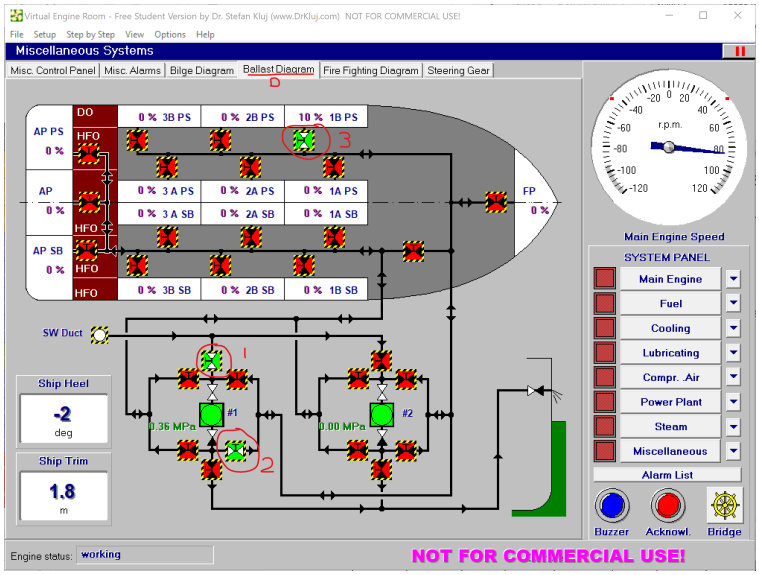
Ballast System

The ballast system includes sixteen example ballast tanks with valves, piping system and ballast pumps. The ballast pumps are connected to the two separate mains, one on each board. This arrangement enables not only filling and emptying of the ballast tanks, but also quick correction of the large stability changes (for example when loading or unloading a cargo).

1. Open the Virtual Engine Room program, then in the Menu bar select "Setup" then "Full Ahead at Sea" 🙂
2. Go to the (A) Miscellaneous system and on the (B) Misc. Control Panel tab turn on both (C) Ballast Pumps.



3. Next go to the (D) Ballast Diagram tab and open the (1) Ballast Pump No 1. suction valve, the (2) Ballast Pump No 1. Discharge to Port Tanks valve, and (3) one of the valves for a tank on the port side (1B PS shown here). The tank should start to fill.



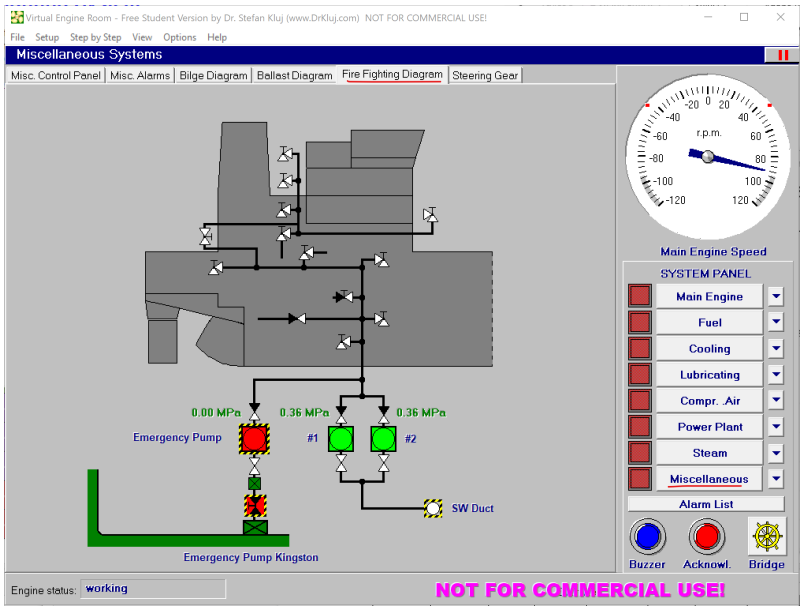
4. At what level will the high alarm go off? (Hint: Check the Alarm List)

5. Close those valves to stop it filling. Figure out what valves need to be opened to empty the tank.
6. Were you able to get the tank back empty again?
7. Time how long it takes to fill half of the tank from empty with a single pump.
8. Determine how to have both pumps work together to fill a tank simultaneously.
9. Time again how long it takes to fill half the tank. What was the difference between these two times? Is it what you would expect?
10. Notice the Ship Heel indicator in the lower left corner of the display. Work to fill an assortment of tanks to maximize heel in one direction. How much heel could you generate?
11. Try going the other direction. Is there a difference between the two sides?
12. Do you think it would be possible to induce an oscillation by moving water back and forth between the ballast tanks?
13. Is it possible to move ballast water from port tanks to starboard tanks directly? Why or Why not?

Fire Fighting System

The fire fighting system includes two fire pumps driven by electric motors and one independent emergency fire pump driven by an independent diesel engine. The emergency fire pump is also connected to a separate sea water chest and is located outside the engine room.

14. In the Miscellaneous system on the Misc control panel tab, turn on both pumps for the firefighting system.
15. Next go to the Fire Fighting Diagram tab, note how both fire main pumps are ON and are providing pressure to the system.



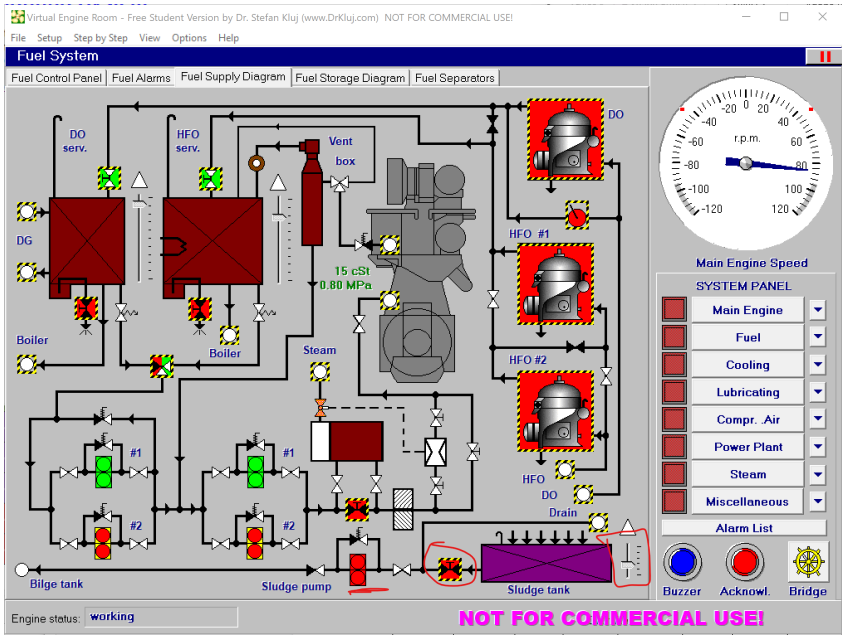
16. Go to the Cooling system, then on the Sea Water Diagram tab and secure the Port Side Kingston valve (the only open SW inlet). then return back to the Fire Fighting Diagram page and note how there is no pressure.
17. Figure out how to restore Fire Main pressure using the Emergency Pump.
18. Reopen the Kingston Valve in the cooling system.

Bilge System

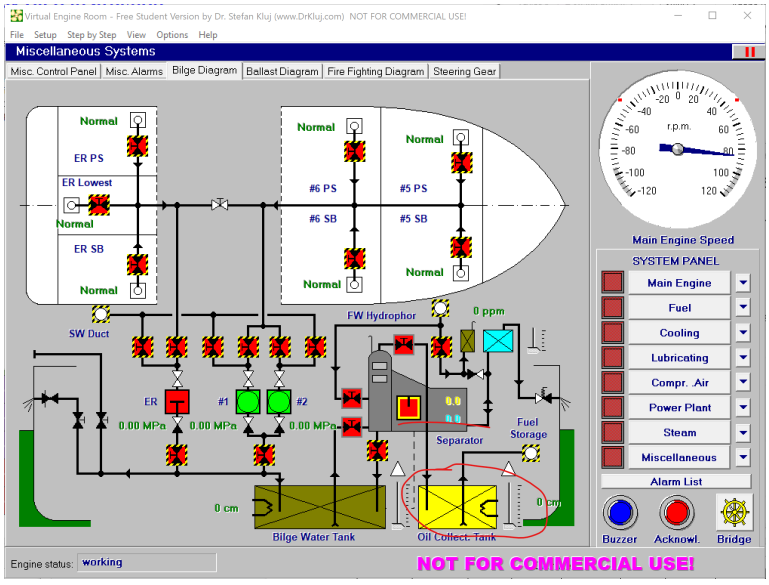
The bilge system includes four hold bilges and three engine room bilges. Each bilge has a well and the related alarm controlled by the bilge level. Three bilge pumps can be used: two (#1 and #2) are centrifugal pumps. The engine room (ER) bilge pump is a displacement type. Each bilge pump has to be primed. This operation is slightly different for each pump type. The bilge water is collected in a separate tank and when the level in this tank reaches the limit, it has to be pumped out to the oily water separator. This is necessary because bilge water discharges must contain less than 15ppm

of oil under the current IMO regulations. The overboard discharge is sampled through an oil content meter. Prior to startup and shutdown the oily water separator must be flushed through with a clean sea water. This is done automatically when the separator operates in the automated mode and its operation is controlled by the level in the bilge water tank. The appropriate checklists (7g and 7h) show how the separator can be operated in the manual mode. The clean water goes overboard through the flush tank and the oil is collected in the oil collect tank. This tank can be emptied manually by the fuel transfer pumps controlled from the fuel system.

19. Once the engine has run for a while you might see the Fuel Sludge tank start to fill up. You can see this in the Fuel system on the Fuel Supply Diagram in the lower right corner.



20. You can empty it by opening the Sludge Tank Suction Valve, then turning the Sludge Pump switch ON on the Fuel Control Panel tab. Go back to the Fuel Supply Diagram to see the sludge tank level go down.
21. Go to the Bilge Diagram (and Misc. Control Panel) in the Miscellaneous system and see if you can get the Oil Separator to work in the MANUAL mode. Once you do you will see the Oil Collect. Tank level start to rise.
22. See if you can empty that tank to a holding tank in the Fuel system.



Cooling System

The cooling system is divided into 2 sub-systems: fresh water cooling and sea water cooling. Sea water is responsible for cooling the fresh water coolers and for the scavenge air direct cooling. The fresh water system cooling includes ME jacket, piston and injector cooling,as well as cooling the diesel generators

The ME/FW and DG/FW system overview is the main task of this window. The active hot-spots enable an easy communication with other co-operating systems. The ME pre-heater by-pass valve should be opened when the heating is OFF and closed when the heating is ON. However, the DG cooling system valves are controlled automatically, so the user does not have to think about the DG pre-heater by-pass valve position. The cooling water outlet temp. controls the FW cooler water flow.

The SW flow overview and control is the main task of this window. The SW enters the system through high and low sea chests on opposite sides of the ship. The low suction is used at sea where it is more likely to remain immersed as the ship rolls and pitches. The high suction can be used in harbour, especially when the water is shallow. The sea chests are connected by a large diameter cross connection. Sea water pumps take suction from the cross connection. The SW re-circulation secures the temperature of the water before the coolers.

23. Note the approximate temperature of the Engine Cylinders (from the Main Engine system, Engine Cylinders)
24. Then go to the Cooling system, then Sea Water Diagram tab and secure the Port Side Kingston valve (the only open SW inlet). Then go do the main Cooling Control Panel and note what happens to the system.
25. Go back to the Main Engine system, and look at the Cylinder Temperatures. Do you also see the RPM fluctuating?
26. Next secure both ME FW Pumps, this should cause the engine to shut off. Look at the Alarm List and try to determine the main cause.

What are your overall takeaways about how a cyber attacker could affect the integrity of the ship by compromising its various water systems.