0.1 Uavailable data

Some data are unavailable from the sea trials, and it makes the data gathered in **??** incomplete. This section summarize what data that is lacking for thrust and power, and how this is handled.

0.1.1 Thrust data

Thruster mapping for the main thrusters

For the sea trials done in August, the calculated thrust force is gathered from the DP system. However, for the November sea trials, no thrust force estimates are available. Kongsberg Maritime have supplied their mapping for the thrusters at Gunnerus, and the mapping they use for the two main thruster is similar to Eq. (**??**), where $c = \rho K_T D^4$, and is written

$$T_a = cn^2, \tag{1}$$

where T_a is in kN, and n in rotations per second $[\frac{1}{s}]$, and c is a constant coefficient, that vary with the sign of the shaft speed. The value of c for bollard pull (**?**) and free run condition is shown in Table 1

Table 1: KM thrustmapping

Bollard condition		
	$n > 0$	$n < 0$
c	6.6	-4.1

Free run condition		
	$n > 0$	$n < 0$
c	9.4	-6.4

Also, in order to have a good estimate of the thrust mapping in stationkeeping and DP maneuvers, the results of the pure DP logs from August has been back-calculated to find the mapping used. The measurement series of thrust force and shaft speed are used to find the constant coeffcient c for both positive and negative shaft speed, and the values found are included in Table 2. Note that the values are in between the bollard pull, and free run condition values.

Table 2: Back-calculated thrust mapping from

	$n > 0$	$n < 0$
c	8.13	-5.8

For the zero speed DP maneuvres completed in November, this mapping could have been applied to find an estimate of the thrust force for the two main propellers.

Unfortunately, MARINTEK only measure the absolute value of the shaft speed for November data, so the rotational direction of the shaft is unknown. From the DP manuevers performed in calm sea (August), often one propeller has positive rotation while the other has negative (see Table **??** and **??** where one thruster generate less thrust than the other. This is simply due to rotational direction, since they have about the same rotational speed (magnitude)). Therefore, in order to have an estimate of the thrust force, a mean of the two K_T values will be used. So in the mapping from $n^2[rps^2]$ to thrust force $[kN]$ a value of

$$K_T = \frac{8.13 + 5.8}{2} = 6.97, \tag{2}$$

will be used. This gives a rough estimate of the thrust force. However, since the mapping already does not take thrust losses into account, it is already quite rough, so this is not a very big issue.

Tunnel thruster

The thrust force for the tunnel thruster is available for the sea trials at calm sea (August), but not for the trials at sea in November. The shaft speed of the tunnel thruster is however logged in November, but Kongsberg did not have a mapping for this thruster since it is delivered by another vendor, and the mapping for this thruster has not been obtained. The thrust mapping could have been back-calculated from August thrust data, but unfortunately, the shaft speed was not logged at that time.

0.1.2 Power data

For power consumption MARINTEK measured the shaft torque for the two main propellers, and found the power from Eq. (**??**). This is for both the sea trials. For the tunnel thruster the power consumption is not measured, and is therefore not available.