



continuously updated from dedicated waterjet bucket transmitter via a separate indication system. Hence, the bucket indicators will show correct values even in case of a control system failure.

The steering indicators show the actual steering of the waterjet in percentage of full starboard/port turn. The steering indicators are continuously updated from a dedicated steering indication transmitter via a separate indication system. Hence, the steering indicators will show correct values even in case of a control system failure.

## 6 Thrust control

The thrust can be controlled by one common control lever for the waterjet units or by one separate control lever for each waterjet unit.

The thrust can be controlled by a joystick lever/turning knob (optional).

The levers control the thrust, which means simultaneous control of both the reversing bucket and the engine RPM.

When the operator brings the thrust/steering control lever to a position, the signal is passed to the Control Panel – Port Touch Screen, main station or Control Panel – Stbd Touch Screen, main station. In the Control Panel - Touch Screen, the control system transforms the command signal to a bucket command, a steering command and an RPM command for each jet unit. The RPM command is sent to the engine RPM governor, and the bucket and steering commands are sent to the bucket and steering controllers. The controllers compare the command with the response signals and send “increase” or “decrease” commands to the hydraulic system when needed.

## 7 Steering control

Steering with lever(s): Each jet is controlled individually by separate levers or in parallel with a common lever.

Steering with steering wheel (optional): The jets are controlled in parallel.

Steering with tillers (optional): The jets are controlled in parallel.

Steering with autopilot (optional): The steering is automatically controlled by an autopilot.

The steering commands are sent to the steering controllers.

## 8 Touch panel illumination

The brightness of the display and external lamps can be set.

The Clean Screen button makes the display safe to clean by covering the interface with a black panel for 10 seconds. To prevent accidental blocking of the interface, this has to be accepted with the Accept button.

The Lamp Test button lights up all external lamps while pressed.

## 9 Waterjet control system failure and alarm handling

### 9.1 General

The waterjet control system is equipped with an internal failure supervision system that in case of errors can give the user information about where in the system the error has occurred.

Failures are indicated by a sounding buzzer and flashing status indications in the touch screens. There are also alarm outputs to be connected to the alarm monitoring system of the ship.

This chapter includes description of optional features, which may not be found in your application. All these options are marked in the text.

If an error is detected by the waterjet control system, an alarm is triggered and a text message describing the error will be displayed in the screens on the bridge stations.

The time the buzzer sounds and the indication lamps flash for different types of failures can be set via editable parameters in the software configuration. The time statements in the following descriptions are default values.

The buzzer sounds also in other situations which require the operator's attention, for instance, at transfer of manoeuvre responsibility.

## 9.2 System warning

There are a number of different system warnings. System warnings are displayed in the screens on each control station. When a system warning has occurred, the control system continues to operate without disruption. However, another fault, or, for instance, a change of station in command may activate a control failure. It is therefore important, at a system warning, to take measures to locate and repair the faulty devices as soon as possible.

## 9.3 Control failure alarm

### 9.3.1 Alarm indications

When the indication **CONTROL FAILURE** starts to flash while the buzzer sounds, a control failure has occurred in one of the waterjet units. The indication flashes and the buzzer sounds for 6 seconds (default). After that, the buzzer is silenced and the indication gets a steady indication.

When a control failure bucket/steering is detected, the bucket/steering is frozen in the position it had when the failure occurred (the hydraulic control valve(s) of the bucket/steering are disconnected). The bucket/steering of the jet can no longer be changed with the control lever, only with the back-up system.

### 9.3.2 Possible alarm causes

The cause for a control failure alarm may be:

- Bucket control loop failure. Bucket control failure occurs if there is a deviation between ordered and resulting bucket position and the bucket position is changing too slowly, or it is changing in the wrong direction. When a bucket control failure is detected, the hydraulic bucket control valves are disconnected (blocked). The bucket is frozen in its present position and is no longer controllable with the control system.
- Steering control loop failure. Steering control failure occurs if there is a deviation between ordered and resulting steering position and the steering position is changing too slowly, or it is changing in the wrong direction. When a steering control failure is detected, the hydraulic steering control valves are disconnected (blocked). The steering is frozen in its present position and is no longer controllable with the control system.
- Command error (failure status on the lever in command). Both the bucket and the steering are maintained as they were at the detection of the failure.

### 9.3.3 Actions to take at control failure alarm

Try to change the manoeuvre responsibility to another station and reconnect the system as described below. If this is not possible, for example on vessels having only one control station, or if the alarm remains, shift over to back-up operation of the waterjet.

### 9.3.4 Restoring the system

To reconnect the control system after recovery:

- 1 Set the control lever in a position roughly corresponding to the present steering and reversing position.
- 2 Press the RECONNECT button. The button is enabled (lit) as soon as the system has recovered. After system reconnect, the system will return to normal operation.

If the control failure alarm was caused by a bucket/steering control loop failure, the RECONNECT button will be enabled directly without corrective actions. If the failure remains, a new control failure alarm will be activated after a few seconds.