



Situational awareness – Key to save operation

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2. Impacts – Whole Body Vibration

3. Situational Awareness

4. Safe Operation

5. Summary

The largest single source of risk in boating is human error

96% *of boating accidents are caused by human error

| Operator inattention

| Operator inexperience

| Excessive speeding

| Speed

| Motions

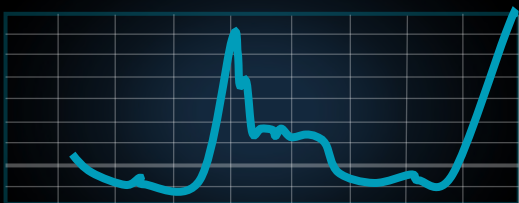
| Objects

| Boats

| Aground

Impacts – WBV

Impact load
The rigid body peak
acceleration (G)

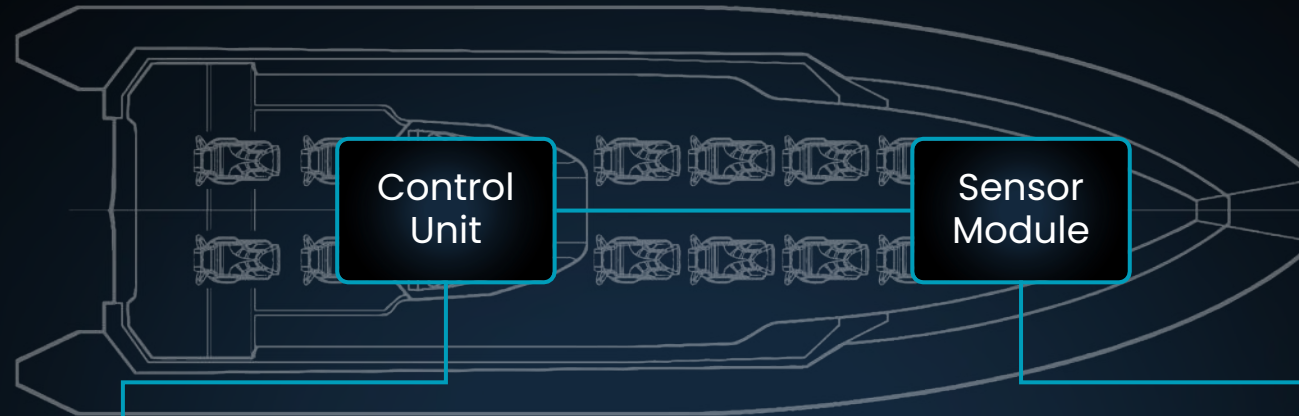


Whole Body Vibration
Vibration Dose Value
(VDV)
Daily Vibration Exposure

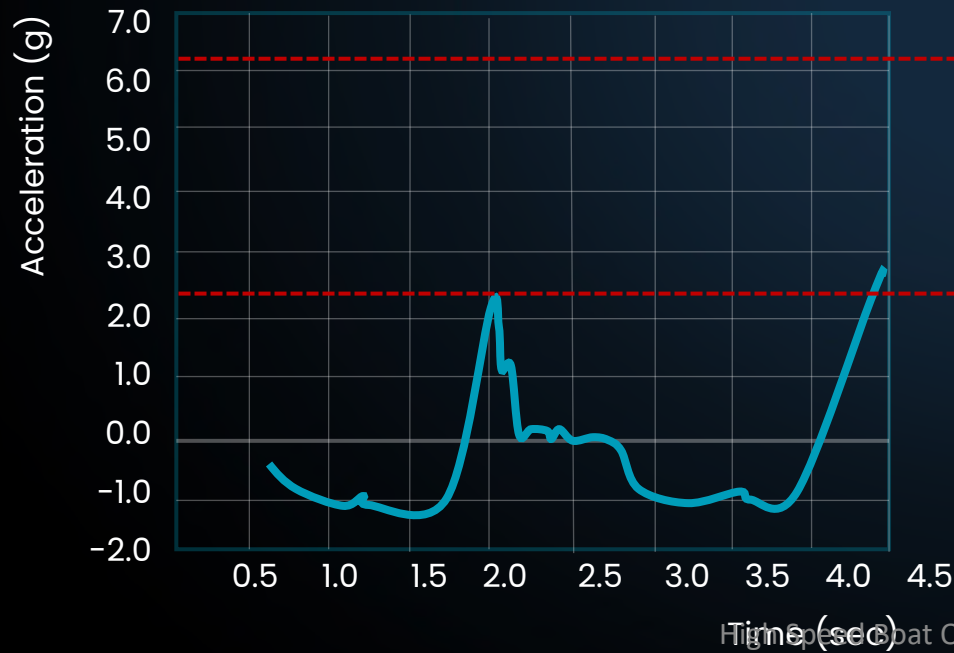


Impacts – WBV

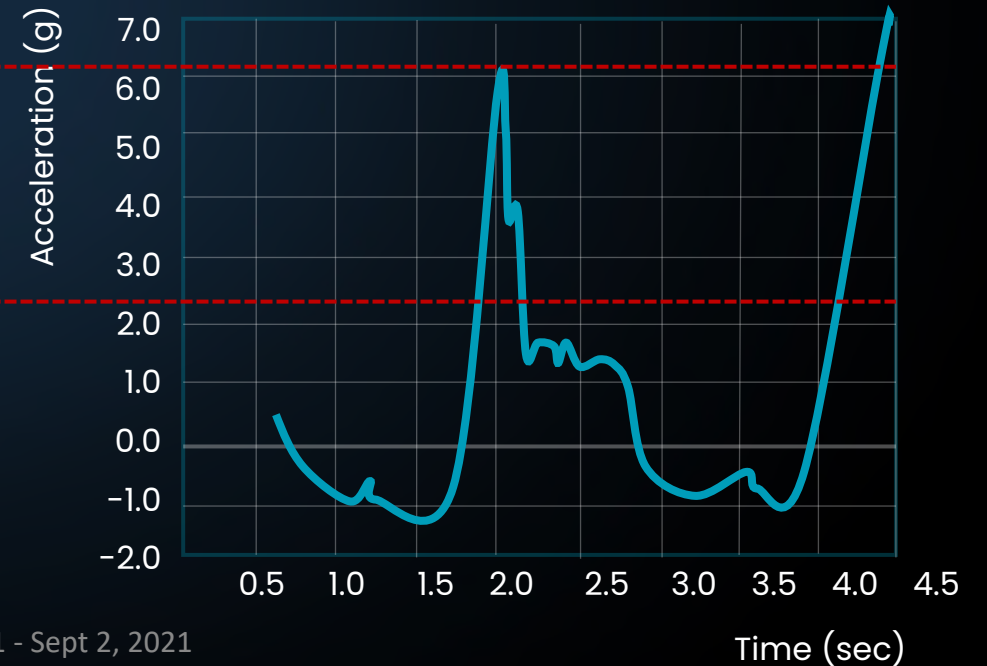
Definition | Shock force caused by slamming



Rear sensor



Front sensor



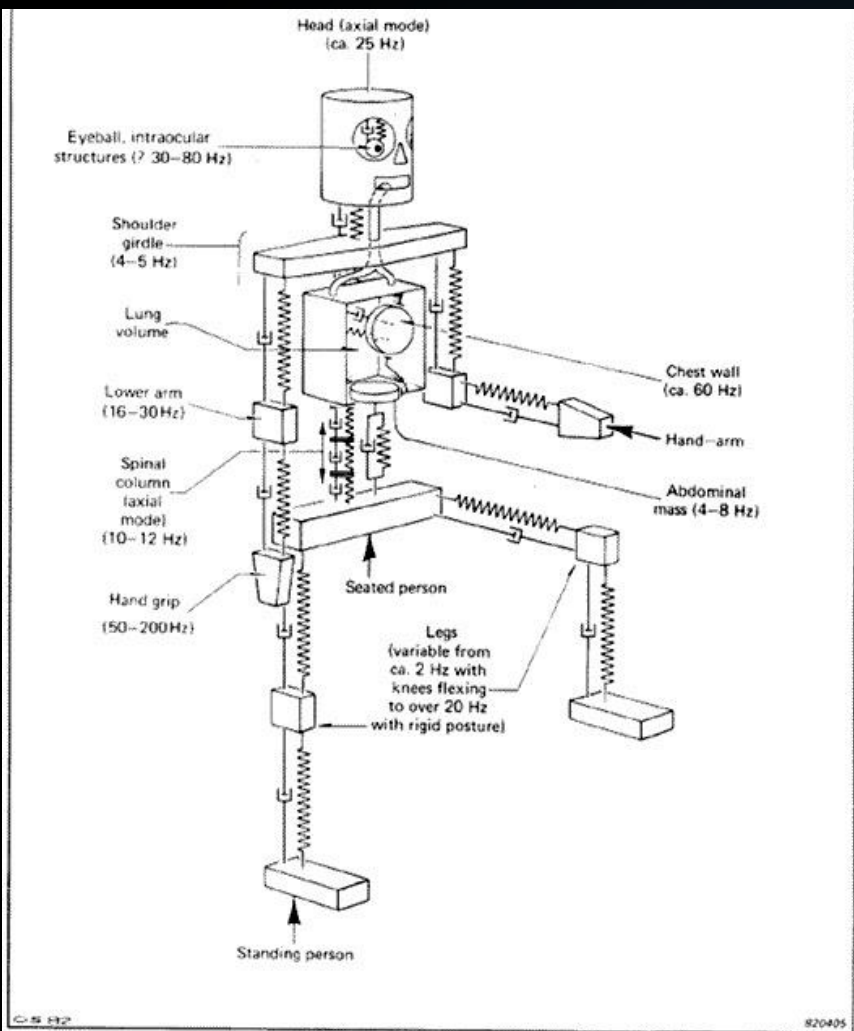


Fig. 1. Simplified mechanical system representing the human body standing on a vertically vibrating platform

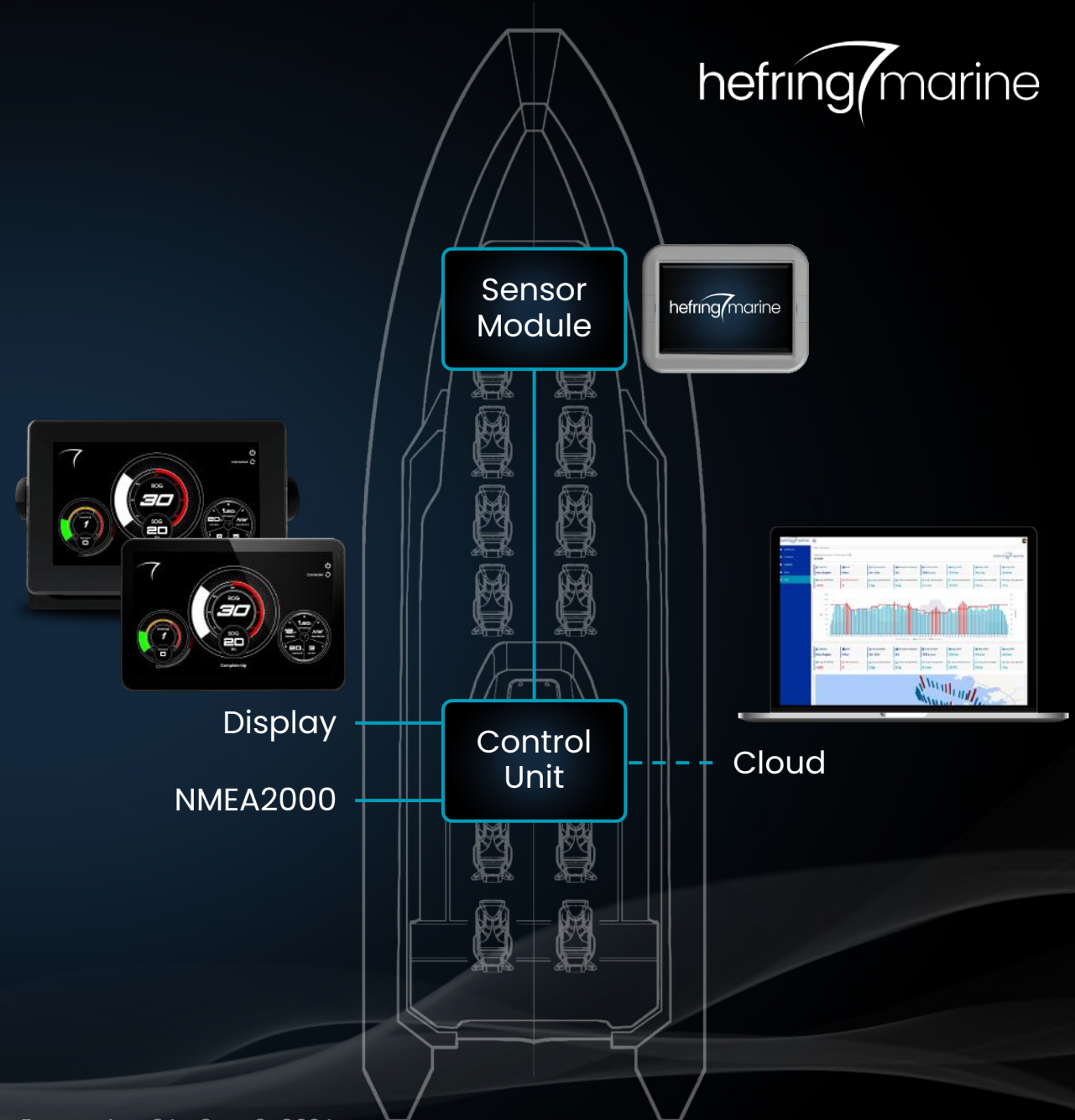
$A_{1/10}$	Transition Zones
$< 1.5 g$	Conditions typically result in a comfortable ride with effective performance for 4 hours or more
$1.5 g - 2.0 g$	Conditions may transition from a comfortable ride to a ride with limited discomfort
$2.0 g - 2.7 g$	Conditions transition from a comfortable ride to a ride with discomfort and limited performance
$2.7 g - 3.2 g$	Conditions transition from discomfort to the onset of extreme discomfort
$3.2 g - 5.5 g$	Conditions transition from extreme discomfort to the onset of concern for personnel safety
$5.5 g - 6.0 g$	Conditions transition from extreme discomfort and concern into

Impacts and WBV are influenced by:

- | Boat
 - | Hull type
 - | Boat length and beam
 - | Weight and weight distribution (Center of gravity)
- | Sea conditions
 - | Wave height
 - | Wave direction
 - | Wavelength (wave frequency)
- | Operator
 - | Throttle control (Speed)
 - | Helm control (Heading)



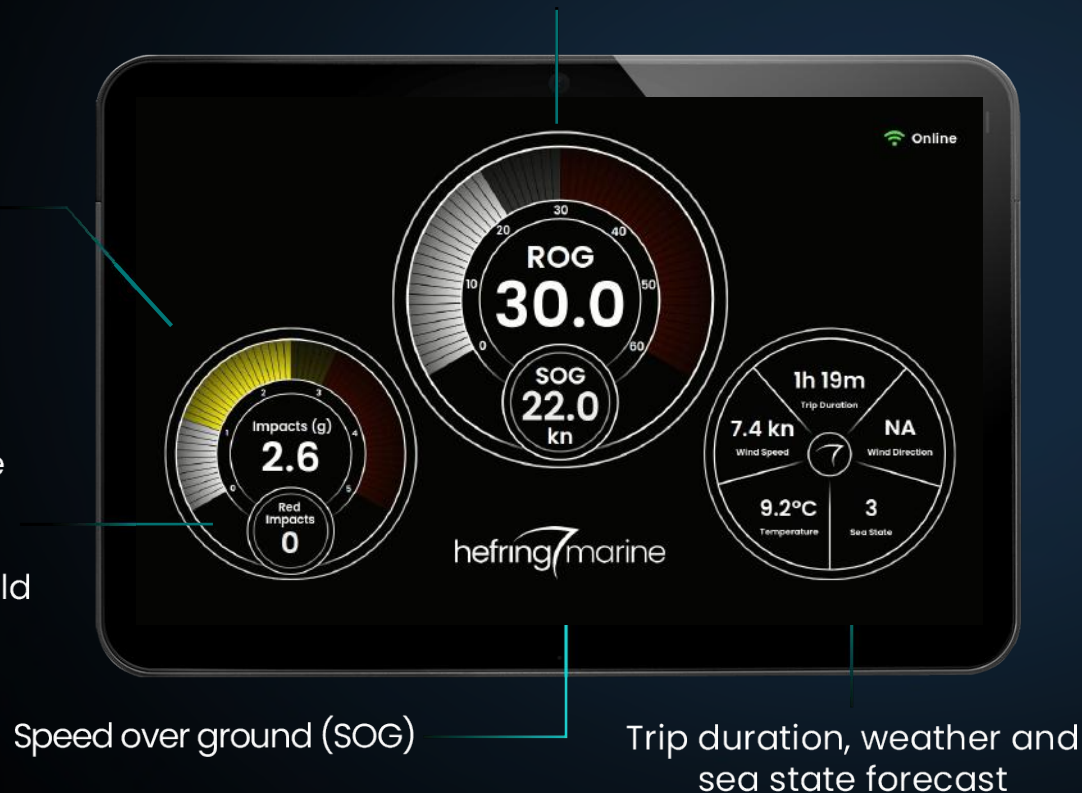
- | Sensors monitoring boat motions
- | ROG ensuring safe operating speeds
- | Speed & impact on operator display
- | Motion, speed & location to cloud
- | Tracking, reporting and analysis



RedSpeed over ground (ROG)
a speed limit generated in real time
showing the safe speed to drive at based
on conditions and vessel movements.

Real-time
wave impact
g-forces

Number of wave
impact forces
recorded above
a safety threshold



Guidance on board

Impacts

- | G-force impacts visualized
- | Impact safety thresholds
- | Impact counter
- | WBV- to be included

Speed

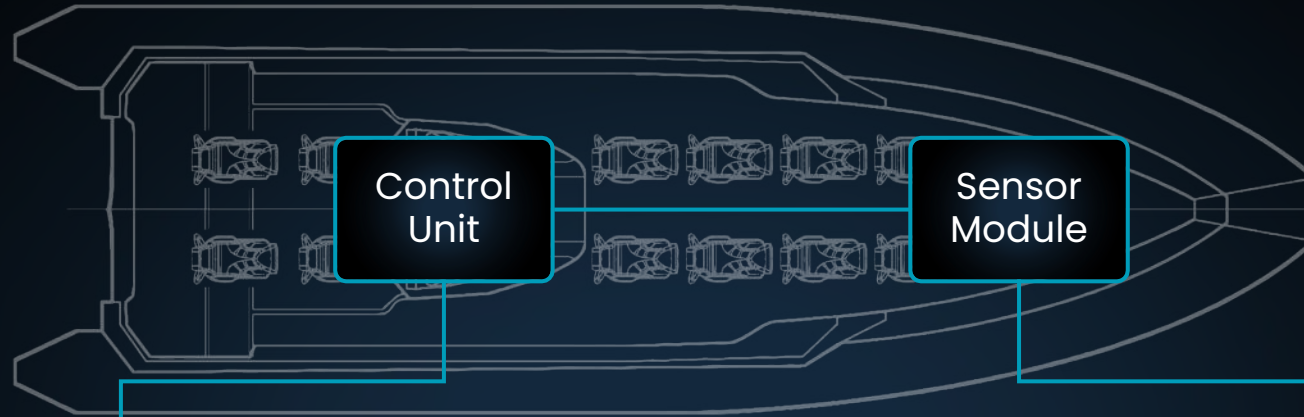
- | Safety speed centre gauge
- | Motions, speed, and impacts

Weather

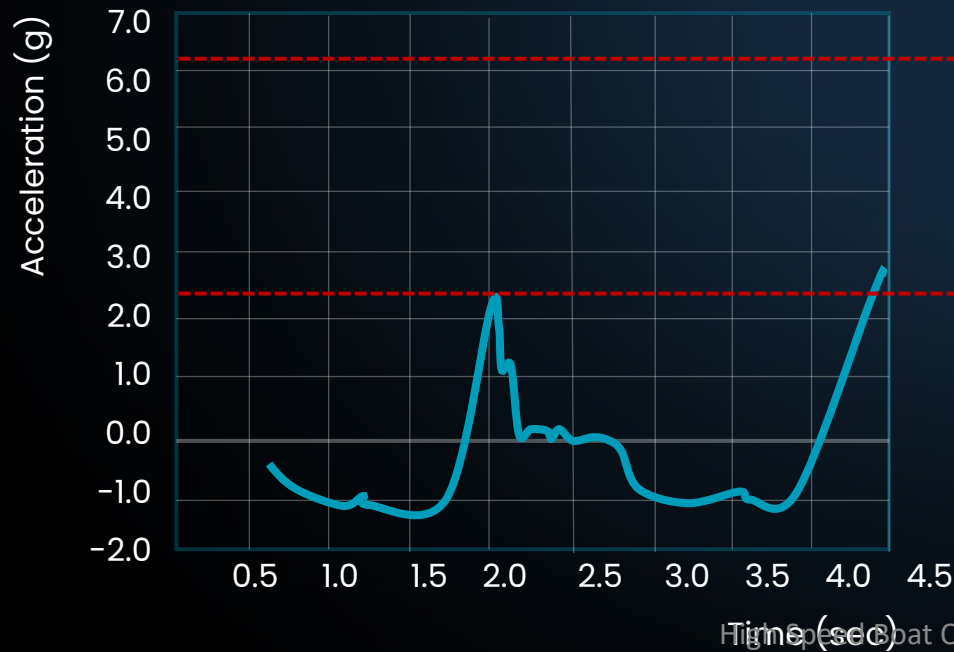
- | Trip duration
- | Wind direction, wind speed, sea state and temperature

Safe Operation

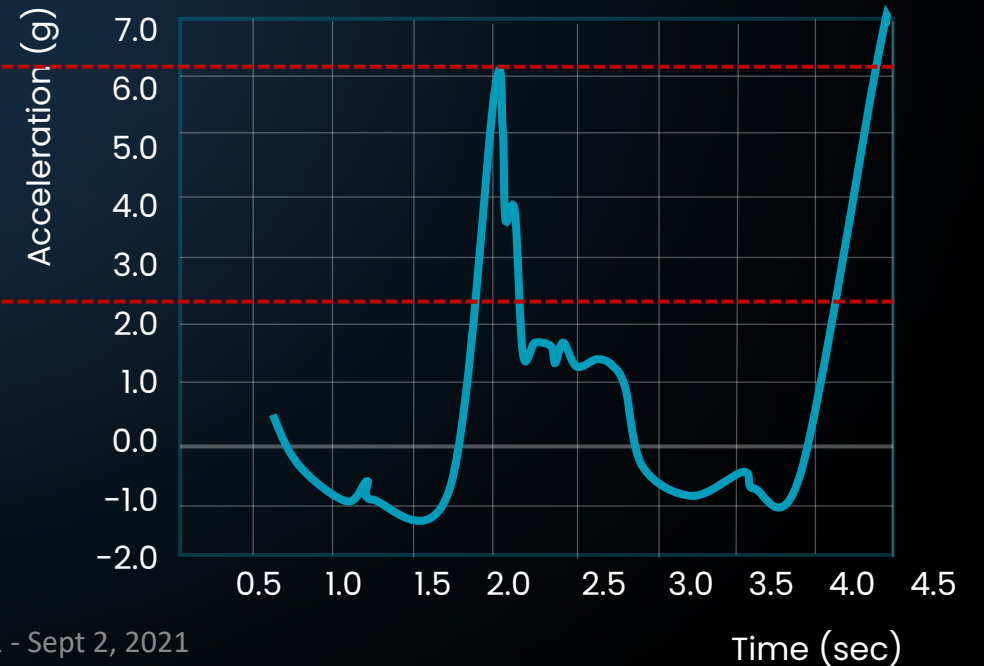
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Rear sensor



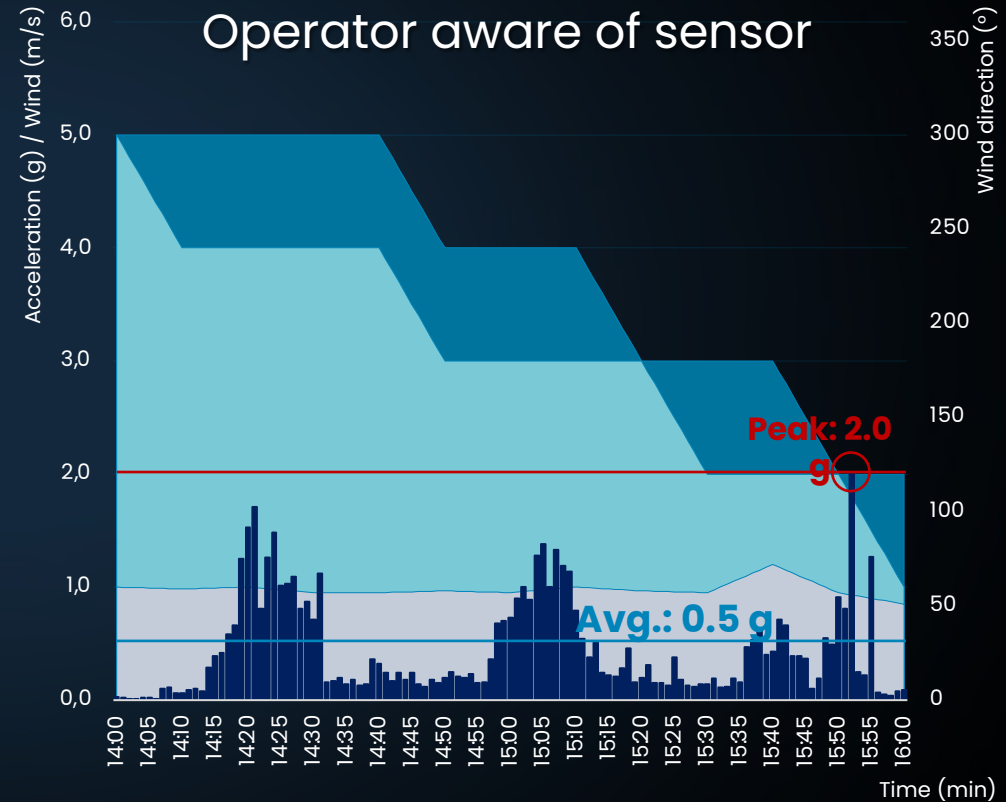
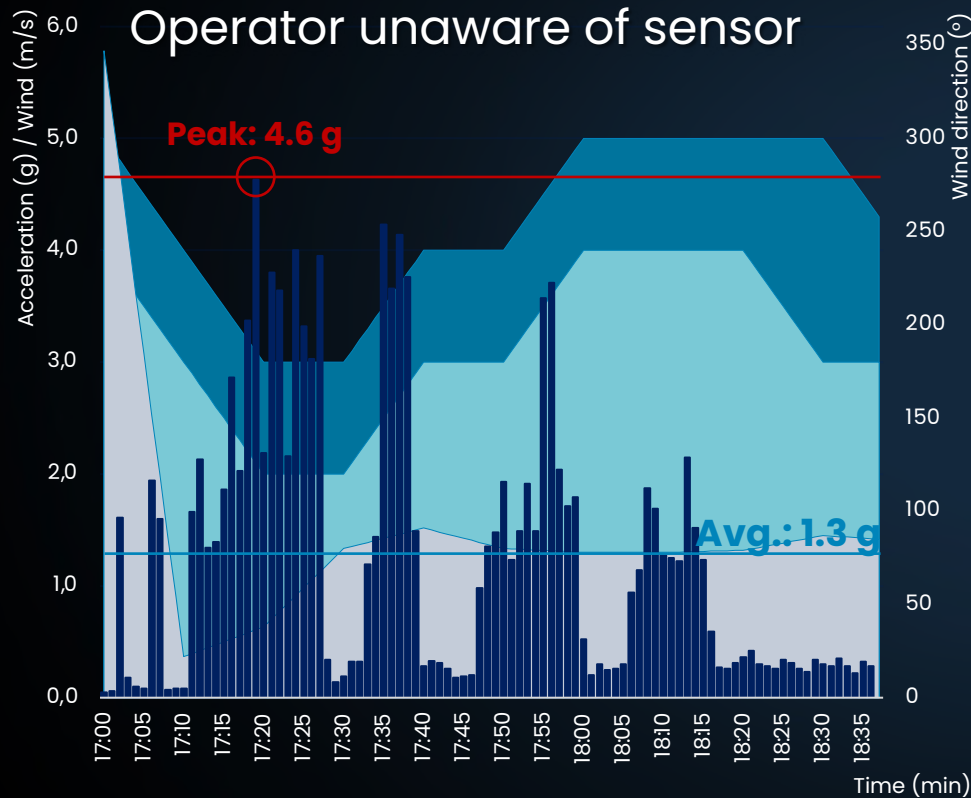
Front sensor



Safe Operation

Operator controls

- | Speed (Throttle position)
- | Heading (Steering wheel position)



Impact and motion reductions of 60-70%

High Speed Boat Operation Forum Aug 31 - Sept 2, 2021

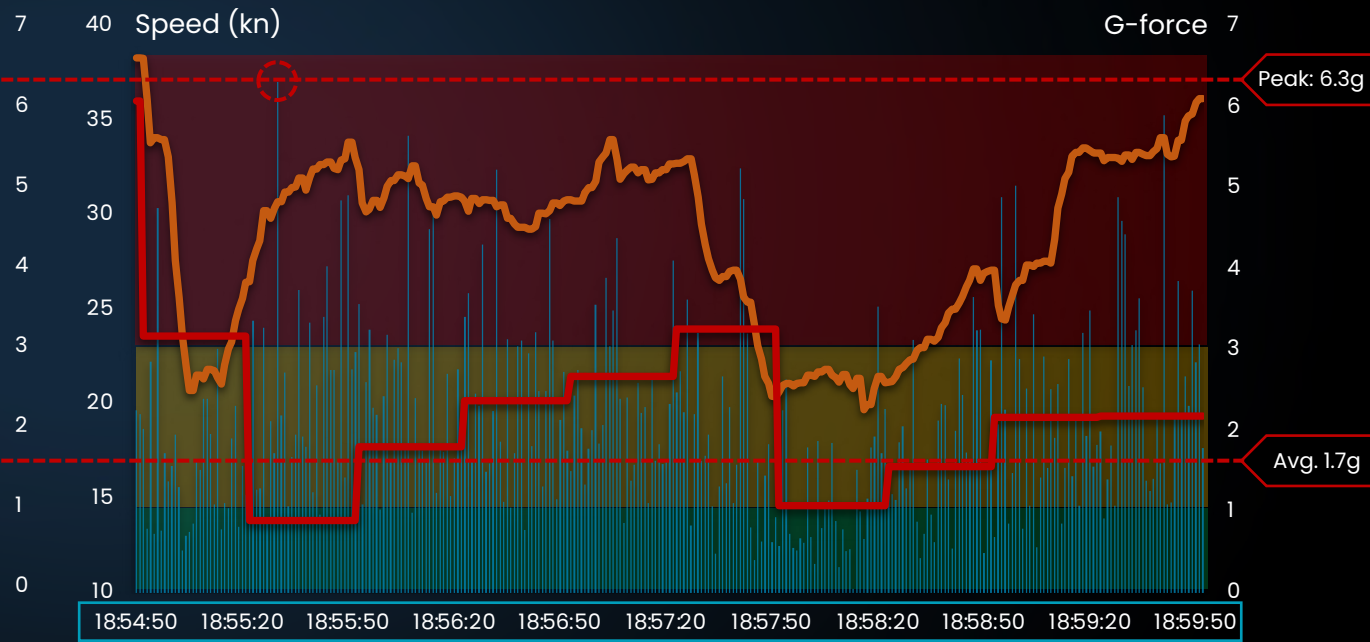
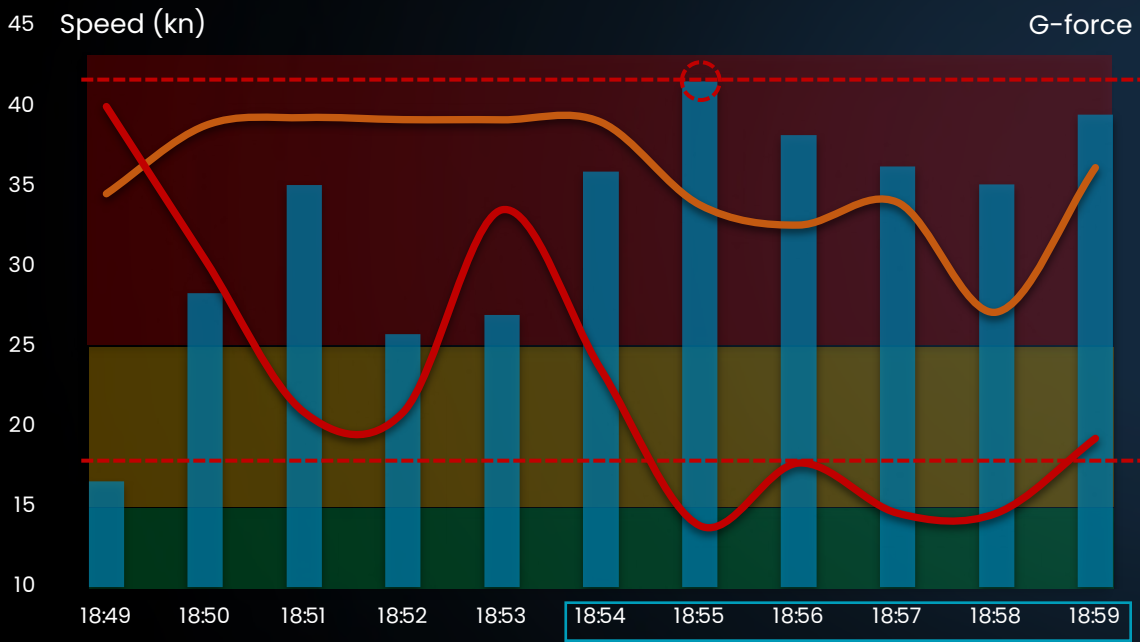
The Icelandic Transportation Safety Board has used research from Hefring Marine in accident reports to show cause of accidents



Safe Operation

- | Impact measurement
- | System frequencies
- | ROG response analysis

Impacts (g)		SOG (kn)		ROG (kn)		Layers
<1g	17%	1-3g	64%	>3g	19%	G-force



10 minutes

Impacts above 3g trigger ROG response
 ROG tracking impacts well
 SOG at higher speed but similar reactions

5 minutes

ROG mimicking operator behaviour
 Operator speed up too fast, leading to 6.3g impact
 ROG would have suggested slower rise in speed



Route Guidance

Optimize safety
and speed
from weather



Heading

Heading from
safest and
quickest route



Fuel efficiency

Speed and heading
for optimal
consumption



Artificial Intelligence

Remote and
autonomous
decision support



Larger vessels

Speed, heading and
route for efficiency
and safety

Summary

The operator, captain is responsible for the safety onboard the vessel, situational awareness is the key to safe operation

Thank you.

Question's