

# NOISE CONTROL FOR SHIPS AND OFF-SHORE INSTALLATIONS



**TNO** innovation  
for life

Ship propulsion, machinery in ships and off-shore installations, off-shore construction activities all produce unnecessary sound as an incidental by-product. The noise levels generated in air and underwater may be excessive in terms of crew and passenger safety or comfort. The noise may injure or disturb marine life in the environment. It may affect the functioning of sonar devices and increase the vulnerability of ships to mines and torpedoes.

With over five decades of R&D and consultancy services to navies and commercial shipbuilding industries, the Acoustics Department of TNO Science and Industry in Delft can claim to have substantial experience in the field of shipboard and underwater acoustics. We have a wide range of knowledge and analytical, experimental and computational tools at our disposal and we make use of traditional passive technologies as well as innovative active technologies to control noise sources.

#### OUR ACTIVITIES

- Contract research
- Consultancy
- Engineering and design
- Modelling and numerical simulations
- Development of technology demonstrators (passive and/or active measures)
- Measurements and testing
- Data analysis and impact assessment
- Instrumentation development
- Training, courses and standardisation

## INCREASED SHIPPING AND OFF-SHORE ACTIVITIES HAVE A DIRECT IMPACT ON ENVIRONMENTAL NOISE



Bron: Koninklijke Marine

### EXPERIMENTAL METHODS

- Multi-channel onboard and underwater noise measurements (microphones, accelerometers, hydrophones)
- Measurement of the acoustic mobility of machinery foundation structures
- Experimental modal analysis
- Diagnostic methods like intensity measurements, transfer path analysis, Near-field Acoustic Holography (NAH)
- Structure-borne, air-borne and fluid-borne sound source characterization
- Reciprocal measurement techniques
- Scale model measurements
- Underwater acoustic measurements in the semi-anechoic water tank of TNO in The Hague

### NUMERICAL AND ANALYTICAL MODELLING TECHNIQUES

- Finite Element Method (FEM)
- Boundary Element Method (BEM)
- Statistical Energy Analysis (SEA)
- BATSOF: software to calculate the mobility of ship foundation and bottom structures
- EQUIP+: a graphical environment to model and visualize sound paths in complex machines
- CABIN/AMRUS: software to estimate onboard and underwater sound levels of ships in the design stage
- PRESTO: software to calculate vibrations and pulsations in fluid-filled pipe systems
- EXHAUST: computer code for design and calculation of radiated exhaust noise levels

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### TNO

TNO is an independent innovation organisation. TNO connects people and knowledge to create innovations that sustainably boost the competitive strength of industry and the welfare of society.

TNO focuses its efforts on seven themes including Defence, Safety and Security: TNO works on a safe and secure society by creating innovations for people working in defence organisations, the police, emergency services and industry.

### CONTACT

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