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Complaint: Norway violates the Water Framework Directive "Mercury wreck" U-864

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1.0. Background

The Green Warriors of Norway (NMF) submitted comprehensive and thorough complaints to the EFTA Surveillance Authority (ESA) in May 2019 and April 2020. The complaints dealt with the mining industry's practice of dumping mining waste into so-called **"seafill"**. Landfill management cannot be transferred directly to seafill, this means that the Regulations and Directives for land-based operations cannot be applied to a so-called seafill. Landfill is, among other things, strictly regulated by Directives 2000/60/EC, 1999/31/EC, 2006/21/EC, 2008/98/EC, 2006/118/EC and 2010/75/EC.

According to NMF, seafill is mainly regulated by 2000/60/EC.

It should be clear enough that 2000/60/EC became statutory for Norway, and that this should be part of national Norwegian law, which happened (finally) 14th December 2018. Without elaborating further. The Norwegian Water Regulation must "correspond" to 2000/60/EC, i.e. must promote the same objectives and motives as provided for in the EEA Agreement.

Seafill is practically impossible to handle properly. No one can guarantee that the state of the aquatic environment goes from "good" to "bad". Life in the sea is very complex. Thus, great uncertainty and knowledge gaps are associated with seafill. Experience from the 1970s mining operations in the Repparfjord indicates that the seabed is partly lifeless over 40 years after the test period. NMF also refers to landfill that contaminates the aquatic environment to this day (Raudsand and Folldal).

Imagine conditions such as stream, temperatures, salinity, seabed terrain in narrow fjords, salmon migration routes, local sea trout needs, coastal cod spawning grounds, shrimp fields, benthos, shellfish, the livelihood of traditional fishing with its fishing loop.

The ocean is our common food dish, a food dish that is our heritage and which is a long-term basis of living.

2.0. This complaint

This complaint is first and foremost focused on the illegal storage of mercury in a so-called **"seafill",** and then other influences are discussed that reinforce an absolute requirement to raise/salvage U-864 and remove contamination from the sediments. Covering is illegal.

"Mercury wreck" U-864 is a German WWII rebuilt type IXD2 submarine, containing approximately 62 tonnes of mercury, and where approximately 5 tonnes mercury is spread around the sediments over large areas. **This represents a ticking environmental threat.**

U-864 is located on the seabed, right next to the coastal community of Fedje with associated vulnerable coast, waterways and rivers. U-864 has been there for 75 years, since 9th February 1945. Since U-864 was located in 2003, the Norwegian Government has been responsible for not removing the mercury from the aquatic environment.

There is some uncertainty about the state of the containers in which the mercury is stored. The containers are initially very robust (5 mm thickness in specially treated forged and welded steel containers), but some containers have probably reduced the thickness due to "wear and tear" and damage. Some containers have been reduced to 1 mm in thickness. Some containers are located on the seabed and are in very poor condition and contribute to continuous pollution.

The Norwegian Government has spent far too much time. Already in 2003, NMF stated that the mercury had to be brought up to the surface together with the wreckage. Seafill of this format is not legal.

2.1. The Norwegian Government timeline

Timeline	Decisions
February 2003	The Navy's HNoMS Tyr locates the wreck of the U-864.
Autumn 2003	The Norwegian Coastal Administration and HNoMS Tyr are conducting investigations. Mercury at U-864 is detected.
2004	Annual sampling of fish and crab is initiated in the area around the wreck.
Autumn 2005	The Food Safety Authority introduces "precautionary" dietary advice that nursing, pregnant and young children should not eat seafood caught by the wreck.
Autumn 2005	On behalf of the Ministry of Fisheries and Coastal Affairs, the Norwegian Coastal Administration is conducting investigations into the wreckage. The surveys confirmed that the submarine had mercury, but they did not provide the necessary basis for a scientifically sound recommendation on how the hazard should be handled.
January 2006	The Norwegian Coastal Administration recommends further investigations.
Autumn 2006	The Norwegian Coastal Administration is conducting further investigations of the wreck and the area around the wreck. The

	condition of the mercury containers in the wreckage section of the wreckage was not confirmed because the wreckage shifted during the dredging work and there was too much risk to continue the dredging work.
September 2006	Regulations on traffic and fishing bans at the wreck of U-864 come into force.
December 2006	The Norwegian Coastal Administration recommends that the wreckage and contaminated sediments around the wreckage be covered. The recommendation is made on the basis of surveys and assessments carried out over the past three years.
February 2007	The Minister of Fisheries and Coastal Affairs decides that the wreckage and contaminated sediments should be covered.
Spring 2007	The Parliament is conducting open hearings on the handling of the wreck of U-864. On the basis of statements from salvage companies about the possibility of raising the wreck, the Minister of Fisheries and Coastal Affairs decides to investigate further the alternative.
Summer 2007- Autumn 2008	The Norwegian Coastal Administration carries out a broad process that involves both; 1) competition for the development of new innovative solutions for lifting; 2) competition between pre-qualified salvage companies for specific proposals for lifting and 3) Det Norske Veritas (DNV) undertakes an independent assessment of the options for handling of the pollution from the wreck with regard to human and environmental risk.
10th November 2008	The Norwegian Coastal Administration submits a final report on environmental measures for the wreck U-864 to the Ministry of Fisheries and Coastal Affairs. The Norwegian Coastal Administration's report and additional reports on U-864 can be found on the Norwegian Coastal Administration's collection page on U-864.
3rd December 2008	Minister of Fisheries and Coastal Affairs, Helga Pedersen, visits Fedje to talk to the citizens about U-864. Press release from the Ministry of Fisheries and Coastal Affairs.
29th January 2009	The Government of Stoltenberg II agreed that the wreck should be raised and the polluted seabed covered with pure masses. At the same time, it was decided to carry out an independent, external quality assurance of the existing cancellation alternative. Press release from the Ministry of Fisheries and Coastal Affairs.
16th December 2009	The Dovre Group and the Department of Transport Economics present and deliver Quality Assurance of management documentation and cost estimates for the selected project alternative (KS2) to the Minister of Fisheries and Coastal Affairs Lisbeth Berg-Hansen. The report from Dovre and the Institute of Transport Economics.
5th March 2010	The Government of Stoltenberg II presents Prop. 81 S (2009-2010) with a proposal that the submarine wreck should be investigated more thoroughly, and to ensure that, after the investigation, there is a reasonable alternative, it is also proposed

	to investigate cover and alternative combining lifting and cover. in this work Press release from the Ministry of Fisheries and Coastal Affairs.
14th January 2011	The Ministry of Fisheries and Coastal Affairs receives the Norwegian Coastal Administration's report on the various alternatives for environmental measures at U-864 (concept selection study - KVU).
18th Mai 2011	The Government Stoltenberg II informs in Prop. 120 S (2010-2011) Additional appropriations and re-prioritization in the state budget 2011 that the Norwegian Coastal Administration, on the basis of assessments from external quality assurance, has been given additional assignments to also consider alternatives that include dredging of contaminated masses.
22nd October 2011	The Ministry of Fisheries and Coastal Affairs receives the Coastal Authority's additional investigation of alternatives that include dredging of contaminated sediments.
25th January 2012	The Ministry of Fisheries and Coastal Affairs receives a report on external quality assurance (KS1) of the Norwegian Coastal Administration's investigation of the various alternatives for environmental measures at U-864 (KVU). The report has been prepared by Metier AS and Møreforsking Molde AS. KS1 report on the handling of U-864.
2nd Mai 2012	Minister for Fisheries and Coastal Affairs Lisbeth Berg-Hansen holds two open consultation meetings, one in Bergen and one in Fedje. Regional and local authorities, as well as the local action group at Fedje, were invited specifically to submit their assessments of the case. From a regional and local point of view, concern was expressed regarding the safety of a cover in a long-term perspective.
15th Mai 2012	The Government Stoltenberg II informs in Prop. 111 S (2011-2012) Additional appropriations and re-prioritization in the state budget 2012 that it will proceed with a preliminary project of two of the six environmental measures alternatives that were investigated in the Norwegian Coastal Administration's draft election survey from 2011. This is the alternative with covering the wreck with cargo and contaminated seabed and the alternative that includes raising cargo and covering the contaminated seabed.
January 2013	As part of the preliminary design of two alternative environmental measures for U-864, the Norwegian Coastal Administration is conducting the first phase of a new detailed mapping of the wreck and the seabed. The purpose is to get updated information on the pollution situation around the wreck and a new visual inspection of the wreck. The data will be used in the further work on the preliminary design of the two alternative environmental measures; a) Covering wrecks and seabed and; b) Raising cargo with subsequent coverings of wreckage and seabed.
March 2013	The coastal plant empties the wreckage for diesel fuel. All diesel tanks were checked and 3 tanks that were intact were emptied.

	About 1,000 litres of pure oil was removed from the submarine wrecks.
January 2014	The Norwegian Coastal Administration is conducting the second phase of the preliminary project for the investigation of wrecks and seabed (first phase completed in January 2013). Among other things, a goal was to investigate the condition of mercury containers in the keel of the wreck's rear section. After extensive dredging work, two rooms were accessed in the keel, but they did not contain mercury containers. One room contained ordinary ballast and the other was empty. Due to the stability of the wreckage, it was not possible to dredge access to a larger part of the keel. Six heavily corroded containers were found in the sediments outside the wreckage, and these were empty. The Norwegian Coastal Administration considers that the surveys provided important data and experience for the further work on the preliminary design of the two alternative methods for environmental measures against mercury pollution.
20th Mai 2014	The Ministry of Transport receives the Norwegian Coastal Administration's preliminary projects for two alternative methods for environmental measures against mercury contamination at U-864: a) lifting of cargo and covering of contaminated seabed and b) covering of wreckage with cargo and contaminated seabed, and recommendation for further handling.
8th October 2014	The Government proposes in Proposition 1 S (2014-2015) for the Ministry of Transport and Communications to allocate NOK 150 million to establish a support filling to secure the unstable slope under the wreck's bow section. This is in accordance with the Swedish Coastal Administration's preliminary projects and recommendation from May 2014, the measure that must be established first, regardless of the choice made when it comes to further handling of the submarine wreckage and cargo.
16th June 2015	The Food Inspectorate repeals the “precautionary” dietary advice from 2005 that pregnant, breastfeeding and young children should not eat seafood from the area by the wreck.
7th October 2015	The Government informs in Proposition 1 S (2015-2016) for the Ministry of Transport and Communications about work in 2015 on the detailed design of and tender process for the support filling to ensure the unstable slope under the wreck section, and that the establishment is planned in spring 2016. A grant is proposed for further work with environmental measures.
15th Mai 2018	The Government of Solberg informs in Prop. 87 S (2017-2018) the status of the work on environmental measures. It is advised that the support filling established in 2016 to ensure the exposed slope under the wreck section of the wreck was established without the spread of significant contamination and that the filling has now settled and stabilized the slope as calculated. It is further informed that the Government will return to the Parliament in a suitable manner regarding environmental measures.

27th June 2018	Transport Minister Ketil Solvik-Olsen attends the Norwegian Coastal Administration's information meeting at Fedje on environmental measures for U-864.
8th October 2018	The Government proposes in the state budget for 2019 to allocate funds to work on establishing cover as an environmental measure for U-864. The Ministry of Transport sends out a press release that "The submarine wreck U-864 at Fedje is covered to prevent future mercury pollution."
December 2018	In Settings 13 S (2018-2019), the Transport and Communications Committee asked the government to consider whether new information or technology has been added that indicates that all or part of the cargo is environmentally sound before the work on cover is implemented.
March 2019	The Norwegian Coastal Administration obtained an external assessment of this, and the assignment was given to Rambøll. Rambøll presented the following assessments in his report: • Coverage is well justified. Some technical solutions must be prepared before a final assessment of the project can be made. • There is no new information indicating a change in the environmental risk assessment made in 2014 in relation to mercury chemistry. • No new information has been provided on actual methods of raising, but the following factors may change the risk assessments that have been used: • Opportunities for using existing technology related to dredging that are not included in previous assessments and which can reduce environmental risk. • Mapping and monitoring methods that can identify containers and mercury in the seabed. Raising technical solutions that can be considered more closely to reduce the need for dredging prior to raising, and thus may result in less spread of contamination than previously proposed methods of raising.
August 2019	In order to obtain a definitive explanation of the instances where there may be uncertainty, the Norwegian Coastal Administration was commissioned to follow up the points where the report points to possible weaknesses. The Norwegian Coastal Administration will deliver its assessment on 1st November 2019.

So far, NOK 10 million has been spent on planning the wreckage and seabed coverage. NMF is determined that the decision is wrong and illegal. The mercury must be brought up to the surface and treated as hazardous waste. It is also perfectly possible to clean the seabed of mercury debris, ammunition and other scrap.

Mercury is a very toxic substance which represents a global and major threat to human health, including in the form of methylmercury in fish and seafood resources, ecosystems and wildlife, for that reason, 2017/852/EC is very central and important in this complaint.
The Regulation 2017/852/EC replaces and repeals Regulation (EC) No 1102/2008.

2017/852/EC implements the obligations of the EU/EEA countries through the Minamata Mercury Convention, which is a global environmental convention aimed at protecting health

and the environment against mercury emissions. The provisions of the Convention also regulate the entire life cycle of the use and handling of mercury.

In this complaint, NMF discusses a selection of EU documentation that is listed. NMF does not exclude associated regulations and directives that can be applied.

Selected documentation:

- 2000/60/EC.
- 1907/2006/EC Regulation. Concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH). Special emphasis on "end-of-waste" status.
- 2017/852. Regulation on mercury, and repealing Regulation (EC) No 1102/2008
- 1999/31/EC Landfill of waste.
- 2008/98/EC Waste.
- 1357/2014/EU Annex III to Directive 2008/98/EC.
- 2000/532/EC Establishing a list of wastes accordingly.
- Candidate List of Substances of Very High Concern for Authorization (SVHCs).
- 2017/997/EU HP 14 Ecotoxic.
- 92/3/Euratom replaced by 2006/117/Euratom on the supervision and control of shipments of radioactive waste and spent fuel.
- OSPAR convention.

NMF has received academic support from:

- Norwegian professor of marine and fisheries law.
- Retired Norwegian technical submarine officer with very long operational experience.

2.2. Fair and impartial justice

NMF remind:

AGREEMENT BETWEEN THE EFTA STATES ON THE ESTABLISHMENT OF A SURVEILLANCE AUTHORITY AND A COURT OF JUSTICE

Article 8:

> *"The members of the EFTA Surveillance Authority shall be completely independent in the performance of their duties. They shall neither seek nor take instructions from any Government or other body. They shall refrain from any action incompatible with their duties. Each EFTA State undertakes to respect this principle and not to seek to influence the members of the EFTA Surveillance Authority in the performance of their tasks."*

Article 20:

> *"(7) Individuals and economic operators shall be entitled to address and be addressed by the EFTA Surveillance Authority in any official language of the EFTA States and the European Communities as regards notifications, applications and complaints. This shall also cover all instances of a proceeding, whether it be opened on notification, application or complaint or ex officio by the EFTA Surveillance Authority."*
> *Cf. Article 37, third paragraph:*
> *"Any natural or legal person may, under the conditions laid down in the preceding paragraphs, complain to the EFTA Court that the EFTA Surveillance Authority has failed to address to that person any decision."*

3.0. 2000/60/EC

Norway is obliged to comply with 2000/60/EC through the EEA-Agreement and the Nature Diversity Act Section 26a:

Act on the implementation of Norwegian law by the main part of the agreement on the European Economic Area (EEA), etc. (EEA law) Chapter 3. Environment:

Art 73. 1. The activities of the Contracting Parties in the environmental field shall be:

a) to preserve, protect and improve the quality of the environment;

b) contributing to the protection of human health;

c) ensure a prudent and sensible utilization of natural resources.

Source: https://www.efta.int/media/documents/legal-texts/eea/the-eeaagreement/Main%20Text%20of%20the%20Agreement/EEAagreement.pdf

Nature Diversity Act Section 26a:

> *"The King may determine the rules necessary for the implementation of Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy in Norwegian legislation."*

Source: https://lovdata.no/lov/2009-06-19-100/§26a

2000/60/EC is not to be misunderstood, as demonstrated by these wise words:

1. 2000/60/EC is based first and foremost on a **one-way clause, namely "reduction", "cessation", "phasing out", "avoiding deterioration"**.
2. Principle of **"polluter pays"**.
3. Principle of **source control**.
4. Principle that surface water should not have a worse environmental condition than **"good"**.

The 2000/60/EC - when adopted nationally - sets the line in that all **degradation and aggravation** that have been found up to and including year 2000 **should gradually cease**.

This means that measures that are initiated hereafter and which directly or indirectly infuse the coastal water **shall only improve** the aquatic environment. Emissions in progress shall cease or be phased out. **Work, conditions or measures that aggravate the aquatic environment should not be able to continue, much less be initiated.**

The choice of direction is clear throughout 2000/60/EC Article 1 (bold and italics text added):

The purpose of this directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which:

> *a) **prevents further deterioration** and protects and enhances the status of aquatic ecosystems.*
>
> *c) aims at **enhanced protection and improvement of the aquatic environment**, inter alia, through specific measures for the **progressive reduction of discharges**, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances.*

Treaty on the Functioning of the European Union (TFEU) Article 191 (ex 174);

Union policy on the environment shall contribute to pursuit of the following objectives:

- **preserving, protecting and improving the quality of the environment.**

3.1. 2000/60/EC Articles 4(6), 4(7) and 4(8)

It should be pointed out that the 2000/60/EC is in accordance with the principle of sustainable development where **"the needs of the present generation must be met without compromising the ability of future generations to meet their own needs"**.

That is a fundamental objective of the European Union (EU), laid down in the Treaty and applicable to all EU activities and policies. Interpretation of the 2000/60/EC, which must comply with the fundamental right to environmental protection, therefore requires an analysis at several levels, having regard to the **directive's ultimate objective of protecting water as a shared asset, which takes the form of maintaining, improving and prohibiting the deterioration of the aquatic environment in the EU**.

New modifications or new sustainable human development activities, potentially causing deterioration, are frequently linked with the fulfilment of the objectives of other policies such as energy, transport, flood protection, coastal protection, water supply and irrigation, etc.

"Water costs" (negative benefits) must balance with the potential benefits and other costs (increased use of other natural resources, including global impacts) of the new interventions and changes for human health, for the maintenance of human safety or for sustainable development. Thus, other categories of potential benefits and costs must be considered and, if possible, calculated.

An analysis of the utility and cost of the project, adapted to the requirements of the directive, is necessary to enable it to assess whether the benefit to the environment and society of preventing deterioration of condition, or of restoring a water body to good condition, is offset by the benefits of the new interventions or changes for human health, maintaining human security or for sustainable development. In case of deterioration of condition, utility and opportunities lost as a result of deterioration of condition (e.g. loss of biodiversity).
A separate control form has been developed to assess whether a project can be realized within the framework of 2000/60/EC article 4(7).

NMF notes that the wording of WFD Article 4(7) makes it clear that "mitigation measures" do not refer to all possible measures being taken. The appropriateness of specific mitigation measures will depend on the adverse ecological effects of the physical modifications in question; on the effectiveness of the measures regarding, in particular, the improvements of the ecological condition and on the technical feasibility and the cost-effective analysis of implementing the measures at the site.

NMF notes that the "Court of Justice of the European Union" (CJEU) has held that a State is required to refuse authorization for a project where it is such as to result in deterioration of the status of the body of water concerned or to jeopardize the attainment of good surface water status, unless the view is taken that the project is covered by a derogation under Article 4(7) of the WFD.

Article 4(8): When applying paragraphs 3, 4, 5 ,6 and 7, a Member State shall ensure that the application does not permanently exclude or compromise the achievement of the objectives of this Directive in other bodies of water within the same river basin district and is consistent with the implementation of other Community environmental legislation.

NMF comment:

2000/60/EC Article 4(7) cannot be used for the following reasons, but not limited by:

- Seafill leads to a deterioration of the status of the current aquatic environment and the likelihood of putting good surface water status at risk is very high.
- 2000/60/EC Article 4(8) has an effect as the adjacent aquatic environment such as rivers and watercourses are directly or indirectly affected in a negative way (i.e. other bodies of water) within the same river basin district.
- Store organic and inorganic waste (tonnes of mercury) into a so-called seafill is considered permanent pollution, because it is not possible to remove the waste again (after-care).
- No one can guarantee that the aquatic condition will not be worse than "good".
- No one can guarantee lasting changes to the unacceptable, the interventions are very large and the risk of permanent irreversible damage is great.
- Letting time heal all wounds is expired and old-fashioned vision.
- "Water costs" (negative benefits) are not in balance with the potential benefits and other costs (increased use of other natural resources, including global impacts) of the new interventions and changes for human health, for the maintenance of human safety or for sustainable development.

4.0. OSPAR

OSPAR started in 1972 with the Oslo Convention against dumping and was broadened to cover land-based sources of marine pollution and the offshore industry by the Paris Convention of 1974. These two conventions were unified, up-dated and extended by the 1992 OSPAR Convention. The new annex on biodiversity and ecosystems was adopted in 1998 to cover non-polluting human activities that can adversely affect the sea. The fifteen Governments are Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

OSPAR is so named because of the original Oslo and Paris Conventions ("OS" for Oslo and "PAR" for Paris). The OSPAR Convention is a legally binding agreement regulating international cooperation on the protection of the marine environment in the Northeast Atlantic. **Norway is actively contributing to international cooperation to monitor and improve the environmental situation in our immediate areas.** OSPAR is the mechanism by which 15 Governments & the EU cooperate to protect the marine environment of the North-East Atlantic.

The OSPAR Commission works under the umbrella of customary international law as codified by the 1982 United Nations Convention on the Law of the Seas (UNCLOS), especially in Part XII and Article 197 on the global and regional cooperation for the protection and preservation of the marine environment.

4.1. Precautionary principle

By virtue of the precautionary principle, preventive measures are to be taken when there are reasonable grounds for concern that human activities may bring about hazards to human health, harm living resources and marine ecosystems, damage amenities or interfere with other legitimate uses of the sea, even when there is no conclusive evidence of a causal relationship. A lack of full scientific evidence must not postpone action to protect the marine environment. The principle anticipates that delaying action would in the longer term prove more costly to society and nature and would compromise the needs of future generations.

4.2. The polluter pays principle

The polluter pays principle is one of the central guiding principles of the OSPAR Convention and requires that the costs of pollution prevention, control and reduction measures must be borne by the polluter.

The polluter pays principle is mainly implemented by means of command-and-control approaches but can also be applied via market-based mechanisms, e.g. for the development and introduction of environmentally sound technologies and products.

4.3. BAT and BEP

The OSPAR Convention requires Contracting Parties to apply Best Available Techniques (BAT) and Best Environmental Practice (BEP) including, where appropriate, clean technology, in their efforts to prevent and eliminate marine pollution. OSPAR has pioneered this concept internationally and adopted a large number of Recommendations and Decisions on BAT and BEP for various industrial technologies and sources of land-based pollution.

As defined in Appendix 1 of the OSPAR Convention BAT "means the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste". BEP is defined as "the application of the most appropriate combination of environmental control measures and strategies". It follows that BAT and BEP for a particular source will change with time in the light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.

NMF comment:

NMF agrees. The OSPAR assessments are valuable considering the U-864's future destiny.

5.0. 2017/852 Regulation on Mercury

Preface:

(1) Mercury is a very toxic substance which represents a global and major threat to human health, including in the form of methylmercury in fish and seafood resources, ecosystems and wildlife. Due to the transboundary nature of mercury pollution, between 40 % and 80 % of total mercury deposition in the Union originates from outside the Union. Action is therefore warranted at local, regional, national and international levels.

(3) The Seventh Environment Action Program adopted by Decision No 1386/2013/EU of the European Parliament and of the Council (3) establishes the long-term objective of a non-toxic environment and, for that purpose, stipulates that action is needed to ensure the minimisation of significant adverse effects of chemicals on human health and the environment by 2020.

(7) The Union and 26 Member States have signed the Minamata Convention on Mercury of 2013 ('the Convention'). The two Member States that did not sign the Convention, Estonia and Portugal, have expressed their commitment to ratify it. The Union and all its Member States are therefore committed to its conclusion, transposition and implementation.

(25) Given that Mercury is an extremely hazardous substance in its liquid form, the permanent storage without pre- treatment of mercury waste should be prohibited

owing to the risks that such disposal poses. Therefore, mercury waste should undergo appropriate conversion, and if applicable, solidification operations prior to permanent storage. For that purpose and in order to reduce the associated risks, Member States should take into account the technical guidelines on mercury of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

Article 18

Report

1. By 1 January 2020 and at appropriate intervals thereafter, Member States shall prepare, provide to the Commission and make publicly available on the internet a report with the following:

(i) a list of sites where stocks of more than 50 metric tonnes of mercury other than mercury waste are located as well as the amount of mercury at each site;

(ii) (a list of sites where more than 50 metric tonnes of mercury waste is accumulated as well as the amount of mercury waste at each site; and

(e) a list of sources supplying more than 10 metric tonnes of mercury per year, where Member States are made aware of such sources.

Member States may decide not to make any of the information referred to in the first subparagraph publicly available on any of the grounds mentioned in Article 4(1) and (2) of Directive 2003/4/EC of the European Parliament and of the Council (1), subject to the second subparagraph of Article 4(2) of that Directive.

NMF comment:

NMF doubts whether the Norwegian authorities have reported the U-864 mercury.

5.1. Mercury in aquatic environment

In the aquatic environment, mercury occurs in many forms which depend on the oxidation-reduction conditions. The forms $HgCl_4^{2-}$ and $HgOH^-$ dominate in the good oxidation conditions, whereas sulphur-related forms (HgS^{2-} and CH_3HgS^-) prevail in the reduction conditions. In the intermediate conditions, the alkyl forms of mercury, MeHgCl and EtHgCl, can most often be found. Soluble forms of mercury, such as $[HgOH]^+$, $[HgCl]^+$, $[HgCl_2]$, $[HgCl_3]^-$, $[HgCl]^{2-}$, and $[HgS_2]^{2-}$, can often be encountered. Higher concentrations of Cl^- ions, which form stable complexes with mercury, such as $HgCl_3^-$, $HgCl_2^-$, $HgCl_4^{2-}$, or $HgBrCl^-$, lead to increased dissolution of solid phases of mercury.

In the aquatic environment, mercury undergoes many different chemical and biochemical processes which condition its speciation and transport between the solid and aqueous phases. In the aquatic environment (water, sediments, aquatic fauna, and flora), most mercury occurs in organic and inorganic forms of divalent mercury and Hg (0), as a form of mercury dissolved in the aqueous phase. mercury adsorption and desorption processes in the aquatic environment play a dominating role in the distribution of different forms of mercury in the particular elements in the aquatic environment. In waters, these processes are also responsible for the course of mercury transport, transformation, and uptake by living organisms, and they also condition the toxicity of this element.

In the aquatic environment, mercury can be adsorbed on sediment particles, thus constituting a substantial mercury resource. In the sediments in water reservoirs, both as a result of chemical reactions and under the impact of biological factors, e.g., those related to the activity of microorganisms, methylmercury, $CH3Hg^+$, and dimethylmercury, $(CH_3)_2Hg$, emerge.

MeHg is the most common form of organic mercury in the environment. Methylmercury is a neurodevelopmental toxicant, and it is also the most toxic form of mercury. MeHg and dioxin-like compounds are considered as the most important toxic compounds in the case of large-scale consumers of seafood. Methylation is a result of abiotic and biotic processes, which are affected by such factors as pH, temperature, the presence of sulphates, and the availability of organic carbon.

The pollution caused by mercury is a serious threat for the marine environment. This is both a hygienic and ecotoxic problem. When this element occurs at levels exceeding its natural level in the seas and oceans, it poses a large threat for aquatic organisms. Methylation is a result of abiotic and biotic processes, which are affected by such factors as pH, temperature, the presence of sulfates, and the availability of organic carbon. The impact of mercury in the environment on human health was found for the first time in relation to the Minamata disease in the 1950s, which caused mass-scale poisoning by methylmercury.

It had accumulated in aquatic organisms which were subsequently eaten by humans. A similar case of poisoning by Mercury accumulated in fish also took place in Sweden. Apart from spectacular cases of poisoning, the presence of mercury in the environment also affects the human population in a more concealed manner. Humans are mainly exposed to methylmercury as a result of their consumption of oceanic fish.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5013138/

NMF comment:

Mercury is very strictly regulated; EU takes this very seriously. 67 tonnes of mercury attempted encapsulated in seafill at a depth of 150 meters is thus not a sustainable solution, and it is illegal.

6.0. Circular Economy

Directive (EU) of the European Parliament and of the Council 2018/850. European Parliament and Council Directive 2018/850 of 30 May 2018 amending Directive 1999/31/EC on the landfill of waste. The act was adopted on 30th May 2018, and is part of the follow-up to the EU's circular economy action plan of 2015. The work will contribute to conversion to a circular economy, where the value of products and materials is preserved for as long as possible, by using them for the longest time, possible, upgraded/repaired, and re-used products and materials. Through this, large positive effects on climate, environment and economy are achieved.

Changes in the European waste regulations will, among other things, contribute to better design of products, reduced waste volumes, reduced waste, increased reuse and material recycling, reduced landfill and a well-functioning internal market with fewer trade barriers. The acts are to ensure to a greater extent that all member states reach the obligations, implement the regulations and that reports are better and more comparable.

NMF comment:

Consumption, emissions, pollution, recycling, circular economy and sustainability are linked. The same applies to the strict criteria for ensuring that waste is handled in a way that does not expose human, animal, groundwater, surface water and the environment as a whole. Post-work and controlled closure are important factors, factors that cannot be followed up for U-864 seafill. Monitoring and inspections shall be carried out regularly in order to detect non-conformities.

Nor does this directive refer to seafill: Directive 2006/21/EC of the European Parliament and of the Council of 15th March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC.
NMF refers to how strictly landfill is regulated, what about seafill?

Figure: Circular economy

According to the waste management hierarchy, landfilling is the least preferable option and should be limited to the necessary minimum. Where waste needs to be landfilled, it must be sent to landfills which comply with the requirements of Directive 1999/31/EC on the landfill of waste. The objective of the Directive is to prevent or reduce as far as possible negative effects on the environment, in particular on surface water, groundwater, soil, air, and on human health from the landfilling of waste by introducing stringent technical requirements for waste and landfills.

This complaint can demonstrate a number of breaches of the directives. Seafill is virtually impossible to follow up and the negative effects are great. The landfill directive defines the different categories of waste (municipal waste, hazardous waste, non-hazardous waste and inert waste) and applies to all landfills, defined as waste disposal sites for the deposit of waste onto or into land. Landfills are divided into three classes:

- Landfills for hazardous waste;
- Landfills for non-hazardous waste;
- Landfills for inert waste.

The Directive 1999/31/EC does not apply to:

- The spreading on the soil of sludges (including sewage sludges and sludges resulting from dredging operations);
- The use in landfills of inert waste for redevelopment or restoration work;
- The deposit of unpolluted soil or of non-hazardous inert waste resulting from prospecting and extraction, treatment and storage of mineral resources as well as from the operation of quarries;
- The deposit of non-hazardous dredging sludges alongside small waterways from which they have been dredged and of non-hazardous sludges in surface water, including the bed and its subsoil.

A standard procedure for the acceptance of waste in a landfill is laid down so as to avoid any risks, including:

- Waste must be treated before being landfilled;
- Hazardous waste within the meaning of the directive must be assigned to a hazardous waste landfill;

- Landfills for non-hazardous waste must be used for municipal waste and for other non-hazardous waste;
- Landfill sites for inert waste must be used only for inert waste;
- Criteria for the acceptance of waste at each landfill class must be adopted by the Commission in accordance with the general principles of Annex II.

The following wastes may not be accepted in a landfill:

- Liquid waste;
- Flammable waste;
- Explosive or oxidising waste;
- Hospital and other clinical waste which is infectious;
- Used tyres, with certain exceptions;
- Any other type of waste which does not meet the acceptance criteria laid down in Annex II.

The directive sets up a system of operating permits for landfill sites. Applications for permits must contain the following information:

- The identity of the applicant and, in some cases, of the operator;
- A description of the types and total quantity of waste to be deposited;
- The capacity of the disposal site;
- A description of the site;
- The proposed methods for pollution prevention and abatement;
- The proposed operation, monitoring and control plan;
- The plan for closure and aftercare procedures;
- The applicant's financial security;

An impact assessment study, where required under Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment.

As you can see, landfill is subject to strict requirements, which seafill cannot be regulated by. Seafill cannot be regulated, reversed or cleaned up (aftercare) and shut down, an irreversible process, no way back. Thus, we come to the next chapter where the NMF presents a selection of examples that show damage to the aquatic environment related to landfill and seafill.

7.0. Salvage wreck U-864

7.1. Introduction

Submarine class type IXD2

U-864 was a German submarine of the Type IXD2 class, the largest submarine class. Laid down 15th October 1942 at the Deutsche Schiff und Maschinenbau in Bremen, and was operational from 9th December 1943.

The Type IXD2 comprised of 28 U-boats and made up the larger part of the Type IXD class as a whole. These put forth ever increasing operational ranges. Type IXD2s were able to reach operations as far away as Japan and the Indian Ocean, making it one of the more lethal U-boat systems to date. The torpedo count increased to 24 (or 72 mines in their place). Operations ran from 1942 to 1944 with most sunk before the end of the war.

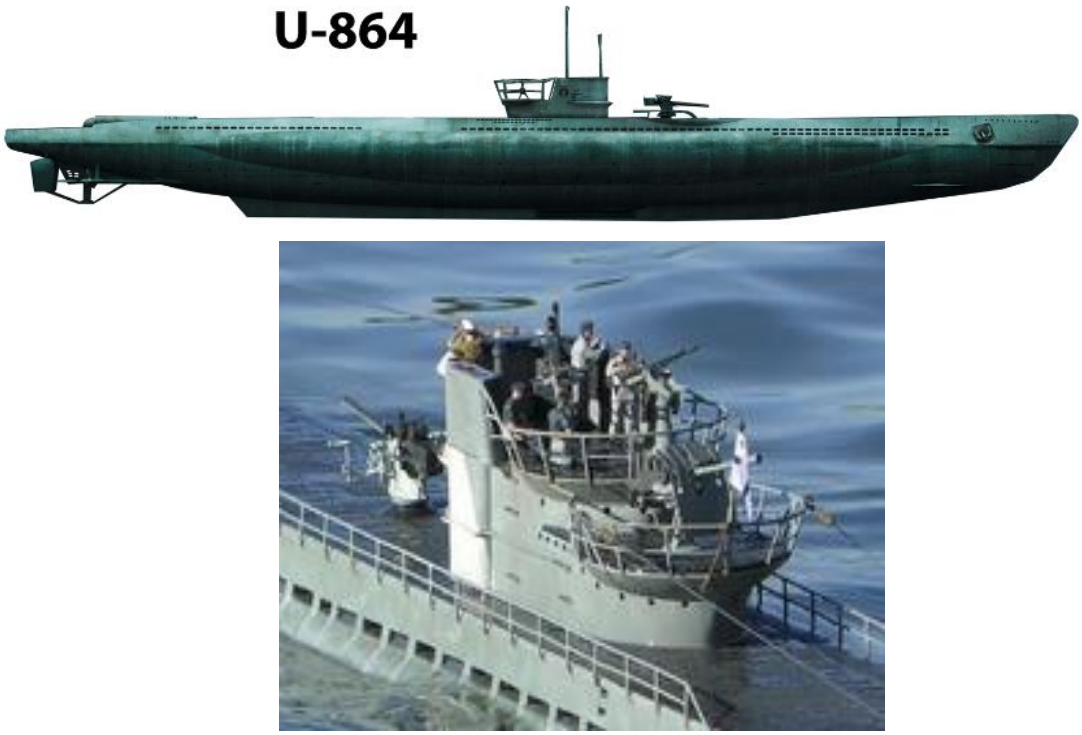


Figure: IXD2 Conning tower

General characteristics

These general characteristics are initially correct, but it was not abnormal to modify and adapt to the nature of the mission, which U-864 also became the subject of.
Weapons, ammunition and spare parts take up space and are often mission-based.
NMF does not disregard that the U-864 was loaded with more ammunition than is expected for the operation, such as torpedoes. The likelihood of reduced torpedo load is high.

Technical information for type IXD

Displacement: (tons)	1616 (sf) 1804 (sm) 2150 (total)	**Speed:** (knots)	19,2 (sf) 6,9 (sm)
Length: (m)	87,60 oa 68,50 ph	**Range:** (miles / knots)	23700/12 (sf) 57/4 (sm)
Beam: (m)	7,50 oa 4,40 ph	**Torpedoes:**	24 4/2 (bow / stern tubes)
Draught: (draft)	5,40 m	**Mines:**	48 TMA
Height:	10,20 m	**Deck gun:**	105/45 150 rounds
Power: (hp)	4400 (sf) 1000 (sm)	**Crew:**	55-63 men
		Max depth:	ca. 230 m (755 feet)

Operation Caesar

Based on the nature of the assignment, U-864 is rebuilt and adapted.
Thus, there is reason to assume that the U-864 was not fully equipped with torpedoes.

In the last months of WWII, U-864 embarked on a mission "Operation Caesar" to carry war material from Germany to Japan for use in the war against the United States. The cargo including drawings of Messerschmitt aircraft, advanced Messerschmitt jet engine parts for use in Japanese aircraft jet engine prototypes, V-2 missile guidance systems and 1,875 bottles (67 tonnes) of metallic mercury to be used for weapons production. The mercury was stored in Corrosion-treated cast/iron containers that were welded to the submarine's cargo keel.

Figure. IXD2 class pressure hull

U-864 left Kiel in Germany on 5th December 1944 and arrived Horten in Norway four days later, due to technical problems with a snorkel mast.

On her way to Bergen she hit a reef and had to go to Farsund for repairs. Radio signals from the submarine were captured by the British and the U-864 mission and route were revealed. She arrived in Bergen on 5th January 1945, where she sustained minor injuries on 12th January after the British bomb attack on the submarine facility there.

On 9th February 1945, the British submarine HMS Venturer was waiting for U-864 off the west coast and sink her, with the loss of the entire crew of 73 people. The boat broke into two parts and sank at 150 meters deep. This was the first known case where a submerged submarine has been slinked by another submerged submarine.

Figure: Lt J S Launders DSC RN

Figure: Korvettenkapitän Ralf-Reimar Wolfram

War cemetery U-864

Given that there are huge amounts of mercury in and around U-864, it must be considered whether the status of the "war cemetery" should be emphasized or whether the environmental threat should be removed. NMF is determined that the consideration of the aquatic environment must be emphasized first and foremost. Environmental pollutants must be removed. Any human remains must be treated respectfully.

The wreck site on Fedje

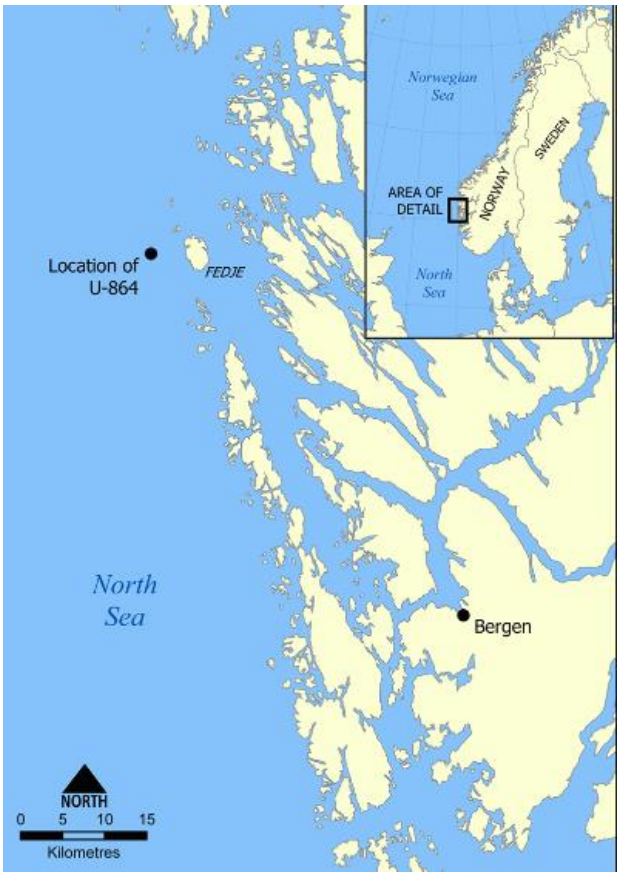


Figure: Location U-864

Figure: U-864 wreck site

7.2. Ministry of Transport

The wreck of U-864 was discovered by the Norwegian Navy's special vessel HNoMS Tyr, 22nd February 2003. U-864 is located about 150 meters deep, approximately 4 km west of Fedje in Hordaland. The wreck is divided into two major sections, the bow and stern section. The bow section lies on an unstable slope, but is subsequently backed by a concrete wall. The rear section identifies several large parts of the submarine's middle section. The wreckage lies on partly sand and mud floor in somewhat hilly terrain. The cargo keel is more or less covered with sand and mud, which helps to preserve/seal the material. In addition, there is a high probability that the actual pressure hull with keel is so intact that it can withstand being lifted.

Approximately 47,000 m² area around the wreckage is mercury contaminated (worse than condition class II/good). Analyzes and calculations indicate that it leaks about 4 kg of mercury annually from the contaminated area.

https://www.regjeringen.no/no/tema/transport-og-kommunikasjon/kyst/u864/id525212/

Ever since, there have been debates, surveys and political discussions on how to best deal with pollution from the mercury cargo in the sunken submarine and the surrounding seabed. In 2014, the Norwegian Coastal Administration (NCA) conducted new surveys of the wreck and presented a thorough study on measures to prevent future mercury pollution. The survey of the wreck showed that removing debris and polluted masses from the seabed near the wreck would spread pollution outside the already affected area, and that capping is the best and most eco-friendly solution.

In the spring of 2016, NCA installed a counter fill on the slope under the bow section of U-864 in order to stabilize the seabed. The operation involved laying approximately 100 000 cubic meters of sand and rock in a controlled and precise manner from a specially designed ship. The result was reduced risk of movement by unconsolidated sediments, including contaminated materials, during seaquakes. Establishing the counter fill is a similar operation as capping, and it therefore showed that capping could be carried out with proven technology and with minimum spreading of contaminated sediments.

On 8th October 2018, the Ministry of Transport issues a press release stating that “the U-boat wreck U-864 at Fedje will be covered to prevent future mercury contamination.”

The Norwegian Government has based its decision on numerous reports and studies conducted by the NCA with the support from a wide range of experts that have concluded that capping is the best and most environmentally friendly solution for U-864. This has been a long and complicated process, and we must now make a final decision. Capping both the wreck and the contaminated seabed is the best solution with the lowest environmental risk, as it will effectively prevent future pollution, says Minister of Transport and Communications Jon Georg Dale.

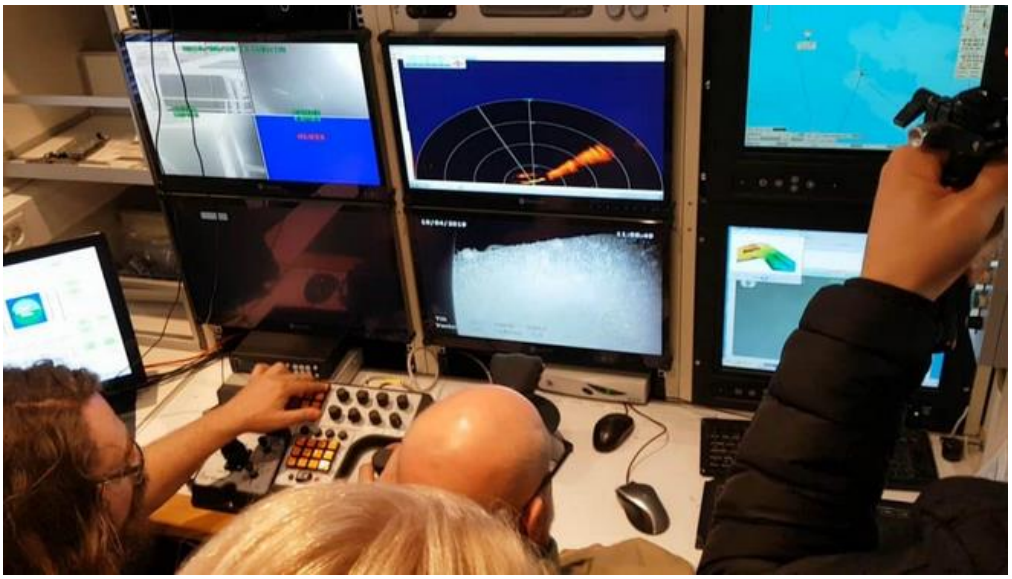
According to studies by the NCA, a capping solution will isolate the mercury in the wreck and the surrounding seabed from the marine environment. The cap will cover an area of 47000 m², including the wreck itself, the contaminated sediments, and a buffer zone of clean seabed of 17 000 m². For 2019, NOK 30 million is allocated for engineering, tender competition and general preparation work. The capping will probably be complete by the summer of 2020.

https://www.regjeringen.no/no/tema/transport-og-kommunikasjon/kyst/u864/id525212/

NMF comment:

The Norwegian Government has acted unsteadily and it takes a long time for a final decision to be made. 17 years of case management is a long time.

Since 2003, NMF has worked hard to salvage U-864. NMF believes that the hull parts can withstand the stresses associated with salvaging. Both pressure hulls are in good condition, and the mercury canisters is welded to the pressure hulls. Available technology ensures safe salvaging without the release of mercury. **NMF has had two dives with ROV and video filming on U-864, in June 2010 and in April 2019.** The hull is not strongly corroded, even the wooden planks on the deck are largely intact. NMF has previously explained through a hearing at The Parliament of Norway that a similar submarine was salvaged outside Denmark in 1993 (U-534). Corrosion samples were taken of U-534 and the result showed that the ballast keel was in good condition. U-864 has the ballast keel down in the mud, and will then be in even better condition.



Control room for ROV underwater operation on MS Miljødronningen during a dive in 2019 on U-864

NMF has presented a solution for the "Hordaland bench" at Parliament of Norway 5th March 2019, where a salvaging method involves attaching wires in the solid pressure hull, slow lifting from the seabed, and wrapping in Kevlar reinforced (5 times the strength of steel) rubber tarpaulin to prevent mercury leakage during lifting (Unitech Subsea concept).

The NMF has read the reports submitted to the Government. The reports have weaknesses and are clearly motivated by covering U-864 and surrounding areas. Norway is a world leader in subsea technology, it is no problem to handle U-864 and the toxic waste.

In 2020, one of the Government's party Christian Democrats (KrF) by Knut Arild Hareide has stated that U-864 must be salvaged.

https://www.bt.no/nyheter/lokalt/i/opQBdV/hareide-lover-svar-om-fedje-ubaaten-i-statsbudsjettet

7.3. Institute of Marine Research

The Institute of Marine Research (IMR) published a report on U-864. NMF refers to the summary here: Mercury[1] content in fish and other seafood at the wreck of U-864 west of Fedje - Results from regular monitoring and extra sampling in 2016.

The report presents results from the annual monitoring for the Norwegian Coastal Administration in 2016 of mercury in seafood near the wreck of U-864 west of Fedje. IMR analysed samples of tusk, brown crab, common ling, Atlantic cod, pollack, Norway redfish, saithe, greater forkbeard, blackmouth catshark, velvet belly lantern shark, ratfish, deep sea king crab and slate pen sea urchin.

Fifteen of 92 tusk had mercury levels above the maximum level (ML) for food safety, all relatively large fish. The mercury level in tusk was still not higher than the background level for the coast of south-west Norway. Other fish and crab claw meat had mercury levels below MLs. Mercury in brown meat of brown crab sampled most closely to the wreck was somewhat elevated (no ML). Also, deep sea king crab had relatively high mercury levels in hepatopancreas. Crab apparently ingest metallic mercury from the contaminated sediment, not accumulating in claw meat.

7.4. Ammunition

Introduction

The term “Ammunition” in this document includes:

- explosives, such as nitroglycerin, nitrocellulose, trinitrotoluene, hexanite, pentrite, hexogen, dynamite and nitrate explosives;
- powders such as smokeless powder and black powder;
- igniters of any kind used in conjunction with other explosives other than those of the main type ammunition;
- cartridges (round) such as: case, propellant and ignition device (primer), cases of any kind fitted with a propellant or primer, projectiles equipped with explosives, tracer or primer, hand grenades, bombs, rockets and mines, and light, fire and smoke boxes, pyrotechnic goods, such as fireworks, matches and candles, smoke and fire or other pyrotechnic kits.

[1] Mercury content in fish and other seafood at the wreck of U-864 west of Fedje - Results from regular monitoring and extra sampling in 2016

Norwegian Defence Material Agency

NORWEGIAN DEFENCE MATERIEL AGENCY

The Norwegian Defense clarifies in 2019 and supports its own conclusion from 2008 and 2018.

The likelihood of the high explosive reacting to mechanical stress is present in connection with a salvage operation if something unforeseen occurs[2]:

> *"With the mechanical influences one can foresee, the probability of accidental detonation, quantified, can be estimated at* 10^{-3} *to* 10^{-5} *for salvage operation and destroy what is found."*

The Norwegian Defence have expertise and experience in risk assessments. The most comprehensive investigation of risk from ammunition from shipwrecks was conducted as a separate supplementary study to the U-864 study in 2008[3]. In this investigation, The Norwegian Defence, together with "Det Norske Veritas" (DNV), assessed what risk torpedoes and other artillery ammunition could pose for salvage the wreckage parts, or covering the wreckage. **The conclusion was that the explosives were considered not to be able to self-detonate** in connection with salvage or covering operations. The likelihood that these explosives will detonate is considered to be only theoretically possible.

The Norwegian Defence is also the only body that has access to necessary operational, both national and NATO, instructional and support tools to assess the danger and practice of destroying military explosives.

NMF comment:

The Norwegian defense has very competent professionals within the term "Ammunition". Quantified estimates are as low as 0.001 % and 0.00001 % (super low probability) for external mechanical stress due to salvage operation. NMF is aware that ammunition that was collected from HNoMS Oslo suffered major crushing injuries in connection with grounding and sinking at Stenneset in Austevoll in January 1994. No undesirable incidents occurred in connection with the work of extracting the ammunition from the wreck.

Figure: HNoMS Oslo

[2] Norwegian Defence, Materiel Agency. Ammunition Report U-864. 2019
[3] Report_explosives_2012

The incident with HNoMS Helge Ingstad shows the same if not equally extensive. The frigate sank in the Hjeltefjord in November 2018.

No undesirable incidents occurred in connection with the work of extracting the ammunition from the wreck.

Figure: HNoMS Helge Ingstad

Torpedo T1/G7a

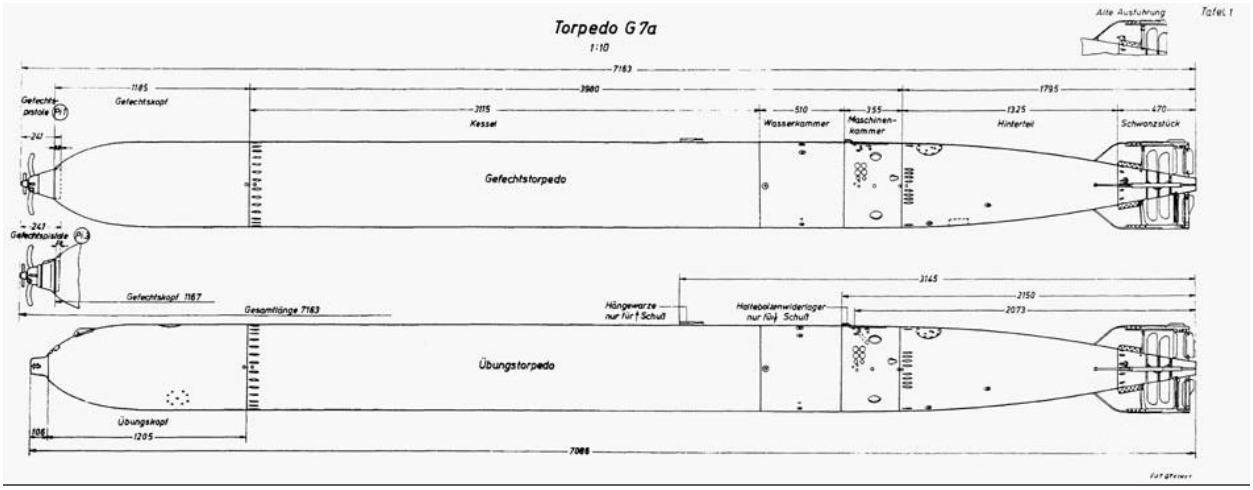


Figure: Torpedo T1/G7a

Expert analysis by a Norwegian retired U-boat officer with long operational services

The torpedoes were propelled with decline, creosote or kerosene. Propulsion: 4-cylinder steam engine (powered by a mixture of overheated steam and compressed air).

High explosives in the head about 280 kg (hexanite approximately 9500 m/s in detonation rate). Pentrite approximately 300 grams was used to set this off (igniter/primer)/Booster. To secure their own crew, the torpedo could not be detonated until after 80-100 meters from U-864, this was determined by what was put (color code) on impellers: arming distance (Pi1 pistol):

100 m (black impeller)/150 m (red impeller)/300 m (blue impeller).

That is why I believe the high-explosives are harmless. This is also supported by the fact that the torpedoes did not detonate when HMS hit U-864 with one torpedo. A stay of 75 years in

the sea contributes to the torpedoes arming chain being corroded/defective, which also makes it impossible to detonate the warhead. Assessment of other potentially hazardous waste in a torpedo such as battery, acids and metals:

No danger of dealing with this in conjunction with the salvage of the U-864, insignificant environmental consequences as this involves small quantities. Overall assessment of the risk of accidental detonation of the torpedoes' warhead is 100 % unlikely.

There is nothing in torpedoes that can indicate that these can be dangerous, and it is 100% certain that an accidental detonation will not occur.

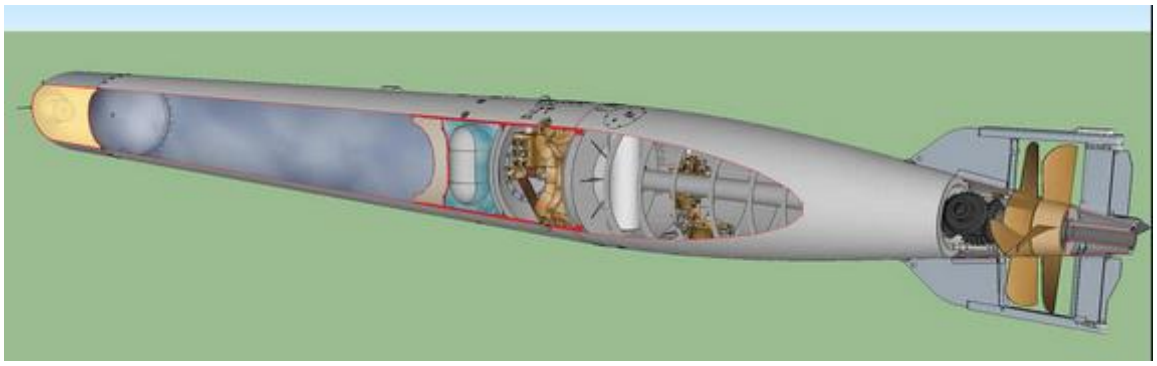
The submarine type has a total of 6 torpedo tubes, 4 forward and 2 aft "ready to use". Based on this particular long-term mission, I am determined that the U-864 was only fitted with 6 torpedoes. In order to accommodate extra personnel and material, the number of torpedoes is reduced. A torpedo takes its place and weight with its 1500 kg and 7,163 m length. The two torpedoes at the stern cannot be removed in the current state.
U-864 did not have mines as these are mounted on a separate plane/cover which is tread on the U-864. At that time, the submarines had various weapons/guns and similar on the outside with associated ammunition.

U-864 had "Laksevåg bunker Bruno" as its maintenance and supply base. It is a well-known case that Russian prisoners of war carried out extensive sabotage of torpedoes, which in 1945 led to up to 50 % of the torpedoes becoming harmless.

Mark VIII: 21inch torpedoes with max range 4,570 meters, 40 knots and warhead of about 340 kg.

German T1/G7a torpedoes: 21 inches with max range 8,000 meters at 40 knots speed and a warhead of 280 kilos of explosives 60 % Trinitrotoluene (TNT) and 40 % Hexanitrodiphenylamine (a most toxic and poisonous explosive).

After the war, the Norwegian U- and K- and "Kobben class" were equipped with ex German T-1 (G7a) torpedoes.



T1/G7a

NMF comment:

NMF agrees and points to the "SMIT TAK" salvage of U-534 in 1993, where 6.5 tonnes of ammunition were handled and demolished in a controlled manner.

https://www.youtube.com/watch?v=Q5EXbwxZ8lg

Figure: Inside the U-534 in 1993

Figure: T1/G7a removed from U-534 in 1993

10.5 cm SK C/32 wet-mount version

Figure: 10.5 cm SK C/32

Figure: 10.5 cm SK C/32 in action

The 10.5 cm SK C/32 (SK –Schiffskanone) was the standard low-angle deck gun mounted forward of the conning tower in type I, type IX and type X U-boats. The Ubts LC/32 mounting used in type I and early type IX U-boats weighed about 5 tonnes. Later type IX and type XB U-boats used the lighter Ubts LC/36 mounting with a maximum elevation of +30°. Ubts LC/36 mounting is 10 % lighter in weight, the total weight is then 4.5 tonnes

Complete round with watertight steel container. Outfit for U-boats was probably only HE incendiary without time fuses. Type IX U-boat: Ammunition stowage per gun 110 rounds, but it may be the case here that the number is reduced due to lack of space.

Complete round weight HE (High Explosive) L/4,4: 24.2 kg.

Projectile length HE L/4,4: 45.9 cm.
Complete round length was 105.2 cm): Brass, steel, iron, aluminium and cobber.

Projectile weight HE L/4,4: 15.1 kg.
Bursting Charge HE L/4,4: 1.395 kg: Fp 02 (cast Trinitrotoluene (TNT)).

Propellant Charge 4.08 kg RPC/40N (4.4/1.7): (Nitroglycerin and Nitrocellulose).

Percussion primer C/12nA St was standard: 0,44 gram consisting of: Barium nitrate 50, 9 %, lead styphnate 22,2 %, antimony sulfide 7,2 %, calcium silicide 19, 7 % and possible a very small quantity of tetrazene a sensitizing agent.
Ammunition onboard: Assumes 110 rounds in storage containers.

Risk of explosive reaction: 0.

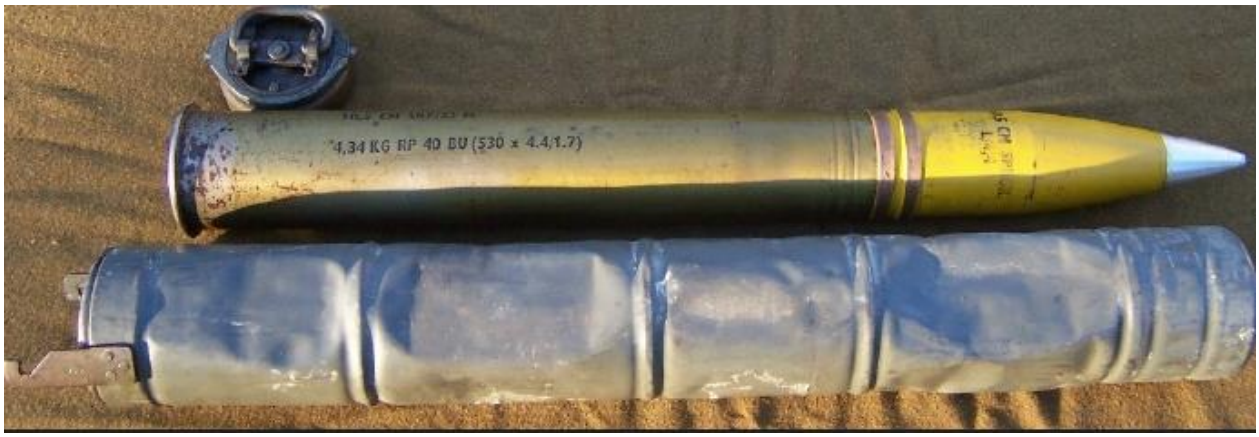


Figure: 10.5 cm SK C/32 round with steel container

3.7 cm Flak M42U

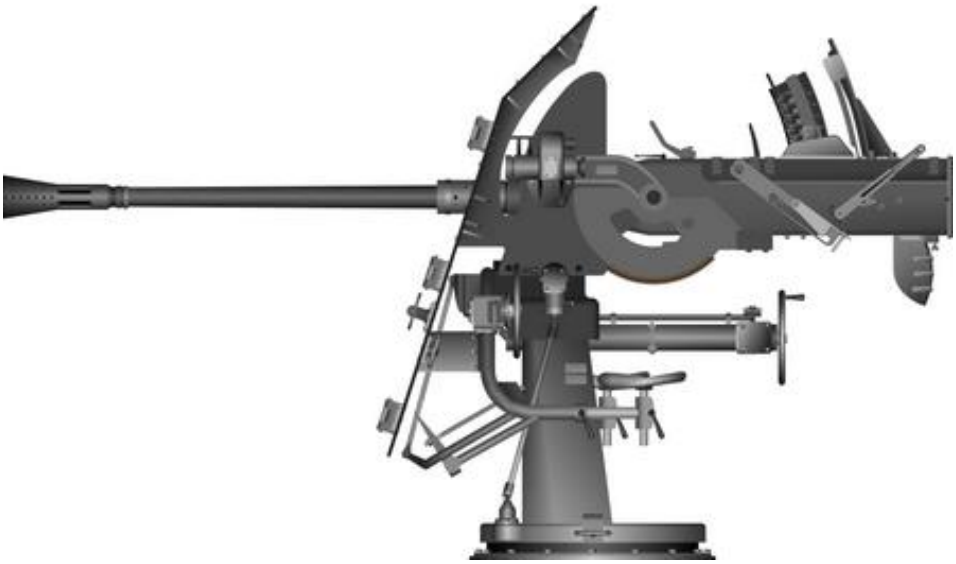


Figure: 3.7 cm Flak 18/36/37

The 3.7 cm Flak M42U was the marine version was a series of anti-aircraft guns produced by Nazi Germany that saw widespread service in the Second World War. The cannon was fully automatic. The gun, when emplaced for combat, weighed 1,750 kg.

Projectile Types and Weights:

HE-T (Heigh Explosive Tracer): (0.635 kg). 40 grams PETN.
HE-I (Heigh Explosive Incendiary): (0.640 kg) 40 grams PETN.
AP-T (Armour Percing Tracer): (0.700 kg).

Weight of Complete Round 1.37 kg and 1.50 kg (AP-T). Brass, steel, iron, aluminium and cobber.

Ammunition onboard: Assumes somewhere between 2000-3000 rounds in storage boxes.

Risk of explosive reaction: 0.

2 x 2 cm Flak 30/Flakvierling

Figure: 2 x 2 cm Flak 30/Flakvierling

The Flak 30 (Flugzeugabwehrkanone 30).

Mass: 450 kg.

Projectile Types and Weights:

HE-T: 6.0 gram high explosive Pentaerythritol tetranitrate (PETN).

HE-I: (0.134 kg). 2.4 gram high explosive (RDX). RDX is an organic compound with the formula $(O_2NNCH_2)_3$.

AP-I: (0.148 kg). 3.0 gram phosphorus.

Weight of Complete Round 0,32 kg. Brass, steel, iron, aluminium and cobber.

Ammunition onboard: Assumes somewhere between 2000-5000 rounds in storage boxes.

Risk of explosive reaction: 0.

Figure: 37 mm and 20 mm rounds

Demolition charges

A few hundred kilos of TNT in package sizes. The detonators (primer) are stored separately.

Risk of explosive reaction: 0.

Grenade

Some hand grenades.

Risk of explosive reaction: 0.

Small arms

"Small arms" (rifles and pistols with ammunition and pyrotechnic) are not included in this assessment, but U-864 contains smaller quantities of this equipment as well.

Risk of explosive reaction: 0.

Steel cylinder for pressurised gas

Risk of explosive reaction: 0.

NMF comment:

Overall, the ammunition is considered to be harmless to handle. 75 years in seawater has also led to the harmlessness of ammunition. Most civilian reports, with the exception of the Norwegian Defence Material Agency report, show great concern about explosions related to salvage operations. NMF relates to the Norwegian Defence Material Agency report and Navy expertise on torpedoes. No danger!

7.5. Mercury

It is estimated that today there are still about 62 tonnes of metallic mercury in steel welded/forged containers placed in the submarine's cargo keel and that there are about 5 tonnes of mercury scattered around the seabed over a large area. An area of 30,000 m² around the wreckage is contaminated by mercury.

Of the two mercury containers retrieved[4] and examined, the one fabricated by welding of steel plate material had developed a pinhole leak in a weld, whilst the other type in forged steel had an 80 % local reduction in wall thickness (initially 5 mm) that most likely would have developed a pinhole leak within 10-20 years if left on the seabed. Both areas have been exposed to shallow marine sediments promoting corrosion attack by 'Microbiologically Induced Corrosion' (MIC) probably associated with Sulphate Reducing Bacteria (SRB).

For mercury containers stored in flooded compartments of the keel and without convective exchange of seawater, the corrosive conditions are less severe and it is assumed that few containers, if any at all, have developed leaks due to corrosion. Even if containers have been locally penetrated by corrosion, accumulation of corrosion products will retard leakage of mercury, especially for containers embedded in sediments.

Figure: Shell segment of forged mercury container cut through area with maximum metal loss

NMF comment:

We are now writing the year 2020, the situation is deteriorating, now U-864 must be raised.

Norske Veritas (DNV) has analyzed the situation and considered how the mercury can be located and retrieved.

[4] DNV 2008. U-864 supplementary study no.1 corrosion V0.1

Figure: One of the Mercury containers taken from the seabed

7.6. DNV examination

DNV`s overall conclusion[5] is: A combination of single caesium vapour magnetometer and pipe tracker, positioned by acoustic LBL technique, is the preferred method to locate sub-bottom canisters. The searching will take at least six days and all surface debris must be cleared from the site prior to operation.

DNV's supporting conclusions are:

C1. None of the techniques that have been discussed will be viable to detect sub-bottom canisters, unless surface debris is cleared from the site prior to operation.

C2. A combination of single caesium vapour magnetometer and pipe tracker (metal detector) systems are assessed to be the preferred method to locate mercury canisters below seabed.

C3. It is recommended that survey positioning should be by acoustic LBL technique – more specifically, wideband technology is proposed. This will give decametric accuracy and high repeatability over a wide area.

C4. Searching for sub-bottom mercury canisters will take at least six days with no weather downtime, and may be performed by one survey-ship with one or two ROVs.

A Gradiometer multi-sensor system deployed from an ROV has the highest probability of any single sensor system of characterising sub-bottom mercury canisters. However, the ROV variation of this sensor does not yet exist, and this technique will carry high risk and development costs.

A combination of single caesium vapour magnetometer and pipe tracker (metal detector) systems (which can both be deployed from ROV) has the second highest probability of characterising sub-bottom mercury canisters. Both systems can be made available after acceptable preparation cost, but survey time will be increased because the site has to be visited by the ROV twice. This is assessed to be preferred methiodal.

Whatever data acquisition techniques are used, it will be good practice to start the survey by testing the techniques in a small area where there is a high probability that canisters are among the sub-bottom debris. Further, it will be good practice to retrieve one or more of the targets to verify the technique.

[5] Veritas 2008. Technical report U-864. Supplementary study

Figure: ROV

DNV's ranking of the described techniques for detection of sub-bottom mercury canisters and ROV-positioning systems are listed in the following table:

Method	Rank	Duration	Advantages	Disadvantages
Detection systems				
Combination of magnetometer and pipe tracker	1	116 hours	Most efficient use of resources to identify targets as mercury canisters	High start-up costs and some technical risk
Caesium vapour magnetometer	2	44 hours	Can cover relatively wide swath during search pattern	Must be towed from ROV, therefore will development costs be incurred. Specialist personnel required
Pipe tracker	3	48 hours	Is deployed on ROV as standard. Possible to identify target as Hg canister	Assumes that target depth is known
Parametric echo sounder	4	N/A	Can be deployed on ROV as standard. High accuracy. Could be used for pre-survey bathymetry.	Cannot classify targets.
Positioning systems				
Acoustic LBL technique for positioning ROV	1		High accuracy and repeatability if many vessels will work in the area	24 hour installation overhead.
Acoustic USBL technique for positioning ROV	2		Most vessels have this system already installed, so low installation overhead.	Poor repeatability and accuracy if many vessels will work in the area

Figure: Ranking of the described techniques

Drift of mercury canisters

Drift of Mercury containers has been calculated by estimating the terminal velocity during free fall in water and assuming the containers will drift horizontally with the same velocity as the ambient current taken to have a low value of Uc = 0.3 m/s and a high value of Uc = 1.6 m/s. Water depth is taken as 150 m. The terminal velocity is found by assuming equilibrium

between weight, buoyancy and drag forces acting on the container during the free fall. **The terminal velocity is given by the formula:**

$$w_t = \sqrt{\frac{2(W-B)}{\rho_w A_p C_D}}$$

where Ap is the projected area and CD is the drag coefficient. The containers will fall in an irregular fashion due to hydrodynamic instability and fluctuations in the current velocity. However, it can be assumed that the drift distance will be limited below and above characterized by two basic falling positions, which will maximize and minimize the terminal velocity. A small terminal velocity will be obtained if the container falls broadside and a large velocity will be obtained if the container falls axially. In the first case the projected area and drag coefficient will both be large, while in the second case, both will be small. Based on the estimated parameters for each of the containers, following limiting drift off distances are found.

Welded container (cylinder shaped)		Forged container (flask shaped)	
			
Length of cylinder:	250 mm	Length of cylindrical section:	280 mm
Diameter (OD) of cylinder:	130 mm	Diameter (OD) of cylindrical section:	115 mm
Weight empty	4.2 kg	Thickness of cylindrical section:	5 mm
		Length of top section:	85 mm
		Length of plug (above flask connection):	40 mm
Both containers hold 2.5 litres of mercury (Hg) weighing around 35 kg Mass density of seawater is taken as ρ_w = 1025 kg/m^3			
Estimated parameters:		Estimated parameters:	
Volume:	0.0033 m^3	Volume:	0.0055 m^3
Buoyancy force (B):	33.4 N	Buoyancy force (B):	55.10 N
Mass of steel:	4.2 kg	Mass of steel:	7.5 kg
Total mass:	39.2 kg	Total mass (M):	42.5 kg
Weight in air (W):	384.5 N	Weight in air (W):	417.3 N
Transversal drag coefficient (C_{Dt})	0.56	Transversal drag coefficient (C_{Dt})	0.56
Axial drag coefficient (C_{Da})	0.85	Axial drag coefficient (C_{Da})	0.20
Projected transversal area (A_{pt})	0.0325 m^2	Projected transversal area (A_{pt})	0.0549 m^2
Projected axial area (A_{pa})	0.0133 m^2	Projected axial area (A_{pa})	0.0104 m^2

	Welded container (cylinder shaped)		Forged container (flask shaped)	
	Broadside	Axially	Broadside	Axially
Terminal velocity	6.14 m/s	7.79 m/s	4.79 m/s	18.44 m/s
Drop time	24.45 s	19.25 s	31.29 s	8.13 s
Drift off (U_c=1.6 m/s)	39 m	31 m	50 m	13 m
Drift off (U_c=0.3 m/s)	7 m	6 m	9 m	2 m

The maximum drift-off distance is 50 m.

NMF comment:

The information is important for understanding the possible spread and how deep the mercury containers are in the sediments. A simplified calculation indicates that the welded canisters (cylinder shaped) will achieve a maximum free fall velocity (terminal velocity) of 8 m/s. This will result in a penetration depth of approximately 700 mm, with a bottle length of 300 mm this results in a mean canister depth of 550 mm. For the forged canisters (bottle shaped) the maximum free fall velocity (terminal velocity) and furthermore the penetration depth is highly dependent on the orientation of the canisters. The maximum free fall velocity (terminal velocity) varies from 5 to 18 m/s for a canister falling broadside and axially respectively. This will result in a penetration depth varying from 500 mm to 3100 mm.

This figure shows the cargo compartment in the keel of a Type IXC Class U-boat /U-534), which is similar to the Type IXD2 class (U-864). Storage seems robust in all directions.

Figure: Storage in the keel

7.7. The Norwegian Coastal Administration

The Norwegian Coastal Administration (NCA) considers that U-864 should be encapsulated (a form of stone, gravel/sand filling) to ensure good environmental quality at the wreck. An area of 47,000 m² will be covered. This includes both the wreckage, the contaminated area at the wreckage of 30,000 m² and a buffer zone against clean seabed of 17,000 m². The cover will be built to withstand all relevant stresses - including the 10,000-year earthquake. This will ensure an environmentally safe and sound solution by establishing a solid and permanent insulation of mercury contamination in and by the wreck of U-864. It is also considered to retrieve parts of the load, followed by covering the area.

NCA has considered that bringing material up to the surface leads to a significantly greater risk of spreading contaminated sediment than just covering the area. This is because the Mercury containers from the cargo do not lie on the seabed, but down in the contaminated sediment outside the wreck and in the wreck - which lies down in extremely polluted sediment. A major operation on the seabed to get mercury containers out of the wreckage and to find containers outside the wreckage will lead to the spread of the contaminated sediments. For 2019, NOK 30 million was set aside for design, tender competition and preparatory work for coverage. The work is scheduled to be completed in the summer of 2020.

https://www.regjeringen.no/no/aktuelt/ubat-vraket-u-864-ved-fedje-tildekkast-for-a-hindra-framtidig-kvikksolvforureining/id2614253/

7.8. Salvage U-864

NMF`s position

Establishment of seafill consisting of mercury and ammunition on the seabed is not permitted. This illegality is carefully discussed by referring to key EU agreements and directives.

NMF was in the Norwegian Parliament for the first time at a hearing on the salvage of U-864 in 2006, where we among other things pointed to the salvage of a similar submarine outside Denmark in 1993, U-534. Corrosion tests of the U-864 keel showed little corrosion attack since 1945. We are writing the year 2020, but as the wreckage is partly in mud, the process of decomposition is slowing down.

It is known that large quantities of mercury are still present in the U-864 keel, about 65 tonnes. NMF is determined that the U-864 can withstand the stress associated with gentle lifting. **The pressure hulls, corrosion-treated steel of 22 mm, are in good condition.** The specially treated cast mercury containers are welded to the cargo-keel in the pressure hull area. The cargo-keel is welded to the pressure hull. This means that, in practice, the mold hull could have been fitted away, and a lifting is still both reasonable and possible. Only pressure hulls and cargo-keels are essential structures that are important for lifting.

The Norwegian Parliament approved coverage of U-864 in 2010, and this has provided guidance for the Norwegian Coastal Administration's work and recommendation on environmental measures for U-864.

Today, there is technology that ensures a safe lifting operation without the release of mercury (BAT in practice). If U-864 is left lying or covered with sand and gravel, there is a significant environmental risk to the aquatic environment and the food chain, not only locally but also spread of mercury in the marine environment in the North Sea and the Barents Sea.

Such a filling represents a perpetual danger and threat to the aquatic environment and sediments.

Figure: U-864 in the sediments

Wreck salvage

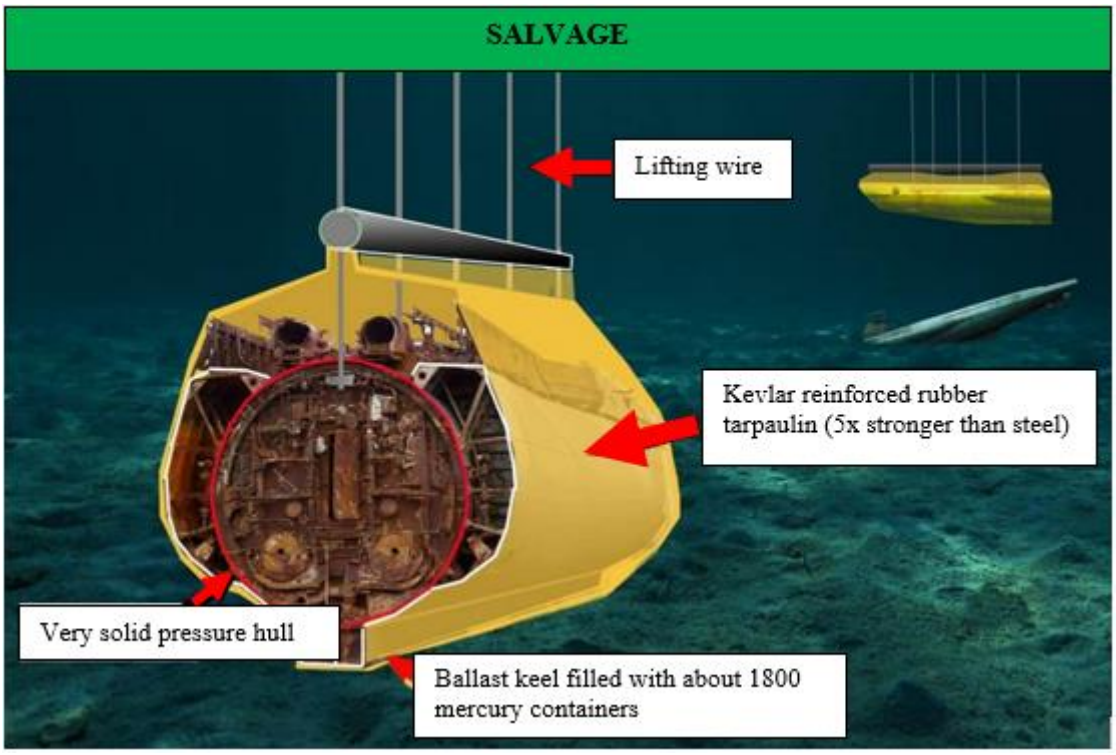


Figure: Salvage

Norway has very good underwater expertise. The Norwegian company UNITECH was engaged by NMF to assess the possibilities to salvage the wreck parts. UNITECH is not in doubt, it is possible to salvage the wreck.

https://www.nmf.no/2020/02/06/klart-for-heving-av-kvikksolvubaten-u-864-film/

NMF reminds us that this is an example, there are large salvage companies in the world that can take on such an assignment as SMIT TAK and SCALDIS:

https://www.smit.com/services/salvage/wreck-removal.html

http://www.scaldis-smc.com/en/activities/salvage-bruin/

UNITECH salvage U-534 video on YouTube:

https://www.youtube.com/watch?v=SSC_R-OYMck

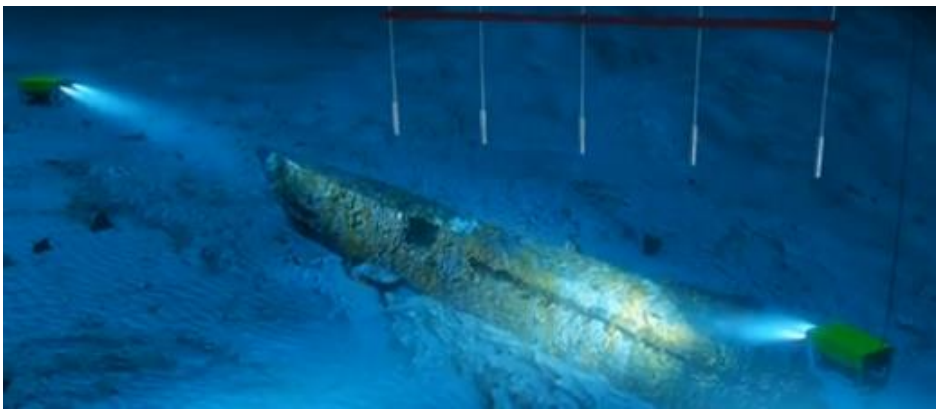


Figure: Fixed lifting points lowered

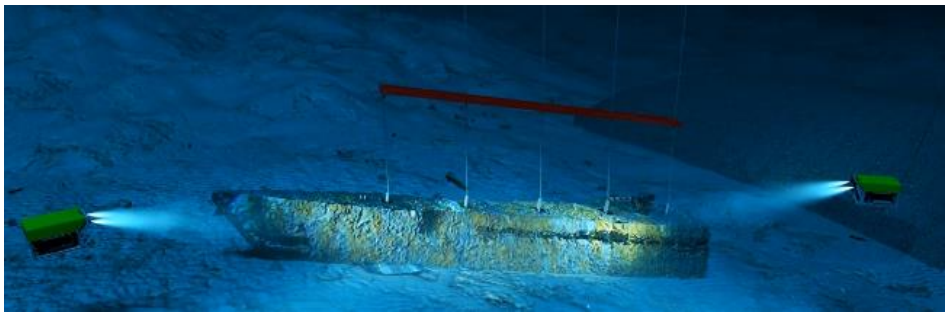


Figure: With the help of ROVs, the lifting points are fixed to the pressure hull, after removing small sections of casing.

Figure: The ROVs monitor the process and send video to the control room of the salvage vessel

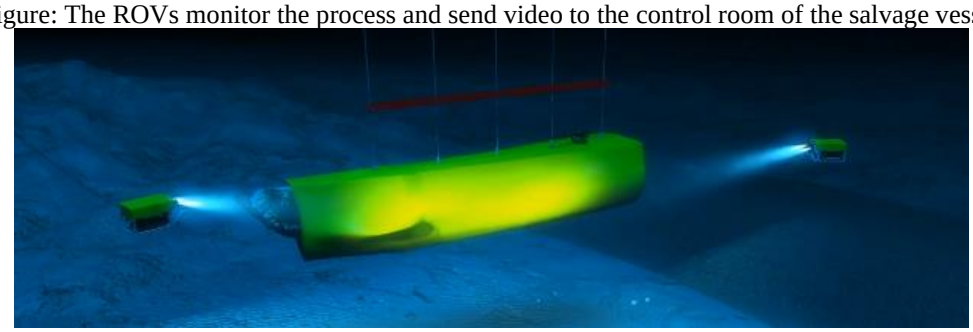


Figure: Heavy duty sail can be placed rolled around the wreckage to protect against leakage and to support lifting

Figure: Powerful compensating winches ensure safe lifting to the surface.

Figure: The U-864 wreckage is guided into the UNITECH hangar

Figure: The transport phase to Tømmerviken

Figure: Safe navigation in narrow waters

Figure: Tømmerviken

Figure: The U-864 wreckage parts are moved onto the dock bed

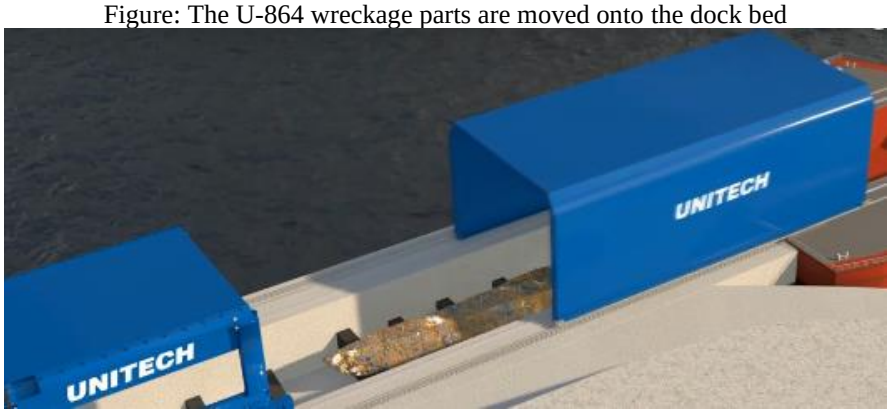


Figure: Superstructure provides dry dock

8.0. Conclusion

Based on this complaint, it is very easy to conclude that U-864 must be salvaged/raised as soon as possible. It is not allowed to store mercury and other toxic waste on the seabed. This is particularly the case for the so-called storage of mercury in seafill on the seabed.

The conclusion is supported in particular by **2000/60/EC**, **Regulation 2017/852**, 1999/31/EC and 2008/98/EC, but also in other documentation.

It should be pointed out that the 2000/60/EC is in accordance with the principle of sustainable development where **"the needs of the present generation must be met without compromising the ability of future generations to meet their own needs"**.

2000/60/EC is not to be misunderstood, as demonstrated by these wise words:

1. 2000/60/EC is based first and foremost on a **one-way clause, namely "reduction", "cessation", "phasing out", "avoiding deterioration"**.
2. Principle of **"polluter pays"**.
3. Principle of **source control**.
4. Principle that surface water should not have a worse environmental condition than **"good"**.

The 2000/60/EC - when adopted nationally - sets the line in that all **degradation and aggravation** that have been found up to and including year 2000 **should gradually cease**.

This means that measures that are initiated hereafter and which directly or indirectly infuse the coastal water **shall only improve** the aquatic environment. Emissions in progress shall cease or be phased out. **Work, conditions or measures that aggravate the aquatic environment should not be able to continue, much less be initiated.**

It is necessary to assess the benefits to the environment and society, and to prevent the deterioration of the condition, or to restore a water body to good condition. This must be

weighed up by the benefits of the new interventions or changes in human health, maintaining human safety or sustainable development.

"Seafill U-864" pose too much damage to the aquatic environment. No one can guarantee good environmental condition in the water. NMF has shown that even landfill leads to inorganic and organic runoff to rivers, streams, groundwater and sea.

There is no danger related to handling the ammunition. The ammunition is nevertheless handled by specialists. **The conclusion was that the explosives were considered not to be able to self-detonate** in connection with salvage or covering operations. The likelihood that these explosives will detonate is considered to be only theoretically possible.

Salvage U-864 is the only solution. NMF has shown the way. After salvage, pick up as much toxic waste as possible.

The human remains must be handled in a respectful manner.

Best regards,

Kurt Oddekalv
(leader NMF)

Anders Løberg
(caseworker NMF)

Rune Birger Nilsen
(caseworker, consultent)