

**Federal Agency Preview of:  
NMFS’s Draft Updated Guidance for Assessing the Effects of  
Anthropogenic Sound on Marine Mammal Hearing:  
Underwater and In-Air Thresholds for Onset of Auditory Injury and  
Temporary Threshold Shifts (Draft Updated Technical Guidance)**

**Federal Agency Preview Report**

**INTRODUCTION**

The U.S. Navy (Navy) recently provided the National Oceanic and Atmospheric Administration’s National Marine Fisheries Service (NMFS) a report entitled *Marine Mammal Auditory Weighting Functions and Exposure functions for US Navy Phase 4 Acoustic Effects Analyses* (2023 Navy Technical Report<sup>1</sup>), which describes the Navy’s proposed methodology<sup>2</sup> for updating the information used to evaluate the impacts of anthropogenic sound on marine mammal hearing. The Navy’s Technical Report describes the rationale and steps used to define updated “auditory weighting functions” and numeric thresholds for predicting auditory effects (temporary threshold shifts (TTS)/Auditory Injury (AUD INJ)) on marine animals exposed to active sonars and other active acoustic sources.

NMFS reviewed the 2023 Navy’s Technical Report and provided input into the development of the final version. NMFS regards the 2023 Navy’s Technical Report as the best available science on this topic, and we plan to adopt it to update our current Technical Guidance (NMFS 2018) via our draft *Updated Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater and In-Air Thresholds for Onset of Auditory Injury and Temporary Threshold Shifts* (draft Updated Technical Guidance). However, before adopting, NMFS is responsible for conducting various reviews of our draft Updated Technical Guidance.<sup>3</sup> This Federal Agency Preview Report compiles the comments of the federal agency reviewers and NMFS’s responses to those comments.

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<sup>1</sup> Authored by Dr. James J. Finneran, United States Navy Marine Mammal Program, Naval Information Warfare Center (NIWC) Pacific (2023).

<sup>2</sup> Note: The methodology provided in the Navy Technical Report is very similar to the methodology used in their previous technical report, which NMFS adopted for our current 2018 Technical Guidance via a peer review and public comment process. For more information, see: <https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance>

<sup>3</sup> Before finalization of the draft Updated Technical Guidance, NMFS will conduct a public comment period in 2024. The draft Updated Technical Guidance underwent Peer Review in October/November 2022. For more information, please see: [https://www.noaa.gov/sites/default/files/2023-05/ID429-FINAL-Peer-Review-Report-508\\_0.pdf](https://www.noaa.gov/sites/default/files/2023-05/ID429-FINAL-Peer-Review-Report-508_0.pdf)

# Federal Agency Preview of NMFS Draft Updated Technical Guidance

The intent of this NMFS-initiated Federal agency preview was to evaluate the methodology proposed in the 2023 Navy Technical Report for consideration and incorporation into NMFS’s draft Updated Technical Guidance). The 2023 Navy Technical Report is included in Appendix A of the draft Updated Technical Guidance document.

NMFS requested the Navy’s assistance in addressing certain comments, which are specifically identified as including input from both NMFS and the Navy.

## FEDERAL AGENCIES PARTICIPATION

NMFS solicited input on the Updated Technical Guidance from various Federal agencies following a peer review in 2022 and before the public comment period in 2024. NMFS contacted 17 Federal agencies to inquire if they wanted to participate in the Federal Agency Preview. Of the 17 agencies contacted, 12 asked to participate in the Preview. Six agencies provided comments<sup>4</sup> on the draft Updated Technical Guidance, three indicated they had no comments to provide, and three had no response (Table 1).

**Table 1: Federal agency preview participants (in alphabetical order).**

Federal Agency	Provided Comments
Bureau of Ocean Energy Management	Yes
Department of Energy	Yes
Department of Transportation	Yes
Marine Mammal Commission	Yes
National Park Service	Yes
National Science Foundation	Yes
U.S. Air Force	No response*
U.S. Army Corps of Engineers	No response*
U.S. Coast Guard	No
U.S. Fish and Wildlife Service	No
U.S. Geological Survey	No
U.S. Navy	No response*

\*NMFS sent multiple emails inquiring about the status of their review of the Updated Technical Guidance, but these agencies never responded.

Federal agency comments are presented following the order of sections in the Updated Technical Guidance, with general comments presented first. Each section presents comments by Federal agency in alphabetical order.

<sup>4</sup> Note: Federal agency comments are presented here as they were provided to NMFS. Generally, NMFS did not make any alterations (i.e., there may be spelling, grammatical, or other minor errors). If alterations were made, they were done for clarity and are indicated by brackets [ ]. Furthermore, NMFS corrected minor typographical errors in the draft Updated Technical Guidance (i.e., edits that provided no substantive change to the document) as suggested by reviewers. Those minor edits are not reflected in this Federal Agency Preview Report.

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### CHANGES TO DRAFT UPDATED TECHNICAL GUIDANCE SINCE FEDERAL AGENCY PREVIEW

After the Federal Agency Preview concluded, there were minor changes made to the Updated Technical Guidance document by the Navy (December 2023). Namely, two new audiograms were published for California sea lions (Kastelein et al. 2024) and a correction to the calculation of the offset between steady-state and impulsive SEL thresholds was made (i.e., rounding error), which was identified as a result of the Federal Agency Preview. These additional changes only resulted in minor changes to the thresholds and weighting functions. Thus, Federal Agencies were alerted to these changes prior to the public comment period and were encouraged to submit any additional comments.

### GENERAL COMMENTS

#### DEPARTMENT of TRANSPORTATION (DOT)

**Comment 1:** DOT commented that there is a benefit to project proponents such as state DOTs having the opportunity to use the draft revised spreadsheet tool.<sup>5</sup> It provides a practical understanding of changes to Zones of Impact [ZOIs] through comparing current versus proposed thresholds. It appears that the ZOIs for Level A Harassment will increase fairly significantly for otariids, phocids, and HF cetaceans. Ultimately, this means more Level A takes for projects, potentially more frequent shut-downs and also more monitors to effectively cover the larger ZOIs.

**Response:** Based on DOT's comment, NMFS is providing a DRAFT optional User Spreadsheet tool, with the updated thresholds and weighting functions during the 2024 public comment period, as a means for the public to better assess changes associated with the Updated Technical Guidance. However, the focus of the public comment period is not on this DRAFT optional tool but rather on the updated thresholds and weighting functions. Thus, NMFS may not publicly respond to any comments associated with this DRAFT optional tool because they are outside the scope of the Updated Technical Guidance review process.

Additionally, until the Updated Technical Guidance is finalized, the 2018 Revised Technical Guidance and current optional User Spreadsheet tool remain in place. Thus, this DRAFT optional tool should NOT be used for any analyses until the Updated Technical Guidance is finalized.

#### MARINE MAMMAL COMMISSION (The Commission)

**Comment 2:** The Commission indicated they are pleased to see that NMFS included in-air thresholds in the Updated Technical Guidance and considered auditory injury (AUD INJ) that does not result in a permanent threshold shift (PTS).

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<sup>5</sup> During the Federal Agency preview, DOT asked that NMFS provide a draft of their optional User Spreadsheet tool with the updated thresholds and weighting functions.

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**Response:** NMFS thanks the Commission for their comment.

**Comment 3:** The Commission commented that NMFS’s behavior thresholds from 2005 are outdated and do not represent the best available science, and it is unclear how and when NMFS plans to update them. Criteria and thresholds for mortality, injury, and behavioral disturbance for explosive sources and behavioral disturbance for active acoustic sources have been developed historically by the U.S. Navy (Navy) and then used by NMFS. However, NMFS has not formally adopted any of those criteria or thresholds by way of a Technical Guidance. The Commission suggests that the Navy’s revisions to its other criteria and thresholds for explosive and active acoustic sources should be similarly incorporated into Technical Guidance. Therefore, the Commission recommends that NMFS: 1) prioritize updating its behavior thresholds and 2) provide the criteria and thresholds for mortality, injury, and behavioral disturbance for explosive sources and behavioral disturbance for active acoustic sources for public review and formalization via Technical Guidance in the near term.

**Response:** NMFS is in the process of updating its marine mammal behavioral disturbance criteria, with the intention of sharing these updated thresholds with our broader NMFS family within early 2024 (i.e., internal agency review). From there, these criteria will undergo the same level of review as our AUD INJ/TTS thresholds (peer review, Federal agency review, and public comment). It is difficult to predict a finalization date at this time.

NMFS has no current plans to adopt mortality and injury thresholds for underwater explosives via our formal review process. However, behavioral disturbance criteria for explosives will likely be addressed via our update marine mammal behavioral disturbance criteria.

### NATIONAL SCIENCE FOUNDATION (NSF)

**Comment 4:** About the document’s title, NSF indicated: “*Although I think this follows the 2018 format, the titles are a little confusing, it may make it easier to reference versions and update if NMFS changed the title slightly.*”

**Response:** NMFS disagrees and will continue using the naming format we have relied upon for the previous two versions of this document in 2016 and 2018 for this draft Updated Technical Guidance.

### EXECUTIVE SUMMARY

#### DEPARTMENT of TRANSPORTATION (DOT)

**Comment 5:** In the Executive Summary, line 43: DOT requested the following edit: “*The Updated Technical Guidance may inform decisions related to mitigation and monitoring requirements, but it does not mandate any specific mitigation ~~be required~~ measures.*”

**Response:** NMFS made the suggested edit.

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### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 6:** In the second paragraph, the Commission indicated, “*These are in a strange order. The FHG info should be first, then WFs, then thresholds. Right now it says the doc includes a protocol for estimating INJ thresholds, and incorporation of mm auditory WFs into the derivation of INJ thresholds.*”

**Response:** NMSF has made all suggested edits to this paragraph.

**Comment 7:** In Table ES1, the Commission commented, “*The manner in which pinnipeds are termed needs to be consistent throughout the doc. PW either means phocid pinnipeds underwater or phocid underwater and needs “pinnipeds” like LF needs “cetaceans” to accompany it. Please ensure it is consistent throughout.*”

**Response:** NMSF has edited for consistency as suggested.

### NATIONAL SCIENCE FOUNDATION (NSF)

**Comment 8:** NSF suggested the first sentence of the Executive Summary be changed to the following, in order to eliminate the need for Footnote 1: “*This document provides technical updates and replaces the NMFS 2018 Revised Technical Guidance (NMFS 2018) for assessing the effects of underwater and in-air anthropogenic (human-made) sound on the hearing of marine mammal species under the jurisdiction of the National Marine Fisheries Service (NMFS) and is referred to herein as Updated Technical Guidance.*”

**Response:** NMFS has made edits to reflect NSF’s suggestion.

**Comment 9:** At the end the third paragraph, NSF suggested the following (addition of underlined phrasing): “*Thus, NMFS has developed an optional, alternative tool for those who cannot fully incorporate these factors into their own analyses (See Updated Technical Guidance’s companion optional User Spreadsheet tool). See later comment about this point, seems like it would be better to just note that an optional, alternative tool is available for use.*”

**Response:** NMFS has made NSF’s suggested edit.

## MAIN DOCUMENT SPECIFIC COMMENTS BY SECTION

### **I Introduction**

#### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 10:** The Commission noted an inconsistency in the Title presented in this section compared with the Title page. Note: NSF made a similar comment.

**Response:** NMSF has made the correction, so the Title in this section matches the Title page.

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**Comment 11:** The Commission noted that USFWS has jurisdiction over all species of manatees...as well as dugongs, marine otters, etc.

**Response:** NMSF has added dugongs to this footnote and removed “West Indian” from manatees to indicate USFWS jurisdiction over all species of manatee.

### NATIONAL SCIENCE FOUNDATION (NSF)

**Comment 12:** For the first sentence of this section, NSF has the following comment: *“Suggest similar edits here as noted in Executive Summary. Also, just to mention, the doc goes back and forth calling it “this” and “the” Updated Technical Guidance (not sure it matters much.) Calling the document “Updated Technical Guidance” rather than something like “2023 Acoustic Technical Guidance” (which could then be “2023 ATG”) or “2023 Guidance” makes it a little awkward in places. Referring to the doc by the year (or the version #) may make it easier to track/refer [to] in future revisions. But, there may be a reason NMFS has moved away from this approach.”*

**Response:** While NMFS anticipates this document will be finalized before the end of 2023, it would be presumptuous to make this assumption before completing the public comment period. Thus, for simplicity, NMFS will continue referring to this document as the draft Updated Technical Guidance.

**Comment 13:** Regarding marine mammal species under NMFS’s jurisdiction (Footnote 5), NSF stated *“pertain” does not seem to be the right term to use. It does pertain to the species, NMFS doesn’t have the jurisdiction to enforce it. Has NMFS tried to coordinate with USFWS? It does cause some confusion that USFWS [U.S. Fish and Wildlife Service] does not adopt/enforce the thresholds, though sometimes they do accept them. Although some edits are suggested here, they likely need to be adjusted based on any agreements with USFWS, etc.”*

Additionally, NSF suggested the following edits to footnote 5: *Although this document presents thresholds for all marine mammal species, the U.S. Fish and Wildlife Service (USFWS) has not officially adopted these thresholds for species under their jurisdiction (e.g., walrus, polar bears, West Indian manatees, sea otters).*

**Response:** In regards to coordination between NMFS and USFWS, NMFS shared this document with USFWS, and they provided no comments during the review. Thus, NMFS is unclear how or if USFWS will rely on this document and cannot speak on their behalf.

As for the suggested edits to this footnote, NMFS disagrees with NSF’s edits because this document does not present thresholds for all marine mammal species (i.e., Sirenian thresholds are not presented in the main text of this document). Furthermore, NMFS thresholds are labeled for pinniped hearing groups only (i.e., they are not labeled to cover walruses, polar bears, or sea otters).

## 1.3 Changes Associated with Draft Updated Technical Guidance

### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 14:** The Commission noted that footnote 10 is identical to footnote 6 and should be deleted.

**Response:** NMSF has made this suggested edit.

### THE NATIONAL SCIENCE FOUNDATION (NSF)

**Comment 15:** Regarding the text about the inclusion of in-air thresholds for pinnipeds, NSF asked: *“Is this applicable to actions that are initiated in air? Or activities that are initiated underwater? Both? As noted in footnote #9, the Navy may be most familiar with the application of these thresholds, but I’m not sure about other entities? While the focus of this document is on establishing/justifying thresholds, how an agency should incorporate/use the in-air thresholds seems unclear. Will there be separate/more guidance on this? Perhaps this may be more evident after reviewing DoN 2017 and other Navy documents, but [it] seems that NMFS should provide more guidance on this aspect. As discussed during the webinar, a User spreadsheet for in-air thresholds and instructions may be necessary and informative.”*

**Response:** The in-air thresholds are for activities initiated in-air that have the potential to exceed the AUD INJ thresholds. Most in-air activities don’t result in animals being exposed at close enough distances or for long enough exposures to typically exceed the AUD INJ thresholds, which is why NMFS previously did not include these thresholds in our NMFS 2018 Revised Technical Guidance. However, to be complete and consistent with Southall et al. 2019,<sup>6</sup> we included them in this updated version of the Technical Guidance.

As for the development or modification of NMFS’s current optional User Spreadsheet tool to incorporate in-air thresholds, NMFS will gauge demand before considering whether to do so. In the meantime, NMFS will help applicants apply the in-air thresholds on a case-by-case basis.

## II NMFS’s Thresholds for Onset of Permanent Threshold Shifts in Marine Mammals

### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 16:** The Commission noticed an inconsistency in abbreviating peak sound pressure level throughout the document.

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<sup>6</sup> Pinniped in-air noise-induced hearing thresholds have existed since Southall et al. 2007. If in-air sound sources previously had the potential to result in noise-induced hearing loss, NMFS suggested the use of these existing thresholds (Southall et al. 2007; Southall et al. 2019), regardless whether NMFS had officially adopted them in our Technical Guidance or not.

**Response:** NMFS has fixed this inconsistency abbreviating peak sound pressure level as PK SPL throughout the document.

### 2.1.1 Application of Marine Mammal Hearing Groups

#### NATIONAL PARK SERVICE (NPS)

**Comment 17:** NPS indicated: “You [NMFS] reference noise-induced hearing loss (NIHL) for the first time. This term is later referenced a few more times in the document. It seems worthwhile to clarify the relationship between NIHL and AUD INJ, PTS, and TTS. From the document itself, it's not clear how NIHL fits together with any of these other definitions.”

**Response:** NMFS thanks NPS for this comment and agrees that more about NIHL should be included in the Updated Technical Guidance, especially about its relationship to TTS and AUD INJ. NMFS has also added NIHL to the Glossary, as well as included this definition as a footnote the first time NIHL is mentioned in the document. NMFS’s intent with using the term NIHL is to encompass noise-induced threshold shifts that either result in TTS or AUD INJ (i.e., it is meant to be a more generic term that includes both TTS and AUD INJ).

### 2.2 Marine Mammal Auditory Weighting Functions

#### BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)

**Comment 18:** BOEM suggested that Footnote 18 and 3 might be better as a table note so it is embedded within table 1.

**Response:** NMFS agrees and has made BOEM’s suggested edit.

### 2.2.3 Derivation of Function Parameters

#### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 19:** As a general comment for Table 2, the Commission stated: “It is generally unclear why the pre-TTS hearing threshold data from TTS studies aren’t used to bolster the composite audiogram. Would have more PW and VHF too, along with the CSL [California sea lion} data.” Specifically, the Commission recommends that “NMFS incorporate the California sea lion hearing threshold data from Kastelein (2021, 2022a and b, and 2023), and any other hearing threshold data that are in prep or in review, in the derivation of the OW composite audiogram and revise the weighting function accordingly. Furthermore, NMFS investigate whether available hearing threshold data from TTS studies of other species should have been used to update the composite audiograms for OW and the other functional hearing groups, including pinnipeds in-air, and update the audiograms appropriately.”

**Response (NMFS and Navy):** Kastelein 2021, 2022a, 2022b, and 2023 all used the same two sea lions for their studies. Their audiograms have now been included in the composite audiogram in the Updated Technical Guidance (For more information: See the **Changes to Draft Updated Technical Guidance Since Federal Agency Preview**

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section of this report). The seals and porpoises used in the TTS studies were already included in the composite audiograms (the published animal IDs changed over the years).

**Comment 20:** In Table 2, the Commission indicated Lemonds 1999 for HF cetaceans for bottlenose dolphins is Lemonds [et al.] 2011 in Appendix A.

**Response:** The Lemonds et al. 2011 reference in Appendix A is correct. NMFS has replaced Lemonds 1999 with Lemonds et al. 2011 in Table 2.

**Comment 21:** In Table 2, the Commission commented that Kastelein 2002 is missing for VHF cetaceans for harbor porpoises.

**Response:** NMFS has corrected this error by including Kastelein et al. 2002b in Table 2.

**Comment 22:** In Table 2, the Commission indicated that Kastak and Schusterman 1998 be added for OW pinnipeds for California sea lions.

**Response:** NMSF has made this suggested addition, and notes the failure to include this reference in the original document was NMFS's error.

### NATIONAL SCIENCE FOUNDATION (NSF)

**Comment 23:** Regarding Table 4, NSF asked “*What about the addition of “in-air”, should that be noted in this table?, as well noting While marine mammals were still divided into hearing groups, in 2023 they’ve been organized into slightly different groupings (e.g., VHF). Should this be clarified as a change here? (Or maybe it’s kind of an outcome noted below?).*”

**Response:** NSF is correct in noting these additional details. In Steps 1 and 2, NMFS has added the phrase “*with addition of in-air pinniped groups and naming convention following Southall et al. 2019*” to provide clarity and address this comment.

### **2.3.1 Impulsive and Non-Impulsive Source Thresholds**

#### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 24:** In the footnote regarding kurtosis, the Commission suggested Guan et al. 2022 be added.

**Response:** NMSF has made this suggested addition.

#### **2.3.2.1 Weighted Cumulative Sound Exposure Level (SEL<sub>24h</sub>) Metric**

#### DEPARTMENT of TRANSPORTATION (DOT)

**Comment 25:** DOT requested clarification on how the thresholds account for exposure duration.

**Response:** Cumulative sound exposure level thresholds are abbreviated SEL<sub>24h</sub> to indicate that all sound occurring within a 24-h period be accounted for when using this metric.

### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 26:** In the section on Recommended Accumulation Period, the Commission asked for clarification on the phrase “*for situations where receivers are predicted to experience unusually long exposure durations. When does this occur such that TTS/PTS are determined over days?*”

**Response:** Associated with this phrase, NMFS provided the following footnote: “*For example, where a resident population could be found in a small and/or confined area (Ferguson et al. 2015) and/or exposed to a long-duration activity with a loud sound source, or where a continuous stationery activity is nearby an area where marine mammals congregate, like a pinniped pupping beach.*”

**Comment 27:** In the section on Recommended Accumulation Period, the Commission suggested the following phrase be deleted: “*that not all action proponents may have the ability to easily apply this additional component.*”

**Response:** NMSF has made this suggested edit.

**Comment 28:** For stationary sources and modeling absent animat modeling, the Commission commented that “*the 24-h accumulation period is inappropriate, often resulting in Level A harassment zones that far exceed Level B harassment zones. In the absence of relevant recovery data for marine mammals, the Commission advocates that animat modeling that considers various operational and animal scenarios should be used to inform the appropriate accumulation time for stationary sound sources. Such modeling could be incorporated into NMFS’s optional User Spreadsheet. The Commission recommends that NMFS prioritize resolving the issue of an appropriate accumulation time for SEL<sub>24h</sub> thresholds in the near future.*”

**Response:** Since the finalization of the 2018 Revised Technical Guidance (NMFS 2018), NMFS has been exploring ways to use animat modeling to inform accumulation periods for stationary sources associated with coastal pile driving. This work slowed considerably in the intervening years due to competing priorities, but NMFS hopes to start re-exploring this important concept again in 2024.

**Comment 29:** The Commission recommends, “*the SEL<sub>24h</sub> thresholds should account for the use of multiple sources by the relevant action proponent(s) in the same general area during the same timeframe. The Commission acknowledges the analyses are more complicated when both impulsive and non-impulsive are used. However, consideration of these factors is not insurmountable and could be incorporated into the optional User Spreadsheet tool or by other means (e.g., Shiny app). Therefore, the Commission recommends that NMFS provide a tool that incorporates the sound emitted from multiple sound sources operating in the same general area during the same timeframe for estimating ranges to SEL<sub>24h</sub> thresholds, when applicable.*”

**Response:** NMFS is in the process of considering how to best evaluate and account for multiple different sources associated with an activity (e.g., vibratory and impact pile driving). In addition to accounting for sound from multiple different sources, there is the consideration of what threshold to use, if there are both impulsive and non-impulsive

sources. As indicated by the Commission a new optional tool would need to be created, since our current optional User Spreadsheet tool does not allow for the evaluation of multiple different sources simultaneously.

**Comment 30:** The Commission commented that “*NMFS continues the approach of maintaining the dichotomy between sounds being either impulsive or non-impulsive does not reflective real-world conditions where animals are exposed to various types of sound (i.e., Very rarely do animals perceive only impulsive or only non-impulsive sound during the course of a day). As such, TTS studies involving complex sound (e.g., multiple types of sound sources, as well as single sources that emit both impulsive and non-impulsive sound) should be conducted.. Applying either the impulsive or non-impulsive threshold to compare SEL<sub>24h</sub> levels of complex sound results in either an overly conservative estimate or an underestimate of impacts. As such, the Commission recommends that NMFS partner with other Federal agencies and industry to fund and/or develop TTS studies that involve complex sound to better represent real-world conditions to which marine mammals are exposed.*”

**Response:** NMFS agrees and highlights understanding sound exposure from more complex sources, specifically in Appendix B (Research Recommendations; Section 1.5).

### NATIONAL SCIENCE FOUNDATION (NSF)

**Comment 31:** Under the last paragraph under Recommended Accumulation Period, NSF comments: “*Consider rewording (here and elsewhere). Since NMFS provides the user spreadsheet, it doesn’t really matter the action proponents level of sophistication. For example, one reason we chose to use the User Spreadsheet is to avoid questions about alternative models selected. So, while we might be capable of using an alternative model, we purposely chose to use the User Spreadsheet.*”

For clarification, NSF suggests this last paragraph be edited as the following: “*NMFS does not provide specifications necessary to perform exposure modeling and relies on the action proponent to determine the model that best represents their activity. However, as an alternative option, NMFS provides a simple means of approximating exposure for action proponent use (See NMFS Optional User Spreadsheet Tool).*”

**Response:** NMFS appreciates and understands NSF’s point. We have made the suggested edit.

### **2.3.2.2 Peak Sound Pressure Level (PK SPL) Metric**

#### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 32:** The Commission commented: “*Has SPLrms been used as [an] acronym? If so, it is spelled out in this footnote [footnote 34].*”

**Response:** The Commission is correct that the acronym RMS SPL had been previously used in the document. Thus, this Footnote is now corrected.

## 2.3.3 Development of AUD INJ Onset Thresholds

### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 33:** Regarding Table 8, the Commission asked: “*Why isn’t there a table for impulsive sounds too?*”

**Response:** There is not an equivalent Table 8 for impulsive sounds because there are not as many available marine mammal impulsive TTS datasets, as there are for marine mammals and non-impulsive sources (i.e., impulsive TTS data are only available for HF cetaceans, VHF cetaceans, and PW pinnipeds). Thus, impulsive thresholds were derived in a different manner. For hearing groups, where impulsive TTS onset data did not exist, Finneran (2023) derived impulsive TTS onset thresholds using the relationship between non-impulsive TTS onset thresholds and impulsive TTS onset thresholds for HF cetaceans, VHF cetaceans, and PW pinnipeds.

## III. Updating Acoustic Technical Guidance and Thresholds

### 3.1 Procedure and Timeline for Updating the Updated Technical Guidance

#### NATIONAL SCIENCE FOUNDATION (NSF)

**Comment 34:** NSF suggests retitling this Section “*Procedure and Timeline for Future Updates to the Acoustic Technical Guidance.*”

**Response:** Based on NSF’s suggestion, NMFS has retitled this Section “*Procedure and Timeline for Future Updates to the Technical Guidance.*”

#### APPENDICES: SPECIFIC COMMENTS BY SECTION

### Appendix A: Finneran Technical Report

#### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 35:** In the Table comparing abbreviations between the Updated Technical Guidance and Appendix A, The Commission suggests the word “translations” be used instead of “conversions.”

**Response:** NMFS has made the suggested edit.

### 3 Weighting Functions and Exposure Functions

#### BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)

**Comment 36:** BOEM asked when this section says “*there are no data showing frequency dependency of INJ in marine mammals: What about the Reichmuth PTS seal paper? What about*

specific mass cetacean strandings linked to frequency ranges from navy sonar testing? I.e. ones showing auditory injury in necropsies.”

**Response (NMFS and Navy):** Reichmuth et al. 2019 is acknowledged in the Updated Technical Guidance (e.g., “*Reichmuth et al. 2019 reported a PTS of 8 dB at 5.8 kHz in a harbor seal (PW) after exposure to a 4.1 kHz tone with cumulative SEL exposure of 199 dB (unweighted). Although these data are not suitable for directly deriving AUD INJ thresholds, they provide an opportunity to compare the resulting AUD INJ threshold value to actual PTS data. Note: The PTS onset threshold for PW pinnipeds is lower than the level (195 dB SEL24h) that resulted in PTS in Reichmuth et al. 2019.*”).

As for data hearing/inner ear data associated with marine mammal stranding events and particular sound sources (e.g., Navy mid-frequency sonar), while hemorrhaging around the ear has been reported with previous beaked whale stranding associated with the use of tactical mid-frequency sonar (Cox et al. 2006), the conditions associated with these stranding events is very different/extreme (i.e., mortality) compared to situations where marine mammals might experience NIHL in the wild. Furthermore, the types of data collected during these stranding events do not provide the level of detail tying a particular frequency to inner ear damage. Thus, the relevance of these types of data to establishing NIHL criteria is not fully justified.

Furthermore, in terms of “frequency-dependency,” this means data showing exposure levels sufficient to produce NIHL at several frequencies. Neither the Reichmuth et al. 2019 (single exposure frequency) nor stranding incidents (unknown received levels, no evidence of NIHL) provide information on the frequency-dependency of NIHL in marine mammals.

#### 4 Marine Mammal Species Groups

##### BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)

**Comment 37:** “*In section 4.3 (VHF cetaceans), where it says “Hearing sensitivity has been measured for several species within this group using behavioral or AEP measurements,” does NMFS really mean two (instead of several)?*.”

**Response:** Table A.1-1 and A.1-2 provide a list of audiograms considered to derive the composite audiogram for all marine mammal hearing groups, including VHF cetaceans. Within these two Tables, there are three different VHF cetacean species provided. However, remember that these two Tables only provide VHF cetacean species where *behavioral* audiograms have been obtained, while the sentence BOEM refers to also includes AEP measurements, which are not directly used to derive composite audiograms. For example, AEP measurements have been obtained for *Kogia* (Ridgway and Carder 2001), Amazon river dolphin (Popov and Supin 1990), and Baiji (Wang et al. 1992). See Southall et al. 2019 (Appendix 3) for a list of audiogram data for VHF cetaceans. Thus, this sentence is correct as written.

### 9 TTS/INJ Exposure Functions for Explosives

#### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 38:** The Commission pointed out “in Tables ES3 and 6 of the main text and Tables A.E-2 and A.9 of Appendix A some of the impulsive  $SEL_{24h}$  thresholds resulted in a 14- or 16-dB difference in the TTS and AUD INJ, when the difference should be 15-dB. For example, the AUD INJ  $SEL_{24h}$  threshold for OW pinnipeds would be 185 dB using the parameters in Table A.9. However, the resulting threshold is specified as 186 dB, which is 16-dB greater than the TTS threshold, not 15-dB.

*The Navy and NMFS have indicated<sup>7</sup> that the differences are due to rounding issues—that is, the thresholds are rounded to the nearest even integer when the fractional part is exactly equal to 0.5. That rounding approach is inconsistent with the manner in which NMFS rounds for other applications (e.g., numbers of takes, source levels, etc.) and should have been specified in the Updated Technical Guidance.*

*Further, because the  $K$  values in Table A.8 were rounded to the nearest dB, it is unclear what the fractional  $K_{TTS}$  and  $K_{AUD\ INJ}$  thresholds are. Thus, numerous thresholds in Tables ES3, 6, A.E-2, and A.9 cannot be recreated based on the information provided in Table A.8. For example, the impulsive AUD INJ threshold for LF cetaceans is 183.12 dB based on Table A.8, not 183.5 dB as denoted by the agencies. It is unclear whether  $K_{TTS}$  is 183.38 dB, 183.4 dB, or some other value. To ensure transparency and enable the public and users of the Updated Technical Guidance to calculate the resulting weighted thresholds, the Commission recommends that NMFS 1) specify how rounding was conducted for the various thresholds and provide the fractional  $K_{TTS}$  and  $K_{AUD\ INJ}$  impulsive thresholds in a table similar to Table 8 in the main text and 2) require the Navy to include the fractional  $K_{TTS}$  and  $K_{AUD\ INJ}$  for both impulsive and non-impulsive sources in Table A.8 of Appendix A for completeness, as well as transparency.”*

**Response (NMFS and Navy):** The 14/16 dB differences in the Tables were due to the rules for rounding. The issue does not occur in the revised version of the Navy Technical document (12/7) (i.e., correcting the  $C_s$ - $C_i$  value eliminated values ending exactly in .5, so numeric differences in the Tables are now consistent). Values in Tables are reported to three significant digits; reporting more than three significant digits (i.e., fractional dBs for  $K$  is not justified).

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<sup>7</sup> The Commission contacted NMFS with this question before submitting their final comment letter. Thus, NMFS worked with the Navy to provide an initial response to this question (as mentioned in the Commission’s comment).

## Appendix B: Research Recommendations for Improved Thresholds

### 1.1 Low-Frequency Cetacean Hearing

#### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 39:** In referring to the “The Subcommittee on Ocean Science and Technology (SOST) Interagency Task Force on Ocean Noise and Marine Life (ITF-ONML),” the Commission commented, “*We’ve been called the IWG-OSML for a number of years. Interagency Working Group on Ocean Sound and Marine Life. Maybe [a] footnote that this is our current name?*”

**Response:** NMFS edited the document to reflect the current name of this SOST ITF.

### 1.5 Sound Exposure to More Realistic Scenarios

#### NATIONAL SCIENCE FOUNDATION (NSF)

**Comment 40:** NSF asked “*What about distributed sources (e.g., airgun array of many small sources) vs larger, single point source? If not already, would this be appropriate to be noted/considered further here?*”

**Response:** NMFS feels NSF’s comment is already inherently addressed as the Section is currently written (i.e., This Section indicates “*Measurements from exposure to actual sound sources (opposed to tones or octave-band noise) under more realistic exposure conditions (e.g., more realistic exposure durations and/or scenarios, including multiple pulses/pile strikes and at frequencies below 1 kHz where most anthropogenic noise occurs) are needed*”).

### 1.10 Metrics and Terminology

#### BUREAU OF OCEAN ENERGY MANAGEMENT (BOEM)

**Comment 41:** BOEM suggested that updated refs to include Zeddies et al. 2022, Guan 2023?

**Response:** NMFS has added the suggested references to this Section.

### 1.11 Effective Quiet

#### DEPARTMENT OF ENERGY (DOE)

**Comment 42:** “*In DOE’s review we mainly have discussed the section on Effective Quiet. In particular –As more data become available, they would be useful in contributing to the better understanding of appropriate accumulations periods for the weighted SEL<sub>24h</sub> metric and NIHL [noise-induced hearing loss], as well as the potential of low-level (e.g., Copping et al. 2014; Schuster et al. 2015; Tougaard et al. 2020; Stöber and Thomsen 2021), continuously operating sources (e.g., alternative energy tidal, wave, or wind turbines) to induce noise-induced hearing loss.*”

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*“I have made a correction and an update directly in the draft, and some comments. We are having a larger conversation around this section. Notably, we are interested to see if there are examples beyond renewable energy that could be pointed to as additional sources of low-level continuously operating sound sources. We are also actively working on and keen to see more research done in this area, and some of it is in progress or planning but not ready for this draft comment period. We’d be curious to see if BOEM has comments on this section as well. As changes are made, we’d be interested in taking another look.*

*In the document I suggested updating a reference to the 2020 State of the Science Report. In that report, many interesting papers are cited, and I am including the relevant ones below in case of interest.”*

Hastie, G. D., Russell, D. J. F., Lepper, P., Elliott, J., Wilson, B., Benjamins, S., and Thompson, D. 2018. Harbour seals avoid tidal turbine noise: Implications for collision risk. *Journal of Applied Ecology*, 55(2), 684-693. doi:10.1111/1365-2664.12981 <https://tethys.pnnl.gov/publications/harbour-seals-avoid-tidal-turbine-noise-implications-collison-risk>

Pine, M. K., Schmitt, P., Culloch, R. M., Lieber, L., and Kregting, L. T. 2019. Providing ecological context to anthropogenic subsea noise: Assessing listening space reductions of marine mammals from tidal energy devices. *Renewable and Sustainable Energy Reviews*, 103, 49-57. doi:10.1016/j.rser.2018.12.024 <https://tethys.pnnl.gov/publications/providing-ecological-context-anthropogenic-subsea-noise-assessing-listening-space>.

Nedwell, J., and Brooker, A. 2008. Measurement and Assessment of Background Underwater Noise and its Comparison with Noise from Pin Pile Drilling Operations During Installation of the SeaGen Tidal Turbine Device, Strangford Lough. Report No. 724R0120. Report by Subacoustech Ltd. for Collaborative Offshore Wind Research into the Environment (COWRIE). [https://tethys.pnnl.gov/publications/measurement-assessment\[1\]background-underwater-noise-its-comparison-noise\[1\]pin-pile](https://tethys.pnnl.gov/publications/measurement-assessment[1]background-underwater-noise-its-comparison-noise[1]pin-pile)

Marmo, B. 2017. Operational noise from tidal turbine arrays and the assessment of collision risk with marine mammals. *The Journal of the Acoustical Society of America*, 141(5), 3921-3921. doi:10.1121/1.4988862 <https://tethys.pnnl.gov/publications/operational-noise-tidal-turbine-arrays-assement-collision-risk-marine-mammals>

Bevelhimer, M. S., Deng, Z. D., and Scherelis, C. 2016. Characterizing large river sounds: Providing context for understanding the environmental effects of noise produced by hydrokinetic turbines. *Journal of the Acoustical Society of America*, 139(1), 85-92. doi:10.1121/1.4939120 <https://tethys.pnnl.gov/publications/characterizing-large-river-sounds-providing-context-understanding-environmental>

Lepper, P., and Robinson, S. 2016. Measurement of Underwater Operational Noise Emitted by Wave and Tidal Stream Energy Devices. In A. N. Popper and A. Hawkins (Eds.), *The Effects of Noise on Aquatic Life II* (pp. 615-622), Springer: New York,

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NY. <https://tethys.pnnl.gov/publications/measurement-underwater-operational-noise-emitted-wave-tidal-stream-energy-devices> .

Lossent, J., Lejart, M., Folegot, T., Clorennec, D., Di Iorio, L., and Gervaise, C. 2018. Underwater operational noise level emitted by a tidal current turbine and its potential impact on marine fauna. *Marine Pollution Bulletin*, 131, 323-334. doi:10.1016/j.marpolbul.2018.03.024 [https://tethys.pnnl.gov/publications/underwater-operational-noise\[1\]level-emitted-tidal-current-turbine-its-potential-impact](https://tethys.pnnl.gov/publications/underwater-operational-noise[1]level-emitted-tidal-current-turbine-its-potential-impact)

Robertson, F., Wood, J., Joslin, J., Joy, R., and Polagye, B. 2018. Marine Mammal Behavioral Response to Tidal Turbine Sound (Report No. DOE-UW-06385). Report by University of Washington for U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, Washington D.C. <https://tethys.pnnl.gov/publications/marine-mammal-behavioral-response-tidal-turbine-sound>

Schmitt, P., Pine, M. K., Culloch, R. M., Lieber, L., and Kregting, L. T. 2018. Noise characterization of a subsea tidal kite. *Journal of the Acoustical Society of America*, 144(5), EL441-EL446. doi:10.1121/1.5080268 <https://tethys.pnnl.gov/publications/noise-characterization-subsea-tidal-kite>

Scholik-Schlomer, A. 2015. Where the Decibels Hit the Water: Perspectives on the Application of Science to Real-World Underwater Noise and Marine Protected Species Issues. *Acoustics Today*, 11(3), 36-44. <https://tethys.pnnl.gov/publications/where-decibels-hit-water-persepectives-application-science-real-world-underwater-noise>

Tougaard, J. 2015. Underwater Noise from a Wave Energy Converter Is Unlikely to Affect Marine Mammals. *PLoS ONE*, 10(7), 1-7. doi:10.1371/journal.pone.0132391 <https://tethys.pnnl.gov/publications/underwater-noise-wave-energy-converter-unlikely-affect-marine-mammals>

**Response:** NMFS is aware of the 2020 State of the Science Report, as well as many of the references DOE included in the comment. We appreciate DOE providing this list of relevant publications. NMFS has now cited the 2020 State of Science Report (Copping and Hemery 2020) in this Section (see Response to next Comment).

As to DOE's question: BOEM did not make any specific comments on this topic.

**Comment 43:** DOE commented that the following text reads awkwardly: “*As more data become available, they would be useful in contributing to the better understanding of appropriate accumulations periods for the weighted SEL<sub>24h</sub> metric and NIHL, as well as the potential of low-level (e.g., Copping et al. 2014; Schuster et al. 2015; Tougaard et al. 2020; Stöber and Thomsen 2021), continuously operating sources (e.g., alternative energy tidal, wave, or wind turbines) to induce noise-induced hearing loss,*” stating that the text juxtaposes renewable energy with hearing loss, although there isn't evidence for it and is generally lower than ambient. More research is of interest, just, not at a high concern level for hearing loss. Perhaps this could be clarified a bit to be low decibel level, or similar, in case taken out of context. DOE suggested the following references be considered:

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A.E. Copping and L.G. Hemery (Eds.), OES-Environmental 2020 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World. Report for Ocean Energy Systems (OES). (pp. 18-26). doi:10.2172/1632880

Kulkarni, S. S., & Edwards, D. J. (2022). A bibliometric review on the implications of renewable offshore marine energy development on marine species. *Aquaculture and Fisheries*, 7(2), 211-222.

**Response:** NMFS edited this sentence as follows (edits underlined): “*As more data become available, they would be useful in contributing to the better understanding of appropriate accumulations periods for the weighted SEL<sub>24h</sub> metric and NIHL, as well as if there is potential for low-level (e.g., Copping et al. 2014; Schuster et al. 2015; Copping and Hemery 2020; Tougaard et al. 2020; Stöber and Thomsen 2021; Kulkarni and Edwards 2022), continuously operating sources (e.g., alternative energy tidal, wave, or wind turbines) to induce noise-induced hearing loss or not (i.e., below effective quiet).*”

NMFS agrees that lower level sources are not as high of a concern as far as the potential for NIHL. Having more data to support this assumption would be useful and was the intent of mentioning them in this sentence because often studies associated with the operation of renewable sources (e.g., wind turbines) do make these comparisons/calculations directly (i.e., Stöber and Thomsen 202).

### Appendix C Updated Technical Guidance Review Processes: Peer Preview, Federal Agency Review, and Public Comment

#### 1.1 Peer Review

##### THE MARINE MAMMAL COMMISSION (The Commission)

**Comment 44:** The Commission suggests the following edits (in italics) to the sentence: For the peer review of this document (October/November 2022), potential qualified peer reviewers were nominated by the “*Marine Mammal Commission (MMC) and its Committee of Scientific Advisors on Marine Mammals*. Nominated peer reviewers were those with expertise in *marine mammal bioacoustics, noise-induced hearing loss or auditory injury,*” and/or acoustics in the marine environment.

They also suggested deleting the following sentence: “*The steering committee consisted of one of MMC’s Commissioners (Dr. Frances Gulland) and two members of [the] Committee of Scientific Advisors (Dr. Aaron Thode and Dr. Sue Moore).*”

**Response:** NMFS has made the suggested edits.

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