Request to National Oceanic and Atmospheric Administration (NOAA) for Incidental Take Regulations Governing Explosive-Severance Activities Conducted during Structure-Removal Operations on the Outer Continental Shelf (OCS) of the Gulf of Mexico (GOM)

(A response to Subpart I — MMPA Petitioning Requirements at 50 CFR 216.104)

(1) A Detailed Description of the Specific Activity or Class of Activities That Can Be Expected To Result in Incidental Taking of Marine Mammals;

During exploration, development, and production operations for mineral extraction on the Gulf of Mexico (GOM) Outer Continental Shelf (OCS), the seafloor around activity areas becomes the repository of temporary and permanent equipment and structures. In compliance with OCS Lands Act (OCSLA) regulations and Minerals Management Service (MMS) guidelines, operators are required to remove seafloor obstructions from their leases within one year of lease termination or after a structure has been deemed obsolete or unusable. To accomplish these removals, a host of activities are required to (1) mobilize necessary equipment and service vessels, (2) prepare the decommissioning targets (e.g., piles, jackets, conductors, bracings, wells, pipelines, etc.), (3) sever the target from the seabed and/or into manageable components, (4) salvage the severed portion(s), and (5) conduct final site-clearance verification work. The MMS has recently completed a programmatic environmental assessment (PEA) that evaluated the potential environmental impacts of these structure-removal/decommissioning activities on the GOM OCS (USDOI, MMS, 2005). No potentially-significant impacts were identified for air and water quality; marine mammals and sea turtles; fish, benthic, and archaeological resources; or other OCS pipeline, navigation, and military uses. However, of all the activities analyzed, those involving target-severance present the greatest opportunity for potential impact on individual marine mammals proximal to removal operations. This request incorporates by reference all of the applicable sections of the Structure-Removal PEA since its scenarios and analyses incorporated the latest operation/activity information and best available science,

There are two primary methodologies used in the GOM for cutting decommissioning targets; nonexplosive and explosive severance. Nonexplosive methods include abrasive cutters (sand and abrasive-water jets), mechanical cutters (e.g., carbide or rotary), diamond wire cutting devices, and cutting facilitated by commercial divers using arc/gas torches. Though relatively slow and potentially harmful to human health and safety (primarily for diver severances), the Structure-Removal PEA analyses clearly indicate that nonexplosive-severance activities have little to no impact on the marine environment and would not result in incidental take of marine mammals.

Explosive-severance activities use specialized charges to achieve target severance. Unlike most nonexplosive methods, severance charges can be deployed on multiple targets and detonated nearly-simultaneously (i.e., staggered at an interval of 900 msec) effecting rapid severances. Coupled with safe-handling practices, the reduced “exposure time” and omission of diver cutting also makes explosive severance safer for offshore workers. However, since the underwater detonation of cutting charges generates damaging pressure waves and acoustic energy, explosive-severance activities have the potential to cause incidental take of proximal marine mammals. For this reason, MMS is requesting incidental-take authorization/regulations governing <u>only</u> the explosive-severance activities that could be conducted under OCSLA decommissionings.

Explosive-Severance Introduction

A number of explosive severing charges have been designed for use in decommissioning operations on the GOM OCS. Depending on their configuration, explosive charges can be deployed and detonated on almost every OCS target in all water depths. Essentially, explosive-severance tools are designed to sever their targets in three fundamental ways; (1) mechanical distortion (ripping); (2) high-velocity jet cutting; and (3) fracturing or "spalling."

Mechanical distortion is best exhibited with the use of explosives such as standard and configured bulk charges. Bulk charges use the shock wave and outwardly expanding gases created by their detonation to apply stress to the proximal target, with the ensuing strain resulting in mass distortion and rupturing (Cooper and Kurowski, 1996). If the situation calls for minimal distortion and an extremely clean severing, most contractors rely upon the jet-cutting capabilities of shaped charges. In order to 'cut' with these explosives, the specialized charges are designed to use the high-velocity forces released at detonation to transform a metal liner (often copper) into a thin jet that slices through its target at a single location or along a delineated line (CSA, 2004). The least used method of severing on the GOM OCS is fracturing. In fracturing, a specialized charge(s) is used to focus pressure waves into the target wall and use refraction forces to spall or fracture the steel on the opposing side (NRC, 1996). Even if the target is not completely severed, the fracturing/heat stress often allows the lift vessel to "jerk" the spall line apart.

There is a wide range of explosive materials available for use in severing charges in GOM decommissioning activities. Severing contractors are responsible for assessing the type of material needed based upon its characteristics in relation to the target size and design, specific marine conditions, and potential methods of charge deployment. Several of the key characteristics of explosive materials are defined in Table 1, and Table 2 lists the specific properties of most of the explosive materials commonly used in severance charges.

Table 1

Key Characteristics of Explosive Materials

Characteristic	Definition as Applied to Explosive Material
Velocity of Detonation	The speed in which the explosive changes through a chemical reaction from a solid (or liquid) state to a gaseous state. *Low Velocity Explosives* change from a solid to a gaseous state over a sustained period up to 400 m/sec (1,300 ft/sec). *High Velocity Explosives* change to a gaseous state almost instantaneously at roughly 1,000 m/sec (3,821 ft/sec) to 10,300 m/sec (33,795 ft/sec), producing a very high pressure wave (up to 5,800,000 psi or 40 mPa).
Density	The amount of a substance contained within a specific area (the ratio of the mass of a substance to its volume). Density is an important characteristic of explosives, as the detonation rate relates directly to the square of the density.
Brisance *or* Shattering Effect	The rapidity with which an explosive develops its maximum pressure. *Brisance* is normally compared to Trinitrotoluene (TNT=1.00) and numbers >1.00 are desirable, and gives an estimate of the destructive power of the given explosive on steels.
Specific Energy *or* Enthalpy	The heat available from a fuel, or in the case of explosives, the working performance of explosive material per kilogram.
Strength *or* Weight Strength	The ability of a given amount of explosive to perform useful work (as in rock and earth blasting) and is compared to blasting gelatin, a composition of 92% nitroglycol and 8% guncotton, that has a strength of 100%.

Table 2

Key Properties of Explosives Used in Severing Activities (DEMEX, 2003)

Name	Principal Uses*	Velocity (m/sec)	Density	Brisance	Water Resistance	Specific Energy (watts/g)	Weight Strength (%)
Initiating Explosives (Primary)							
Lead Azide	4	5,300	5.00	0.39	Fair	466	39
Diazodinitrophenol (DDNP)	4	6,600	1.63	0.92	Fair		76
Lead Styphnate	4	5,200	2.90	0.40	Fair	470	40
High Explosives (Secondary)							
Pentaerythritol tetranitrate (PETN)	2,3,5	8,400	1.70	1.73	Good	675	96
Cyclonite (RDX)	1,2,3,5	8,750	1.76	1.57	Good	675	93
Homocyclonite (HMX)	1,2,5	9,100	1.91	1.45	Good	664	93
Trinitrotoluene (TNT)	1,2,3,5	6,900	1.65	1.00	Good	488	74
Ammonium Picrate (Explosive D)	1,2,5	7,150	1.60	1.25	Poor	321	70
Nitroglycerin (NG)	1,5	7,600	1.81	1.81	Fair	720	96
Nitroglycol (NGC)	1,5	7,300	1.48	2.06	Fair	780	105
Nitromethane (NM)	1,2,5	6,290	1.14	1.33	Fair	533	86
Hexanitrohexaazaisowurzitan (HNIW)	1,2,5	10,300	2.10				
High Explosives (Tertiary)							
Composition B	1,2,5	7,840	1.68	1.30	Good		
Composition C-4	1,2,5	8,040	1.59	1.32	Good		
Cyclotol 70/30	1,2,5	8,060	1.73	1.31	Good		
Octol 75/25	1,2,5	8,643	1.81	1.16	Good	503	
Plastic Bonded (PBX9404)	1,2,5	8,800	1.86	1.37	Good		
Pentolite 50/50	1,2,5	7,465	1.66	1.22	Good	588	
Detasheet	1,2,5	7,300	1.62	1.12	Good	495	
Torpex (Aluminized Explosive)	1,2,5	7,500	1.81	1.64	Good	867	
Blasting Gelatin	1,2,5	7,300	1.50	1.91	Fair	740	100
HTA-3 Aluminized Explosive	1,2,5	7,870	1.90	1.19	Good	573	
Binary Explosives							
Binex 42P	1	4,000	1.50		Good		
Helex (Liquid, Solid)	1,2,5	7,100	1.14		Good		85
PLX (Liquid, Liquid)	1,2,5	6,200	1.14	1.27	Good	535	85
Kinepak (Solid, Liquid)	1,5	6,100	1.15		Good		80

*Principle Uses
1—Demolition Charges
2—Shaped Charges
3—Detonating Cord
4—Detonator Primer
5—Metal Severance

Bulk-Charge Cutters

Besides being the most common explosive cutters, bulk charges are the most often-used severing tools used on the GOM (CSA, 2004). As the name implies, the charge is made up of a bulk amount of explosive material (e.g., Composition B, C-4, HMX, etc.), designed to sever their targets using the mechanical distortion and subsequent ripping resulting from the shock wave and expanding gas bubble released during the charge's detonation. Bulk charges can be developed and engineered in several different configurations depending upon marine conditions, available support services, and target characteristics.

For internal cuts on surface accessible or "open-pile" targets, bulk charges can be deployed by hand or with the deck crane, lowering the charge to the required cut depth with ropes and harnesses. Divers and/or ROV's are required for the placement of externally-deployed bulk charges or in cases where internal bulk cutters are needed to sever subsea targets (e.g., skirt piles, casing stubs, and well heads). Depending on the charge configuration, divers may also be necessary to deploy some bulk cutters for the internal severing of surface-accessible, large-diameter caissons.

Standard Bulk Charge

Standard bulk charge cutters rely upon minimal designs that center on a simple container that holds the main charge and booster. Depending upon the explosive materials' pliability or viscosity, the charge container may consist of a section of polyvinylchloride (PVC) pipe, capped at both ends. A harness assembly consisting of nylon/polypropylene ropes or stainless wire line is generally fixed to the container or housing, allowing the explosive technicians (blasters) to lower the charge into the target or for guiding and positioning charges into subsea targets by ROV's or divers. The rope or line also gives the blaster a place to secure the fragile detonation cord and or signal wire so that it does not become chafed or damaged during the charge placement. Once the charge is at the proper cut depth, a brace or "t-bar" assembly is fastened to the rope/wire to maintain the charge's positioning and allow the blaster (and all other personnel, equipment, vessels, etc.) to be "backed-off" the target for detonation.

Double-Detonation Bulk Charge

Similar to a standard bulk charge cutter, the double-detonation bulk charge employs two or more boosters and detonation signals, often located at opposite ends of the cutter. When initiated, the forces of the dual detonations collide with one another at the midpoint of the charge, creating an outward focused force used to distort and mechanically sever its target (Manago and Williamson, 1998). Like a standard bulk charge, double-detonation cutters are assembled with simple components (i.e., PVC pipe, duct tape, rope/wire harnesses, etc.) making them fairly inexpensive and easy to develop.

Ring-Configured Bulk Charge

The ring-configured charge is a bulk charge design that employs a donut or ring-shaped charge housing that allows more of the explosive to be placed closer to the target wall. The increased efficiency often allows the overall charge weight to be reduced by 10-15%, over standard bulk charges for the same size target (NRC, 1996). Like standard bulk charge housings, the ring-configured charge form can be built from PVC tubing, making them easy to design and deploy. Borrowing from double-detonation charges, the ring charge can also be designed with multiple boosters and detonation signals, further enhancing its effectiveness. One alternation on the charge's housing design uses flexible tubing such as semi-rigid pipe or fire hoses to form a "flexible linear" bulk charge. Deployed only by divers, the flexible charge housing is situated around the inner periphery (internal cut) or outer diameter (external cut) of a target and braced into position with fill material or sandbags (DEMEX, 2003).

Focusing-Configured Bulk Charge

Focusing-configured bulk charges use specifically-designed charge housings to direct their explosive power towards the target in a horizontal manner; ultimately increasing the efficiency of the cut and reducing the flaring that commonly occurs in standard bulk charges. These charges take advantage of the principle of 'tamping' or 'stemming;' an energy enhancement process that uses overlying layers of steel and or concrete in the charge housing to confine and focus the explosives (CSA, 2004). Much more complex than other bulk charges, the housings for focusing charges must be specially fabricated and sized for each particular target diameter prior to mobilizing offshore. The overall weight of the charge, housing, and tamping material often necessitates cable harnesses and handling duties are delegated to a deck crane; especially for large diameter targets.

Shaped-Charge Cutters

Unlike the ripping affect achieved by bulk cutters, shaped charges are intended to sever targets by jet-cutting. Shaped charges utilize special housings that are designed to create a cavity or void between the explosive material and target wall. Employing a phenomenon known as the Monroe Effect, the shock wave produced at detonation accelerates and deforms the shaped housing into a high-velocity (24,000-27,000 fps) plasma jet within the void space (JRC, 2002). The formed jet is able to cut through steel targets of various thicknesses based upon the void shape and the "stand-off" distance to the target wall. Because the "cutting" efficiency of shaped charges is several times greater than that of bulk charges, they can often greatly reduce the net explosive weight needed to sever similar-sized targets. However, since shaped charges require an air gap within the void/stand-off space for proper jet formation, waterproof casings and casing deployment devices require prefabrication several weeks in advance; ultimately resulting in four to five times higher cutter costs (NRC, 1996).

Conical-shaped charges (CSC) have the cavity created in the shape of a cone designed to cut round holes and to penetrate deep into targets. Industry's primary use of CSC's is in the development of perforating guns; multiple CSC assemblies placed down boreholes and detonated to penetrate through the drill casing and into the surrounding geologic strata for the extraction of hydrocarbons. Linear-shaped charges (LSC) have a void shaped into a chevron or inverted "V" along its entire length, and they are designed to cut linearly through its target. Subcontractors use LSC's on a wide range of decommissioing targets in many different configurations depending on cutting requriements.

Internally-Deployed Shaped Charges

If LSC's are deployed to sever piles, the charge housings are required to be curved to a specific arc (depending upon the inner diameter (ID) of the target) with the void space on the convex surface. Likewise, the waterproof casing(s) require the same orientation to lie perfectly against the inner periphery of the target wall, holding fast to the charge housing inside while accounting for the proper stand-off distance (Saint-Arnaud et al., 2004). Since most severing targets are not entirely concentric and are often fabricated with "stabbing guides" (internal alignment braces within piles), the LSC housing and respective casing cannot be constructed or deployed as a single, 360º component. For this reason, some internal LSC's are designed to be deployed via a charge-delivery device that can be inserted into a target retracted, navigated past any obstructions to the required cut depth, and then mechanically actuated to position the casings (generally 2 or 4) tightly against the target wall. Another common practice relies upon divers to deploy each component (i.e., charge housing, det-cord, and bracing), especially when used to sever large diameter caissons. Once at the proper cut depth and oriented, the diver braces the charge housing snug to the target with simple turnbuckle rigging.

When LSC's are used for internal severance of conductors, "casing cutter" devices have been designed and prefabricated with compensation/tolerances for the specific ID of most of the common casing sizes. Though used in some small-pile decommissioning work, the primary use of casing cutters in the GOM is for well-workover operations and plugging and abandonment (P&A) activities. Some well activities necessitate severing the smaller, internal casings that are pulled to allow larger casing cutters to sever the outer casings or conductor itself. Because of the small ID of most casings, most of the charges use less than 3-4 lb of explosives to achieve effective cuts.

Externally-Deployed Shaped Charges

Linear shaped charges can also be used to conduct external severings. As with internally-deployed LSC's, externally-deployed charge housings are required to be curved to a specific arc, but in this case, dependent upon the target's outer diameter (OD). The void space is also required to be formed on the concave surface so that its cutting jet is directed inward. Similarly, the casing(s) are oriented in the same manner with the proper stand-off distance figured into its design depending upon the wall thickness of the intended target. Since external LSC's generally encounter fewer obstructions, the housings and waterproof casings are often constructed in two piece designs, which can be deployed by either divers or via specialized ROV configurations. This feature is highly-beneficial for above-mudline (AML) cutting, but as with other external, below-mudline (BML) severing methods, operators must first employ sediment jetting around the target to allow for diver/ROV access and charge deployment.

Fracturing-Charge Cutters

Fracturing charges are currently the least used explosives cutting tools on the GOM. Generally available as "plaster" or shock-refraction cutters, fracturing charges sever targets by taking advantage of the reflected shock wave resulting from the initial force developed during detonation (NRC, 1996). The wave propagation results in spalling or fracturing of the target wall opposite of the charge, with the ensuing gas bubble expanding and causing the completion of the cut. Not very effective on wells or grouted piles, fracturing charges are primarily available in the form of an adhesive-backed tape, which has always required divers for deployment (CSA, 2004). Severing contractors are currently working on improvements to the charges, including charge delivery systems that could negate the need for divers.

Explosive-Severance Targets

Well-Related Targets

A well is a series of casings (interlocking steel tubing) set into the seafloor through which the initial drilling and later production operations are conducted. The outer casing or conductor could be up to 48 in (122 cm) in diameter and is fixed to the surrounding formation with cement forced down and through the drill pipe. Successive casings become narrower in diameter as the well deepens, with each subsequent string set into the previous with a wedge of cement called a "shoe." When a platform is used for shallow-water production activities, the conductor is extended to a lower deck of the facility where specialized production fittings (Christmas trees) can be attached to the casing head. This assembly of casing "strings," casing or tubing heads, and specialized equipment makes up the wellhead. A subsea production device consists of valve assemblies designed to help produce the well, test the system, or shut-in operations if warranted. Subsea trees are assembled completely topside and then lowered to a foundation embedded in the seafloor by the drilling vessel. Once set, the production device is clamped to the casinghead using mechanical or hydraulic controls.

Platform-Related Targets

Consisting of one or more above waterline decks tied atop a submerged tubular frame, jacketed platforms are the most common non-well structures found in the GOM. There are currently over 2,375 jacketed platforms in place on the OCS, making up about 60 percent of all bottom-founded, surface structures. Brought on location in sections, the platforms are secured to the seafloor by piles driven through the jackets legs, which may number anywhere from 3 to 12 or more with leg and pile diameters spanning from around 18 in (46 cm) to over 96 (244 cm) in (NRC, 1996). Commonly called conventional piles, these pilings are driven tens to hundreds of feet into the seabed and are often grouted or cemented to the surrounding jacket leg for added stability. Once leveled, the deck assemblies, collectively called topsides, are welded to the tops of the piles protruding from the jacket legs with additional bracing where necessary. Most jacketed platforms are typically placed above previously drilled exploration wells to support their production, additional drilling operations, and equipment housing.

In situations where additional load support and/or storm protection is needed, support bracing and sleeves are added to the lower jacket to accept skirt piles. Similar to conventional pilings, the skirt piles are driven deep into the seabed to pin the bracing and jacket and depending upon environmental conditions and platform requirements skirt piles may also be grouted to their surrounding sleeves. In many circumstances, platforms use both conventional piles through the jacket legs in addition to braced skirt pilings to compensate for extreme load weights and stresses.

Caissons are the second most prolific (30%) surface structures installed in the GOM with over 1,215 structures located primarily on the shallow shelf. Simpler in design and fabrication than traditional jacketed platforms, most caissons consist of a steel pipe of a single diameter that generally ranges from 36 (91 cm) to 96 in (244 cm) (NRC, 1996). The caisson pipe is driven over existing wells to an adequate depth that will allow for shoring against varying sea states. Though primarily installed for well protection, some caissons may also be used as foundations for equipment and terminations points for pipeline operations. In locations with multiple wells and/or deeper water depths, tapered caissons may be employed. The tapered caisson employs a large diameter pipe at and below mudline (10-15 ft), which tapers to a smaller diameter in the water column and at the surface. Depending on the level and type of operation, some caissons may also use conventional or skirt piles to enhance their structural support, with the resulting tripod structure utilizing the caisson as the main leg of the structure.

Similar to conventional platforms, well protectors consist of small piled jackets (with legs generally less than 36 in), which may or may not support decking. Used primarily to safeguard producing wells and their associated production trees from boat damage and debris, the design of most well protectors tends to avoid the large tubulars and deck reinforcements often necessary for supporting drilling and production equipment. There are currently over 420 well protectors deployed in the shallow shelf areas of the GOM (<60 m), accounting for around 10 percent of all bottom-founded, surface structures.

Because of the increasing complexity of platform designs and the growing need for multi-staged salvage operations, contractors are often required to sever horizontal and diagonal members (bracings) on the submerged platform jackets. These braces provide support and stiffening to the jacket assembly, creating a tubular "web" between the platform legs. Diagonal and horizontal cuts on the members allow the jacket to be divided into sections. The decreased weight of the prepared section permits decommissioning contractors to take advantage of smaller lift vessels.

Mooring- and Pipeline-Related Targets

Deepwater operations in the GOM often use anchored/moored facilities such as tension leg platforms (TLP's), spars, and mobile offshore production units (MOPU's; converted semisubmersible drilling rigs). When their anchors cannot be retrieved during decommissioning operations or in an emergency, the mooring components (e.g., chains, cables, synthetic lines, TLP tendons, anchors, etc.) would need to be severed. Explosive-severance tools can also be used to cut pipelines and their components (e.g., couplings, valve assemblies, etc.) and cement or concrete formed structures and foundations (employed to secure moorings, tendons, and riser assemblies).

Explosive-Severance Scenarios

The explosive-severance activities proposed under this petition are grouped into five blasting categories (e.g., very small, small, standard, large, and specialty); each based upon the specific range of charge weights. Depending on the design of the target and other variable marine conditions, the severance charges developed under each of these categories could be designed for use in either a BML or AML configuration. These factors, combined with an activity location within either the shelf (<200 m) or slope (>200 m) species-delineation zone, results in 20 separate severance scenarios (Table 3).

Table 3

Blasting Category Parameters and Associated Severance Scenario Numbers

Blasting Category	Charge Range	Configuration	Species-Delineation Zone	Scenario Number
Very-Small Blasting	0-10 lb	BML	Shelf (<200 m)	A1
			Slope (>200 m)	A2
	0-5 lb	AML	Shelf (<200 m)	A3
			Slope (>200 m)	A4
Small Blasting	>10-20 lb	BML	Shelf (<200 m)	B1
			Slope (>200 m)	B2
	>5-20 lb	AML	Shelf (<200 m)	B3
			Slope (>200 m)	B4
Standard Blasting	>20-80 lb	BML	Shelf (<200 m)	C1
			Slope (>200 m)	C2
	>20-80 lb	AML	Shelf (<200 m)	C3
			Slope (>200 m)	C4
Large Blasting	>80-200 lb	BML	Shelf (<200 m)	D1
			Slope (>200 m)	D2
	>80-200 lb	AML	Shelf (<200 m)	D3
			Slope (>200 m)	D4
Specialty Blasting	>200-500 lb	BML	Shelf (<200 m)	E1
			Slope (>200 m)	E2
	>200-500 lb	AML	Shelf (<200 m)	E3
			Slope (>200 m)	E4

Depending upon operator preferences and certain marine, operational, an engineering conditions, each of the 20 explosive-severance scenarios could employ any one or combination of bulk-, shaped-, or fracturing-charge cutters to be used on any platform-, well-, mooring-, or pipeline-related target.

(2) The Date(s) and Duration of Such Activity and the Specific Geographical Region Where It Will Occur;

Decommissioning operations conducted under OCSLA authority can occur on any day of a given year during the time period of the rule under petition (5 years). Operators often schedule most of their decommissionings from June to December (approximately 80%; Figure 1) to take advantage of the often calm seas and good weather and when structure installations tend to decrease – since both commissioning and decommissioning operations compete for the same management groups, equipment, vessels, and labor force (TSB and CES, LSU, 2004).

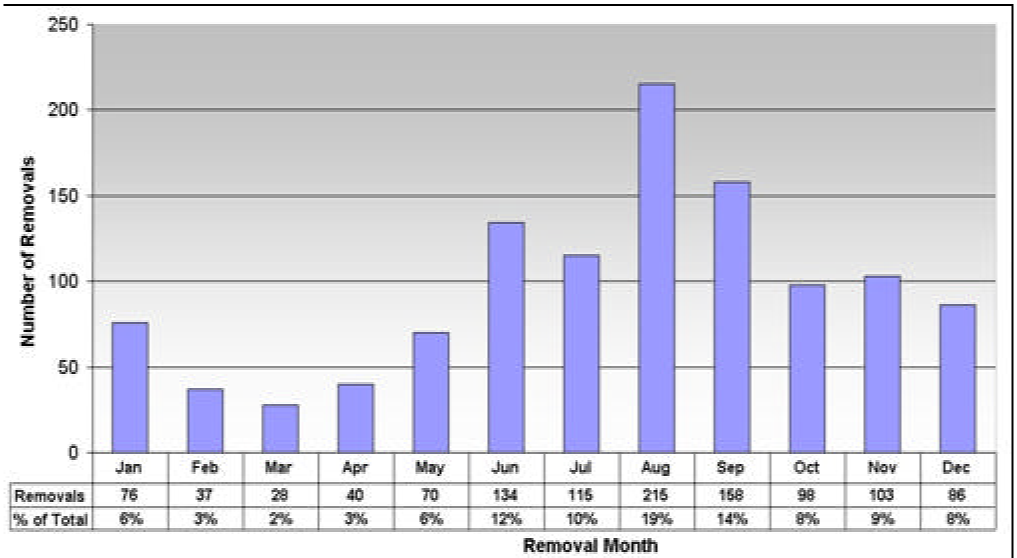

Figure 1 "Seasonal" Trends of Removal Operations Using Both Explosive- and Nonexplosive-Severance Tools from 1994-2003 (Source: MMS Data)

Depending upon the target, a complete decommissioning operation may span several days or weeks; however, the explosive-severance activity or "detonation event" for most removal targets (even those with multiple severances) only last for several seconds because of charge staggering (i.e., 900 msec intervals). For complex targets or in instances where the initial explosive-severance attempts are unsuccessful, more than one detonation event may be necessary per decommissioning operation. Even though hours or days may pass to allow for necessary mitigation measures and redeployment of new charges, each detonation event would similarly last for seconds.

During the past 10 years (1994-2003), there has been an average of 156 platform decommissionings per year, with over 60 percent involving explosive-severance activities (Table 4). In addition to historical activity averages, many of the older, nominally-producing structures in the mature GOM fields are beginning to near decommissioning age; subsequently lending to an increase in removal operations. Despite advancements in nonexplosive-severance methods and the additional requisite marine protected species (MPS) mitigation, MMS expects explosive-severance activities to continue being used in at least 63 percent of all platform removals for the foreseeable future. See Appendix A of the Structure-Removal PEA for additional forecasting discussions.

Table 4

Platform Removals from 1994 to 2003 (Source: MMS Data)

Severing Method	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Average/Year
Nonexplosive	44	42	101	79	48	67	52	48	42	55	58 (37%)
Explosive	120	120	55	113	42	80	102	69	165	118	98 (63%)
Total/Year	164	162	156	192	90	147	154	117	207	173	156

Explosive well-severance activities are often performed as secondary projects under P&A activities or left after P&A work to be ancillary targets during associated platform-removal operations, as a result, permit documents are not specific as to the proposed severance method. Even though limited information exists, MMS's database indicates that an average of 534 permanent P&A activities have occurred annually since 1994 (Table 5).

Table 5

Permanent Well Abandonments from 1994 to 2003 (Source: MMS Data)

Well Type	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Average/Year
Exploratory	308	232	330	406	240	341	386	317	338	363	326 (61%)
Development	197	165	240	278	215	191	239	223	134	192	207 (39%)
Total / Year	505	397	570	684	455	532	625	540	472	555	533 (100%)

Based upon industry estimates, MMS projects that approximately 17 percent of well severances may be conducted with explosive cutters. Applying this percentage to the permanent P&A activity rates (with standard deviation applied for ranges), MMS estimates that 72-105 explosive well severances could occur annually.

In 2002, MMS contracted Louisiana State University's Center for Energy Studies (CES) to prepare a modeling report, *Modeling Structure Removal Processes in the Gulf of Mexico*, addressing platform-removal forecasting needs (Kaiser et al., in preparation). The framework for most of the modeling was difficult to develop because most of the important factors involved with decommissionings are not observable and often impossible to incorporate. These unquantifiable variables include the direct / indirect costs, human safety concerns, environmental issues, the potential "cost of failure," operator / contractor experiences and preferences, scheduling, and the configuration and reliability of the cutter itself. Despite caveats, several effective methodology and economic-based models were developed and analyzed in the report. The primary projections from the report's "pessimistic" and "optimistic" forecasting models (Section 1.3.4; Kaiser et al., in preparation) were reviewed to determine annual averages and ranges for each of the five-year periods, and the results for the two most concurrent / applicable periods are presented in Table 6.

Table 6

Projected Number of Platform-Removal Operations Using Explosive Severing Tools

Forecasting Model I ("Pessimistic")					
Forecast Period	Caissons	Well Protectors	Jacketed Platforms	Period Total	Annual Period Average
2002-2006	111	73	288	472	94
2007-2011	152	63	386	601	120
Forecasting Model II ("Optimistic")					
Forecast Period	Caissons	Well Protectors	Jacketed Platforms	Period Total	Annual Period Average
2002-2006	199	105	494	798	160
2007-2011	232	106	502	840	168
Annual Range for Forecast Period 2002-2006: 94—160					
Annual Range for Forecast Period 2007-2011: 120—168					

From *Modeling Structure Removal Processes in the Gulf of Mexico* (Kaiser et al., in preparation).

Based upon a review of the historical trends, industry projections, and recent forecast modeling, MMS estimates that between 170 and 273 explosive-severance activities would occur annually. Table 7 lists the estimated ranges of each severance scenario for platform and well and total annual averages.

Table 7

Explosive-Severance Projections for the Proposed Action

Explosive-Severance Scenario	Annual "Platform" Severance Projections		Annual "Well*" Severance Projections		Annual "Combined" Projection Totals	
	(low)	(high)	(low)	(high)	(low)	(high)
A1	13	18	9	13	22	31
A2	2	5	1	2	3	7
A3	8	12	3	5	11	17
A4	3	6	1	2	4	8
B1	14	20	19	24	33	44
B2	4	8	3	4	7	12
B3	5	9	4	7	9	16
B4	2	6	1	2	3	8
C1	22	35	20	26	42	61
C2	4	9	2	4	6	13
C3	8	13	4	6	12	19
C4	2	5	3	5	5	10
D1	5	8	4	8	9	16
D2	0	1	1	3	1	4
D3	1	2	1	2	2	4
D4	0	1	0	0	0	1
E1	1	2	0	0	1	2
E2	0	0	0	0	0	0
E3	0	0	0	0	0	0
E4	0	0	0	0	0	0
Total	**94**	**160**	**76**	**113**	**170**	**273**

* Well projections include pipeline and mooring severance estimates.

The proposed explosive-severance activities could occur in all water depths of the Central and Western Planning Areas (CPA and WPA) and a portion of the Eastern Planning Area (EPA) offered under Lease Sale 181/189 (Figure 2). Water depths in the area of the proposed action range from 4 to 3,400 m (13-11,155 ft), with the majority of existing facilities and wells (Figure 3) found within the CPA, concentrated on the upper shelf waters (<200 m; 656 ft) off of Louisiana.

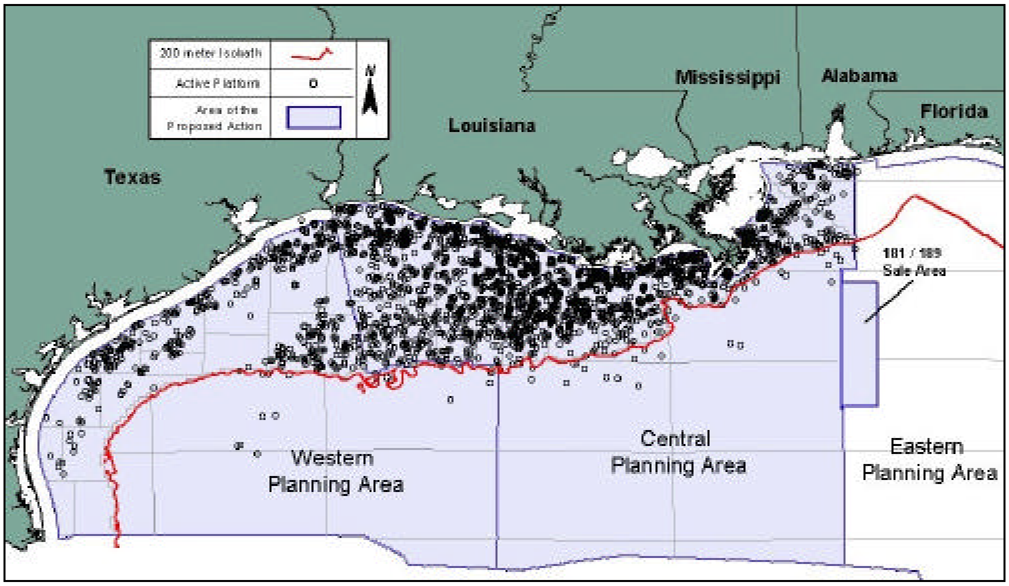

Figure 2 Proposed Explosive-Severance Activity Area Showing Active Platform Distribution

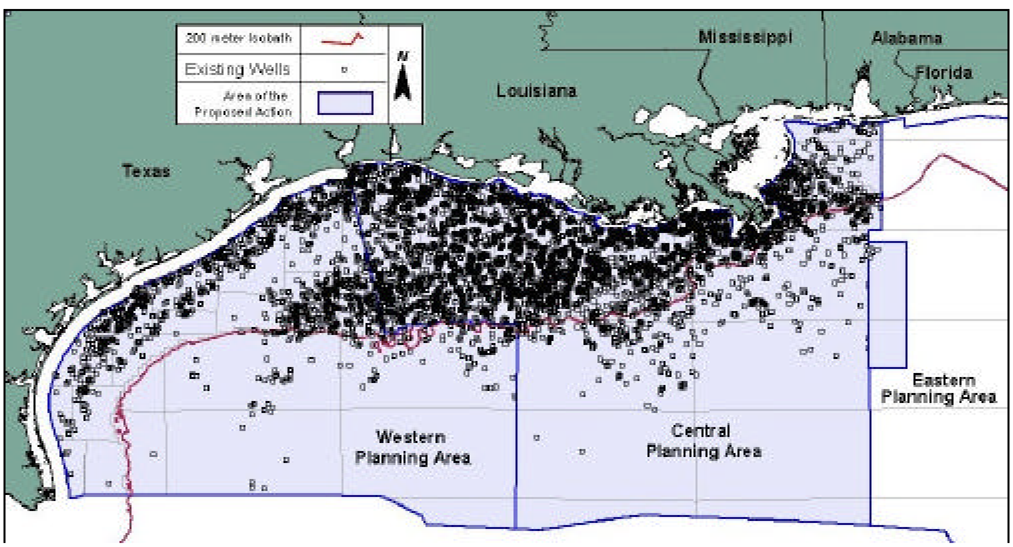

Figure 3 Proposed Explosive-Severance Activity Area Showing Existing Well Distribution

(3) The Species and Numbers of Marine Mammals Likely To Be Found within the Activity Area;

Table 8 lists the marine mammals and associated population estimates for species found on the entire GOM OCS (Population Estimate[1]) and the specified activity area (Population Estimate[2]).

Table 8

Population Estimates for Marine Mammal Species in the Northern Gulf of Mexico[1] and Activity Area[2]

Species	Population Estimate[1]	Population Estimate[2]
Killer Whale (*Orcinus orca*)	133	133
False Killer Whale (*Pseudorca crassidens*)	1,038	698
Pygmy Killer Whale (*Feresa attentuata*)	408	408
Dwarf Sperm Whale (*Kogia sima*)	742[a]	643
Pygmy Sperm Whale (*Kogia breviceps*)	742[a]	643
Melon-headed Whale (*Peponocephala electra*)	3,451	3,451
Risso's Dolphin (*Grampus griseus*)	2,169	1,617
Short-finned Pilot Whale (*Globicephala macrorhynchus*)	2,388	2,388
Sperm Whale (*Physeter macrocephalus*)	1,349	1,250
Bryde's Whale (*Balaenoptera edeni*)	40	0
Cuvier's Beaked Whale (*Ziphius cavirostris*)	95	66
Blainville's Beaked Whale (*Mesoplodon densirostris*)	106[b]	89
Gervais' Beaked Whale (*Mesoplodon europaeus*)	106[b]	89
Bottlenose Dolphin (*Turisops truncatus*)	27,559[c]	10,385
Atlantic Spotted Dolphin (*Stenella frontalis*)	30,947[d]	2,950
Pantropical Spotted Dolphin (*Stenella attenuatus*)	91,321[d]	73,086
Striped Dolphin (*Stenella coeruleoalba*)	6,505[d]	5,978
Spinner Dolphin (*Stenella longirostris*)	11,971[d]	781
Rough-toothed Dolphin (*Steno bredanensis*)	2,223[d]	1,095
Clymene's Dolphin (*Stenella clymene*)	17,355	17,104
Fraser's Dolphin (*Lagenodelphis hosei*)	726[d]	0
Absent from Stock Assessment:		
Northern Right Whale (*Eubalaena glacialis*)	Extralimital	n/a[e]
Minke Whale (*Balaenoptera acutorostrata*)	Rare	n/a[e]
Sei Whale (*Balaenoptera edeni*)	Rare	n/a[e]
Blue Whale (*Balaenoptera musculus*)	Extralimital	n/a[e]
Fin Whale (*Balaenoptera physalus*)	Rare	n/a[e]
Humpback Whale (*Megaptera novaeangliae*)	Rare	n/a[e]
Sowerby's Beaked Whale (*Mesoplodon bidens*)	Extralimital	n/a[e]

[1] Source: 2003 NOAA Stock Assessments for the Gulf of Mexico: http://www. nefsc.noaa.gov/psb/assesspdfs.html
[2] Source: From (Fulling et al., 2003) and (Mullin and Fulling, 2004)
[a] This estimate of abundance is for pygmy and dwarf sperm whales combined.
[b] This estimate is based on the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.).
[c] This estimate is combination of bottlenose from northern GOM Continental Shelf stock (25,320) and oceanic stock (2,239).
[d] This estimate is for oceanic waters, which is the best available for the GOM.
Extralimital : known by only a few records resulting from unusual wanderings of animals into the region (Würsig et al., 2000).
Rare: present in such small numbers throughout the region that it is seldom seen (Würsig et al., 2000).
[e] n/a: no population estimate given

(4) A Description of the Status, Distribution, and Seasonal Distribution (When Applicable) of the Affected Species or Stocks of Marine Mammals Likely To Be Affected by Such Activities;

The GOM is a semi-enclosed marginal sea of the Atlantic Ocean bounded by the United States, Mexico, and Cuba. Entry from the Atlantic Ocean into the GOM is gained through the Straits of Florida, and entry from the Caribbean Sea is gained through the Yucatan Channel. The Gulf is characterized by a very wide, gently sloping continental shelf around most of its margin. The only area of the U.S. Gulf (north of the Exclusive Economic Zone) where the water depth reaches 200 m within 50 km of the shore is off the Mississippi River delta. Continental shelf waters (< 200 m deep) comprise about 35 percent of the Gulf surface and continental slope waters (200-3,000 m) make up another 40 percent (Wursig et al., 2000). In contrast to the smooth, gentle slope of the continental shelf, the Gulf continental slope is steep and irregular with canyons and knolls. The remaining 25 percent of the Gulf waters are the abyssal depths, mainly of the Sigsbee Abyssal Plain.

The GOM marine mammal community is diverse and distributed throughout the northern Gulf waters. The only two sp ecies that are commonly found in continental shelf waters are bottlenose dolphins and Atlantic spotted dolphins (Fulling et al. 2003). Slope waters are routinely inhabited by 20 species, most of which have worldwide distribution in deep, warm-temperate to tropical waters. Two exceptions to worldwide distributions are Atlantic spotted dolphins (*Stenella frontalis*) and clymene dolphins (*Stenella clymene*). Common in the Gulf, these two species are found only in the Atlantic and its associated waters.

Listed below are the individual species that routinely inhabit the GOM and, thus, might be affected by the subject activities. Mullin and Fulling (2004) reported that many of these species were widely distributed but some had a more regional distribution and these are noted in species accounts. It was also reported that there was some evidence of seasonal changes in slope waters species abundance but that the Gulf marine mammal community remained diverse and abundant throughout the year and no commonly occurring species vacated the slope waters seasonally. Seasonal observations are also reported under individual species accounts. Unless noted otherwise, the information in the individual species accounts is from the 2003 Stock Assessment Report available on the NOAA's website.

There are species that have been reported from Gulf waters, either by sighting or stranding, that are not included in the species accounts (Wursig et al. 2000; Mullin and Fulling, 2004). These species include the blue whale (*Balaenoptera musculus*), the northern right whale (*Eubalaena glacialis*), and the Sowerby's beaked whale (*Mesoplodon bidens*), all considered extralimital in the GOM, and the humpback whale (*Megaptera novaeangliae*), the fin whale (*Balaenoptera physalus*), the sei whale (*Balaenoptera borealis*), and the minke whale (*Balaenoptera acutorostrata*), all considered rare occasional migrants in the Gulf. Because of the scarcity of these species in the Gulf, no potential effect from subject activities is expected.

Killer Whale (*Orcinus orca*)

Status

The population of killer whales in the GOM is provisionally being considered a separate stock for management purposes by the National Marine Fisheries Service (NMFS). However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

This species is not listed as endangered or threatened under the ESA. The status of killer whales in the northern GOM, relative to the optimum sustainable population (OSP), is unknown. There are not sufficient data to assess population trends for this species. The GOM stock is not a strategic stock because the average annual fishery-related serious injury and mortality has not exceeded potential biological removal (PBR) for the last two years. The fishery-related serious injury and mortality for this stock is unknown, but NMFS assumes it to be less than 10% of the calculated PBR and considers it to be insignificant.

Distribution

The killer whale is a cosmopolitan species that occurs in all oceans and seas and is considered the most widespread cetacean worldwide. These animals are not limited by such habitat features as water depth or temperature (Reeves et al., 2002). Killer whale sightings in the northern GOM have primarily been in deeper waters off the continental shelf (>200 m).

Seasonal Distribution

Killer whale sightings in the northern GOM have occurred primarily in summer months (May through September). There was one opportunistic sighting of a single killer whale in the northern GOM in November. Thirty-two individual killer whales have been photo-identified in the GOM with 6 resighted over a 5-year period and 1 resighted over 10 years. Three of the resightings involved individual whales that had moved over 1,100 km from the original sighting location (O'Sullivan and Mullin, 1997). It is not known whether killer whales in the northern GOM remain within the GOM or range more widely (Würsig et al., 2000). However, resighting individual whales in similar seasons in subsequent years would suggest that either the animals return seasonally to the northern Gulf after moving out of the area (particularly if surveys at other times of the year did not find killer whales) or that killer whales remain in the northern Gulf year.

False Killer Whale (*Pseudorca crassidens*)

Status

The population of false killer whales in the GOM is provisionally being considered one stock for management purposes by NMFS. Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

This species is not listed as endangered or threatened under the ESA. The status of false killer whales in the northern GOM, relative to the OSP, is unknown. There are not sufficient data to assess population trends for this species. The GOM stock is not a strategic stock because the estimated 1997-2001 average annual fishery-related serious injury and mortality did not exceed PBR.

Distribution

The false killer whale occurs in oceanic depths (usually >1,000 m) of all tropical and warm temperate waters (Reeves et al., 2002). Species sightings in the northern GOM occurred primarily in the deep waters off the continental shelf.

Seasonal Distribution

False killer whales have only been sighted during the late spring and summer by extensive NMFS aerial and shipboard surveys. Whether this indicates seasonal distribution or is an artifact of survey effort is not clear.

Pygmy Killer Whale (*Feresa attentuata*)

Status

The population of pygmy killer whales in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

Pygmy killer whales are not listed as threatened or endangered under the ESA. The status of pygmy killer whales in the northern GOM, relative to the OSP, is unknown. There are not sufficient data to assess population trends for this species. The GOM stock is not a strategic stock because the average annual fishery-related serious injury and mortality has not exceeded PBR for the last two years. The fishery-related serious injury and mortality for this stock is unknown, but NMFS assumes it to be less than 10% of the calculated PBR and considers it to be insignificant.

Distribution
The pygmy killer whale is an oceanic species with a worldwide, pantropical range (Reeves et al., 2002). Species sightings in the northern GOM occurred primarily in the deep waters off the continental shelf.

Seasonal Distribution
Sightings of pygmy killer whales have occurred in all seasons in the northern GOM during NMFS surveys.

Dwarf Sperm Whale (*Kogia sima*)

Status
The population of dwarf sperm whales in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of dwarf sperm whales in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution
The dwarf sperm whale is distributed worldwide in temperate to tropical waters. Reeves et al. (2002) reported that pygmy sperm whales are thought to inhabit waters primarily seaward of the continental shelf and that dwarf sperm whales are "somewhat more coastal," occurring in shelf-edge and slope waters. In the northern GOM, sightings of dwarf and pygmy sperm whales occur primarily along the continental shelf edge and over the deeper waters off the continental shelf. These two species are virtually impossible to differentiate in the field.

Seasonal Distribution
Dwarf sperm whales and their cogeners, pygmy sperm whales, are often combined into a *Kogia* category because of the inability to differentiate the two species at sea. Sightings of *Kogia* spp. have been documented in all seasons in the northern GOM.

Pygmy Sperm Whale (*Kogia breviceps*)

Status
The population of pygmy sperm whales in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of pygmy sperm whales in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution

The pygmy sperm whale is distributed worldwide in temperate to tropical waters. Reeves et al. (2002) reported that pygmy sperm whales are thought to inhabit waters primarily seaward of the continental shelf and that dwarf sperm whales are "somewhat more coastal," occurring in shelf-edge and slope waters. In the northern GOM, sightings of dwarf and pygmy sperm whales occur primarily along the continental shelf edge and over the deeper waters off the continental shelf. These two species are virtually impossible to differentiate in the field.

Seasonal Distribution

Pygmy sperm whales and their cogeners, dwarf sperm whales, are often combined into a *Kogia* category because of the inability to differentiate the two species at sea. Sightings of *Kogia* spp. have been documented in all seasons in the northern GOM.

Melon-headed Whale (*Peponocephala electra*)

Status

The population of melon-headed whales in the GOM is provisionally being considered a separate stock for management purposes by NMFS. Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of melon-headed whales in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution

Melon-headed whales are pantropical and oceanic, usually found between 20^0N and 20^0S (Reeves et al., 2002). In the northern GOM, sightings have occurred primarily in deeper waters off the continental shelf.

Seasonal Distribution

Sightings of melon-headed whales have occurred in all seasons in the northern GOM during NMFS surveys.

Risso's Dolphin (*Grampus griseus*)

Status

The population of Risso's dolphins in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of Risso's dolphins in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock is unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution

The Risso's dolphin is extensively distributed, occurring in tropical and warm temperate waters of all oceans and large seas, except the Black Sea (Reeves et al., 2002). Typically found in deep water (>1,000 m) on the upper continental slope, Risso's dolphins are known to move into more shallow water on the continental shelf, perhaps following prey. Sightings of this species in the northern GOM occurred primarily along the continental shelf and continental slope.

Seasonal Distribution

Sightings of Risso's dolphins have occurred in all seasons in the northern GOM during NMFS surveys. Mullin and Fulling (2004) report that in the northeastern GOM, Risso's dolphins were three times more abundant in winter than in summer.

Short-finned Pilot Whale (*Globicephala macrorhynchus*)

Status

The population of short-finned pilot whales in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of short-finned pilot whales in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution

The short-finned pilot whale is widespread and abundant in warm temperate to tropical marine waters of the world (Reeves et al., 2002). Sightings of this species in the northern GOM occurred primarily along the continental shelf and continental slope.

Seasonal Distribution

Sightings of short-finned pilot whales have occurred in all seasons in the northern GOM during NMFS surveys.

Sperm Whale (*Physeter macrocephalus*)

Status

The population of sperm whales in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to delineate sperm whale stock structure within the GOM or to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of sperm whales in the northern GOM is unknown (relative to the OSP). This species is listed as endangered under the ESA and is the only commonly occurring marine mammal in the GOM with this status. Insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. Sperm whales are designated as strategic because of their endangered status.

Distribution

Sperm whales are found worldwide in ice-free waters from the equator to the edges of the polar ice pack (Reeves et al., 2002). In the northern GOM, sperm whales are widely distributed throughout oceanic waters (>200 m). The highest densities of sperm whales in the Gulf are in the slope waters between 200 and 2,000 m deep (Mullin and Fulling, in press). Mullin and Fulling (2004) report that there are increased sightings of sperm whales off the Mississippi River delta, and in the southeastern Gulf, west of the Dry Tortugas. They speculate that these whale concentrations may be due to the primary productivity associated with the Mississippi River plume and the productivity bolstered by nutrient upwelling along the Loop Current front and periodic formations of cyclonic gyres in the southeast Gulf, respectively.

Seasonal Distribution

Sperm whales have been sighted in all seasons in the GOM on NOAA surveys. However, sightings have been more common during the summer months.

Bryde's Whale (*Balaenoptera edeni*)

Status

The population of Bryde's whales in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation and/or residency.

The status of Bryde's whales in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution

The Bryde's whale occurs in tropical to temperate oceans of the world (Reeves, et al., 2002). Species sightings in the northern GOM are not common and have almost exclusively occurred in the eastern Gulf. Mullin and Fulling (2004) reported that all four Bryde's whale sightings made on NOAA surveys between 1996 and 2001 were in northeastern Gulf slope waters (200 – 1,000 m).

Seasonal Distribution

Sightings of Bryde's whales have occurred in the northern GOM mainly during the spring-summer months; however, Jefferson et al. (1992) reported that strandings have occurred throughout the year.

Cuvier's Beaked Whale (*Ziphius cavirostris*)

Status

The population of Cuvier's beaked whales in the GOM is provisionally being considered a separate stock for management purposes by NMFS. Inadequate biological information prohibits the determination of Cuvier's beaked whale stock structure in the GOM and Atlantic Ocean.

The status of Cuvier's beaked whales in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. However, this is considered a strategic stock because of evidence of human induced mortality and serious injury that has been associated with several acoustic (primarily naval) events. None of these events have occurred in the GOM.

Distribution

The Cuvier's beaked whale is distributed worldwide in deep offshore, tropical to cool temperate marine waters (Reeves et al., 2002). Species sightings in the northern GOM occurred primarily in the deep waters off the continental shelf.

Seasonal Distribution

Strandings of Cuvier's beaked whales have been recorded throughout the year in the northern GOM. During NMFS surveys, beaked whales were recorded in all seasons, but identifying the whales to the species level is difficult from aerial observations. Some of the aerial sightings may have been Cuvier's beaked whales.

Blainville's Beaked Whale (*Mesoplodon densirostris*)

Three species of the genus *Mesoplodon* have been recorded in the GOM, based on sightings and strandings. These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*), and Sowerby's beaked whale (*M. bidens*). The latter of these, Sowerby's beaked whale, is known in the Gulf from only one stranding record and is considered extralimital because of its typical range in the northern temperate waters of the North Atlantic. Identification of *Mesoplodon* species in the field is very difficult so these species are combined as beaked whales. This species grouping may also include some Cuvier's beaked whales that were not identified to species.

Status

The population of Blainville's beaked whales in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation and/or residency.

The status of Blainville's beaked whales in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. However, this is considered a strategic stock because of evidence of human-induced mortality and serious injury that has been associated with several acoustic (primarily naval) events. None of these events have occurred in the GOM.

Distribution

The Blainville's beaked whale has widespread distribution in the tropical and warm temperate world oceans (Reeves et al., 2002). Sightings and stranding of this whale have rarely been identified to the species level in the northern GOM. Beaked whale sightings in the Gulf have occurred primarily in the deep waters off the continental shelf.

Seasonal Distribution

Sightings of beaked whales have occurred in all seasons in the northern GOM during NMFS surveys.

Gervais' Beaked Whale (*Mesoplodon europaeus*)

Three species of the genus *Mesoplodon* have been recorded in the GOM, based on sightings and strandings. These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*), and Sowerby's beaked whale (*M. bidens*). The latter of these, Sowerby's beaked whale, is known in the Gulf from only one stranding record and is considered extralimital because of its typical range in the northern temperate waters of the North Atlantic. Identification of *Mesoplodon* species in the field is very difficult so these species are combined as beaked whales. This species grouping may also include some Cuvier's beaked whales that were not identified to species.

Status

The population of Gervais' beaked whales in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation and/or residency.

The status of Gervais' beaked whales in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. However, this is considered a strategic stock because of evidence of human induced mortality and serious injury that has been associated with several acoustic (primarily naval) events. None of these events have occurred in the GOM.

Distribution

The Gervais' beaked whale appears to be distributed only in the tropical and warm temperate waters of the Atlantic Ocean (Reeves et al., 2002). Sightings and stranding of this whale have rarely been identified to the species level in the northern GOM. Beaked whale sightings in the Gulf have occurred primarily in the deep waters off the continental shelf.

Seasonal Distribution

Sightings of beaked whales have occurred in all seasons in the northern GOM during NMFS surveys.

Bottlenose Dolphin (*Turisops truncatus*)

Status

Thirty-eight stocks of bottlenose dolphins are recognized by NMFS in the northern GOM for management purposes. These include 33 inshore stocks; 3 coastal stocks in the Eastern, Central and Western Gulf waters delineated as from the shore to 9 km seaward of the 10-fathom (18 m) contour; 1 outer continental shelf stock occurring from the coastal stock boundary to 9 km seaward of the 100-fathom (183 m) contour, and 1 continental shelf edge and slope stock occurring from the outer continental shelf boundary to the Exclusive Economic Zone (EEZ) boundary. These stocks may in fact overlap adjoining stocks in some areas and may be genetically indistinguishable from those stocks. The GOM bottlenose dolphin population consists of a coastal ecotype and an offshore ecotype.

The status of bottlenose dolphins in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution

Bottlenose dolphins are cosmopolitan marine mammals found in tropical and temperate oceans and peripheral seas. This species occupies a wide variety of habitats and is considered perhaps the most adaptable cetacean (Reeves et al., 2002). As shown by the numerous stocks mentioned above, this widespread species occurs throughout the GOM. Bottlenose dolphin habitat ranges from inshore bays and sounds to the deep waters of the continental slope. During NMFS oceanic surveys, bottlenose dolphins were seen primarily in water depths less than 1,000 m, and the highest density of this species was in northeastern Gulf slope waters (Mullin and Fulling, 2004). However, densities are similar between the eastern and western Gulf outer continental shelf waters. Bottlenose dolphins were also fairly evenly distributed between the coastal waters (< 20 m) and the outer continental shelf waters (20 to 200 m) (Fulling et al., 2003).

Seasonal Distribution

Sightings of bottlenose dolphins have occurred in all seasons in the northern GOM during NMFS surveys.

Atlantic Spotted Dolphin (*Stenella frontalis*)

Status

The population of Atlantic spotted dolphins in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, there is no current information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of Atlantic spotted dolphins in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution

Atlantic spotted dolphins are one of two GOM dolphin species that occur only in the Atlantic Ocean (along with clymene dolphins). Also, only this species and the bottlenose dolphin are commonly found in the shallower continental shelf waters (<200 m depth) of the Gulf (Mullin and Fulling, 2004). Atlantic spotted dolphins are primarily distributed in waters between 10 and 500 m in the GOM and are not known to occur inshore. The density of Atlantic spotted dolphins is much greater in the eastern Gulf outer continental shelf waters that those of the western Gulf (Fulling et al., 2003).

Seasonal Distribution

Sightings of Atlantic spotted dolphins have occurred in all seasons in the northern GOM during NMFS surveys.

Pantropical Spotted Dolphin (*Stenella attenuatus*)

Status

The population of pantropical spotted dolphins in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, there is currently no information to differentiate this stock from the Atlantic stock(s). Additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of pantropical spotted dolphins in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution

Pantropical spotted dolphins are found worldwide in all tropical to warm temperate waters between about 40^0N and 40^0S (Reeves et al., 2002). In the northern GOM, this species is widely distributed in deeper waters and is the most common cetacean in the oceanic northern GOM (Mullin et al., 2004; Wursig et al., 2000). The highest density for pantropical spotted dolphins is in the abyssal waters (> 2,000 m) but this species has been observed, though rarely, in the more shallow waters over the continental shelf (Mullin and Fulling, 2004).

Seasonal Distribution

Sightings of pantropical dolphins have occurred in all seasons in the northern GOM during NMFS surveys. However, Mullin and Fulling (2004) report that this species is two times more abundant in summer in the northeastern Gulf than in winter.

Striped Dolphin (*Stenella coeruleoalba*)

Status

The population of striped dolphins in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of striped dolphins in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution

The striped dolphin is cosmopolitan in distribution occurring in tropical and warm temperate waters (Reeves et al., 2002). In the northern GOM, sightings have occurred primarily in the deeper waters off the continental shelf (Mullin and Fulling, 2004).

Seasonal Distribution

Sightings of striped dolphins have occurred in all seasons except summer in the northern GOM during NMFS surveys.

Spinner Dolphin (*Stenella longirostris*)

Status

The population of spinner dolphins in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of spinner dolphins in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution

The spinner dolphin is generally a worldwide pantropical species including numerous regional populations and four subspecies (Reeves et al., 2002). Sightings of spinner dolphins in the northern GOM have primarily occurred on the continental slope east of Mobile Bay (Mullin and Fulling, 2004).

Seasonal Distribution
Sightings of spinner dolphins have occurred in all seasons in the northern GOM during NMFS surveys.

Rough-toothed Dolphin (*Steno bredanensis*)

Status
The population of rough-toothed dolphins in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of rough-toothed dolphins in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution
The rough-toothed dolphin occurs in tropical and warm temperate waters globally (Reeves et al., 2002). In the northern GOM, sightings have occurred in both oceanic waters and in continental shelf waters (Fulling et al., 2003). This species may have a greater-than-expected presence in shelf waters (see Seasonal Distribution). Mullin and Fulling (2004) report that there may be similar numbers of rough-toothed dolphins in shelf waters as there are in oceanic waters.

Seasonal Distribution
Sightings of rough-toothed dolphins have occurred in all seasons in the northern GOM during NMFS surveys. Higher densities of rough-toothed dolphins were found in the fall in northern Gulf shelf waters than were found in oceanic waters in the spring (Fulling et al., 2003).

Clymene Dolphin (*Stenella clymene*)

Status
The population of clymene dolphins in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of clymene dolphins in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution
Clymene dolphins are found only in the deep tropical and subtropical waters of the Atlantic Ocean, including the GOM and the Caribbean Sea (Reeves et al., 2002). This is one of the two species commonly occurring in the Gulf that are limited to the Atlantic. In the northern GOM, sightings have occurred primarily over the deeper waters off the continental shelf and mostly west of Mobile Bay (Mullin and Fulling, 2004).

Seasonal Distribution
Clymene dolphins were sighted in all seasons except fall in the northern GOM during NMFS surveys.

Fraser's Dolphin (*Lagenodelphis hosei*)

Status

The population of Fraser's dolphins in the GOM is provisionally being considered a separate stock for management purposes by NMFS. However, additional morphological, genetic, and/or behavioral data are required to confirm the Gulf stock delineation.

The status of Fraser's dolphins in the northern GOM is unknown (relative to the OSP). This species is not listed under the ESA as threatened or endangered and insufficient data prohibits determination of population trends. The total fishery-related mortality and serious injury for this stock in unknown but is assumed by NMFS to be less than 10% of the calculated PBR and considered insignificant. This is not a strategic stock.

Distribution

Fraser's dolphins are found worldwide in tropical waters, primarily in water depths greater than 1,000 m (Reeves et al., 2002). In the northern GOM, sightings have occurred primarily over the deeper waters off the continental shelf.

Seasonal Distribution

Sightings of Fraser's dolphins have occurred in all seasons in the northern GOM during NMFS surveys.

(5) The Type of Incidental Taking Authorization that Is Being Requested (I.E., Takes by Harassment Only; Takes by Harassment, Injury and/or Death) and the Method of Incidental Taking;

The MMS requests that the NMFS promulgate regulations for any potential take (level B or level A) of 21 species of marine mammals, as listed in Table 8, incidental to conducting explosive-severance activities related to structure-removal operations regulated by the MMS. The severance operations have the potential to take marine mammals by contact with shock wave (pressure) and acoustic energy released from underwater detonations and the resultant mortality, injury, hearing damage, and behavioral effects as defined by NMFS. Since NMFS believes that the take criteria and thresholds established for the U.S. Navy's Winston Churchill ship shock tests (USDON, 1998 and 2001) represent the best available science, MMS has adopted these standards into this petition and associated PEA.

Criteria for nonlethal, injurious impacts (level A harassment) are currently defined as the incidence of 50-percent tympanic-membrane (TM) rupture and the onset of slight lung hemorrhage for a 12.2-kg dolphin calf. Level A harassment take is assumed to occur:

1. at an energy flux density value of 1.17 in-lb/in^2 (which is about 205 dB re 1 µPa^2-s); and
2. if the peak pressure exceeds 100 psi for an explosive source; i.e., the "safe" peak pressure level to avoid physical injury recommended by Ketten (1995).

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The horizontal distance to each threshold is determined and the maximum distance at which either is exceeded is taken to be the distance at which Level A harassment would occur (USDON, 2001). The NMFS recognizes two levels of noninjurious acoustical impacts (Level B harassment). One criterion for level B harassment is defined by the onset of TTS. Two thresholds are applied. TTS is assumed to be induced:

1. at energies greater than 182 dB re 1 µPa^2-s within any ? -octave band; and

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2. if the peak pressure exceeds 12 psi for an explosive source.

As with Level A harassment, the horizontal distance to each threshold is determined and the maximum distance at which either is exceeded is taken to be the distance at which Level B harassment (TTS) would occur (USDON, 1998 and 2001; CSA, 2004).

Sub-TTS behavioral effects may also be considered to constitute a take by Level B harassment if a marine mammal reacts to an activity in a manner that would disrupt some behavioral pattern in a biologically significant way; however, NMFS does not believe that single, minor reactions (such as startle or "heads-up" alert displays, short-term changes in breathing rates, or modified single dive sequences) that have no biological context qualify as takes (66 FR 22450, May 4, 2001). This would include minor or momentary behavioral responses to single events such as underwater explosions.

(6) By Age, Sex, and Reproductive Condition (If Possible), the Number of Marine Mammals (by Species) that May Be Taken by Each Type of Taking Identified in Paragraph (a)(5) of this Section, and the Number of Times Such Takings by Each Type of Taking Are Likely to Occur;

In order to acquire potential incidental-take numbers necessary for the Structure-Removal PEA and this request, fundamental modeling components required contracting, development, and evaluation. Under continuous guidance provided by NMFS, MMS used the criteria/thresholds discussed in the previous section, and undertook the incidental-take determination and estimation tasking in the following steps:

- predictive modeling of detonation pressure/energy propagation,
- propagation model verification and utilization,
- predictive modeling of marine mammal take estimates, and
- take-estimate calculation.

Predictive Modeling of Detonation Pressure/Energy Propagation

To help determine the ranges for the blasting categories anticipated under the proposed action, MMS contracted Applied Research Associates (ARA), Inc. to develop a model and prepare a report that would estimate shock wave and acoustic energy propagation caused by underwater explosive-severance tools (Dzwilewski and Fenton, 2003). In addition to incorporating previous research on open-water or AML explosions, ARA developed their "UnderWater Calculator" (UWC) to consider the overall reduction of energy released into the water column resulting from BML detonations. Therefore, in application, the UWC can be configured so that its propagation estimates reflect either open-water/AML conditions or the affects of BML "attenuation"; the pressure and acoustic energy reduction related to its absorption by the surrounding sediments and the severance target. As with most "theoretical" models developed to consider a wide range of parameters under multiple conditions, ARA suggested that the UWC results be repeatedly compared with *in-situ* data from actual explosive-severance activities. For additional information on the ARA UWC, see Appendix B of the PEA (USDOI, MMS, 2005).

Propagation Model Verification and Utilization

In November 2002, MMS's Technology Assessment and Research (TAR) Program began working with MMS's GOM Region to modify an existing project designed to develop and test the efficiency of LSC's (http://www.mms.gov/tarprojects/429.htm). The modifications made it possible to allow BML, *in-situ* data measurements to be taken during the final testing on actual OCS targets. The testing was conducted, and Annex B of the project's final report (Saint-Arnaud et al., 2004) compares the peak overpressure (psi), impulse (psi-s), and energy flux density (EFD; psi-in) measurements collected from the testing with calculated results from the ARA UWC. In all but two occurrences/outliers (i.e., 4.05-lb LSC peak overpressure; transducers H and I), the ARA UWC range projections were much greater than those actually recorded. The comparisons of impulse and EFD indicated an even greater disparity between the ARA UWC calculations and *in-situ* measurements and in several instances; the UWC values were over 10-times greater than the actual readings. For additional information on the *in-situ* comparisons, see Appendix C of the PEA.

Based upon the comparison discussion and subsequent coordination with NMFS, MMS determined that the impact ranges projected by ARA's UWC were highly conservative and would result in highly-protective impact-zone calculations. Therefore, MMS feels confident in using the ARA UWC for both incidental-take estimate calculations and mitigation development (Section 13 of this request).

Predictive Modeling of Marine Mammal Take-Estimates

With a pressure/energy propagation model developed and validated, MMS contracted Marine Acoustics, Incorporated (MAI) for services related to explosive-severance simulation runs in their Acoustic Integration Model© (AIM). The AIM model can be configured to calculate a three-dimensional (3D) sound field that simulates a particular physical environment related to specific marine conditions and the propagation of pressure waves and acoustic energy generated by underwater explosions (Frankel and Ellison, 2004). Two species-specific delineation zones were also considered in the model's development with numerous virtual animals ("animats") developed to correlate to the marine mammal types and densities that can be found in the specific shelf (<200 m) or slope (>200 m) areas of the GOM. The animats were then exposed to the projected sound field in 3D and time in order to simulate the animals' real movement patterns and to allow AIM to predict the amount of pressure/acoustic energy exposure each animat received. When compared to the preestablished impact thresholds, the predictions could be used to determine the number of animals that might be taken by the explosive-severance activities. For additional information on the MAI modeling, see Appendix D of the PEA.

Take-Estimate Calculations

With the AIM modeling complete, MMS calculated the total estimated-take numbers for all of the projected explosive-severance activities. A detailed discussion of the equations used in the calculations and the complete set of summary tables for each severance category are provided in Appendix D and Appendix E of the PEA. Since all of the modeling efforts summarized above could not compensate for the effective mitigation measure proposed in Section 13, it must be emphasized that all of the calculated incidental-take estimates are likely to be much higher than the take numbers expected to result from the actual, mitigated activities. Therefore, Table 9 provides a list of the maximum take-estimate totals for the projected explosive-severance activities.

Table 9

Calculated Take-Estimate Totals for All Explosive-Severance Scenarios

Species	Level B (Harassment & >) (based on 12 psi)				Level A (Injury) (based on 100 psi - 0.43% of Level B)			
	Annual Projections (Low)	Annual Projections (High)	5-yr Projections (Low)	5-yr Projections (High)	Annual Projections (Low)	Annual Projections (High)	5-yr Projections (Low)	5-yr Projections (High)
Bryde's Whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sperm whale	0.89	2.01	4.45	10.05	0.00	0.01	0.02	0.04
Kogia spp.	0.30	0.69	1.50	3.45	0.00	0.00	0.01	0.01
Beaked Whale								
Cuvier's beaked	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mesoplodon spp.	0.12	0.28	0.60	1.40	0.00	0.00	0.00	0.01
killer whale	0.06	0.13	0.30	0.65	0.00	0.00	0.00	0.00
Blackfish								
Globicephala spp.	4.50	10.50	22.50	52.50	0.02	0.05	0.10	0.23
melon-headed whale	6.42	14.98	32.10	74.90	0.03	0.06	0.14	0.32
false killer whale	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
pygmy killer whale	0.12	0.28	0.60	1.40	0.00	0.00	0.01	0.01
Fraser's dolphin	0.12	0.28	0.60	1.40	0.00	0.00	0.00	0.01
Risso's dolphin	1.44	3.32	7.20	16.60	0.01	0.01	0.03	0.07
bottlenose dolphin	148.77	227.54	743.85	1,137.70	0.64	0.98	3.20	4.89
rough-toothed dolphin	8.16	12.73	40.80	63.65	0.04	0.05	0.18	0.27
Stenella								
Atlantic spotted dolphin	35.52	54.62	177.60	273.10	0.15	0.23	0.76	1.17
pantropical spotted dolphin	33.80	77.41	169.00	387.05	0.15	0.33	0.73	1.66
Clymene dolphin	11.99	27.48	59.95	137.40	0.05	0.12	0.26	0.59
striped dolphin	6.35	14.53	31.75	72.65	0.03	0.06	0.14	0.31
spinner dolphin	2.10	4.82	10.50	24.10	0.01	0.02	0.05	0.10

(7) The Anticipated Impact of the Activity Upon the Species or Stock;

Underwater explosions are the strongest manmade point sources of sound in the sea (Richardson et al., 1995). The underwater pressure signature of a detonating explosion is composed of an initial shock wave, followed by a succession of oscillating bubble pulses (if the explosion is deep enough not to vent through the surface) (Richardson et al., 1995). The shock wave is a compression wave that expands radially out from the detonation point of an explosion. Although the wave is initially supersonic, it is quickly reduced to a normal acoustic wave. The broadband source levels of charges measuring 0.5-20 kg are in the range of 267-280 dB re 1 µPa (at a nominal 1-m distance), with dominant frequencies below 50 Hz (Richardson et al., 1995; CSA, 2004).

The following sections discuss the potential impacts of underwater explosions on marine mammals, including the most serious effects, mortality or injury, hearing effects, and behavioral effects.

Mortality or Injury

It has been demonstrated that nearby underwater blasts can injure or kill marine mammals (Richardson et al., 1995). Injuries from high-velocity underwater explosions result from two factors: (1) the very rapid rise time of the shock wave; and (2) the negative pressure wave generated by the collapsing bubble, which is followed by a series of decreasing positive and negative pressure pulses (CSA, 2004). The extent of injury largely depends on the intensity of the shock wave and the size and depth of the animal (Yelverton et al., 1973; Craig, 2001).

The greatest damage occurs at boundaries between tissues of different densities because different velocities are imparted that can lead to their physical disruption; effects are generally greatest at the gas-liquid interface (Landsberg, 2000; CSA, 2004). Gas-containing organs, especially the lungs and gastrointestinal tract, are the most susceptible. Lung injuries (including lacerations and the rupture of the alveoli and blood vessels) can lead to hemorrhage, air embolisms, and breathing difficulties. The lungs and other gas-containing organs (nasal sacs, larynx, pharynx, and trachea) may also be damaged by compression/expansion caused by oscillations of the blast gas bubble (Reidenberg and Laitman, 2003). Intestinal walls can bruise or rupture, which may lead to hemorrhage and the release of gut contents. Less severe injuries include contusions, slight hemorrhaging, and petechia (Yelverton et al., 1973; CSA, 2004). Ears are the organs most sensitive to pressure and, therefore, to injury (Ketten, 2000; CSA, 2004). Severe damage to the ears can include rupture of the tympanic membrane, fracture of the ossicles, cochlear damage, hemorrhage, and cerebrospinal fluid leakage into the middle ear. By themselves, tympanic membrane rupture and blood in the middle ear can result in partial, permanent hearing loss. Permanent hearing loss can also occur when the hair cells are damaged by loud noises (ranging from single, very loud events to chronic exposure). Potential effects on marine mammal hearing are discussed below.

Hearing Effects

The acoustic impacts of underwater explosions on marine mammals must be discussed in the context of what is known about marine mammal hearing. Mammalian hearing functions over a wide range of sound intensities, or loudness. The sensation of loudness increases approximately as the logarithm of sound intensity (Richardson and Malme, 1993). Sound intensity is usually expressed in decibels (dB), units for expressing the relative intensity of sounds on a logarithmic scale. Because sound pressure is easier to measure than intensity and intensity is proportional to the square of sound pressure, sound pressure level is usually reported in units of decibels relative to a standard reference pressure.

Odontocetes

Most of the energy of odontocete social vocalizations is concentrated near 10 kHz, above the low-frequency range where most industrial sounds are concentrated. Source levels for whistles may be as high as 100-180 dB re 1 μPa at 1 m (Richardson et al., 1995). Odontocete echolocation pulses are generally much higher in frequency, 30-100 kHz or higher, and source levels may be above 200 dB re 1 μPa at 1 m (Au, 1980).

Understandably, the smaller odontocetes appear to be most sensitive to sounds at frequencies above about 10 kHz, with sensitivity deteriorating progressively below that level. Species whose hearing has been tested include the bottlenose dolphin (*Tursiops truncatus*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), harbor porpoise (*Phocoena phocoena*), Risso's dolphin (*Grampus griseus*), and killer whale (*Orcinus orca*) (Johnson, 1968; Andersen, 1970; Nachtigall et al., 1995, 1996; Szymanski et al., 1999; Tremel et al., 1999). Although estimated auditory thresholds may be too high for frequencies less than 1-10 kHz because of problems inherent with the use of small holding tanks for testing, hearing sensitivity extends at least as low as 40-75 kHz in bottlenose dolphins (Johnson, 1968). The upper range of the tested species extends to 80-150 kHz in at least some individuals (Johnson, 1968; Andersen, 1970; Nachtigall et al., 1995, 1996; Szymanski et al., 1999; Tremel et al., 1999; CSA, 2004).

Sperm whales (*Physeter macrocephalus*) produce clicks, which may be used to echolocate (Mullins et al., 1988), with a frequency range from less than 100 Hz to 30 kHz and source levels up to 230 dB re 1 μPa-m or greater (Møhl et al., 2000). There are no specific data on the hearing sensitivity of sperm whales, but immature animals, at least, appear to have medium- and high-frequency hearing abilities similar to the other odontocete species tested (Carder and Ridgway, 1990). Sperm whales often react by becoming silent when exposed to pulsed sounds at frequencies ranging from a few kHz up to at least 24 kHz (Richardson et al., 1995).

There are no published data on the hearing abilities of *Mesoplodon* or *Ziphius* spp. beaked whales (CSA, 2004).

Mysticetes

Baleen whale vocalizations are composed primarily of frequencies below 1 kHz, and some contain fundamental frequencies as low as 16 Hz (Watkins et al., 1987; Richardson et al., 1995; Rivers, 1997; Moore et al., 1998; Stafford et al., 1999; Wartzok and Ketten, 1999). Thus, the dominant frequencies in baleen whale sounds overlap with those in many industrial sounds. Although there is apparently much variation, the source levels of most baleen whale vocalizations lie in the range of 150-190 dB re 1 μPa at 1 m.

The low-frequency vocalizations made by baleen whales and their auditory anatomy suggest that they have good low-frequency hearing (Ketten, 2000), although specific data on sensitivity, frequency or intensity discrimination, or localization abilities are lacking. Behavioral evidence suggests that baleen whales also hear well at frequencies above 1 kHz (Richardson et al., 1995), and they are known to react to seismic pulses (e.g., Richardson et al., 1995; Greene et al., 1999; Miller et al., 1999; McCauley et al., 2000).

Temporary Threshold Shift

The mildest form of hearing damage, temporary threshold shift (TTS), is defined as the temporary elevation of the minimum hearing sensitivity threshold at particular frequency(s) (Kryter, 1985; CSA, 2004). TTS may last from minutes to days. Although few data exist on the effects of underwater sound on marine mammal hearing, in terrestrial mammals, and presumably in marine mammals, received levels must exceed an animal's hearing threshold for TTS to occur (Richardson et al., 1995; Kastak et al., 1999; Wartzok and Ketten, 1999).

Most studies involving marine mammals have measured exposure to noise in terms of sound pressure level (SPL), measured in dB_{rms} or dB_{peak} pressure re 1 µPa. Exposure to underwater sound can be expressed in terms of energy, also called sound exposure level (SEL), or acoustic energy (measured in dB re 1 μPa^2-s), which considers both intensity and duration. There appears to be a linear relationship between energy and the level of TTS, with duration and frequency seemingly unimportant (CSA, 2004). If TTS is defined as a measurable threshold shift of 6 dB or better (Finneran et al., 2000), the onset of TTS was associated with an energy level of about 184 dB re 1 µPa2-s (CSA, 2004). However, the data are very limited, and Finneran (2003) has cautioned that they should be interpreted with caution (CSA, 2004).

Permanent Threshold Shift

Permanent threshold shift (PTS) is a permanent decrease in the functional sensitivity of an animal's hearing system at some or all frequencies (CSA, 2004). The principal factors involved in determining whether PTS will occur include sound impulse duration, peak amplitude, and rise time. The criteria are location and species specific (Ketten, 1995) and are also influenced by the health of the receiver's ear.

At least in terrestrial animals, it has been demonstrated that the received level from a single exposure must be far above the TTS threshold for there to be a risk of PTS (Kryter, 1985, Richardson et al., 1995; CSA, 2004). Sound signals with sharp rise times (e.g., from explosions) produce PTS at lower intensities than do other types of sound (Gisiner, 1998; CSA, 2004).

For explosives, Ketten (1995) estimated that greater than 50-percent PTS would occur at peak pressures of 237-248 dB re 1 µPa and that TTS would occur at 211-220 dB re 1 µPa. The "safe" peak pressure level to avoid physical injury recommended by Ketten (1995) is 100 psi (237 dB re 1 µPa, or about 212 dB re 1 µPa2-s). PTS is assumed to occur at received levels 30 dB above TTS-inducing levels. Studies have shown that injuries at this level involve the loss of sensory hair cells (Ahroon et al., 1996; CSA, 2004).

Behavioral Effects

Based on the information presented in Richardson et al. (1995), the possible behavioral effects of noise from underwater explosions on marine mammals may be categorized as follows:

1) The noise may be too weak to be heard at the location of the animal (i.e., below the local ambient noise level, below the hearing threshold of the animal at the relevant frequencies, or both);
2) The noise may be audible, but not loud enough to elicit an overt behavioral reaction;
3) The noise may elicit behavioral reactions, which may vary from subtle effects on respiration or other behaviors (detectable only statistically) to active avoidance behavior; and
4) With repeated exposure, habituation (diminishing responsiveness) to the noise may occur. Continued disturbance effects are most likely with sounds that are highly variable in their characteristics, unpredictable in occurrence, and associated with situations perceived by the animal as threatening.

Behavioral reactions of marine mammals to sounds such as those produced by underwater explosives are difficult to predict. Whether or how an animal reacts to a given sound depends on factors such as the species, hearing acuity, state of maturity, experience, current activity, reproductive state, time of day, and weather. If a marine mammal reacts to a sound by changing its behavior or moving a short distance, the impacts may not be significant to the individual, stock, or species as a whole. However, if a sound displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts could be significant (CSA, 2004).

Richardson et al. (1995) summarized available information on the reported behavioral reactions of marine mammals to underwater explosions. Observations following the use of seal bombs as scare charges indicate that pinnipeds rapidly habituate to and, in general, appear quite tolerant of noise pulses from explosives. Klima et al. (1988) reported that small charges were not consistently effective in moving bottlenose dolphins away from blast sites in the GOM. Since dolphins may be attracted to the fish killed by such a charge, rather than repelled, scare charges are not used in the GOM platform removal program (G. Gitschlag, personal communication, in Richardson et al., 1995).

There are few data on the reactions of baleen whales to underwater explosions. Gray whales were apparently unaffected by 9- to 36-kg charges used for seismic exploration (Fitch and Young, 1948). However, Gilmore (1978) felt that similar underwater blasts within a few km of the gray whale migration corridor did “sometimes” interrupt migration.

Humpback whales have generally not been observed to exhibit behavioral reactions (including vocal ones) to explosions, even when close enough to suffer injury (hearing or other) (Payne and McVay, 1971; Ketten et al., 1993; Lien et al., 1993; Ketten, 1995; Todd et al., 1996). In Newfoundland, humpbacks displayed no overt reactions within about 2 km of 200- to 2,000-kg explosions. Whether habituation and/ or hearing damage occurred was unknown, but at least two whales were injur ed (and probably killed) (Ketten et al., 1993). Other humpback whales in Newfoundland, foraging in an area of explosive activity, showed little behavioral reaction to the detonations in terms of decreased residency, overall movements, or general behavior, although orientation ability appeared to be affected (Todd et al., 1996). Todd et al. (1996) suggested caution in interpretation of the lack of visible reactions as indication that whales are not affected or harmed by an intense acoustic stimulus; both long- and short-term behavior as well as anatomical evidence should be examined. The researchers interpreted increased entrapment rate of humpback whales in nets as the whales being influenced by the long-term effects of exposure to deleterious levels of sound.

As discussed above, Finneran et al. (2000) exposed captive bottlenose dolphins and belugas to single, simulated sounds of distant explosions. The broad-band received levels were 155-206 dB; pulse durations were 5.4-13 ms. This was equivalent to a maximum spectral density of 102-142 dB re 1 µPa2/ Hz at a 6.1 Hz bandwidth. Behavioral alterations began at received levels of 181-194 dB (120-127 dB re 1 µPa2/Hz). Although pulse durations differed, the source levels required to induce these reactions were similar to those found by Ridgway et al. (1997) and Schlundt et al. (2000).

Since the majority of this information was taken from the Structure-Removal PEA, refer to Chapter 4.3.1.1 for a more thorough discussion of the proposed explosive-severance impacts on marine mammals and Chapter 4.5.3 for a discussion of potential cumulative impacts.

Conclusions

Impacts to marine mammals from explosive-severance activities conducted under the proposed action are potentially adverse but not significant. The projected Level A takes, even with no mitigation, are very unlikely and, for most species, none. No deaths or serious injuries to strategic stocks or listed species are projected. If any marine mammals are displaced from preferred grounds, it will be for the short term, and no critical habitat is involved. Level B harassment takes may disrupt behavioral patterns in a few individuals of a few species, but no effect is projected on annual recruitment or survival. With proposed mitigation measures in place, the potential impacts on marine mammals are expected to be negligible.

(8) The Anticipated Impact of the Activity on the Availability of the Species or Stocks of Marine Mammals for Subsistence Uses;

There are no subsistence uses of marine mammals in the northern GOM.

(9) The Anticipated Impact of the Activity Upon the Habitat of the Marine Mammal Populations, and the Likelihood of Restoration of the Affected Habitat;

Since the explosive-severance activities proposed under this application are only conducted on stationary OCS structures, no impacts are anticipated on marine mammal habitat.

(10) The Anticipated Impact of the Loss or Modification of the Habitat on the Marine Mammal Populations Involved;

Since the explosive-severance activities proposed under this application are only conducted on stationary OCS structures, no impacts are anticipated on marine mammal habitat.

(11) The Availability and Feasibility (Economic and Technological) of Equipment, Methods, and Manner of Conducting Such Activity or Other Means of Effecting the Least Practicable Adverse Impact Upon the Affected Species or Stocks, Their Habitat, and on Their Availability for Subsistence Uses, Paying Particular Attention to Rookeries, Mating Grounds, and Areas of Similar Significance;

Nonexplosive-severing tools are an available option for OCS decommissioning targets in all water depths. With the exception of minor air and water quality concerns (i.e., exhaust from support equipment and toxicity of abrasive materials), nonexplosive severing tools generally cause little to no environmental impacts; therefore, there are very few regulations regarding their use. However, the use of nonexplosive cutters leads to greater human health and safety concerns, primary because (1) divers are often required in the methodology (e.g., torch/underwater arc cutting and external tool installation and monitoring), (2) more personnel are required to operate them (increasing their risks of injury in the offshore environment), (3) lower success rates require that additional cutting attempts be made, and (4) the cutters can only sever one target at a time; taking on average 30 min to several hours for a complete cut. The last two items are often hard to quantify and assign risks to the cutters, but the main principle is that there is a linear relationship between the length of time any offshore operation is staged and on-site (exposure time) and the potential for an accident to occur (TSB and CES, LSU, 2004). Therefore, even if there are no direct injuries or incidents involving a diver or severing technicians, the increased "exposure time" needed to successfully sever all necessary targets could result in unrelated accidents involving other barge/vessel personnel.

A brief discussion of the primary nonexplosive-severance options is provided below. Refer to Chapter 1.4.7.1 of the Structure-Removal PEA for more information on nonexplosive methodologies and comparisons with explosive methods.

Abrasive Cutters

Abrasive cutters sever decommissioning targets by using a system that infuses cutting material (i.e., sand, garnet, copper slag, etc.) into a jet of water to wear away the object at a focused point. There are currently two types of abrasive cutters in use today in the GOM; sand cutters and abrasive water jet cutters (AWJ). For most BML cuts, both AWJ's and sand cutters can be deployed from inside the target, but a few companies offer external AWJ systems that use diver/ROV-mounted equipment. Sand cutters use a power swivel mounted on top of the pile/conductor to turn the cutting nozzle set at the proper cut depth. However, many internal AWJ systems have rotating nozzles and centralizing arms/rings built into the deployed cutting assembly itself, negating the need for a power swivel

Sand cutters and AWJ's have diverse equipment requirements, which primarily involve the different processes for creating the abrasive slurry. Sand cutters use equipment that mixes the cutting material with a high volume of water (80-100 gal/min) before being pumped through a low pressure (4,000-10,000 psi) cutting nozzle (NRC, 1996). Abrasive water jet equipment is most often designed for air delivery of its abrasive down to a high pressure (50,000-70,000 psi) diamond orifice, where it is mixed at low water volumes (50-80 gal/min) and focused on the target (TSB and CES, LSU, 2004).

The distinctions between equipment, pressure, and delivery systems also define what target types and within what water depths sand cutters and AWJ's can be used. Since cutting efficiency decreases with distance to the nozzle, sand cutters are generally limited to uncemented conductors and shallow-water, single-thickness piles that are surface assessable (open-piled). Even though some sand cutting systems can cut up to two cemented casing strings, the power swivel and cutting assembly must be pulled from the conductor so that each cut set of internals can be removed from the well. Most AWJ systems work equally well on piles and grouted conductors (either eccentrically or concentrically set), but if the cutting jet encounters voids or water gaps between the strings, the energy of the jet is decreased and an incomplete cut may occur. The air delivery systems used in most AWJ's also limit its use to shallow-water targets. To contend with the limitations, some AWJ designs are now incorporating a fluid/water delivery system, which can extend the AWJ's cutting range beyond 600 ft with some ROV-deployed units working in 1,100 ft of water (Manago and Williamson, 1998).

With most BML targets, the extremely small cut left by sand cutters and AWJs make severance verification difficult. Since there are no visual indicators, cutter operators often rely on feedback from water pressure or acoustic signals to gauge whether the cut has been completed. At that point, the equipment is removed and the structure is pulled by the crane assembly on the assisting lift vessel. Because the small cut size also does little to decrease the friction or suction made on the target by 15 ft or greater of sediments, the crane often has to pull several times the actual target weight to get the structure to move. If at that point, no movement is recorded, many removal contractors consider the cut unsuccessful and redeploy the cutters or use an alternate severing method (TSB and CES, LSU, 2004).

Mechanical Cutters

One of the oldest and most widely-used severing technologies in the GOM is mechanical cutters. Also referred to as casing cutters, these devices generally consist of a carbide-blade cutting assembly connected to a string of drill pipe. The string is mounted below and rotated by either the power swivel on the drill/workover rig or a pile-mounted swivel. To allow for deployment, the cutter's blades are initially collapsed back against the drill string and lowered into an open pile or conductor. Once set at the proper cut depth, hydraulic pressure (drill water) forces the blades outward while the power swivel rotates the entire assembly (Manago and Williamson, 1998). The assembly continues to turn while the hydraulic pressure steadily forces the blades out, cutting through the pile or casing strings.

Diver Cutters

Divers have been employed by removal contractors for several decades and have been used in almost every phase of decommissioning operations. A component of most barge crews, divers often conduct pre-severing surveys of the submerged sections of caissons, platform jackets, and conductors to determine the structural integrity of the target and in some cases, to search for marine protected species around the structure. Divers are also used to rig slings and other lift-related gear, as well as for installing, monitoring, and/or operating subsea severing equipment (e.g., AWJ's, external cutting equipment, explosive severing charges, etc.). However, the primary use of divers is associated with the use of torch cutting operations. There are two basic cutting torches that divers use: the underwater arc cutter and the oxyacetylene/oxy-hydrogen torch.

Underwater arc cutters use the extreme temperatures (~10,000°F) created by a high-voltage arc between an electrode and the target to melt the contacted metal. The developed flame is shielded and kept from extinguishing by a protective sheath of air, forced out a tube surrounding the torch tip. The compressed air also serves to evacuate the molten metal (plasma) away from the tip of the torch, creating a hole or cut (if drug across the target surface). Arc cutters are similar to standard (surface) arc welding systems in that a comparable power unit supplies the cutter with the necessary DC (direct current) voltage. However, since there are no filler or jointing metals added, the added compressed air system makes the unit function more like a typical plasma cutter. Much like the torches used by topside welders, the oxyacetylene/oxy-hydrogen torches used by divers depend on an ultra-high temperature flame created from a mixture of oxygen and acetylene or hydrogen to melt through metal targets. In water depths greater than 25 ft, divers often use torches set with a mixture of oxygen and hydrogen, since the hydrogen tends to be more stable under increased pressures (TSB and CES, LSU, 2004). As an average, a diver using an arc cutter or torch can burn one linear inch of steel per one-inch thickness in one minute, ultimately requiring several hours to conduct a complete cut on a pile or caisson (NRC, 1996).

Diver cutting is generally limited to single wall, conductive targets such as caissons, pilings, braces, and structural components (NRC, 1996). Though rare, there are instances where diver cutters are used to sever wells, but problems concerning multi-string designs, grouted annular spaces, and trapped explosive gases often make the operations extremely complex and dangerous. In choosing to use divers on BML targets, operators must also consider additional excavation or jetting activities and equipment. Besides the standard pile/caisson jetting, external diver cutting on BML targets requires the excavation of a trench around the target to allow the diver access to the cutline. Depending on the sediment conditions and the risk of cave-in, the exterior jetting may need to extend down and out 20 ft from the mudline/target. Internal cutting (diver within the pile/caisson) also requires internal jetting (usually 5 ft below the cutline) to allow the diver access and mobility. In addition, some exterior sediment excavation is necessary to avoid the formation of gas pockets, which could explode when contacted by the torch or cutting arc (NRC, 1996).

Diamond Wire Cutter

The diamond wire cutter (or diamond wire saw) is the most recent addition to nonexplosive cutting technology on the GOM OCS. Capable of severing most all structural materials with ease, industrial diamonds are embedded into nodules that are set within a steel wire at preset intervals. The wire is strung through the cutter on a group of framed pulleys in an arrangement that resembles a band saw. A set of electrically or hydraulically-driven motors are used to turn the pulleys and draw the wire into the target. Since the diamond wire is unaffected by grouting, internal voids, component composition, or the target's symmetric or concentric design (or lack thereof), the cutter can effectively sever any target upon which it can be configured and fastened. Diamond wire cutters (DWC) have been used to sever caissons, piles, structural braces, wells and conductors, pipelines, and moorings, as well as concrete and wooden objects such as creosote pilings and cement piles. Though not as commonly used as other nonexplosive tools, diamond wire services are being configured and deployed in an increasing number of operations; in both topside and subsea configurations.

For use in subsea operations, large-target DWC's can be deployed by either divers or ROV's, being fastened to their targets by manually or via self-actuating hydraulic/electric clamping systems (TSB and CES, LSU, 2004). Service providers have even designed smaller, ROV-housed and driven diamond wire units for small targets such as jacket members, fasteners, cables, and mooring lines. The primary limitation of most of the available diamond wire cutters is that the device can only be used for external installations and severings. Therefore, when a standard cutter is required for a BML cuts on piles, caissons, and wells, evacuation and jetting services must be employed for trenching around the targets (similar to diver cutting requirements) to allow for the mounting of the cutting assembly. However, recent advancements in DWC technology has led to the creation of a modified cutting system that allows for BML severing without jetting or excavating. The 'sub-bottom-cutter' is deployed to the seabed from a surface crane, and once in location, deploys a jetted tubing system to each side of the target (i.e., pile, conductor, well equipment, etc.) that tracks the diamond wire through the tubular and surrounding sediments. Since the cutter's capabilities are impervious to the mud plug within and surrounding the target, no pile jetting is required.

Other Nonexplosive Cutters

Though not often used in BML severing, a tubular cutting tool called a guillotine saw is available and can be employed by divers or ROV's to cut horizontal, diagonal, and vertical structure members, conductors, and pipelines during decommissioning activities. Once secured to the tubular, the guillotine saw uses toothed, high-speed steel or carbide blades that are drawn back and forth across the target's surface in much the same manor as a hacksaw. Several different size guillotines are available to sever targets with a diameter of 2 to 32 in. A series of hydraulic shears have also been developed to sever a number of targets during removal operations. Primarily deployed from ROV's, these shears can be used to cut steel mooring cables and wire (up to 6 in) and riser assemblies up to 12 in diameter. Several rotary cutting tools have also been deployed from ROV's to cut mooring lines and small tubulars; however, their limited capabilities often limit their use to non decommissioning severing jobs.

(12) Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must submit either a plan of cooperation or information that identifies what measures have been taken and/or will be taken to minimize any adverse affects on the availability of marine mammals for subsistence uses;

Not applicable.

(13) The Suggested Means of Accomplishing the Necessary Monitoring and Reporting that Will Result in Increased Knowledge of the Species, the Level of Taking or Impacts on Populations of Marine Mammals that Are Expected to Be Present while Conducting Activities and Suggested Means of Minimizing Burdens by Coordinating Such Reporting Requirements with Other Schemes Already Applicable to Persons Conducting Such Activity. Monitoring Plans Should Include a Description of the Survey Techniques that Would Be Used to Determine the Movement and Activity of Marine Mammals Near the Activity Site(S) Including Migration and Other Habitat Uses, Such as Feeding;

Based upon the analysis found the Structure-Removal PEA, MMS believes the mitigation measures listed below would prevent any significant impacts from occurring if used during removal operations. The monitoring requirements and methodologies for the 20 scenarios were developed in coordination with explosive-severance experts and protected species scientists from NMFS and MMS, taking into consideration MPS characteristics and surfacing rates, calculated impact parameters, and current/*status quo* mitigation requirements. While charge criteria and reporting requirements are standard for all scenarios, the individual survey requirements and requisite times vary. General descriptions of the charge criteria, monitoring terms/methods, and reporting requirements are provided below. The specific survey, time, and methodology requirements for each explosive-severance scenario follow.

For additional information on decommissioning mitigation refer to Appendix F of the PEA (USDOI, MMS, 2005).

General Requirements

Charge Criteria

The charge criteria discussed below (e.g., charge size, detonation staggering, and explosive material) are applicable for all of the explosive-severance scenarios conducted under the proposed action.

Charge Size (All Scenarios)

The options available under the multiple explosive-severance scenarios allow for the development of any size charge between 0 and 500 lb. Most often determined in the early planning stages, the final/actual charge weight establishes the specific mitigation scenario that must be adhered to as a permit condition. Charges greater than 500 lb are prohibited and their proposed usage will require additional National Environmental Policy Act (NEPA) analyses and ESA (ESA) consultations.

Detonation Staggering (All Scenarios)

Multiple charge detonations shall be staggered at an interval of 0.9 sec (900 msec) between blasts to prevent an additive pressure event. For decommissioning purposes, a "multiple charge detonation" refers to any configuration where more than one charge is required in a single detonation "event."

Explosive Material (All Scenarios)

There are many important properties (i.e., velocity, brisance, specific-energy, etc.) related to the explosive material(s) used in developing severance charges. Material needs vary widely depending upon target characteristics, marine conditions, and charge placement. Since specific material and personnel safety requirements must be established and followed, MMS feels that all decisions on explosive composition, configuration, and usage should be made by the qualified (i.e., licensed and permitted) explosive contractors in accordance with of the applicable explosive-related laws and regulations.

Monitoring Terms and Methods

The following monitoring terms are general descriptions of the terminology applicable to all explosive-severance activities. The monitoring methods are observation activities (i.e., visual or electronic surveys) designed to detect MPS in the vicinity of decommissioning operations. The requisite survey(s) and related time-period(s) will vary depending upon the nature of the severance-scenario.

Impact Zone (Term; All Scenarios)

The impact zone is the area (i.e., a horizontal radius around a decommissioning target) in which a MPS could be affected by the pressure and or acoustic energy released during the detonation of an explosive-severance charge. The impact zone radii were derived using conservative pressure/energy propagation data from Applied Research Associates, Inc.'s UnderWater Calculator (UWC). The monitoring surveys and associated time periods were designed to allow for adequate detection of MPS that may be present within each impact zone based upon potential species and the overall size of the impact area.

Predetonation Survey (Term; All Scenarios)

A predetonation (pre-det) survey refers to any MPS monitoring survey (e.g., surface, aerial, or acoustic) conducted prior to the detonation of any explosive severance tool. The primary purpose of pre-det surveys is to allow detection of any possible MPS within the scenario-specific impact zone and to continue monitoring the animal(s) until it leaves the area for the allotted time period.

Postdetonation Survey (Term; All Scenarios)

A postdetonation (post-det) survey refers to any MPS monitoring survey (e.g., surface, aerial, or post-post-det aerial) conducted after the detonation "event" occurs. The primary purpose of post-det surveys is to detect any MPS that may have been impacted (i.e., stunned, injured, or killed) by the detonation and resultant pressure/energy release. The post-det surveys are key in providing essential reporting information on the effectiveness of the pre-det survey efforts.

Waiting Period (Term; All Scenarios)

Variable by scenario, the waiting period refers to the time in which detonation operations must hold before the requisite monitoring survey(s) can be reconducted. The purpose of a waiting period is to allow any inbound or previously detected outbound MPS to exit the impact zone under their own volition.

Company Observer (Term; Scenarios A1 - A4)

Trained company observers will be allowed to perform MPS detection surveys for Very-Small blasting scenarios A1-A4. An "adequately-trained" observer is an employee of the company or severance contractor who has attended observer training courses offered by private or government entities.

NMFS Observer (Term; Scenarios B1-E4)

NMFS observers are required to perform MPS detection surveys for all blasting scenarios with the exception of Scenarios A1-A4. These observers are qualified NMFS employees or third-party contractors delegated under the Platform Removal Observer Program (PROP) of NMFS' Galveston Laboratory. Generally, two observers will be assigned to each operation for detection survey duties. However, because mitigation-scenarios C2, C4, D2, D4, E2, and E4 require a minimum of three (3) observers for the simultaneous surface, aerial, and acoustic surveys, at least two (2) "teams" of observers will be required. The PROP Coordinator will determine each "team" size depending upon the nature of the operations, target structure configuration, support vessel accommodations, and other environmental monitoring conditions.

Surface Monitoring Survey (Method; All Scenarios)

Surface monitoring surveys are to be conducted from the highest vantage point available on the structure being removed or proximal surface vessels (i.e., crewboats, derrick barges, etc.). Surface surveys will be restricted to daylight hours only, and the monitoring will cease upon inclement weather or when it is determined that marine conditions are not adequate for visual observations.

Aerial Monitoring Survey (Method; Scenarios B1-E4)

Aerial monitoring surveys are to be conducted from helicopters running low-altitude search patterns over the extent of the potential impact area. Aerial surveys will be restricted to daylight hours only, and they cannot begin until the requisite surface monitoring survey has been completed. Aerial surveys will cease upon inclement weather, when marine conditions are not adequate for visual observations, or when the pilot/removal supervisor determines that helicopter operations must be suspended. Aerial surveys are required for all severance scenarios with the exception of scenarios A1-A4.

Acoustic Monitoring Survey (Method; Scenarios C2, C4, D2, D4, E2, and E4)

Acoustic monitoring surveys are required to be conducted on all Standard, Large, and Specialty blasting scenarios conducted on slope (>200 m) activities (e.g, C2, C4, D2, D4, E2, and E4). Contractors conducting acoustic surveys will be required to use NOAA-approved passive acoustic monitoring devices and technicians. Acoustic surveys will be run concurrent with requisite pre-det surveys; beginning with the surface observations and concluded at the finish of the aerial surveys when the detonation(s) is allowed to proceed.

Post-Post-Det Aerial Monitoring Survey (Method; Scenarios C4, D2, D4, E2, and E4)

Post-post-det aerial monitoring surveys will be to be conducted within 2-7 days after detonation activities conclude, by either helicopter or fixed-wing aircraft. Observations are to start at the removal site and proceed leeward and outward of wind and current movement. Any injured or killed MPS must be noted in your survey report, and if possible, tracked and collected after notifying NMFS. Post-post-det aerial surveys are only required for mitigation-scenarios C4, D2, D4, E2, and E4.

Reporting Requirements

All explosive-severance activities in the GOM will be mandated to abide by the reporting requirements listed in this section. The information collected under these requirements will be used by MMS and NMFS to continually assess mitigation effectiveness and the level of MPS impacts.

Reporting Responsibilities and Filing Times

The reporting responsibilities will be assumed by the NOAA Fisheries' MPS observer for scenarios B1-E4 and the collected data will be prepared and routed in accordance with PROP guidelines for filing times and distribution. For Very-Small scenarios A1-A4, the company observer will be responsible for recording the data and preparing a trip report for submittal within 30-days of completion of the severance activities. Trip reports for scenarios A1-A4 will be sent to MMS and NOAA Fisheries at the following addresses:

Minerals Management Service
Gulf of Mexico Region
1201 Elmwood Park Blvd
New Orleans, LA 70123-2394
Attention: Regional Supervisor,
Office of Leasing and Environment

National Marine Fisheries Service
Southeast Region
9721 Executive Center Drive N
St. Petersburg, FL 33702
Attention: Assistant Regional Administrator,
Protected Resources Division

Information Requirements

In addition to basic operational data (i.e., area and block, water depth, company/platform information, etc.), the trip reports must contain all of the applicable information listed in Table 10.

Table 10

Minimum Information Requirements for Explosive-Severance Monitoring Reports

Information Type	Details
Target	• Type/Composition – pile, caisson, concrete piling, nylon mooring, etc. • Diameter and thickness – *example*; 30” x 1 ½” pile, ¾” wire rope, etc.
Charge	• Type – bulk, configured-bulk, linear-shaped, etc. • Charge weight/material – RDX, C4, HMX, etc. • Configuration – internal/external, cut depth (BML), water depth (AML), etc. • Deployment method – diver, ROV, from surface, etc.
Monitoring	• Survey Type – pre-det and post-det; surface, aerial, etc. • Time(s) initiated/terminated • Marine Conditions
Observed MPS	• Type/number – basic description or species identification (if possible) • Location/orientation – inside/outside impact zone, inbound/outbound, etc. • Any “halted-detonation” details – i.e., waiting periods, re-surveys, etc. • Any “Take-Event” details – actual MPS injury/mortality

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Take-Event Procedures

In the event that a MPS is shocked, injured, or killed during the severance activities, the operations will cease and the observer will contact MMS at (504) 736-3245 and NMFS’ Southeast Regional Office (SERO) at (727) 570-5312. If the animal does not revive, efforts should be made to recover the carcass for necropsy in consultation with the appropriate NMFS’ Stranding Coordinator. The Sea Turtle Standing and Salvage Network can be reached at (305) 361-4478, and the SERO Marine Mammal Stranding Coordinator can be reached via a 24-hour pager at (305) 862-2850. As noted above, details concerning the take event are required to be recorded in the trip report.

Specific Requirements

As noted, the charge criteria and reporting requirements listed above will be standard for all decommissionings employing explosive-severance activities. However, depending upon the severance scenario, there are six different MPS monitoring surveys that could be conducted before and after all detonation events. The specific monitoring requirements, survey times, and impact zone radii for all explosive-severance scenarios are summarized in Table 11.

Table 11

Survey and Time Requisite Summary for All Explosive-Severance Scenarios

Blasting Category	Impact Zone Radius	Scenario	Pre-Det Surface Survey (min)	Pre-Det Aerial Survey (min)	Pre-Det Acoustic Survey (min)	Post-Det Surface Survey (min)	Post-Det Aerial Survey (min)	Post-Post-Det Aerial Survey (Yes/No)
Very-Small	261 m (856 ft)	A1	60	N/A	N/A	30	N/A	No
		A2	90	N/A	N/A	30	N/A	No
	293 m (961 ft)	A3	60	N/A	N/A	30	N/A	No
		A4	90	N/A	N/A	30	N/A	No
Small	373 m (1,224 ft)	B1	90	30	N/A	N/A	30	No
		B2	90	30	N/A	N/A	30	No
	522 m (1,714 ft)	B3	90	30	N/A	N/A	30	No
		B4	90	30	N/A	N/A	30	No
Standard	631 m (2,069 ft)	C1	90	30	N/A	N/A	30	No
		C2	90	30	120	N/A	30	No
	829 m (2,721 ft)	C3	90	45	N/A	N/A	30	No
		C4	90	60	150	N/A	30	Yes
Large	941 m (3,086 ft)	D1	120	45	N/A	N/A	30	No
		D2	120	60	180	N/A	30	Yes
	1,126m (3,693ft)	D3	120	60	N/A	N/A	30	No
		D4	150	60	210	N/A	30	Yes
Specialty	1,500 m (4,916 ft)	E1	150	90	N/A	N/A	45	No
		E2	180	90	270	N/A	45	Yes
	1,528 m (5,013 ft)	E3	150	90	N/A	N/A	45	No

Accounting for similar pre- and post-det surveys, the 20 severance scenarios correspond roughly with 8 basic mitigation processes that vary only in differences in impact zone ranges and survey times. As noted in Appendix E of the Structure-Removal Operations PEA (DOI, MMS, 2005), the impact zone radii were derived using the "UnderWater Calculator" (UWC), a verified model that predicts the detonation pressure/energy propagation resulting from underwater detonations. Time requisites were established by NMFS and MMS protected species scientists, taking into consideration likely MPS and their surfacing rates. The mitigation process details for each of the explosive-severance scenarios follows.

Very-Small Blasting Category

Shelf (<200 m) and Slope (>200 m) Scenarios A1, A2, A3, and A4

An operator proposing explosive-severance activities conduced under the very-small blasting category will be limited to 5-lb (AML) and 10-lb (BML) charge sizes and conduct all requisite monitoring during daylight hours out to the associated impact-zone radii listed below:

A1 and A2 - 261 m (856 ft)
A3 and A4 - 293 m (961 ft)

Required Observers
Owing to the small impact zone and in an effort to encourage industry to develop and use smaller/more effective cutting charges, company observers would be allowed to conduct the MPS monitoring for all of the very-small blasting scenarios. To qualify as an "adequately trained" observer, operator/contractor personnel must attend observer training courses offered by private or government entities. In addition to meeting all reporting requirements, company observers would:

- Brief appropriate crew of the monitoring efforts and notify topsides personnel to report any sighted MPS to the observer or company representative immediately;
- Establish an active line of communication (i.e., 2-way radio, visual signals, etc.) with blasting personnel; and
- Devote the entire, uninterrupted survey time to MPS monitoring and not secondary tasking.

Pre-Det Monitoring
Before severance charge detonation, the company observer will conduct a 60 min (Scenarios A1 and A3) or 90 min (Scenarios A2 and A4) **surface monitoring survey** of the impact zone. The monitoring will be conducted from the highest vantage point available from either the decommissioning target or proximal surface vessels. If during the survey a MPS is:

- **Not sighted**, proceed with the detonation;
- **Sighted outbound and continuously tracked clearing the impact zone**, proceed with the detonation after the monitoring time is complete to avoid reentry;
- **Sighted outbound and the MPS track is lost** (i.e., the animal dives below the surface),

    Halt the detonation,
    Wait 30 min, and
    Reconduct a 30 min **surface monitoring survey**; or

- **Sighted inbound**,

    Halt the detonation,
    Wait 30 min, and
    Reconduct a 30 min **surface monitoring survey**.

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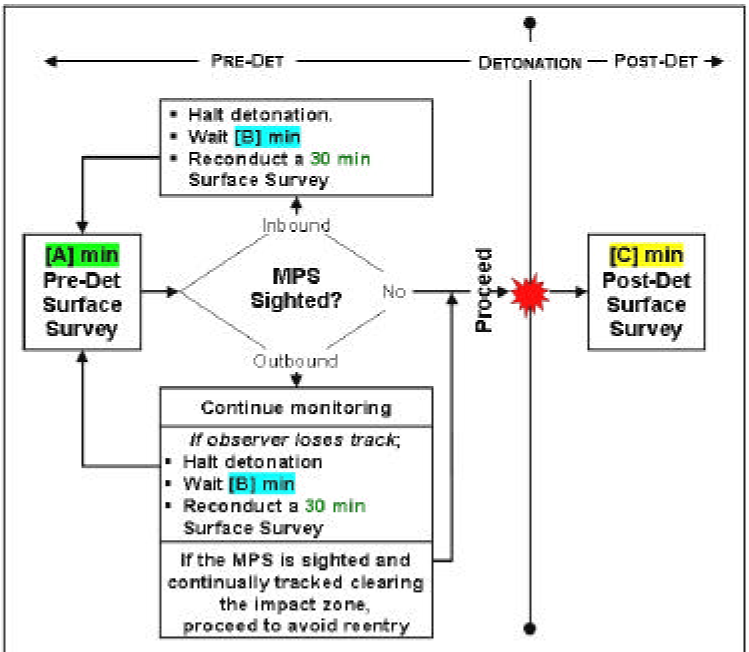
Post-Det Monitoring
After severance charge detonation, the company observer will conduct a 30 min **surface monitoring survey** of the impact zone to detect for impacted MPS. If a MPS is observed shocked, injured, or killed, the operations will cease, attempts should be made to collect/resuscitate the animal, and the observer will contact MMS and NMFS as per the take event procedures described on page 40 of this request. If no

MPS are observed to be impacted by the detonation, the company observer is to record all of the necessary information as per the conditions detailed in MMS's permit approval letter (i.e., MMPA/ESA incidental-take requirements) and prepare a trip report for routing to MMS and NMFS.

If unforeseen conditions or events occur during a very-small blasting operation that necessitates monitoring requirements fall outside of the applicable regulations, the company observer, severance contractor, and company representatives are directed to contact the NMFS' PROP coordinator and MMS's GOM Region for additional guidance. A flowchart of the monitoring process and associated survey times for very-small severance-scenarios A1, A2, A3, and A4 is provided in Figure 4.



Scenario	Pre-Det Surface [A]	Waiting Period [B]	Post-Det Surface [C]
		(Minutes)	
A1	60	30	30
A2	90	30	30
A3	60	30	30
A4	90	30	30

Figure 4. Surveys, time requisites, and monitoring process for very-small severance-scenarios A1, A2, A3, and A4.

Small Blasting Category

Shelf (<200 m) and Slope (>200 m) Scenarios B1, B2, B3, and B4

An operator proposing explosive-severance activities conduced under the small blasting category will be limited to 20-lb charge sizes (AML or BML) and conduct all requisite monitoring during daylight hours out to the associated impact-zone radii listed below:

B1 and B2	-	373 m (1,224 ft)
B3 and B4	-	522 m (1,714 ft)

Required Observers
Generally, two NMFS observers (PROP or contracted personnel) are required to perform MPS detection surveys for small-blasting scenarios. If necessary, the PROP Coordinator will determine if additional observers are required to compensate for the complexity of severance activities and or structure configuration. In addition to meeting all reporting requirements, the NMFS observers would:

- Brief affected crew and severance contractors of the monitoring efforts and notify topsides personnel to report any sighted MPS to the observer or company representative immediately;
- Establish an active line of communication (i.e., 2-way radio, visual signals, etc.) with company and blasting personnel; and
- Devote the entire, uninterrupted survey time to MPS monitoring.

Pre-Det Monitoring
Before severance charge detonation, both NMFS observers will conduct a 60 min (Scenarios B1 and B3) or 90 min (Scenarios B2 and B4) **surface monitoring survey** of the impact zone. The monitoring will be conducted from the highest vantage point available from either the decommissioning target or proximal surface vessels. Once the surface monitoring is complete (i.e., the impact zone cleared of MPS), one of the NMFS observers will transfer to a helicopter to conduct a 30 min **aerial monitoring survey**. As per PROP-approved guidelines, the helicopter will transverse the impact zone at low speed/altitude in a specified grid pattern. If during the aerial survey a MPS is:

- **Not sighted**, proceed with the detonation;
- **Sighted outbound and continuously tracked clearing the impact zone**, proceed with the detonation after the monitoring time is complete to avoid reentry;
- **Sighted outbound and the MPS track is lost** (i.e., the animal dives below the surface),
    - Halt the detonation,
    - Wait 30 min, and
    - Reconduct a 30 min **aerial monitoring survey**; or

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- **Sighted inbound**,
    - Halt the detonation,
    - Wait 30 min, and
    - Reconduct a 30 min **aerial monitoring survey**.

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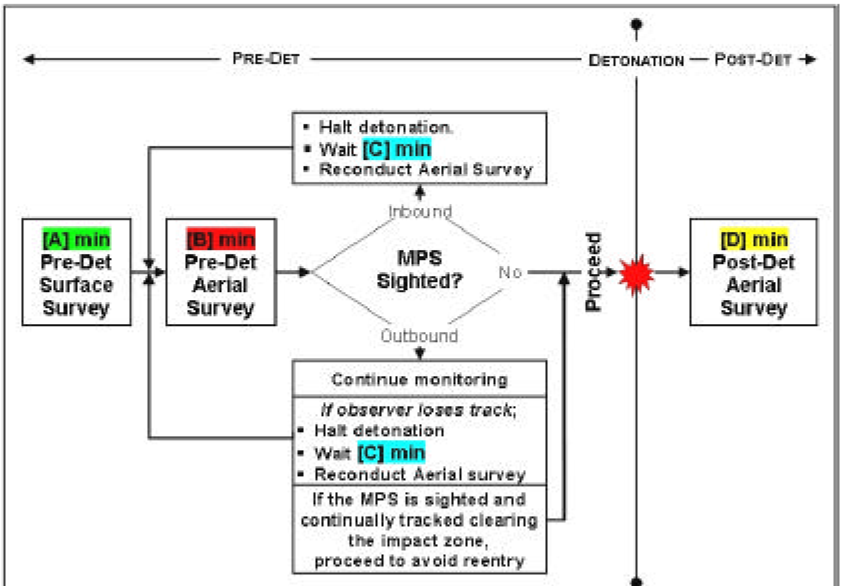
Post-Det Monitoring
After severance charge detonation, the NMFS observer will conduct a 30 min **aerial monitoring survey** of the impact zone to detect for impacted MPS. If a MPS is observed shocked, injured, or killed, the

operations will cease, attempts will be made to collect/resuscitate the animal, and NMFS SERO will be contacted as per the take event procedures described on page 40 of this request. If no MPS are observed to be impacted by the detonation, the NMFS observer will record all of the necessary information as per the conditions detailed in MMS's permit approval letter and PROP guidelines for the preparation of a trip report.

If unforeseen conditions or events occur during a small-blasting operation that necessitates monitoring requirements fall outside of the applicable regulations, the NMFS observer will contact the PROP coordinator and/or MMS's GOM Region for additional guidance. A flowchart of the monitoring process and associated survey times for small severance-scenarios B1, B2, B3, and B4 is provided in Figure 5.



Scenario	Pre-Det Surface [A]	Pre-Det Aerial [B]	Waiting Period [C]	Post-Det Aerial [D]
	(Minutes)			
B1	60	30	30	30
B2	90	30	30	30
B3	60	30	30	30
B4	90	30	30	30

Figure 5. Surveys, time requisites, and monitoring process for small severance-scenarios B1, B2, B3, and B4.

Standard Blasting Category

Shelf (<200 m) Scenarios C1 and C3

An operator proposing shelf-based (<200 m), explosive-severance activities conduced under the standard blasting category will be limited to 80-lb charge sizes (BML or AML) and conduct all requisite monitoring during daylight hours out to the associated impact-zone radii listed below:

C1 - 631 m (2,069 ft)
C3 - 829 m (2,721 ft)

Required Observers
Generally, two NMFS observers (PROP or contracted personnel) are required to perform MPS detection surveys for standard-blasting, shelf scenarios C1 and C3. If necessary, the PROP Coordinator will determine if additional observers are required to compensate for the complexity of severance activities and or structure configuration. In addition to meeting all reporting requirements, the NMFS observers would:

- Brief affected crew and severance contractors of the monitoring efforts and notify topsides personnel to report any sighted MPS to the observer or company representative immediately;
- Establish an active line of communication (i.e., 2-way radio, visual signals, etc.) with company and blasting personnel; and
- Devote the entire, uninterrupted survey time to MPS monitoring.

Pre-Det Monitoring
Before severance charge detonation, both NMFS observers will conduct a 90 min **surface monitoring survey** of the impact zone. The monitoring will be conducted from the highest vantage point available from either the decommissioning target or proximal surface vessels. Once the surface monitoring is complete (i.e., the impact zone cleared of MPS), one of the NMFS observers will transfer to a helicopter to conduct a 30 min (Scenario C1) or 45 min (Scenario C3) **aerial monitoring survey**. As per PROP-approved guidelines, the helicopter will transverse the impact zone at low speed/altitude in a specified grid pattern. If during the aerial survey a MPS is:

- **Not sighted**, proceed with the detonation;
- **Sighted outbound and continuously tracked clearing the impact zone**, proceed with the detonation after the monitoring time is complete to avoid reentry;
- **Sighted outbound and the MPS track is lost** (i.e., the animal dives below the surface),

  Halt the detonation,
  Wait 30 min, and
  Reconduct the 30 min (C1) or 45 min (C3) **aerial monitoring survey**; or

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- **Sighted inbound**,

  Halt the detonation,
  Wait 30 min, and
  Reconduct the 30 min (C1) or 45 min (C3) **aerial monitoring survey**.

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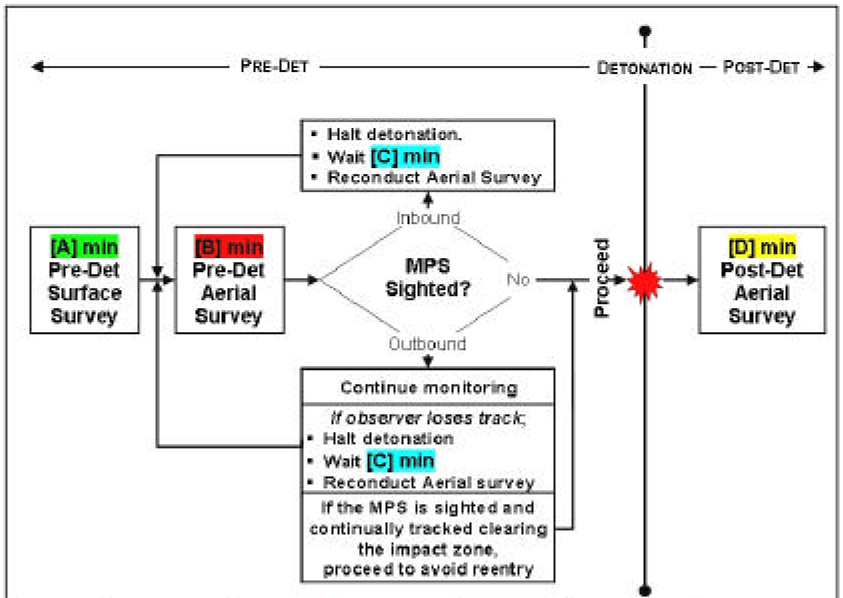
Post-Det Monitoring
After severance charge detonation, the NMFS observer will conduct a 30 min **aerial monitoring survey** of the impact zone to detect for impacted MPS. If a MPS is observed shocked, injured, or killed, the operations will cease, attempts will be made to collect/resuscitate the animal, and NMFS SERO will be contacted as per the take event procedures described on page 40 of this request. If no MPS are observed to be impacted by the detonation, the NMFS observer will record all of the necessary information as per the conditions detailed in MMS's permit approval letter and PROP guidelines for the preparation of a trip report.

If unforeseen conditions or events occur during a standard-blasting operation that necessitates monitoring requirements fall outside of the applicable regulations, the NMFS observer will contact the PROP coordinator and/or MMS's GOM Region for additional guidance. A flowchart of the monitoring process and associated survey times for standard severance-scenarios C1 and C3 is provided in Figure 6.



Scenario	Pre-Det Surface [A]	Pre-Det Aerial [B]	Waiting Period [C]	Post-Det Aerial [D]
	(Minutes)			
C1	90	30	30	30
C3	90	45	30	30

Figure 6. Surveys, time requisites, and monitoring process for standard severance-scenarios C1 and C3.

Slope (>200 m) Scenarios C2 and C4

An operator proposing slope-based (>200 m), explosive-severance activities conduced under the standard blasting category will be limited to 80-lb charge sizes (BML or AML) and conduct all requisite monitoring during daylight hours out to the associated impact-zone radii listed below:

C2	-	631 m (2,069 ft)
C4	-	829 m (2,721 ft)

Required Observers
Since standard-blasting, slope scenarios require a minimum of three (3) NMFS observers (PROP or contracted personnel) for the simultaneous surface, aerial, and acoustic monitoring surveys, at least two (2) "teams" of observers will be required. The PROP Coordinator will determine each "team" size depending upon the complexity of severance activities and or structure configuration. In addition to meeting all reporting requirements, the NMFS observers would:

- Brief affected crew and severance contractors of the monitoring efforts and notify topsides personnel to report any sighted MPS to the observer or company representative immediately;
- Establish an active line of communication (i.e., 2-way radio, visual signals, etc.) with company, blasting, and acoustic monitoring personnel; and
- Devote the entire, uninterrupted survey time to MPS monitoring.

Pre-Det Monitoring
Before severance charge detonation, NMFS observers will begin a 90 min **surface monitoring survey** and a 120 min (Scenario C2) or 150 min (Scenario C4) **passive-acoustic monitoring survey** of the impact zone. The surface monitoring will be conducted from the highest vantage point available and the acoustic monitoring will be conducted using NOAA-approved passive-acoustic monitoring devices and technicians. Once the surface monitoring is complete (i.e., the impact zone cleared of MPS), the acoustic survey will continue while one of the NMFS observers transfer to a helicopter to conduct a 30 min (Scenario C2) or 60 min (Scenario C4) **aerial monitoring survey**. As per PROP-approved guidelines, the helicopter will transverse the impact zone at low speed/altitude in a specified grid pattern. If during the aerial survey a MPS is:

- **Not sighted or detected** (acoustically), proceed with the detonation;
- **Sighted outbound and continuously tracked clearing the impact zone and not detected** (acoustically), proceed with the detonation after the monitoring time is complete to avoid reentry;
- **Sighted outbound and the MPS track is lost** (i.e., the animal dives below the surface),

    Halt the detonation,
    Wait 30 min (C2) or 45 min (C4), and
    Reconduct the 30 min (C2) or 60 min (C4) **aerial monitoring survey**; or

- **Sighted inbound or detected** (acoustically),

    Halt the detonation,
    Wait 30 min (C2) or 45 min (C4), and
    Reconduct the 30 min (C2) or 60 min (C4) **aerial monitoring survey**.

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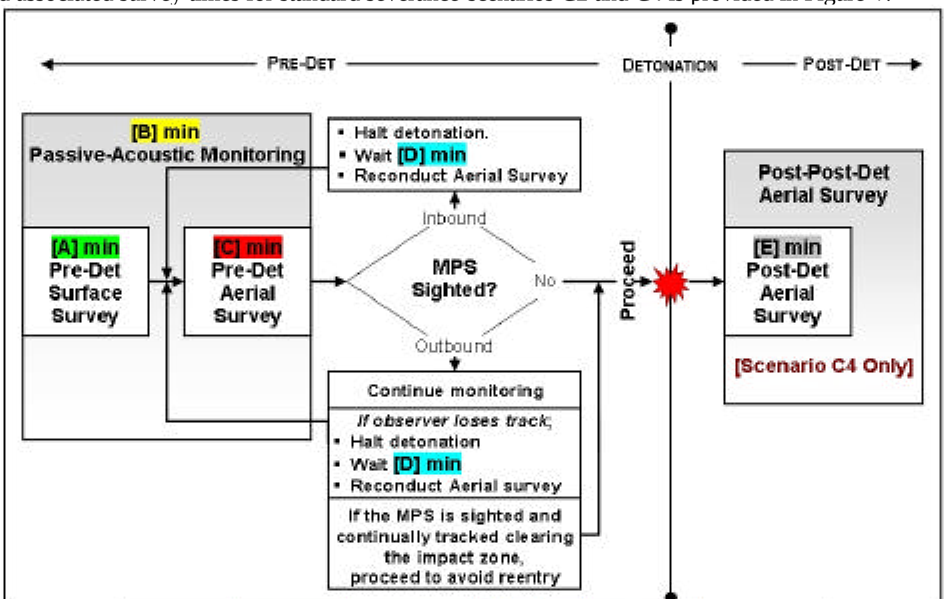
Post-Det Monitoring

After severance charge detonation, the NMFS observer will conduct a 30 min **aerial monitoring survey** of the impact zone to detect for impacted MPS. If a MPS is observed shocked, injured, or killed, the operations will cease, attempts will be made to collect/resuscitate the animal, and NMFS SERO will be contacted as per the take event procedures described on page 40 of this request.

Scenario C4 also requires a **post-post-det aerial monitoring survey** to be conducted within 2-7 days after detonation activities conclude. Conducted by helicopter or fixed-wing aircraft, observations are to start at the removal site and proceed leeward and outward of wind and current movement. Any injured or killed MPS must be recorded, and if possible, tracked and collected after notifying NMFS SERO. If no MPS are observed to be impacted during either aerial survey, the NMFS observers will record all of the necessary information as per the conditions detailed in MMS's permit approval letter and PROP guidelines for the preparation of a trip report.

If unforeseen conditions or events occur during a standard-blasting operation that necessitates monitoring requirements fall outside of the applicable regulations, the NMFS observer will contact the PROP coordinator and/or MMS's GOM Region for additional guidance. A flowchart of the monitoring process and associated survey times for standard severance-scenarios C2 and C4 is provided in Figure 7.



Scenario	Pre-Det Surface [A]	Passive Acoustic [B]	Pre-Det Aerial [C]	Waiting Period [D]	Post-Det Aerial [E]
	(Minutes)				
C2	90	120	30	30	30
C4	90	150	60	45	30

Figure 7. Surveys, time requisites, and monitoring process for standard severance-scenarios C2 and C4.

Large Blasting Category

Shelf (<200 m) Scenarios D1 and D3

An operator proposing shelf-based (<200 m), explosive-severance activities conduced under the large blasting category will be limited to 200-lb charge sizes (BML or AML) and conduct all requisite monitoring during daylight hours out to the associated impact-zone radii listed below:

D1 - 941 m (3,086 ft)
D3 - 1,126 m (3,693 ft)

Required Observers
Generally, two NMFS observers (PROP or contracted personnel) are required to perform MPS detection surveys for large-blasting, shelf scenarios D1 and D3. If necessary, the PROP Coordinator will determine if additional observers are required to compensate for the complexity of severance activities and or structure configuration. In addition to meeting all reporting requirements, the NMFS observers would:

- Brief affected crew and severance contractors of the monitoring efforts and notify topsides personnel to rep ort any sighted MPS to the observer or company representative immediately;
- Establish an active line of communication (i.e., 2-way radio, visual signals, etc.) with company and blasting personnel; and
- Devote the entire, uninterrupted survey time to MPS monitoring.

Pre-Det Monitoring
Before severance charge detonation, both NMFS observers will conduct a 120 min **surface monitoring survey** of the impact zone. The monitoring will be conducted from the highest vantage point available from either the decommissioning target or proximal surface vessels. Once the surface monitoring is complete (i.e., the impact zone cleared of MPS), one of the NMFS observers will transfer to a helicopter to conduct a 45 min (Scenario D1) or 60 min (Scenario D3) **aerial monitoring survey**. As per PROP-approved guidelines, the helicopter will transverse the impact zone at low speed/altitude in a specified grid pattern. If during the aerial survey a MPS is:

- **Not sighted**, proceed with the detonation;
- **Sighted outbound and continuously tracked clearing the impact zone**, proceed with the detonation after the monitoring time is complete to avoid reentry;
- **Sighted outbound and the MPS track is lost** (i.e., the animal dives below the surface),

    Halt the detonation,
    Wait 30 min, and
    Reconduct the 45 min (D1) or 60 min (D3) **aerial monitoring survey**, or

- **Sighted inbound**,

    Halt the detonation,
    Wait 30 min, and
    Reconduct the 45 min (D1) or 60 min (D3) **aerial monitoring survey**.

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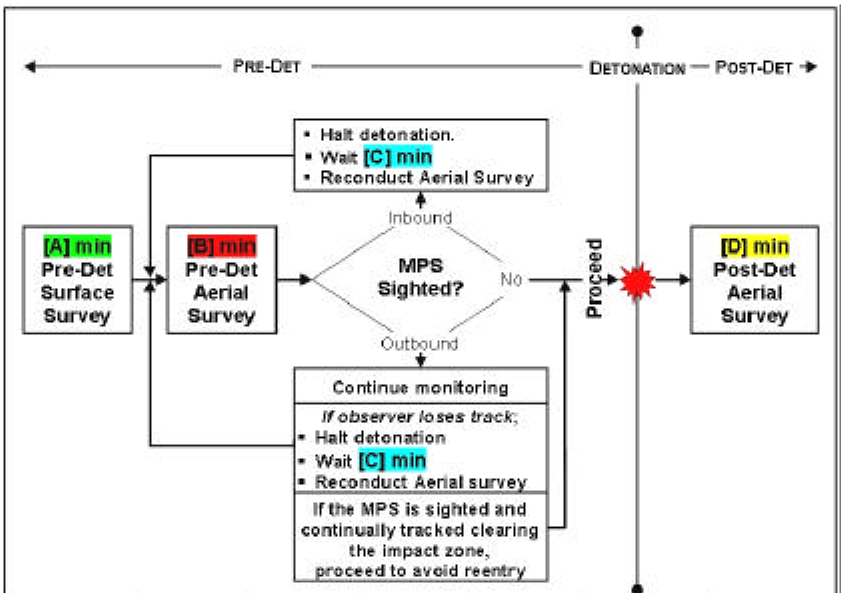
Post-Det Monitoring
After severance charge detonation, the NMFS observer will conduct a 30 min **aerial monitoring survey** of the impact zone to detect for impacted MPS. If a MPS is observed shocked, injured, or killed, the operations will cease, attempts will be made to collect/resuscitate the animal, and NMFS SERO will be contacted as per the take event procedures described on page 40 of this request. If no MPS are observed to be impacted by the detonation, the NMFS observer will record all of the necessary information as per the conditions detailed in MMS's permit approval letter and PROP guidelines for the preparation of a trip report.

If unforeseen conditions or events occur during a large-blasting operation that necessitates monitoring requirements fall outside of the applicable regulations, the NMFS observer will contact the PROP coordinator and/or MMS's GOM Region for additional guidance. A flowchart of the monitoring process and associated survey times for large severance-scenarios D1 and D3 is provided in Figure 8.



Scenario	Pre-Det Surface [A]	Pre-Det Aerial [B]	Waiting Period [C]	Post-Det Aerial [D]
	(Minutes)			
D1	120	45	30	30
D3	120	60	30	30

Figure 8. Surveys, time requisites, and monitoring process for large severance-scenarios D1 and D3.

Slope (>200 m) Scenarios D2 and D4

An operator proposing slope-based (<200 m), explosive-severance activities conduced under the large blasting category will be limited to 200-lb charge sizes (BML or AML) and conduct all requisite monitoring during daylight hours out to the associated impact-zone radii listed below:

D2 - 941 m (3,086 ft)
D4 - 1,126 m (3,693 ft)

Required Observers
Since large-blasting, slope scenarios require a minimum of three (3) NMFS observers (PROP or contracted personnel) for the simultaneous surface, aerial, and acoustic monitoring surveys, at least two (2) "teams" of observers will be required. The PROP Coordinator will determine each "team" size depending upon the complexity of severance activities and or structure configuration. In addition to meeting all reporting requirements, the NMFS observers would:

- Brief affected crew and severance contractors of the monitoring efforts and notify topsides personnel to report any sighted MPS to the observer or company representative immediately;
- Establish an active line of communication (i.e., 2-way radio, visual signals, etc.) with company, blasting, and acoustic monitoring personnel; and
- Devote the entire, uninterrupted survey time to MPS monitoring.

Pre-Det Monitoring
Before severance charge detonation, NMFS observers will begin a 120 min **surface monitoring survey** and a 180 min (Scenario D2) or 210 min (Scenario D4) **passive-acoustic monitoring survey** of the impact zone. The surface monitoring will be conducted from the highest vantage point available and the acoustic monitoring will be conducted using NOAA-approved passive-acoustic monitoring devices and technicians. Once the surface monitoring is complete (i.e., the impact zone cleared of MPS), the acoustic survey will continue while one of the NMFS observers transfer to a helicopter to conduct a 60 min **aerial monitoring survey**. As per PROP-approved guidelines, the helicopter will transverse the impact zone at low speed/altitude in a specified grid pattern. If during the aerial survey a MPS is:

- **Not sighted or detected** (acoustically), proceed with the detonation;
- **Sighted outbound and continuously tracked clearing the impact zone and not detected** (acoustically), proceed with the detonation after the monitoring time is complete to avoid reentry;
- **Sighted outbound and the MPS track is lost** (i.e., the animal dives below the surface),

    Halt the detonation,
    Wait 45 min, and
    Reconduct the 60 min **aerial monitoring survey**; or

- **Sighted inbound or detected** (acoustically),

    Halt the detonation,
    Wait 45 min, and
    Reconduct the 60 min **aerial monitoring survey**.

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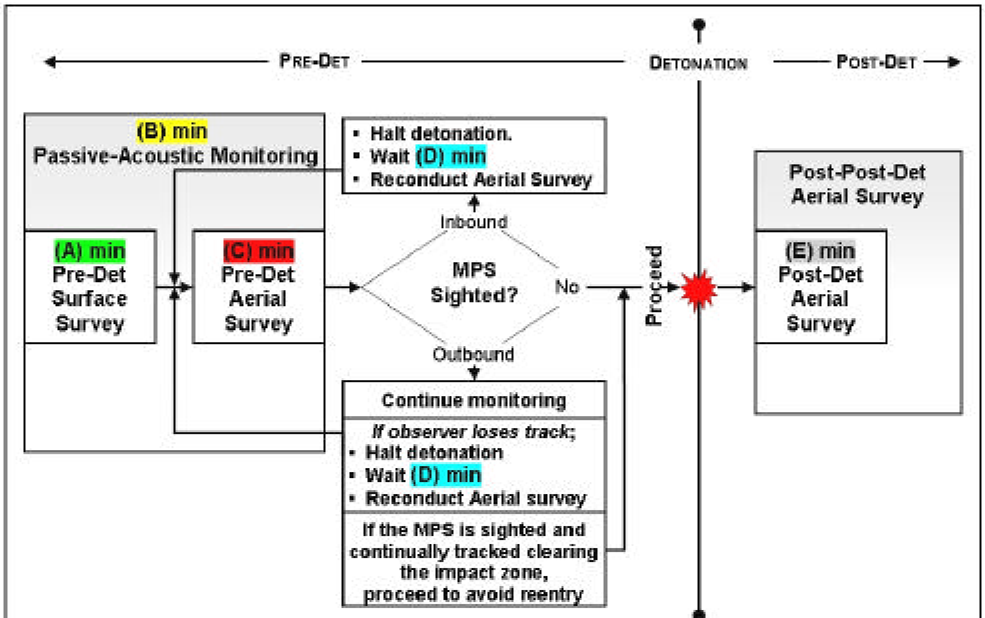
Post-Det Monitoring
After severance charge detonation, the NMFS observer will conduct a 30 min **aerial monitoring survey** of the impact zone to detect for impacted MPS. If a MPS is observed shocked, injured, or killed, the

operations will cease, attempts will be made to collect/resuscitate the animal, and NMFS SERO will be contacted as per the take event procedures described on page 40 of this request.

Scenarios D2 and D4 also require a **post-post-det aerial monitoring survey** to be conducted within 2-7 days after detonation activities conclude. Conducted by helicopter or fixed-wing aircraft, observations are to start at the removal site and proceed leeward and outward of wind and current movement. Any injured or killed MPS must be recorded, and if possible, tracked and collected after notifying NMFS SERO. If no MPS are observed to be impacted during either aerial survey, the NMFS observers will record all of the necessary information as per the conditions detailed in MMS's permit approval letter and PROP guidelines for the preparation of a trip report.

If unforeseen conditions or events occur during a large-blasting operation that necessitates monitoring requirements fall outside of the applicable regulations, the NMFS observer will contact the PROP coordinator and/or MMS's GOM Region for additional guidance. A flowchart of the standard monitoring process and associated survey times for large severance-scenarios D2 and D4 is provided in Figure 9.



Scenario	Pre-Det Surface [A]	Passive Acoustic [B]	Pre-Det Aerial [C]	Waiting Period [D]	Post-Det Aerial [E]
	(Minutes)				
D2	120	180	60	45	30
D4	120	210	60	45	30

Figure 9. Surveys, time requisites, and monitoring process for large severance-scenarios D2 and D4.

Specialty Blasting Category

Shelf (<200 m) Scenarios E1 and E3

An operator proposing shelf-based (<200 m), explosive-severance activities conduced under the specialty blasting category will be limited to 500-lb charge sizes (BML or AML) and conduct all requisite monitoring during daylight hours out to the associated impact-zone radii listed below:

E1 - 1,500 m (4,916 ft)
E3 - 1,528 m (5,012 ft)

Required Observers
Generally, two NMFS observers (PROP or contracted personnel) are required to perform MPS detection surveys for specialty-blasting, shelf scenarios E1 and E3. If necessary, the PROP Coordinator will determine if additional observers are required to compensate for the complexity of severance activities and or structure configuration. In addition to meeting all reporting requirements, the NMFS observers would:

- Brief affected crew and severance contractors of the monitoring efforts and notify topsides personnel to report any sighted MPS to the observer or company representative immediately;
- Establish an active line of communication (i.e., 2-way radio, visual signals, etc.) with company and blasting personnel; and
- Devote the entire, uninterrupted survey time to MPS monitoring.

Pre-Det Monitoring
Before severance charge detonation, both NMFS observers will conduct a 150 min **surface monitoring survey** of the impact zone. The monitoring will be conducted from the highest vantage point available from either the decommissioning target or proximal surface vessels. Once the surface monitoring is complete (i.e., the impact zone cleared of MPS), one of the NMFS observers will transfer to a helicopter to conduct a 90 min **aerial monitoring survey**. As per PROP-approved guidelines, the helicopter will transverse the impact zone at low speed/altitude in a specified grid pattern. If during the aerial survey a MPS is:

- **Not sighted**, proceed with the detonation;
- **Sighted outbound and continuously tracked clearing the impact zone**, proceed with the detonation after the monitoring time is complete to avoid reentry;
- **Sighted outbound and the MPS track is lost** (i.e., the animal dives below the surface),

    Halt the detonation,
    Wait 45 min, and
    Reconduct the 90 min **aerial monitoring survey**; or

- **Sighted inbound**,

    Halt the detonation,
    Wait 45 min, and
    Reconduct the 90 min **aerial monitoring survey**.

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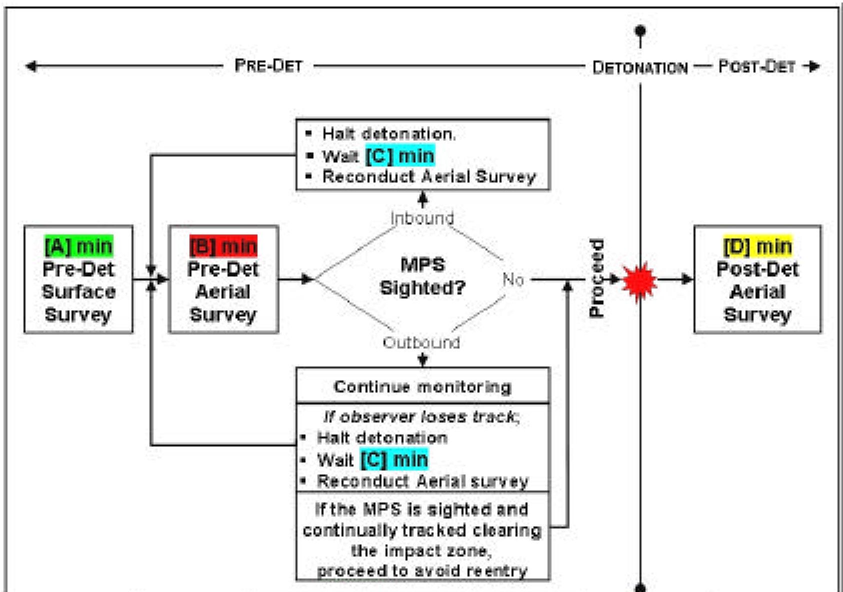
Post-Det Monitoring

After severance charge detonation, the NMFS observer will conduct a 45 min **aerial monitoring survey** of the impact zone to detect for impacted MPS. If a MPS is observed shocked, injured, or killed, the operations will cease, attempts will be made to collect/resuscitate the animal, and NMFS SERO will be contacted as per the take event procedures described on page 40 of this request. If no MPS are observed to be impacted by the detonation, the NMFS observer will record all of the necessary information as per the conditions detailed in MMS's permit approval letter and PROP guidelines for the preparation of a trip report.

If unforeseen conditions or events occur during a specialty-blasting operation that necessitates monitoring requirements fall outside of the applicable regulations, the NMFS observer will contact the PROP coordinator and/or MMS's GOM Region for additional guidance. A flowchart of the monitoring process and associated survey times for specialty severance-scenarios E1 and E3 is provided in Figure 10.



Scenario	Pre-Det Surface [A]	Pre-Det Aerial [B]	Waiting Period [C]	Post-Det Aerial [D]
	(Minutes)			
E1	150	90	45	45
E3	150	90	45	45

Figure 10. Surveys, time requisites, and monitoring process for large severance-scenarios E1 and E3.

Slope (>200 m) Scenarios E2 and E4

An operator proposing slope-based (>200 m), explosive-severance activities conduced under the specialty blasting category will be limited to 500-lb charge sizes (BML or AML) and conduct all requisite monitoring during daylight hours out to the associated impact-zone radii listed below:

E2 - 1,500 m (4,916 ft)
E4 - 1,528 m (5,012 ft)

Required Observers
Since specialty-blasting, slope scenarios require a minimum of three (3) NMFS observers (PROP or contracted personnel) for the simultaneous surface, aerial, and acoustic monitoring surveys, at least two (2) "teams" of observers will be required. The PROP Coordinator will determine each "team" size depending upon the complexity of severance activities and or structure configuration. In addition to meeting all reporting requirements, the NMFS observers would:

- Brief affected crew and severance contractors of the monitoring efforts and notify topsides personnel to report any sighted MPS to the observer or company representative immediately;
- Establish an active line of communication (i.e., 2-way radio, visual signals, etc.) with company, blasting, and acoustic monitoring personnel; and
- Devote the entire, uninterrupted survey time to MPS monitoring.

Pre-Det Monitoring
Before severance charge detonation, NMFS observers will begin a 180 min **surface monitoring survey** and a 270 min **passive-acoustic monitoring survey** of the impact zone. The surface monitoring will be conducted from the highest vantage point available and the acoustic monitoring will be conducted using NOAA-approved passive-acoustic monitoring devices and technicians. Once the surface monitoring is complete (i.e., the impact zone cleared of MPS), the acoustic survey will continue while one of the NMFS observers transfer to a helicopter to conduct a 90 min **aerial monitoring survey**. As per PROP-approved guidelines, the helicopter will transverse the impact zone at low speed/altitude in a specified grid pattern. If during the aerial survey a MPS is:

- **Not sighted or detected** (acoustically), proceed with the detonation;
- **Sighted outbound and continuously tracked clearing the impact zone and not detected** (acoustically), proceed with the detonation after the monitoring time is complete to avoid reentry;
- **Sighted outbound and the MPS track is lost** (i.e., the animal dives below the surface),

    Halt the detonation,
    Wait 45 min, and
    Reconduct the 90 min **aerial monitoring survey**; or

- **Sighted inbound or detected** (acoustically),

    Halt the detonation,
    Wait 45 min, and
    Reconduct the 90 min **aerial monitoring survey**.

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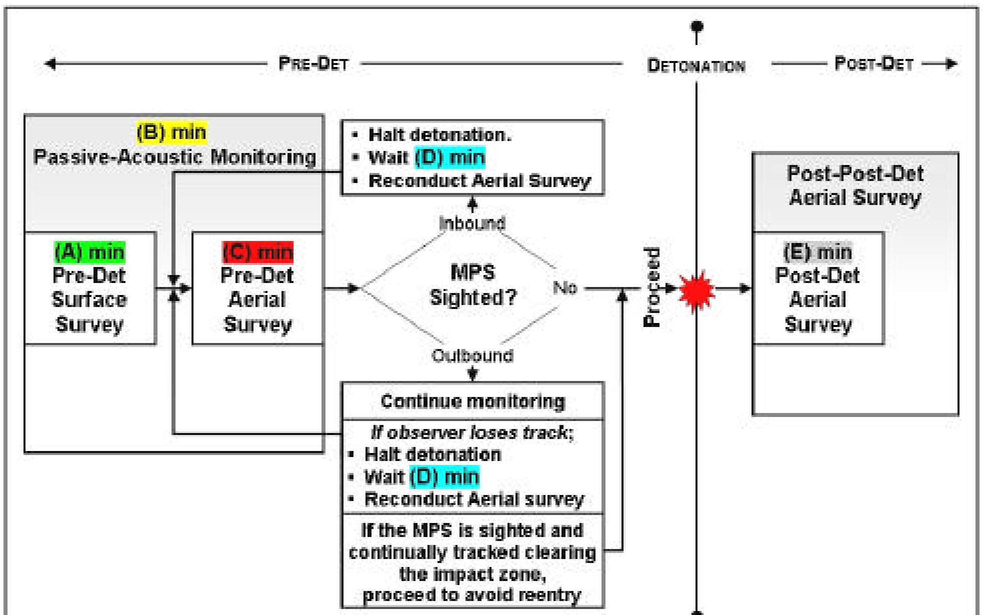
Post-Det Monitoring
After severance charge detonation, the NMFS observer will conduct a 45 min **aerial monitoring survey** of the impact zone to detect for impacted MPS. If a MPS is observed shocked, injured, or killed, the

operations will cease, attempts will be made to collect/resuscitate the animal, and NMFS SERO will be contacted as per the take event procedures described on page 40 of this request.

Scenarios E2 and E4 also require a **post-post-det aerial monitoring survey** to be conducted within 2-7 days after detonation activities conclude. Conducted by helicopter or fixed-wing aircraft, observations are to start at the removal site and proceed leeward and out ward of wind and current movement. Any injured or killed MPS must be recorded, and if possible, tracked and collected after notifying NMFS SERO. If no MPS are observed to be impacted during either aerial survey, the NMFS observers will record all of the necessary information as per the conditions detailed in MMS's permit approval letter and PROP guidelines for the preparation of a trip report.

If unforeseen conditions or events occur during a specialty-blasting operation that necessitates monitoring requirements fall outside of the applicable regulations, the NMFS observer will contact the PROP coordinator and/or MMS's GOM Region for additional guidance. A flowchart of the monitoring process and associated survey times for specialty severance-scenarios E2 and E4 is provided in Figure 11.



Scenario	Pre-Det Surface [A]	Passive Acoustic [B]	Pre-Det Aerial [C]	Waiting Period [D]	Post-Det Aerial [E]
			(Minutes)		
E2	180	270	90	45	45
E4	180	270	90	45	45

Figure 11. Surveys, time requisites, and monitoring process for large severance-scenarios E2 and E4.

(14) Suggested Means of Learning of, Encouraging, and Coordinating Research Opportunities, Plans, and Activities Relating to Reducing Such Incidental Taking and Evaluating Its Effects.

Recent Severance-Related Research

To help determine the impact ranges for the blasting categories proposed in this application, MMS contracted Applied Research Associates (ARA), Inc. to develop a model and prepare a report that would estimate shock wave and acoustic energy propagation caused by underwater explosive-severance tools (Dzwilewski and Fenton, 2003). As with most "theoretical" models developed to consider a wide range of parameters under multiple conditions, ARA suggested that their modeling results be repeatedly compared with *in-situ* data from actual explosive-severance activities. Previous *in-situ* research had been performed by the Naval Surface Warfare Center (NSWC) for MMS (Conner, 1990), but uncertainties concerning transducer ranging devalued the sediment-attenuation conclusions. Considering the uncertainties, NMFS provided guidance suggesting that additional *in-situ* data comparison must be conducted.

In November 2002, MMS's Technology Assessment and Research (TAR) Program began working with MMS's GOM Region to modify an existing project designed to develop and test the efficiency of LSC's (Saint-Arnaud et al., 2004; http://www.mms.gov/tarprojects/429.htm). The modifications made it possible to allow BML, *in-situ* data measurements to be taken during the final testing on actual OCS targets. While developing the measurement phase of the project, MMS again coordinated with NMFS to address the concerns expressed over the NSWC's range uncertainties, ultimately modifying field procedures to include the use of a sector-scanning sonar in conjunction with reflectors attached to each transducer array string. The testing was conducted, and Annex B of the project's final report (Appendix C of the Structure-Removal Operations PEA; USDOI, MMS, 2004) compares the peak overpressure (psi), impulse (psi-s), and energy flux density (EFD; psi-in) measurements collected from the testing with calculated results from both the ARA UWC and the applicable NSWC similitude equations. In all but two occurrences/outliers (i.e., 4.05-lb LSC peak overpressure; transducers H and I), the ARA UWC range projections were much greater than those actually recorded (Saint-Arnaud et al., 2004).

Future Severance-Related Research

Since the number of targets, charge sizes, and marine conditions were limited, MMS is currently working with both industry and acoustic measurement groups to conduct additional research on targets offering a wider range of parameters. Similar to the TAR project, the research program under development will focus on in-situ "targets-of-opportunity" offered by industry. As with previous work, the program will use transducer array assemblies to measure, record, and calculate the peak pressure, impulse, and acoustic energy released into the water column from severance charges. With a greater knowledge of the actual impacts, future protective and mitigative measures can be developed to address specific concerns of northern GOM marine mammals. In addition, the potential new information on impact-reducing factors (i.e., lower charge weights, increased BML cut depths, experimental mitigation techniques, etc.) will encourage industry to push research and development of less harmful and more efficient charges.

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