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Applying the United Kingdom Comparative Assessment Process to Decision Making for the Decommissioning of California OCS Platforms

John B. Smith[1] and Robert C. Byrd[2]

[1] TSB Offshore, Inc.

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Abstract

This paper reviews the legal and regulatory regime for decommissioning oil and gas platforms on the United Kingdom Continental Shelf (UKCS) and in the North Sea and the process followed by UK regulatory authorities in approving an exception (derogation) to the requirement to fully remove all structures. This exception allows the footings, i.e., the lower base section of the jacket structure, of large steel jacketed platforms to remain in-situ. The paper provides details on how UK Platform Ninian North (Ninian) was removed and the Comparative Assessment of decommissioning options prepared by the owners of the platform that supported the decision by UK regulatory authorities to allow the jacket footings to remain in-situ. The paper notes that the U.S. Outer Continental Shelf (OCS) Oil and Gas Regulations allow partial removal of platform jackets under some circumstances and that there are eight California oil and gas platforms which have jackets that would qualify for partial removal, i.e.,derogation, based on the criteria established for North Sea oil and gas installations.To obtain permit approvals from federal and state regulatory agencies to leave the lower portions of largeCalifornia platform jackets in-situ, the owners of the platforms will need to clearly demonstrate partially removing the jackets is the best overall (optimum) decommissioning option. This can be demonstratedby preparing Comparative Assessmentswhich evaluate platform decommissioning options using safety, technical, environmental, and economic (cost) criteria

Index terms—

remaining in-situ. This paper summarizes the results of a Comparative Assessment prepared for Platform Ninian North (Ninian) that supported the decision by UK regulatory authorities to allow the jacket footings to remain in-situ. The paper notes there are eight California oil and gas platforms having jackets that would qualify for derogation consideration based on the criteria established for North Sea oil and gas installations. Based on the UK practice, the authors believe a strong case can be made for leaving the lower jacket structure (footings) of large California platforms in-situ by preparing Comparative Assessments of decommissioning options. The Comparative Assessments would likely show that partial removal of the large jackets is the optimum decommissioning option. It would also provide Federal and state regulatory agencies with project related technical, safety and cost information on decommissioning options that is not typically included in environmental impact assessment documents prepared to satisfy National Environmental Policy Act (NEPA) requirements but is critical to informed decision-making.

1 a) UK Legal and Regulatory Regime

The decommissioning of offshore oil and gas infrastructure on the UKCS is primarily governed by the Petroleum Act of 1998, as amended by the Energy Act of 2016. The Petroleum Act sets out the requirements for a formal Decommissioning Program which must be approved by the UK Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) before the owners of an offshore installation or pipeline may proceed with decommissioning. OPRED is a regulatory body within the Department for Business, Energy, and Industrial Strategy (BEIS).

The OPRED has issued Guidance Notes (UKBEIS, 2018) describing the regulatory requirements set out in the Petroleum Act and Energy Act, and the UK's obligations under international treaties, namely the United Nations Convention on the Law of the Sea 1982, which prohibits the disposal (dumping) of platforms and other man-made structures at sea without the express prior approval of the relevant coastal state. The International Maritime Organization (IMO) has issued guidelines and standards requiring signatory coastal states to ensure that unused oil and gas installations are removed in whole or in part where there is no I. Introduction reasonable justification for allowing the installation to remain on the sea floor.

The UK, along with 14 other European government bodies (contracting parties), is also a signatory to the Convention for the Protection of the Marine Environment of the North-East Atlantic 1992, more commonly known as the OSPAR Convention. Under OSPAR Decision 98/3, the topsides of all oil and gas installations and the jackets of platforms weighing less than 11,023 short tons1 (10,000 metric tons) must be returned to shore for recycling and disposal (OSPAR, 1998). In addition, all installations put in place after February 9, 1999 (when OSPAR 98/3 came into force) must be completely removed. However, OSPAR 98/3 also provides exceptions (derogations) on a case-bycase basis for removing certain installations that may be difficult to entirely remove due to technical and/or safety factors 1 To obtain OPRED approval for a derogation, the owners of the installation must conduct consultations with stakeholders and prepare a detailed Comparative Assessment of decommissioning options to identify the optimum or best option. The OPRED also requires owners/operators to prepare an Environmental Impact Assessment (EIA) to analyze environmental impacts of decommissioning activities and potential mitigation measures which would be implemented to minimize those impacts. The installations that qualify for potential derogation consideration are: .

? Steel constructions (excluding topsides) weighing more than 11,023 short tons installed before February 9, 1999, where the footing may remain in place.

? Gravity based concrete installations, floating concrete installations, and any concreteanchorbase installed before February 9, 1999. ? Other unused offshore installations when it is possible to demonstrate exceptional and unforeseen circumstances resulting from structural damage, deterioration, or similar difficulties.

To comply with OSPAR requirements, UK oil and gas regulations also require partially removed installations be removed to a minimum depth of 180 feet(55 m) below the ocean surface (Mean Low Water/MLW) to ensure navigation safety. We note that the US Coast Guard similar safe navigation reference depth is 85 feet.

Prior to granting a derogation, and as part of the consultation process, BEIS must provide notification to the OSPAR Executive and other contacting parties who may provide comments and issue an opinion on the proposed derogation. There is no requirement for an owner of an installation to prepare a Comparative Assessment nor for BEIS to consult with the OSPAR Executive and contracting parties for cases where full removal is the chosen option. Under sections 29 and 34 of the 1998 Petroleum Act, owners of facilities are perpetually liable for partially removed structures (UKBEIS, 2018). Owners are also required to develop a monitoring plan for structures like jacket footings approved to remain in-situ on the seabed.

2 b) UK Comparative Assessment Guidelines

The v. Societal

? The engagement of interested stakeholders will be important to assess and take account of the views of different interest groups. ? The impacts on fisheries and fishing activity both historical and future potential will be of paramount importance.

? Employment and regional development opportunities should be considered.

3 vi. Economic

? In assessing alternative decommissioning options proportionality should be considered and costs should be balanced against the other assessment criteria.

4 c) UK Platforms Approved for Partial Removal

To date, a total of five steel-jacketed oil and gas platforms have been approved by OPRED to be removed with the footings of the jackets remaining insitu. The jacket footings and drill muds and cuttings found at the base and surrounding the perimeter of the jacket were approved to remain in-situ based on the results of Comparative Assessments of decommissioning options conducted by the platform owners. The first large platform approved to be removed with the jacket footings remaining in-situ was Platform North West Hutton in 2009. This was followed by Platform Murchison in 2017, Miller in 2018, Brent Alpha in 2020, and Ninian in 2022. Table 1 provides information on the water depths of the platforms and the total combined and individual weights of the

topside and jacket. Also shown are the estimated weights of the jacket footings approved to remain in-situ, the percentage of the total jacket weight remaining in-situ, and the height the remaining jacket footings rise above the original mudline of the seabed. As can be seen in the data, there is a wide variation in the percentage of total jacket weight (35-70 percent) remaining in-situ and the heights the remaining footings rise above the seabed. The variation is due to the different structural designs of the jackets and pilings securing the jackets to the seabed. 1 Combined weight of the topsides and jacket. 2 Topside/jacket weights are estimated weights reported in decommissioning program documents. 3 Includes piles, grout, concrete, anodes, marine growth. 4 Height the remaining footings rise above the original mudline of the seabed. As noted above, the OSPAR guidelines allow an exception (derogation) to the requirement to fully remove the footings of large steel jackets weighing more than 11,023 tons (excluding topsides). "Footings" are defined by OSPAR as those parts of a steel installation which are below the highest point of the piles which connect the installation to the seabed or, in the case of an installation constructed without piling, form the foundation of the installation, and contain amounts of cement grouting like those found in piled installations. The definition also includes those parts of a steel installation which are so closely connected to the footings as to present major engineering problems in severing them (OSPAR, 1998).The footings of large platforms are massive and can account for 35-70 percent of the total jacket weight (see Table 1).

5 II. Ninian Platform

Ninian was a drilling and production platform situated approximately 100 miles northeast of the Shetland Islands; the platform stood in 463 feet of water and the combined weight of the topside (13,727 tons) and the jacket (19,487 tons) was reported to be 33,214 tons (CNR, 2019). The topside of the platform was fully removed and transported to shore for recycling and disposal. The footings of the jacket (Figure **??**) were approved to remain in-situ by OPRED based on the results of Comparative Assessment of decommissioning options conducted by the owners of the platform (CNR, 2017).

6 a) Platform Ninian Comparative Assessment

This section summarizes the results of the Comparative Assessment prepared by Canadian Natural Resources International (CNR) to assess the decommissioning options for the Platform Ninian jacket and the drill cuttings pile that had formed at and surrounding the base of the jacket (CNR, 2017). A derogation case for the jacket and drill cuttings pile was submitted to OSPAR for review and subsequently approved by BEIS. The jacket decommissioning options included full and partial removal, the latter option of which also involved leaving the footings of the jacket insitu. A total of five drill cuttings options were assessed: 1. Recover to the surface, treat, and release liquids offshore, transport solids to shore. 2. Recover to surface, slurry to shore. 3. Recover to surface, reinject in offshore disposal well. 4. Disperse drill cuttings on the seabed. 5. Leave in-situ.

The Comparative Assessment recommended the Ninian jacket be partially removed to the top of the footings (between 254-290 feet below sea level) using multiple lifts, with the footings remaining in-situ (CNR, 2017). This option resulted in a significant reduction in risks to project personnel, environmental impacts, and total costs compared to the full removal option. The assessment also recommended the drill cuttings remain in-situ to degrade naturally over time. This option was considered superior to recovering or dispersing the drill cuttings on the seabed based on the lack of proven technology for recovering the drill cuttings, the adverse environmental impacts resulting from dispersal of the drill cuttings, and cost considerations. Each decommissioning option was assessed against the safety, technical, environmental, societal, and total cost criteria established by OSPAR and BEIS to identify the best overall (optimum) decommissioning option. Both quantitative and qualitative data were used to support the assessment. The results of the Comparative Assessment for the Ninian jacket are summarized in Table 2 and described in more detail below. The Environmental Statement prepared by CNR for decommissioning the Ninian platform determined there would be no significant adverse effects on the environment from leaving the jacket footings and drill cuttings pile in-situ (CNR, 2017a). The safety assessment determined full removal of the jacket would result in a 150 percent increase in risk to project personnel compared to the partial removal option. For full removal, the Potential Loss of Life (PLL) was calculated to be 2.5 x 10 -2 per year (1 in 40 years); the PLL for partial removal was 1.0 x 10 -2 per year (1 in 100 years). The PLL for full removal was much higher than the maximum tolerable PLL limit of 1 x 10 -3 per year (1 in 1,000 years) established by the UK Health and Safety Executive (HSE) and violated the UK regulatory principle that risks should be reduced to as low as reasonably possible (ALARP). The increase in risk for full removal was due in-part to the larger number of lifts required to fully remove the jacket compared to the partial removal option. This increased the overall length of time to complete the removal work thereby increasing the exposure risk to personnel participating in decommissioning activities. The Comparative Assessment acknowledged partial removal of the jacket Full jacket removal increases PLL by 150 percent compared to the partial removal option. For full removal, the PLL is 2.5 x 10 -2 per annum, or 1 in 40 years; the PLL for partial removal is 1.0 x 10 -2 per annum or 1 in 100 years.

? Risk to other users of the sea 0 2.3 x 10 -5

Full removal eliminates the risk to other users. Partial removal creates a long-term hazard to fishermen from the potential snagging of fishing gear on the remaining footings. The PLL for fishermen is extremely small, 2.3 x 10 -5 per annum or 1 in 43,103 years. Technical

7 ?

Technical feasibility 25% 100% Full removal is much more technically challenging than partial removal.

8 ?

9 Use of proven technology and equipment 33% 100%

The techniques and equipment required to remove the footings do not have a proven track record. This increases the probability of a forced deviation (excursion) from planned operations.

? Ease of recovery from excursion 75% 100%

Full removal is more likely to result in an excursion which can cause a delay or extension of removal operations and an increase in costs compared to partial removal. Environment

10 ?

Environmental impacts 66% 100%

Full removal results in greater offshore and onshore environmental impacts than partial removal due to the larger volume of steel removed and processed. There is no significant difference in emissions to the atmosphere between full and partial removal. Societal

11 ?

12 Commercial impact on fisheries 100% 94%

There is no significant difference on fish catch between full and partial removal; the obstruction caused by the footings has a footprint of less than 2.5 acres and is situated in an area where the level of fishing activity is low to moderate. would create a long-term hazard to fishermen from the potential snagging of fishing gear on the remaining footings. The PLL for fishermen was calculated to be extremely small, 2.3 x 10 -5 or 1 in 43,103 years.

13 ii. Technical

The technical assessment determined full removal of the Ninian jacket would be much more complex and technically challenging than partial removal; it also determined the techniques and equipment required to remove the large Ninian footings did not have a proven track record. The use of novel or unproven techniques increases the probability the removal techniques could fail, necessitating an excursion (deviation) in planned operations resulting in a delay or postponement of operations and an increase in costs. Among the technical challenges were:

1. Jacket stability: Progressive cutting of the jacket renders the remnant jacket less rigid and potentially unstable, increasing the potential for collapse of the structure. 2. Cutting tool deployment: Below the derogation height (top of the pilings) there were numerous diagonal cross members within the complex steel lattice framework of the jacket that would be difficult to access, cut and remove using remotely operated vehicle (ROV) deployed mechanical and abrasive cutting tools. This increased the potential that inherently risky diver intervention services would be required to assist in positioning or retrieving cutting equipment. 3. Failed cuts: Diamond wire and abrasive water jet cutting techniques are prone to operational difficulties that can lead to incomplete cuts. Failure to make the complete cuts required to free each jacket section for lifting could result in the crane and other equipment on the heavy lift vessel (HLV) being exposed to a severe risk of damage due to the loss of stability and structural integrity of the section being removed. 4. Pile severing: The Ninian jacket was secured to the seabed by 26 piles (8 leg piles and 18 skirt piles) many of which were grouted with cement (CNR, 2017). Failure to obtain internal access to the piles would require excavation of large pits around the piles to provide access for divers to deploy mechanical or abrasive cutting tools to externally sever the piles, thereby exposing divers to significant risks from collapse of the pit walls. 5. Dropped objects: Cutting the footings into sections would result in unstable loads that when lifted by the HLV crane and loaded onto vessels or cargo barges would increase the potential for dropped objects and risk of injuries and fatalities to project personnel.

iii. Environmental The environmental assessment noted the full removal option resulted in greater environmental impacts than partial removal. The primary factors differentiating the two options were the scale of operations and the physical presence of jacket footings left in-situ. The full removal option involved removing nearly 20,000 tons of steel, nearly double the tonnage removed in the partial removal option. The full removal option therefore required a larger vessel spread and resulted in more vessel traffic and anchoring activity than the partial removal option. Full removal also required the footings to be removed to a depth of nine feet (UK regulatory requirement) below the seabed resulting in disturbance of the drill cuttings pile and the potential release of hydrocarbon contaminants in the marine environment. The drill cuttings pile would not be disturbed under the partial removal option. Full removal also resulted in more onshore impacts (increased noise, traffic, emissions, landfills). The assessment also acknowledged the potential environmental impacts associated with the release of contaminants from the jacket and shell mounds as they degrade naturally in the marine environment. The impacts were determined to be insignificant.

14 iv. Societal

The results of the assessment showed there was no significant difference on impacts on commercial fisheries between the full and partial removal options. The assessment noted the obstruction caused by the footings had a footprint of less than 2.5 acres and was situated in an area where the level of fishing activity is low to moderate. The assessment also showed the socioeconomic impact on amenities (i.e., employment, public services) to be equivalent for full and partial removal options.

15 v. Economic

The economic assessment determined full remove would increase total project costs by 46 percent compared to the partial removal option. The significant increase in costs for the full removal option was driven by the larger tonnage of steel required to be removed, and the longer duration and complexity of operations compared to partial removal.

16 b) California Decommissioning Overview

There are a total of 27 oil and gas platforms located off the coast of California, 23 on the federal Outer Continental Shelf (OCS) which are located beyond three nautical miles offshore, and four in state waters (Figure 3). The OCS platforms are in water depths ranging from 95 to 1,198 feet, and range in size from small structures like Gina having a total weight of 1,400 tons, to ultra-large structures like Heritage and Harmony having estimated removal weights ranging from 69,000 to 87,000 tons (TSB Offshore, Inc., 2016). At the close of 2022 eight (Gail, Grace, Harvest, Hermosa, Hidalgo, Habitat, Hogan, Houchin) of the 23 OCS platforms were on terminated leases and in the early stages of being decommissioned (Tab.3)The full removal of Platforms Gail (739 ft. wd.), Harvest (675 ft. wd.), and Hermosa (603 ft. wd.) would each establish a world water depth record (approximately 500 ft. wd.) for fully removing conventional oil and gas platform jackets from the seafloor (Chevron, 2022).

In contrast to the North Sea and the Gulf of Mexico (GOM) where numerous oil and gas platforms have been decommissioned, there is little or no infrastructure available in California to support large oil and gas platform decommissioning operations. There are currently no heavy lift vessels (HLVs) stationed on the U.S. west coast that have capability to remove the large OCS platforms efficiently and safely. The HLVs would need to mobilize from the North Sea, GOM, or other distant locations at great expense (Smith and Byrd, 2023). There are also no port-based facilities in California that have the capability to offload and process the topside components and jackets of the large OCS platforms. Absent the construction of new or expanded materials disposal facilities, the dismantled topside and jacket sections are likely to be loaded onto cargo barges and towed to materials disposal yards in the GOM or overseas locations.

(Source, MRS Environment, Inc.) Decommissioning plans for four of the platforms (Gail, Harvest, Hermosa, Hidalgo) are expected to be submitted to BSEE for review and approval in the near term (BSEE, 2022). The platforms are in water depths ranging from 430 to 739 feet and have estimated jacket/pile removal weights ranging from 12,950 to 22,300 tons. Platform Ninian, in comparison, was in 403 feet of water and had an estimated jacket/pile removal weight of 19,487 tons. The full removal of jackets of Gail (739 ft. wd.), Hermosa (603 ft. wd.), Harvest (675 ft. wd.) and Hidalgo (430 ft. wd.) and the other deep-water platforms will be technically challenging due to the massive size of the jacket footings, the structural complexity of the jackets, and the numerous piles (16 to 28 per platform) securing the jackets to the seabed. To date, there have been no projects where jacket footings of this size and water depth have been removed from the seabed.

The safety, technical, environmental, and economic benefits resulting from partial rather than full removal of the Platform Ninian jacket were documented in the Comparative Assessment of decommissioning options prepared for the removal of the structure (see Table 2). Similar benefits are likely to be achieved if the jacket footings and drill cuttings of large California platforms are approved to remain in-situ rather than being fully removed. Highlighted below are some of the likely benefits that could be achieved by partially removing the jackets of large California platforms.

17 i. Worker Safety

? Partial removal significantly reduces the potential risks of deaths and injury to project personnel.

ii. Technical

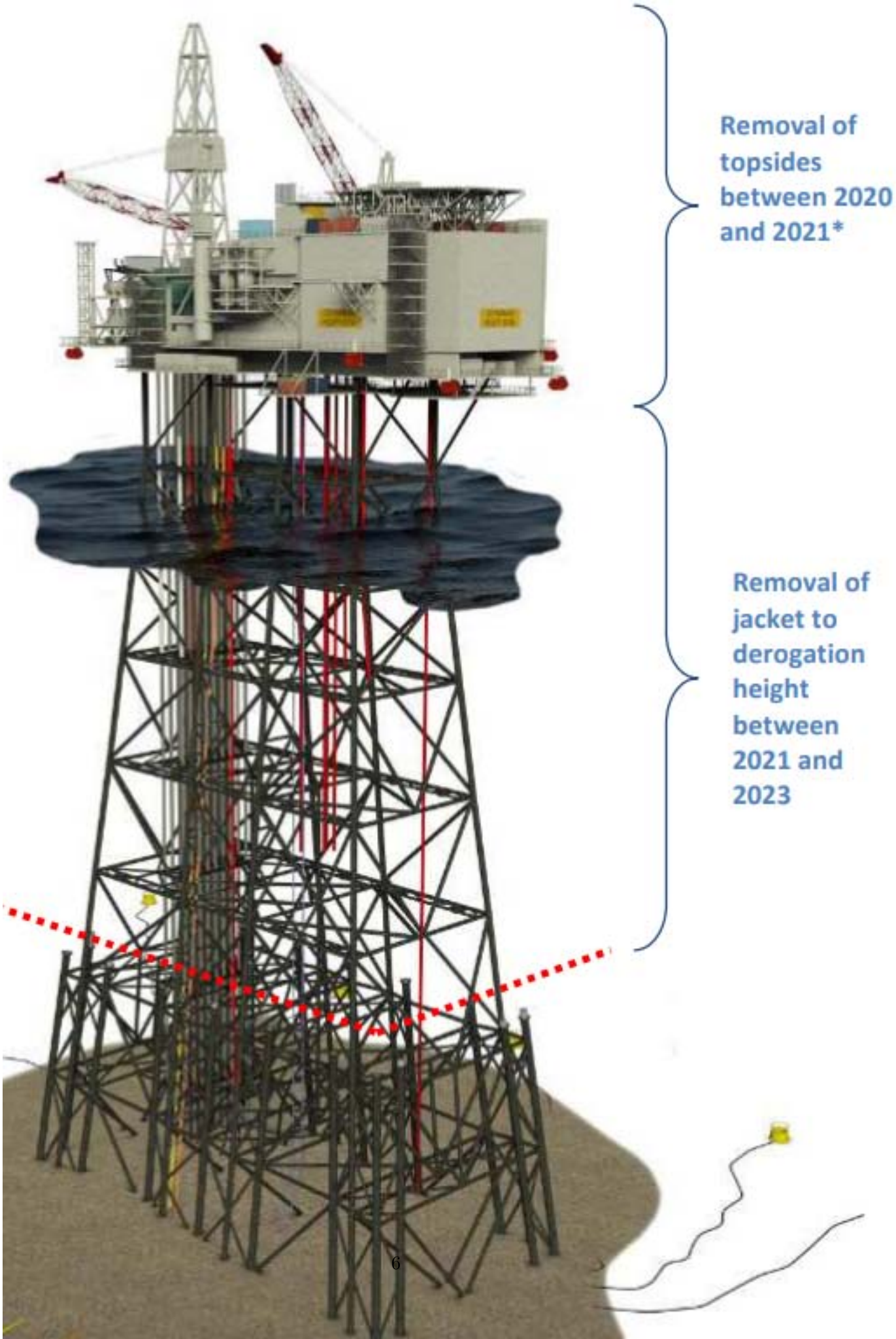
? Partial removal much less complex, requires less time, uses proven technology, and is much less likely to be impacted by adverse weather/ oceanographic conditions and technical issues resulting in postponement, delay, or extension of removal operations.

iii. Environmental

? Partial removal results in a significant reduction in environmental impacts, both offshore and onshore. ? Partial removal obviates the need to use explosives, which may be required if the legs and piles of the jacket cannot be completely severed internally using mechanical and abrasive cutting tools. [1] [2]

[1] All weights cited in this paper are reported as short tons (2000 pounds) except HLV lift capacities which are in metric tons (1000 kg or

[2] pounds).


Removal of topsides between 2020 and 2021*
Removal of jacket to derogation height between 2021 and 2023

2

Figure 2: Figure 2 :

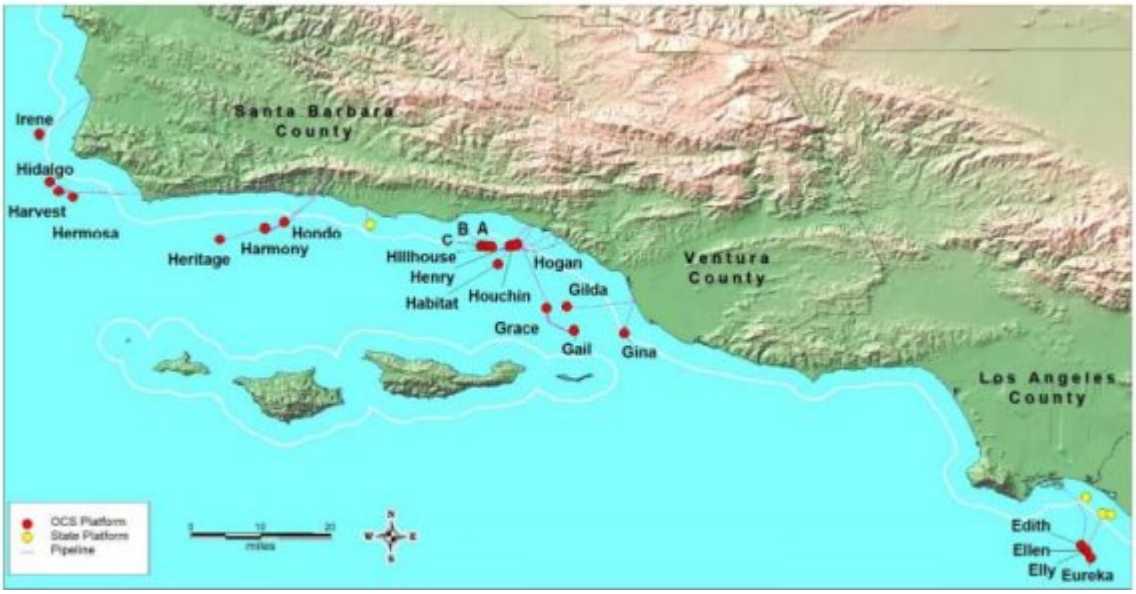


Figure 3:

1

Platform	Year Removed	Water Depth (ft)	Total Weight 1„2 (tons)	Jacket Weight 3 (tons)	Jacket Weight Removed (tons)	Weight of Footings In-situ (tons)	Percent of Jacket Weight In-situ Remaining	Height of Footings 4 (ft)
NW Hutton	2009	472	41,480	19,257	10,141	9,116	47%	130
Murchison	2017	512	57,575	30,476	9,210	21,266	70%	144
Miller	2018	338	52,157.	20,485	13,363	7,122	35%	66
Brent	2020	460	50,310	31,657	9,382	22,274	70%	183
Alpha Ninian	2022	463	33,214	19,487	10,471	9,016	46%	254-290

Figure 4: Table 1 :

2

	Criteria/Metric	Full Removal	Partial Removal	Summary of Key Results
			Safety	
?	Risk to personnel Potential loss of life (PLL)	2.5 x 10 -2	1.0 x 10 -2	

Figure 5: Table 2 :

3

Platform	Year Installed and Age in Years		Operating Status 2 nd Qtr. 2023	Water Depth (feet)	Estimated Removal (short tons) Weight	Wells Drilled	OCS Operator 1
			San Pedro Bay -Los Angeles County				
Eureka	1984	38	Producing	700	33,377	50	BOC
Elly 2	1980	42	Producing	255	9,400	0	BOC
Ellen	1980	42	Producing	265	11,655	63	BOC
Edith	1983	39	Producing	161	8,556	18	DCOR
			Eastern Santa Barbara Channel -Ventura and Santa Barbara County				
Hogan	1967	55	Leases terminated	154	5,098	39	BWEG 3
Houchin	1968	54	Leases terminated	163	5,615	35	BWEG 3
A	1968	54	Producing	188	4,896	52	DCOR
B	1968	54	Producing	190	4,959	57	DCOR
C	1977	45	Producing	192	5,718	38	DCOR
Henry	1979	43	Producing	173	4,006	23	DCOR
Hillhouse	1969	53	Producing	190	5,834	47	DCOR
Gina	1980	42	Producing	95	1,380	12	DCOR

Figure 6: Table 3 :

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Global Journal

Figure 7:

4

Platform	Year Installed	Water Depth (ft)	Topside Removal Weight (tons)	Jacket/Pile Removal Weight (tons)	Total Removal Weight 1 (tons)	Number of Piles Main	
Eureka	1984	700	8,000	21,000	33,377	24	0
Gail	1987	739	7,693	22,300	37,057	8	12
Harvest	1985	675	9,024	20,016	35,150	8	20
Hermosa	1985	603	7,830	19,500	30,868	8	20
Hidalgo	1986	430	8,100	12,950	23,384	8	8
Harmony	1989	1,198	9,839	55,250	86,513	8	20
Heritage	1989	1,075	9,826	46,370	69,192	8	26
Hondo	1976	842	8,450	15,100	29,478	8	

Figure 8: Table 4 :

.1 III. Summary and Conclusions

There are 27 steel-jacketed oil and gas platforms located offshore California, eight of which have jackets that would qualify to be considered for partial removal (derogation) under OSPAR if they were in the North Sea. To date, five large platforms have been approved to be partially removed on the UKCS with their jacket footings and drill muds and cuttings remaining insitu. The derogated jackets were approved to remain insitu by UK regulatory authorities based on the results of Comparative Assessments of decommissioning options conducted by the owners of the facilities demonstrating partial removal of the jackets was the best overall (optimum) decommissioning option taking into consideration technical, safety, environmental, societal, and economic criteria. Of the eight California platforms that would qualify for partial removal consideration in the North Sea, four (Gail, Harvest, Hermosa, Hidalgo) are expected to be removed by the end of the decade. The full removal of platform jackets will be technically challenging and establish new world water depth records for conventional steel-jacketed structures. To date, there have been no projects where jacket footings of this size and weight have been removed from the seabed.

Based on the practice followed in the UK, the authors of this paper believe a strong case can be made for allowing the jacket footings of the platforms to remain in-situ at or below a safe navigation depth acceptable to the U.S. Coast Guard, likely 85 feet, irrespective of whether the jacket is converted to an artificial reef. To obtain permit approvals from federal and state regulatory agencies to leave the footings of the jackets and drill cuttings in-situ, the owners of the platforms will need to clearly demonstrate that partially removing the jackets is the optimum decommissioning option. This can be demonstrated by adopting the practices that have been followed in the UK and North Sea under OSPAR for preparing Comparative Assessments of decommissioning options. The authors recommend the operators of large OCS platforms offshore California and in the Gulf of Mexico who propose to partially remove platform jackets prepare Comparative Assessments to support their decommissioning applications. The Comparative Assessments can also be prepared to support the case for allowing partial removal of smaller platform jackets and allowing pipelines and drill muds and cuttings to remain in-situ.

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