



Decommissioning Close Out Report Knarr Gas Pipeline

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Abbreviations

Abbreviation	Explanation
CoP	Cessation of Production
FPSO	Floating Production Storage and Offloading
GRP	Glass Fiber reinforced plastics
JV	Joint Ventures
KGP	Knarr Gas Pipeline
NCS	Norwegian Continental Shelf
NSTA	North Sea Transition Authority
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
PLEM	Pipeline End Manifold
PLET	Pipeline End Termination
SFF	Scottish Fishermen's Federation
SUKL	Shell UK Ltd
UKCS	United Kingdom Continental Shelf

1 SUMMARY

1.1 Summary of Decommissioning Programme

The Knarr Field, located in the Norwegian Continental Shelf, was developed with subsea well templates connected to an FPSO, with gas exported to the UK via the Knarr Gas Pipeline (KGP). The field is situated in Block 34/3, about 50 kilometres northeast of the Snorre field, in water approximately 410 meters deep (Figure 1:1).

The field included subsea well templates connected to an FPSO, with shuttle tankers for oil export and gas exported via the KGP system to the UK. The FPSO was decommissioned and removed in 2022.

The UKCS components of KGP, covered by the decommissioning programme, include:

- 11.6 km of the KGP system pipeline extending into the UKCS
- Tie-in spools (#1-7) between the KGP pipeline and Knarr PLEM
- Concrete mattresses at crossings

The initial phase (phase 1) of the KGP decommissioning included:

- Isolation of the KGP system from FLAGS by closing valves on the Knarr Tee and Knarr PLEM, ensuring a double barrier isolation for cutting and removal activities.
- Depressurization, pigging/cleaning and water filling the KGP pipeline
- Filling the section between the Knarr Tee and Knarr PLEM, and the Knarr PLEM piping with MEG to protect against degradation/corrosion.
- Pigging the KGP from the Knarr PLEM to the Knarr FPSO on the NCS to displace pipeline contents back to the FPSO for disposal, clean the pipeline internal surface, and fill it with filtered seawater.

The intermediate phase (phase 2) of the decommissioning included:

- Cutting and removing a small section of spool #7 to isolate KGP from UK infrastructure. This physically isolates the KGP system from the PLEM and downstream infrastructure, with an abandonment plug installed on the PLEM side.
- An as-left survey of the KGP subsea infrastructure was conducted establishing the initial post-decommissioning status for ongoing monitoring.

These works ensure compliance with the Petroleum Act 1998 and Energy Act 2016. The as-left state of the pipeline allows for later decommissioning and removal of the PLEM, spool section #8 (between the Knarr Tee and PLEM), and GRP spool covers coinciding with the FLAGS pipeline system decommissioning.

Due to the proximity of the UKCS subsea infrastructure to the operational FLAGS gas pipeline, the removal of the Knarr Tee, Knarr PLEM, remaining KGP, spools and all associated infrastructure will be concluded at a later date, when the FLAGS gas pipeline enters CoP, estimated to be within the next 25-30 years.

The removal and disposal of all such remaining KGP related infrastructure will be subject to a future, separate Decommissioning Programme as stipulated in the Knarr Gas Pipeline DP (May 2024), in Section 1.1, Table 1-3 and Table 4-2.

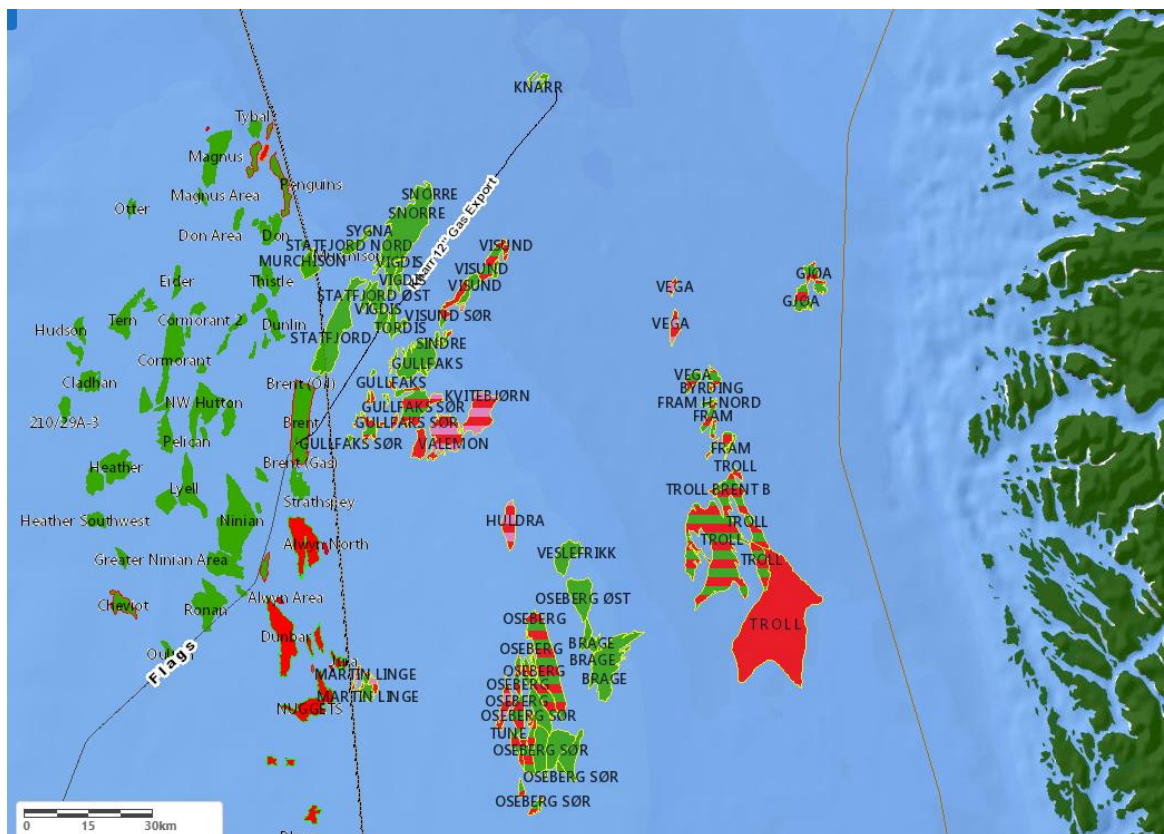


Figure 1:1: The Knarr Field and Knarr Gas Export Pipeline

- Cessation of production was agreed by the NSTA on June 14, 2021; ref. Preparatory Works Request (PWR) submitted by Gassco on 29/04/2021.
- Production formally ceased on May 1, 2022.
- The Decommissioning programme was formally approved by OPRED on May 22, 2024.

- A summary of the infrastructure to be decommissioned and the approved decommissioning options is outlined in the tables below.

Table 1.1: Overview of the Decommissioned Pipelines In The Approved DP	
Number of Pipeline(s) to be decommissioned	1
Total km of Pipeline(s) to be decommissioned	11.6km
Total km of Pipeline(s) left in situ	11.596.7km (3.3m removed)

Table 1.2: Overview of the Stabilisation Features In The Approved DP	
Type	Number
Concrete Mattresses	22
Gravel bags	34
Rock Cover for Pipeline	Ca 151.000te

Table 1.3: Summary of the Approved Decommissioning Option(s) In The Approved DP	
Type	Selected Option
1. Pipeline Crossings and Spools sections #1-7	<p>The GRP cover on spool #7, adjacent to the PLEM, will be temporarily removed to achieve the KGP-PLEM disconnection and reinstated at the end of the disconnection operation. The GRP cover will be secured by rock from 34 drop bags filled with rock.</p> <p>12" Knarr Gas Export Pipeline (PL3039): "KGP will be disconnected at spool #7 and a small part of the spool (~3m) removed as part of Phase 2 to isolate it from UK infrastructure.</p>
2. Stabilisation Features	Spools #1-7 and pipe crossing mattresses will be left in situ under rock cover. 34 gravel bags to remain in place stabilizing the GRP cover.

1.2 Schematic of Installation(s)/Pipeline(s) being decommissioned

Figure 1.2 show a schematic of the field and pipeline layout with the UK scope of KGP decommissioning indicated by red dashed area. Note that the FPSO and risers were removed in 2022.

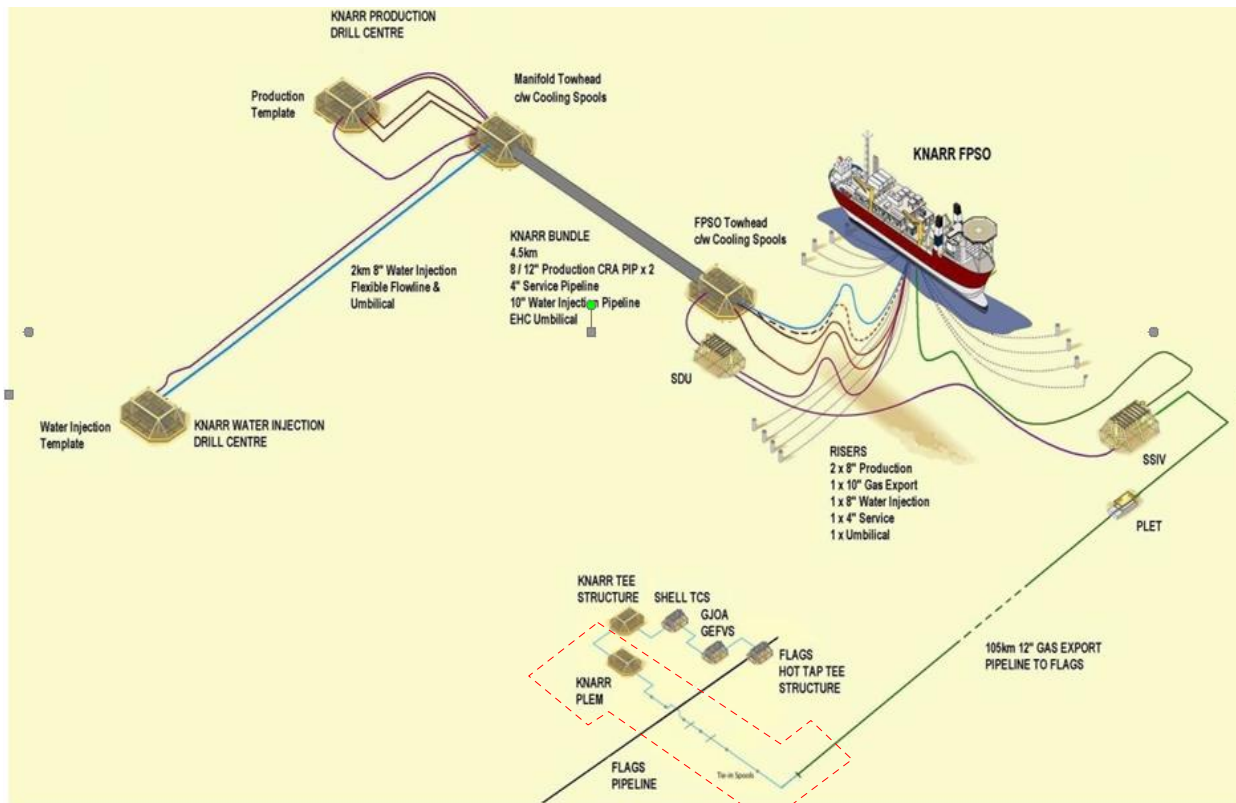


Figure 1:2: Knarr Field Layout. UK scope of KGP decommissioning indicated by red dashed area

Figure 1:3 shows the detailed location of the UKCS pipeline system routing and subsea infrastructure.

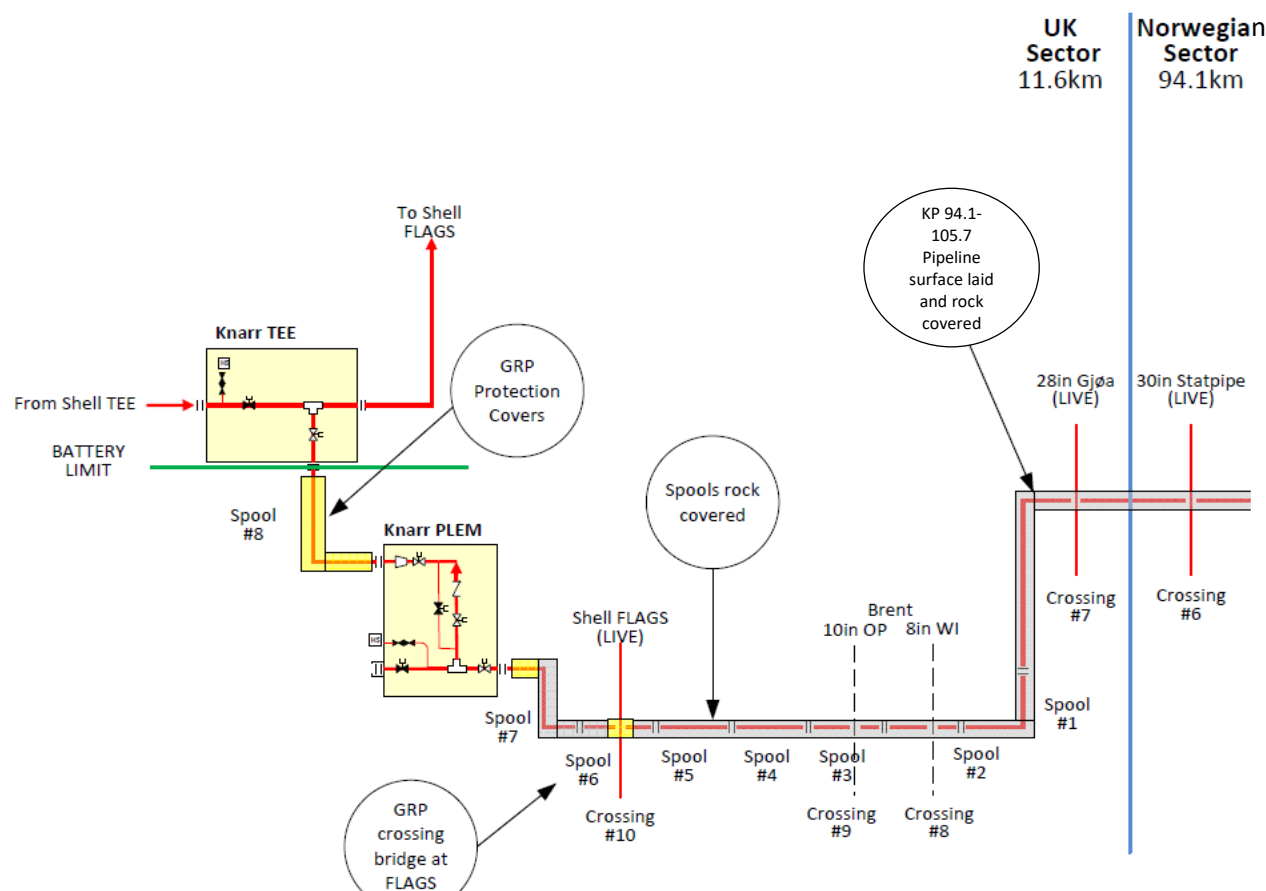


Figure 1:3: Knarr Gas Pipeline and Pipeline Crossings (Crossings 7 – 10 in UKCS).

A rigid spool links the SSIV at the Knarr field to the main Knarr Gas Pipeline End Termination (PLET). The KGP system route is about 105.7 km long, with a 12" rigid pipeline connecting to the Knarr Pipeline End Manifold (PLEM) and Knarr Tee through a series of spools. 11.6 km of the KGP system extends into the UKCS, with the pipeline surface-laid, rock-covered, and at a depth of approximately 140 m.

1.3 Project Delivery against the Approved Schedule

Below is the schedule/timeline for the approved decommissioning programme.

Activity	2021				2022				2023				2024				2025				2026			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Gassco start-up meeting																								
KGP JV start-up meeting and risk assessment																								
Issue KGP abandonment application to OPRD (UK)																								
Contract Award approval by KGP JV																								
Technical Review (NA)																								
PCB Review (aligned with tender input)																								
Gassco Alignment Review																								
IPR (Independent Project Review)																								
Issue consent application (PSA)																								
Gassco BDP MC																								
Gassco MC DG4 Recommendation																								
KGP JV DG4 Approval																								
PSA approval of consent application (PLET)																								
Offshore execution																								
Target Decommissioning Programme approval date																								
Notification on Cease of Production (CoP)																								
Planning for cleaning and disconnection																								
Cease of Production																								
Cleaning																								
Disconnection at PLEM Isolation KGP																								
As left survey																								
Close Out Report																								

1.4 Associated Decommissioning Approvals

Table 1.4: Associated Decommissioning Approvals	
Phase 1: 137/V/24 Consent to the modification of Pipeline PL3039	Approved by the North Sea Transition Authority June 2013
Phase 2: Approval of a programme of abandonment to A/S Norske Shell	Approved by OPRED May 2024
Approval of a programme of abandonment to INPEX Idemitsu Norge AS	Approved by OPRED May 2024
Approval of a programme of abandonment to Wintershall DEA Norge AS	Approved by OPRED May 2024
Chemical Permit CP/3360/1 (Version 1)	Approved by OPRED May 2024
Marine Licence ML/1120/1 (Version 1)	Approved by OPRED May 2024

2 DECOMMISSIONING ACTIVITIES

2.1 Contracts Awarded

Table 2.1: Contracts Awarded
Decommissioning phase (1 st offshore campaign 2022); Marine Contract awarded DeepOcean Norway AS June 2021. Phase 1 activities were completed on May 18, 2022
Abandonment phase (2 nd offshore campaign June 2024): Marine Contract awarded DOF Subsea Norway AS 29.08.2023. Phase 2 completed on June 14, 2024

2.2 Pipelines & Jumpers

Table 2.2: Pipelines & Jumpers Decommissioning			
PL Number	Description	Agreed Decom Solution and Date of Removal	Current Status (Please state the length in kms, left in situ/removed)
PL3039	12" Knarr Gas Export Pipeline 11.6km	Phase 2 of the Knarr Gas Pipeline (KGP) decommissioning involved cutting and disconnecting a 3.3-meter section of spool #7 from the Pipeline End Manifold (PLEM) to isolate the KGP from UK infrastructure. The spool was retrieved and transported to shore in Norway (CCB Ågotnes) with 0.4T of steel delivered to Norscrap (certified recycling company) for recycling.	The remaining 11.596,7 km of spool sections and the KGP were left in situ, cleaned, and covered with rock to a sufficient depth to protect against trawling activity, posing minimal risk to marine users. The removal of the Knarr Tee and Knarr PLEM will be deferred to a later date, coinciding with the cessation of production (CoP) of the FLAGS gas pipeline, which is estimated to occur within the next 25-30 years. This

		Phase 2 was completed on June 14, 2024.	option causes minimal seabed disturbance, has lower energy usage, and reduces risk to personnel.
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2.3 Pipeline Stabilisation Features

Table 2.3: Pipeline Stabilisation Features Decommissioning		
Description	Agreed Decom Solution and Date of Removal	Status
Gravel dump bags	During Phase 2 of the offshore campaign, the GRP cover on spool #7, adjacent to the PLEM, was temporarily removed and reinstated after removal of the pipe section. 34 gravel dump bags were lowered by the vessel crane and opened by the ROV when in position. The 70 ton of gravel was installed as a support around the reinstated PLEM inlet GRP cover to make it overtrawable. No bag material was left subsea.	Completed
Mattresses	During the offshore campaign 22 pipe crossing mattresses were left in situ under rock cover as part of the decommissioning process. This approach minimizes seabed disturbance and reduces the risk of construction and removal works near live pipeline infrastructure	Completed
Rock cover for pipeline	All crossings will remain in situ, buried under rock cover, until the final decommissioning activities is carried out (Phase 3). This approach minimizes the risk of construction and removal works near live pipeline infrastructure.	Completed

2.4 Results of Post Decommissioning Surveys & Debris Clearance

Table 2.4: Post Decommissioning & Debris Clearance
<p>An as-left survey was performed by the survey vessel Edda Flora. The results described here are based on a preliminary survey report. The pipeline is covered with rock installation throughout the UK sector, and the rock cover is in good condition. The Knarr PLEM and connecting spools 7 and 8 had a close visual inspection with leakage from the abandonment plug on spool 7 as a special area of interest. No leakages observed. A corridor 50m at either side of the pipeline was surveyed for debris. The specific size requirement for debris reporting given by Gassco was at the limit for the survey equipment at the outer limit of the corridor. A conservative target selection has been used for the post-processing of data, resulting in 10 minor unidentified targets and 2 confirmed minor soft rope debris. One target (L=0.9m, H=0.5m W=0.7m) located 13.5m offset from the gravel-covered pipeline and adjacent to a trawl scar was identified at KP103.856. This target does not pose a significant hazard to other sea users. The most sustainable solution, based on a Gassco evaluation of the environmental impact with a new vessel operation, is to leave the unidentified targets registered during post-processing in situ.</p>

Coordinates of the targets:										
Date	Time	KP	Easting	Northing	WGS84 Easting	WGS84 Northing	Description (Code)	Dimension (m)	Offset/Side of Pipe	Analytic Signal (nT)
06.09.2024	23:12:14	94,613	437244.26	6773372.91	1° 50.084' E	61° 5.284' N	Unidentified(TAUN) - Possible hard debris - from SSS	L=0.5 H=0.3 W=0.3	10.4 m / R	
06.09.2024	23:11:51	94,650	437272.87	677331.5	1° 50.116' E	61° 5.253' N	Unidentified(TAUN) - Possible hard debris - from SSS	L=1.7 H=0.3 W=1.0	43.8 m / L	
06.09.2024	23:03:11	95,483	436807.99	6772621.9	1° 49.612' E	61° 4.876' N	Unidentified(TAUN) - Possible coils of wire debris - from SSS	L=1.6 H=0.1 W=1.2	16.4 m / L	
06.09.2024	22:15:15	100,306	434082.55	6768658.5	1° 46.664' E	61° 2.714' N	Unidentified(TAUN) - Possible hard linear debris - from SSS	L=1.8 H=0.1 W=0.2	23.8 m / R	
06.09.2024	21:46:32	103,308	431590.34	6767005.64	1° 43.932' E	61° 1.799' N	Unidentified(TAUN) - Possible area of wire debris - from SSS	L=10.0 H=0.2 W=5.6	27.2 m / R	
06.09.2024	21:46:00	103,360	431572.27	6766935.21	1° 43.913' E	61° 1.761' N	Unidentified(TAUN) - Possible area of wire debris - from SSS	L=7.3 H=0.4 W=4.2	23.1 m / L	
06.09.2024	21:40:49	103,856	431129.71	6766707.87	1° 43.427' E	61° 1.633' N	Unidentified(TAUN) - Possible hard linear debris - pipework - from SSS	L=9.0 H=0.5 W=0.7	13.5 m / R	
06.09.2024	21:14:31	105,298	429916.42	6765928.08	1° 42.097' E	61° 1.201' N	Unidentified(TAUN) - Possible hard debris - from SSS	L=3.0 H=0.1 W=0.9	19.1 m / L	
06.09.2024	21:01:03	105,483	429735.87	6765895.2	1° 41.898' E	61° 1.181' N	Unidentified(TAUN) - Possible hard debris - from SSS	L=0.9 H=0.6 W=0.9	19.3 m / L	
06.09.2024	20:56:28	105,565	429650.92	6765901.2	1° 41.803' E	61° 1.183' N	Unidentified(TAUN) - Possible hard debris - from SSS	L=0.4 H=0.1 W=0.4	42.1 m / L	
06.09.2024	20:56:21	105,566	429651.33	6765906.06	1° 41.804' E	61° 1.186' N	Unidentified(TAUN) - Possible hard debris - from SSS	L=1.6 H=0.6 W=1.0	37.4 m / L	

2.5 Key Milestones

Table 2.5: Key Milestones
Decommissioning campaign offshore started on May 1, 2022 with the Knarr Cessation of Production (CoP). The offshore campaign started immediately thereafter with depressurization of Knarr Gas Pipeline (KGP) and the pigging/cleaning of pipeline from Knarr PLEM to Knarr FPSO. The campaign was completed on May 17, 2022 and the KGP was left in situ. The abandonment campaign offshore was mobilised on June 3, 2024, for cutting of KGP upstream KGP PLEM and installation of abandonment plug. Demobilisation June 14, 2024.

2.6 Stakeholder Engagement

Table 2.6: Stakeholder Engagement
<p>Main stakeholders involved in both decommissioning- (2022) and abandonment (2024) phases were KGP Joint Ventures (AS Norske Shell, Wintershall Dea Norge AS (later acquired by Harbour Energy Norge AS), INPEX Idemitsu Norge AS) and Shell UK Ltd. (SUKL) as operator of SEGAL pipeline (downstream KGP PLEM to UK). KGP JV has been involved through regular JV meetings, project meetings as per Gassco project governance process and other meetings as required. Owners have also been involved in procurement processes for marine contracts and decisions for entering execution phases for both offshore campaigns. As part of all commercial proximity- and disconnection agreements KGP JV has been consulted both during development and up to signing of such. KGP JV has also received monthly project reports both during the decommissioning- and abandonment phases of the project.</p> <p>SUKL has been affected party for relevant proximity agreement with project. SUKL has also been involved in miscellaneous risk sessions in project, such as HAZOP, ALARP and similar. Start of offshore campaigns have been subject to ISSOW (integrated safe system of work) permit – allowing entry into the FLAGS Safety Zone – by SUKL. Further SUKL had one representative onboard the offshore vessel, and received daily reports during the offshore campaigns.</p>

3 IMPACT ON ENVIRONMENT

3.1 Activities

During phase 1 of the project, a discharge of MEG was reported as part of the offshore installation activities on the Knarr PLEM – filling the section between the Knarr Tee and Knarr PLEM with MEG. This was communicated to OPRED as per existing procedure (PON1) on May 9, 2022. The discharge occurred at the

Knarr PLEM from the decommissioning vessel's downline valve due to a check valve failure, releasing 480 litres of MEG. Immediate actions included closing the valves, replacing the check valve, installing an additional check valve, and conducting a leak test to verify integrity.

Phase 2 of the project, involving the cutting and removal of a small section of spool #7 to isolate the Knarr Gas Pipeline (KGP) from UK infrastructure, was carried out within the framework specified in the Decommissioning Program and the chemical permit issued by OPRED. No discharges beyond the applied MEG volume were reported.

3.2 Future Monitoring

Table 3.1: Future Surveys and Monitoring Proposals	
1. Pipelines and Flowlines	
Inspection of Knarr Gas Pipeline every 12 th year	
2. PLEM/Spools	
Inspection of PLEM and Spool 8 every 4 th year	
3. Pipeline Stabilisation Features	
Inspection of rock cover every 12 th year	
4. Drill Cuttings	
N/A	
5. Environmental Surveys	
N/A	

4 IMPACT ON HSE

4.1 Details of any Incidents / Accidents during Project Execution

Project was carried out according to plan and without any incidents.

5 WASTE

The waste handling has been carried out according to Norwegian Regulations on the Recycling and Treatment of Waste.

The 12" spool section, measuring 3,3m in length and weighing 400 kg, was returned to shore on June 14, 2024, by the vessel Maersk Installer. Subsequently, it was delivered to the licensed waste disposal facility, Norscrap West AS.

The 34 empty gravel dump bags, each weighing 4.5 kg, were recovered to the deck and delivered to a licensed waste disposal facility ashore.

Table 5.1: Materials/Waste Returned to Shore				
Material/Waste	Total Weight (t) – as per the approved DP	Tonnage In situ	Tonnage to shore (including date)	Disposal Method
3.3 m of 12" Steel Pipe	0.4Te	1171.6Te	0.4Te returned to shore in Norway (CCB Ågotnes) June 2024.	Steel delivered to Norscrap on June 14, 2024 for recycling

Gravel dump bags	0.153Te	0	0.153Te, June 2024	Delivered to a licensed waste disposal facility ashore
Total	0.553Te	1171.6Te	0.553Te	

6 LESSONS LEARNED

A meeting regarding reinstatement of GRP cover was held between Gassco, OPRED and SFF (Scottish Fishermen's Federation) on April 8, 2024. Agenda for the meeting was different methods for securing and leaving the GRP cover in an over trawable state. SFF gave an explanation regarding their members challenges of trawling in areas where drop bags are used. Based on this meeting, Gassco decided to use a method for emptying gravel dump bags instead of installing drop bags.

Early involvement of SFF during planning can save time for getting approvals approved.

7 COST SUMMARY

Cost data has been provided in confidence to OPRED on September 3, 2024.

8 PHOTOGRAPHS



Figure 2: Pipe section removed during Decommission Phase 2