RFI BSEE 2
Pebble Project EIS

Request for Information

Title/Subject:	**Cook Inlet Natural Gas Pipeline: Maintenance Schedule**
Requestor:	**BSEE**
Date Transmitted:	**12/06/2019**
Recipient:	**Pebble Limited Partnership**
Response Requested by:	Click here to enter text.
Rationale:	BSEE needs information on how the buried sections of the subsea portion of the natural gas pipeline in Cook Inlet will be inspected, maintained, and repaired (when necessary).
Describe the Information Requested and Level of Detail:	We request information on the inspection and maintenance activities for the subsea portion of the natural gas pipeline crossing Cook Inlet during the operations phase, including schedule, time of year, and equipment/vessels necessary for these activities. Please include information regarding how pipeline repairs will be handled.

Recipient Response Form

Date Received from USACE:	Click here to enter text.
Response from Recipient (Describe Information Requested to the Level of Detail Requested; Provide Attachments as Needed):	Please see attached memorandum from Intecsea.
List Number and Type of Response Attachments:	408005-00888-SU-MEM-00009 BSEE RFI2 Maintenance.pdf.
Date Returned to USACE:	Click here to enter text.

AECOM Intake Form

Date Response was Received:	Click here to enter text.
Received by (Name):	Click here to enter text.
Describe any Follow-up Related to this RFI (Communications, Clarifications):	Click here to enter text.

NANA WorleyParsons

Intecsea
Worley Group

THE pebble PARTNERSHIP

MEMORANDUM

DATE	December 13, 2019
TO	Tanya Yang, Stephen Hodgson, James Fueg
FROM	Jonathan Caines
COPY	Mike Paulin, John Brand
PROJECT	Pebble Partnership – Marine Pipeline
SUBJECT	BSEE RFI Response – Maintenance Schedule (RFI 2)
DOC NO	408005-00888-SU-MEM-00009

INTRODUCTION

Pebble Limited Partnership (Pebble) intends to install an NPS12 x 0.812in wall thickness, ~167 km long, marine pipeline across the southern Cook Inlet as part of their overall Pebble Mine Project; see Figure 1 below. Because the submarine portion of the pipeline crosses the OCS, it will require a Right of Way (ROW) from the Bureau of Safety and Environmental Enforcement (BSEE).

OBJECTIVE

The purpose of this memorandum is to provide responses to a Request for Information that Pebble has received from BSEE, as summarized below.

RFI BSEE NO. 2

Rationale

BSEE needs information on how the buried sections of the subsea portion of the natural gas pipeline in Cook Inlet will be inspected, maintained, and repaired (when necessary).

Information Requested and Level of Detail

We [BSEE] *request information on the inspection and maintenance activities for the subsea portion of the natural gas pipeline crossing Cook Inlet during the operations phase, including schedule, time of year, and equipment/vessels necessary for these activities. Please include information regarding how pipeline repairs will be handled.*

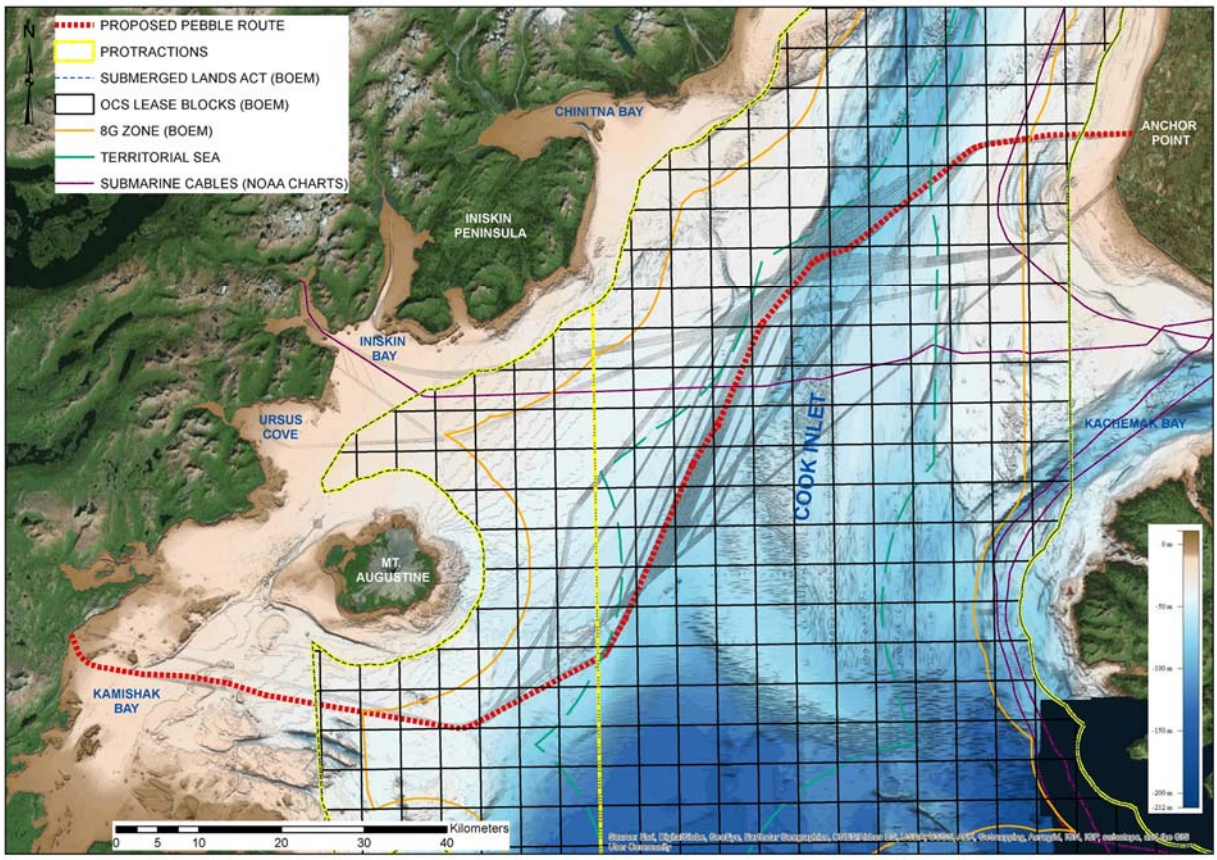

Figure 1 – Pebble Marine Pipeline Route

Response – Inspection and Maintenance

The Amakdedori Port Route (APR) pipeline will utilize industry best-practices for inspection and maintenance activities during operations. The integrity of the pipeline system, both during installation and throughout its operational life, is important for economic, operational and environmental reasons. When a gas pipeline suffers damage that prevents transport of gas, a rapid deployment to assess any spills shall be followed by an appropriate repair plan to return the pipeline to an acceptable operating mode.

The integrity of the APR pipeline will be monitored during operations for geometry deformation monitoring using intelligent pigging (in-line-inspection) to inspect for and detect any changes in the pipeline geometry, pipe deformation, and estimate any strain in the pipe wall. In this type of inspection, geo-pigs and caliper pigs are run to make an integrity assessment after any suspected environmental loading (such as an ice-interaction event) and form part of a regular maintenance plan to assess pipeline free span formation / migration, thaw settlement, pipe buckling, and/or third-party damage.

The operational inspection philosophy for the APR pipeline will incorporate routine in-line-inspection of the line (typically on the order of every 3 – 5 years, with frequency to be determined during design as part

of the project Operations, Maintenance and Repair Philosophy), during the summer season, with data trends compiled and analysed to obtain pipeline behaviour. A baseline survey will be completed immediately after pipeline construction to ensure that strains resulting from installation are not treated as the result of environmental loadings. Analysing intelligent pig data will allow Pebble to conduct remediation planning and qualification testing, as may be required over the APR pipeline's service life. In the event that this surveying indicates suspected free spanning, pipe movement, damage, or loss of cover, then appropriate inspection tools (such as an offshore support vessel and ROV; to be confirmed) will be deployed to visually inspect the pipeline route centreline and cover conditions. It is not envisaged that external visual inspection by ROV with surface vessel support will form part of the routine inspection program, unless anomalous pipe conditions are detected by routine in-line inspection. Intelligent pig data combined with visual inspection results will be compared to the design conditions to assess needs for remedial action, increased operational monitoring, or design derating, as may be applicable.

Every five (5) years, an intelligent- or smart-pig will be used to inspect the entire line length for internal corrosion / metal loss using magnetic-flux-leakage or ultrasonic testing. More frequent MFL or UT pig inspection will be performed if internal corrosion / metal loss is suspected or confirmed / detected; on an annual basis or as determined by a corrosion monitoring philosophy developed in consideration of predicted corrosion rates. Prior to use of an MFL or UT tool, a caliper pig is run to ensure tool passage. Internal corrosion is not expected for APR, due to the sweet dry fuel gas being transported. As part of this 5-year smart-pig inspection, an ROV / visual inspection is recommended to inspect the pipeline route conditions for any seabed bedform migration or changes to backfill cover.

A brief description of these pigs / equipment follows below. The pipeline length and flow rate (pig travel speed), and battery life (smart-pigs only) are factors which influence their application and inspection / pig-survey duration:

Caliper Pig

A caliper pig is sent after a gauging plate run and can generally accommodate a 30 to 50% change in pipeline inner diameter. These pigs are also used to confirm that any selected metal loss inspection tool (e.g., MFL or UT pig) can fit through the pipeline system. Caliper pigs can also identify, measure, and assess mechanical damage by detecting changes in the pipeline ID resulting from denting, buckling, or other foreign object blockage. Local deformations must typically exceed 2 to 3% of the pipeline ID to be recorded by a caliper pig, which is why more specialized tools such as MFL or UT are used for accurate pipe wall inspection and measurement.

Geo-Pig

Geo-pigs provide 3-D inertial mapping of axial, vertical and lateral pipe positions and are capable of measuring the physical positions of the pipeline for comparison with prior survey data. This information can be used to compute the pipeline curvature and any corresponding bending strains in the pipe wall. A benchmarked elevation survey at or near the pipeline entry and exit points is required using conventional elevation survey equipment, to account for mapping drift. Geometry pigging is essential for monitoring limit state bending strain conditions in offshore pipelines.

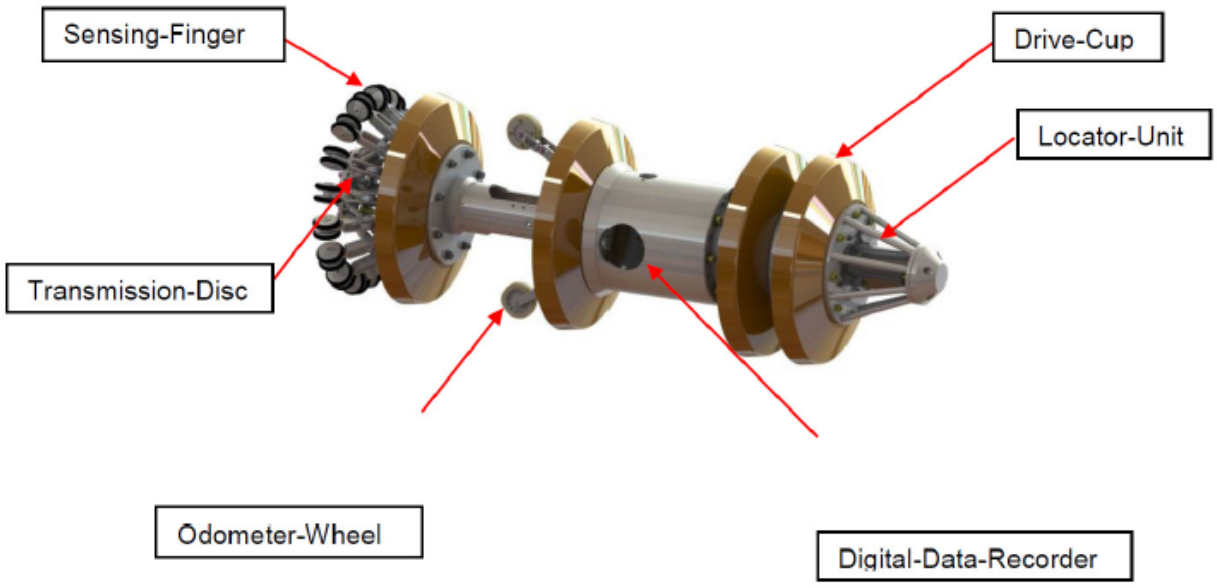

Figure 2 Example Caliper Pig [Ref. 1]

Smart-Pigs (MFL or UT)

An MFL or UT pig can provide accurate measurement and location identification of any internal corrosion, if present or suspected based on fluids and corrosion coupon monitoring. In general, smart-pigs are free floating, carry their own power supply, and store raw data for analysis after inspection. These types of inspection tools would typically only be used for specialized inspections and not as part of routine monitoring.

Response – Repair

During operations, there are two different damage scenarios that need to be considered in terms of repair method selection:

1. Operational damage which is caused either by corrosion or erosion. This damage tends to occur slowly over a period of time. Routine inspection of pipelines monitors the pipeline condition and ensures the pipe damage is identified at an early stage to facilitate a planned maintenance activity. A routine monitoring and inspection program will be developed and deployed for the project.

2. Damage due to external impact / 3rd party interaction or environmental / geohazards. With this scenario the damage could breach the pipeline without prior warning and introduce a non-piggable bore restriction or stop pipe flow. In the event of a breach, the flow of gas will be halted immediately, by taking the compressor station offline and closing the mainline valves at the shore crossings. As neither the location nor the extent of the damage will be known prior to the incident,

all options need to be considered. Therefore, an emergency pipeline repair plan will be developed for the project to address this scenario and to minimize the pipeline down time.

When damage occurs, an assessment shall be performed to check whether the operational conditions are maintained; the defect/damage and the remaining life of the pipeline shall be estimated considering the fatigue and cyclic loading at the defect. Based on the assessment results, the required corrective action and the type of repair can be planned. Pipeline investigations via diver or preferably ROV with surface support (or other available remote sensing technology), as applicable, and repair planning will be undertaken to determine the extent-of-damage, including the pipe condition, operational consequences, need for intervention / repair, and whether environmental pollution controls are required. The extent of damage and associated intervention requirements are presented in Table 1. The repair method and type of equipment depends on the severity of damage and the water depth. Depending on the extent of damage, the response time may need to be immediate, regardless of the time of year, or could be delayed until a more favourable timeframe in Cook Inlet (such as summer).

Table 1 Extent of Pipeline Damage

Extent-of-Damage	Response Time	Flow Modification and Required Intervention
Major rupture / leak (> 1 x OD)	Immediate	• Stop flow, isolate damaged section, and replace pipe section.
Large leak (> 1 x OD)	Immediate	• Stop flow, isolate damaged section, and install welded or mechanical pipeline seal. • This includes pipe wall damage such as dents or gouges, which may lead to pipeline failure.
Minor / isolated leak where damage is not affecting pipeline integrity (< 1 x OD)	As soon as practicable	• Not likely to be detected immediately. May be detected by routine inspection / surveillance program (e.g., internal in-line inspection followed by external ROV / submersible / diver). • Flow interruption may not be required if there is no product loss and no potential for damage growth (crack / leak growth).
Superficial (< 1 x OD)	As soon as practicable	• No flow interruption. • Consider monitoring damaged area with increased inspection regime.

In general, each repair situation is different in terms of water depth, pipeline diameter, location in the route / seabed, soils / slopes, operating conditions of the pipeline, nature and severity of damage, consequences of interruption in production, environmental conditions, locally available repair equipment and allowable repair methods. Damage to the pipeline can range from a small pinhole leak to a full-bore rupture and displacement.

Depending on the nature and extent of the damage and the seasonal (winter or summer) conditions, temporary repair methods might be used for initial repairs to ensure pipeline integrity and maintain gas flow. Offshore repair work will be scheduled during the summer season; while emergency repairs during winter will utilize temporary repair methods (e.g., clamps, sleeves) if possible, to limit offshore work during unfavourable timeframes while ensuring pipeline integrity and maintaining gas flow.

The damaged pipeline sections can be repaired by means of:

1. Recovery and retrieval of the pipeline length up to the damaged repair area and re-installation using a pipelay vessel or suitable construction work vessel / barge. This would require support vessels and infrastructure similar to what is utilized during construction, but for a limited duration dependent on the length of pipeline to be replaced. Construction support vessel(s) and dredging / jetting equipment with diver and / or ROV support may be required to expose the damaged pipeline and prepare for retrieval and removal (reverse pipelay). Pipe haul barges may also be required to take away recovered pipe, depending on the extent of damage and pipe to be removed.

2. Seabed lift and above-water retrieval of the damaged area, followed by local repair and lowering of the pipeline after repair to the seabed. A construction support vessel or pipelay barge with sufficient crane capacity would be required for these tasks, along with support vessel(s) and ROV monitoring. A repair such as this could be completed in approximately 1 week, depending on extent of damage, vessel, crew, and support service availability, etc., and must be confirmed at the time of need.

3. Repair of the damaged area on the seabed without lifting or re-installing the intact pipeline sections using e.g., commercially-available pipeline repair clamps. Construction and dive / ROV support vessel(s) would be required, as well as dredging / jetting to expose any buried pipeline segments affected.

A leaking or damaged section of pipe can be repaired/replaced by means of welding a new segment (above water or hyperbaric), inserting a flanged piece, and/ or use of mechanical clamps / connectors. Since most of the APR pipeline will be trenched and buried, any damaged section(s) would need to be exposed via seabed excavation. Depending on the extent of damage, pipeline location, and soil conditions, dredging to expose the damaged pipeline section could be done via clam-shell, extended reach backhoe, jet trenching machine, or hand-jet trenching by diver or ROV.

The water depth has a large influence on the limits, practicality and duration of a pipeline repair; in 'shallow' water, professional divers could use air-diving up to 30m, and then saturation diving up to a limit of 200m water depth. ROVs can be used for remote intervention to remove risks associated with diving. To prevent risks associated with diving in Cook Inlet, any major APR pipeline system repairs / section replacements will be completed above the surface in as much as practical. Less severe damage can be repaired using epoxy-filled split sleeves or clamps to maintain pipeline strength until a permanent repair can be scheduled (during summer). These temporary repair methods are deployed on the seabed and may require diver intervention.

Activities that either precede or succeed deployment of a pipeline repair system / actual replacement of the damaged section include the following tasks. It is envisioned that the APR pipeline system would be shut down and shut-in immediately upon detection of a leak, as part of the leak detection system and response philosophy to be developed for the project. If suitable based on the nature and location of the leak, emergency repairs would be actioned as soon as possible and more permanent repairs (damaged pipe replacement) performed later and scheduled considering time of year. In general, offshore work will be scheduled during the summer construction season; emergency repairs during winter will utilize temporary repair methods (e.g., clamps, sleeves) if possible, to limit offshore work during unfavourable timeframes while ensuring pipeline integrity and maintaining gas flow.

- Survey and identification of damage, damage location, and extent
- Damage severity and intervention method assessment
- Uncover (if applicable) the pipeline and the damage site
- Pipeline decommissioning and dewatering, if required
- Mobilize the necessary vessels and repair equipment needed to perform the repair operation
- Perform visual inspections and metrology (diver, or preferably ROV)
- Isolation of the damaged section pipe with internal plugs , if required
- Pipeline lifting to gain full round access
- Measurement and positioning of clamps, spool pieces and/or mechanical repair clamps/connectors as applicable, including design and analysis
- Pipe coating(s) removal
- Pipe cutting
- Removal of damaged section
- Pipe-end preparation
- Install new pipeline section and lowering the replacement spool
- Remedial burial of the repaired segment
- Dewatering, testing, and commissioning of the repair
- Removal of repair system equipment

These activities require mobilization and preparations of equipment, permits, dewatering spreads, vessels and skilled crews such as divers, ROV operators and construction supervisors as well as regulatory bodies or certifying authorities. Equipment mobilization durations depend on time of year, local vessel access and availability, and general industry demand / activity at the time of need. These aspects have a considerable impact on the overall duration and costs of a pipeline repair and shall be considered with at least equal care when assessing the most appropriate repair plan to address a damage scenario. Depending on the extent and type of damage, it's possible that pipeline derating may be required to accommodate temporary repairs and until permanent repairs can be completed.

A brief description of typical pipeline repair equipment is provided in Table 2.

Table 2 Typical Pipeline Repair Equipment

Equipment	Purpose
DP Support Vessel	Platform to operate ROV's and to conduct repair operations.
Pipelay vessel	Working platform to replace or re-lay (reinstall) pipeline in case of an extensive section of damaged pipeline.
Flooding/Dewatering/Drying Spread	Pressure equalization prior to cutting, flooding, dewatering, drying prior to returning to service to minimize water content and risk of hydrates.
Seabed Dredging/Leveling Equipment	Exposure of the pipeline, if locally trenched or buried, to allow for survey and repair operations.
Pipeline Lifting Frames	Elevation of pipeline off the seabed in the vicinity of any repair, for the purpose improving access for repair equipment and operations.
Pipeline Cutting Tool	Cutting of pipeline (and coatings) to allow removal of any damaged sections.
Pipeline Coating Removal Tool	Removal of external pipeline coatings in the vicinity of any section that has been damaged (by the Pipeline Cutting Tool). Required in the event that the Pipeline Recovery Tool grips the pipeline on its external steel surface.
External Weld Bead Removal Tool	Removal of external longitudinal weld seam (if applicable) to prevent interference on connector seal.
End Preparation Tool	Machining of the end face of the pipeline to prevent interference on connector seal.
Pipeline Recovery Tool	Tool connected to the end of the cut pipeline to allow recovery to surface. Design to allow the pipeline to be dewatered and isolated prior to recovery.

Equipment	Purpose
Pipeline Repair Clamp	Permanent clamp installed around the pipeline in the vicinity of minor damage (dent) for the purpose of ensuring the structural integrity of the pipeline without the need for cutting out and replacing an entire section of pipe.
Subsea Measurement Tool	Performance of measurements between pipeline ends for accurate spool piece and connector assembly.
Subsea Pipeline Connectors	Connector assembly and modular system used for the installation and connection of a new section of pipeline.
Replacement Spool Piece	New section of pipeline used to replace area of damage.

Commercially-available integrated pipeline repair systems could be used, depending on the nature, location, and work restrictions associated with any damage. These purpose designed integrated pipeline repair systems have been developed primarily to meet the challenges of both shallow and deep water repairs with diver support, as well as to allow diverless repair work. Prospective systems include the SirCOS connection system [Ref. 2], Oil States Industries Hydro Clamp for minor damage repairs or the ROV-deployable Grip and Seal Hydraulic Coupling (GSHC) known as the HydroCouple [Ref. 3], or the Oceaneering Pipeline Connection and Repair Systems (PCRS) [Ref. 4].

REFERENCES

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4. Oceaneering – Pipeline Repair Connections, Available Online https://www.oceaneering.com/pipeline-repair-systems/