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Sakhalin Energy Investment Company LTD.

Comparative Environmental Analysis of the Piltun-Astokh Field Pipeline Route Options

Сравнительный анализ воздействия на окружающую среду вариантов маршрута трассы трубопровода Пильтун-Астохского месторождения.

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Executive Summary

Project Background
Sakhalin Energy Investment Company (SEIC) is developing oil and gas reserves in the Sea of Okhotsk off the northeast coast of Sakhalin Island in the Russian Far East. The Sakhalin II project is being developed under a Production Sharing Agreement between the Government of the Russian Federation and SEIC.

The project is being implemented in two phases. Phase 1 commenced oil production from the southern part of the Piltun-Astokhskoye (PA) Field with the installation of the Molikpaq drilling and production platform. The Molikpaq (PA-A) began production in mid-1999 and produces oil typically from early June to mid-December during the ice-free season. The oil is transferred from PA-A via a sub-sea pipeline to a floating storage and offloading tanker (FSO) and periodically offloaded from the FSO to shuttle tankers. During the ice-season, production is shut-in and the FSO leaves Russian waters. Phase 2 is an integrated oil and gas development that will allow year-round oil and gas production from the PA Field, as well as establish uninterrupted gas and condensate production from the Lunskoye Field to the south.

The PA Field is located near summer and autumn feeding grounds of the Western Gray Whale (WGW), a species that is listed as endangered by the Russian Federation and, since the year 2000, has been listed as critically endangered by the International Union for the Conservation of Nature (IUCN). Owing to the proximity of the feeding grounds to the PA field and SEIC's ongoing commitment to ensure that the impact from its activities on the WGW population are minimised, SEIC has sponsored a broad range of WGW research and monitoring programmes annually since 1997. The programmes have been developed in consultation with independent whale researchers and have been aimed at gathering information regarding population size, distribution on the feeding grounds, site fidelity, fecundity, general health, behaviour, food sources and distribution. In addition to providing information for the Sakhalin II environmental impact assessments (EIAs), the results have also been used to assist the Company in developing specific WGW mitigation and protection measures relative to the Company's planned oil and gas development activities.

SEIC carried out multiple EIAs for Phases 1 and 2 of the Sakhalin II project beginning with the initial Project Feasibility Study in 1992. Between 2002 and 2003, both a Phase 2 EIA and a specific Western Gray Whale EIA were developed addressing the project's potential impact on the WGW population. These EIAs concluded that potential impacts to the WGW could result from, among other things, noise, disturbance of the physical environment associated with dredging and installation of sub-sea pipelines, oil spills, and collision with vessels. However, with mitigation measures in place, potential residual impacts were assessed as acceptable.

Russian Government technical and environmental approval of Phase 2 was received in December 2003 and construction is now under way. Phase 2 includes installation of the PA-B platform north of PA-A, and installation of a platform at Lunskoye. Additional Phase 2 activities include: i) installing offshore pipelines from the PA platforms to shore with a common landfall; ii) installing pipelines from Lunskoye to shore; iii) constructing an onshore processing facility (OPF) near Lunskoye; iv) constructing a Liquefied Natural Gas (LNG) processing plant and an Oil Export Terminal (OET) in Aniva Bay; v) installing an onshore pipeline system to transport hydrocarbon production from the north to the LNG plant and OET at the south of the

island at Aniva Bay; and vi) installing an offshore pipeline and associated tanker loading facilities in Aniva Bay (see Figure 1).

The PA-B and Lunskoye combined drilling/production topside facilities will each be placed on a separately installed concrete gravity-based structure (CGBS). The oil and gas produced at the offshore platforms will be dehydrated to prevent internal corrosion before entering the pipelines. The outside surface of the pipe will be coated with asphalt enamel for protection against external corrosion from the seawater, and cathodic protection will be installed along the entire length of pipeline both onshore and offshore to provide further assurance against external corrosion. The design factor for the burst strength of the PA Field offshore pipeline is twice the factor normally applied as an industry standard. In addition the offshore pipelines will be buried to a minimum depth of 2m in sediment for protection against potential physical damage from ice scour and vessels.

The current proposed route for the pipeline system at PA Field runs from PA-B south to PA-A, and then due west from PA-A in a single pipeline corridor to shore with a landfall south of Piltun Bay. The landfall section of the pipeline passes through the southern end of the WGW feeding area at Piltun on its way to shore. This route forms the basis upon which Russian Government approvals were obtained; however one of the conditions issued by the state environmental expert review stated that additional acoustics studies should be carried out with respect to WGW impacts.

Recent Developments

In 2003, additional seabed surveys were conducted as part of the final detailed engineering design process. These surveys indicated that the required burial depth for a section of the offshore pipeline should be deeper than originally designed to add an additional margin of safety associated with ice scouring and seabed mobility. This will result in a longer construction period and will require larger and potentially noisier construction vessels and equipment. Additionally, instead of relying on published acoustics data for various vessel types, during 2003 and 2004, SEIC implemented an acoustics monitoring programme to acquire source noise level measurements for the specific vessels and equipment that would be used for offshore pipeline construction at Piltun. In some cases the measured levels were higher than anticipated from the literature.

After reviewing the new information, SEIC announced in April of 2004 that it would reschedule the 2004 offshore pipelines construction work in the PA Field until 2005-2006, and at the same time implemented an integrated environmental and engineering work programme designed to re-evaluate noise and other impacts and ensure minimal disturbance to the WGW. Offshore pipeline construction work during 2004 was then focused on pipeline construction at the Lunskoye Field and Aniva Bay further south, which was previously planned for completion later in the construction period.

In the event that impacts from constructing the original pipeline would be reassessed as unacceptable with regard to the WGW, SEIC also identified and assessed two alternative pipeline routes located further east and south of the original route and outside the Piltun WGW feeding area. The overall work programme for 2004 was then expanded to include an evaluation and comparison of the three Piltun pipeline route alternatives with regard to WGW impact. For comparative purposes, the original route from PA-A to shore was designated as the Base Case; Alternative 1 comes to shore approximately 20 km south of the Base Case; and Alternative 2 comes to shore approximately 12km south of the Base Case (see Figure 2).

The 2004 environmental and engineering programme was executed by Russian and international scientific and engineering firms and included marine noise source level and transmission loss measurements, development of a 3-D acoustics model to more accurately predict sound levels from construction and operations activities and oil spill quantitative risk assessment and trajectory modelling. Additionally, the Company carried out a variety of other environmental and engineering surveys of both the offshore and related onshore sections of the route alternatives, and completed another season of extensive WGW surveys (ongoing since 1997). The body of information obtained from past surveys, studies, and EIAs, combined with the information obtained from the 2004 programme, has enabled SEIC to assess impacts and establish mitigation measures to ensure that the WGW is not adversely impacted by the Company's planned offshore activities at the PA Field.

The Comparative Environmental Analysis

The "Comparative Environmental Analysis of the Piltun-Astokh Field Pipeline Route Options" (hereafter referred to as the CEA) brings together the body of work referenced above and should be considered as supplementary and complimentary to the WGW EIA and other related SEIC documentation.

The primary purpose of the CEA is to identify and analyse the main sources of impact to the WGW from SEIC's construction and operations activities, evaluate the magnitude of the impacts and outline mitigation measures that could reduce the impacts to acceptable levels. It compares the advantages and disadvantages from an environmental perspective for the three Piltun pipeline route alternatives, including their landfalls and connective routes to the main north-south onshore pipeline associated with the development of the PA Field. The report also includes an environmental analysis of associated platform installation activities, long-term operations and cumulative impacts associated with other Sakhalin offshore oil and gas development activities relative to the WGW.

The CEA report will be used internally by SEIC to support its overall decision-making process with regard to selection of the optimum PA Field pipeline route option. In addition to WGWs and the environment, other significant factors that will be considered in the decision-making process include technical feasibility and safety, Russian Government approvals, project schedule implications and project economics.

IUCN Independent Scientific Review Panel

In an effort both to retain transparency and to obtain additional input regarding the approach SEIC has taken to managing work in the environmentally sensitive areas on and around Sakhalin specifically with regard to WGW conservation, SEIC announced in August 2004 that it had commissioned the IUCN (The International Union for the Conservation of Nature) to convene an Independent Scientific Review Panel (ISRP). The ISRP's brief was to review the Company's environmental analyses and impact assessments and the effectiveness of mitigation measures to minimise the impact of its operations on the WGW as it develops the Sakhalin II Phase 2 project. The objectives of the ISRP are as follows:

- Establish an independent expert opinion of the issues and scientific knowledge pertinent to the conservation of WGW and related key elements of biodiversity in the context of proposed development under the Sakhalin II Project;
- Analyse the potential risks and impacts of the project for the conservation of the WGW and related key elements of biodiversity. The analysis covered, *inter alia*, the

proposals for siting, routing and operation of the oil and gas exploration, production and transportation infrastructure;
- Assess the projected effectiveness of the proposed mitigation measures and identify alternatives if necessary;
- Assess the requirements for monitoring of the impacts of the Project on biodiversity, and especially on the health and survival of WGW, in terms of the adequacy of what has been proposed and any additional or alternative monitoring measures that could provide useful information.

In order to assist the ISRP to carry out their evaluation, SEIC worked with the ISRP from August 2004, providing EIA and related documentation, attending Panel briefing sessions and submitting the CEA report to the ISRP on November 30th, 2004. The CEA was posted on SEIC's public website on February 12th, 2005 and a report from the ISRP will be published on the IUCN website on February 16th. Following receipt of the report from the ISRP, the Company will take into consideration the findings and recommendations prior to finalising its construction plans for the future.

CEA Structure

Chapter 1 of the CEA includes a brief introduction to outline the project background, history and recent developments that have led to the writing of the CEA. Chapter 2 describes the technical aspects of SEIC's development activities, including construction methods, schedule, and a description of the facilities. Chapter 3 comprises an overview of the current knowledge of the ecology of the WGW. Chapters 4 through 7 include a review of the primary sources of potential impact on the WGW from SEIC's planned offshore activities including noise, food resources, collision and oil spills respectively. The comparative assessment for the onshore segments of the pipeline associated with the corresponding offshore alternatives is described in Chapter 8. An overview of the cumulative impacts is presented in Chapter 9 and a summary of the conclusions is presented in Chapter 10.

The remainder of this Executive Summary is structured to follow the content of the CEA.

WGW Ecology

SEIC-sponsored WGW research and monitoring has been focused on enhancing the understanding of potential anthropogenic impact associated with underwater noise, assessing environmental effects from platform operations and helping establish and verify the effectiveness of mitigation measures aimed at the various sources of potential impacts from SEIC's offshore oil and gas development. From the WGW research and monitoring effort, the size of the WGW population feeding offshore NE Sakhalin Island adjacent to Piltun Lagoon is currently estimated at approximately 100 and it is likely that this area constitutes the primary summer and autumn feeding habitat for this population. A population of approximately 24,000 Eastern Gray Whales is found on the other side of the Pacific but there is no known interaction between the stocks.

When the ice begins to break up in the Sea of Okhotsk (typically late May), WGWs begin arriving at the shallow coastal waters off the northeast coast of the island to feed during the summer and autumn. They leave the area to begin the migration south during October and November before the ice returns. It is thought that WGWs spend the winter and early spring in the South China Sea breeding and calving before beginning their annual return to the Sea of Okhotsk.

Within the Piltun area, feeding whales are typically sighted within 6 km of the shoreline in water depths of 20 m or less over a distance of approximately 90 km from north to south. In 2001, aerial and marine surveys identified a second feeding area south of the Piltun area and east of Chaivo Bay in water depths ranging from 30-65 m. Studies indicate that WGWs migrate between and utilise both the Piltun and Chaivo feeding areas during the summer and autumn feeding season. The Chaivo offshore feeding area, although very rich in prey biomass, is more variable in terms of whale distribution and abundance and no mother/calf pairs have been observed in this area. The WGW feeds predominantly on benthic (seabed-dwelling) organisms that they consume by ploughing into the sediment and then extract by filtration against baleen plates as they expel associated sediment.

WGW do not form dense aggregations in the Piltun feeding area, but scatter along the coast, alone or in groups of two, only occasionally forming clusters. The number of whales using an area may be related to the distribution and abundance of food species present in the area.

Using the results of WGW research and monitoring along with environmental impact assessments carried out for the Sakhalin II project, a number of general mitigation measures have been developed to minimise potential impacts from SEIC's offshore activities. To ensure a consistent and co-ordinated strategy to protect the WGW, since 2001 the general mitigation measures have been developed into specific WGW protection programmes (WGWPP). The WGWPP, produced by SEIC in consultation with marine mammal and WGW experts, are publicly available on SEIC's website. They include a summary of relevant project construction and operations activities and related potential impacts and a description of protection measures that apply to specific marine activities, including ongoing Phase 1 operations and Phase 2 construction activities such as dredging and pipelaying.

Noise

Anthropogenic noise will be generated by the planned construction and operational activities, primarily during platform installation and pipeline construction. Such noise has the potential to affect the WGW. The propagation of noise in the ocean is highly dependent on the characteristics of the sound source and the environment in which the sound travels. The relatively near-shore, shallow water environment of the Piltun feeding area is less conducive to long-range sound propagation then the open ocean. This is primarily due to the significant attenuating influences of the seabed and sea surface.

Continuous underwater sounds of the types associated with offshore pipeline construction and platform installation may affect WGWs if the received sound levels are high enough to induce avoidance behaviour or cause temporary or permanent hearing impairment. Based on published studies regarding marine mammals and noise, in most cases a temporary avoidance by whales of small portions of feeding areas or migration routes is not likely to result in biologically significant impacts to the population. However, because the WGW is critically endangered and relies heavily on the Piltun area for feeding, the impact of industry-related noise on the whales at Piltun has been assessed in considerable detail by the Company and is addressed in this document.

There are no measured audiograms available for any baleen whale and the hearing capabilities of gray whales are currently unknown. Based on the range of frequencies in their calls, the optimum hearing range is considered to be between ~20 Hz and 2-4

kHz. Quantitative information on the reactions of gray whales, especially feeding gray whales, to continuous anthropogenic sounds of the types associated with offshore pipeline construction and platform installation is very limited. Most available information relates to migrating or breeding whales that appear to be less tolerant of anthropogenic sounds than feeding gray whales.

To facilitate the assessment of potential impact to the WGW from noise generated by its construction and operations activities and to support its overall WGW protection and mitigation efforts, SEIC commissioned the development of a 3D Acoustic Model in 2004 that enables the prediction of noise levels and attenuation through the Piltun offshore environment. This model can predict propagation profiles from point sources, such as a platform or a single vessel, and from multiple sources as well such as dredgers, pipelay barges and support tugs, collectively known as a pipeline spread. As part of the development and validation of the model in 2004, SEIC carried out a comprehensive acoustic monitoring programme that included extensive transmission loss and source level measurements on vessels used during pipeline construction activities at Lunskoye, and carried out acoustics studies in the PA Field area as well.

SEIC is using the resulting enhanced modelling capability as a tool to more accurately assess potential noise impacts to the WGW from planned PA Field marine activities. Although various studies have been performed on the behavioural reactions of gray whales to anthropogenic noise (pulsed and continuous), little information is known about the impact threshold from noise generated by dredging and pipelaying operations. Based on the information available, SEIC has used a noise threshold level of 120 dB for impact assessment purposes. The criterion considered of major importance in quantifying noise impacts on WGW is the number of whales potentially impacted i.e. showing avoidance behaviour, within a certain area for a particular duration. For this purpose, WGW density distribution calculations were performed for the months July-November using relevant distribution data based on years of aerial, vessel based and shore based survey data. Noise contour maps were generated showing the area potentially exposed to sound energy from offshore construction activities in a certain month (see Figure 3). Combined with the WGW density calculations, the total number of whales present within any part of the feeding area exposed to a level >120 dB was calculated.

By matching the results of noise predictions using the model to the analysis of several years' work in WGW observations, a sophisticated method of predicting acoustic impacts on the WGW was developed and is described in this section of the CEA. This method was then applied to the modelling of the pipeline construction scenarios and platform operations.

Food Resources

As benthic feeders, the seabed and the quality and quantity of the benthos are crucial to the WGW during the summer and autumn feeding period. Therefore, an assessment of the potential impacts of the project on food resources was included in the CEA.

Physical, chemical and biological marine surveys have been carried out annually by SEIC in the PA Field area since 1998 to determine and characterise the environment and in particular the seabed. Specific benthic characterisation studies in the WGW feeding areas have also been undertaken since 2001.

The coastal marine environment off the northeast Sakhalin coast is physically dynamic, being affected by a strong diurnal tidal regime, by heavy wave action in autumn and by ice through the winter and spring months. This seasonal freeze and thaw cycle, together with the nutrient-bearing influence of the Amur River from the north and the local inputs from the northeastern coast lagoon systems, result in a particularly productive marine environment. Evidence of a localised upwelling between Piltun and Chaivo Lagoons can also be seen in nutrient data, seawater temperature and other parameters mapped for the Sea of Okhotsk.

The annual oceanographic studies sponsored by SEIC have indicated lower levels of nutrients in surface waters than in deeper seawater layers of the water column. Whether this is indicative of a local hotspot of primary productivity, reflects normal primary productivity for the wider area as a whole, or is merely showing localised enrichment from deeper upwelling water, is difficult to determine. Over the northeast Sakhalin coast, sediment types are heterogeneous in distribution and dominated by medium to fine sands.

From Nyiskiy Bay in the south to Tropto Bay in the north, amphipods and isopods are generally the most abundant groups in water depths less than 15 m, with the highest densities occurring patchily along the shoreline between the northern and southern limits of Piltun Bay in depths of 5-15 m. This area of higher abundance adjacent to Piltun Bay corresponds with the distribution and abundance of WGW sightings. Off Piltun, WGW tend not to feed in waters deeper than 15-20 m where the seabed is characterised by lower concentrations of amphipods. It is consequently considered highly likely that amphipods are a key component of the WGW diet.

The implication of the dynamic coastal environment is that the benthos is a product of this and is dependent on a certain type and level of physical disturbance for its continuing existence. The degree to which the benthos is disturbed each winter by ice scouring is not known. However, the benthos of the shallow inshore WGW feeding area at Piltun is likely to be most affected by this type of disturbance. The offshore feeding area (in water depths greater than 30 m) is unlikely to receive any direct physical disturbance from winter ice.

The PA Field in general does not support benthos of a type that is favoured as a food source and is not an area favoured by feeding WGW. In any case, studies indicate that the installation and operation of the PA-A complex has had no significant impact on benthos outside the 250 m radius from the platform and has therefore had no impact on potential WGW food sources. The situation at PA-B can be expected to be similar.

For any of the pipeline routes, the main disturbance will arise through the dredging and backfilling activities necessary to bury the pipelines for protection from ice scour. The severity, extent and duration of the disturbance impact is determined by the size of the area affected, the presence of a potential food source and proximity to known whale feeding areas. Only the Base Case route alternative has some potential to affect currently utilised WGW food resources.

Following completion of construction, benthic recovery will proceed via re-colonisation from either side of the undisturbed areas bordering the relatively narrow pipeline construction corridor. This will supplement the natural benthic regenerative processes that operate annually following the natural disturbances from WGW feeding, ice scour and wave action. Recovery is expected within one to two seasons

and the physical presence of the pipeline will have no long-term effects on the sediment or benthos in its vicinity.

Vessel Collision

As identified in prior SEIC EIAs, there is a potential risk of collision between vessels constructing and servicing the PA field and WGWs transiting and feeding in the area. A direct relationship exists between the volume of ship traffic and ship speed and the number and severity of ship-whale collisions that can be expected. The risk of ship-whale collisions can be considered lowest when the number of vessels is low (particularly in areas known to be regularly frequented by whales), vessel speed is less than 10 knots, and marine mammal observers (MMOs) are present on the vessels. The risk of collisions can also be considered low when the maximum number of vessels (and distances travelled) is restricted to transiting within designated shipping lanes that are located outside of the primary areas used by WGWs.

Since 2003, MMOs have been present on all principal vessels used by SEIC to keep a lookout for marine mammals and to advise on actions necessary in cases where they are observed in close proximity to vessels. Prior to 2003, members of the crew were instructed to record marine mammal sightings. MMOs prepare observation logs of all sightings and subsequent measures taken during the surveys. This data is routinely loaded into an SEIC database, and the information is used to help develop mitigation measures in the WGW protection planning process.

Few whales have been sighted close to the PA-A platform and to date all reports made by the MMOs confirm that there have been no marine mammal collision-related incidents associated with Phase 1 or Phase 2 activities. The proposed PA-A to PA-B pipeline is located in an area where WGWs have not been frequently sighted. The Base Case route from PA-A to shore runs through the southern edge of the Piltun feeding area, while the pipeline routes proposed under Alternatives 2 and 1 are located 12 km and 20 km to the south relative to the Base Case route.

The closer an activity is being carried out to the Piltun feeding area, the higher the risk of WGW collisions. Although the potential numbers of whales present in the area is highest for the Base Case route, the likelihood of a ship-whale collision is low once the appropriate mitigation measures have been applied. These include use of MMOs, establishing construction corridors, and designating specific corridors for transiting vessels supporting operations.

Oil Spill Risk

Previous SEIC EIAs have concluded that the impact from a major oil spill could be significant to the WGW population and that a control framework will be required for the project lifetime.

Building upon these past EIAs, Phase 1 oil spill planning, oil spill trajectory modelling and other related oil spill studies and activities that have been ongoing since 1997, an oil spill Quantitative Risk Assessment (QRA) was commissioned by SEIC during 2004 to compare oil spill risk from current oil transport and transfer operations (Phase 1) with proposed pipeline operations (Phase 2), and to compare the oil spill risk from the three PA Field pipeline alternatives.

The frequency per year of the range of spill volumes from a variety of sources was calculated taking into account the design and operating controls in place. The

assessment was based on industry databases, peer-reviewed research, expert judgement and SEIC studies. Oil spill release volumes were then modelled for different consequence scenarios using fluid dynamics calculations and historical databases for release volumes.

The QRA concluded that the risk from pipeline operations is dominated by releases from very small holes that could result in release rates that may be undetectable by the leak detection system, but over a period of time (e.g. one week), could result in substantial volumes of oil being lost. Although these risks are low, the finding stresses the importance of corrosion control, pipeline condition monitoring and low-level leak detection procedures.

The QRA also concluded that the Phase 2 development yields an overall improvement in oil spill risk compared to oil export operations at PA-A, both in terms of likelihood (spill frequency) and potential spill volumes. Introduction of a second platform in the PA Field will increase the risk of a blowout over the existing case of one operating platform. SEIC have a systematic approach to the reduction of blowout risk both through rigorous design standards and specific operating procedures. For each platform, the design QRA leads to the development of a platform HSE Case in which hazards and mitigation of risks are described in detail and then they are reduced to a level that is determined to be as low as reasonably practicable and with acceptable residual risk.

In order to more fully assess environmental impact, additional oil spill trajectory modelling was undertaken during 2004 to determine the areas potentially impacted by oil from spills occurring at various pipeline and platform locations. The primary output from the model is spill location or “excursion envelopes”, which indicate the area within which a slick is likely to be located under a range of wind and sea conditions. These envelopes also indicate likely times between spillage and impact at locations on the perimeter of the envelope. In particular, the envelopes indicate average times of impact to waters over WGW feeding areas and provide a visual image of comparative risk of different locations of spill source (e.g. pipeline alternatives).

Trajectory modelling of potential pipeline leaks has shown that leaks located further to the south impact surface waters over the inshore WGW feeding area more slowly than those located along the Base Case route. This indicates a reduced potential for adverse effects due to a greater time available for response actions, more time for evaporation of volatiles, and a greater dilution and natural dispersion of oil entrained in the water column.

Oil may affect whales through physical impact or through indirect pathways. The possible pathways for harmful effects of oil through physical impact include surface contact, ingestion, inhalation of vapours, and irritation of exposed tissues. Much of the literature relating to oil effects on whales is speculative however, with relatively little empirical data available.

If bottom sediments are impacted by oil, and if that oil is persistent, bottom-feeders such as gray whales could be exposed to hydrocarbons long after a spill has dissipated from the surface. However, data on the impact to cetaceans of prolonged exposure to hydrocarbons in bottom sediments and food sources is lacking. Spills from buried sections of the pipeline may result in contamination of overlying sediments and the extent will depend on the size of the spill, depth of pipeline section

and sediment characteristics. The persistence of sediment-bound oil will depend on the above and also the degree of ice scour (sediment reworking) that occurs over winter. Only the Base Case route could result in direct oil impact on the sediments within the identified WGW feeding area, and amphipods appear to be particularly sensitive to the effects of oil. However, the low probabilities of spillage together with pipeline design and other proposed mitigation and response planning reduce the risk of a spill and hence impact to a very low level.

Onshore

In addition to the offshore pipeline route alternatives, the terrestrial environmental impacts of the corresponding landfalls and onshore pipeline corridors are addressed in the CEA.

Since 1998, SEIC has carried out numerous onshore environmental surveys and literature reviews to optimise the location of the proposed onshore pipeline route. These surveys, encompassing the area of the Base Case route, formed the basis upon which the proposed Base Case route was selected. The Base Case route has been evaluated through the Russian approvals process that required both a design and environmental review, and was further evaluated in the Phase 2 project EIA. Residual impacts following implementation of mitigation measures were considered acceptable.

For the CEA, key onshore environmental receptors were identified and compared between the three routes following site-specific environmental surveys of the two new alternatives during 2004. Key receptors identified included various Red Data Book species, fauna, vegetation, surface water, hydrology and socio-economic factors. Potential impacts to key onshore receptors from pipeline construction and operation were determined and their potential effects on the key receptors were compared between the Base Case and the alternatives.

Cumulative Effects

Cumulative effects refer to the impacts on the environment that result from a combination of past, existing and future human activities. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. A discussion of offshore cumulative impacts is appropriate because cumulative impacts, rather than the isolated impacts associated with specific SEIC operations, are ultimately more likely to have effects on WGWs and their environment.

Human activities off northeast Sakhalin include hydrocarbon exploration and development, commercial vessel traffic, fishing and coastal development. The migratory nature of the WGW and the adverse impacts that these whales may experience in waters distant from the PA Field contributes to the complexity of the issue. With respect to WGW impacts, the activities of SEIC are basically limited in extent to northern Sakhalin Island and its associated offshore regions, with transportation corridors operating toward the south and Aniva Bay. In contrast, the migratory WGW spend a significant portion of the year (November-May) in or travelling to and from their winter range that is thought to be the South China Sea. Within the CEA, the cumulative impact section is focused on the area of oil and gas development activities offshore NE Sakhalin.

There are currently seven defined prospective areas with delineated oil and gas fields along the northeast coast of Sakhalin. However, only one other project in the

vicinity of SEIC's offshore development activities on the northeast Sakhalin coast has a development plan approved by the Russian Federation and offshore construction activities planned during the next few years. Based on information in the public domain, SEIC is aware that a platform and offshore pipeline will be installed offshore Chaivo during 2005 and that production activities are likely to commence during 2006.

Noise will also be generated by the PA-A, PA-B and Chaivo platforms during production operations and the potential noise footprint from this activity was also modelled. For the operations phase, the analysis of noise impact on the WGW was conducted using a more conservative noise threshold of 110 dB due to the continuous nature and long duration of the operations period. The model output shows that the 110 dB noise contours remain well offshore from the Piltun feeding area and well inshore of the offshore feeding area and therefore no cumulative noise impact associated with platform operations is anticipated. In addition to the noise generated by the platforms, vessels will also be supporting offshore operations and this activity was also modelled at both PA-A and PA-B. The model indicated that the 110 dB noise threshold from transiting support vessels does not impact the feeding areas.

While the addition of third-party offshore production operations does increase the overall risk of an oil spill in the region, produced oil offshore in the northeast will be transferred to shore via pipeline rather than shipping via tankers. Production at Lunskoye will be predominantly gas and condensate and oil from the offshore fields to the north is relatively light with consequently a relatively short persistence at sea. Also, shorelines in the region are predominantly sandy with some bedrock and boulders and so persistence of oil on shorelines is also likely to be relatively short. Marsh areas with soils rich in organic material, in which oils can persist, are sheltered within lagoons and are thus protected from spills occurring offshore. Protection of these lagoons is given the highest priority in the existing SEIC oil spill response plans, and bay-protection deployments are regularly exercised. Additional offshore developments on the Sakhalin Shelf can be expected to adopt similar standards to those of Sakhalin II.

Any consideration of the possible cumulative impacts facing WGW on their migration route and wintering/calving grounds is speculative since the actual migration route(s) and location of the wintering/calving grounds are unknown. If, as currently presumed, WGW migrate to the South China Sea, they may follow a migration route that takes them along the east coast of Korea or west coast of Japan before entering the East China Sea and finally the South China Sea. This region is among the most heavily developed in the world, with extensive industrial development along the coasts. Since WGW numbers are so low, any adverse impacts in any areas of their range would likely be significant.

As future Sakhalin oil and gas prospects develop, it will be incumbent on relevant operators and stakeholders to review planned schedules of works and operations with the aim of ensuring that potential cumulative impacts upon the WGW are identified and properly mitigated.

Conclusions

The criteria developed for measuring impacts from anthropogenic noise on the WGW reflect the current state of knowledge of the WGW and are considered to be conservative. The Acoustic Model developed as part of this CEA is a state of the art

tool for understanding the propagation of noise in the marine environment. The criteria and tools have been and will continue to be used to predict and assess noise impact from all SEIC construction and operations activities, individually and collectively.

The noise impact from pipeline construction activities on the WGW is acceptable for all three potential Piltun route options, provided that appropriate mitigation measures are in place during construction. Pipeline construction along Alternative 1 has the least potential noise impact on the WGW and requires no mitigation, and construction along Alternative 2 potentially requires some minor mitigation. Construction along the Base Case route requires specific mitigation, including winter dredging, summer construction over two seasons, and selected pipelay spreads to minimise noise impact to acceptable levels.

Assessment of potential noise impact from PA-B platform installation activities and Phase 2 preparatory work at the PA-A platform is ongoing and will focus on noise mitigation of tugs. Ongoing operations at PA-A since installation in 1998 have had no recognised detrimental noise effects on the resident WGW population. Long-term operation of the offshore platforms will not result in significant noise impact to the WGW.

With regard to food resources, dredging of the Base Case route will result in the temporary loss of a small part of the feeding area. Benthic recovery will proceed by re-colonisation from either side of the narrow pipeline route corridor, along with natural benthic regenerative processes that occur there annually following natural disturbances from WGW feeding, ice scour and wave action. The biomass of food species tends to decline toward the south and appears to be less favoured by feeding WGWs. Construction of Alternatives 1 and 2 will have no significant impact on WGW food resources.

Collision risks are lower for the two alternative routes when compared with the Base Case. However, pipeline construction spreads progress at a low speed and mitigation methods are well established to achieve an acceptably low collision risk. Though the potential for collision risks will increase with the number of vessels operating in an area, the majority of these operations will be in areas with infrequent WGW sightings. Mitigation methods are well established from Phase 1 and have contributed to a zero collision record to date.

The overall risk of an oil spill from the offshore Piltun pipeline system is very low and considered acceptable. The expected volume from any spill is an order of magnitude less than that from existing Phase 1 transport facilities because pipeline operations, based upon worldwide industry statistics, have inherently less risk than that of tanker operations.

The risk to benthos from oil spills is difficult to quantify. The only pipeline route with potential to directly impact the benthos in the WGW feeding area in the event of a pipeline leak is the Base Case. However, the conservative pipeline design makes the likelihood of a leak occurring extremely low. Leak detection and pipeline gauging will ensure that if a leak does occur it will be detected with minimum delay followed by corrective action.

The overall environmental impacts from onshore pipeline construction along the three onshore route options are considered acceptable provided appropriate mitigation

measures are put in place. Mitigation includes minimisation of soil erosion during construction, minimisation of run-off to surface waters, suitable construction period for wetland crossings, horizontal direction drilling of Chaivo Lagoon, winter crossing of key rivers, and exclusion zones around Steller's Sea Eagle nests during the nesting season. The onshore Base Case route requires the least mitigation, followed by Alternative 2, followed by Alternative 1.

SEIC has demonstrated that with suitable mitigation all three pipeline routes are acceptable in terms of environmental impact in general and impact on the WGW in particular. The Base Case is therefore considered to be acceptable, provided appropriate mitigation measures as outlined in the CEA are implemented prior to and during construction activities. The report shows that the more southerly alternative offshore routes evaluated require fewer mitigation measures as potential impacts to the WGW diminish with distance from their feeding area.

The Acoustic Model will be further developed through 2005 in order to refine offshore mitigation methods and better understand the acoustic implications of current and future operations. All future construction activities close to sensitive WGW areas will be studied using the same methodology as applied in this CEA in order to reduce impacts to as low as reasonably practicable, and to ensure that cumulative impacts are considered and managed. A comprehensive WGW monitoring programme will be developed and carried out during all construction activities to ensure that impacts from activities are maintained within the defined acceptable limits.

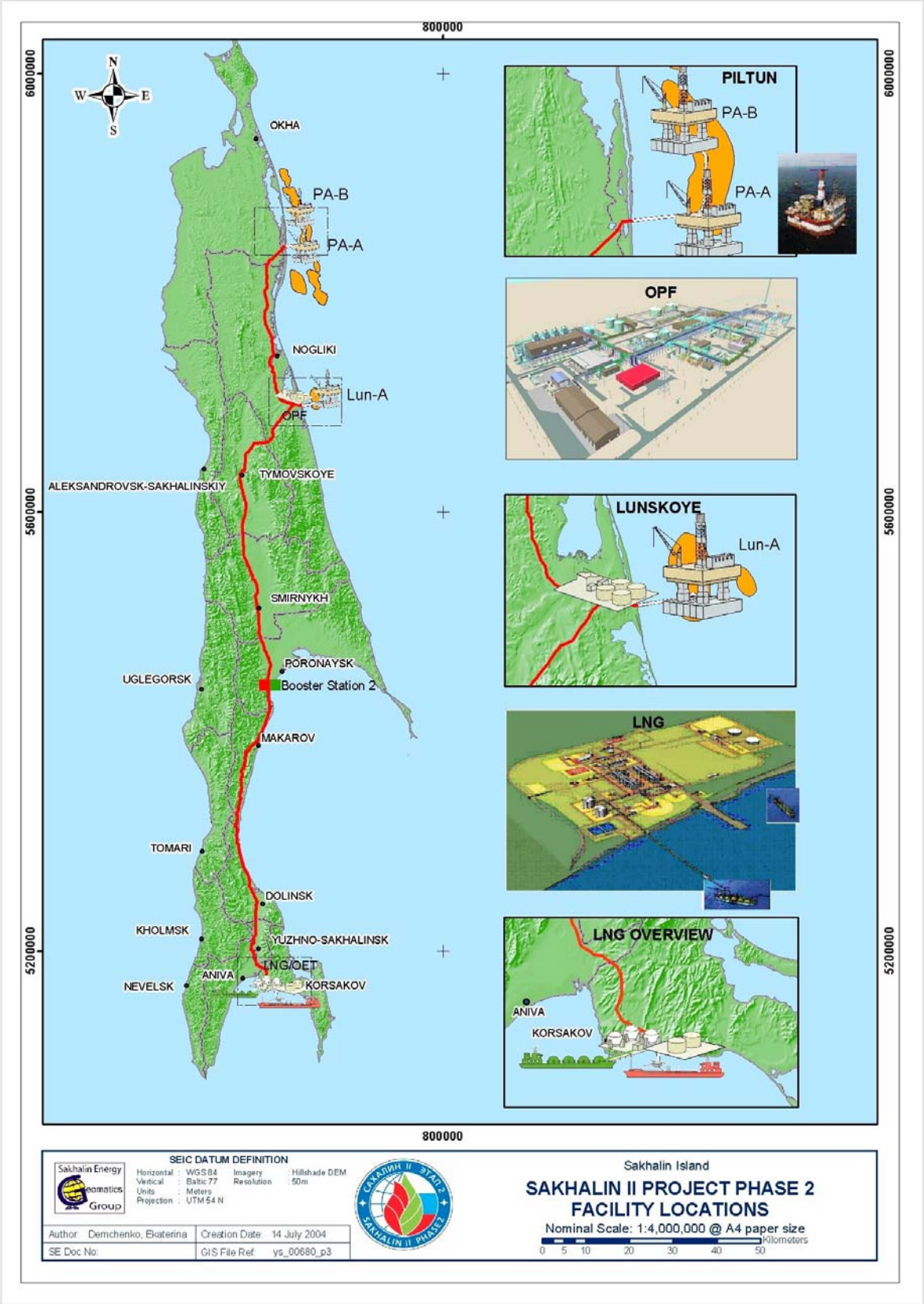
The impact criteria and mitigation methods developed in this CEA will be incorporated into SEIC's 2005 WGWPP. This plan will be binding upon SEIC and its contractors. An overall offshore construction plan will also be developed and maintained such that cumulative impacts from concurrent activities are understood and impacts remain within defined, acceptable limits.

SEIC will continue to work on environmental aspects related to planned activities in an effort to continually improve the Company's environmental performance and minimise impacts to the environment. The Company will also continue to ensure that the valuable knowledge that has been acquired on the WGW is shared with, and made available to other oil and gas operators on the Sakhalin Shelf, the Russian Government, and the wider scientific and public communities in due course.

Figure 1.1 Sakhalin II Project Phase 2 Facility Locations

Figure 1.2 Proposed Offshore Pipeline Routes

Figure 1.3 Noise Contour Map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SMIRNYKH
PORONAYSK
UGLEGORSK
Booster Station 2
MAKAROV
TOMARI
DOLINSK
KHOLMSK
YUZHNO-SAKHALINSK
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NEVELSK
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Lun-A
LNG
LNG OVERVIEW
ANIVA
KORSAKOV
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Sakhalin Energy Investments Group
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Vertical : Baltic 77
Units : Meters
Projection : UTM 54 N
Imagery : Hillshade DEM
Resolution : 50m
САХАЛИН II ЭТАП 2
SAKHALIN II PHASE 2
Author: Demchenko, Ekaterina
Creation Date: 14 July 2004
SE Doc No:
GIS File Ref: ys_00680_p3
Sakhalin Island
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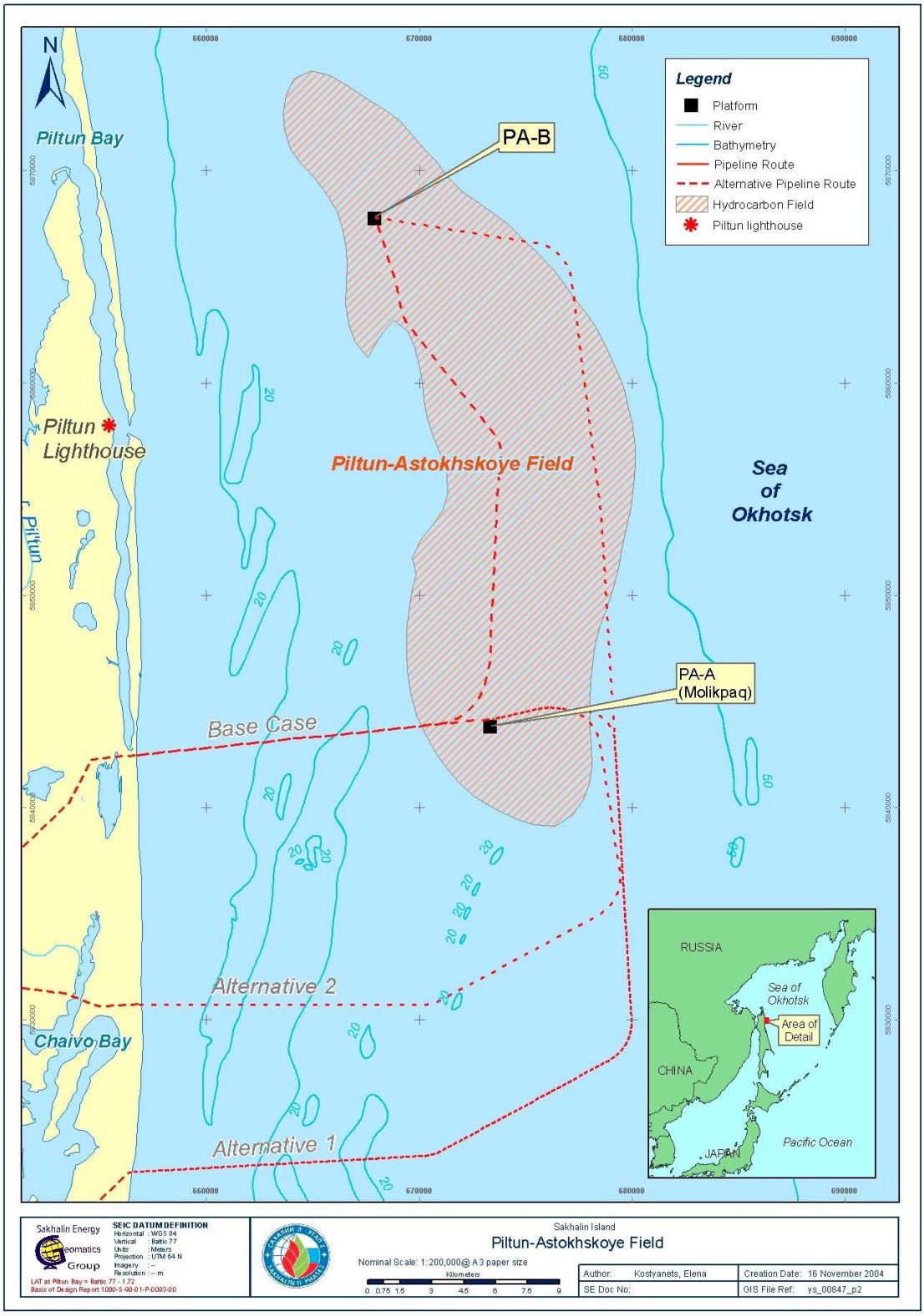
Kilometers


N
Legend
Platform
River
Bathymetry
Pipeline Route
Alternative Pipeline Route
Hydrocarbon Field
Piltun lighthouse
PA-B
PA-A
(Molikpaq)
Piltun Bay
Piltun
Lighthouse
Piltun-Astokhskoye Field
Sea
of
Okhotsk
Piltun
Base Case
Alternative 2
Alternative 1
Chaivo Bay
RUSSIA
Sea of
Okhotsk
Area of
Detail
CHINA
JAPAN
Pacific Ocean
660000
670000
680000
690000
Sakhalin Energy
Geomatics
Group
SEIC DATUM DEFINITION
Horizontal : WGS 84
Vertical : Baltic 77
Units : Meters
Projection : UTM 54 N
Imagery : --
Resolution : -- m
LAT at Piltun Bay = Baltic 77 - 1.72
Basis of Design Report 1000-S-90-01-P-0003-00
Sakhalin Island
Piltun-Astokhskoye Field
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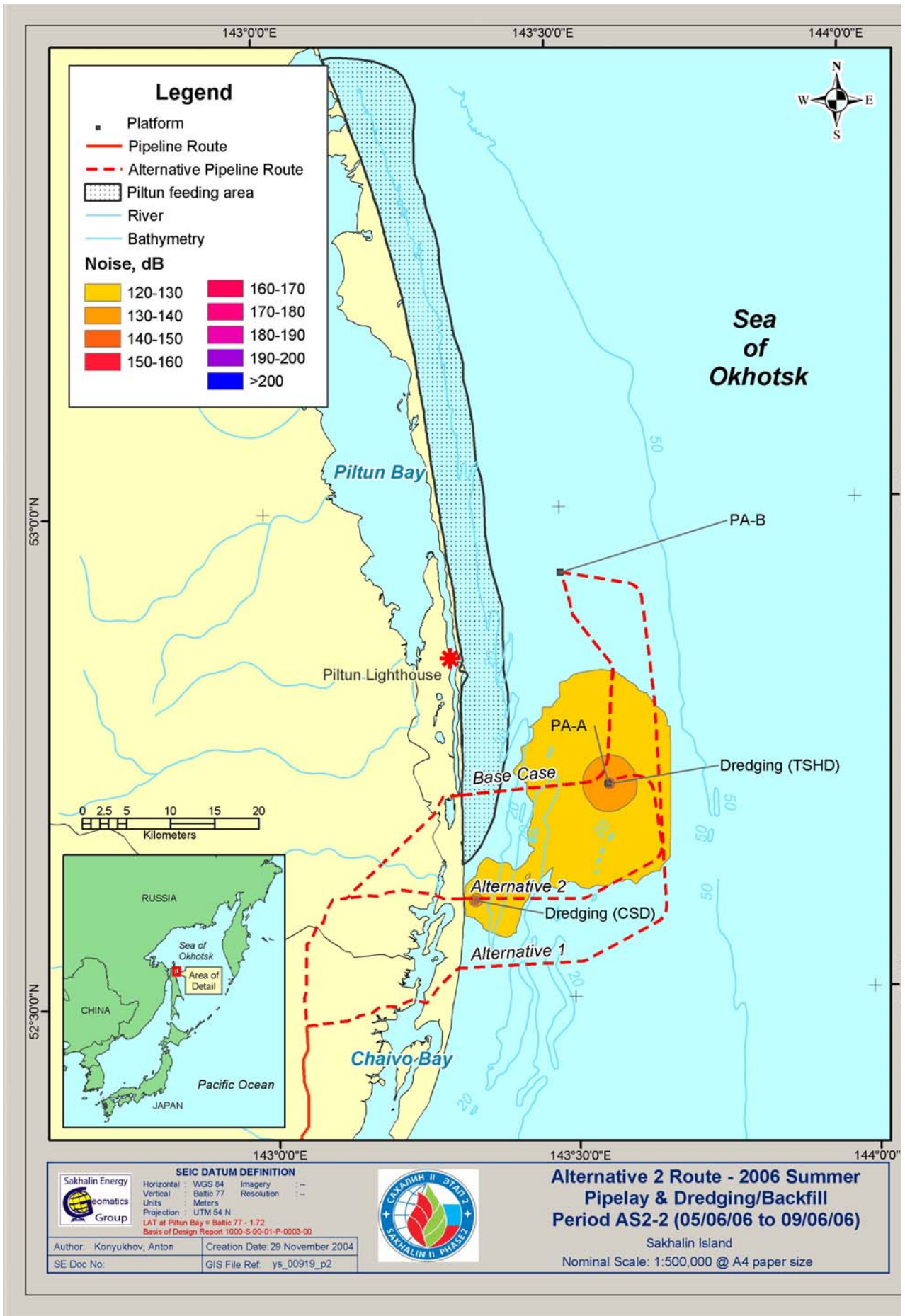
Author: Kostyanets, Elena
Creation Date: 16 November 2004
SE Doc No:
GIS File Ref: ys_00847_p2


Legend
Platform
Pipeline Route
Alternative Pipeline Route
Piltun feeding area
River
Bathymetry
Noise, dB
120-130
130-140
140-150
150-160
160-170
170-180
180-190
190-200
>200
143°0'0"E
143°30'0"E
144°0'0"E
53°0'0"N
52°30'0"N
N
W
E
S
Sea of Okhotsk
Piltun Bay
PA-B
Piltun Lighthouse
PA-A
Base Case
Dredging (TSHD)
Alternative 2
Dredging (CSD)
Alternative 1
Chaivo Bay
0 2.5 5 10 15 20
Kilometers
RUSSIA
Sea of Okhotsk
Area of Detail
CHINA
Pacific Ocean
JAPAN
SEIC DATUM DEFINITION
Horizontal : WGS 84
Vertical : Baltic 77
Units : Meters
Projection : UTM 54 N
Imagery : –
Resolution : –
LAT at Piltun Bay = Baltic 77 - 1.72
Basis of Design Report 1000-S-90-01-P-0003-00
Sakhalin Energy Geomatics Group
САХАЛИН II ЭТАП 2
SAKHALIN II PHASE 2
Author: Konyukhov, Anton
Creation Date: 29 November 2004
SE Doc No:
GIS File Ref: ys_00919_p2
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Sakhalin Island
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