APPROVAL OF THE APPLICATION TO FORM THE PIKKA UNIT

Findings and Decision of the Director
of the Division of Oil and Gas
Under a Delegation of Authority
from the Commissioner of the State Of Alaska
Department of Natural Resources

June 18, 2015

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I. INTRODUCTION AND DECISION SUMMARY

The State of Alaska, Department of Natural Resources, Division of Oil and Gas (Division) received the initial Application for the formation of the Pikka Unit (PKU) (Application), on February 5, 2014 from the proposed PKU Operator, Repsol E&P USA Inc. (Repsol). The proposed PKU covers approximately 63,304 acres. Attachments 1 and 2 set out the acreage proposed for unitization in Exhibits A and B.

The proposed PKU is made of State of Alaska Oil and Gas Leases (State Leases) as well as State of Alaska and Arctic Slope Regional Corporation (ASRC) Oil and Gas Leases (Joint Leases). ASRC and the Division each hold executive rights with respect to interests in oil, gas, and associated substances within these Joint Leases pursuant to the 1991 Settlement Agreement Between Arctic Slope Regional Corporation and the State of Alaska. This decision only affects the interests held by the State of Alaska.

"A unit must encompass the minimum area required to include all or part of one or more oil or gas reservoirs, or all or part of one or more potential hydrocarbon accumulations." 11 AAC 83.356(a). Repsol has submitted confidential geological, geophysical, and engineering data which demonstrate that the area approved for unitization includes all or part of an oil and gas reservoir and one or more potential hydrocarbon accumulations.

The Division finds that the approval of the PKU promotes conservation of all natural resources, promotes the prevention of economic and physical waste and provides for the protection of all parties of interest, including the State. AS 38.05.180(p); 11 AAC 83.303. I approve the Application. The retroactive effective date of the PKU formation is June 1, 2015.

II. APPLICATION AND LEASE SUMMARY

Repsol submitted the Application on February 5, 2014, and simultaneously paid the $5,000.00 unit application filing fee, in accordance with 11 AAC 83.306 and 11 AAC 05.010(a)(10)(D), respectively. The Application included: the unit operating agreement, a multiple royalty ownership unit agreement form that included Arctic Slope Regional Corporation (ASRC) and the State as royalty owners but did not address joint lands, Exhibit A (Attachment 1), legally describing the proposed unit area, its leases, and ownership interests; Exhibit B (Attachment 2), a map of the proposed unit; and Exhibit G, Plan of Exploration, for the PKU. Repsol also submitted evidence of notice to proper parties. The Application also included confidential economic and technical data.

The Division notified Repsol by letter dated March 10, 2014 that the Application was incomplete. The initial Application did not include a joint lands unit agreement executed by the proper parties, as required under 11 AAC 83.306. From February 11, 2015 to March 3, 2015, DNR, Repsol, and ASRC conducted a series of meetings to develop an acceptable joint lands unit agreement and the Division deemed the Application complete on March 23, 2015. Further review by DNR and ASRC resulted in the approved joint lands unit agreement included as Attachment 5.

The Division published a public notice in the "*Alaska Dispatch News*" and in the "*Arctic Sounder*" on March 26, 2015, under 11 AAC 83.311. Copies of the Application and the public notice were provided to interested parties. DNR provided public notice to the North Slope Borough, the City of Barrow, the City of Nuiqsut, the Kuukpik Corporation, the Arctic Slope Regional Corporation (ASRC), the Nuiqsut Postmaster, the Barrow Postmaster, the radio station KBRW in Barrow, as well as the Alaska Department of Environmental Conservation, the Alaska Department of Fish and Game, the Alaska Oil and Gas Conservation Commissioners, and the ADF&G Division of Habitat. The public notices invited interested parties and members of the public to submit comments by April 27, 2015. No comments were received.

Leases within the proposed unit are described in Attachments 1 and 2. When a lease is partially committed to a unit agreement, that commitment constitutes a severance of the lease as to the unitized and nonunitized portions of the lease under 11 AAC 83.373. Attachments 3 and 4 describe the new and segregated leases. ADL 392995 was created from ADL 391303 and is outside the PKA boundary. ADL 392995 would normally expire July 31, 2015 but will be extended two years to July 31, 2017 as allowed under 11 AAC 83.373(b). The other leases created under 11 AAC 83.373, ADL 392994, ADL 392997, ADL 392993 and ADL 392996 will retain the parent lease terms and expire August 31, 2018.

Joint Leases composed of three or four sections of land were included in the application. In twelve of these leases each section within the Joint Lease has a unique division of ownership between the State of Alaska and ASRC. In accordance with the terms of the 1991 Settlement Agreement Between Arctic Slope Regional Corporation and the State of Alaska, these Joint Leases will be segregated into separate leases with the same terms and conditions as the original lease. All Joint Land acreage proposed for unitization will be included in the PKA. Attachments 3 and 4 describe the new and segregated leases.

III. DISCUSSION OF DECISION CRITERIA

A unit may be formed to conserve the natural resources of all or a part of an oil or gas pool, field, or like area when determined and certified to be necessary or advisable in the public interest (AS 38.05.180(p)). Conservation of the natural resources of all or part of an oil or gas pool, field, or like area means "maximizing the efficient recovery of oil and gas and minimizing the adverse impacts on the surface and other resources." 11 AAC 83.395(1).

The DNR Commissioner (Commissioner) reviews applications related to units under 11 AAC 83.303 - 11 AAC 83.395. By memorandum dated September 30, 1999, the Commissioner approved a revision of Department Order 003 and delegated this authority to the Division Director.

The Commissioner will approve a proposed unit upon a finding that it will (1) promote conservation of all natural resources, including all or part of an oil or gas pool, field, or like area; (2) promote the prevention of economic and physical waste; and (3) provide for the protection of all parties of interest including the state. 11 AAC 83.303(a).

In evaluating these three criteria, the Commissioner will consider (1) the environmental costs and benefits of unitized exploration or development; (2) the geological and engineering characteristics of the potential hydrocarbon accumulation or reservoir proposed for unitization; (3) prior exploration activities in the proposed unit area; (4) the applicant's plans for exploration or development of the unit area; (5) the economic costs and benefits to the state; and (6) any other relevant factors, including measures to mitigate impacts identified above, the commissioner determines necessary or advisable to protect the public interest. 11 AAC 83.303(b).

A discussion of the subsection (b) criteria, as they apply to the Application, is set out directly below, followed by a discussion of the subsection (a) criteria.

A. Decision Criteria considered under 11 AAC 83.303(b)

1. Environmental Costs and Benefits

The proposed area is habitat for various mammals, waterfowl, and fish. Area residents may use this area for subsistence hunting and fishing. Oil and gas activity in the proposed unit area may affect some wildlife habitat and some subsistence activity. DNR develops lease stipulations through the lease sale process to mitigate the potential environmental impacts from oil and gas activity.

DNR also considers environmental issues during the lease sale process and the unit plan of operations approval process. Alaska statutes require DNR to give public notice and issue a written finding before disposal of the state's oil and gas resources. AS 38.05.035(e); AS 38.05.945; 11 AAC 82.415. In the written best interest finding, the Commissioner may impose additional conditions or limitations beyond those imposed by law. AS 38.05.035(e).

Approval of the formation of the PKU has no direct environmental impact. This decision is an administrative action and does not authorize any on-the-ground activity. The unit formation does not entail any environmental costs in addition to those that may occur when plans of operations to conduct lease-by-lease exploration or development are issued. The Unit Operator must obtain approval of a plan of operations from the State and permits from various agencies on State leases before drilling a well or wells or initiating development activities to produce reservoirs within the unit area. 11 AAC 83.346. Potential effects on the environment are analyzed when permits to conduct exploration or development in the unit area are reviewed. Repsol is operating under an approved plan of operations and plan of exploration

2. Prior Exploration Activities in the Pikka Unit Area

The proposed PKU encompasses approximately 63,304 acres of State Leases and Joint Leases in the central North Slope area in the vicinity of the Colville River delta. The proposed unit lies partially adjacent to the Colville River Unit (CRU) to the west and the Oooguruk and Placer Units to the east.

The PKU area has been part of numerous exploration efforts since the 1960s, but remained lightly explored until the 1990s due to sub-economic well results and remoteness from existing pipelines and other infrastructure. Prior to 2012 only five exploration wells had been drilled within the proposed PKU Unit: Colville Delta State 1 (1970), Colville Delta 25 1 (1986), Kuukpik 3, Till 1, and Colville River 1 (the latter three in 1993). Since 2012 Repsol has drilled six wells, two pilot holes, and two sidetracks in the proposed unit area. Of these wells only the Qugruk 2 well information is currently public; the Qugruk 1, 1PH, 3, 3A, 5, 5A, 6, and 7 information is still confidential as per 20 AAC 25.537(d). Repsol permitted three wells planned for the 2015 drilling season: Qugruk 301 (anticipated Total Depth [TD] of 4,146' Measured Depth [MD]); Qugruk 8 (anticipated TD 5,100' MD); and Qugruk 9 (projected TD 7,300' MD). Repsol has integrated all surrounding well data and their recently drilled Qugruk wells with 3-D seismic to identify multiple potential development and exploration targets and has provided sufficient data and analyses over the area from multiple stratigraphic intervals to justify the configuration and size of the proposed PKU.

Seismic coverage in the proposed PKU area consists of both 2-D and 3-D surveys. Proprietary 3-D seismic datasets cover a large portion of the proposed unit. The primary 3-D seismic surveys licensed and interpreted by Repsol in the proposed unit area are the Fiord 3-D (2000), North Tabasco 3-D (2012), and Big Island 3-D (2008). Repsol used these seismic surveys to map depth structure, fault patterns, truncation edges, and amplitude anomalies associated with potential reservoir sandstones.

Nearby units contain multiple Participating Areas (PAs), consistent with the likelihood that multiple reservoirs can be developed in the proposed PKU. Created in 1998, the CRU is anchored by the Alpine PA formed in 2000 and encompasses five satellite PAs: the Fiord-Kuparuk and Fiord-Nechelik PAs created in 2006, the Nanuq-Kuparuk and Nanuq-Nanuq PAs formed in 2006, and the Qannik PA formed in 2008. The Oooguruk Unit, created in 2003, includes the Nuiqsut and Kuparuk PAs formed in 2008 and the Torok PA created in 2010, and the operator sanctioned an expanded Torok development project (Nuna) in 2015. The Kuparuk River Unit (KRU), created in 1982, includes the major producing Kuparuk PA formed in 1982 plus four satellite PAs: the West Sak PA formed in 1997, the Tabasco and Tarn PAs issued in 1998, and the Meltwater PA created in 2001. In 2012 Repsol formed the Qugruk Unit, located west of the proposed PKU and north of CRU, primarily to develop potential reservoirs in the Nanushuk Formation Brookian topset play. One unit well has been drilled (Qugruk 4), but no production has been achieved. Three other units were formed nearby in 2011 – Placer, Southern Miluveach (SMU), and Tofkat – primarily targeting oil production from the Kuparuk C sandstone. Neither the Placer Unit nor Tofkat has seen additional drilling, but development drilling in the Kuparuk Mustang reservoir at SMU began in 2015 with the goal of first production in 2016.

Exploration in and near the PKU area began with a focus on large structures with Ellesmerian sequence targets in the late 1960s to the mid-1970s. There was a shift toward exploring combination structural/stratigraphic prospects in the Beaufortian sequence in the mid-1970s through the mid-1990s. From the mid-1990s to the present, there has been increased emphasis on drilling stratigraphic and combination traps with multiple reservoir targets in the Beaufortian

and Brookian sequences. Beyond the information presented in this decision, details of many individual well summaries, cores, and test results are described in previous unit decisions in the vicinity surrounding the PKU, including the CRU, Qugruk, Oooguruk, SMU, Tofkat, and Placer unit decisions and the Tabasco, Tarn, Meltwater, Qannik, Fiord Kuparuk, Fiord Nechelik, Nanuq Kuparuk, and Nanuq Nanuq PA decisions.

Exploration for Ellesmerian structural traps

The first exploration prospects drilled in the area were based on identifying large structural features on 2-D seismic. Prior to the Prudhoe Bay discovery at **Prudhoe Bay State 1** in December 1967, two dry holes had been drilled on the Colville High, a very large structural high on the Barrow Arch west of Prudhoe Bay, near the PKU area. At the time, the Colville High was considered a more promising trap exploration play than the Prudhoe Bay structure and the Lisburne Group carbonates were considered the most prospective candidate as a reservoir unit. The Sinclair **Colville 1** and Unocal **Kookpuk 1** wells were drilled in successive years (1965 and 1966) during this era with disappointing results. Both wells were drilled beyond the northwest truncation of the Kuparuk Formation and were unproductive in the targeted deeper sediments (Ivishak Formation and Lisburne Group). Both wells were plugged and abandoned as dry holes. The Sinclair Colville 1 well, completed in early 1966 bottomed in basement at a TD of 9,930' MD. Eleven cores were taken in the well: one from probable Ugnu sands within the permafrost; one in the Torok Formation; one from siltstone just below the Lower Cretaceous Unconformity (LCU); one in the Shublik Formation; and one from the Echooka Formation. Three cores were cut in the Lisburne and Endicott Groups and two were obtained in the basement. Three drill stem tests (DSTs) were taken in the Lisburne, the Echooka, and the Shublik. None of the tests flowed oil to the surface, but the Shublik test recovered some mud-cut oil and the Echooka test some gas-cut mud; the Lisburne test recovered some gas-cut salt water.

The Unocal Kookpuk 1 well, completed in 1967 (TD 10,193'MD) bottomed in Pre-Mississippian argillite basement after drilling the complete Ellesmerian stratigraphic section. Two conventional cores were recovered. Core one recovered two feet of siltstone from the top of the Shublik Formation. Core tow recovered 16 feet of argillite from the basement complex. Occasional trace oil shows were present in the Torok Formation between approximately 4,750' and 5,500' MD. Cuttings samples from this interval were described as predominantly inter-bedded siltstone and shale with very rare occurrences of very fine-grained sandstone. The well logs were consistent with the dominantly fine grained cuttings, with gamma ray response in the range from 90-105 API units and the deep resistivity curve consistently around 4-5 ohm-meters. No flow tests were attempted.

The 1967-1968 discovery of North America's largest oil field at Prudhoe Bay came as a surprise in that the primary objective in the Lisburne Group carbonates paled in comparison to the spectacular reservoir quality discovered in the Ivishak Formation. Exploration strategy shifted immediately to drilling more Ivishak targets in structural traps, with secondary deeper Ellesmerian objectives.

Gulf Oil Corporation drilled the **Colville Delta State 1** well (TD 9,299' MD) in 1970 in the northern part of the proposed PKU as an Ellesmerian structural play. The well reached total

depth in the Mississippian Endicott Group. Mudlog oil shows were noted in the Tuluvak Formation, the Nanushuk Formation, the Sag River Sandstone, the Ivishak Formation, and the Lisburne Group. An Ivishak flow test recovered 114 barrels per day of muddy formation water with a trace of oil. The test in a silty sandstone interval near the top of the Nanushuk Group did not flow oil to the surface. Water and less than one barrel of 20.8° API gravity oil were recovered by reverse circulation. None of the untested show intervals appear productive based on wireline logs. In the Kingak Formation, the Nuiqsut sandstone was not present due to erosion by the LCU, and the older Nechelik interval appeared to be non-reservoir shale. Wireline logs through the deeper portions of the Kingak Formation are consistent with non-reservoir siltstone deposited in a distal basin setting.

Exploration for Beaufortian structural/stratigraphic traps

The Kuparuk River field, the second largest field in North America, was discovered in 1969 while drilling to a deeper Ivishak/Lisburne structural objective on the Colville High. After drilling additional Kuparuk delineation wells, geologists developed the understanding that the field is trapped by a combination of structural and stratigraphic components, including anticlinal plunge on the Barrow Arch, sandstone depositional limits, and truncation of Lower Kuparuk Formation sandstones at the LCU. Even after the discovery of the Kuparuk River field, the second phase of exploration drilling still focused primarily on deeper structural closures but also had secondary shallower objectives in combination structural/stratigraphic traps in the Kuparuk Formation.

As more wells were drilled in the area, geologists recognized that the Kuparuk C sandstone unevenly distributed in the subsurface, preserved above the LCU in two types of settings: 1) in depositional lows and 2) in down-thrown fault blocks. As a result, exploration prospects from the mid-1970s through the mid-1980s in the PKU area were generally based on testing a structural high or horst block for an Ivishak Formation target in conjunction with a well trajectory that would drill through the projected Kuparuk Formation in a depositional low or down-thrown fault block. As more exploration wells were drilled, the primary exploration objectives changed from structural Ellesmerian plays to Kuparuk structural/stratigraphic plays.
Until the mid-1980s the presence of potential Upper Jurassic reservoir sandstones within the Kingak Formation was not known even though earlier wells drilled through Jurassic sandstone packages en route to deeper Ellesmerian objectives. Jurassic sandstones penetrated in early wells that encountered were commonly interpreted as Kuparuk sandstones. For example, the **Nechelik 1** well, drilled west of the proposed PKU by Sohio in 1982, encountered potential reservoir quality sandstones in the Jurassic Nuiqsut sandstone that were originally misidentified as Cretaceous-age Kuparuk. Sohio did cut cores in the Torok Formation, Kuparuk Formation, Eileen interval, Ivishak Formation, Kavik Formation, Echooka Formation, and Lisburne Group, but carried out no drill stem tests.

In 1985 Texaco drilled the **Colville Delta 1** well (1-½ mile east of the northern portion of the proposed PKU) to a depth of 9,457’ MD to evaluate Ellesmerian sequence targets in the Endicott Group, Lisburne Group, and Ivishak Formation, as well as the Beaufortian sequence Kuparuk Formation. Through apparent serendipity, Texaco encountered oil-bearing Jurassic sandstone in the Kingak Formation later identified as the Nuiqsut interval. Three zones were tested in the

Nuiqsut. The lower interval tested at an unstimulated rate of 31 Barrels of Oil Per Day (BOPD) of 22.7° API gravity oil; after acid stimulation and on nitrogen lift, it produced at a calculated rate of 25-100 BOPD. The middle zone produced at a calculated rate of 30 BOPD of 17.7° API gravity oil on nitrogen lift. The upper Nuiqsut had the best sand development, testing at rates of 373 to 1075 BOPD of 25° API gravity oil with a Gas-to-Oil Ratio (GOR) of 400-500 Standard Cubic Feet per Stock Tank Barrel (SCF/STB) after fracture treatment. As a result of this discovery and encouraging well results Texaco drilled the **Colville Delta 1A** sidetrack to core and further evaluate the Nuiqsut sandstone. Core porosities ranged 8-17% with an average of 11.3%; permeability varied greatly, ranging from less than 0.1 to 122 Millidarcies (mD), with an average of approximately 1.5 mD.

Texaco followed up the Nuiqsut discovery by drilling two delineation wells in 1986: the **Colville Delta 2** and **Colville Delta 3** wells. In the Colville Delta 2 well, the Nuiqsut interval (6,235-6,411' MD) was perforated over its entire thickness and after two fracture treatments flowed 24-40° API gravity oil at rates between 200 and 800 BOPD. A Torok turbidite sandstone (referred to informally as either the Moraine or Nuna interval) was also tested and flowed 44 barrels of water with a trace of oil. The Colville Delta 3 was drilled to the base of the Nuiqsut interval for a total depth of 6,800' MD. The Nuiqsut sandstone (at the top of the interval from 6,330-6,464' MD) was tested and produced 27.7° API gravity oil at a calculated rate of 290 BOPD after fracture treatment. The Moraine Torok sandstone was also tested in Colville Delta 3, initially recovering a mixture of diesel and 16-20° API gravity oil after being perforated with diesel, later producing 234 barrels per day of 24.6-29.2° API gravity oil/diesel mixture after diesel-based gel fracture stimulation.

Early in 1986, at the same time that Texaco was delineating their Nuiqsut discovery with subsequent Colville Delta wells, Amerada Hess drilled the **Colville Delta 25 1** well (near the eastern boundary within the northern part of the proposed PKU and approximately three miles southwest of the Texaco Colville Delta wells) to a total depth of 6,871' MD, about 100 feet below the base of the Nuiqsut interval. Seven cores were taken in the well: two in the Miluveach Formation (all shale with no oil shows); one in the Kingak Shale (mudstone, siltstone, and sandstone with oil shows); and four in the Nuiqsut interval (sandstone, siltstone, and shale with oil shows). The well tested oil from two zones in the Nuiqsut sandstone (6,328-6,402' MD and 6,436-6,480' MD) that flowed at an average rate of 159 barrels of 25° API gravity oil with a GOR of 200 to 835 SCF/STB after fracture stimulation. The well also encountered 21 feet of true vertical thickness of hydrocarbon-bearing Kuparuk C sandstone (6,111-6,134' MD), but the zone was not tested. The upper 15 feet of the interval appears from density log data to contain abundant pore-occluding siderite cement.

The Colville Delta wells described above were drilled as vertical or moderately deviated wellbores before horizontal drilling and sophisticated hydraulic fracturing stimulation techniques became commonplace. The drilling muds used most likely damaged the formations and inhibited the productivity of the reservoir tests. Texaco's major challenge at the time was how to avoid damaging the reservoirs with drilling fluids to allow production of the relatively low API gravity oil. Thus, despite the encouraging drilling results in the Nuiqsut sandstones, given the viscosity of the oil, the challenges of developing an oil field in the Colville Delta, and the limits on drilling technology and completion techniques at the time, Texaco considered the project uneconomic

and did not pursue further delineation and development. The resource identified in the Colville Delta 1, 1A, and 2 wells remained undeveloped without further exploration drilling until 2003, when Pioneer and Armstrong drilled three exploration wells to the northeast of the proposed PKU in what later became the Oooguruk Unit. The primary target for the three Oooguruk exploration wells was the Kuparuk C sandstone. Turbidite sandstones of the Torok and Seabee Formations and the Nuiqsut/Nechelik sandstones of the Kingak Formation were secondary exploration objectives. Currently, three reservoirs are under development and production within the Oooguruk Unit: the Nuiqsut sandstone of the Kingak Formation; the Kuparuk C sandstone, and the Moraine/Nuna sandstone in the Torok Formation (first encountered and tested by Texaco in the Colville Delta wells).

Encouraged by the discovery of hydrocarbons in the Nuiqsut sandstone in the Colville Delta area, ARCO Alaska drilled several wells in the proposed PKU area during the early 1990s. ARCO drilled the **Till 1**, **Colville River 1**, and **Kuukpik 3** wells within the boundary of the proposed PKU and the **Fiord 1** and **Fiord 2** wells to the west. The primary objectives of these wells were the Kuparuk C and Nuiqsut sandstones. ARCO's geologic understanding of the area as stated in their permit to drill applications was that the Nuiqsut lay directly underneath the Kuparuk.

ARCO completed the Fiord 1 well in April 1992 (10,250' TD), which bottomed in the Lisburne Group to evaluate Ellesmerian sequence structural targets as well as younger stratigraphic prospects. Potential reservoirs in the Lisburne Group and Ivishak Formation were determined to be wet. ARCO cored and tested the Nechelik sandstone. Based on a four hour test, a 37 foot interval of Nechelik produced at a rate of 180 BOPD of 28° API gravity oil. A 29 foot interval of Kuparuk was tested for 41.3 hours with an average oil rate of 1065 BOPD of 33° API gravity oil with a GOR of 500 SCF/STB. The Fiord 1 well is the discovery well for Nechelik and Kuparuk production in the Fiord pool, the basis of the Fiord Nechelik and Fiord Kuparuk participating areas at CRU.

In 1993 ARCO drilled three wells and a sidetrack within the proposed PKU: Till 1, Colville River 1 and 1PB1, and Kuukpik 3. ARCO drilled the Till 1 well in early 1993 through the base of the Nuiqsut interval (TD 6,975' MD) approximately one and three quarter miles east-northeast of the location of the **Qugruk** 7 well later drilled by Repsol in 2014. The Nanushuk/Torok interval appears predominantly silty from well logs. Six sidewall cores were taken in the Torok (5,658-5,732' MD). This interval consists of interbedded sandstone, siltstone, and mudstones with the gamma ray response varying between 55-85 API units and the deep resistivity log varying from 3.8-5 ohm-meters. A thin 12 foot thick Kuparuk C sandstone is present from 6,303-6,315' MD. Two sidewall cores from this interval measured 10% and 11% porosity and 0.25-0.31 mD permeability. The Nuiqsut interval was encountered from 6,592-6,830' MD. The Nuiqsut interval in this well is fairly well developed, consisting of inter-bedded siltstone, very fine-grained sandstone, and claystone based on mudlog descriptions. Good hydrocarbon shows were reported in the mudlogs, but porosity and permeability is estimated to be poor. Five sidewall cores were taken in the Nuiqsut interval (6,605 – 6,823' MD); three of those were in the upper sandstone (6,600 – 6,687' MD), where gamma ray readings in the 55-90 API range suggest decreased matrix content. The deep resistivity log in this upper sandstone is fairly consistent between around 4-5.5 ohm-meters. The porosity measurement for all three sidewall

cores was 11% and the permeability ranged from 2.56-76.8 mD. The two sidewall cores taken in the lower Nuiqsut interval measured 8% porosity and two permeability measurements of 1.36 mD and 1.96 mD. No tests were attempted in the well.

The Colville River 1 and 1PB1 holes were drilled by ARCO in 1993, reaching 7,303' MD below the base of the Nuiqsut interval in the original hole (1PB1) before plugging back and sidetracking to a TD of 6,700' MD in the Miluveach Formation. Located approximately one and three quarter miles east of the **Qugruk 8** drill site in the southeastern part of the proposed PKU, the original objective for the well was the Kuparuk Formation, which proved unsuccessful, present as only a thin five foot interval. Weak oil shows were present in thinly interbedded and mostly cemented very fine- to fine-grained sandstone, siltstone, and shale in the basal portion of the Torok Formation (5,700' and 6,050' MD). A few sidewall cores taken in this Torok interval measured porosity of 9-18% and permeability ranging 1-7 mD. No production tests were attempted. The Alpine C interval is silty and log data indicate poor reservoir quality in the Nuiqsut interval; both represent distal basin deposition at this location. No cores or production tests were attempted in this portion of the well.

The Kuukpik 3 well was drilled in 1993 by ARCO to a TD of 6,880' MD, fully penetrating the Nuiqsut interval before bottoming in distal Nechelik siltstone. It is located in the northern part of the proposed PKU and one mile northeast of Repsol's confidential Qugruk 1 and 1A wells drilled in 2013. Conventional cores were acquired in the Kuparuk C interval (6,239-6,255' MD) and Nuiqsut sandstone (6,310-6,370' MD). Core porosity in the Kuparuk C sandstone averaged 17% and permeability averaged 7.5 mD and 6.0 mD (horizontal and vertical permeability, respectively). The gamma ray log varied from 65-75 API units. Core porosity in the Nuiqsut interval averaged 12% and permeability averaged 0.6 mD.

DSTs were attempted over four prospective intervals, the Nuiqsut sandstone, the Kuparuk C sandstone, the lower Torok Formation, and the Tuluvak Formation. All four tests were produced with nitrogen lift. DST 1 flow tested the Nuiqsut interval (6,340-6,405' MD) at a rate of 24 BOPD after fracture treatment. DST 2 tested the Kuparuk C sandstone (6,234-6,249' MD) at a calculated flow rate of 20 BOPD of 23° API gravity oil. DST 3 tested a 55' interval of the lower Torok Formation (5,663-5,718' MD), flowing 90 barrels of water per day (BWPD). DST 4 tested a 26' thick sandstone in the Tuluvak Formation (2,682-2,710' MD); it flowed intermittently and produced an unspecified volume of 21°API oil, water, and mud mixture.

ARCO drilled the Fiord 2 and **Bergschrund 1** wells in 1994. Well history files indicate dual objectives for both, targeting Torok turbidites as well as and Kuparuk C sandstones., Drilled before Bergschrund 1, Fiord 2 had strong mudlog shows in the Tuluvak Formation at 2,900' MD, but the well's more important result came from the top of the Kingak Formation, where Union Texas Petroleum, a working interest owner in both wells, recognized potential in a thin 10 foot sandstone at the top of the Kingak Formation. They hypothesized that it could thicken to the west in the Bergschrund 1 area. Indeed, the Bergschrund 1 discovered an oil charged Jurassic sandstone reservoir younger than the Nuiqsut that had not been previously recognized in the area, soon thereafter named the Alpine sandstone. The Alpine tested light oil (39° API gravity) at a rate of 2,380 BOPD. The thin correlative sandstone in the Fiord 2 well was, in fact, the edge of a large, prolific reservoir. Further drilling in the area around the Bergschrund well confirmed the

presence and excellent reservoir quality of the Alpine C sandstone now encompassed by the CRU Alpine PA.

ARCO drilled the **Fiord 3** (TD 7,030' MD) and **Fiord 3A** (TD 9,147' MD) wells in 1995 as Alpine and Nuiqsut delineation wells. Both wells reached a total depth in the upper part of the Nuiqsut sandstone. The Alpine sandstone was present but not tested in both wells; based on log calculations, the Fiord 3 well had 20 feet and the Fiord 3A well 51 feet of net pay. Ten sidewall cores were obtained in the top 20 feet of the Alpine sandstone in the Fiord 3 well. Porosity ranged 12-22% and averaged 18% and permeability ranged from less than one to 8.5 mD. Three sidewall cores were taken in a well-developed 30 foot thick Torok sandstone at 6,195' MD with porosity measurements ranging from 13.6-17.6%, averaging 15.2% and two permeability measurements of 0.56 mD and 3.99 mD. The Torok sandstone was not developed in the Fiord 3A well. Nanushuk and Tuluvak Formation topset sandstones with mudlog shows are present in both wells.

In 1999 ARCO drilled the **Fiord 4** (TD 7,171' MD), **Fiord 5** (TD 7,490' MD), and **Fiord 5PH** (TD 7,412' MD) wells to delineate the Nechelik and Kuparuk discoveries in the CRU. In the Fiord 4 well, the Nanushuk/Torok interval displayed good mudlog shows, especially around 5,900' MD. The Kuparuk C sandstone was present as a siderite cemented hard streak atop LCU at 6,689' MD, resting directly on top of the Nechelik sandstone interval. Although the Nechelik was not tested, 30 feet of sandstone at the top of the interval had consistent gamma ray log readings around 50 API units and the deep resistivity readings around 9-10 ohm-meters. The Fiord 5 and 5PH wells encountered 15 feet of Kuparuk C sandstone, underlain by approximately 100 feet of distal Nuiqsut siltstone resting on underlying Nechelik sandstone. Sixty-Six feet of core was taken in the Fiord 5 well, five feet of base Nuiqsut and 61 feet of the underlying Nechelik sandstone. The upper 30 feet of the Nechelik interval contained well developed sandstone with porosity ranging 11-19%, averaging 14%, and permeability ranging from 1mD to 75 mD and averaging 11 mD. Two DSTs were conducted in the Fiord 5 well. A Nechelik-only test flowed at a calculated rate of 1,400 BOPD of 29° API gravity oil. A combined Kuparuk and Nechelik test flowed at a calculated rate of 2,400 BOPD of 30° API gravity oil.

In 2004 ConocoPhillips drilled the **Placer 1** and **Placer 2** deviated wells with bottom-hole locations two to three miles east of the proposed PKU. The primary objective for both wells was the Kuparuk C sandstone, and to obtain whole core in the Kuparuk interval. The Placer 1 well was drilled to a depth of 7,761' MD and bottomed in the Miluveach Formation. The well penetrated a 17 feet true vertical thickness of Kuparuk C sandstone. Well logs indicate that much of the sandstone is siderite-cemented. Core porosity averaged 17.2% and ranged from 6.3% in the siderite cemented zones up to 35.6% in the non-siderite cemented zones. Permeability measurements range from less than one mD in siderite cemented zones up to 3,546 mD in the non-cemented zones. The Placer 2 well was drilled to a depth of 9,118' MD and bottomed in distal Nuiqsut siltstones and mudstones. The Kuparuk interval in the Placer 2 well lacks reservoir sandstone, and is represented as a siderite cemented hard streak atop LCU at 8,220' MD. A well-developed Nuiqsut sandstone was present at the top of the Nuiqsut interval (8,840 – 8,900' MD) that had good mudlog shows. Gamma ray values range between 65 and 75 API units and the deep resistivity ranges between four and five ohm-meters. The Nanushuk/Torok interval appears silty and shaly in both wells, but did yield mud log oil shows.

No tests were conducted in either well. The Placer unit was formed in 2011, primarily to evaluate and develop the potential Kuparuk reservoir, but to date no further well testing or drilling has occurred.

In 2003 ConocoPhillips drilled the **Oberon 1** well to a total depth of 7,580' MD. Located approximately three miles southeast of the southern end of the proposed PKU, the primary target was Kuparuk C sandstone preserved above the LCU. A secondary target was the Alpine sandstone. The well bottomed in distal Nuiqsut/Nechelik siltstones and shales below a thin (15 foot) poorly developed Alpine interval. The Kuparuk C interval appears as a thin cemented transgressive lag at 6,807' MD on top of the LCU (at 6,810' MD) that corroborates the mud log description: a thin, firm to hard sandy siltstone grading to lower fine-grained sandstone with common glauconite and siderite cement. Porosity was estimated to be poor due to the presence of clay matrix and siderite cement. Well logs identify the Alpine interval as a 15 foot thick, very fine grained sandstone and siltstone with poor reservoir quality. Deep resistivity measurements are consistently in the three to five ohm-meter range and the gamma ray measurements range 75-90 API units. Estimated porosity from density/neutron logs ranges approximately 12-18%. Occasional weak oil shows were also present in the Torok Formation, but the intervals appear to be of non-reservoir quality based on well logs and mud log descriptions. No core or production tests were gathered or attempted in this well.

As noted above, further exploration and development drilling in the CRU area has led to development of six PAs, representing five reservoir units in the CRU just to the west of the proposed PKU. In stratigraphic order, these intervals are the shallow marine Nechelik sandstone of the Kingak Formation, (Fiord-Nechelik PA), the shallow marine Alpine sandstone of the Kingak Formation (Alpine PA), the shallow marine C-member sandstone of the Kuparuk Formation (Fiord-Kuparuk and Nanuq-Kuparuk PAs), the deepwater turbidite Nanuq sandstone of the Torok Formation (Nanuq-Nanuq PA), and the shallow marine Qannik sandstone of the Nanushuk Formation (Qannik PA).

At the Oooguruk Unit, immediately east of the proposed PKU, additional producing reservoirs include the shallow marine Nuiqsut sandstone of the Kingak Formation (Nuiqsut PA) and the deepwater turbidite Nuna/Moraine sandstone of the Torok Formation (Torok PA and Nuna project area, younger and depositionally isolated from the Torok Nanuq reservoir at CRU).

Geologic and Engineering Characteristics of the Reservoirs and Potential Hydrocarbon Accumulations

Geologic, geophysical, and engineering data submitted by Repsol to the Division in support of the application to form the PKU included interpretations of 2-D and 3-D seismic data, seismic attribute analysis, structure maps, interval isopachs, and net pay maps integrating seismic and well data, interpreted well logs and proprietary petrophysical analyses, well correlations, and geologic cross sections from wells within the proposed unit and surrounding area. All proprietary data and interpretations will be held confidential in accordance with AS 38.05.035(a)(8)(C). Based on non-confidential well control there are multiple potential hydrocarbon accumulations and reservoirs within the proposed PKU.

Jurassic sandstone reservoir potential

The PKU area contains three oil-bearing Upper Jurassic sandstones, all informal members of the Kingak Formation. From oldest to youngest, these are the Nechelik, Nuiqsut, and Alpine intervals. All three sandstones appear to have the same general depositional setting and lithologic characteristics. The sandstones are very fine- to fine-grained quartz arenites, which contain up to 15% glauconite. These shallow marine sandstones were shed generally southward from a northern provenance area that foundered during Late Jurassic to Early Cretaceous rifting and opening of the Canada Basin. The regional setting of the CRU, PKU, and Colville Delta area is interpreted from seismic and regional well control as a broad, very low gradient marine shelf on a south-facing passive margin. The shelf was likely a muddy one with limited accommodation space and relatively low rates of sedimentation. The three major successively stacked Upper Jurassic sand/silt/mud sequences were deposited in progradational and aggradational coarsening upward cycles over a period of approximately 20 million years.

A number of factors contributed to the preservation of the Jurassic sandstone packages: eustatic and tectonic sea level changes; local topography created by normal faulting resulting from pre-breakup rift related extensional tectonics; point source contributions of localized rivers; incised valley topography; and eroded highs sculpted by localized erosion during lowstands of sea level. The Alpine interval records the last significant sandstone pulse of Jurassic sedimentation, best developed in the vicinity of the Alpine field. The Alpine interval is absent in the northern Colville Delta area, likely due to the combined effects of non-deposition and erosion at the LCU. The locus of depositional accommodation for the underlying Nuiqsut sandstones appears to have been mainly to the northeast of the preserved Alpine sandstones, whereas the older Nechelik sandstone is best preserved to the north.

Structure at the Jurassic stratigraphic level in the proposed unit area consists of a broad southeast plunging anticline. Several prominent northwest-southeast trending normal faults are present in the proposed unit area. These faults tend to have a down to the southwest offset in the western part of the area and a down to the northeast offset in the eastern part. A younger set of normal faults with a more northerly trend is also present, particularly in the eastern part of the proposed unit. The trapping mechanism for the sands is interpreted to be predominantly stratigraphic, with the sands thinning and transitioning to mudstone in the southern, downdip (distal) direction and erosional truncation by the LCU in the northern, updip (proximal) direction. To date, the Nuiqsut sandstone is the only interval of the Jurassic Kingak Formation that has successfully tested hydrocarbons within the proposed unit area. No water leg has been observed within these Jurassic sandstones.

The depositional setting, geometry, and reservoir characteristics of the Nechelik, Nuiqsut and Alpine sandstones are well defined in the units adjacent to the proposed PKU from numerous well penetrations, core analyses, well test and production data, and seismic data. The oil gravity for the Nuiqsut sandstone producing at Oooguruk is typically in the low- to mid-20° API range. In the CRU, Nechelik oil ranges approximately 28-30° API and the Alpine oil around 40° API. Oil-bearing Nuiqsut and Nechelik sandstones have both been encountered within the proposed PKU. The Nuiqsut sandstone was tested in the Colville Delta 1, 2, and 3 wells, the Colville Delta 25 1, and the Kuukpik 3 wells. The calculated flow rates for these Nuiqsut tests are

generally less than those from the same unit at Oooguruk to the northeast. A possible reason is a general decrease in reservoir quality to the southwest as the sandstone intervals becomes more distal. Perhaps a more likely explanation is formation damage in the older wells as a result of the more primitive drilling fluids and stimulation techniques available during the 1980s. The fine-grained lithology and low permeability of the Nuiqsut sandstone coupled with relatively low gravity (around 20° API) oil makes the Nuiqsut sandstone a very challenging reservoir to develop from both a geologic and engineering point of view. Continued delineation drilling and testing is needed to determine the commercial viability and producible area of the Nuiqsut sandstone identified by the existing wells in the proposed PKU.

Because the Nechelik interval sandstones are best developed in the northern part of the CRU along a northeast-southwest depositional trend, any Nechelik reservoir would likely be restricted to the northern part of the proposed PKU. Alpine sandstones are likely to be discontinuously distributed and generally thinner in the PKU relative to their counterparts in the CRU. Alpine C sandstone was encountered in the Fiord 3 and 3A wells between the proposed PKU and CRU but neither penetration was tested.

Kuparuk C reservoir potential

Regional structure at the Kuparuk/LCU stratigraphic level is dominated by the Colville High, an extremely large, roughly circular, four-way closure that constitutes a major segment of the Barrow Arch. The proposed PKU area is centrally located relative to the area of maximum structural closure on the Colville High. At a finer scale, numerous northwest-southeast striking faults exert important control on the presence or absence of reservoir sandstones, both by syndepositional faulting creating accommodation, and by post-depositional faulting preserving reservoir sands from erosion. The trapping mechanism for Kuparuk sandstones within the regional Colville High closure is thought to be primarily structural with deposition and erosion controlling the distribution of reservoir.

The Kuparuk C sandstone is one of the major reservoirs on the North Slope with a long history of production from numerous fields, most notably within the KRU. The sandstones were deposited on a shallow marine shelf in paleo-topographic lows that formed primarily as a result of late Jurassic and Cretaceous aged rift faulting. This depositional setting results in dramatically variable sand thicknesses and aerial extent of individual sand bodies. The sandstones were deposited directly above the LCU, one of the major unconformities on the North Slope. The sandstone in the Kuparuk C interval is believed to be sourced primarily from erosion of older sandstones that subcrop below the LCU. Within the KRU, erosion and re-working of the underlying, aerially pervasive Kuparuk A sandstones provided much of the source sediments, though increased chert content in the Kuparuk C sandstones argues for contribution from provenance areas with Ivishak and older Ellesmerian formations exposed at the LCU. Outside the KRU, Kuparuk C sandstone is distributed irregularly.

Repsol integrated available subsurface control from well data with various seismic attributes to predict the presence of Kuparuk C sandstone within the proposed unit. Seismic data was primarily used to define areas of potential accumulation on the LCU, map detailed LCU subcrop patterns, and in an attempt to directly detect reservoir-prone sandstone using seismic attributes.

Kuparuk C sandstone generally displays high impedance that may produce a strong peak amplitude anomaly above the LCU when present. However, due to interference effects of different underlying subcropping strata and the limits of seismic data to resolve both the top and the base of the sandstone when the interval is thin, the amplitude patterns can be complex and sometimes misleading. This can be further complicated by the common presence of dense secondary siderite cement, either in the Kuparuk sandstone or in thin transgressive lag deposited at the unconformity, which can give a strong amplitude signature, but result in significantly diminished reservoir quality.

Siderite cementation and glauconite content are the primary controls on reservoir quality, causing great variability in porosity and permeability. Core data reveal that porosity can range from 8% to 30% and permeability can range from less than 0.1 mD to over 3,000 mD. In areas with little cementation the Kuparuk C sandstone has demonstrated the capability to produce at very high rates from relatively thin sandstones.

Numerous smaller accumulations of Kuparuk C sandstone have been discovered and developed outside the KRU in the area surrounding the proposed PKU. Currently Kuparuk C sandstone is in production to the northeast within the Oooguruk Unit and two separate accumulations in the CRU (Fiord-Kuparuk and Nanuq-Kuparuk PAs). As noted previously, the Kuparuk C reservoir at the Mustang project in the Southern Miluveach Unit is currently under development, and the interval was a key objective for the formation of the Placer and Tofkat Units.

Within the proposed PKU, the Kuukpik 3 well encountered 15-20 feet of hydrocarbon-bearing Kuparuk C sandstone that tested at a calculated flow rate of approximately 20 BOPD. Similar Kuparuk C sandstone was present in the Colville Delta 25-1 well, but was not tested. Thin Kuparuk C sandstone intervals are also present in the Fiord 3 and 3A wells adjacent to the west of the proposed unit. Even given the vagaries of exploring for Kuparuk C sandstones, it is quite possible that Kuparuk oil may eventually be produced within the proposed unit area.

Torok and Nanushuk Formation reservoir potential

The Nanushuk and Torok Formations are time-equivalent to one another, representing fundamentally different depositional settings in the Brookian sequence distinguished at the seismic scale. Major east- and northeast-flowing river systems originating in what is now the Chukchi Sea and western Brooks Range filled the Colville Foreland basin from west to east during Aptian to Cenomanian (Early to mid-Cretaceous) time, building an advancing continental terrace topped by coastal plain, river deltas, shoreline, and shallow marine shelfal environments. This style of basin fill created large scale clinoform packages that are readily imaged in seismic data. The clinoform systems are differentiated into 1) non-marine to shallow marine topset strata and 2) deepwater slope to basinal foreset and bottomset strata. The Nanushuk Formation comprises the sand-prone topset units, deposited inboard of the shelf edge. The upper part of the Torok Formation consists almost entirely of mudstone and siltstone, deposited beyond the shelf margin on the relatively steep upper to middle slope. The lower Torok, deposited in lower slope, toe-of-slope, and proximal basin floor environments, generally contains significant packages of turbidite and other sediment-gravity flow sandstones that bypassed the shelf and upper slope (particularly during lowstand cycles) and came to rest where on the lower gradient seafloor. At

the same time, still further out into the basin floor setting, slow deposition of very fine clay, volcanic ash, and organic matter created the black shale source rock facies of the lower Hue Shale, informally recognized as the highly radioactive zone (HRZ) or gamma ray zone (GRZ). Due to the overall progradation of these clinoforms across the basin, the generalized succession of the lower Brookian sequence in this area consists of the HRZ shale at the bottom, overlain by sand-prone lower Torok Formation, transitioning upward to mud-prone upper Torok, overlain by sand-prone Nanushuk Formation.

Reservoir sandstones may occur in various sizes and shapes in both the Torok and Nanushuk Formations. River-dominated deltas in the Nanushuk and submarine fans in the Torok may produce lobate reservoir geometries, whereas shelf-edge deltas or forced-regressive shoreface (Nanushuk) and various lower slope to proximal basin floor systems (Torok) may create thin, elongate bodies that can extend for 10 to 20 miles north-south along depositional strike. In the PKU area, sandstones from both formations are generally very fine to fine grained and well-sorted to very well-sorted. Torok and Nanushuk sandstones consist chiefly of quartz, chert, sedimentary and metamorphic lithic grains (rock fragments), with varying amounts of clay matrix and accessory minerals. The lithic components make these Brookian sands susceptible to compactional porosity reduction upon deep burial, but this is not a major issue high on the Barrow Arch in the PKU area, where potential Torok and Nanushuk reservoirs currently lie mostly between about 4,000 feet and 6,000 feet and were never buried to dramatically greater depths by younger Brookian strata.

As noted above, deepwater sandstones of the Torok Formation are compositionally similar to their equivalents in the Nanushuk, but the deposition is controlled more by sediment gravity processes and turbidity flows rather than deltaic or shelf processes. For this reason, deposits of Torok sandstones may consist of thinner individual sandstones interbedded with finer-grained siltstone and shale, depending on sediment supply, local basin floor topography, and other factors.

The CRU Nanuq-Nanuq PA and the modest development of the Oooguruk Unit Torok PA represent the only sustained Torok Formation production to date. The Torok Formation was tested in the Colville Delta 2 and Kuukpik 3 wells as described above, and good Torok Formation mudlog shows were noted in the Fiord 3, Fiord 4, Fiord 5, and Fiord 5PH wells. In early 2015 Caelus sanctioned a significant expansion of Torok development in the Oooguruk Unit (Nuna project), and ConocoPhillips drilled the Moraine 1 well to evaluate development of the same reservoir interval in the western portion of the KRU.

Structure at the stratigraphic level of the Nanushuk sandstones consist of a broad, arcuate, nearly flat shelf with local low-relief structural closures (dips generally less than one degree) and a generally east- to southeast dipping slope outboard of the shelf edge, where original depositional dips in places exceed about seven degrees. The trapping mechanism appears to be dominantly stratigraphic; the sandstones appear to pinch out or onlap up-dip to the west and shale-out depositionally downdip to the east.

Within the CRU, one zone of the Nanushuk Group, the informally designated Qannik sandstone, is currently being developed with six producing wells and three injection wells. The oil gravity

ranges 27-32° API, with an approximate viscosity of two centipoise and solution GOR of approximately 404 SCF/STB. The initial reservoir pressure was approximately 1,865 pounds per square inch. A gas-oil contact has been identified within the Qannik sandstone at a depth of approximately -4,000' subsea. The Qannik sandstone is the only Nanushuk Formation sandstone developed to date.

For the purposes of mapping and prospecting throughout both the Qugruk Unit and proposed PKU area, Repsol has subdivided the Nanushuk and time equivalent Torok Formation into nine individual zones, informally named Nanushuk 0 through Nanushuk 8. Based upon their subdivisions, the Qannik sandstone that is being developed in the CRU is equivalent to the Nanushuk 2 interval. Based on interpretation of available seismic data and regional subsurface mapping, Repsol believes that several Nanushuk sandstones are prospective within the western portion of the proposed unit.

None of the wells drilled by prior operators within the proposed unit area conclusively demonstrated the productivity of the Nanushuk interval with a drill stem test. However, good mudlog shows within the proposed PKU were noted in the Colville Delta 1 and Fiord 1, 3, 3A, 4, 5, and 5PH wells. The potential for multiple producible reservoirs at various levels of the Torok and Nanushuk clinoform sequence in the proposed PKU is high.

Tuluvak Formation reservoir potential

The Upper Cretaceous Tuluvak Formation is a younger Brookian sandstone than the Nanushuk and Torok Formations. The sandstone has been identified in six wells in the area at depths between 2,500 and3,000 feet: **Gulf Colville Delta 1**, Kuukpik 3, Fiord 2, Fiord 3 and 3A, and the Qugruk 2. All six wells had good mudlog shows. A 26 foot interval was tested in the Kuukpik 3 well and flowed back an unspecified volume of oil, water, and mud mixture. The oil gravity was approximately 21° API. Because a strong gas kick was encountered while drilling through the Tuluvak interval in the Qugruk 2 well, it was plugged and abandoned at 2,525’ MD. The shallow position and cold temperature of the Tuluvak Formation, located near the base Permafrost, makes development of this oil-bearing sandstone problematic and care is required to drill through this interval.

2015 Wells

Repsol drilled three exploration wells in the proposed PKU area during the 2015 drilling season: Qugruk 8 in Section 18 of Township 11 North, Range 6 East, Umiat Meridian, with a projected total depth of 5,100’ MD; Qugruk 9 in Section 6 of Township 12 North, Range 6 East, Umiat Meridian, with a projected total depth of 7,300’ MD; and Qugruk 301 in Section 6 of Township 11 North, Range 6 East, Umiat Meridian, with a projected total depth of 4,146’ MD. Limited news reports indicate that drilling goals were achieved and that production tests yielded positive results.

Conclusions

Repsol provided the Division comprehensive interpretation and analysis of the available data in support of the application to form the PKU. The application included interpretations of 2-D and 3-D seismic data, seismic attribute analysis, structure maps, interval isopachs, and net pay maps integrating seismic and well data, interpreted well logs and proprietary petrophysical analyses from wells within the proposed unit and surrounding area, well correlations, and geologic cross sections. Through careful interpretation of 3-D seismic and analyses of previously drilled wells in the area, as well as Repsol's recent drilling activity, Repsol has identified multiple potential hydrocarbon accumulations and reservoirs over a large area in several stratigraphic intervals. Follow up drilling and testing is required in order to delineate and progress to commercial development.

The ultimate purpose for forming a unit is to protect the correlative rights of all parties, prevent waste and ensure greater ultimate recovery during development and production of a pool or reservoir which has been discovered by drilling and evaluated by testing. The unit plan provided by Repsol commits to the drilling of additional wells to delineate and determine the commercial viability of these accumulations for further development and also to evaluate additional identified prospects.

3. Plans of Exploration

Repsol submitted a (POE), as part of the Application, and met with the Division for a technical presentation on January 28, 2015. To date Repsol has drilled 11 wells in the PKU area, including sidetracks, and conducted numerous flow tests.

In the proposed POE, Repsol states that it "agrees to drill three wells during the next five years, these wells will include at a minimum the following wells, all of which are currently being drilled:" the Qugruk 8, Qugruk 9 and Qugruk 301 wells. It is the Division's understanding that these three wells have recently been completed with positive test results according to Repsol. So while Repsol suggests it may drill additional wells, its proposed POE, as written, commits only to drilling wells that are already drilled.

A POE "must describe the applicant's *proposed* exploration activities, including the bottom-hole locations and depth of proposed wells, and the estimated date drilling will commence." 11 AAC 83.341(a) (emphasis added). A list of completed wells is not proposed exploration activity, and thus Repsol's proposed POE fails to meet the regulatory requirements for a POE. Without an acceptable POE, the Division would be unable to approve the unit.

The Division has discretion to propose modifications to a unit agreement that would qualify the agreement for approval. 11 AAC 83.316(b). Accordingly, the Division proposes the following modification: Considering the drilling work Repsol has conducted this year, it is acceptable that the initial POE not include additional wells for 2015. By October 1, 2015, however, Repsol must submit a Second POE that sets forth the proposed exploration activities that it will conduct

between December 1, 2015 and December 1, 2016. Repsol may alternatively submit a Plan of Development by October 1, 2015, if appropriate.

4. The Economic Costs and Benefits to the State and Other Relevant Factors

DNR has an obligation to protect the public's interest in maximizing economic and physical recovery from the state's oil and gas resources. AS 38.05.180(a)(1)(A). Maximizing economic recovery of hydrocarbons ensures royalty and tax revenues and increased employment opportunities over the long-term. Realization of these potential benefits requires exploration and development of state oil and gas leases.

The PKU will provide economic benefits to the State by promoting exploration and development of all unitized leases as a single lease, rather than development conducted on a lease-by-lease basis. Development on a unitized basis will prevent redundant expenditures and activities. Although leases included in the unit will no longer be available for competitive development the Division will ensure reasonable development through review and approval of future plans of exploration and development.

Other relevant factors includes mitigation measures. 11 AAC 303(b)(6). The leases within the PKU will continue to be subject to the mitigation measures attached to the leases at issuance. These mitigation measures include measures to minimize environmental impacts and protect the State's and public interest in the land.

B. Decision Criteria considered under 11 AAC 83.303(a)

1. Promote the Conservation of All Natural Resources

A unit may be formed under AS 38.05.180(p) "[t]o conserve the natural resources of all or a part of an oil or gas pool, field, or like area." Conservation of the natural resources of all or part of an oil or gas pool, field, or like area means "maximizing the efficient recovery of oil and gas and minimizing the adverse impacts on the surface and other resources." 11 AAC 83.395(9). The unitization of oil and gas reservoirs or accumulations and the formation and expansion of unit areas to develop hydrocarbon-bearing reservoirs or accumulations are well-accepted means of hydrocarbon conservation. Unitization, with development occurring under the terms of a unit agreement, can promote efficient evaluation and development of the State's resources, and minimize impacts to the area's cultural, biological, and environmental resources. The PKU unit agreement provides the framework for maximizing efficient recovery of oil and gas within the proposed unit. The leases in the proposed unit also remain subject to mitigation measures, as well as a variety of state and federal regulatory requirements, that are designed to protect other natural resources within the unit area.

2. The Prevention of Economic and Physical Waste

Unitization, as opposed to activity on a lease-by-lease basis, may prevent economic and physical waste. Economic waste is often referred to as the drilling of wells in excess of the number

necessary for the efficient recovery of the oil and gas in place. Physical waste, among other things, includes the inefficient, excessive, or improper use of, or unnecessary dissipation of, reservoir energy.

Unitization may also prevent economic and physical waste by eliminating redundant expenditures for a given level of production, or by avoiding loss of ultimate recovery with the adoption of a unified reservoir management plan. Annual approval of the PKU development activities as described in the future plans of development must also provide for the prevention of economic and physical waste.

3. The Protection of All Parties of Interest, Including the State

The people of Alaska have an interest in the development of the State's oil and gas resources to maximize the economic and physical recovery of the resources. AS 38.05.180(a). Future annually approved plans of development will provide for continued review and approval of Repsol's plans to develop the PKU in a manner which will maximize economic and physical recovery. Combining interests and operating under the terms of the PKU Agreement and PKU Operating Agreement assures an equitable allocation of costs and revenues commensurate with the resources.

The formation of the PKU protects the economic interests of the working interest owners, the State, and ASRC. Unitization promotes the State's economic interests because hydrocarbon recovery will be maximized and additional production-based revenue will be derived from the increased production. Diligent exploration and development under a single approved unit plan without the complications of competing leasehold interests promotes the State's interest. Operating under the PKU Agreement provides for accurate reporting and record keeping, State approval of plans of exploration and development and operating procedures, royalty payments, royalty in-kind taking, and emergency storage of oil and gas, all of which will further the State's interest.

The State and ASRC are co-owners of Joint Leases within the unit. Because of this the PKU Agreement is different than most unit agreements in Alaska. The State is a royalty owner and charged with the protection of all parties. In contrast ASRC is a private corporation with responsibility to shareholders and the authority to contractually obligate itself and other parties. In most cases the State and ASRC have aligned interests and management decisions are united. In the event of a dispute, Article 20 of the PKU Agreement outlines the use of third party arbitration in place of the typical DNR appeal process. This article was included to place DNR and ASRC on an equal footing with regards to management of the PKU should a conflict develop. A similar agreement is used with ASRC for the Colville River Unit and has successfully provided for development and production since 1998.

ASRC will separately provide its approval or disapproval of the PKU. As set forth in the Joint Leases, the State's approval of unitization of the Joint Leases is effective only as to the State's undivided interests.

IV. FINDINGS AND DECISION

A. The Conservation of All Natural Resources

1. Creation of the PKU will provide for exploration and development of the unitized area(s) under the PKU Agreement and will maximize the efficient recovery of oil and gas and minimize the adverse impacts on the surface and other resources, including hydrocarbons, gravel, sand, water, wetlands, and valuable habitat.

2. The unitized development and operation of the leases in this expansion will reduce the amount of land and fish and wildlife habitat that would otherwise be disrupted by individual lease development. This reduction in environmental impacts and preservation of subsistence access is in the public interest.

3. There is potential for environmental impacts associated with development. All unit development must proceed according to an approved plan of development. Additionally, before undertaking any specific operations, the Unit Operator must submit a unit Plan of Operations to the Division and other appropriate state and local agencies for review and approval. The lessees may not commence any drilling or development operations until all agencies have granted the required permits. DNR may condition its approval of a unit Plan of Operations and other permits on performance of mitigation measures in addition to those in the modified leases and the Agreement, if necessary or appropriate. Compliance with mitigation measures will minimize, reduce or completely avoid adverse environmental impacts.

B. The Prevention of Economic and Physical Waste

1. Repsol submitted geological, geophysical and engineering data to the Division in support of the Application. Division technical staff determined that the PKU area encompasses all or part of one or more oil and gas reservoir(s) and potential hydrocarbon accumulations.

2. The available geological, geophysical and engineering data justify including the proposed lands, as described in Section III, A.2.of this decision.

C. The Protection of All Parties in Interest, Including the State

1. The unit formation as approved protects all parties' interests including the people of Alaska who have an interest in the development of the State's oil and gas resources to maximize the economic and physical recovery of the resources.

2. The economic, geological, geophysical, and engineering data that Repsol provided reasonably justify the inclusion of the PKU acreage under the terms of the applicable regulations governing formation, expansion, and operation of oil and gas units and

participating areas (11 AAC 83.301 – 11 AAC 83.395) and the terms and conditions under which these lands were leased from the State.

3. Repsol provided evidence of reasonable effort to obtain joinder of any proper party to the Agreement.

4. Repsol holds sufficient interest in the unit area to give reasonably effective control of operations.

5. The unit formation meets the requirements of 11 AAC 83.303 with the following modification: Repsol will submit a Second POE by October 1, 2015 that sets forth the proposed exploration activities that it will conduct between December 1, 2015 and December 1, 2016. Repsol may alternatively submit a Plan of Development by October 1, 2015, if appropriate..

6. The Division complied with the public notice requirements of 11 AAC 83.311.

7. The unit expansion will not diminish access to public and navigable waters beyond those limitations (if any) imposed by law or already contained in the oil and gas leases covered by this decision.

8. The PKU Agreement provides for additional expansions and contractions of the unit area in the future, as warranted by data obtained by exploration or otherwise. The PKU Agreement thereby protects the public interest, the rights of the parties, and the correlative rights of adjacent landowners.

9. The approved unit is effective retroactively to June 1, 2015.

10. Repsol shall submit revised Exhibits A and B within 60 days of the issuance of this decision.

11. ADL 391303 is severed as to lands committed to the PKU and as to lands not committed to the PKU. 11 AAC 83.373(a). Upon unitization that portion of ADL391303 not committed to the unit is severed, assigned a new lease number, ADL392995, and granted a two-year extension of the lease term with an expiration date of July 31, 2017. 11 AAC 83.373(b).

12. ADL 391396, ADL 391393, ADL 391391 and ADL 391387 are severed as to the lands committed to the PKU and as to lands not committed to the PKU. 11 AAC 83.373(a). The portions of these leases not committed to the unit are assigned the following new lease numbers and will retain their original expiration date of August 31, 2018: ADL 392994, ADL 392997, ADL 392993 and ADL 392996. The new and severed leases are further described in Attachments 3 and 4.

13. Twelve Joint leases will be segregated into individual single section leases with the same terms and conditions as the original lease. All Joint Leases proposed for unitization will be included in the PKU. Attachments 3 and 4 describe the new and severed leases.

For the reasons discussed in this Findings and Decision, I hereby approve the PKU formation.

An eligible person affected by this decision may appeal it, in accordance with 11 AAC 02. Any appeal must be received within 20 calendar days after the date of "issuance" of this decision, as defined in 11 AAC 02.040(c) and (d), and may be mailed or delivered to Mark D. Myers, Commissioner, Department of Natural Resources, 550 W. 7th Avenue, Suite 1400, Anchorage, Alaska 99501; faxed to 1-907-269-8918; or sent by electronic mail to dnr.appeals@alaska.gov. This decision takes effect immediately. An eligible person must first appeal this decision in accordance with 11 AAC 02 before appealing this decision to Superior Court. A copy of 11 AAC 02 may be obtained from any regional information office of the Department of Natural Resources.

Sincerely,

Corri A. Feige
Director

Cc: Department of Law
Teresa Imm, ASRC

V. ATTACHMENTS

1. Pikka Unit Proposed Exhibit A
   Description of Lands within the Proposed Unit

2. Pikka Unit Proposed Exhibit B
   Map of Proposed Unit Area

3. Pikka Unit Description of Lands within the Approved Unit

4. Pikka Unit Map of Approved Unit Area

5. Pikka Unit Approved Joint Lands Unit Agreement

1. Pikka Unit Proposed Exhibit A
Description of Lands within the Proposed Unit

2. Pikka Unit Proposed Exhibit B

Map of Proposed Unit Area

3. Pikka Unit Description of Lands within the Approved Unit

4. Pikka Unit Map of Approved Unit Area

5. Pikka Unit Approved Joint Lands Unit Agreement