



THE STATE  
of **ALASKA**  
GOVERNOR BILL WALKER

Department of Natural Resources

Division of Oil & Gas  
Anchorage Office

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November 14, 2016

**CERTIFIED MAIL  
RETURN RECEIPT REQUESTED**

Katrina Garner  
Manager of Reservoir Management  
Alaska Resource  
BP Exploration (Alaska) Inc.  
PO Box 196612  
Anchorage, AK 99519-6612

Re: Prudhoe Bay Unit, Western Satellites 2017 Plan of Development – Approval

Dear Ms. Garner:

On September 29, 2016, the State of Alaska, Department of Natural Resources, Division of Oil and Gas (Division) timely received the proposed Prudhoe Bay Unit (PBU) – Western Satellites 2017 Plan of Development (POD). The Division notified BP Exploration (Alaska) Inc. (BPXA) by email on October 7, 2016 that the POD was complete. The Division met with BPXA and the other PBU working interest owners on September 20, 2016 for the PBU Western Satellites annual agency review.

The PBU Western Satellites consist of five Participating Areas (PAs): Aurora, Borealis, Midnight Sun, Orion, and Polaris. The Aurora, Borealis, and Midnight Sun PAs produce primarily from the Kuparuk River Formation, while the Orion and Polaris PAs produce oil with higher viscosity from the Schrader Bluff Formation. The PAs commenced sustained production between late 1999 (Polaris PA) and mid-2002 (Orion PA) with oil production peaking in March 2004 at approximately 50,550 barrels of oil per day (BOPD). Production from the Western Satellites PAs during the latest report period ending June 2016 was ~25,000 BOPD. The reporting period for average daily oil production rate and wellwork operations mentioned below of each PA extends from July 1, 2015 to June 30, 2016. The POD periods for Western Satellites PAs run from January 1 to December 31.

#### **Aurora PA POD**

The average daily oil production rate at the Aurora PA increased from 4,305 BOPD in 2015 to 6,303 BOPD in 2016. The increase in production is attributable to two new sidetrack producer wells (S-42A and S-44A) coming online in late 2015 and a hydraulic fracture treatment of the S-135 well in early 2016. BPXA also conducted wellwork operations totaling 74 wellwork jobs (19 rate adding jobs) during the reporting period. Wells under evaluation in the S-107 pattern and east of the S-105 were not drilled in the 2016 POD period. The S-112 lateral injector was drilled to support the newly drilled S-42A; however, the target was not attained due to wellbore stability problems.

For the Aurora 2017 POD, no new wells are proposed. Potential future infill targets have been identified and will be considered for future drilling. The reservoir management goals remain as targeting instantaneous voidage replacement ratio (VRR) of 1.2 in each fault block and maintaining reservoir pressure above the level required to optimize miscible injectant (MI).

### **Midnight Sun PA POD**

The small, fault-bounded Midnight Sun PA continues to produce from two wells with two water injectors online. Average daily oil production rate at the Midnight Sun PA increased from 960 BOPD in 2015 to 1,134 BOPD in 2016. A new WAG injector well (P1-122i) was drilled in early 2015 from the Point McIntyre P1 pad to the Midnight Sun PA. The Point McIntyre pad is the closest pad supplied with MI. BPXA successfully completed remedial actions to restore integrity and zonal isolation in the P1-122i injector well during the 2016 POD period. The P1-122i well started receiving MI injection in October 2016. The MI injection is projected to greatly increase the recovery factor from the PA. No other well or facility work is proposed in the 2017 POD.

### **Polaris PA POD**

The Polaris PA is managed as a WAG flood with injectors alternating between produced water and MI. Average daily oil production rate at the Polaris PA increased during the 2016 POD period from 3,890 BOPD in 2015 to 4,306 BOPD in 2016. No new wells were drilled in the Polaris PA in 2016, but the high level of wellwork jobs continued. BPXA performed 63 wellwork jobs with eight rate adding jobs. Production and injection logging has helped to identify matrix bypass events (MBE) in several wells in previous years. MBEs in injectors S-215, W-212, and W-202 were remediated in 2015 and 2016 by fixing waterflood regulating valves. A production log was performed in W-202 to identify a potential MBE, and injection logs were also run in the W-212 and W-216 wells.

No new drill wells are planned for 2017 and no Polaris PA wells have been drilled since June 2011. Much of the down-dip eastern portion of the PA remains undrilled. The M-Pad development and S-Pad expansion projects were included in BPXA's West End Development project which entered the Select Stage in 2014, but the project is now deferred. The 2017 POD lists plans to continue work on the dynamic model at the M- and S-Pad area to improve subsurface description, an alternative sand control technology will be tested in a planned rotary sidetrack, and the wellwork program will continue to maintain production and mitigate decline.

### **Borealis PA POD**

Average daily oil production rate at the Borealis PA decreased from 8,768 BOPD in 2015 to 8,517 BOPD in 2016. No new wells were drilled in 2016, but the wellwork program continued. There were 85 wellwork jobs performed, seven adding rate, during the reporting period. Two Z-Pad booster pumps were repaired in the Z-504A and Z-504B wells and hydraulic fracture treatments were pumped in the L-123 and L-124 wells to bring both wells back online. BPXA shut in V-Pad production and injection in June 2016 due to piping over-stress findings from an engineering report. V-Pad was shut in to mitigate the potential for a loss of primary containment. Initial repairs will be performed with installation of new risers and gravel work to relieve stress

on piping to modules. BPXA plans to have production and injection from the pad back online by the end of 2016.

The 2017 POD for the Borealis PA proposes no new wells, but recently drilled Z-Pad wells have been used to update the reservoir simulation model to evaluate scenarios for additional drilling or well sidetrack potential. The wellwork program will continue in support of reservoir management goals targeting VRR of 1.0 and maintenance of reservoir pressure to optimize MI benefits.

### **Orion PA POD**

Average daily oil production rate at the Orion PA increased slightly during the reporting period from 4,693 BOPD in 2015 to 4,747 BOPD in 2016. L-Pad well operability problems continued during the 2016 POD period. Significant producer downtime at L-Pad is caused by sand production, matrix bypass events (MBEs), and downhole equipment failures. Producers L-200, L-203, L-204, L-205, and L-250 were all shut-in during some portion of the 2016 POD period along with the offset injectors for these wells. V-Pad piping stress and subsidence issues resulting in pad shut-in also impacts the Orion PA's Schrader Bluff production. No new wells were drilled during the 2016 POD period. There were 91 wellwork operations conducted during the 2015-16 reporting period including 15 waterflood regulating valve changeouts to adjust injection profiles and address possible MBEs. MI injection occurred in 13 wells during the reporting period.

BPXA's plans for the 2017 POD period consist mainly of continued evaluation and studies, work on dynamic models, and further engineering to address sand handling capabilities. There will be a continuation of the wellwork program in 2017, but no new wells are planned. Plans to re-drill L-200 and L-205 as vertical wells with frac-pack completions are being evaluated in an effort to eliminate junctions on multi-lateral wells, reduce sand production, and prevent MBEs.

### **West End Development project status: Schrader Bluff development**

The West End Development project incorporates the expansion of Schrader Bluff oil development mainly in the Orion and Polaris PAs. The plans for integrated development of these PAs entered "Select Stage" in June 2014. The West End Development project was established to address problems encountered with facility processing capability of sand-laden viscous oil, facilities debottlenecking, gas handling, mechanisms to provide artificial lift, reducing reservoir uncertainties, reducing viscous well downtime, and optimizing pad design. As of September 2015, BPXA deferred many plans for the West End Development project and cancelled the West End optimization project focused on facilities debottlenecking and enhancing gas and water handling capabilities.

While the West End Development project has been deferred, some work continues on this project. At I-Pad, work continues on the dynamic models for pad development scenarios and evaluation of learnings from other ongoing technology trials. The S-Pad expansion and M-Pad development work plans include similar references to sand control evaluations and work on the dynamic models. Work is ongoing to optimize the separation systems efficiency at GC-2 to

improve processing of the large volumes of sand being produced. BPXA plans to complete benefits and feasibility analysis for GC-2 processing capabilities during the 2017 POD. During the past several years, solids handling at GC-2 was upgraded via installation of a solids accumulator, improved sand jetting procedures, and dehydrator sand jetting. These upgrades realized some improvement in sand handling; however, they did not deliver the required level of improvement. Engineering work on facility and well design is ongoing to address the sand-laden oil production issue.

### **Consideration of 11 AAC 83.303 Provisions**

When considering a POD, the Division must consider the criteria in 11 AAC 83.303(a) and (b). Accordingly, the Division considered the public interest, conservation of natural resources, prevention of economic and physical waste, protection of all interested parties including the state, environmental costs and benefits, geological and engineering characteristics of reservoirs or potential hydrocarbon accumulations, prior exploration activities, plans for exploration or development, economic costs and benefits to the state, and any other relevant factors, including mitigation measures. 11 AAC 83.303(a)-(b).

In approving prior PODs for the PBU Western Satellites, the Division considered 11 AAC 83.303 and found that the PODs promoted conservation of natural resources, promoted prevention of waste, and protected the parties' interests. The Division incorporates by reference those findings.

The Western Satellites PAs are all mature fields where oil production has been declining since reaching peak production. The continued wellwork involved in bringing wells back online and remediating MBEs is crucial to continuing production, stemming decline, and maximizing the recovery from these mature fields. Combined average daily oil production from the fields increased this reporting period. The Aurora PA experienced a fifty percent increase in average production attributable to wellwork and two new sidetrack wells. New well and sidetrack targets continue to be evaluated throughout the Western Satellite PAs, but only one new sidetrack well was drilled in 2016. Sidetrack and new drill wells over the last two years have decreased to the point of no proposed drilling in 2017. While the wellwork program helps to maximize recovery of the remaining hydrocarbons and provide economic returns to the state, it is expected the well evaluation program will identify new well targets to drill soon.

The state has an interest in the efficient recovery of its resources and maximizing economic benefits to the state for the resources produced. With recoverable oil estimates as high as 145 MMSTB in the northwestern tracts of the Orion and Borealis PAs, it is in the public interest to see the Borealis and Orion PA I-Pad area resources developed sooner rather than later. During the 2014 POD period, the I-Pad development, which is associated with West End Development project, entered the Select Stage. Unfortunately, BPXA has elected to defer the West End Development project until economic conditions improve. At the time of deferral, there continues to be an absence of physical, on-the-ground work conducted in the I-Pad area. Oil production is important for increasing state revenues and adding jobs associated with expansion of the Schrader Bluff development in PBU. It is not in the state's interest for areas with known hydrocarbon reservoirs to not be diligently produced.

## Decision

Having considered the 11 AAC 83.303 (a) and (b) criteria, the Division finds that the 2017 POD complies with the provisions of 11 AAC 83.303. Accordingly, the 2017 POD is approved for the period January 1, 2017 through December 31, 2017.

This approval is only for a general plan of development. Specific field operations will require an approved Plan of Operations. Under 11 AAC 83.343, the 2018 POD is due on October 2, 2017, 90 days before the 2017 POD expires.

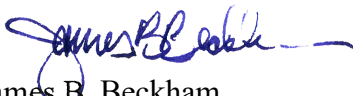
BPXA has deferred much of the work it planned to complete for the West End Development project until economic conditions improve. The Division understands the difficulties with developing viscous, sand-laden oil in a low price environment; however, it is expected that work continues to advance critical elements of the West End Development project. To provide evidence of continuing progress on Schrader Bluff development, the Division requests the following in future PODs:

- Thorough updates on sand control alternatives and learnings from other ongoing technology trials
- Results of the benefit and feasibility analysis for GC-2 processing capabilities
- Technical updates on the Borealis, Orion, and Polaris reservoir models specific to accomplishments, potential infill locations, quality of history matching, and future plans.

A 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 Andrew T. Mack, Commissioner, Department of Natural Resources, 550 W. 7<sup>th</sup> Avenue, Suite 1400, Anchorage, Alaska 99501; faxed to 1-907-269-8918; or sent by electronic mail to [dnr.appeals@alaska.gov](mailto: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.

If you have questions regarding this decision, contact Kyle Smith with the Division at (907) 269-8807, or via email at [kyle.smith@alaska.gov](mailto:kyle.smith@alaska.gov).

Sincerely,



James B. Beckham  
Acting Director

cc: DOL