

PRESSURE MAINTENANCE OR IMPROVED RECOVERY PROJECT APPLICATION GUIDELINE

Background

Water, natural gas or a fluid such as CO₂ may be injected into an oil pool to achieve higher oil recovery than by primary depletion alone. A waterflood, gas injection or enhanced oil recovery (EOR) project approval is issued as a Special Project Order under Section 75 of the Energy Resource Activities Act. The approval specifies the wells that may be used for injection service, the maximum wellhead injection pressure and a maximum average reservoir pressure, as well as other operating and reporting conditions. Detailed information related to waterflooding - water source and injection wells - can be found in the [Water Service Well Summary Information](#) document.

An oil project is produced under a project daily oil allowable (DOA), subject to a gas-oil ratio adjustment factor (FGOR) based on oil and gas production volumes from the previous reporting month. The allowable production may be taken from any one or combination of wells in the project, typically with preferential production from wells with the lowest GOR. The project DOA may be either the sum of the individual well DOAs, or based on volumetric reserves for the project portion of the pool. As an incentive to a pressure maintenance project, the base DOA value is calculated using an increased recovery factor, typically 40%. Pools may be operated with simultaneous gas injection and waterflooding. Injected gas volume is credited against gas production, FGOR based on monthly gas sales. Once a project has shown positive response, typically increased oil rate and decreasing GOR, an application made be made to replace the DOA with a voidage balance production restriction, monthly production based on the previous month's voidage replacement.

Where the applicant is not the permit holder for all wells in the pool, the Regulator expects consultation to occur prior to making application. Typically a Unitization Agreement provides advantage for all owners, however the Regulator may issue a pressure maintenance approval for only a portion of a pool if it can be demonstrated that pool oil recovery will significantly benefit. The approval may limit lease-line wells to individual DOAs if equity is a demonstrated concern.

An approval will contain a condition that Progress Reports be filed with the Regulator on a scheduled basis, to allow review of performance and conformity with approval conditions.

Oil pools in the province have typically shown very favourable response to pressure maintenance projects, especially if commenced early in the production life of the pool.

Application

An application for approval of a Project for Pressure Maintenance or Improved Recovery, as a Special Project under Section 75 of the *Energy Resource Activities Act* should contain, when applicable:

- Well names and locations (surface and bottom, if different) and Well Permit (WA) numbers of the proposed injection well(s), and general drilling, completion and activity history.

MAPS

- A map of the project area, illustrating tenure and registered owners, within this area and in adjacent title- holdings.
- A map of the status and completion zone for all wells within 3 kilometers of the area.

GEOLOGY AND RESERVOIR

- A discussion of the geology of the pool, including relevant cross-sections or fence diagrams, together with contour maps showing structure on top of the formation and top and base of porosity.
- A discussion of the reservoir rock properties, including isopach maps of net pay, together with details of the estimations of average net pay, porosity, permeability, water saturation and fluid-interface elevations. Net pay values should be based on cut-offs accepted by the BC Energy Regulator after discussion with the operator.
- A general discussion of the history and development of the pool for which the scheme is proposed, including a tabulation of completion details, initial potential and latest test data for all wells completed in the pool. Graphs of

production histories for all wells in the pool, showing production rates and cumulative volumes, together with appropriate gas-oil and water-oil ratios.

- A discussion of the reservoir fluid properties, such as saturation pressure, oil and gas formation volume factors, oil and gas viscosities, solution gas-oil ratio, PVT studies, and relevant fluid analyses. Details of the variation of these properties with pressure should be included.
- An estimate of the volume of hydrocarbons originally in place in the pool.

PROPOSAL

- A discussion of the primary producing mechanism in the pool and details of estimations of the rate-time performance and ultimate recovery under continued primary depletion.
- A general discussion of the need for an improved recovery scheme in the pool and the reasons for selecting the method being proposed.
- A prediction of the pool's rate-time performance and ultimate recovery under the proposed scheme. This should include the results obtained from relevant laboratory experiments, together with a discussion of the methods used in calculating areal, vertical, and displacement sweep efficiencies, and in predicting injection and production rates.
- A discussion of the optimization of injection pattern and the scheduling of injection start-up, together with details of the proposed level of reservoir withdrawal balance to be maintained under the improved recovery scheme.
- A discussion of the source of injection fluid and its compatibility with existing reservoir fluids including its effect on the reservoir wettability.
- Details of the completion of the injection-fluid source and injection wells, including diagrams showing existing and proposed completion intervals, casing and tubing details, depths of packers and nature of the inhibited fluid to be used in annuli.
- Wellbore integrity testing, log results and interpretation, including;
 - Evidence of hydraulic isolation of the injection zone.
 - Cement integrity/inspection logs – less than 10 years old.
 - A full length casing inspection log, required for any existing well greater than 10 years old being converted for disposal service.
- Details of the surface injection-fluid handling, distribution and metering facilities, including flow diagrams.
- Method of continuous measuring and recording of wellhead injection pressures.

NOTE: Pro-active monitoring of penetrated shallow aquifers is recommended practice, though not required at present, and it is advisable to include a monitoring plan in the application.

LETTERS

- Written statements from other interested parties indicating their reaction to the proposed improved recovery scheme. An example of such statements is provided here [Consent to Inclusion in a Reservoir Project](#) or here [No Objection to Reservoir Project](#).

The application should be submitted to the Supervisor of the Reservoir Engineering Department of the BC Energy Regulator via email at Reservoir@bc-er.ca. Additional copies may be made available to owners directly affected upon request. Notice of an application may be published on the Regulator's website.