

Application Checklist for CO₂ EOR Storage under *Directive 065*

Last Updated November 2022

This checklist is provided as a summary of what the AER expects to be included in a CO_2 EOR storage application. It is not necessarily comprehensive. Applicants are expected follow all application requirements in *Directive 065*.

Notification

- □ A map illustrating notifications as described in table 1 of the directive.
- □ A statement as to whether the parties shown on the map referred to above have been notified about the application and, if so, include any statements of concern received.
- □ A statement indicating that notification of the scheme for emergency response plan (ERP) purposes has been made. See *Directive 071: Emergency Preparedness and Response Requirements for the Petroleum Industry* for requirements.

Description of Proposed CO₂ EOR Storage Well

- □ Unique well identifier (surface and bottom, if different) of the proposed CO₂ EOR storage well and general drilling, completion, and activity history.
- □ EOR zone with zone top and base, perforations, and depth of the production packer. Note that the packer is expected to be within 15 metres (TVD) above of the top of injection perforations unless technically justified. The length of open casing below the bottom perforations must not extend beyond 15 metres (TVD) unless technically justified.
- □ The base of the usable groundwater available for locations across Alberta by using the Base of Groundwater Protection Query Tool on the AER's Systems & Tools on the AER website, <u>www.aer.ca</u>.
- □ Provide a phased wellbore risk assessment. Note that a wellbore risk assessment as described in section 2.1.5, "Application Requirements for a CO₂ EOR Storage Scheme," part 15(b), must initially focus on the fluid containment within a 1.6 km radius surrounding the proposed injection wells or the maximum expected fluid plume, whichever is larger. It is expected that the risk assessment will evolve as the EOR project scales up with continued CO₂ injection to reach an eventual long-term state. Therefore, a wellbore risk assessment is also required to focus on the 1.6 km beyond the CO₂ fluid plume for the projected full pool development plans as described in section 2.1.5 part 15(a).

- □ Provide a statement on the details of an AER-approved up-to-date emergency response plan (ERP) that the applicant maintains in the area of the proposed operation.
- Proposed maximum wellhead injection pressure (MWHIP); unless the default table MWHIP is requested, provide a detailed report of a step-rate injectivity test (SRT) or other acceptable test such as a minifrac (also referred to as DFIT or diagnostic fracture injection test and described in *Directive 040: Pressure and Deliverability Testing Oil and Gas Wells*, section 4.7, "Fall-Off Tests"), or a technically justified location analogue, performed to determine fracture (formation parting) pressure. An SRT should include the following information:
 - \Box evidence that shows the time steps were of equal duration
 - □ evidence that pressures are moving toward stabilization (radial flow) at the end of each stage
 - □ the wellbore schematics of the proposed injection well or analogue well
 - □ the directional survey for the proposed well or analogue well
 - \Box the SRT data in both graphical and tabular form
 - □ submission of any continuous pressure and injection data collected
 - □ calculation of an MWHIP with a discussion on the appropriate safety factor to ensure fluid containment; discussion should include the potential fracturing of the storage formation and the caprock due to dynamic changes in the thermal gradient over the life of the scheme, including monitoring of the injectivity

Notes on step-rate injectivity tests (SRTs):

- Data is commonly acquired at the wellhead but preferably should also do so with bottomhole pressure recorders.
- The safety factor must be applied at the bottomhole formation parting pressure.
- If bottomhole pressure recordings are used for MWHIP determination, corrections for hydrostatic and friction losses should be appropriately accounted for.
- When density or significant viscosity differences exist between the test fluid and that proposed for CO₂ fluid, the results of the test should be adjusted for differences in hydrostatic and friction pressures.
- Early-time injection period should be sufficient to overcome wellbore storage effects and achieve radial flow conditions.
- SRT data conducted after a hydraulic fracture stimulation may be inconclusive or using data from hydraulic facture stimulation using proppant may not be acceptable for determining formation parting pressure.

- MWHIP based on 8 × TVD of the perforation top of the proposed injection well interval without an injectivity test based evaluation will not be accepted for CO₂ EOR storage schemes.
- Note that for injectivity tests, to measure the formation parting pressure, if the total water injection volume is more than 500 m³, applicants should follow the <u>Temporary Injection</u> application process.

Discussion and Justification to Support Proposed CO2 EOR storage Operations

- □ reservoir geology, history, and containment requirements
 - □ a geological discussion should include geological setting, continuity, areal extent, thickness, and lithology of the proposed EOR pool, including average porosity, water saturation and permeability. It should also include any gas-oil, gas-water, oil-water contacts; cross-sections; and structural contour and isopach maps.
 - □ a discussion of the geological setting of the bounding formations, base and caprock, including rock properties, continuity, areal extent, integrity, thickness, and evidence of fracturing or faulting.
- □ description of the source of the injection fluid and sufficiency of the source also applies for CO₂ EOR storage
- \Box the reservoir rock type, quality, and continuity
- □ the proposed ER scheme area and the underlying drilling spacing unit in the area and formation
- □ the applicant's reservoir fluid volumetric estimates and our database estimates
- □ the reservoir fluid pressure, volume, and temperature (PVT) characterization
- \Box the reservoir pressure depletion trend from production initiation and the effect of CO₂ injection on this, if ER has already been implemented
- □ the effect of reservoir energy depletion on production performance trends and the effect of CO₂ injection on this
- □ the list of wells and their individual status in the pool and the list of wells that will be in or are in the proposed ER scheme area
- \Box the scheme holder's record of compliance with approval conditions
- □ the performance of the scheme in meeting the original hydrocarbon recovery estimates is assessed while considering an application to terminate a scheme

- □ There are different methodologies to estimate storage capacity for CO_2 EOR storage schemes. Section 2.1.5 describes the theoretical assessments for new (prior to commencement of CO_2 injection) CO_2 EOR storage schemes; the AER suggests relying on reservoir simulation models to update initial storage capacity estimates (on an annual basis) for models calibrated to performance history data post commencement of CO_2 EOR storage injection.
- □ Submission of results from modelling and simulations undertaken should include pressure plumes and the CO_2 phase distribution (plus a tabulated summary of the estimated per cent of the free-phase CO_2 in structural and stratigraphic trappings, residual trapping, dissolved in the formation water, and dissolved in the oil phase).
- \Box summary of the gross quantity of new CO₂ injected into the scheme (not including reinjected CO₂), the recycled CO₂ measured and accounted for as the net CO₂ injected, the net CO₂ volumes stored in the reservoir (the net geological sequestration volumes), the CO₂ volumes produced and reinjected, and the mass of CO₂ reported in tonnes

Directive 051 Applications

Meeting Directive 051 requirements is a condition of Directive 065 applications.

- □ *Directive 065* scheme approval requires that CO₂ EOR storage wells meet the *Directive 051* class III well requirements prior to the well going on injection. It is necessary to ensure that integrity of the wellbore will prevent migration of injected fluids to other zones and protect the groundwater interval.
- □ The *Directive 051* application should include the recent completion logging, testing requirements, and associated discussion for the proposed disposal well.
- □ *Directive 051* requirements for any additional logging or monitoring will also be reflected on your *Directive 065* scheme approval.