ALBERTA INNOVATES

CLEAN RESOURCES MILESTONE REPORT

Milestone Reports will use this template to capture key results and outcomes from the reporting period. This template represents the minimum information expected and additional topics relevant to the milestone should be included. The Applicant will work with the AI Project Advisor during the report preparation period to ensure that the final submission of the Milestone Report meets the reporting requirements.

Alberta Innovates is governed by FOIP. This means Alberta Innovates can be compelled to disclose the information received under this Application, or other information delivered to Alberta Innovates in relation to a Project, when an access request is made by anyone in the general public.

In the event an access request is received by Alberta Innovates, exceptions to disclosure within FOIP may apply. If an exception to disclosure applies, certain information may be withheld from disclosure. Applicants are encouraged to familiarize themselves with FOIP. Information regarding FOIP can be found at http://www.servicealberta.ca/foip/. Should you have any questions about the collection of this information, you may contact the Manager, Grants Administration Services at 780-450-5551.

1. FUNDING AND PARTNERS

List the Contributing Partners and Project Supporters in the tables below. Organization names will be publicly shared in the project summary document discussed below but contribution amounts will be kept confidential.

CONTRIBUTING PARTNERS:

Organization Name	Cash Funding	In-Kind Contribution	Committed?
CanERIC	$25,388		$25,388
Canadian Natural Resources Limited (Canadian Natural)		$25,388	$25,388

PARTNERS AND SUPPORTERS (OTHER THAN CONTRIBUTING PARTNERS):

Organization Name	Nature of Support
N/A	

2. PROJECT STATUS

Please indicate by check mark if you experienced any of the following changes to the Project. Check all that apply. **Include an explanation for the change.**

RESPOND BELOW

Minor Changes	
☐	A decrease in the total Project Costs and the Investment, where the parties have made provisions for the adjustment and proportional return, where applicable, of the Contribution
☐	A company name change of any Party listed in the Investment Agreement, where no change of corporate control has taken place
☐	A minor change to the work plan which does not change the end goal of the Project
☐	An increase or decrease of the funding on one Milestone, where the Investment to the same Payee will be adjusted by the same increase or decrease at a later Milestone or Milestones with a new MRP
☐	Any one or more of the Expected Milestone Completion Dates is changed by less than 90 days, without changing the original (or legally amended) Project Completion Date by more than 90 days
☐	The Project Completion Date is delayed by less than 90 days
☐	A change to the contact person(s) in the Notices section of the Investment Agreement
☐	Other

Major Changes	
☐	An increase or decrease of the funding on one Milestone, where the Investment will be adjusted by the same increase or decrease at a later Milestone to a different Payee
☐	A substantial change in the nature of the Project which changes the overall intention of the Investment, and which may or may not impact the Project Completion Date
☐	A change to a Milestone Completion Date longer than 90 days, whether or not it affects the Project Completion Date
☐	A change, or cumulative changes to the Project Completion Date resulting in the revised Project Completion Date being later than 90 days from the original date, whether due to delay or suspension
☐	A change of any Party to the Investment Agreement
☐	A Change of Control or name change of any Party (as applicable under a particular Program)
☐	Other

Use the sections below as the executive summary. This summary is an update to what was provided within the *Investment Agreement - Schedule C* and provides only a high-level description of the opportunity, project goals, key results, outcomes and benefits. More in-depth descriptions are expected in the sections that follow. This information will be used to prepare a project summary document that Alberta Innovates will use to communicate the value of funded projects to internal and external stakeholders. The project summary document may be used to inform annual reports, website postings, and learning sessions with Alberta government representatives.

A. EXECUTIVE SUMMARY

CURRENT STATUS (70 WORDS)

Please highlight the significant components of the project that have been completed to date.

Test has concluded. EGAS compressor was installed at 131/09-32-007-08W2 (131/09-32) on November 27th, 2020. The trial was performed over a 3-month period.

The trial was a success. The EGAS was proven to be a cost effective solution to compress sour fluids. The EGAS compressor reduced annulus pressure by 177 psi, which caused the majority of gas production to flow up the annulus. By separating the gas out of the liquid stream in the wellbore, it can readily be conserved at surface. Lastly, installation costs, equipment rental, and fuel costs over the 3-month trial were on budget.

Our goals for this period and results:

Task	Goal	Deliverable	Result
1. Install EGAS compressor at 131/09-32-007-08W2	1. Install the EGAS compressor on time. 2. Install the EGAS compressor on budget.	1. Planned On-stream Date: 11/27/2020 2. Budgeted Install Cost: $8.1K	1. Actual On-stream Date: 11/27/2020 2. Actual Install Cost: $5.3K
2. Optimize EGAS Compressor	Reduce 131/09-32's casing pressure by 180 psi.	Reduce 131/09-32's casing pressure by 180 psi.	131/09-32's casing pressure was reduced by 177 psi.
3. Increase gas flow rate up annulus, reduce gas flow rate up tubing.	Increase pump efficiency without modifying pumping unit, to prove less gas is flowing up tubing, and more gas is flowing up annulus.	Increase pump efficiency without modifying pumping unit, to prove less gas is flowing up tubing, and more gas is flowing up annulus.	Pump efficiency initially increased by 47%. Currently pump efficiency is 25% higher than prior to the install.
4. Operate EGAS compressor for 3-month trial, ensuring costs remain on budget.	Operate EGAS compressor for 3-month trial, ensuring costs remain on budget.	Budgeted Rental and Maintenance Cost: $13.0K	Actual Rental and Maintenance Cost: $15.4K

Table 2.1: Tasks, Goals, Deliverables & Results

B. PROJECT UPDATE

This section is focused on the overall project.

3. KNOWLEDGE OR TECHNOLOGY OPPORTUNITY DESCRIPTION

Based on the Project Type, i.e. Knowledge Generation or Technology Development, that was identified the Application, please provide a narrative describing the opportunity the project represents using the following sub-headings.

- **Knowledge or Technology Gaps:** Explain the knowledge or technology gap that is being addressed through this project, along with the context and scope of the knowledge or technical problem.
- **Knowledge or Technology Description:** Include a discussion of the project objectives.
- **Updates to Project Objectives:** Describe any changes that have occurred compared to the original project objectives. Include overall objectives of any testing or simulations to date.

RESPOND BELOW

Knowledge or Technology Gaps:

Currently there are not many options for cost effective sour spec compressors. Most sour spec compressors are very expensive, and therefore only have applications where there are large gas volumes. The EGAS compressor offers a cost effective solution that can be used on lower volume applications.

Sour spec compression gives the ability to reduce surface casing pressures of sour wells, which causes the majority of the gas to be produced up the annulus. By separating the gas out of the liquid stream in the wellbore, it can readily be conserved at surface.

The EGAS compressor can be manufactured in many sizes depending on the gas volumes and thus can be used in many applications.

Knowledge or Technology Description:

The EGAS compressor is a double acting reciprocating compressor which compresses gas without the need for a scrubber or blow case. The compressor works in sour applications, and in addition can handle gas associated fluids. Objectives of the trial were to:

- Test compressor design and confirm it operates as advertised. I.e. a cost effective solution for low volume sour gas applications.
- Confirm compressor will increase gas flow up annulus.
- Reduce 131/09-32's casing pressure by 180 psi.

Updates to Project Objectives:

No changes.

4. PROJECT SCHEDULE

Please provide a narrative describing any updates to the project schedule using the following sub-headings.

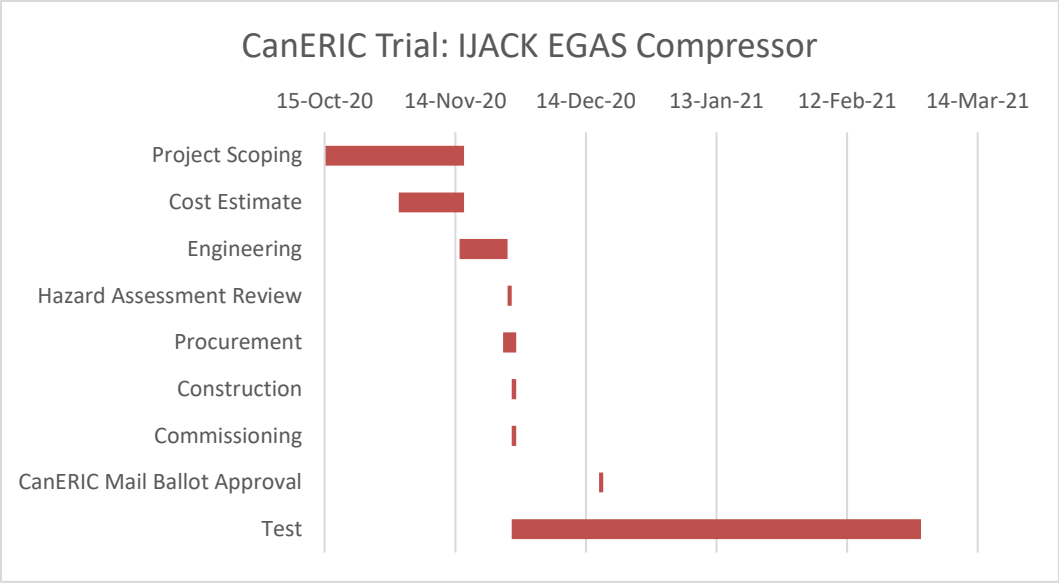
- **Project Progress:** Include a discussion of any changes to the schedule and describe any challenges that have been encountered in executing the project as planned.
- **Gantt Chart Update:** Include an updated Gantt chart illustrating the original schedule, the progress of the project and any changes to the schedule for the project.

RESPOND BELOW

- **Project Progress:**
    - The project has concluded.
    - The install of the pump was on schedule.

- Trial adhered to original timeline.

- **Gantt Chart Update:**



Please provide a narrative outlining any updates to the budget for this reporting period and the project.

- Summarize the project expenditures in the table below so that the information is current as of the end of the reporting period.

RESPOND BELOW

5. BUDGET

Total Project Budget	Total AI Funding	Total Expenditures for the Reporting Period	AI Payment for the Reporting Period	Total Project Expenditures to Date	AI Total Contribution to Date (including current payment)
$50,775	$25,388	$52,171	$25,388	$52,171	$0

Table 5.1: Budget Summary

	Deemed value/Actual cost	Costs paid by others	Costs paid by CanERIC	Actual CTD
Mob, Install, Takedown	$8,100	$0	$8,100	$5,334
Operator time/testing	$19,500	$15,233	$4,268	$21,280
Facility value	$10,155	$10,155	$0	$10,155
Testing	$0	$0	$0	
Equipment	$13,020	$0	$13,020	$15,402
TOTAL	$50,775	$25,388	$25,388	$52,171

Table 5.2: Cost Details

C. MILESTONE PROGRESS AND LEARNINGS

This section is focused on the current and next milestone.

1. MILESTONE PROGRESS

Please provide a narrative describing the progress made to achieving the objectives within this milestone.

- For each task within the milestone, describe the progress made with respect to the activity's advancement. Please note any variances to the planned activity and discuss the implications of these variances.
- If there are additional project activities that are relevant to the report, please include the details of these results and provide any supporting documents as an appendix to the report as necessary.

RESPOND BELOW

- **Objectives of the test:**
  1. **Test compressor design and confirm it operates as advertised**. I.e. can reduce casing pressure, handle sufficient gas rates, and operate under sour conditions. This was confirmed throughout the test. See Appendix for associated data.
  2. **Confirm compressor will increase gas flow up annulus**. This was confirmed by an increase in downhole pump efficiency and gas rate after the compressor was installed. Downhole pump efficiency was initially increased by 47%. Gas rate was initially increased by 0.9 E3m3/d.
  3. **Reduce casing pressure of 131/09-32 by 180 psi:** The compressor reduced casing pressure by 177 psi.

2. LEARNINGS DURING MILESTONE

Please discuss the key learnings obtained during this reporting period.

- Discuss the importance of the learnings for the project advancement.
- As appropriate, describe key findings and lessons learned for each task within the milestone, and the importance of those learnings towards the project advancement.

RESPOND BELOW

- **Corrosion inhibitor:** When the compressor was initially installed, the 131/09-32 well was on a corrosion inhibitor program, whereby chemical was dripped down the annulus. After the compressor was installed, the dripped chemical began diverting to the suction of the compressor, instead of down the wellbore. Two issues came from this. First, the well was no longer protected from corrosion, and second, a precipitate formed in the suction of the compressor, causing blockage and some minor damage. To rectify the problem, the liquid corrosion inhibitor was replaced with corrosion inhibitor pellets. Since implementing this change, there have been no issues, and the corrosion inhibitor is reaching the bottom of the wellbore as intended.

3. EXPECTED ACTIVITIES IN THE NEXT MILESTONE

Please provide a narrative outlining the key tasks for the upcoming reporting period.

- Describe the expected activities for the next reporting period, including any anticipated differences from the project workplan.

RESPOND BELOW

- The project has concluded.

D. METRICS

Please provide a narrative outlining the project's performance metrics. Please use the following sub-headings in your narrative. If this is a mid-project Milestone Report, please comment on significant deviations in this narrative. If this is a Final Milestone Report, please be more specific and comment on all the Metrics that were originally identified for the project. **The *Work Plan, Budget and Metrics* workbook, *Performance Metrics* tab requires an update only at the end of the project.**

- **Clean Resources Metrics:** Discuss how current results of the project may impact the Clean Resources Metrics as described in the *Investment Agreement – Schedule C*. Focusing on major deviations from the plan, discuss any changes or updates to these metrics and the driving forces behind the change. Include any mitigation strategies that might be needed if the changes result in negative impacts.
- **Program Specific Metrics:** Discuss how current results of the project impact the Program Metrics as described in the *Investment Agreement – Schedule C*. Discuss any changes or updates to these metrics and the driving forces behind the change. Include any mitigation strategies that might be needed if the changes result in negative impacts.
- **Project Success Metrics:** Discuss the progress of the project strategic metrics and describe the path forward to successfully achieving them.

RESPOND BELOW

- **Program Specific Metrics:**

1. **Well Metrics**

	Before Compressor Install	After Compressor Install	Delta
Oil (m3/d)	3.8	7.3	3.5
Water (m3/d)	3.5	13.8	10.3
Gas (E3m3/d)	0.6	1.5	0.9
Casing Pressure (kPa)	1427	214	-1,213
Tubing Pressure (kPa)	1434	1772	338
Fluid Level (m)	9	342	333
Flow Temp (deg C)	13	20	7
Pump Efficiency (%)	30	77	47

E. REPORT SIGNATURES

Publication of Non-Confidential and Aggregate Information by Alberta Innovates

Alberta Innovates may (1) publish and/or disseminate in the public domain certain information contained within this Milestone Report as a way to promote success stories about innovation in the Province of Alberta and/or (2) use certain information contained within this Milestone Report as a way to verify information contained herein. On these bases, Alberta Innovates deems the following information in this Milestone Report to be non-confidential and subject to disclosure by Alberta Innovates in its sole discretion at any time: The information captured in the Applicant and Project Summary Tables, including but not limited to Applicant and Applicant Representative Contact Information, Project Title, Project Start and End Dates, Project Start and End TRLs, Total Project Cost, Alberta Innovates Funding Amount, the Names of Contributing Partners, and Section A: Executive Summary.

Alberta Innovates will also aggregate certain information contained within this Milestone Report for the purposes of reporting or dissemination in the public domain. For clarity, 'aggregate' means removal of personal identifiers such as names, locations and addresses of the Applicant and employees, and combining such information with that of other Applicant submissions.

Consent and Declaration of Applicant

By submitting this Milestone Report, including any supporting documentation, I, in my capacity as the authorized representative of the Applicant, legally represent for and on behalf of the Applicant that:

- The Applicant acknowledges, understands and agrees to the disclosure of non-confidential information and aggregate information as identified above, by Alberta Innovates in its sole discretion;
- The Applicant Representative is legally authorized to submit this for and on behalf of the Applicant;
- All information contained in this Milestone Report, is true and accurate;

Applicant Representative Name and Title	**Applicant (Organization)**
Signature	**Date**

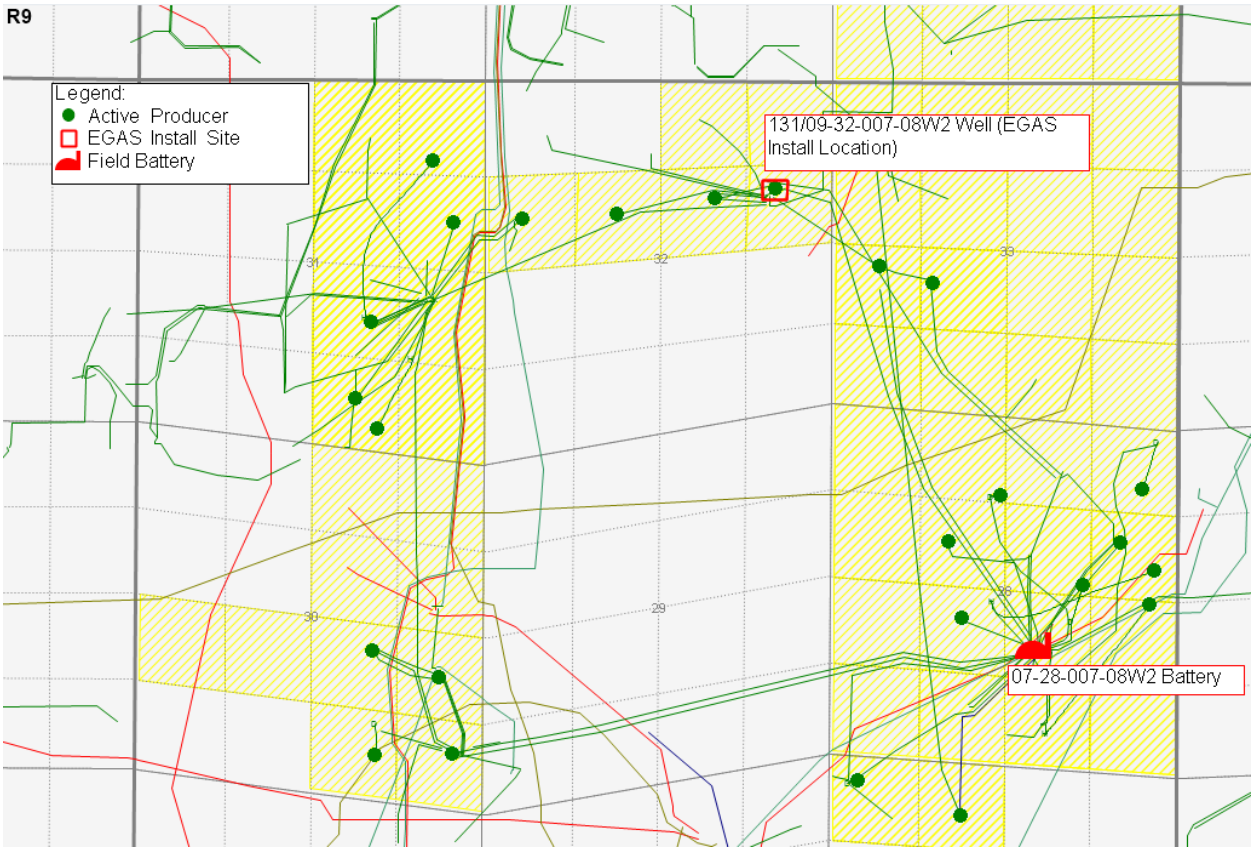
F. ATTACHMENTS

Please include all relevant attachments which may include but not limited to:

- Updated Gantt chart
- *Work Plan, Budget and Metrics* workbook updated to reflect completed milestone
- List of all communication exercises from this milestone
- Final Milestone Report: List of all academic papers, publications and conference presentations for the entire project

G. APPENDIX

APPENDIX A: MAP


R9
Legend:
Active Producer
EGAS Install Site
Field Battery
131/09-32-007-08W2 Well (EGAS Install Location)
07-28-007-08W2 Battery
31
32
33
30
29
28

APPENDIX B: EGAS COMPRESSOR DATA OUTPUT

Outage due to corrosion inhibitor blockage. See Section C, 2: Learnings During Milestone for details.

APPENDIX C: 131/09-32-007-08W2 PRODUCTION PLOT

APPENDIX D: 131/09-32-007-08W2 FLOW TEMPERATURE AND PRESSURE