PTAC

Alberta Upstream Petroleum Research Fund

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26-WDRC-RFP-03

SOURCE AND LEAK PATHWAY IDENTIFICATION PROCESSES AND TOOLS

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www.ptac.org
Suite 1550,
520 Fifth Avenue SW
Calgary, AB. T2P 3R7

1. Background & Rationale

The Well Decommissioning Research Committee (WDRC) of the Alberta Upstream Petroleum Research Fund (AUPRF) has identified a recurring and cross-cutting diagnostic gap affecting multiple priority topics: improving confidence in surface casing vent flow (SCVF) and gas migration (GM) source identification; distinguishing flow path/origin versus storage zones; and evaluating the applicability of logging tools for multi-annular vent flow problems. Recent discussions emphasize that diagnostics and source attribution are the central technical bottleneck in progressing remediation, verifying success, and enabling risk-based closure decisions—particularly in complex well configurations and multi-annular scenarios.

Multiple well decommissioning challenges share an overarching diagnostic theme: improving confidence in vent flow and GM source identification; distinguishing flow path/origin versus storage zones; and evaluating logging tool applicability for multi-annular vent flow issues. The combined problem is that current diagnostic processes/tools do not reliably produce actionable, confidence-rated pathway identification across complex well configurations, slowing progress on remediation and risk-based closure decisions.

Key diagnostic challenges that need to be addressed:

- Source ambiguity: similar surface observations may arise from different mechanisms (e.g., behind-casing channelling, casing/tubing leaks, wellhead seal leakage, shallow gas, or multi-annular communication).
- Multi-annular complexity: simultaneous or intermittent flow across multiple annuli can obscure the true origin and leak pathway, especially in legacy well configurations.
- Commingling and fingerprinting limits: gas composition and isotopic signatures can be informative but may be non-unique when multiple sources mix along the pathway.
- Low-rate / low-pressure flow: SCVF can be intermittent and difficult to quantify repeatably; measurement accuracy at low flows can be a limiting factor in diagnosis and verification.
- Tool limitations and uncertainty: many cased-hole logs and cement evaluation methods infer conditions indirectly and can be ambiguous; reliable interpretation often requires integrating multiple measurements and well history.
- Gas migration variability near surface: GM can be spatially and temporally variable in soil, influenced by near-surface conditions; methods must address false positives/negatives and define defensible detection boundaries.
- Data and access constraints: incomplete records, uncertain cement types, limited annulus access, or obstructions can constrain diagnostics; the workflow must explicitly manage data gaps.

The diagnostics suite must be designed to directly support surface casing vent flow (SCVF) and gas migration (GM) requirements, including testing, classification, reporting, repair/deferral decisions, and record retention expectations as set out in AER Directive 087 (Well Integrity Management) and the related well life-cycle requirements in AER Directive 020 (Well Abandonment).

The suite should remain usable across other Canadian jurisdictions where similar concepts apply. In particular, proponents should note overlaps with British Columbia and Saskatchewan, and identify which elements of the Alberta-focused workflow map cleanly to those jurisdictions and where material differences exist (e.g., thresholds, submission platforms, notification timing).

In addition to workflow standardization, WDRC seeks an assessment of existing diagnostic prototypes and commercial tools, and the definition of equipment requirements and validation methods needed to enable integrated surface and downhole diagnostics that are field-ready for Alberta conditions. Proponents must demonstrate how outputs support Alberta regulatory expectations (e.g., testing/classification/reporting/record retention) and reference where that mapping is addressed in their deliverables.

2. Benefits to Producers

Producers benefit when diagnostic efforts reliably translate into actionable, confidence-rated pathway identification because it reduces the cycle time and cost of repeated interventions and improves the defensibility of risk-based decisions. WDRC and AUPRF project reporting has highlighted that accurate leak path identification and proper placement are key to remediation success and that persistent gaps remain in reliable pathway identification, placement, and verification.

Expected producer benefits include:

- Fewer diagnostic/rework loops by standardizing a pathway identification process that produces usable outputs (not just raw data).
- Higher repair success probability through better linkage between diagnostic findings, pathway hypotheses, and treatment/access planning.
- Improved auditability and knowledge transfer, enabling better learning across projects and well types via structured evidence packs and documented rationale for confidence ratings.
- Better alignment with risk-based approaches by producing outputs that support defensible closure decisions and prioritization.

3. Research Objectives

Proponents must deliver an integrated “Diagnostics Suite” consisting of processes, evaluation methods, and tools (which may include software, templates, protocols, and/or field-ready workflows) that accomplish the following objectives:

- Standardize pathway identification workflows for SCVF/GM that are repeatable across common and complex well configurations (including multi-annular cases).
- Produce confidence-rated pathway hypotheses that distinguish (a) origin/source vs (b) storage zones and (c) flow paths—explicitly documenting uncertainty and evidence strength.
- Evaluate diagnostic tool applicability (including logging tool applicability for multi-annular vent flow) and define a decision logic for selecting tools based on well configuration, suspected mechanisms, and uncertainty.
- Define minimum evidence standards and QA/QC for diagnostics that support auditable decision-making and enable comparative learning across wells/projects.
- Enable verification planning by integrating post-treatment monitoring considerations where they support pathway confirmation and remediation validation.
- Extend the diagnostics suite to explicitly support development and field deployment of integrated surface and downhole diagnostic equipment (hardware + software) that improves leak pathway and source attribution.
- Assess existing prototype and commercial technologies (surface SCVF quantification, downhole leak-location tools, fibre-optic DAS/DTS, sampling systems) for current status, Alberta usability, and remaining gaps.
- Define engineering-grade functional and non-functional requirements (hazardous area suitability, calibration, environmental limits, data standards) to enable procurement and validation of new diagnostic equipment.

4. In Scope

This is a directed and tightly scoped RFP. The intent is to obtain implementable, producer-ready workflows and tools that reduce ambiguity in SCVF/GM pathway attribution and support defensible decision-making. Proposals that are primarily broad literature reviews or conceptual discussions—without producing practical workflows, decision logic, templates, confidence-rating methods, and worked examples suitable for direct producer use—may be deemed non-responsive. The proposal must address the following in-scope elements:

- Diagnostic process and workflow design

    - A structured end-to-end diagnostic workflow from initial screening through hypothesis generation, targeted diagnostics, interpretation, and decision outputs.
    - Explicit handling of uncertainty and confidence scoring/ratings for pathway identification, with rationale capture.
- Tool and method assessment (diagnostics suite content)
    - A comparative assessment of diagnostic tools/methods relevant to SCVF/GM, including guidance on logging tools for multi-annular vent flow issues.
    - A "diagnostics selector" (decision logic) that links problem type and uncertainty to recommended diagnostic options and expected evidentiary value.
    - Explicitly address when single tools are likely to be ambiguous and specify integrated diagnostic combinations (e.g., cement evaluation + noise/temperature + pressure/bleed-down diagnostics + gas sampling/fingerprinting) to raise confidence.
    - Include guidance for selecting and interpreting gas sampling (composition and isotopes) and explain limitations due to commingling and multi-source pathways.
    - Include guidance for low-rate vent measurement and repeatability controls (instrument suitability, stabilization time, and data logging).

- Evidence capture and data products
    - An "evidence pack" approach (templates and structure) for compiling well history, integrity indicators, SCVF/GM indicators, and explicit data gaps, to support reproducibility and auditability.
    - Include a data dictionary and minimum metadata requirements for all diagnostic inputs/outputs (well state, pressure/temperature conditions, tool settings, calibration/QA, timestamps).
    - Provide an evidence-strength rubric (e.g., direct vs inferred indicators) and requirements for documenting alternative hypotheses and why they were rejected.

- Equipment Development & Prototype Assessment. This RFP also invites proponents to include (as an optional but encouraged component) an equipment-oriented workstream that:
    - Assesses existing prototypes and commercial tools applicable to SCVF/GM source and pathway identification in Alberta, and
    - Defines actionable requirements and validation approaches for integrated surface and downhole diagnostic equipment. The equipment workstream is intended to complement—not replace—the workflow and evidence-pack

deliverables. Proponents may propose evaluation of existing devices, identify readiness gaps (e.g., hazardous-area certification, cold-weather operation, calibration/QA, data interoperability), and propose focused development or adaptation to address Alberta well configurations and regulatory needs.

- Prototype scan and status: identify existing prototypes/commercial tools relevant to SCVF/GM diagnostics (surface meters, remote shut-in/monitoring systems, downhole noise/temperature/ultrasonic tools, DFOS DAS/DTS) and summarize maturity, Alberta usability, and data defensibility.

5. Out of Scope

The following are out of scope unless explicitly proposed as a limited demonstration activity that directly supports the deliverables:

- Performing physical well repairs, abandonment operations, or construction work as a primary activity.
- Developing broad emissions programs unrelated to SCVF/GM pathway identification (e.g., generalized LDAR program design) beyond what is needed to avoid misattribution and support diagnostics.
- Producing a full jurisdiction-wide GHG inventory (except where narrowly required for diagnostic interpretation or decision logic inputs).
- Purely theoretical reviews without producing implementable workflows/tools and confidence-rated outputs usable by producers.
- Proposals heavy on general literature review without implementable workflow/tools will be considered non-responsive

6. Project Deliverables

Proposals must commit to producing the following deliverables (with clear versioning and producer-ready formats):

- Milestones, Schedule, and Outcome Tracking: Proponents must include a delivery schedule that provides time estimates, milestone dates, and completion dates for each required deliverable listed in this RFP.
- Diagnostics Suite Framework (core deliverable): A documented, step-by-step diagnostic workflow that results in confidence-rated pathway identification outputs and clearly separates source/origin vs storage vs flow path conclusions.
- Tool Applicability & Selection Guide: A comparative assessment and selection logic for diagnostic tools, including explicit guidance for multi-annular vent flow and logging tool applicability limitations and best-fit contexts.

- Evidence Pack Templates + Minimum Evidence Standards: Practical templates for evidence capture (well integrity indicators, SCVF/GM indicators, data gaps) and minimum QA/QC expectations for diagnostic data collection and interpretation.
- Case Study Package (demonstration of use): A set of worked examples (case studies) that show how the diagnostics suite produces confidence-rated pathway conclusions and how the conclusions inform decisions.
- Validation Plan and Acceptance Criteria: A validation/ground-truthing plan with measurable acceptance criteria, including QA/QC, documentation practices, and (if field work is proposed) how results will be assessed against independent indicators.
- Final Report + Producer-Facing Summary: A final technical report and a concise producer-facing guidance document summarizing recommended workflows, tool selection logic, and how to interpret confidence ratings.
- Prototype & Commercial Technology Landscape: A structured inventory and assessment of relevant surface and downhole diagnostic technologies (including any existing prototypes), documenting Alberta usability, maturity/TRL, deployment constraints, data quality/QA, and gaps relative to SCVF/GM pathway attribution needs.

7. Success Criteria

For clarity, success requires that the final suite be usable “as delivered” by producers (not requiring extensive additional development), and that it demonstrably reduces off-scope diagnostic iteration by producing confidence-rated, evidence-traceable pathway conclusions. A proposal will be considered successful if it demonstrates that the delivered diagnostics suite:

- Produces actionable outputs: Delivers pathway identification conclusions that are usable for next-step decisions (e.g., diagnostic follow-up selection, remediation planning, verification planning), not merely data collection.
- Improves confidence and transparency: Includes a documented confidence rating approach and shows traceability from evidence → interpretation → conclusion, including explicit treatment of uncertainty and data gaps.
- Addresses complex configurations: Explicitly covers multi-annular vent flow cases and provides defensible guidance on logging tool applicability (where tools are informative, ambiguous, or not recommended).
- It is reproducible and auditable: Provides evidence pack templates and QA/QC guidance sufficient for consistent application across teams and for learning across wells/projects.
- Demonstrates performance through examples/validation: Demonstrates the workflow on case studies and includes a validation plan with acceptance criteria appropriate to the proposed scope and data access.