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Cyclic Solvent Process (CSP) Short Horizontal Well (SHW) Experimental Pilot

Approval 11604



Background of Scheme

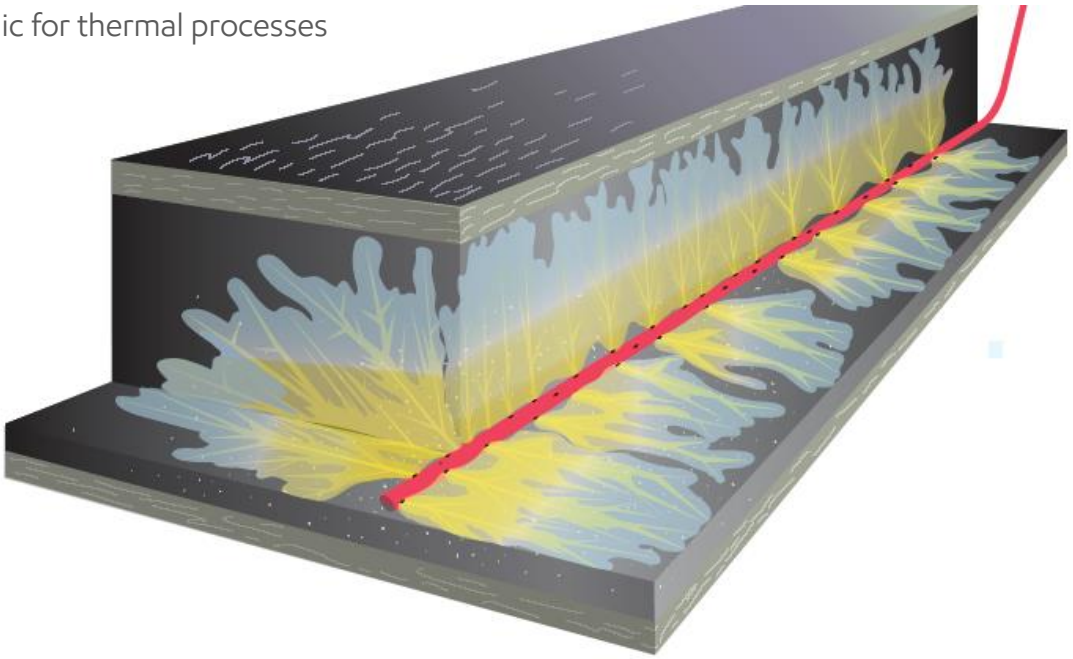
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CSP Process Background

- **Cyclic Solvent Process (CSP) is a non-thermal, in-situ, bitumen recovery process**
- **Alternating cycles of solvent injection and solvent-bitumen production via horizontal well**
  - Solvent injected as liquid below formation fracture pressure
  - Solvent penetrates reservoir through viscous fingering, reduces bitumen viscosity
  - Production through gravity segregation, re-compaction, and gas/solvent vaporization
  - Blowdown at end of process can maximize recovery

- **Non-thermal solvent injection has significant benefits**
  - Potential to access reservoir not economic for thermal processes
  - Significant reduction in GHG emissions
  - No fresh water usage

- **CSP research program includes**
  - Short horizontal well pilot
  - Several smaller field trials
  - Laboratory experimental program
  - Simulation study



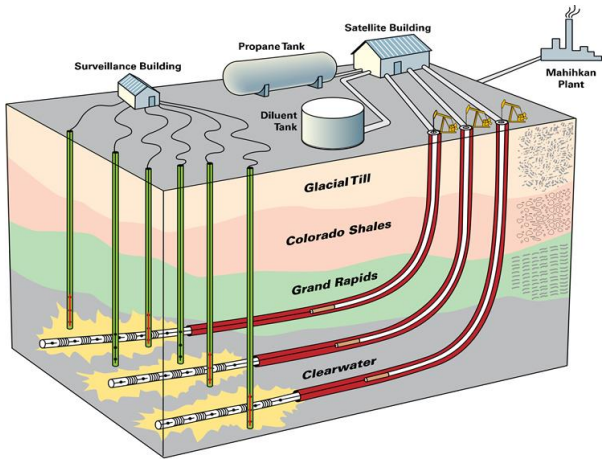
CSP SHW Pilot Background

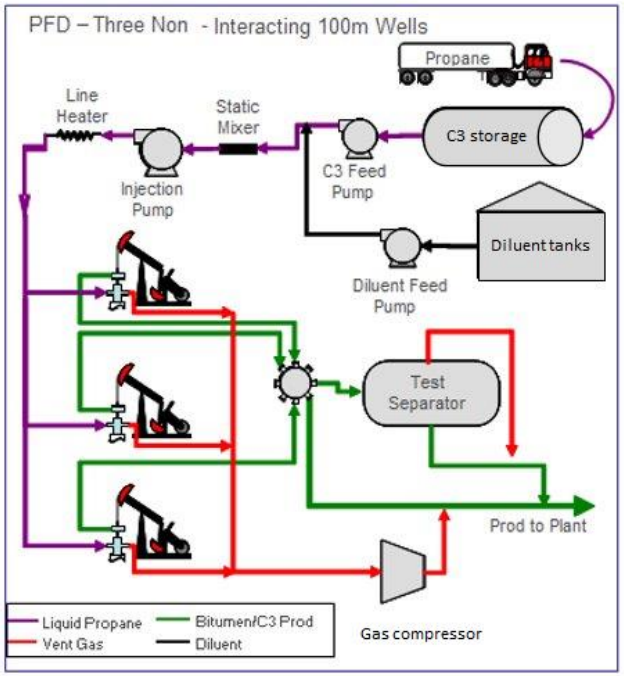
Pilot Facilities

- Three 100 [m] horizontal injection/production wells equipped with downhole temperature, pressure measurement and electric heaters
- Six observation wells with mix of thermal, pressure and passive seismic monitoring equipment
- Surface
  - Storage for propane, diluent, water, methanol, nitrogen
  - High pressure (solvent, water) injection facilities with heaters
  - Artificial lift
  - Separation and flow measurement by 3-phase separator, 7 Coriolis meters, 4 turbine meters
  - Process heating and heat trace
  - Buried pipeline to connect to field gathering system
- Liquid and gas sampling throughout pilot for compositional analysis
- Measurement, Accounting, and Reporting Plan (MARP) includes metering of solvent, load fluid application and water injection
- Uses existing Mahihkan plant for production gathering and processing

Pilot overall plan

- Each well to inject up to ~14,000 [m^3] of solvent over pilot operation
- Injection includes solvent (propane and diluent) and water
- Three wells to be used to test injection/production scenarios
- Expect to gain technical data and operating experience with the CSP process to assess viability



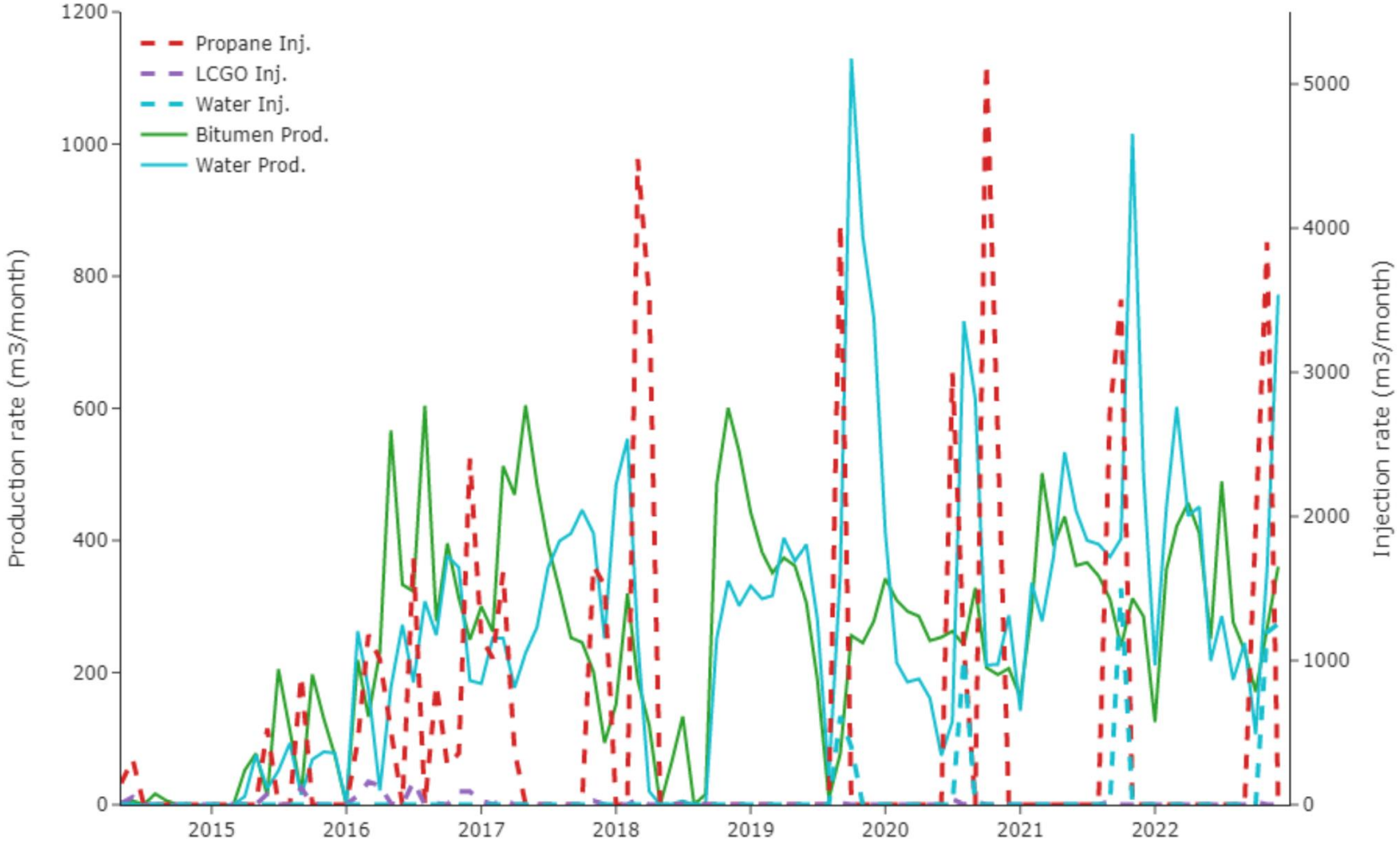


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Subsurface

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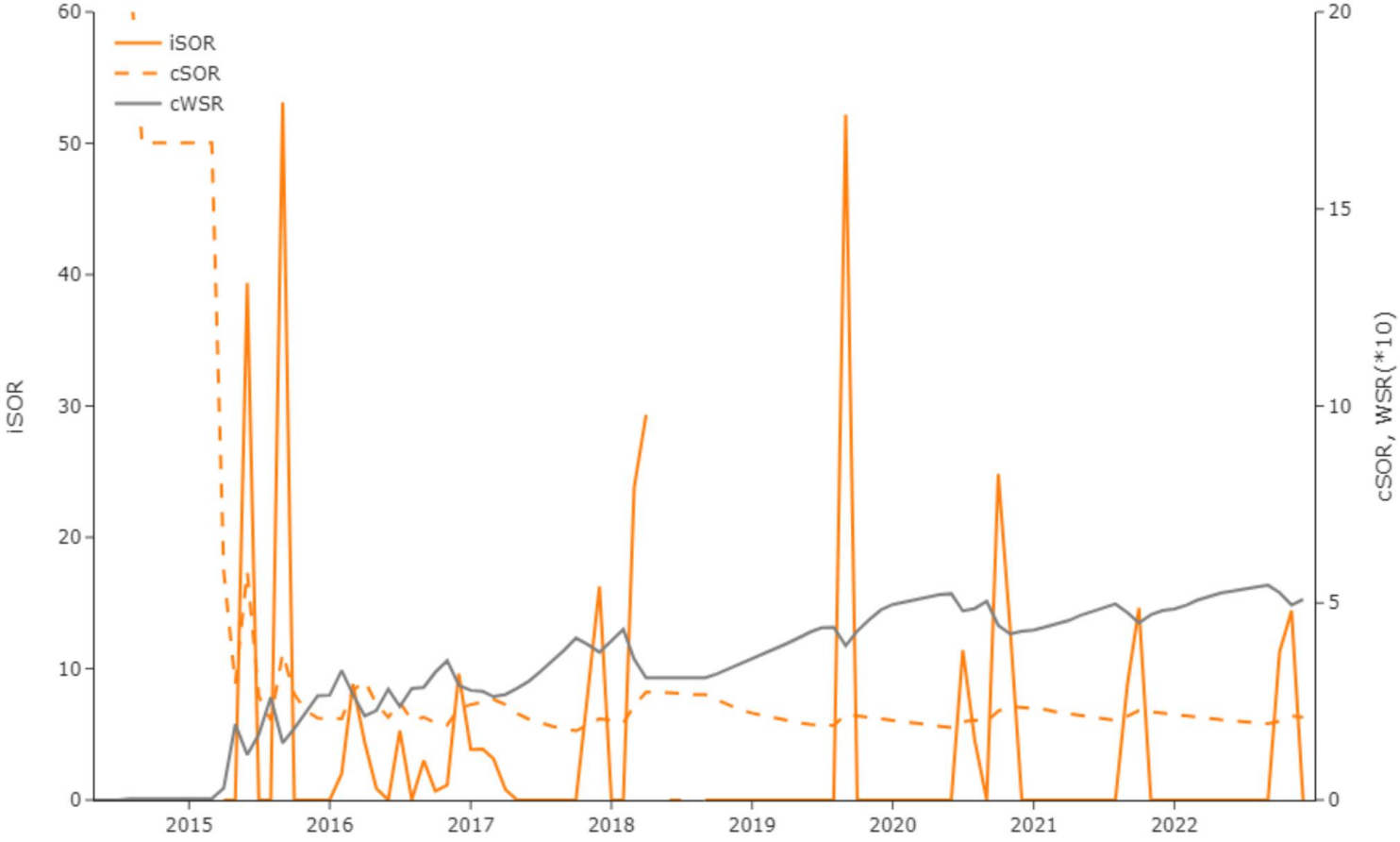
CSP Pilot Production Performance



- Water injection started in 2019 for water-chase enhancement trial
- All three wells are actively in production throughout the life time of pilot

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CSP Pilot Production Performance

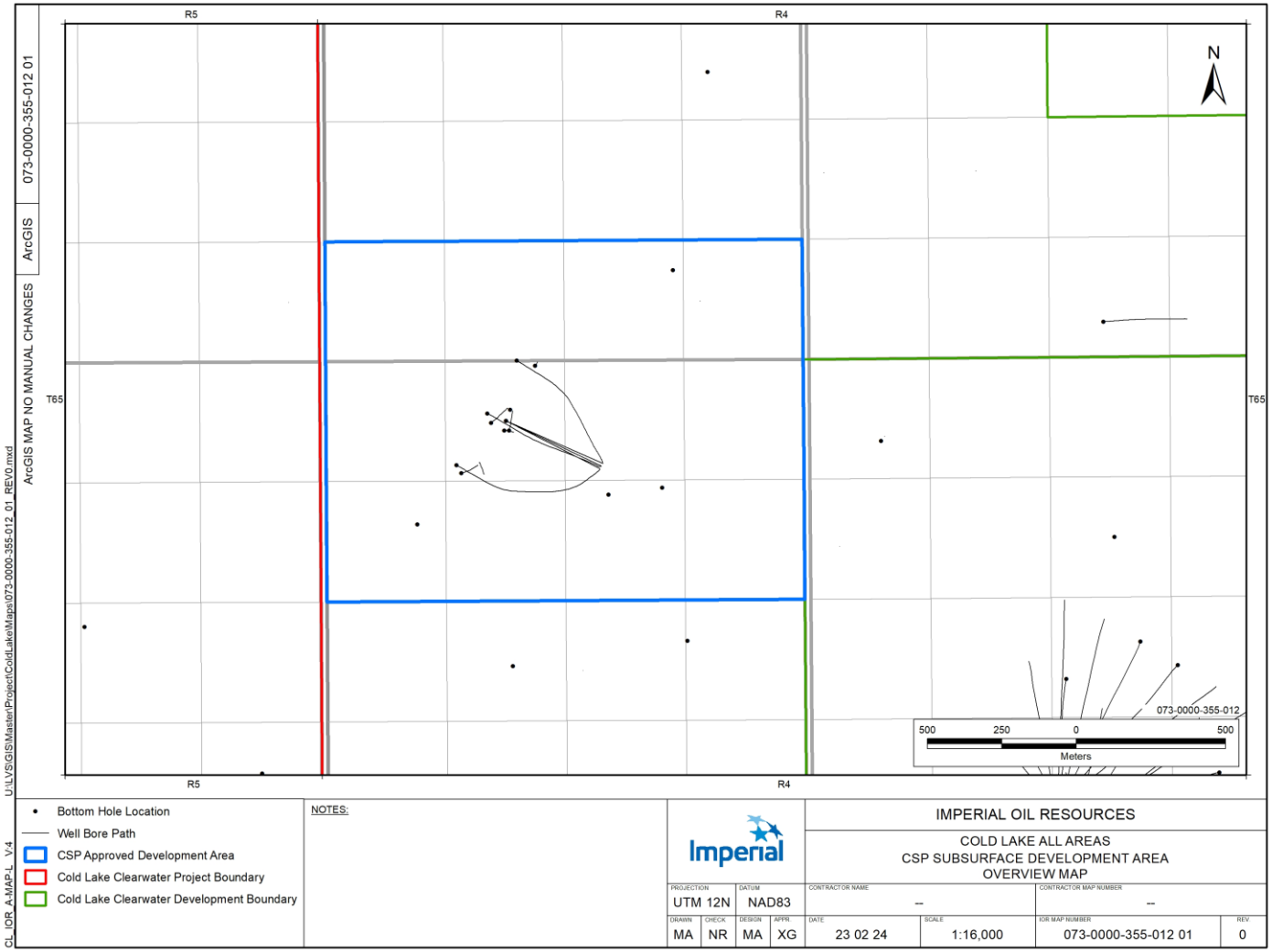


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Major Events

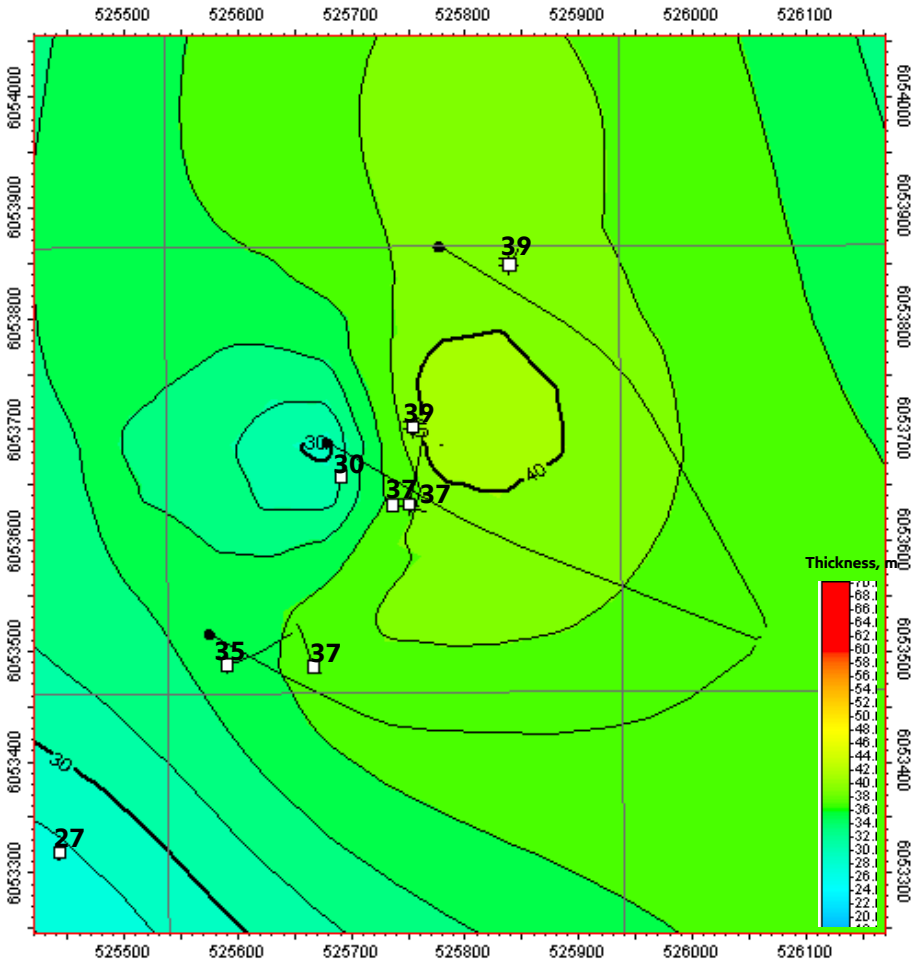
Time	Events
June 2014 – Aug 2014	Pilot interruption due to heavy liquid formation in the surface facility (e.g. wellhead, test separator, group line and pipeline) and hydrate formation in the pipeline causing multiple plugging issues
Sept 2014 – April 2015	Develop pilot facility and operational solution with main focus on the flow assurance solvent study and facility changes/upgrades
June 2015 – Dec 2016	Light Catalytic Gas Oil (LCGO) co-injection with solvent
Dec 2015 – Feb 2016	Facility changes implementation including pipeline upgrading, surface liquid system boosting and change in vent gas system
Mar 2018 – Oct 2018	Pilot interruption due to major pipeline plugging and associated integrity program
Sept 2019 – Present	CSP enhancement water-chase trial at pilot
Oct 2022 - Present	Isotope tracer utilized to verify potential inter-well communication

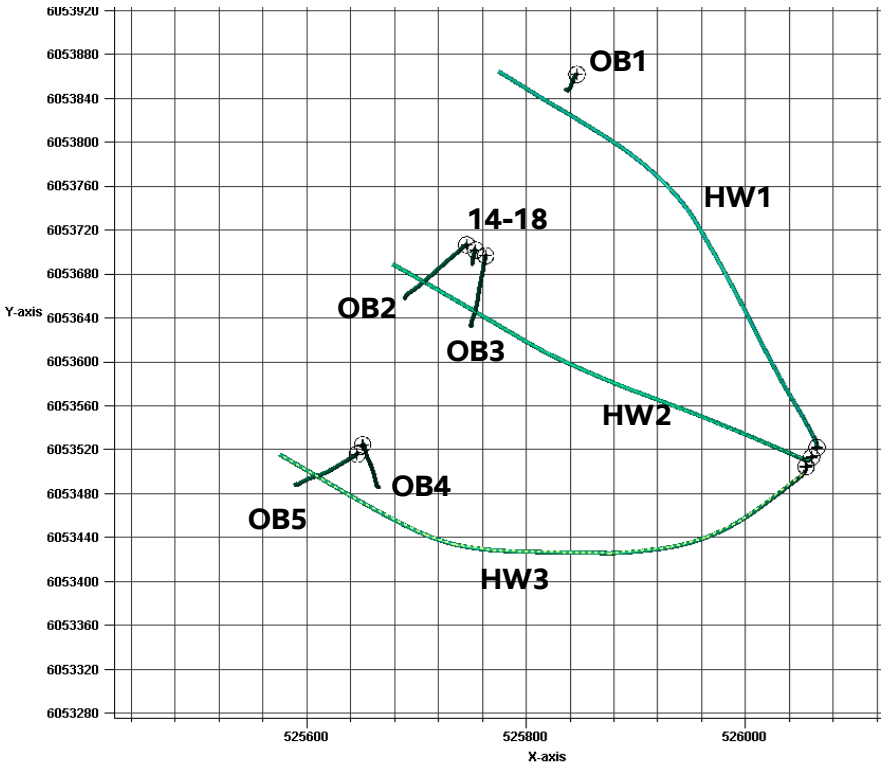
Drilled/Approved Map

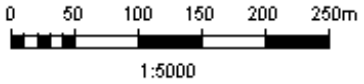


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Map	
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Horizon name	Signature

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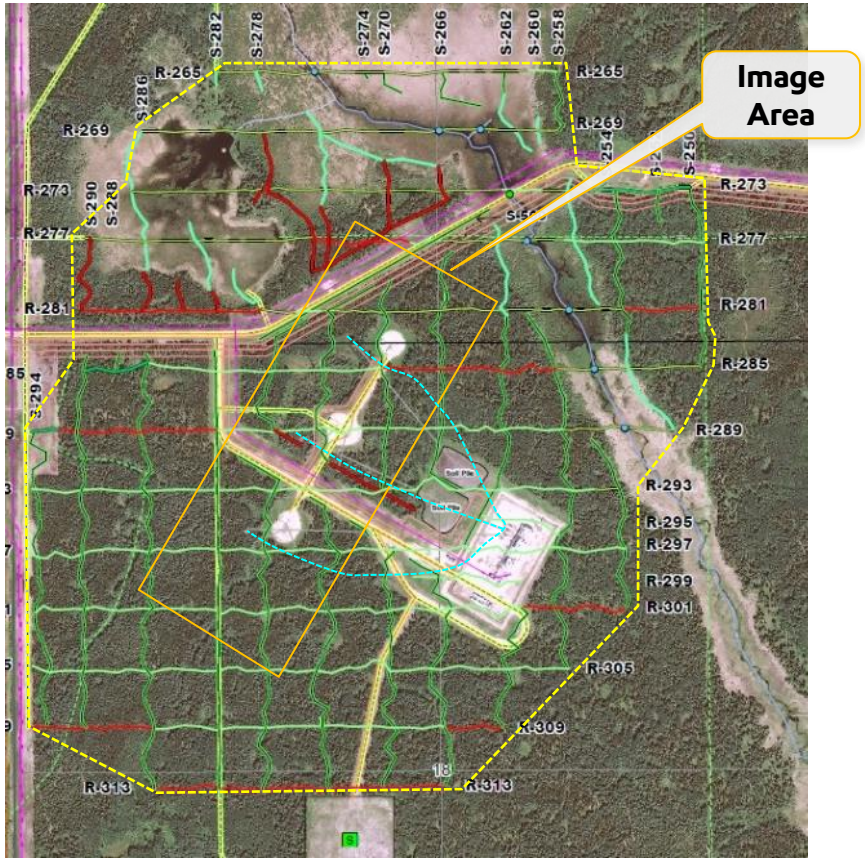
Gas/Water Intervals

- Geological interpretation shows no bottom water or top gas is in contact with the resource in the CSP pilot area

Geomechanical Anomalies

- No observed geomechanical anomalies within pilot area

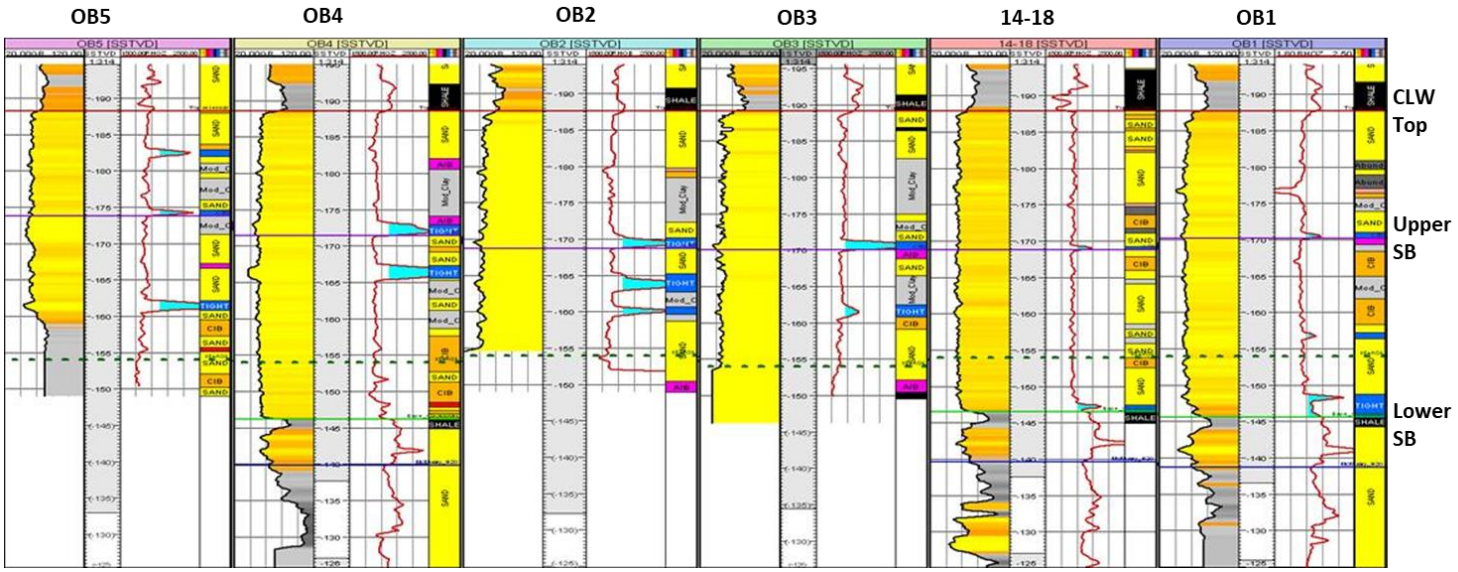
Seismic Acquisition

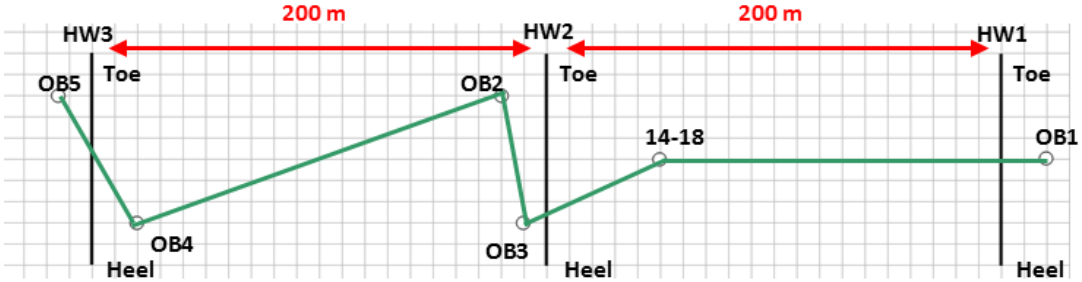


- Three seismic monitors (M1, M2 and M3) were conducted on CSP pilot area
  - M1: Dec 18, 2016
  - M2: Feb 8, 2017
  - M3: Dec 10, 2017
- No seismic acquisition requested in 2022

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Representative Well Cross Section





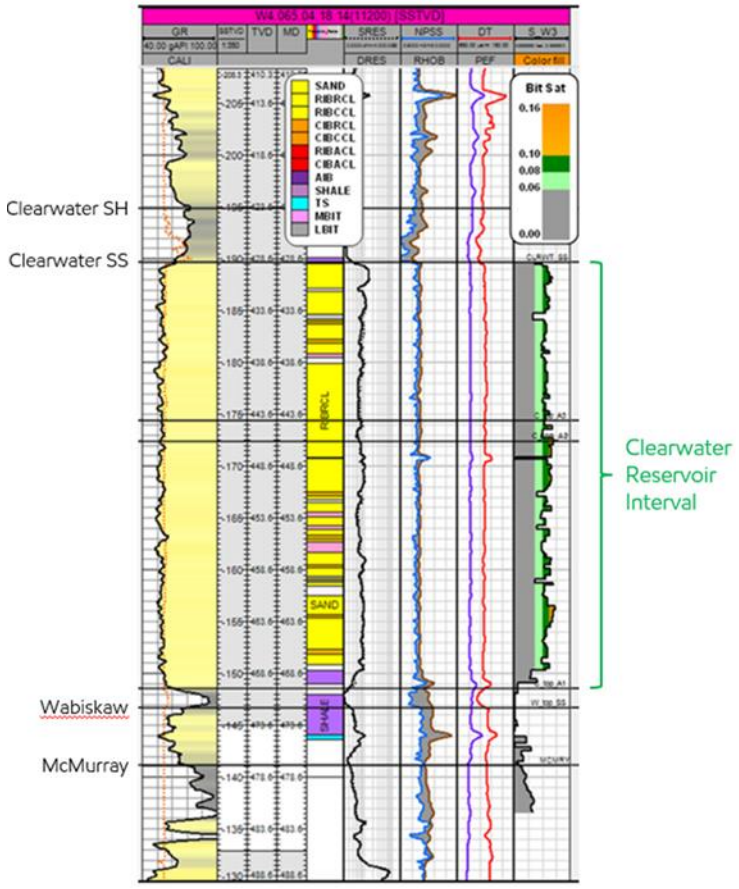
- Pay zone and primary target is annotated
- No top gas and bottom water observed

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Average Reservoir Properties and Original Bitumen in Place (OBIP)

Reservoir Properties	Value
Depth	Clearwater @ 400m
Environment of Deposition (EOD)	Deltaic
Reservoir characterization	• Characterized as "thick-lean" sand-rich reservoir • Contain two sequences (or reservoir units) separated by a tight streak
Gross thickness	~35m
Average net pay thickness	~25-30m
Average porosity	~0.35
Average bitumen wt%	~8.6% (5% to 12% range)
Average permeability	~1.0-1.7 Darcy
Bitumen viscosity	~100,000 to 1 million cp

Area	OBIP (*1000 m3)	EBIP (*1000 m3)	Drainage Area (sq km)	Recovery% to YE 2022	Ultimate Recovery%
Development area	10166	4067	1.92	0.25%	~0.5%
Combined active well area	318	127	0.06	8%	~13%



- CSP pilot project area is within Cold Lake operation approval 8558
- Ultimate recovery is referred to the bitumen recovery at end of currently planned cycle 7

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Co-injection

Co-injection

- Primary solvent propane has been co-injected with flow assurance solvent in early stage of CSP pilot (HW1 cycle 1-3 and HW3 cycle 1-5) to study the impact on injectivity, and mitigate potential flow assurance problem
- No co-injection implemented in the rest of cycles for HW1 and HW3
- No co-injection tested for HW2 all cycles

Injection strategy

- LCGO (Light Catalytic Gas Oil) is used for co-injection
- Two types of concentration have been tested, i.e. 6% and 12%
- LCGO recovery during production is around 75%-90%

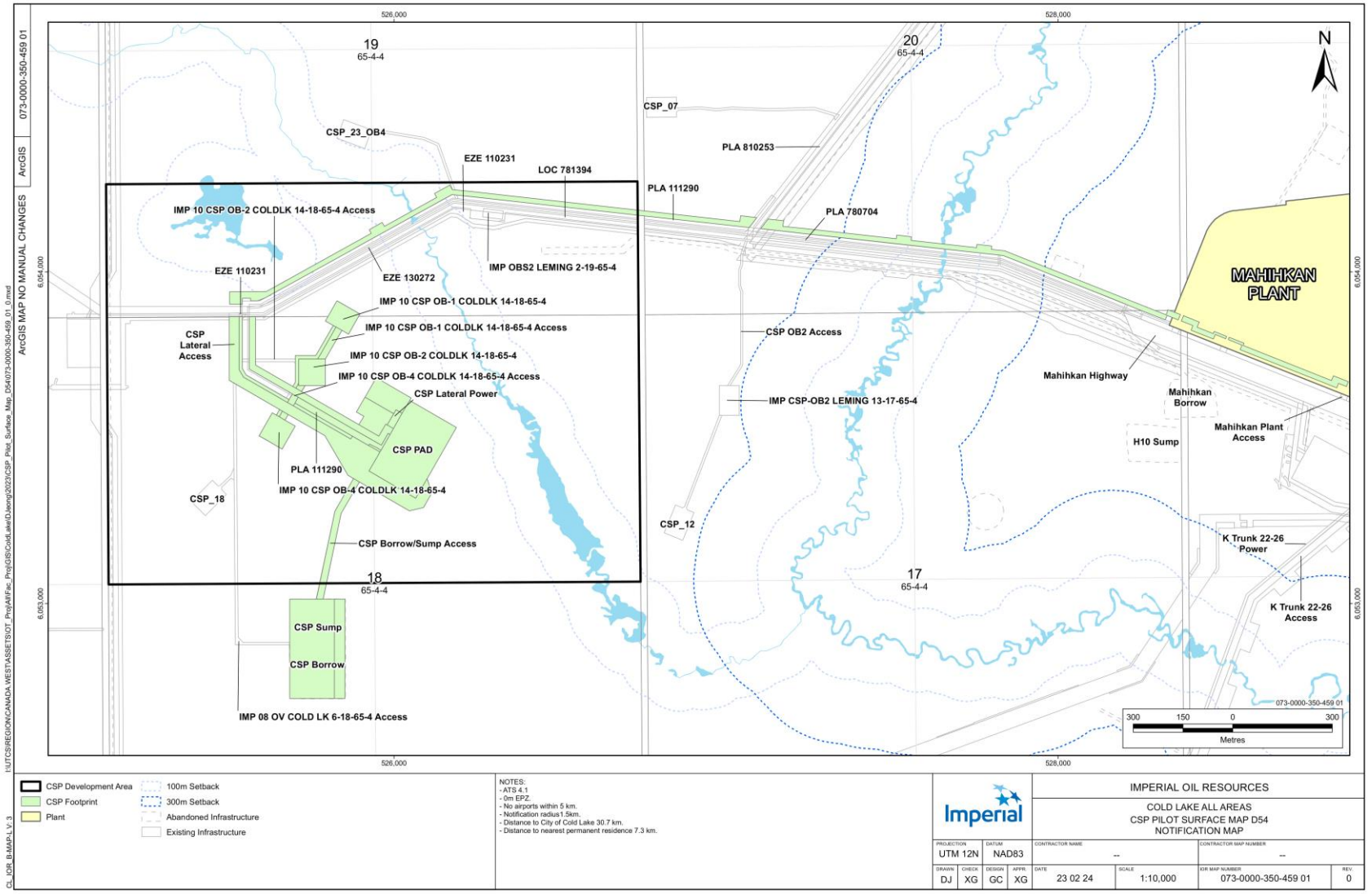
Co-injection impact

- Main objective of LCGO co-injection is to enhance the injectivity during injection
- The LCGO co-injection doesn't impact the overall CSP production
- The injection strategy (no co-injection) applied on HW2 demonstrated that injectivity is not significantly impacted by LCGO
- The LCGO co-injection was phased out for the remaining cycles

Surface

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Built and Planned Surface Infrastructure

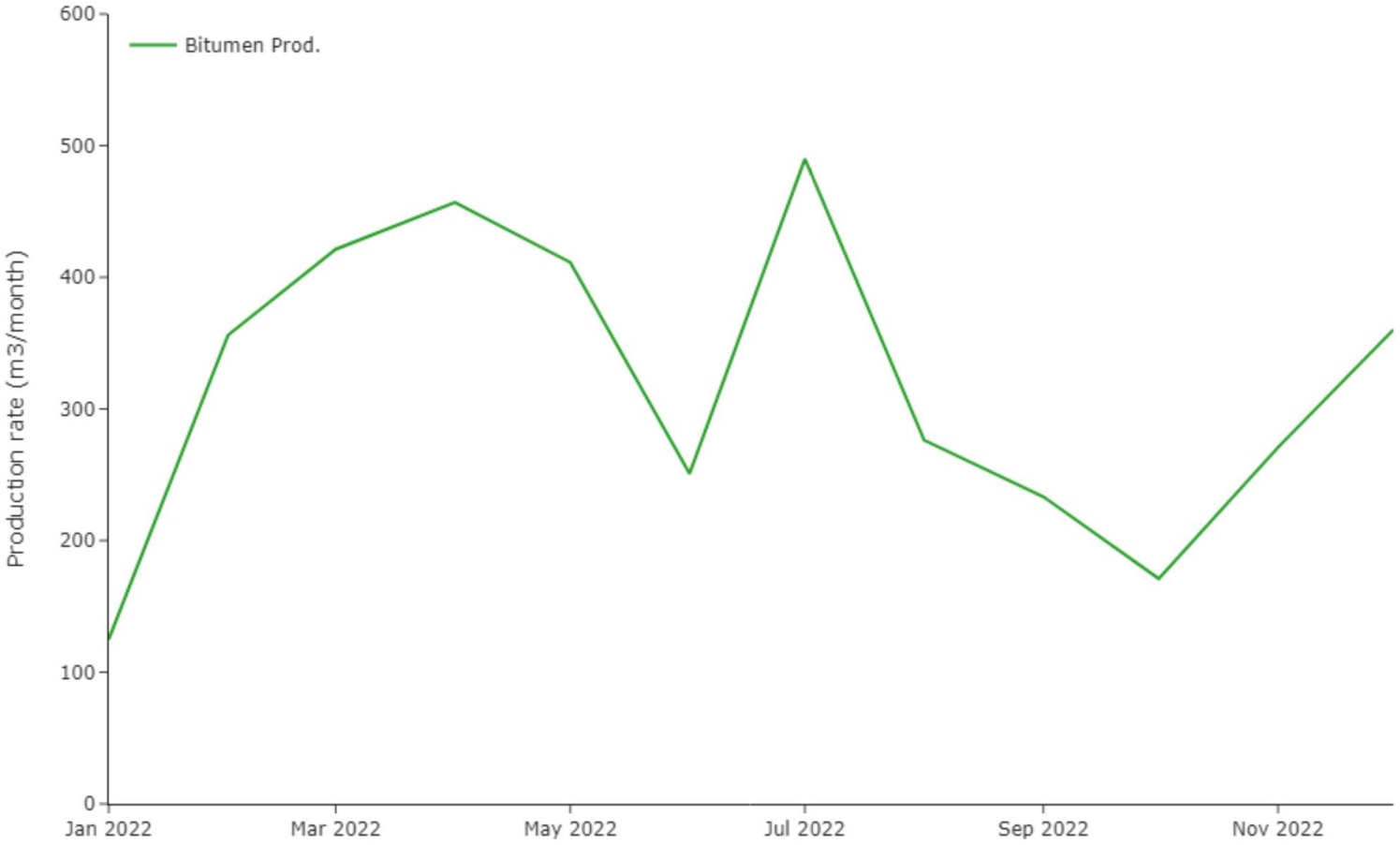


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Facility Modifications

- No modifications implemented to the central processing facility at CSP pilot in 2022 that required AER application approval

Comparison of Annual Operational Rate to Design



- CSP production sent to Mahihkan plant that is under Cold Lake operation approval 8558 without separate license

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Historical and Upcoming Activity

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Summary of Suspension and Abandonment Activity

- No suspension and abandonment activities at CSP pilot in 2022

Regulatory and Operational Changes

Regulatory

- Application number: 1938437
- Application description:
  - > Scheme amendment to allow isotope tracer to be injected during HW2 cycle 7 injection in order to better understand inter-well communication
- Approval date: August 16, 2022

Operation

- No events occurred in 2022 that could materially affect performance, energy or material balance
- No updates or major technical innovations were conducted in 2022

Account Compliance History

- No reportable incidents, voluntary self-disclosures, contraventions and associated remediation occurred at CSP pilot project in 2022

Scheme's Future Plans

- No activities are currently in company plan to occur in 2023 that could significantly alter scheme performance
- Company planning cycle extends beyond D054 submission date, therefore, any additions to pilot thereafter will be captured in 2024 submission
- Current scheme is still scheduled to expire on Dec 31, 2024