TEXAS CLASS III UIC
REGULATORY REQUIREMENTS

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IN-SITU RECOVERY

Non-invasive mining process

Uranium extracted by reversing the natural deposit process

Existing groundwater fortified with oxygen leaches the uranium from sands

Leached solution passed over ion exchange resin (much like in a domestic water softener) to recover uranium

Groundwater restored to pre-mining state
O2 INJECTION/CARBONATE COMPLEX

$U_4$ to $U_6$

$2\text{UO}_2 + \text{O}_2 \rightarrow 2\text{UO}_3$

$\text{UO}_3 + 2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{UO}_2(\text{CO}_3)_2 + \text{H}_2\text{O}$
INCREASE IN SALINITY BY ION EXCHANGE

\[ \text{Na}_2\text{UO}_2(\text{CO}_3)_2 + 2\text{RCl} \rightarrow \text{R}_2\text{UO}_2(\text{CO}_3)_2 + 2\text{NaCl} \]
INCREASE TRACE ELEMENTS/CA/NaHCO3

Oxidation, pH↓

Oxidation of iron sulfides – Fe (ppt) SO₄↑ pH↓
FeS₂ + 15/4 O₂ + 7/2 H₂O → Fe(OH)₃ [ppt] + 4 H⁺ + 2 SO₄⁻

Oxidation of ferroselite – Fe (ppt) Se↑ pH↓
FeSe₂ + 11/4 O₂ + 7/2 H₂O → Fe(OH)₃ [ppt] + 4 H⁺ + 2 SeO₃⁻

Oxidation of molybdenum sulfide – Mo↑ S↑ pH↓
2 MoS₂ + 9/2 O₂ + 2 H₂O → Mo₂O₅ + 4 H⁺ + 2 S₂O₃⁻
Thiosulfate

Dissolution of calcium carbonate from lowered pH caused by oxidation of one mole of FeS₂ – CaSO₄ (ppt) HCO₃↑ pH↑
[Ca↑ further lowers CaSO₄ & HCO₃ solubility]
2 H₂SO₄ + 4 CaCO₃ + 4NaCl → 4NaHCO₃ +2 CaSO₄ [ppt] +2 Ca ++ + 2 Cl⁻
TCEQ UIC PROGRAM FOR ISR

- Agreement State for Safe Drinking Water Act compliance.


- TCEQ Regulations 30 TAC 336. Aquifer Exemptions assure that water in the mine zone does not serve as a drinking water supply (the water is not suitable). UIC Permits provide for protection of underground sources of drinking water. Production Area Authorization provide for adequate, site specific, baseline and monitoring well networks.

- Restoration required

- Financial Assurance Required
FINANCIAL ASSURANCE

Before any ISR activity can begin, TCEQ requires that groundwater restoration be fully bonded with cash or cash equivalent to pay the cost of a third party contractor to conduct and complete the activity if necessary.
TCEQ's UIC PROGRAM PROTECTS USDWs

Mining solutions must be confined to the production zone within the monitoring well network by compliance with regulatory requirements:

- Area of Review
- Baseline for Restoration
- Monitoring Well Requirements
- MIT
- Construction Requirements
- Operating Requirements
- Reporting Requirements
- Excursion Remedial Action
- Restoration Requirements
- Post Restoration Monitoring
- Plugging and Abandonment
- Financial Assurance

Uranium Resources
REQUIRED

GROUNDWATER RESTORATION
POST RESTORATION CHANGES TO WATER QUALITY

- Increase in salinity from ion exchange; RO is highly effective dissolved salts are reduced below baseline.

- Increase in calcium and carbonates due to pH drop; RO is largely effective. Parameters are harmless.

- Increase in uranium, trace elements due to oxidation; RO is partially effective because host formation has been oxidized. Uranium, progeny typically limit water quality before mining.
RESTORATION VALUES NOT ACHIEVED

TCEQ risk assessment (by rule):

- uses for which the groundwater was suitable at baseline levels.
- actual existing use of groundwater in the area prior to and during mining.
- potential future use of baseline quality groundwater and of proposed restoration quality.
- the effort made by the permittee to restore the groundwater to baseline.
- technology available to restore groundwater for particular parameters.
- the cost of further restoration efforts.
- the consumption of groundwater resources during further restoration.
- the harmful effects of levels of particular parameter.
“There have been no documented cases of offsite groundwater contamination in south Texas in over 30 years of in situ uranium mining at over 30 different sites.”

* Executive Director's Response to Public Comment, Permit No. UR03070 (October 2008)