Produced Water Management
Leading Management Practices for Reducing Leaks and Spills

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Who is EDF?

• Non-profit environmental advocacy

• Comprised of technical and legal expertise

• Sound science informs sound policy

• EDF is active in encouraging (to a degree fund) science to identify and fill knowledge gaps
Produced Water

All water that returns to the surface during life of well

- Hydraulic fracturing flowback

- Formation water
  - More than just total dissolved solids

- Return of on-going operation chemicals

- Transformational products
  - High heat + high pressure = chemical reactions
Disposition of Produced Water

- Injection/disposal wells
- Recycle back into hydraulic fracturing operations of subsequent wells
- Reuse outside oil and gas operations
  - Irrigation
  - Livestock
- Discharge
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Environmental Issues with Recycle or Reuse

- **Storage**
  - Larger volumes for longer periods of time
- **Transportation**
  - Longer distances and greater flows
  - Multiple staging points
  - Centralized storage facilities
  - Treatment facilities
Leaks and Spills

• Studies show the majority (potentially 70%+) of groundwater impacts from O&G operations are a result of surface operations

• Recycle/reuse drive more and larger surface management of produced water

• Highlight the need to address leaks and spills
Produced Water Spills

Tx RRC Probable Cause – 2016 Data

- Mechanical/mechanical failure: 39%
- Internal corrosion: 20%
- External corrosion: 13%
- Weather: 13%
- Operator-human error: 6%
- Theft/vandalism: 2%
- Third party: 1%
- Corrosion: 1%
- Unknown: 4%
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You build it, it will break.
Design/Construction/Operation Storage Facilities and Pipelines

• Engineering projects requiring appropriate design

• Design to account for possible failure
  – Keeping a leak from becoming a release

• Ensure construction adheres to design

• Document design changes during construction

• Routine inspections and maintenance
Impoundment - Design Elements

• Geotechnical
  – Bedding
  – Berms
    • Side slopes
    • Top width
    • Construction lifts/compaction tests

• Liners
  – Double lined with leak detection
  – Bedding beneath secondary liner

• Leak detection

• Filling and off-loading operations
Liner Selection and Installation

• Primary and secondary liner
  – Thickness
  – Puncture strength
  – Tear strength
  – Chemical compatibility

• Installation
  – Anchoring
  – Seam welding
  – Directional orientation of seams

• Interspatial material

• Bedding beneath secondary liner
Filling and Off-Loading Operations

• Minimize placement of hoses/couplings inside impoundments

• Install permanent pipeline headers for filling and off-loading

• Extra liner material in “wear zone”
  – Consider different color to readily identify “wear zone” area

• Spill catchments at couplings for filling and off-loading

• Continuous monitoring during filling/off-loading
Leak Detection

• Option - “draining and inspections” as form of leak detection

• Preference – double liner with leak detection
  – Proper slope to leak detection sump
  – Interspatial material
    • Geogrid

• Water will still pass through a liner
  – Determine action leak rate
Construction Quality Assurance Specific to Impoundments

• Assure Liner integrity
  – International Association of Geosynthetic Installers
    • Certified welder program
    • Certified installer program
  – In-place liner integrity verification

• In-field liner weld test
  – Non-destructive
    • Test if weld is complete
  – Destructive
    • Force on weld to cause weld to fail
Tanks - Design Elements

• A Number of Design and Operation Standards
  – API Standard 650
  – API Standard 653
  – ASME Boiler and Pressure Vessel Code
  – AWWA Standard D100
  – AWWA Standard D102
  – AWWA Standard M42
  – STI SP001
  – Underwriter Laboratories’ UL 142
Tanks - Design Elements

• Secondary Containment
  – Sufficient volume for release plus expected precipitation (25-year storm)
  – Release volume – largest tank or interconnected tank system that acts as a single tank
  – Maintained to remove accumulated liquids

• Leak Detection
  – Volume tracking
  – API 650 (Welded Tanks for Oil Storage) Appendix I
Leak Detection Systems - Tanks

Figure I-1—Concrete Ringwall with Undertank Leak Detection at the Tank Perimeter (Typical Arrangement)

Figure I-2— Crushed Stone Ringwall with Undertank Leak Detection at the Tank Perimeter (Typical Arrangement)
Leak Detection Systems - Tanks

Figure 1-4—Double Steel Bottom with Leak Detection at the Tank Perimeter (Typical Arrangement)

Figure 1-5—Double Steel Bottom with Leak Detection at the Tank Perimeter (Typical Arrangement)
Modular Site-Assembled Tanks

Part tank, part impoundment
  - Vertical walls
  - Liner

Leak detection and containment required
Construction Quality Assurance
Storage and Pipelines

• Oversight of construction activities
  – Document and evaluate field tests

• Any design changes documented and approved by engineer

• Development of certified as-built plans after construction
Routine Maintenance

- Routine visual inspections
- Using a check list is a good idea
- Identify needed maintenance
- Confirm maintenance completed