Produced Water Management Leading Management Practices for Reducing Leaks and Spills

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EDF
ENVIRONMENTAL DEFENSE ACTION FUND™
Legislative arm of Environmental Defense Fund

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

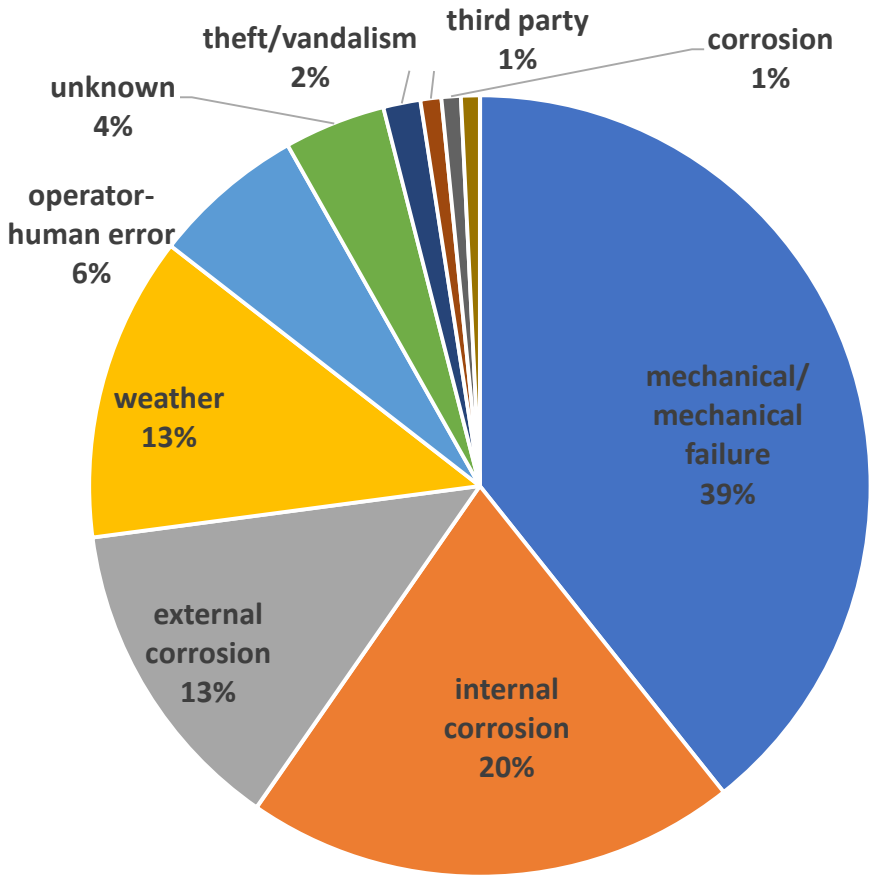
- Storage
  - Larger volumes for longer periods of time
- Transportation
  - Longer distances and greater flows
  - Multiple staging points
    - Centralized storage facilities
    - Treatment facilities

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



Produced Water Spills

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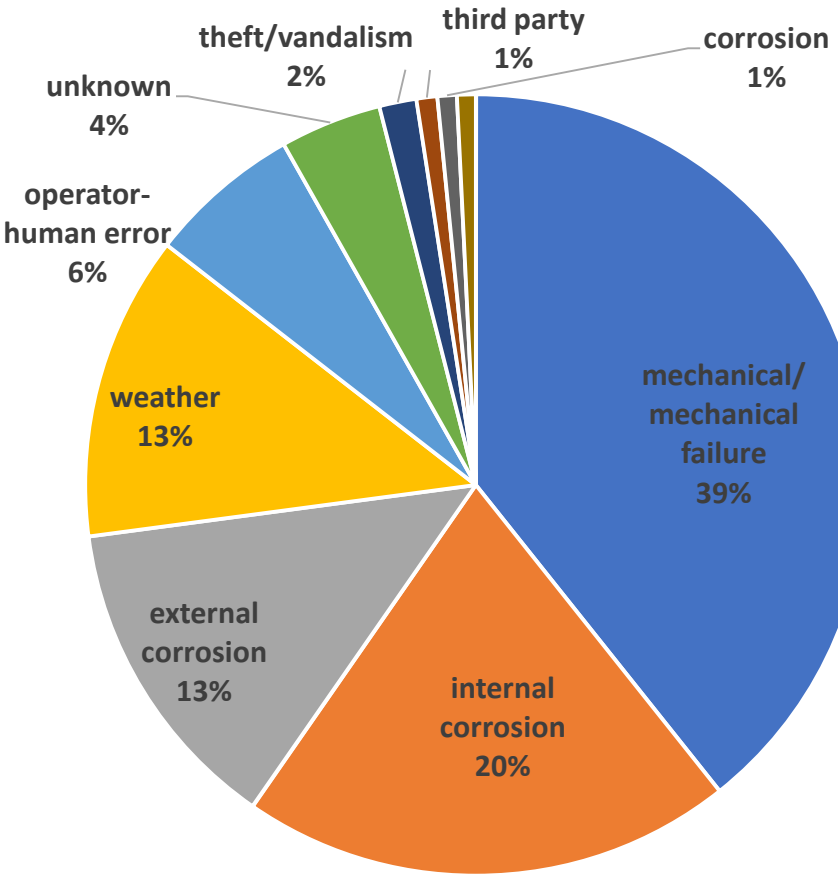

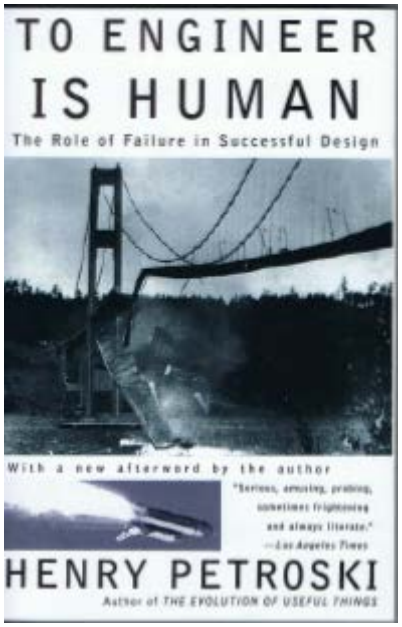

You build it, it will break.

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

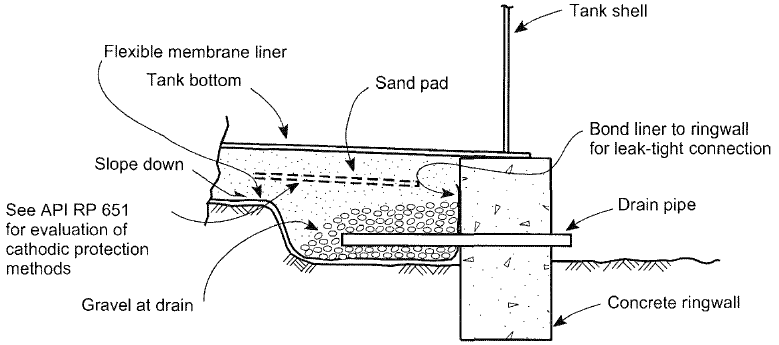

Figure I-1—Concrete Ringwall with Undertank Leak Detection at the Tank Perimeter (Typical Arrangement)

I-1

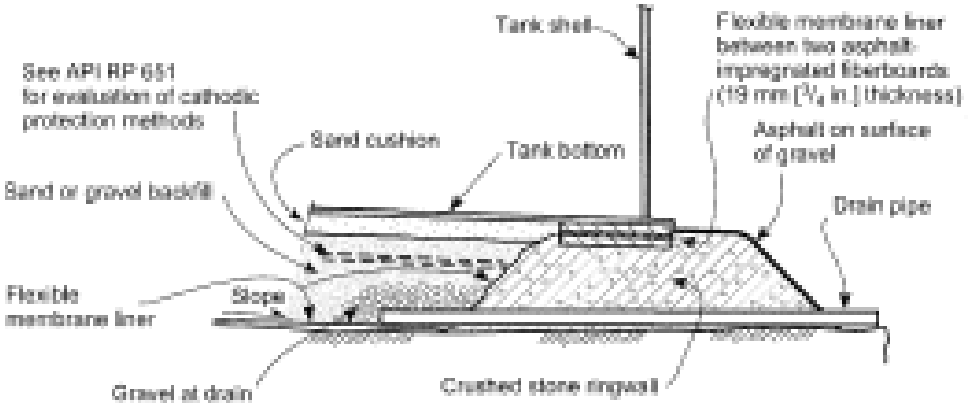

Figure I-2—Crushed Stone Ringwall with Undertank Leak Detection at the Tank Perimeter (Typical Arrangement)

Leak Detection Systems - Tanks

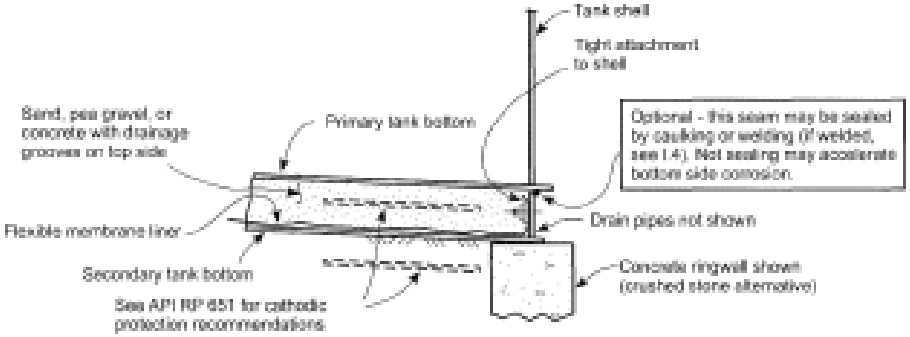

Figure I-4—Double Steel Bottom with Leak Detection at the Tank Perimeter (Typical Arrangement)

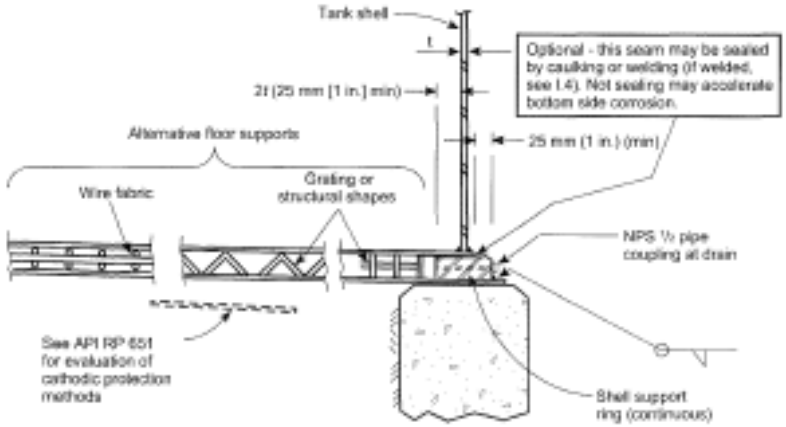

Figure I-5—Double Steel Bottom with Leak Detection at the Tank Perimeter (Typical Arrangement)

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

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