Utility Service Group

WATER STORAGE TANKS:

INSPECTION METHODS

Service Trucks

Would could go wrong?

Tank Failure: 300,000 gal Auburn, MA

Sidewall failure due to corrosion

Water Tank Styles & Design Issues:

Leg Tank

Single Pedestal

Fluted Column

Composite Elevated

Standpipe

Reservoir or Ground Storage

Bolted Tanks

Redwood Tank


Other Tanks…

Leg Tank

House Tank

EFFECTIVE TANK CONDITION ASSESSMENT OVERVIEW

- AWWA STANDARDS
- WHY INSPECT?
- SELECTING AN INSPECTOR
- WHAT TO INSPECT
- INSPECTION FREQUENCY
- INSPECTION TYPES

AWWA Standards

- **AWWA D100**
  Welded steel tanks for water storage
- **AWWA D102**
  Coating steel water storage tanks
- **AWWA C652**
  Disinfection of water storage facilities
- **AWWA G200-04**
  Distribution Systems Operation and Management
- **AWWA C655-09**
  Field Dechlorination

WHY INSPECT?

WHY INSPECT?

- **AWWA M42 (1998): Chapter 9**

  “A good, comprehensive preventive maintenance program can extend the life of an existing tank indefinitely.”

WHY INSPECT?

- **AWWA M42 (1998): Chapter 9**

  “Many thousands of dollars can be saved and complaints from citizens can be eliminated if a planned approach to tank maintenance is adopted.”

WHY INSPECT?

- **AWWA "Steel Water Storage Tanks" (2010) Chapter 10, Page 381:**

  "Why have a maintenance program? The answer is simple: Preventive maintenance has been, and always will be, less expensive than crisis maintenance."

WHY INSPECT?

- **DETERMINATION OF MAINTENANCE NEEDS FOR ONE OF THE WATER SYSTEMS MOST VALUABLE ASSETS:**

SANITARY CONDITIONS
STRUCTURAL CONDITIONS
SAFETY CONDITIONS
COATINGS CONDITIONS
SECURITY CONDITIONS

HOW TO SELECT AN INSPECTOR?

- “ Only organizations and individuals that are qualified and equipped to do the work should do inspections.”
- **Ask for qualifications of inspectors**
- **Request sample inspection reports**
- **Request adequate insurance certificates**

INSPECTION CONTRACTS:

- **Require a written contract that defines the scope of the inspection:**
  - should cover all (**6**) general categories
  - provide for pressure relief valves, or portable potable pressure tanks, and all other equipment necessary to conduct a safe and thorough inspection
  - state method of disinfection
  - State method of field de-chlorination
  - furnish insurance certificates naming tank owner as an additional insured

INSPECTION REPORTS:

- Report should include quality videotapes or color photographs documenting findings
- Report should be detailed and cover conditions under all (6) categories
- Report on all conditions NOT just deficiencies
- Provide recommendations and cost estimates

OWNER NOTIFICATION:

- “ Any sanitary defect, contamination, safety hazard or serious structural damage found should be reported at the time of the inspection so the facility owner can have them *corrected immediately*.”

WHAT TO INSPECT:

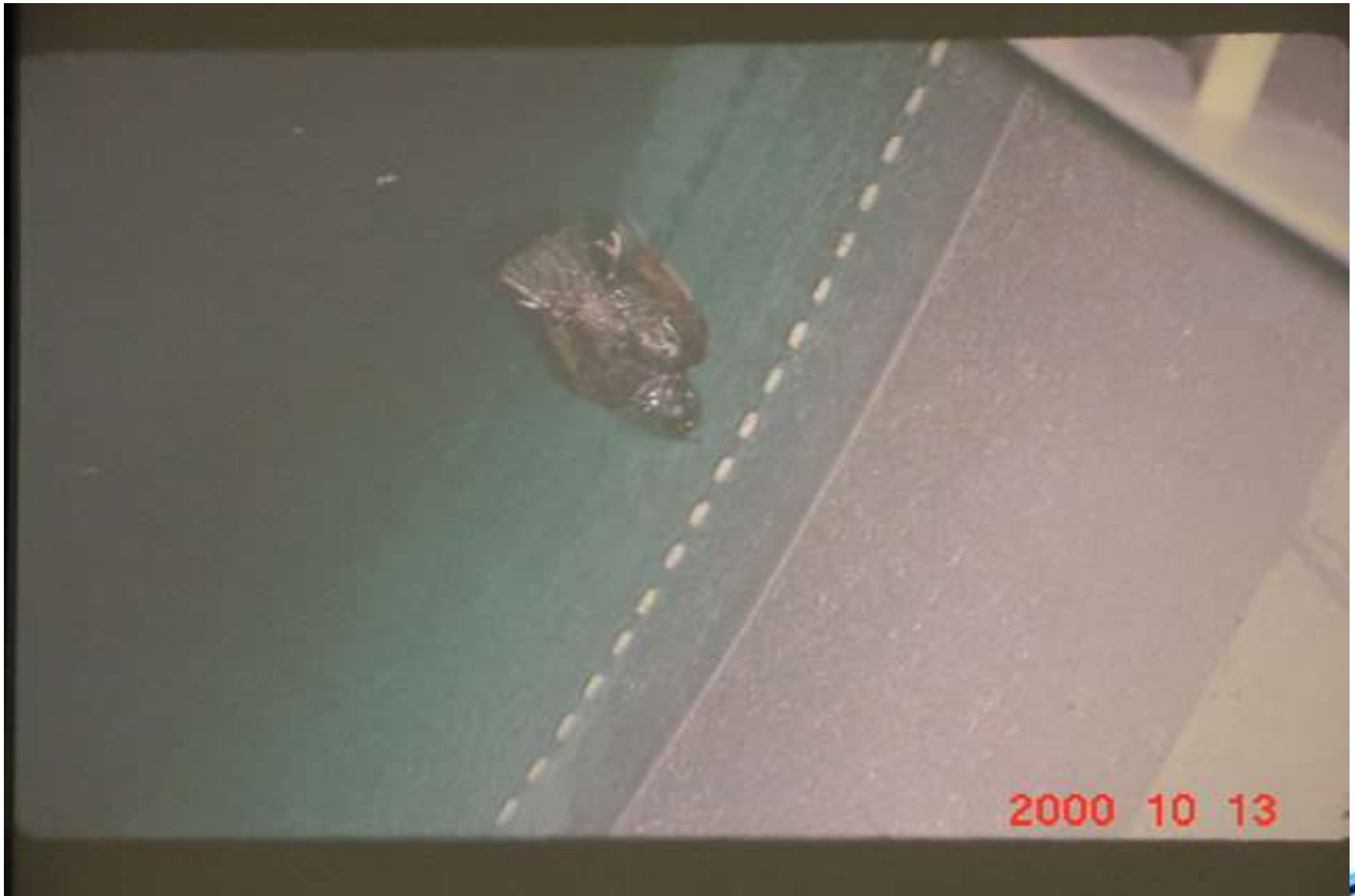
- **Six general categories of items on storage facilities that *must* be inspected:**
  - **Structural Conditions**
  - **Safety Conditions**
  - **Sanitary Conditions**
  - **Coating Systems Conditions**
  - **Security Conditions**
  - **General Details**

Sanitary Conditions

- Roof Openings
- Access Hatches
- Low Spots on Roofs
- Vents
- Overflows

Sanitary Conditions: Roof Openings

Sanitary Conditions: Roof Openings



Sanitary Conditions: Roof Openings

Sanitary Conditions: Roof Openings

Sanitary Conditions: Roof Openings

Sanitary Conditions: Roof Openings

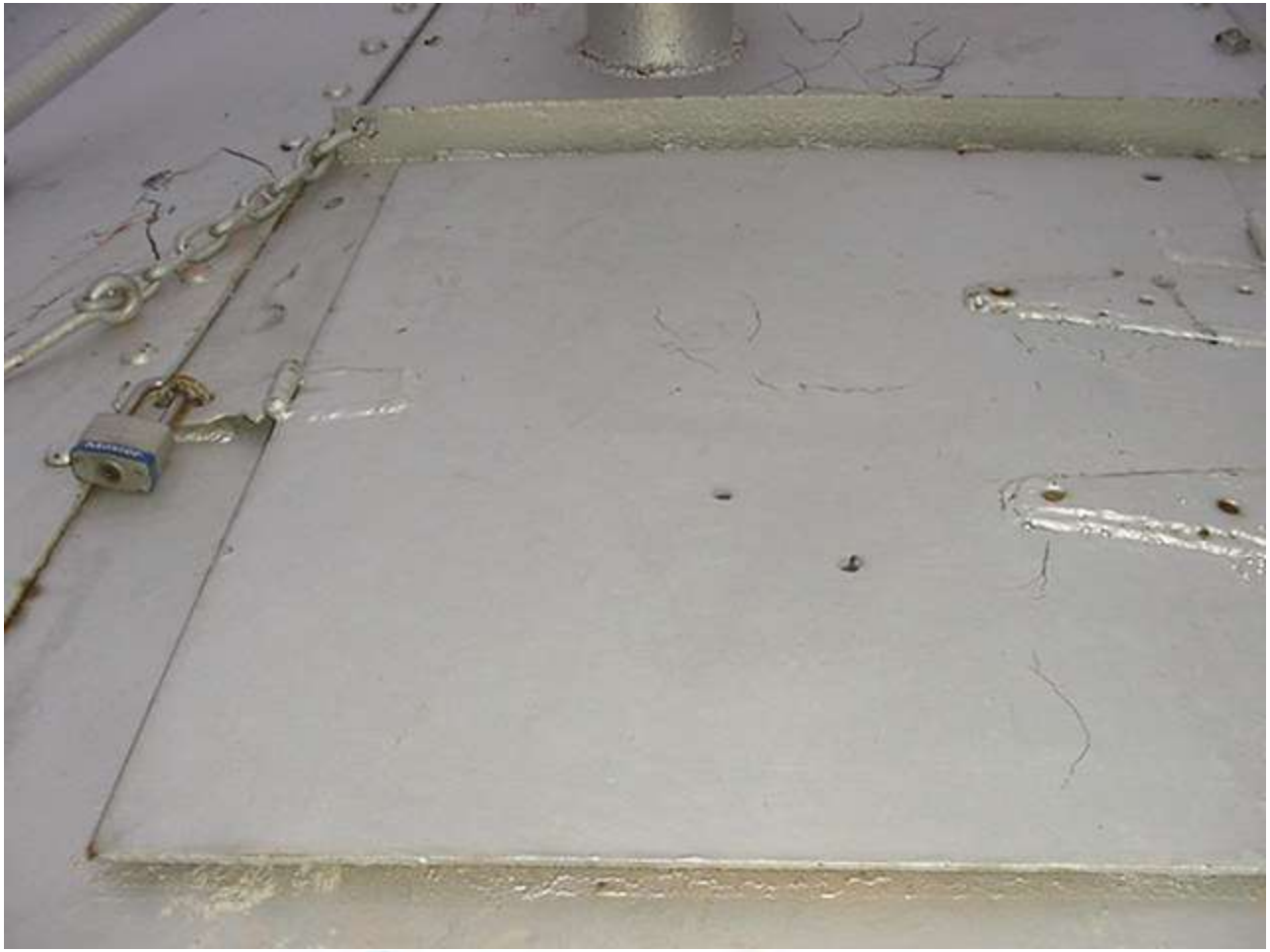
Sanitary Conditions: Roof Openings

Sanitary Conditions: Roof Openings

Sanitary Conditions: Roof Openings

Sanitary Conditions: Roof Openings

Sanitary Conditions: Access Hatches



Sanitary Conditions: Access Hatches

Sanitary Conditions: Access Hatches

Sanitary Conditions: Access Hatches

Sanitary Conditions: Access Hatches

Sanitary Conditions: Low Spots on Roof

Sanitary Conditions: Vents

Sanitary Conditions: Vents

Sanitary Conditions: Vents

Sanitary Conditions: Vents

Sanitary Conditions: Vents

Sanitary Conditions: Vents

Sanitary Conditions: Vents

Sanitary Conditions: Vents

Sanitary Conditions: Vents

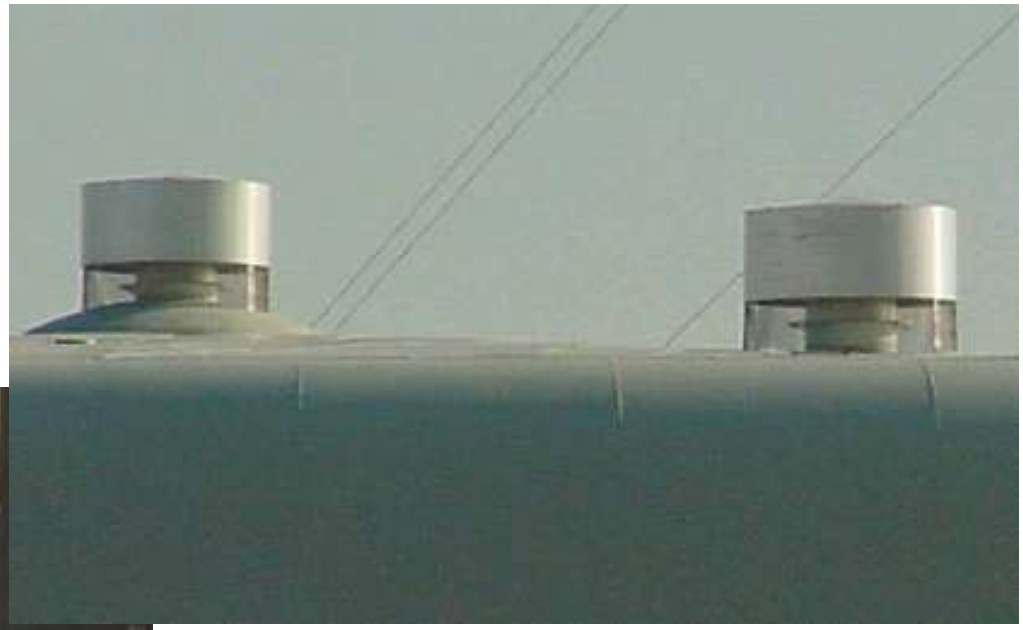
Sanitary Conditions: Vents

Sanitary Conditions: Vents

Sanitary Conditions: Vents

Sanitary Conditions: Vents

Sanitary Conditions: Secure Vent



Sanitary Conditions: Overflows

Sanitary Conditions: Overflows

Sanitary Conditions: Overflows

Sanitary Conditions: Overflows

Sanitary Conditions: Overflows

Sanitary Conditions: Overflow

Utility Service Group

Overflow pipe full of dead birds

Sanitary Conditions: Overflows

Safety Conditions

- **Regulations**

- **Appurtenances**
  - Ladders
  - Fall Prevention
  - Handrails
  - Access
  - Confined Space
  - Radiation

Safety Conditions: Regulations

- **OSHA (Occupational Safety and Health Administration)**
  - 29 CFR 1910: General Industry
  - 29 CFR 1926: Construction Industry

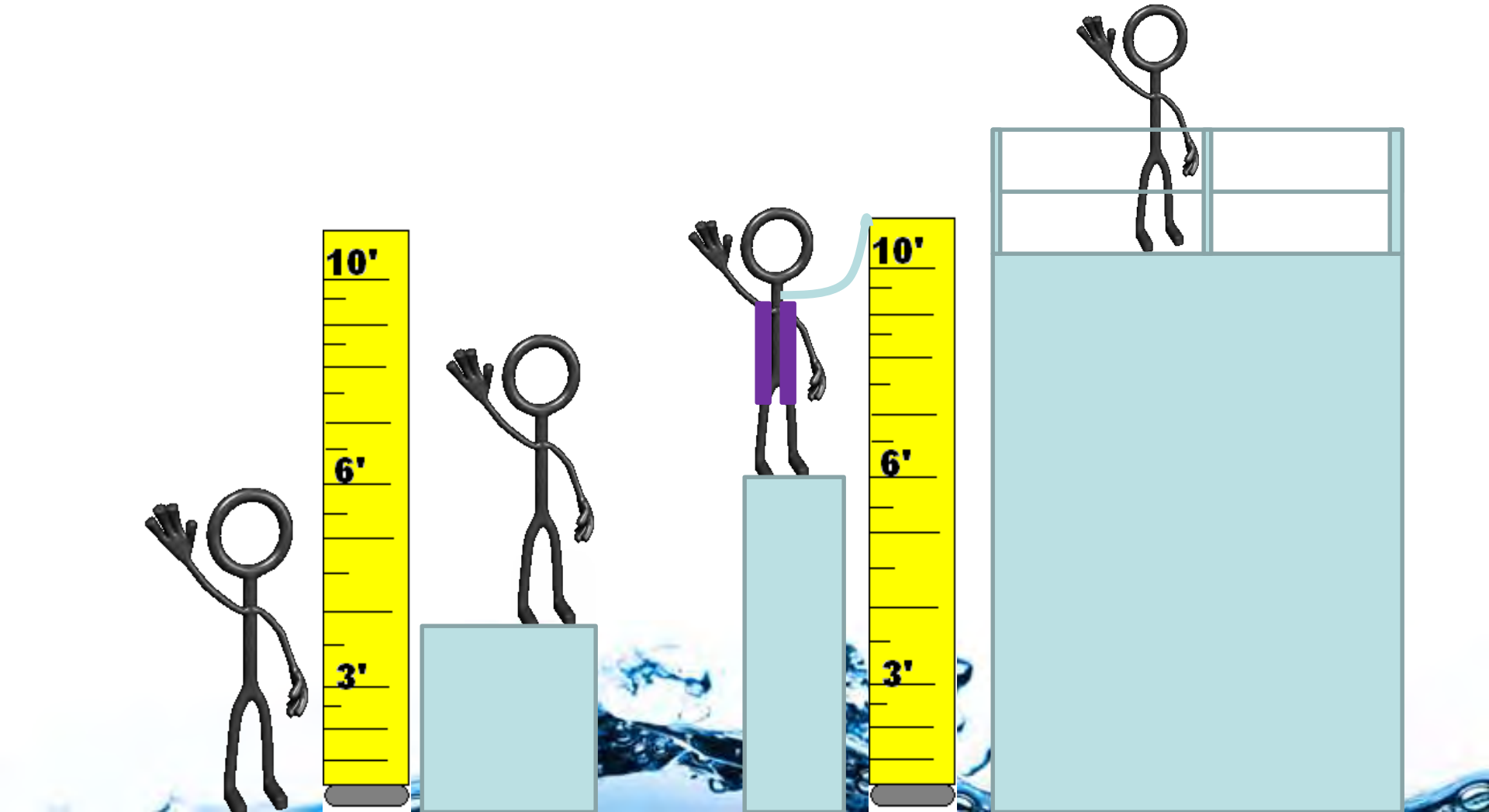
Safety Conditions: Fixed Ladders

- **29 CFR 1910.27**
  - Minimum design load of 200 lbs.
  - 12 in. rung distance
  - 16 in. minimum side rail distance
  - 7 in – 15 in. toe clearance
  - 76 – 90 degree pitch
  - 15 in. clearance from centerline
  - 30 in. headroom

Safety Conditions: Fall Prevention

- **29 CFR 1926.502**
  - A fall protection system must be used when working 6 feet or more above a lower level
- **Systems include**
  - Guardrail Systems
  - Safety Net Systems
  - Personal Fall Arrest Systems
  - Positioning Device Systems
  - Warning line Systems

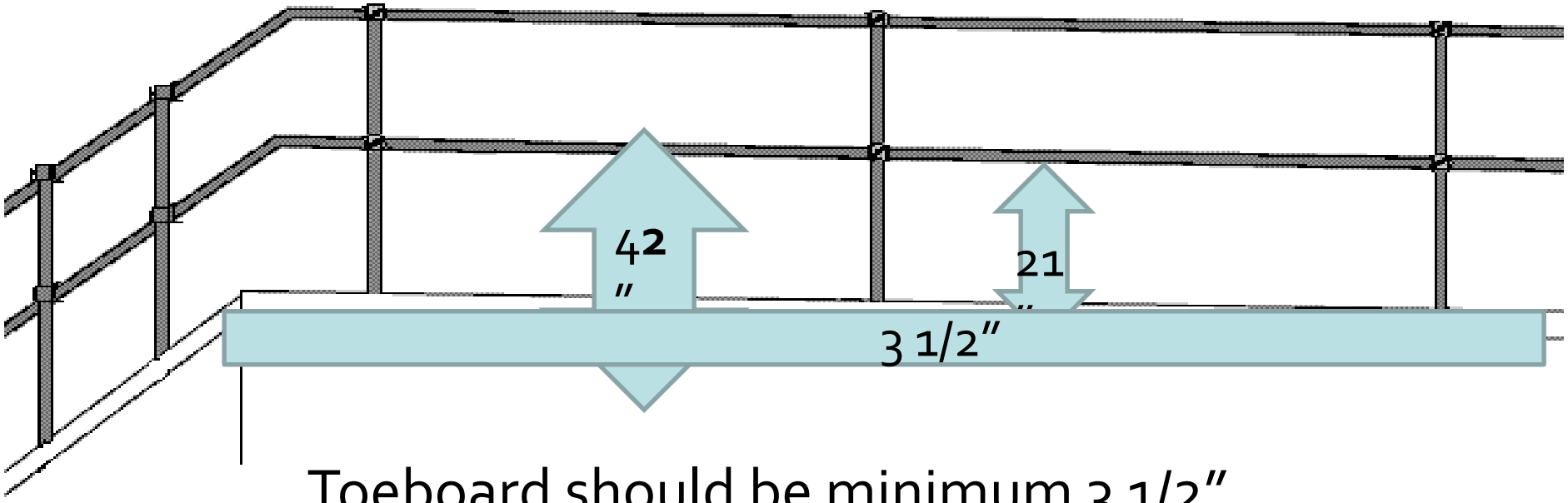
6ft RULE



Guardrail Height

Top Handrail should be 42" (+ or – 3") to the top of the rail

Mid Handrail should be 21" or midway between the toprail and the platform



Toeboard should be minimum 3 1/2"

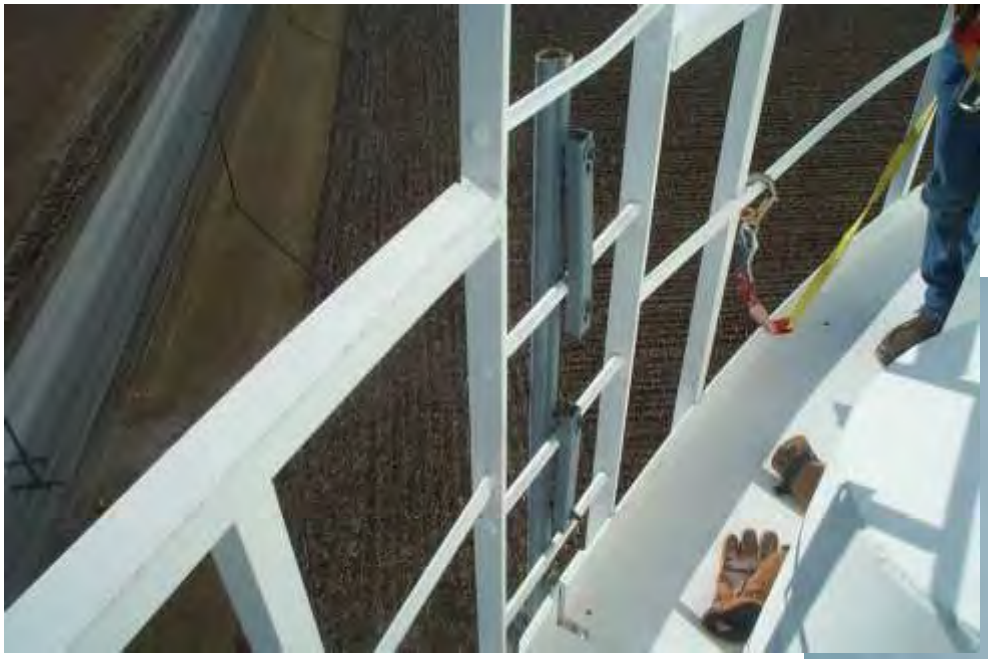
Safety Conditions: Fall Prevention

Safety Conditions: Fall Prevention

Safety Conditions: Fixed Ladders

Safety Conditions: Fixed Ladders

Safety Conditions: Fixed Ladders

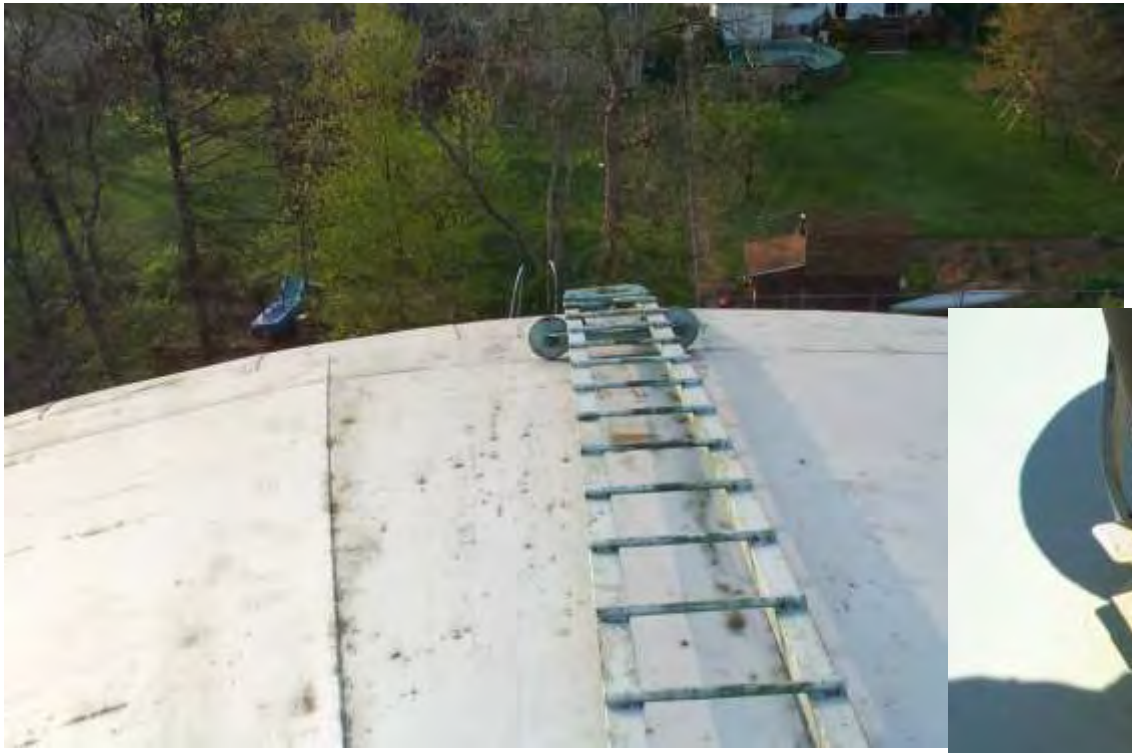


Safety Conditions: Fixed Ladders

Safety Conditions: Fixed Ladders

Safety Conditions: Fixed Ladders

Safety Conditions: Fixed Ladders

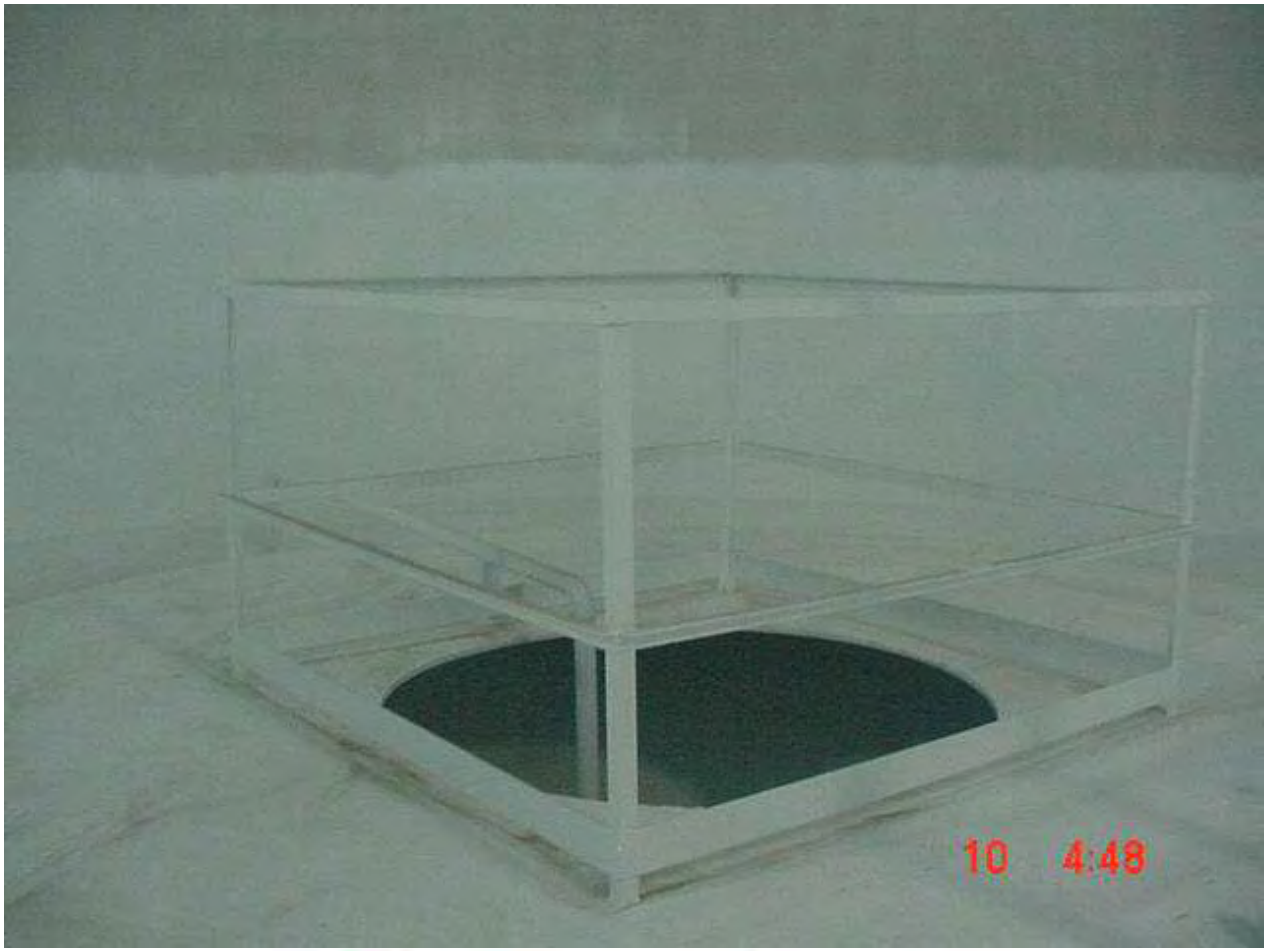


Safety Conditions: Handrail Systems

- **29 CFR 1910.23**
- **Handrail shall consist**
  - Top rail 42” tall (200 lb force)
  - Toe board
  - Intermediate rail
  - No openings greater than 19”
  - 2”x2”x3/8” posts 8’ intervals

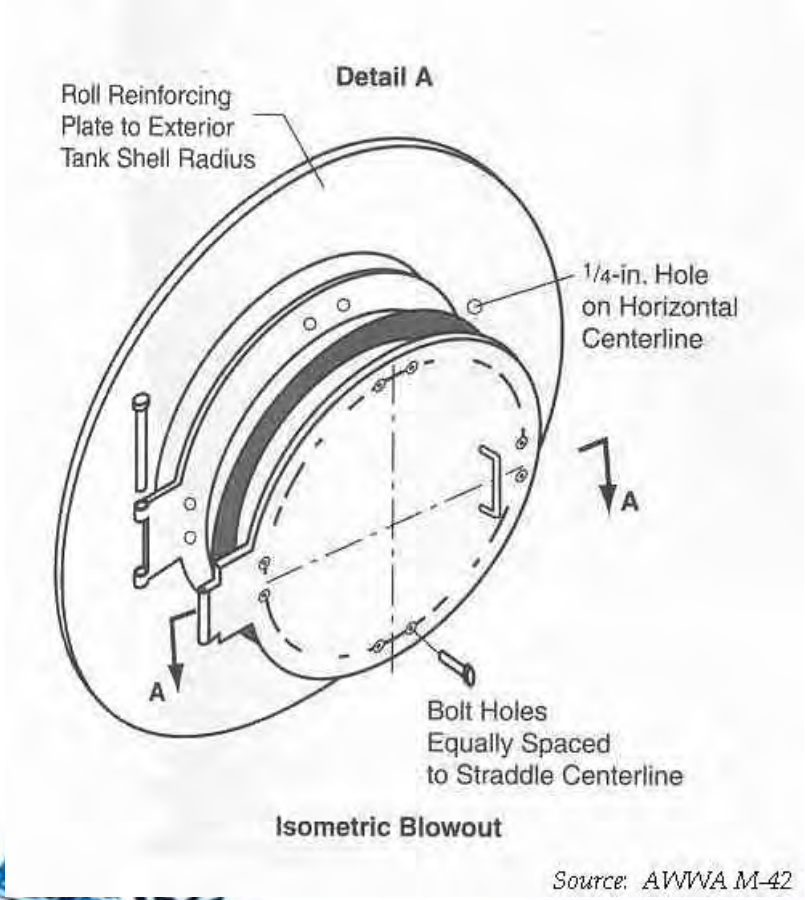
Safety Conditions: Handrail Systems

Safety Conditions: Handrail Systems



Safety Conditions: Access

- **29 CFR 1910.37**
  - **Minimum of 22”**
  - “Every building or structure …. the blocking of any single means of egress due to fire or smoke, shall have at least two means of egress remote from each other, “



Safety Conditions: Access

- **AWWA D100**
  - Section 7.1 – ”**Two manholes** in the first ring of the tank shell”
  - Section 5.1.2 – “manhole shall not be less than 12in.x18in.”
  - Section 5.6.1 – Opening above the water line
  - Section 5.6.2 - Opening near the tank center
    - “shell manway may be substituted”

Safety Conditions: Access

Safety Conditions: Access

Safety Conditions: Radiation

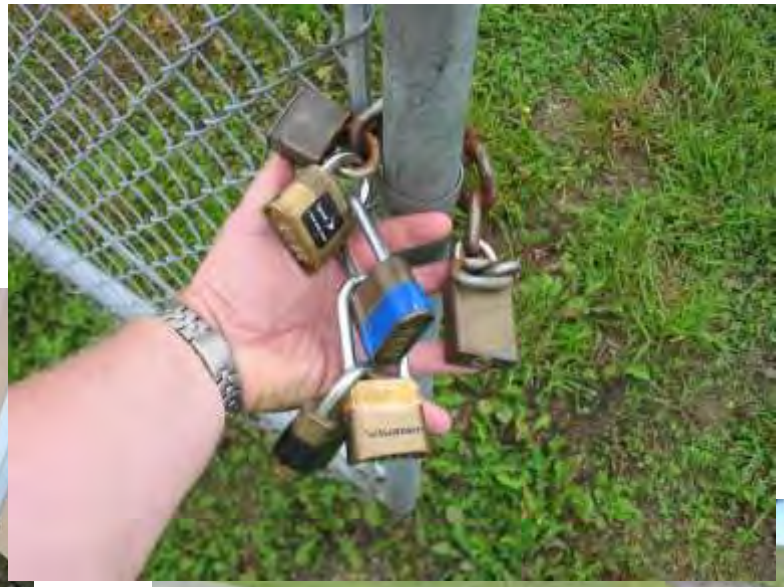
- **FCC Issues**
  - Hazard Communications
  - Safety Plan

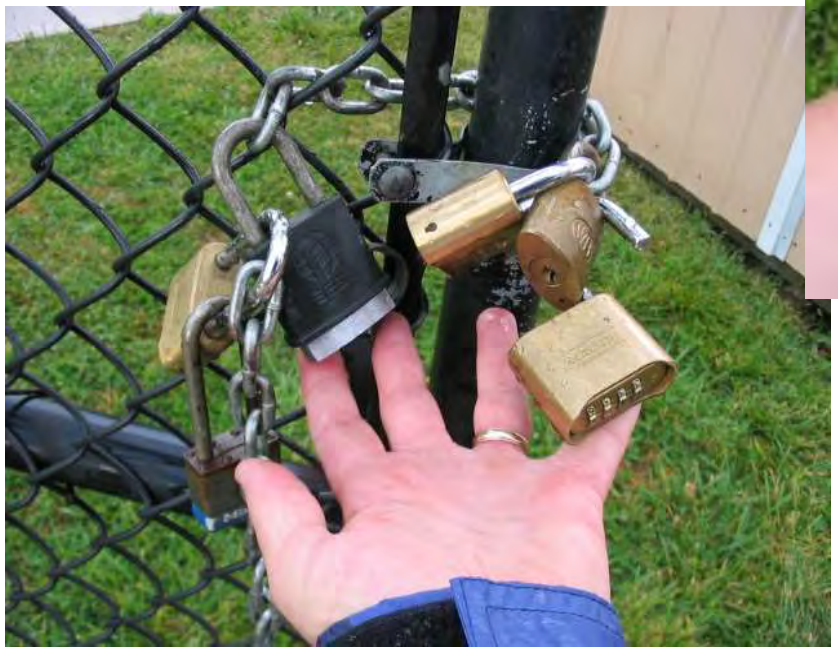
Security Conditions: Threats

- Terrorist Acts
- Disgruntled Employees
- Pranks
- Environmental

Security Conditions

Security Conditions: Site Access





Security Conditions

Security Conditions

Security Conditions

Security Conditions

Security Conditions

Security Conditions: Bullet Hole

Structural Conditions

- Anchor bolts
- Foundations
- Wind rods
- Riser/Shell steel
- Spider Rods
- Roof Trusses
- Weld Seams

Structural Conditions: Anchor Bolts

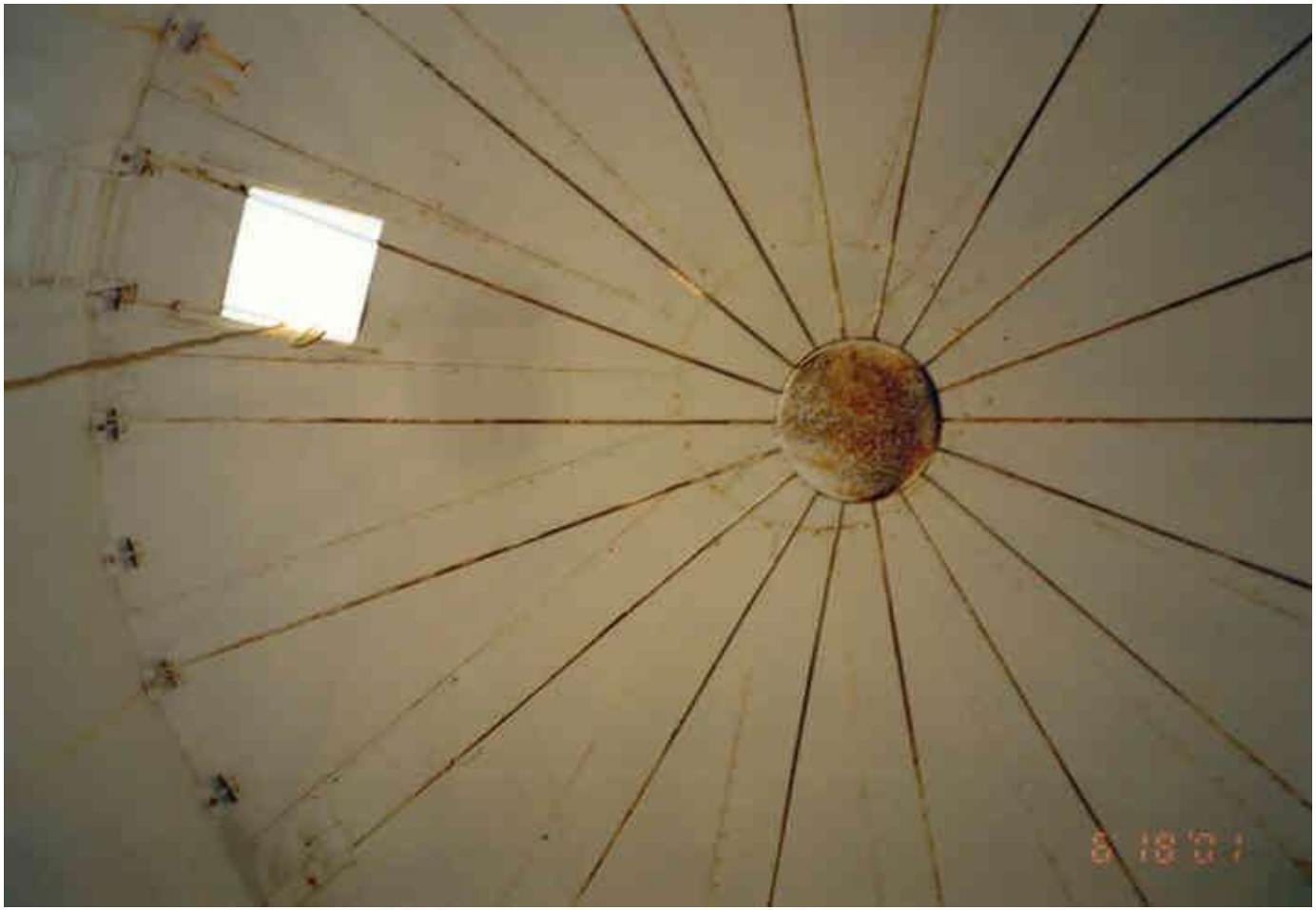
Structural Conditions: Anchor Bolts

Structural Conditions: Foundations

Structural Conditions: Wind Rods

Structural Conditions: Wind Rods

Structural Conditions: Spider Rods



Structural Conditions: Roof Trusses

Structural Conditions: Roof Trusses

Structural Conditions: Roof Trusses

Structural Conditions: Roof Trusses

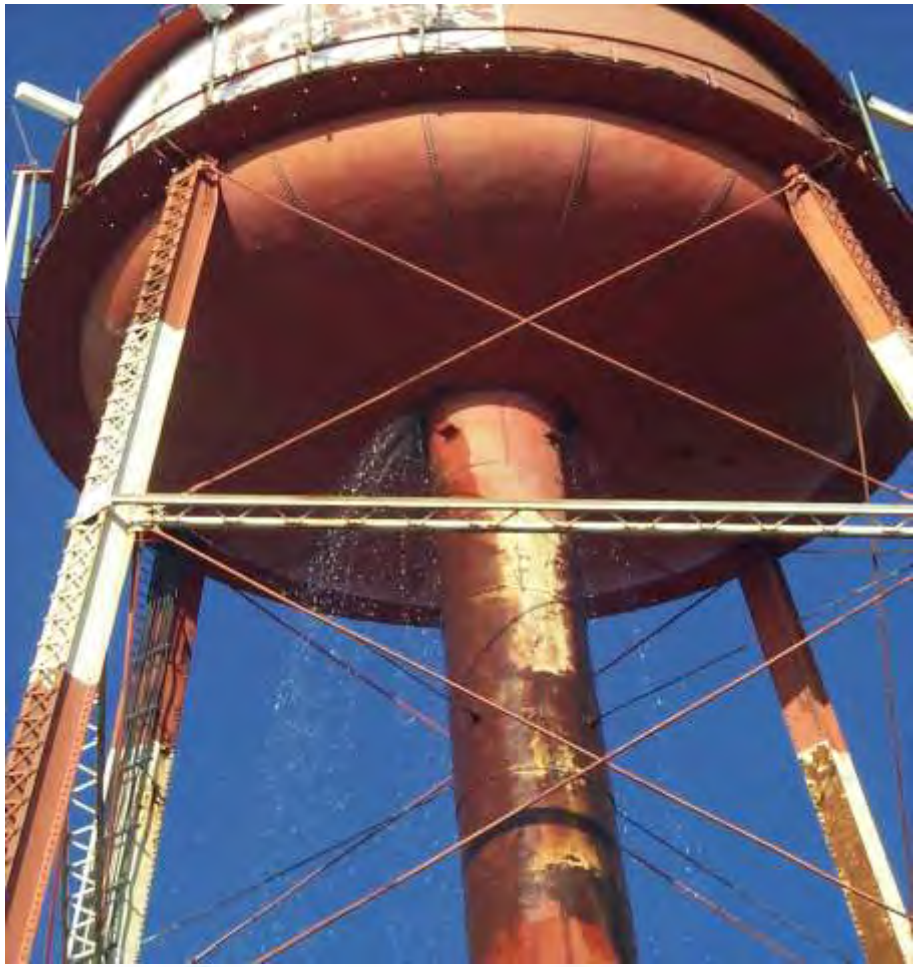
Structural Conditions: Roof Trusses

Structural Conditions: Roof Trusses

Structural Conditions: Roof Trusses

Structural Conditions: Roof Trusses

Structural Conditions: Weld Seams

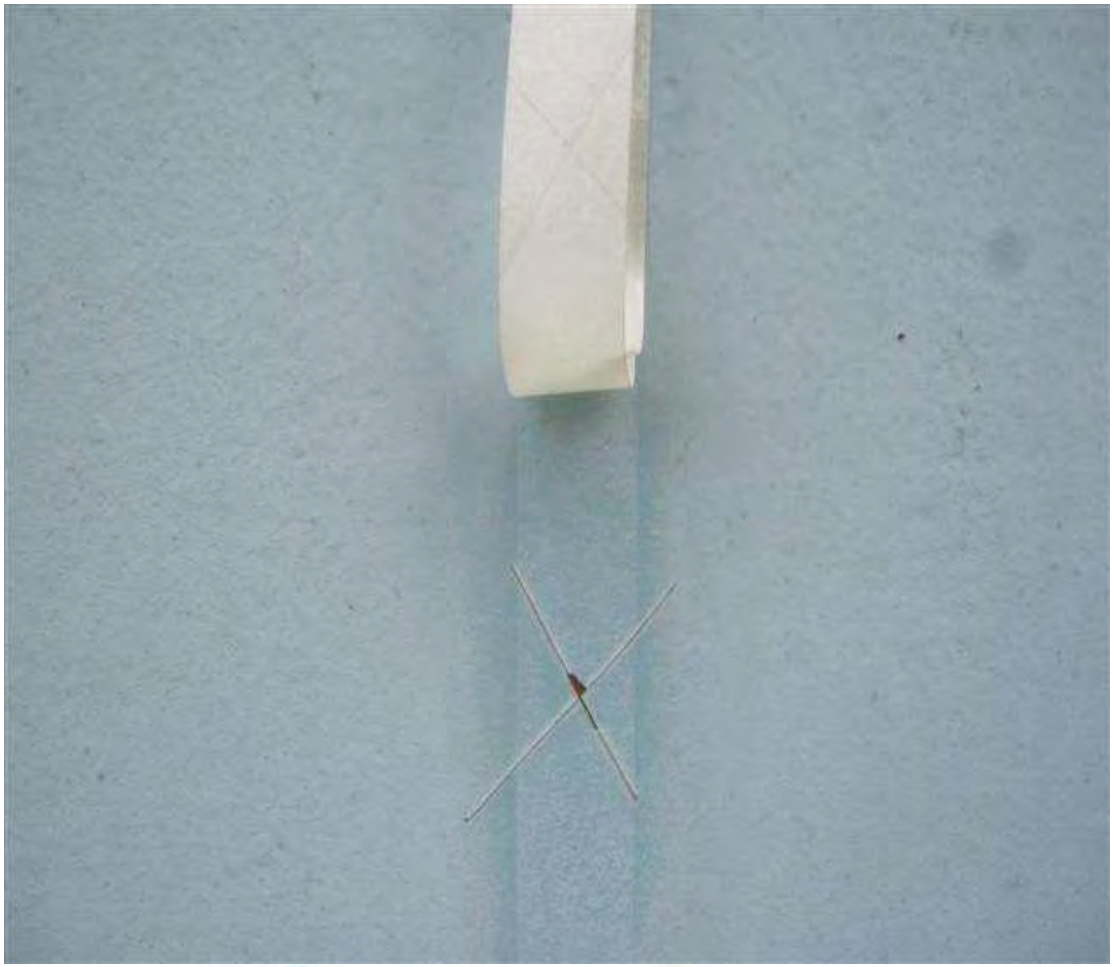


Coatings Conditions

- Generic type and general condition
- Approximate percentage and type of coatings system failure
- Adhesion
- Coating System Thickness
- Extent of Pitting Damage
- Heavy Metal Presence

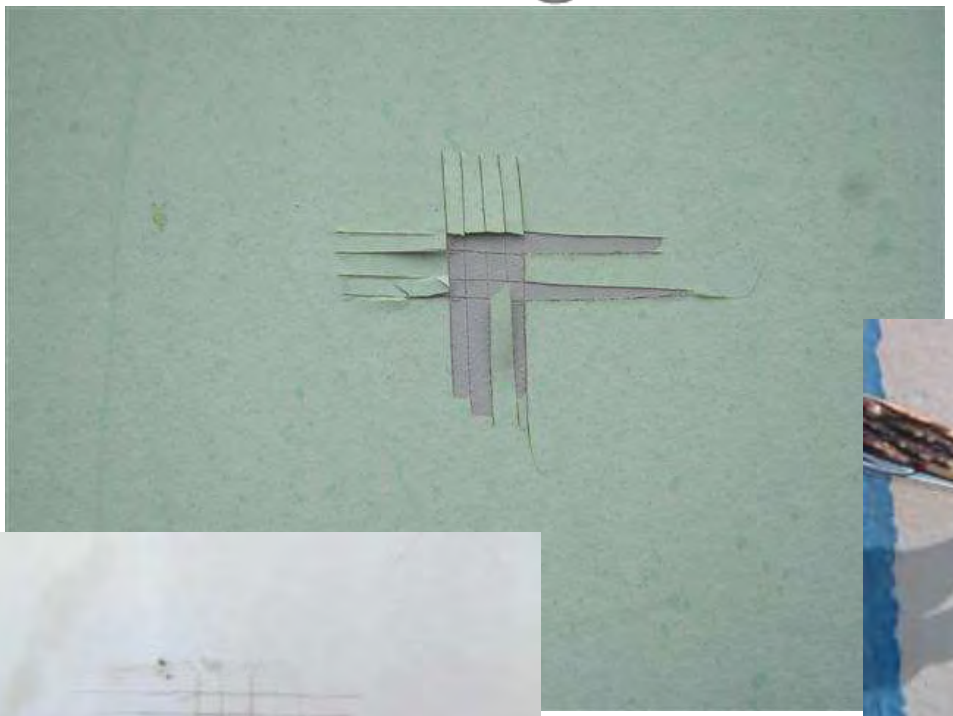
Coatings Conditions

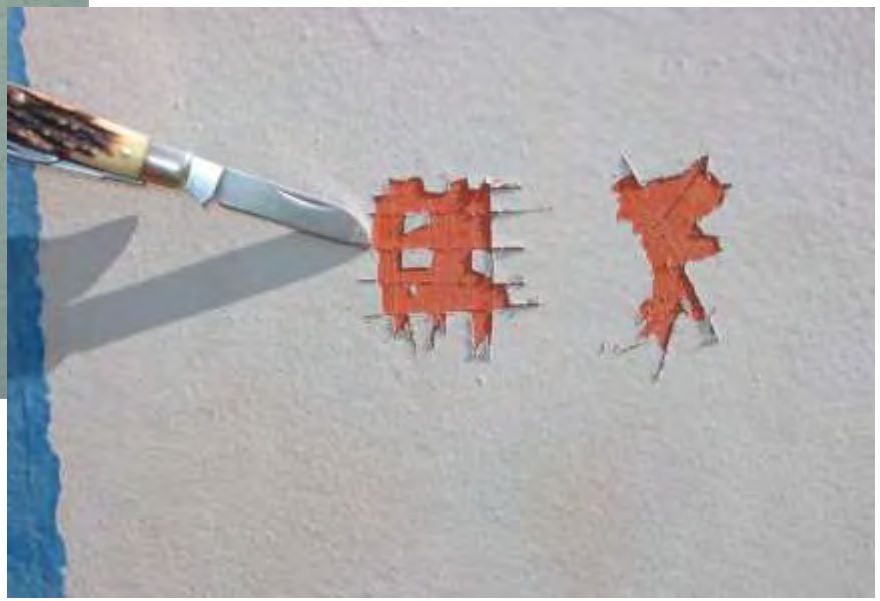
Coatings Conditions



Coatings Conditions

Coatings Conditions





Coatings Conditions

Coatings Conditions

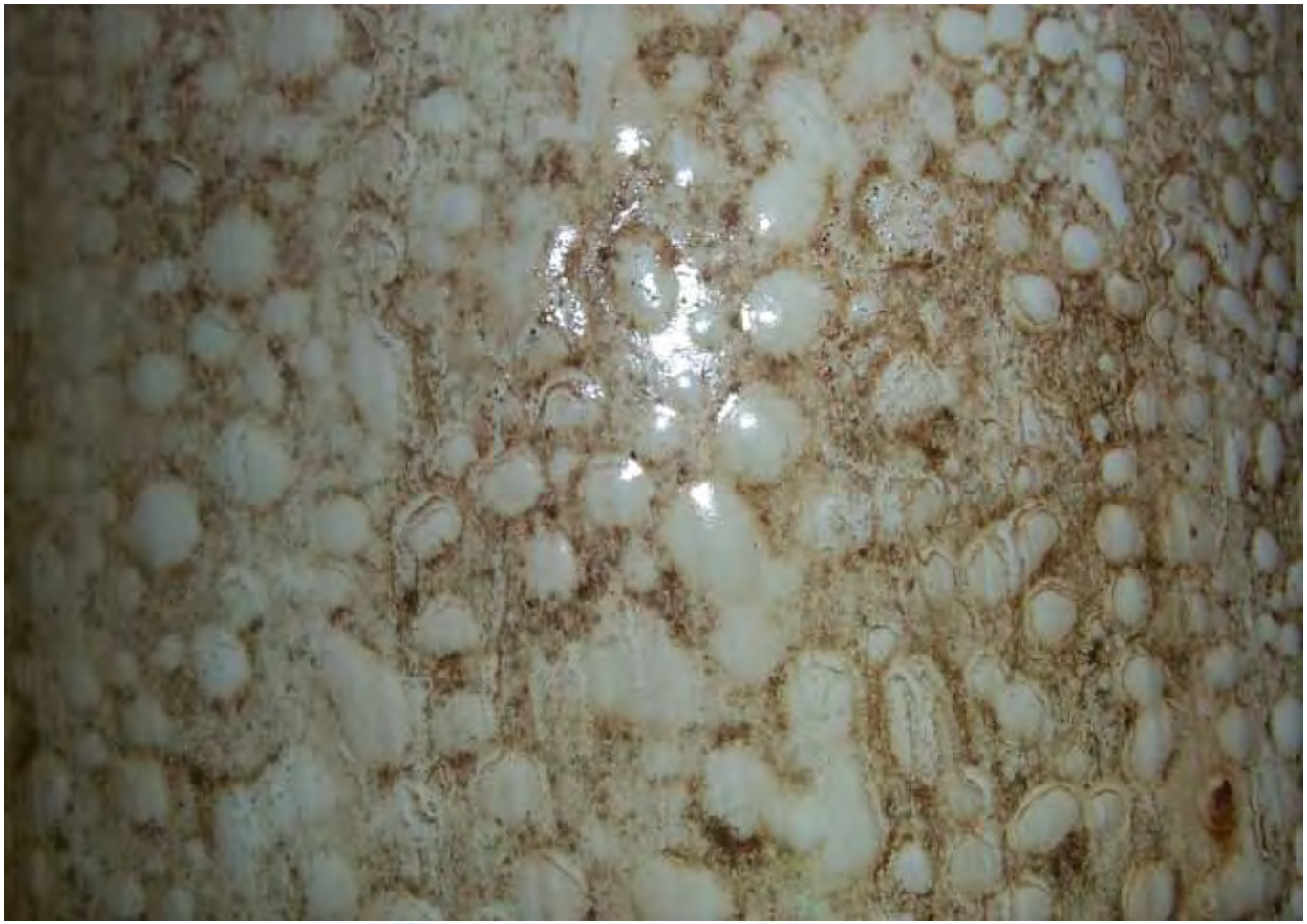
Coatings Conditions

Coatings Conditions

Coatings Conditions

Coatings Conditions

Coatings Conditions



Coatings Conditions

Coatings Conditions

Coatings Conditions

Coatings Conditions

Coatings Conditions

Sediment Removal

Sediment Removal

Sediment Removal

Sediment Removal

INSPECTION FREQUENCY

- **AWWA M42:**
  - "The maximum interval for periodic inspections of the tank interior should normally be 3 years. It is usually advisable to wash out the tank at the time of inspection." Page 67

ROV Inspection Device

INSPECTION FREQUENCY

- **AWWA M42:**
  - "… proper inspections cannot be conducted if sediment covers the bottom of the tank. Tanks should be washed out and inspected at least every 3 years, and where water supplies have sediment problems, annual washouts are recommended." Page 88

TYPES OF INSPECTIONS

- **Routine:** daily/weekly
- **Periodic:** monthly/quarterly
- **Comprehensive:** 3-5 years

Types Of Inspections

- **AWWA G200-04 Distribution Systems Operation and Management, Section 4.3.1.3 states:**

"The utility shall have a written inspection program outlining frequency, procedures and maintenance of records. The inspection program shall include such features as routine (daily/weekly); periodic (monthly/quarterly); and comprehensive (3-5 years) inspections."

EFFECTIVE TANK CONDITION ASSESSMENT SUMMARY

- AWWA STANDARDS
- WHY INSPECT?
- SELECTING AN INSPECTOR
- WHAT TO INSPECT
- INSPECTION FREQUENCY
- INSPECTION TYPES

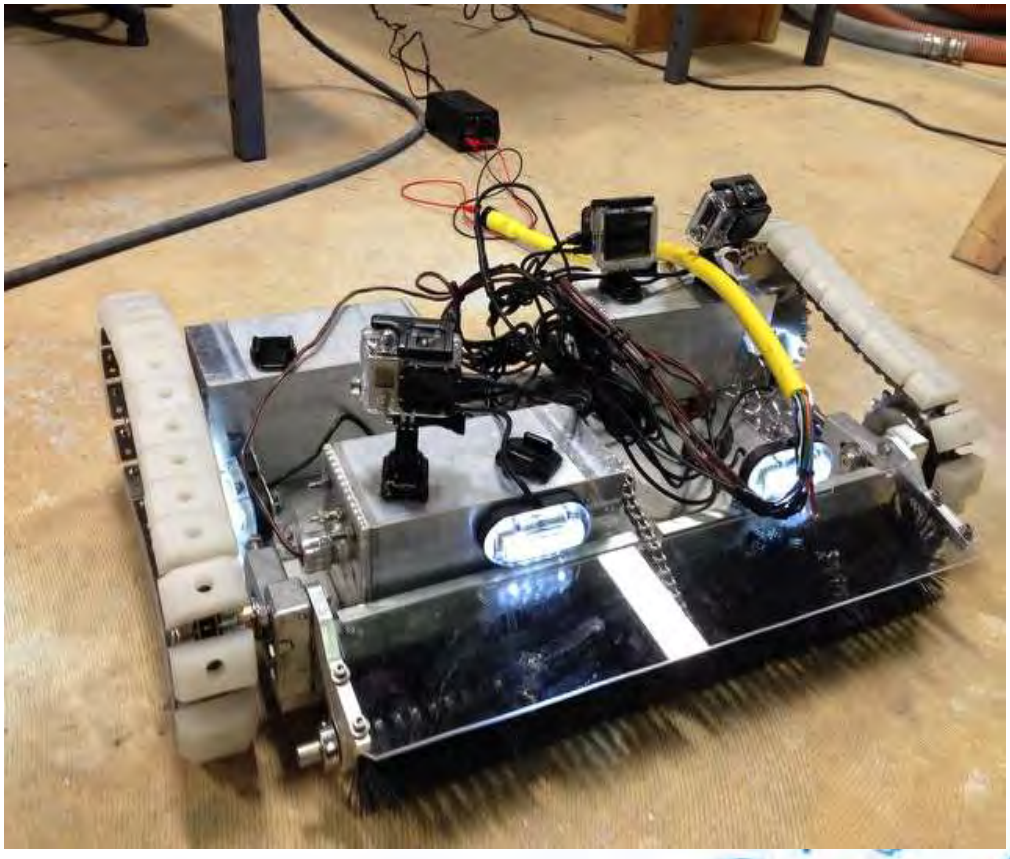
What Robotics offers

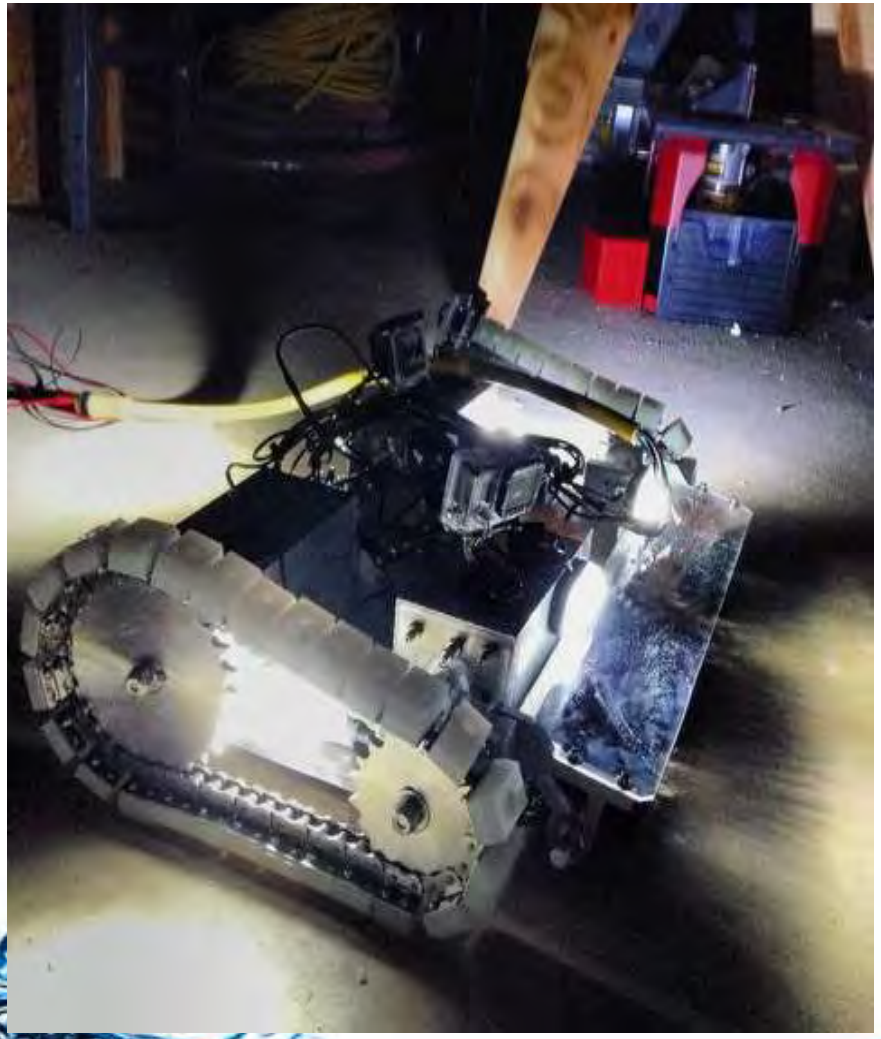
- Lower Cost
- Lower Risk
- Time savings
- Tanks remain ONLINE and Operational

Robots vs. Divers

- Decisions men make
- Liability/Safety
- Time efficiency

Utility Service Group

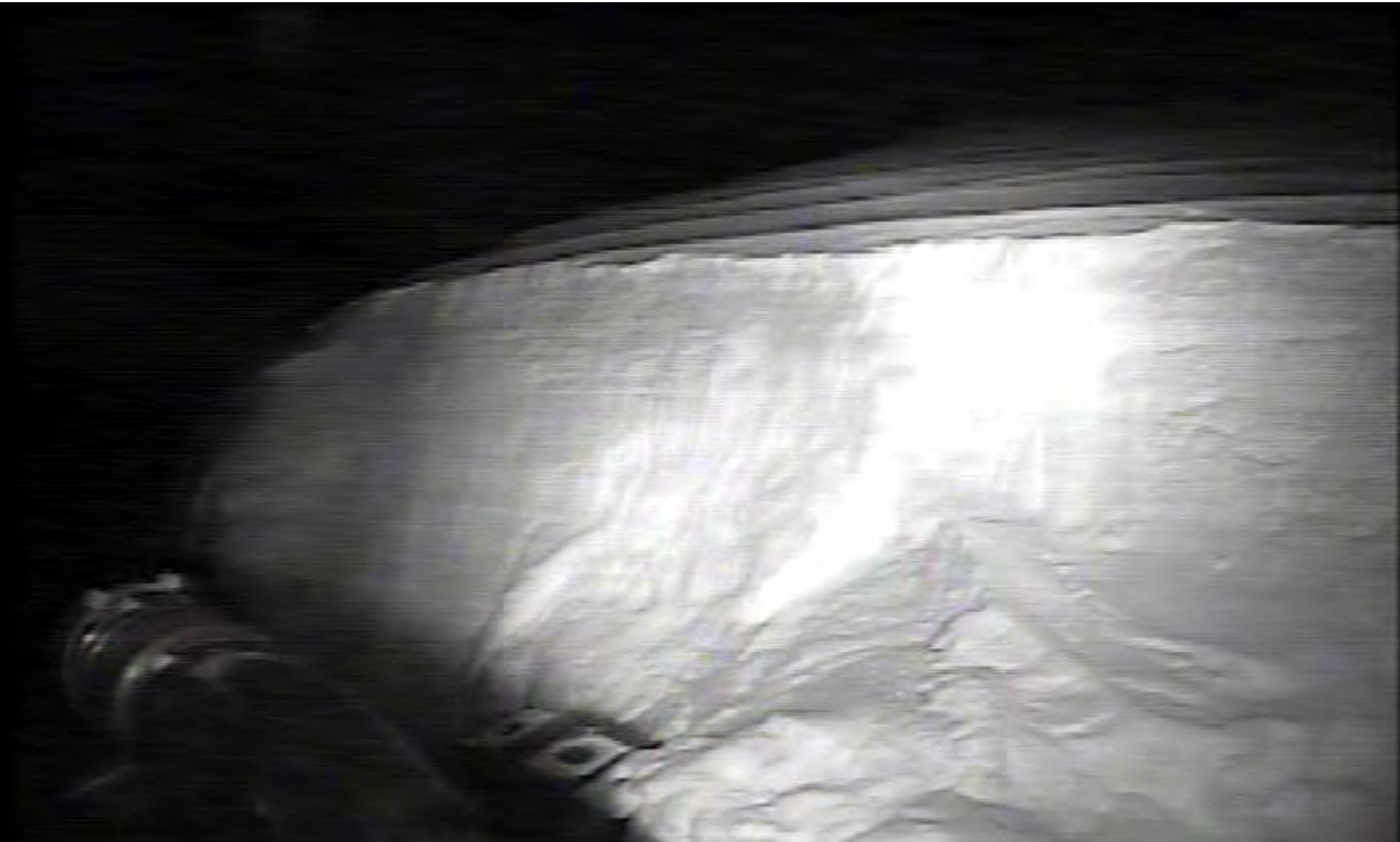


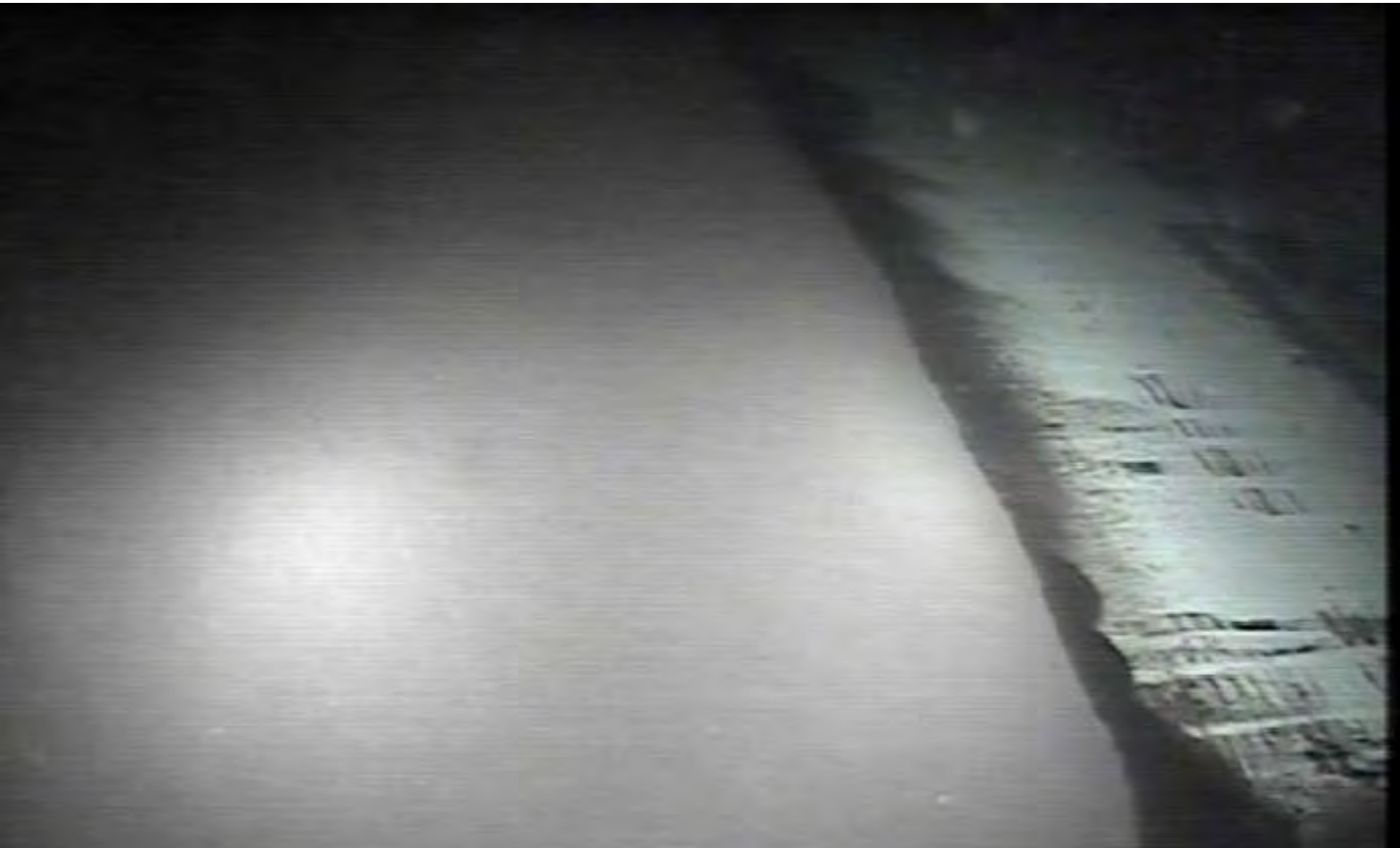


What do we inspect?

- **Sediment**

✓**What depth of sediment should be cleaned?**





What do we inspect?

- Sediment
- Tank Structure

✓Floors: Tell a bigger story than simply how dirty it is

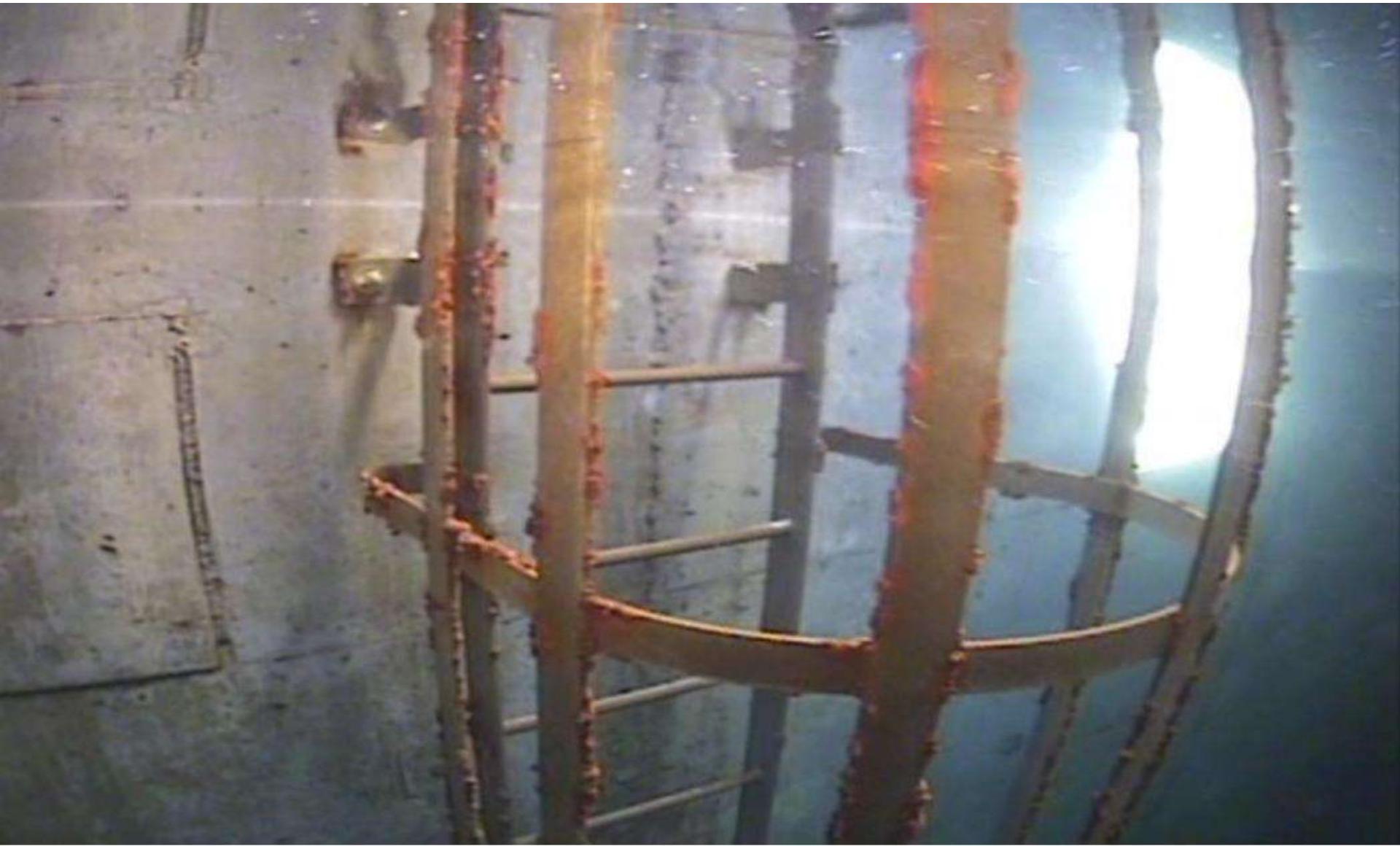
What do we inspect?

- Sediment
- Tank Structure
- Ceilings

✓Concrete problems / Steel tank problems

What do we inspect?

- Sediment
- Tank Structure
- Floors
- Ceilings
- Pipes, ladders, columns, hatches, vents and screens



What do we inspect?

- Sediment
- Tank Structure
- Floors
- Ceilings
- Pipes, ladders, columns, hatches, vents and screens
- Cathodic protection and less metal in tanks

What do we inspect?

- Sediment
- Tank Structure
- Floors
- Ceilings
- Pipes, ladders, columns, hatches, vents and screens
- Cathodic protection and less metal in tanks
- **Specific Requests...**

Common Problems

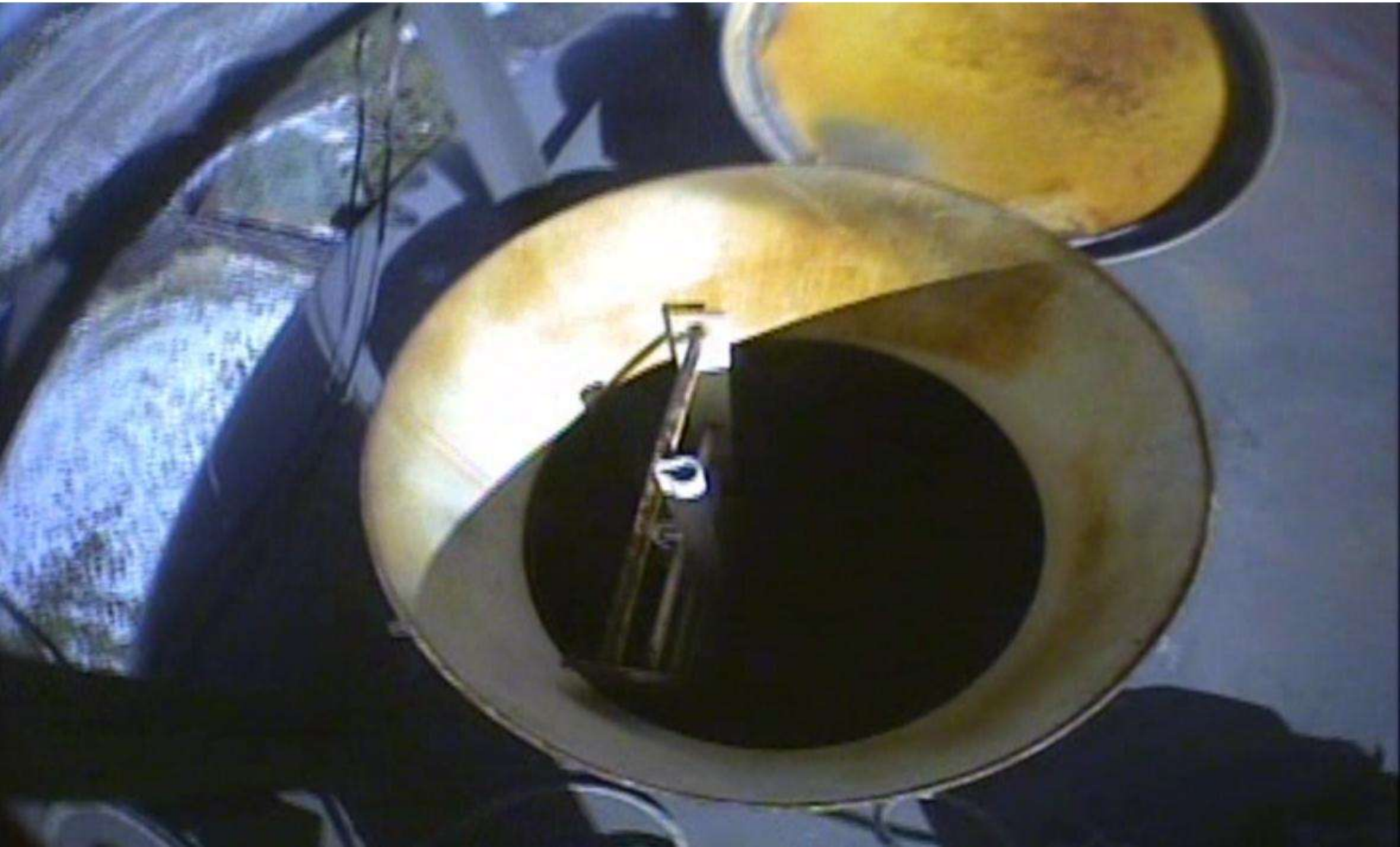
- Need to cut locks due to lost keys
- Structure failure
- Coating failures

Common Problems

- Need to cut locks due to lost keys
- Structure failure
- Coating failures
- Concrete cracks

Common Problems

- Need to cut locks due to lost keys
- Structure failure
- Coating failures in steel tanks
- Concrete cracks
- Animals
- Hatch minimums & other tank designs



Wrap Up

Robotic Solution =

- ✓ **Lower Cost**
- ✓ **Lower Risk**
- ✓ **Time savings**
- ✓ **Tanks remain ONLINE and Operational**

Chemical Cleaning for Water Storage Tanks

Kevin Barnes
Utility Service Co, Inc
15 Dec 2011

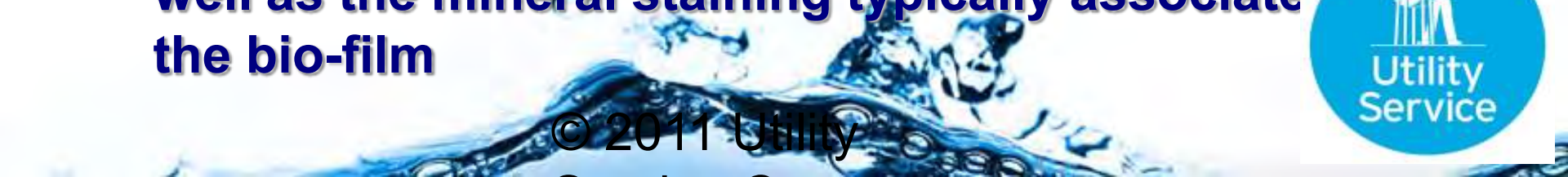
CHEMICAL CLEANING OF THE STORAGE TANK

Removal of Bio-film from all tank surfaces:

- **Reduces disinfectant demand**
- **Reduces risk of nitrification**
- **Reduces risk of DBP formation**

CHEMICAL CLEANING OF THE STORAGE TANK

- Washout inspection involves sediment removal and pressure washing of tank surfaces followed by disinfection in accordance with AWWA C652
- Pressure washing and the disinfection process will NOT kill and remove the bio-film on interior tank surfaces
- Failure to remove the bio-film leaves a major source of disinfectant demand in the tank which simply regenerates during the summer months
- A low pressure NSF 60 certified chemical application can remove all biological growth from the tank as well as the mineral staining typically associate the bio-film



CHEMICAL CLEANING OF THE STORAGE TANK

- In addition to the impact on disinfectant demand, bio-film and Fe/Mn stain removal makes inspection and repairs to failures in the coating much easier and more thorough
- Maintaining the integrity of the coating is vital and will minimize biological re-growth by eliminating those anchor sites where colonization occurs
- Our experience has shown a direct correlation between interior coating surface roughness and bio-film growth

Organic Deposits on Tank Interior

Organic Deposits on Tank Interior

Bio Film on Tank Interior

Bio-film in Storage Vessels

CHEMICAL CLEANING OF THE STORAGE TANK

- **PRESSURE WASHING ALONE WILL NOT REMOVE BIO-FILM, which is an ongoing source for chlorine consumption and DBP production**

Bio-film removal process

Before

During

After

Bio-film Removal

Bio-film Removal


06/20/2011 16:08


06/20/2011 11:13


06/20/2011 11:22


06/20/2011 14:32


06/20/2011 14:33


06/20/2011 15:44