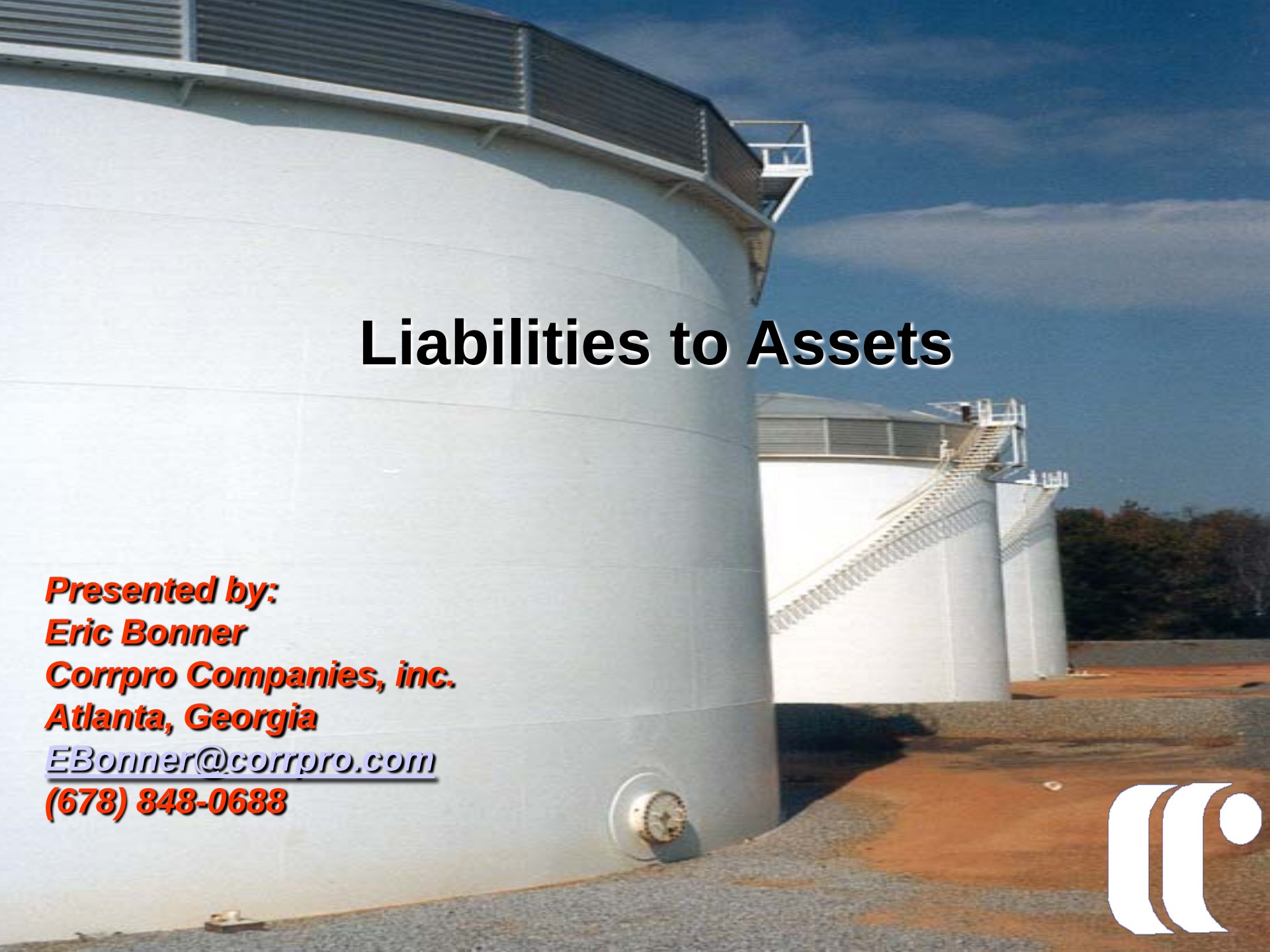
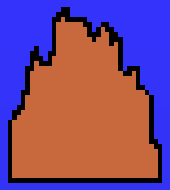
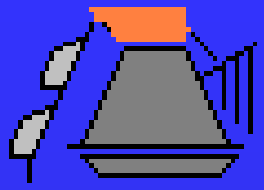


Liabilities to Assets

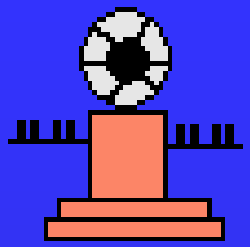
Presented by:
Eric Bonner
Corrpro Companies, inc.
Atlanta, Georgia
EBonner@corrpro.com
(678) 848-0688



IRON OXIDE

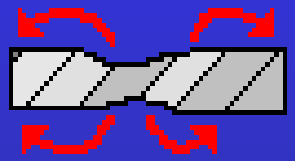


REFINING

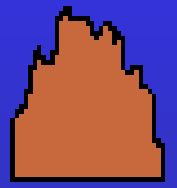


MILLING

STEEL



CORROSION



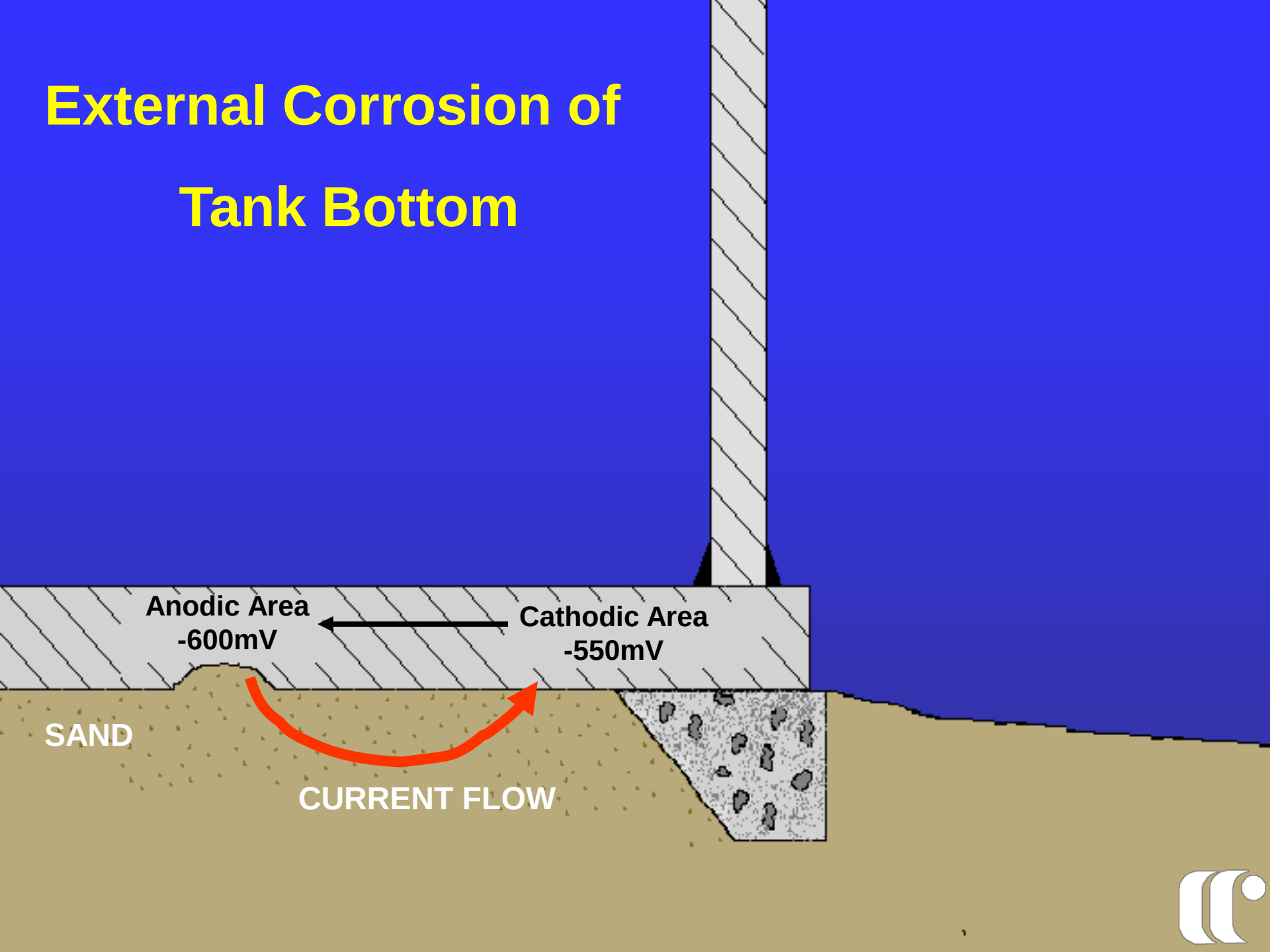
IRON OXIDE

THE PROBLEM…..

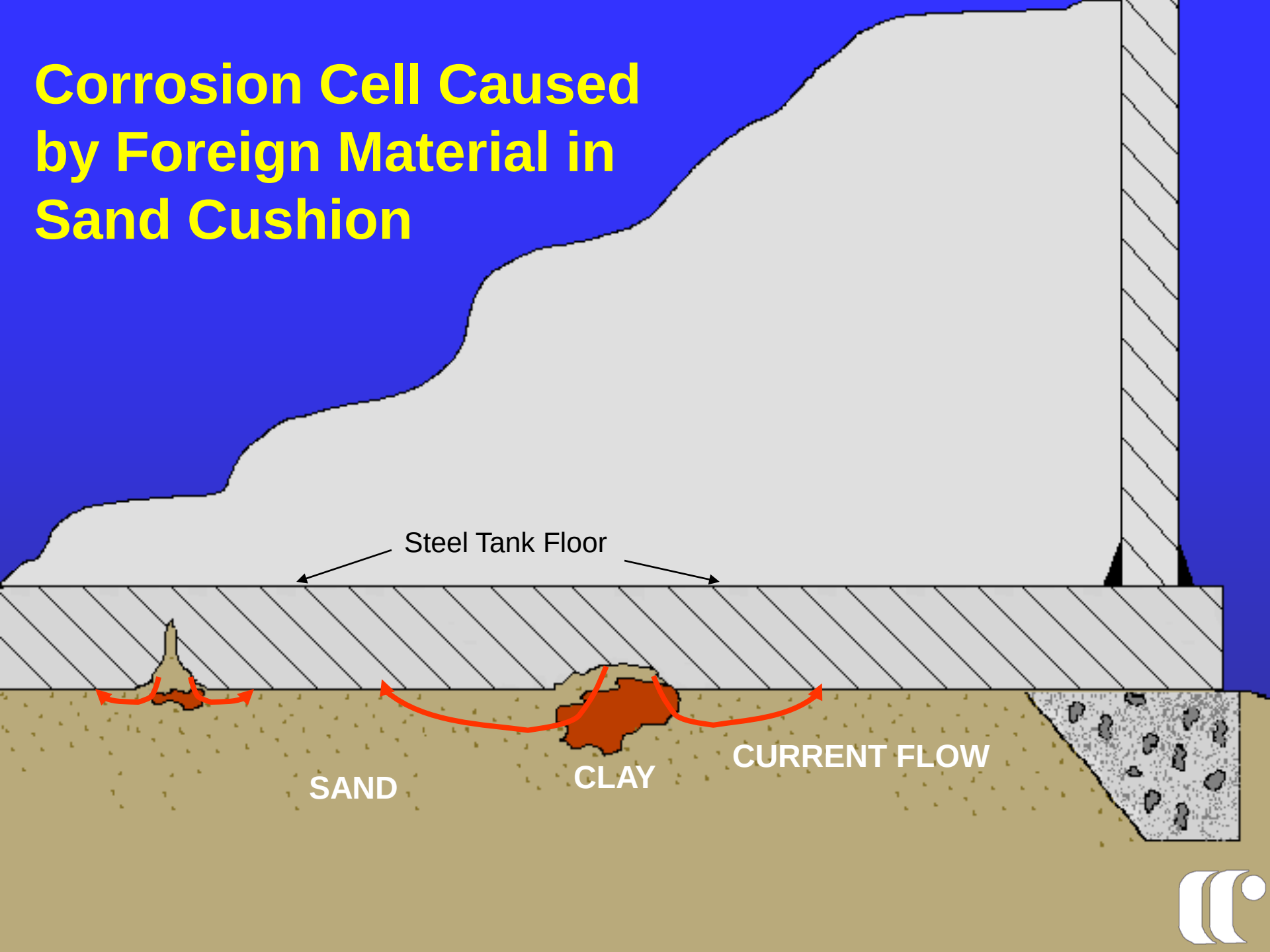
Why Provide Corrosion Control?

- **Regulatory Compliance**
- **Preserve Assets That Have Become LIABILITIES!**
- **Dramatically Reduce Likelihood of Product Releases**
- **Significantly Reduce Maintenance Costs**
- **Environmental Preservation**

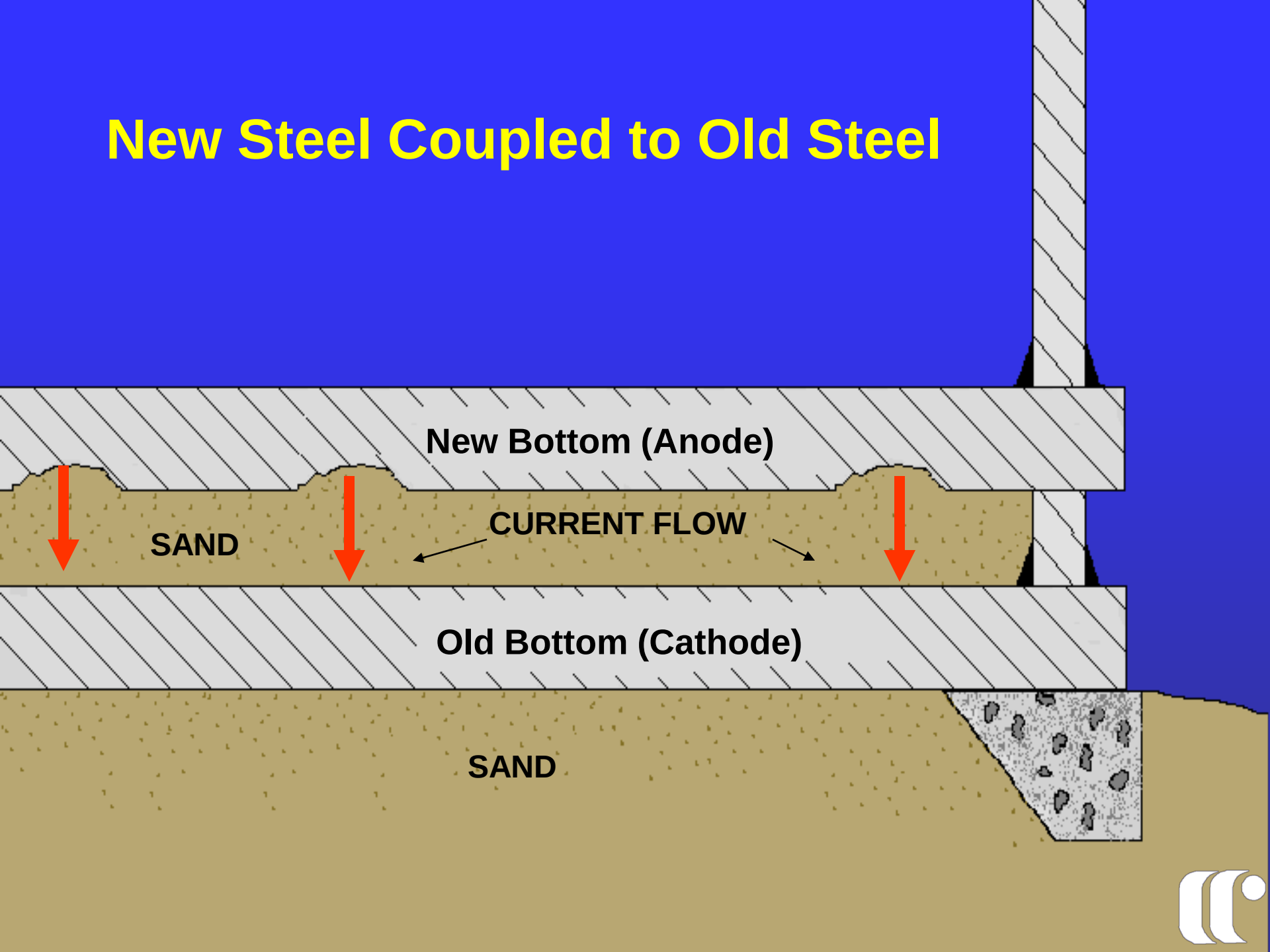
External Corrosion of Tank Bottom



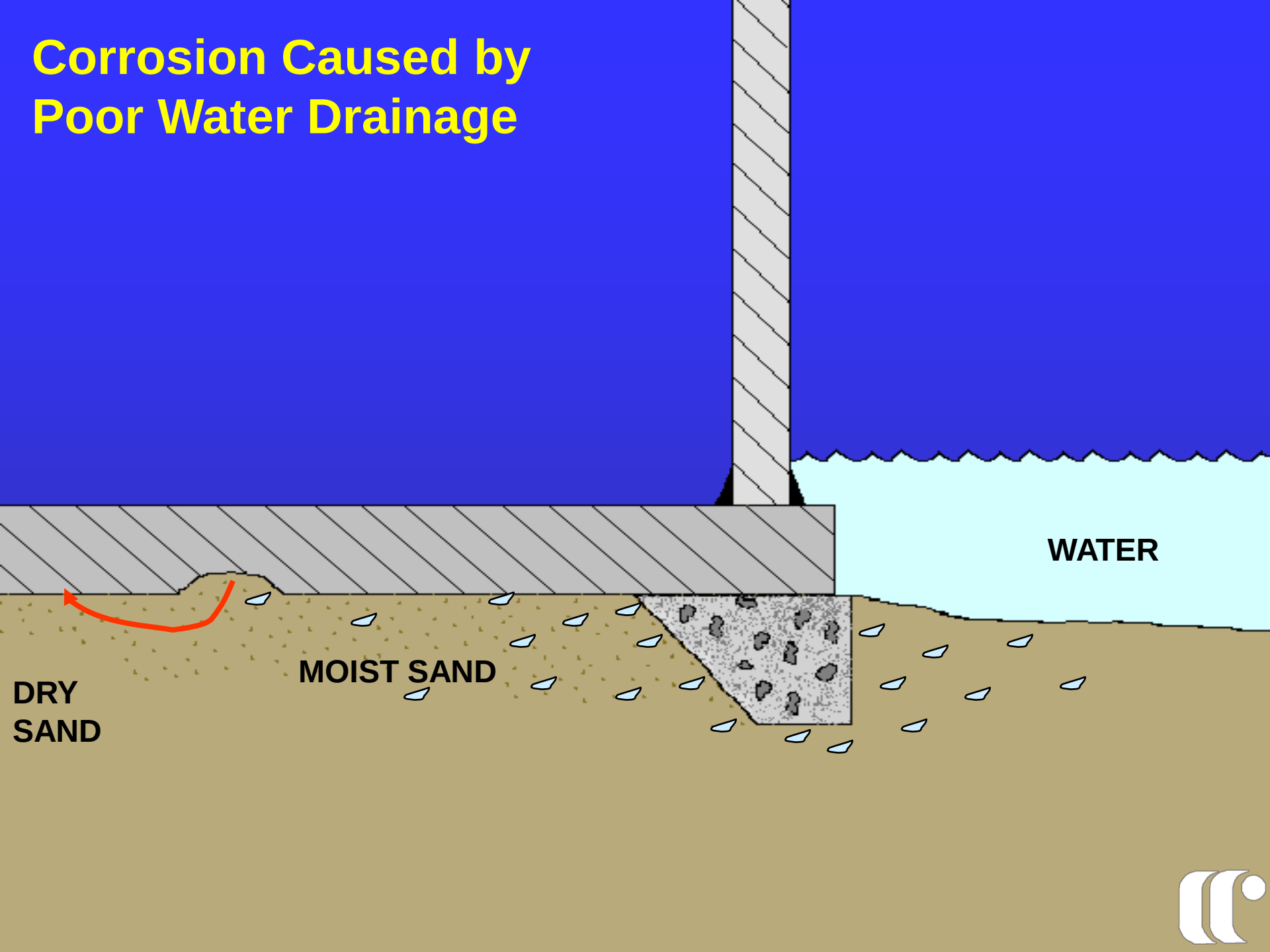
Corrosion Cell Caused by Foreign Material in Sand Cushion



New Steel Coupled to Old Steel



Corrosion Caused by Poor Water Drainage



State Level

- Approximately 25% of States now require cathodic protection be installed and maintained on new, refurbished, or repaired tanks in contact with soil or sand foundations.

- A number of other states are in the process of implementing regulations governing AST's.

MAJOR OIL

- **Vast Majority of Oil Marketers Have Employed CP for Decades**
- **Laws Changing Dramatically**

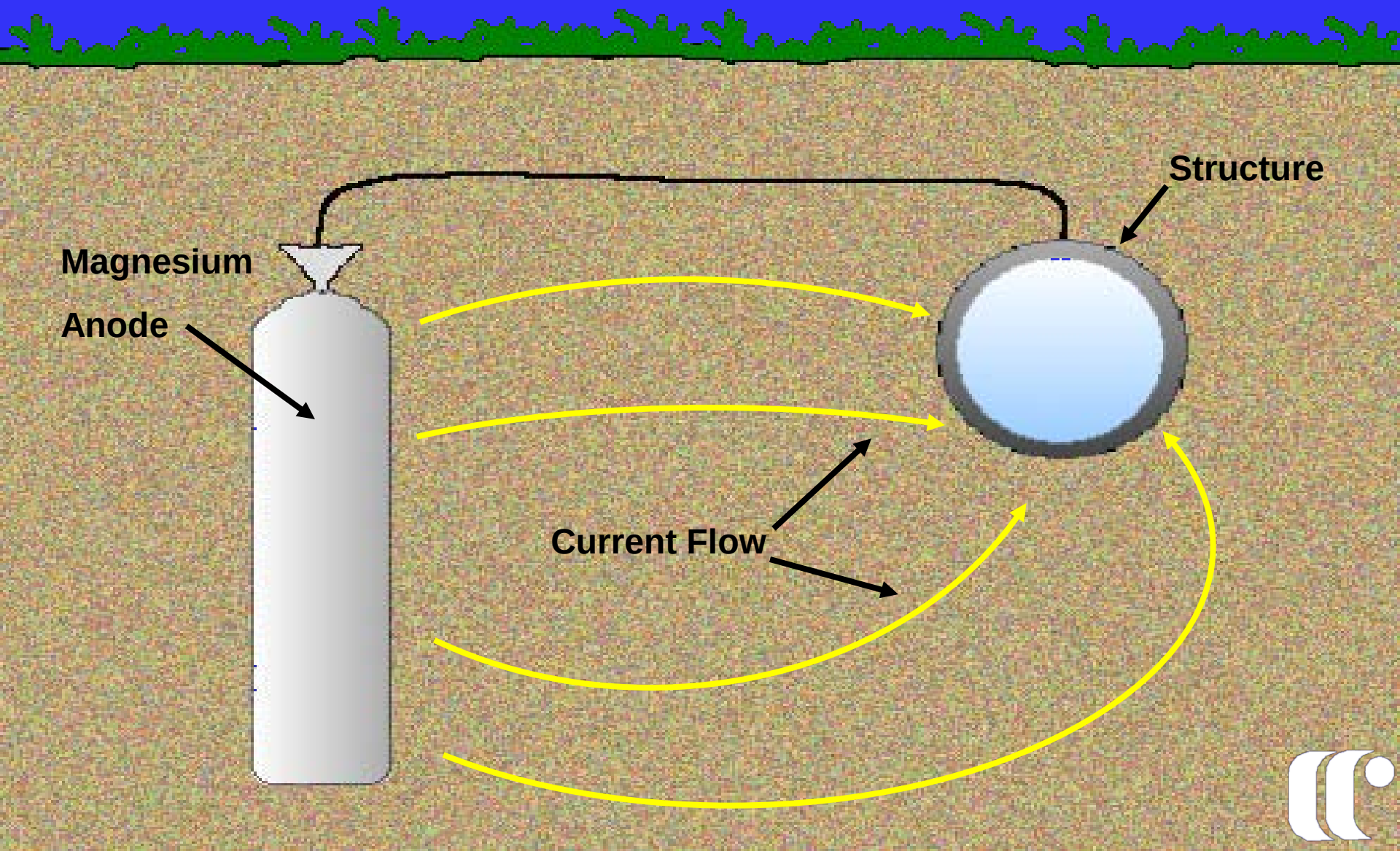
Types of Cathodic Protection

Galvanic: *Current obtained from a metal with a higher energy level.*

Impressed Current: *Requires external power source (transformer rectifier).*

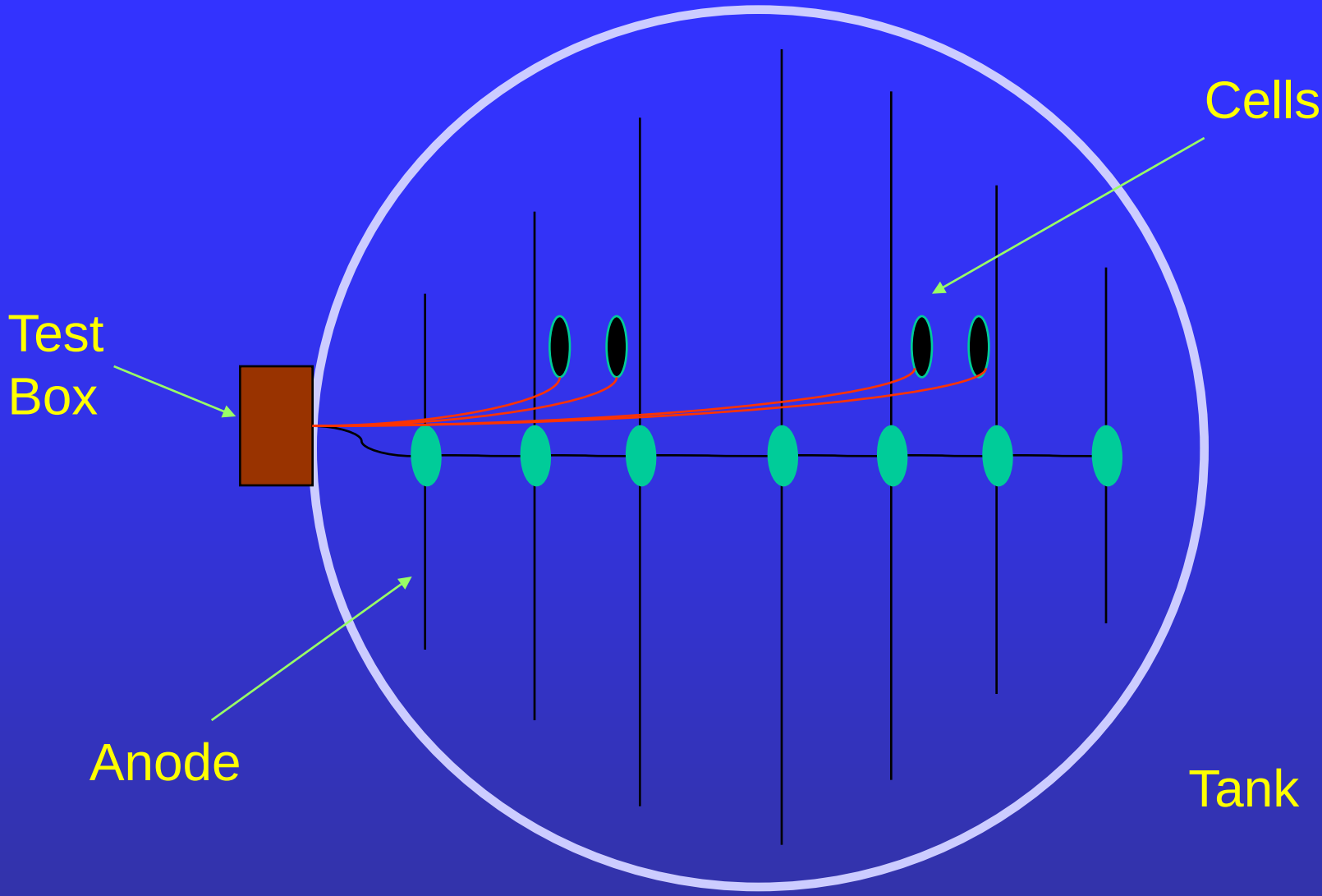

MARCO
CONTENTS
1-9# "CERTIFIED"
MARCO GALVOMAG
MAGNESIUM ANODE
MARCO ENGINEERING EXCELLENCE

Galvanic Cathodic Protection



Galvanic System

- Difficulty in meeting NACE -850mV Criteria
- Sand Quality impacts anode performance / life
- Typically Very Short Life / Poor Track Record
- Not recommended for large diameter AST's



Galvanic Anodes

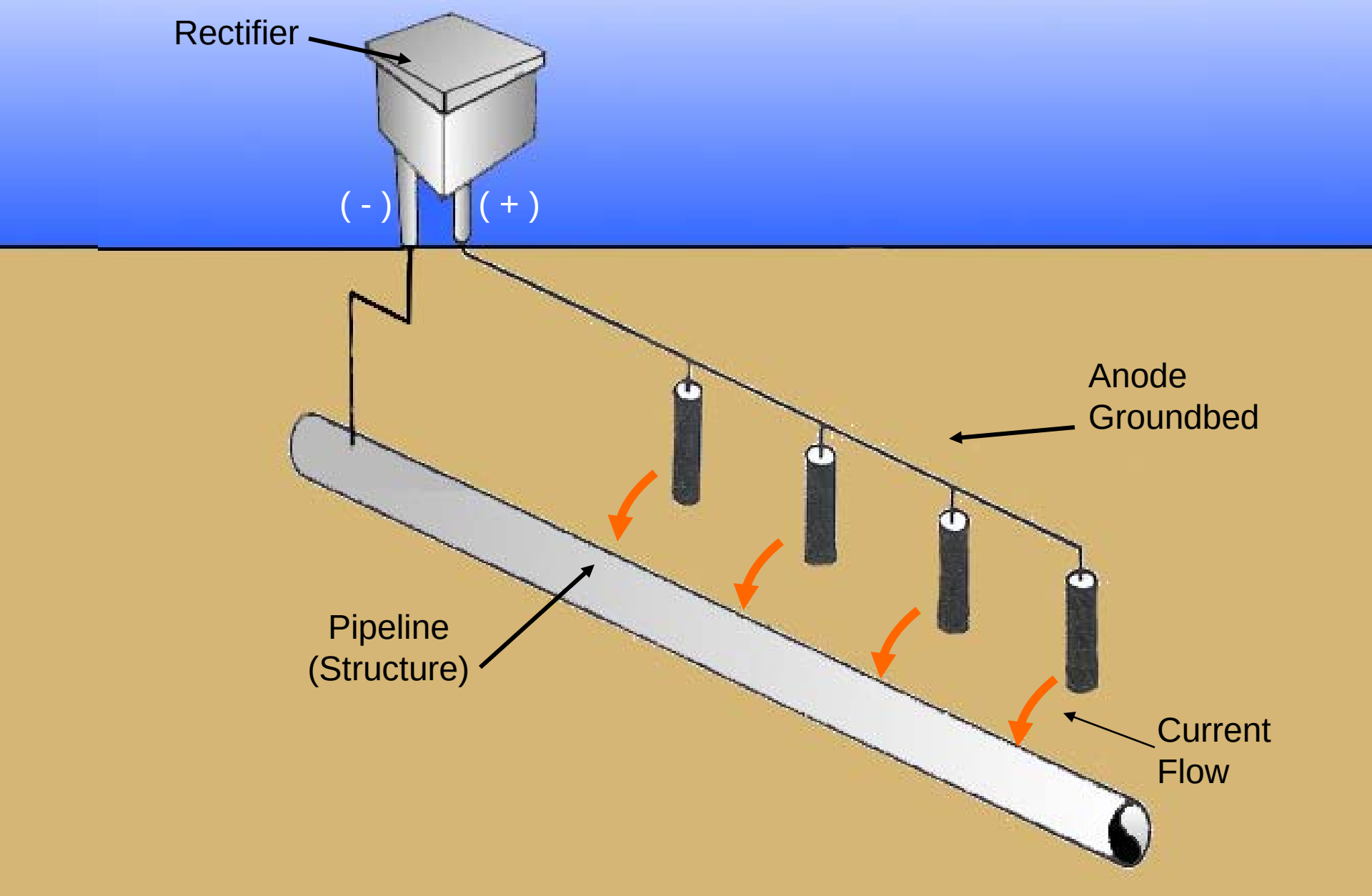
SAND QUALITY

- **The rate of corrosion is dependent on the characteristics of the sand.**
- **The 1st means of corrosion control is a good quality sand material.**
- **On-site testing has indicated that provided sand is as much as ten times more corrosive than recommended sand.**

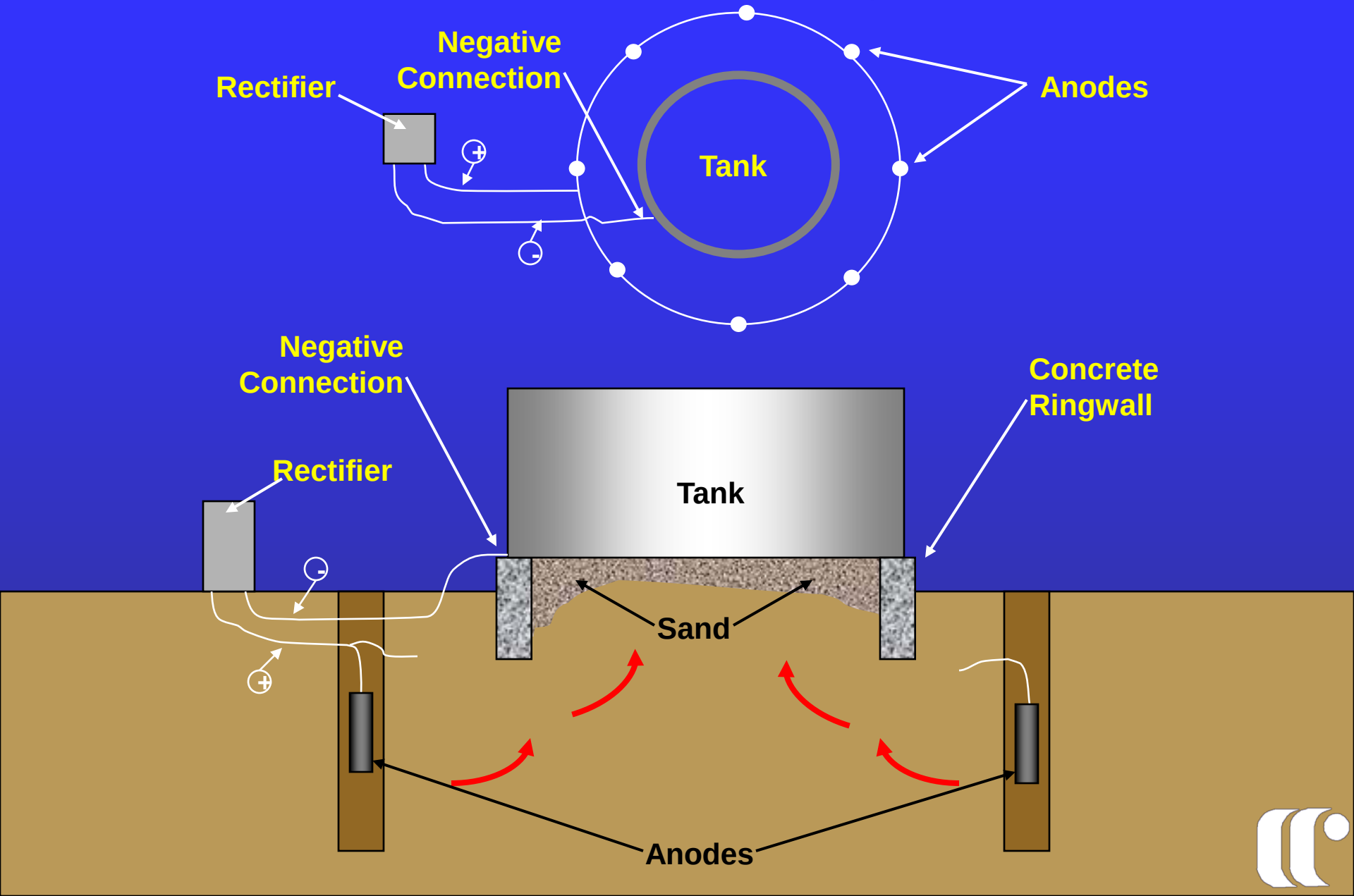
Sand Recommendation

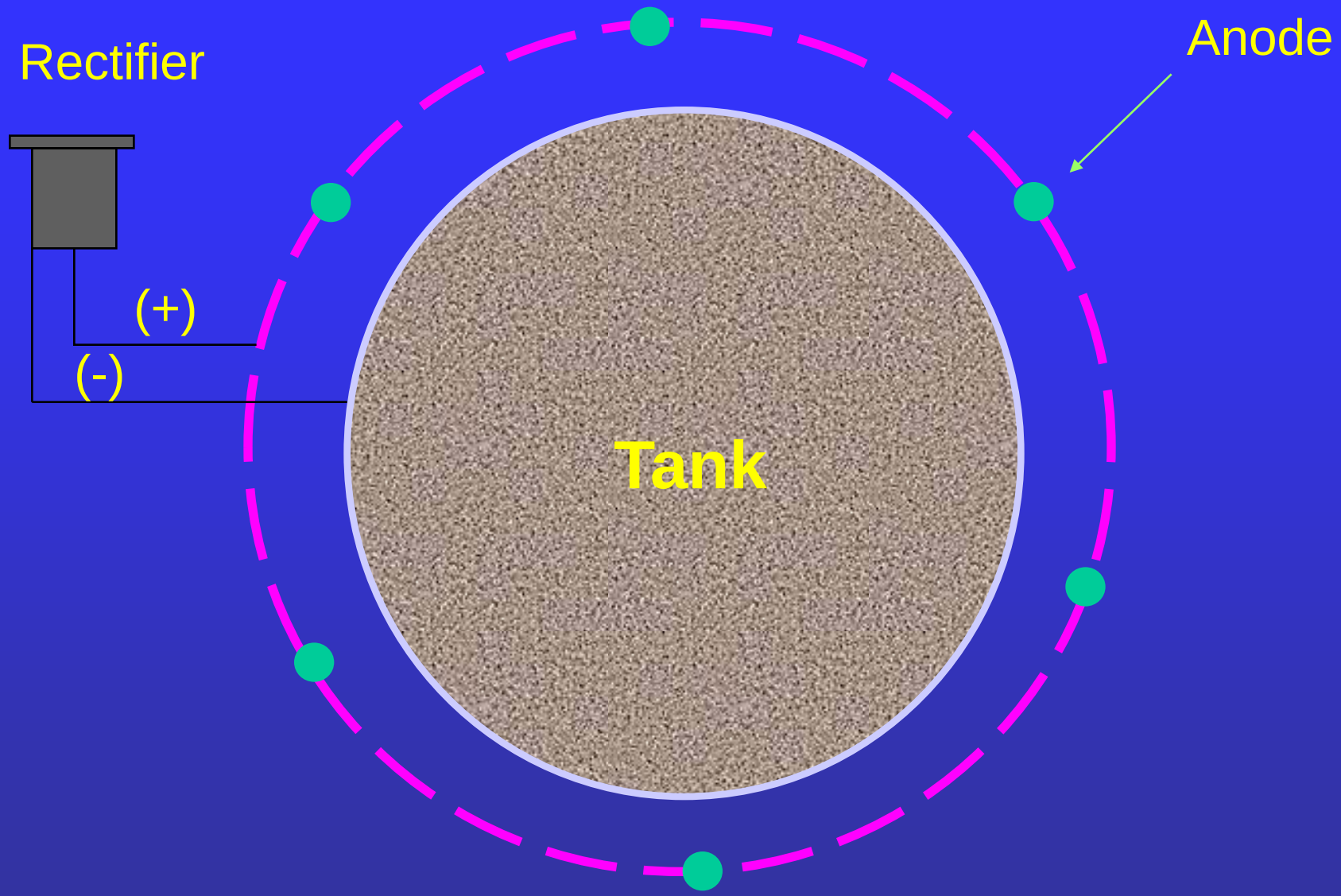
- Silica
- pH Between 6.5 and 8.5
- Moisture less than 5%
- Chlorides less than 10 ppm
- Resistivity greater than 30,000 ohm-cm

Impressed Current System

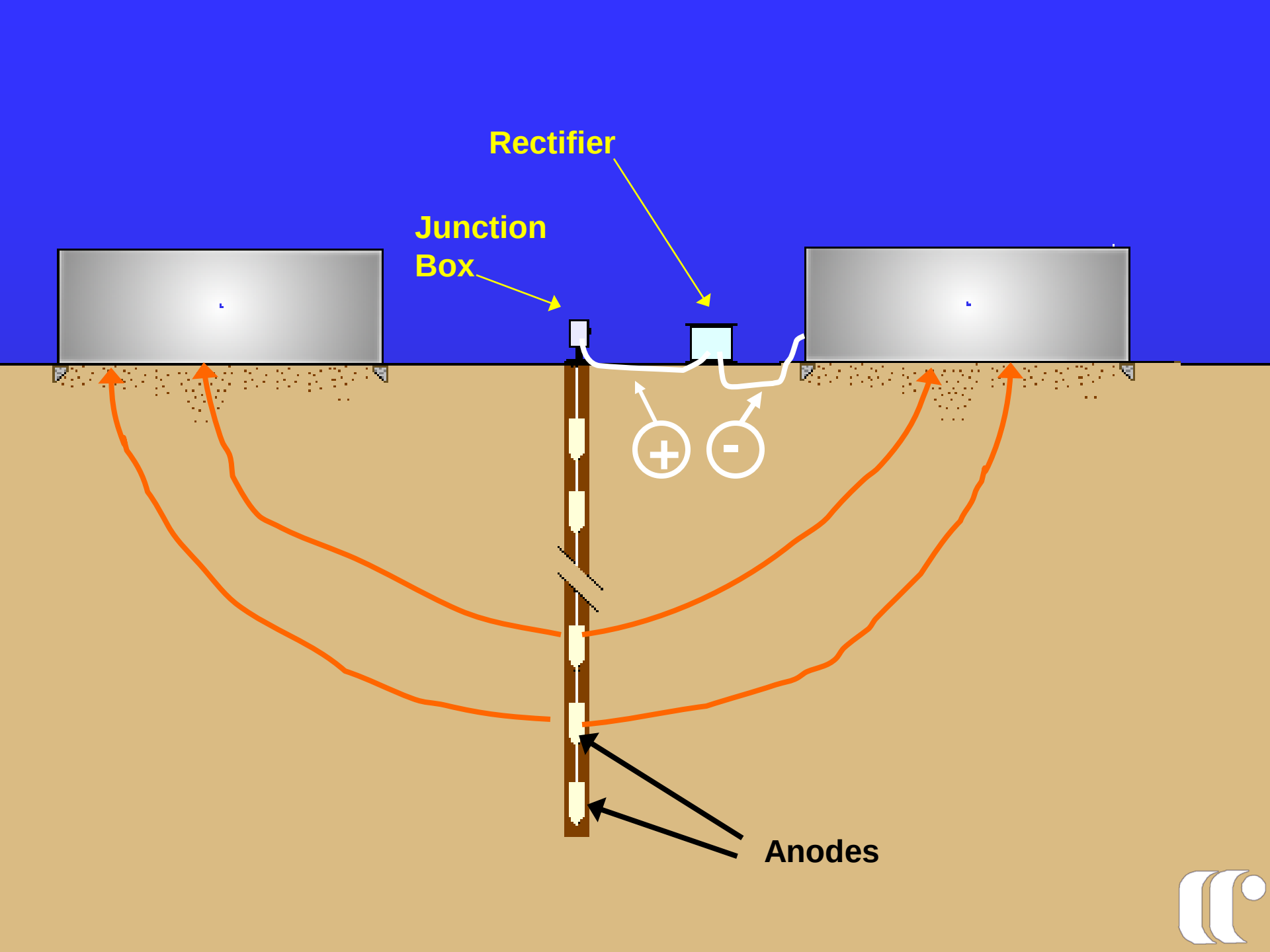


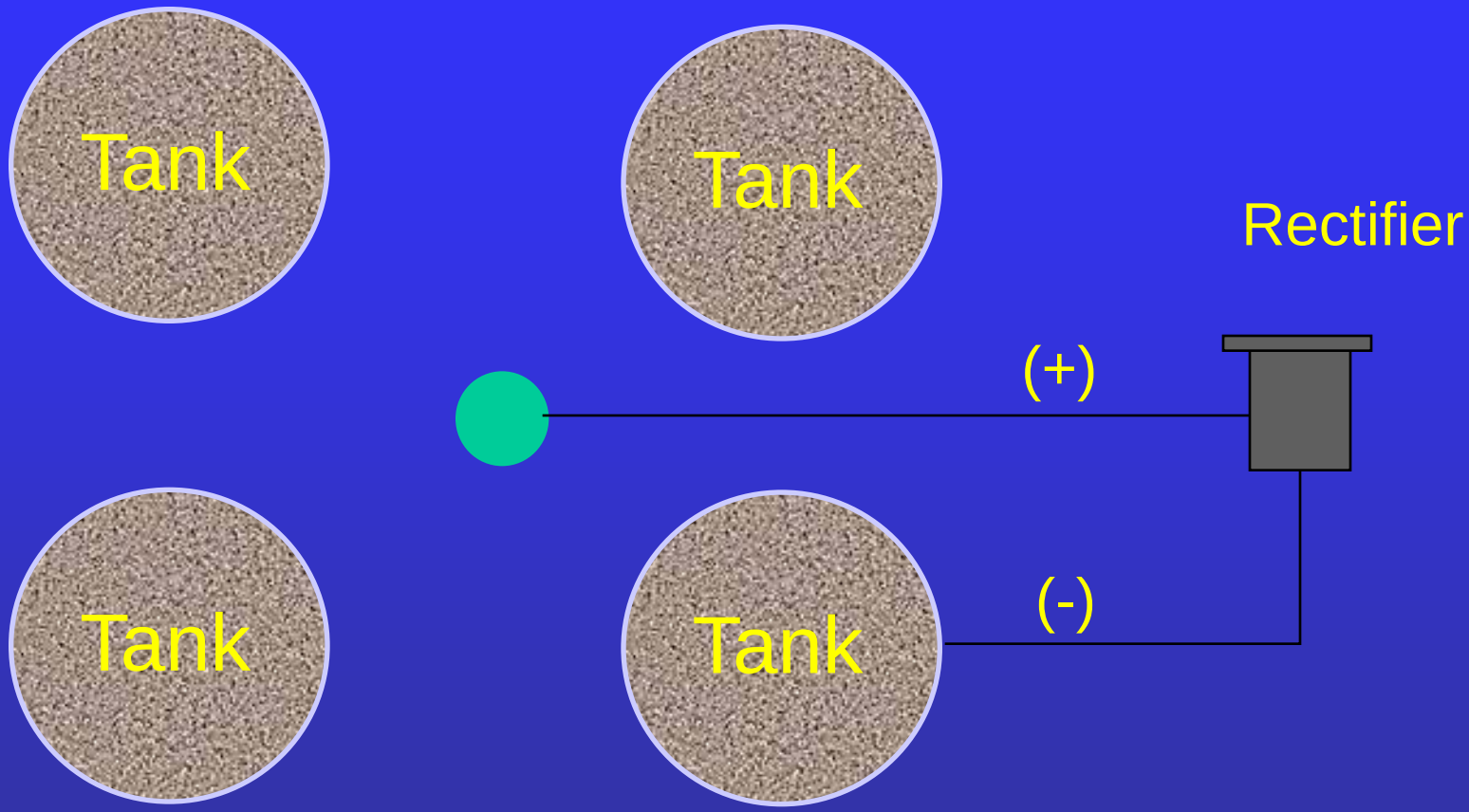
Above Ground Storage Tank Vertical Impressed Current Anodes - Existing Tanks





Shallow Anodes


Rectifier
Junction Box
+
-
Anodes



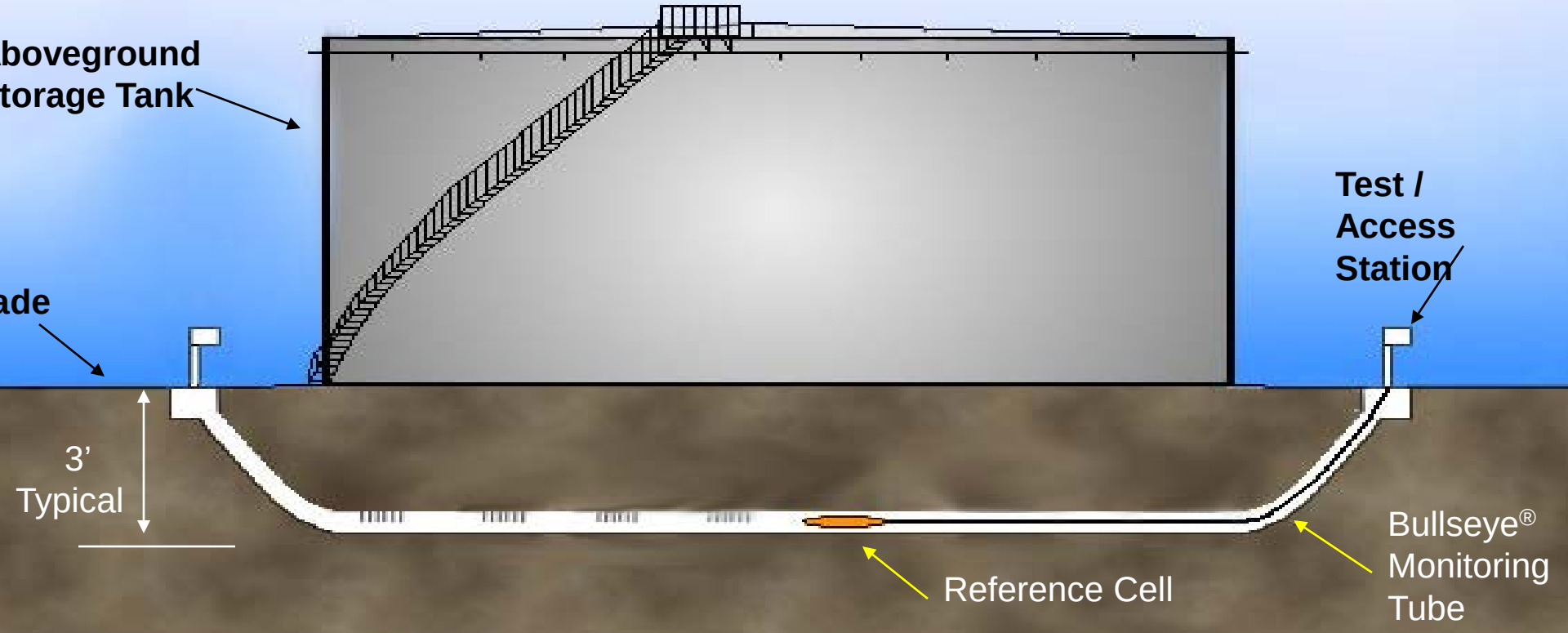
Deep Anode

MFL Floor Inspection

Mechanical Integrity

- **API-653 Inspections Should Coincide With the Results of a CP System Evaluation**
- **Corrosion Engineers and Mechanical Inspectors Must be on the Same Page**

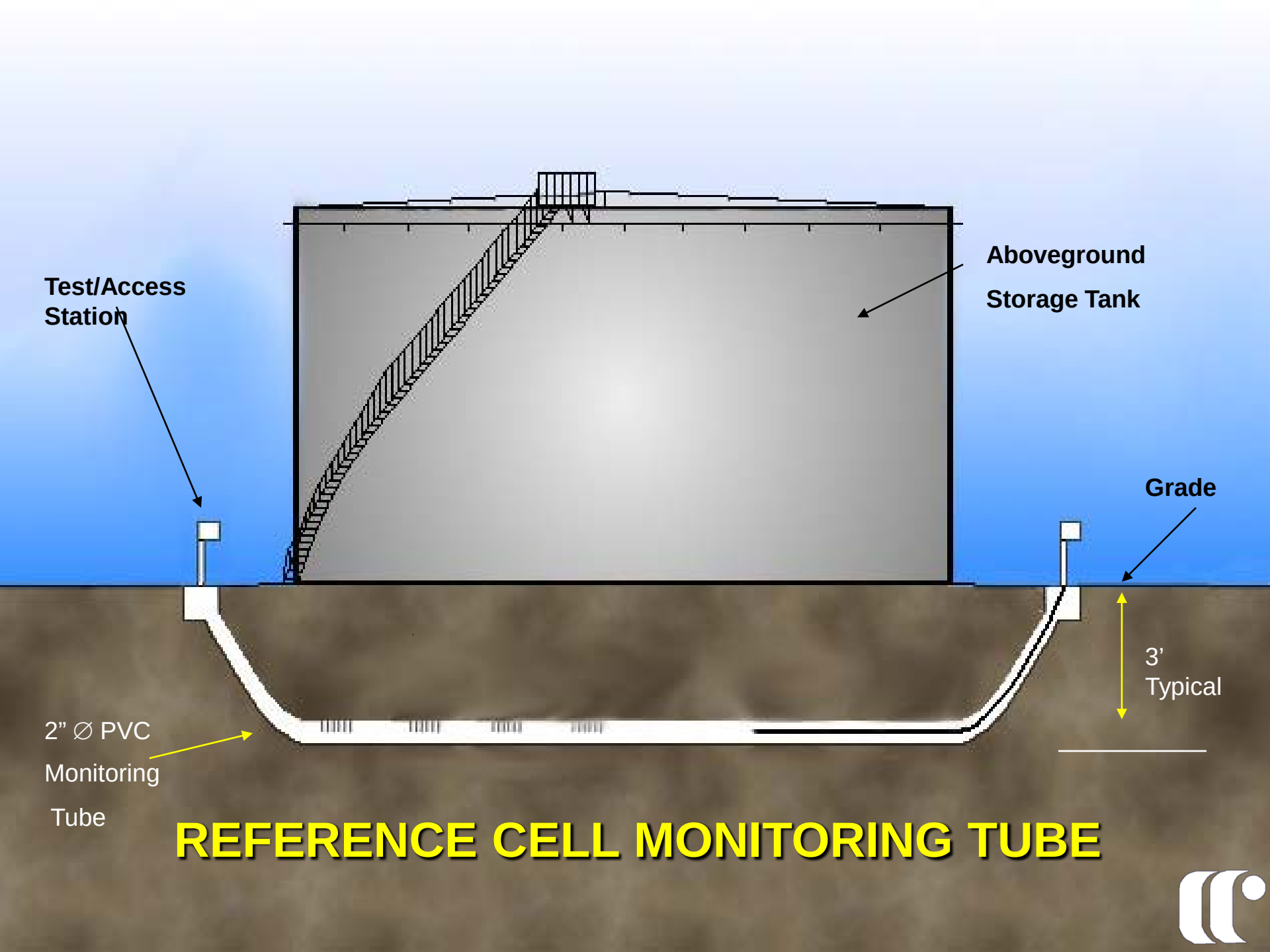
Rim Potential Measurements



	Rim	25'	Center	55'	Rim
On	-1411	-698	-404	-601	-1455
Off	-902	-664	-402	-578	-911

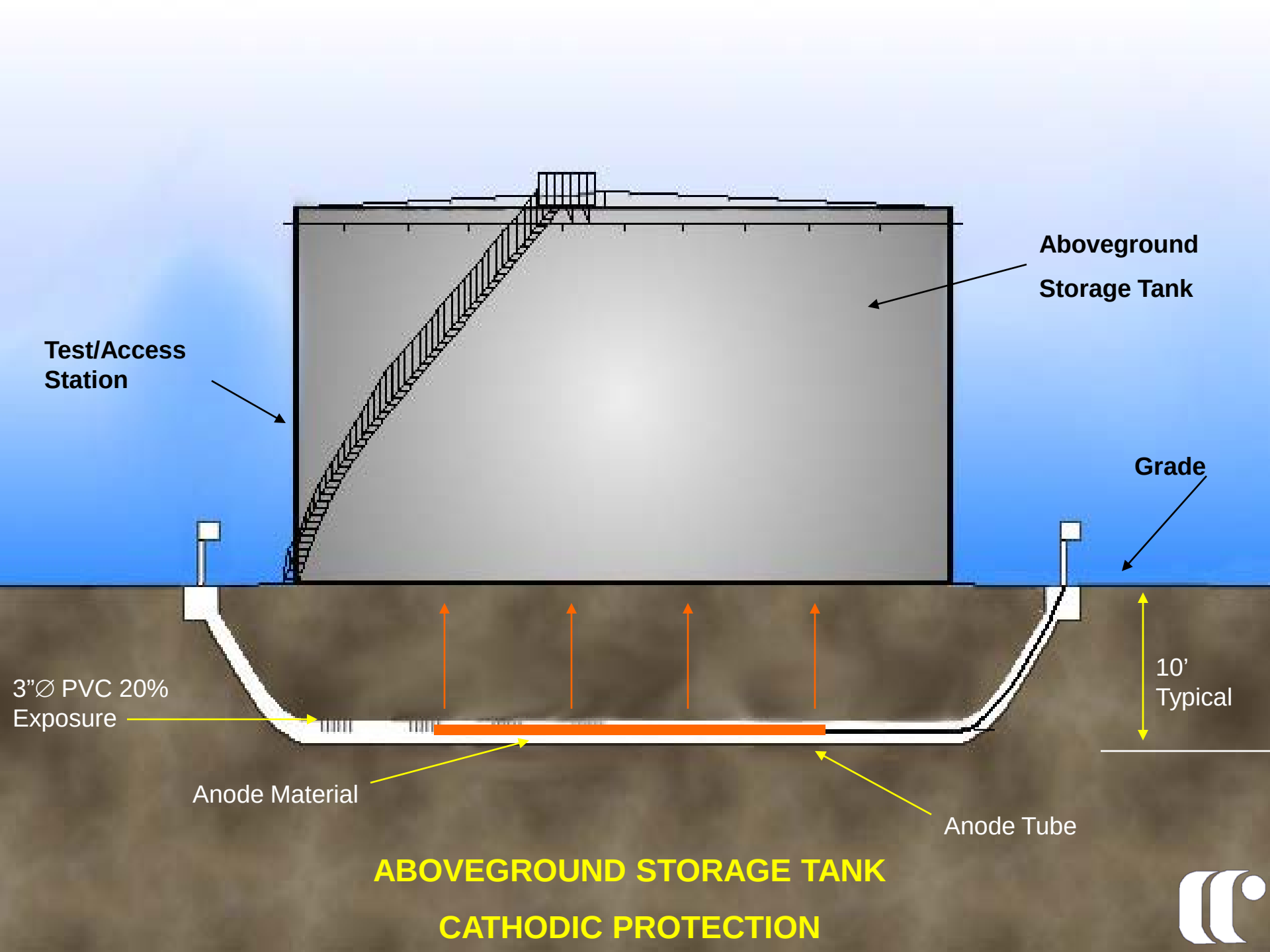
Potentials (mV)

Directional Boring Under Existing AST



REFERENCE CELL MONITORING TUBE

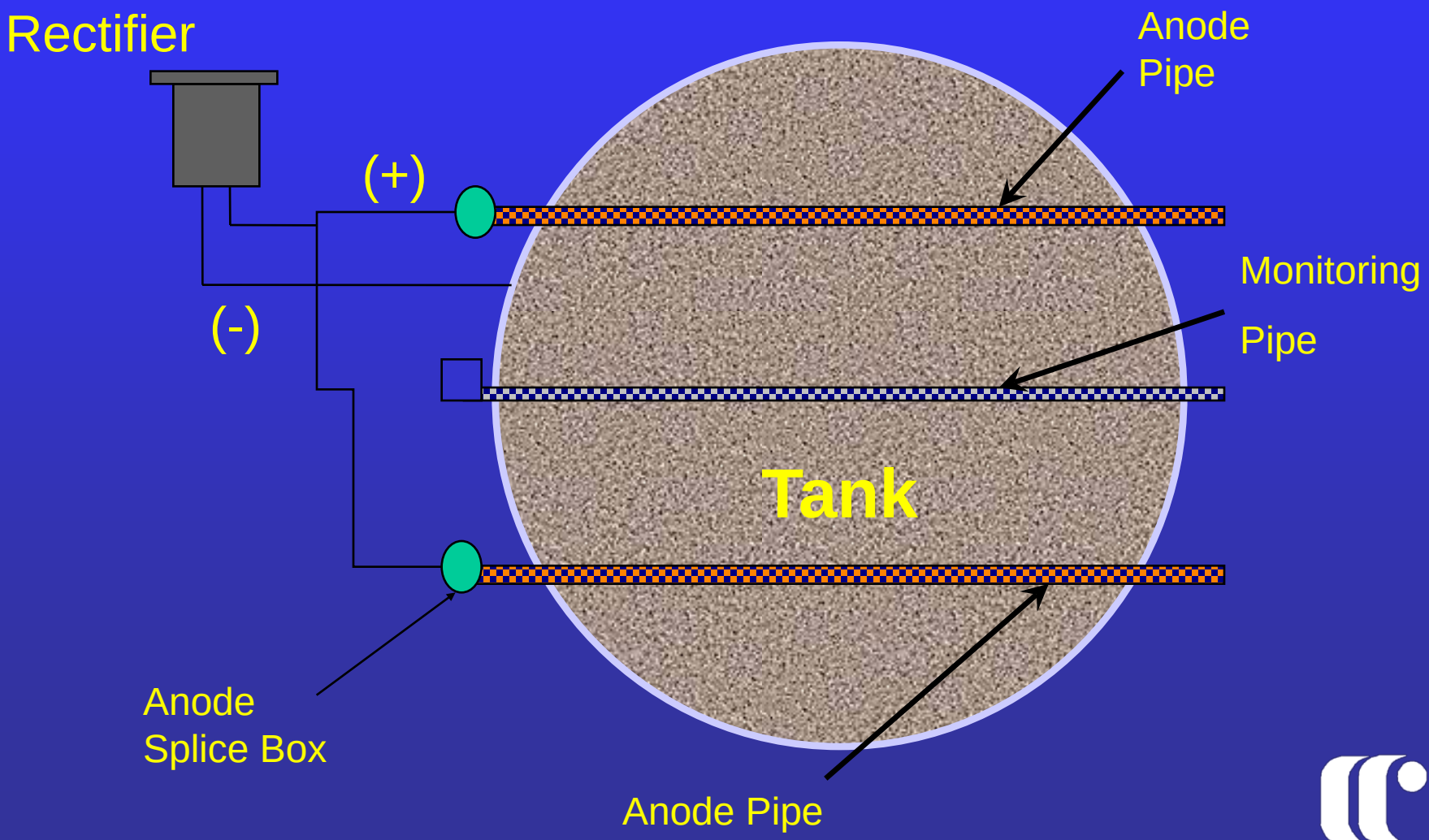
Directional Bore Under Tank for Anode or Reference Cell Placement



ABOVEGROUND STORAGE TANK

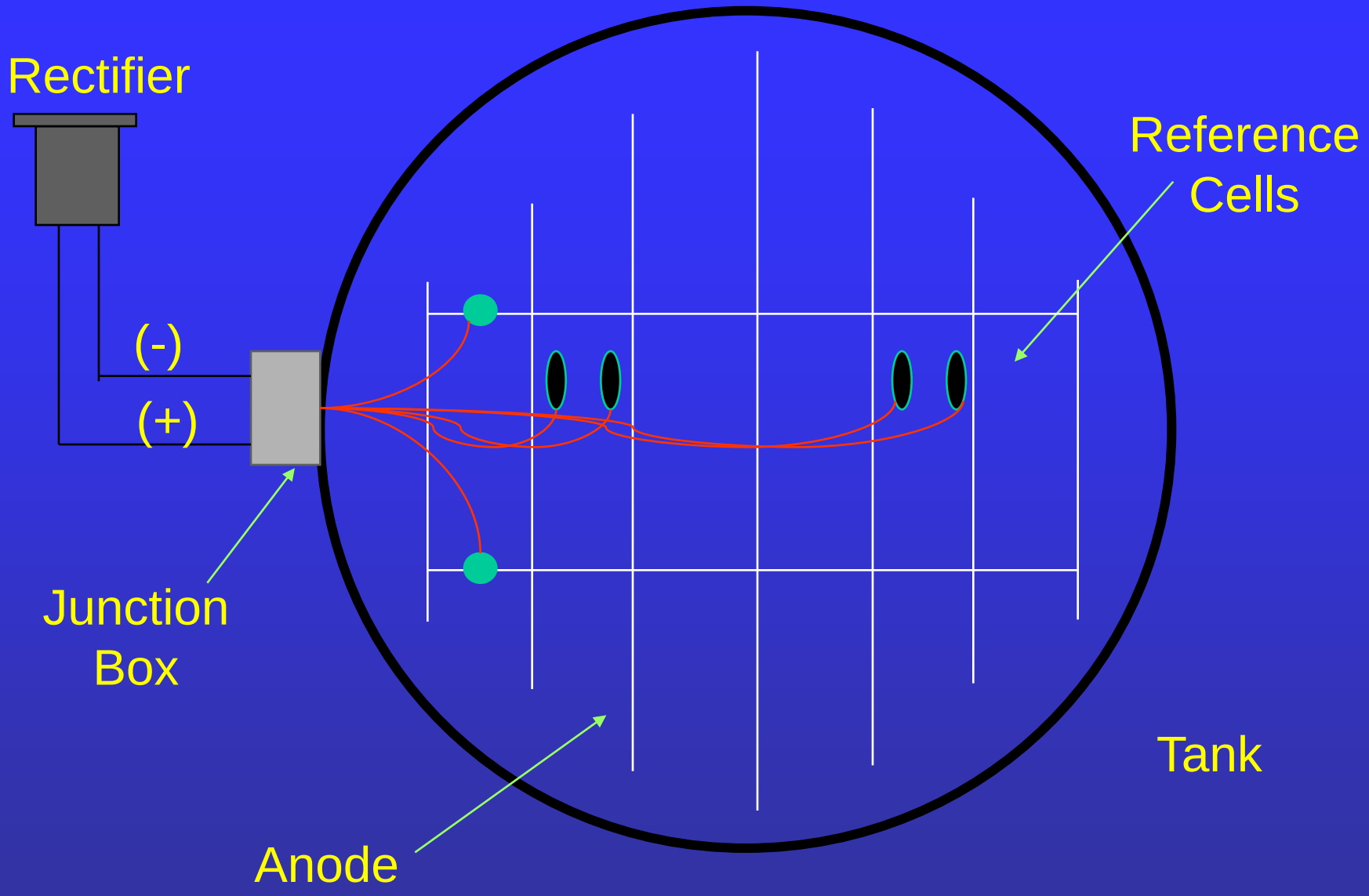
CATHODIC PROTECTION

Computer Guided Horizontally Bored Anode System



CP Applications for Re-bottomed or New Tanks

New Floor Installation on Existing AST



Impressed Current

CP Installation on Rebottomed Tank

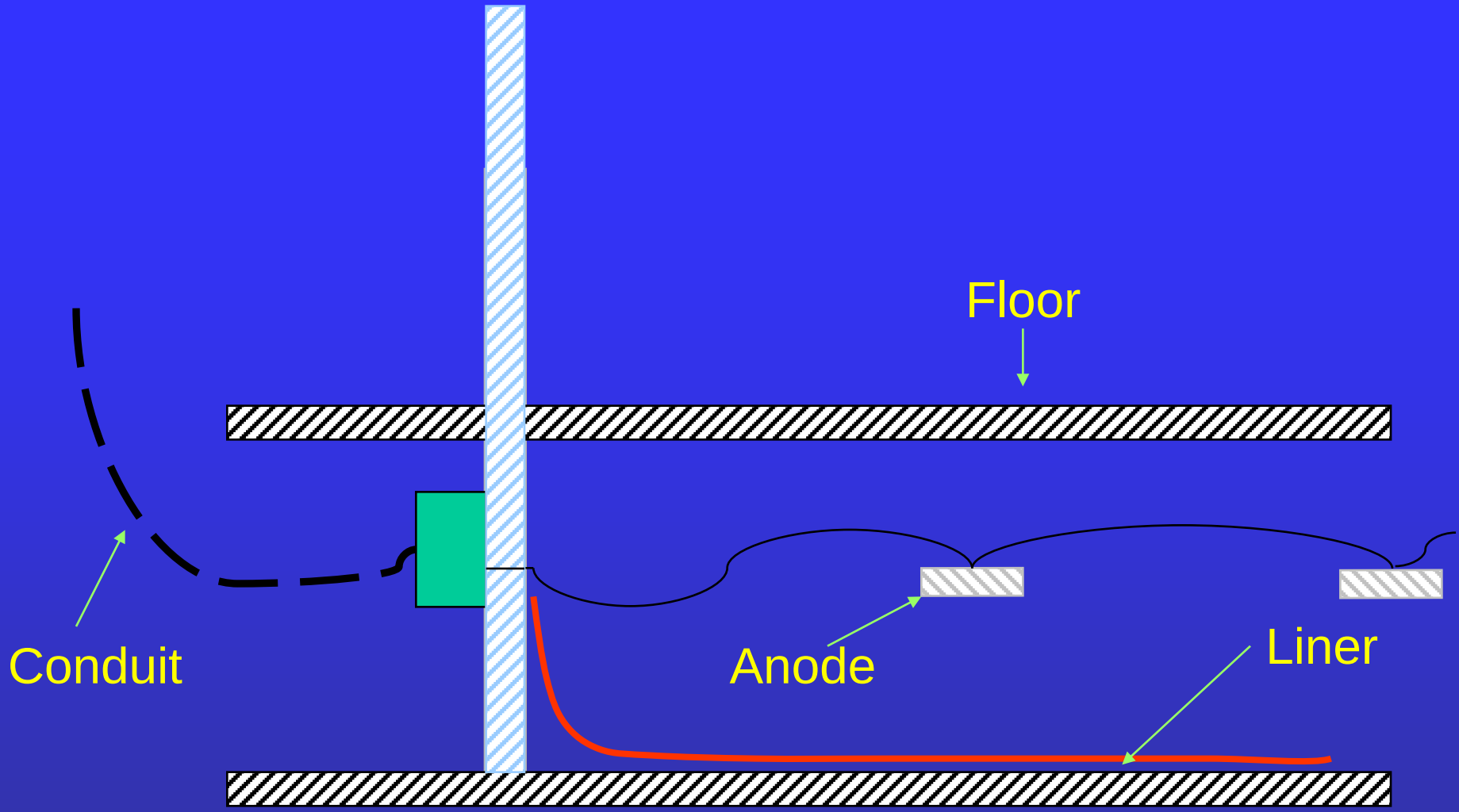
Above Ground

Storage Tank Bottoms

with Secondary Containment


New Tank Construction with Liner


Anode & Reference Cell Placement
in High Resistance Sand



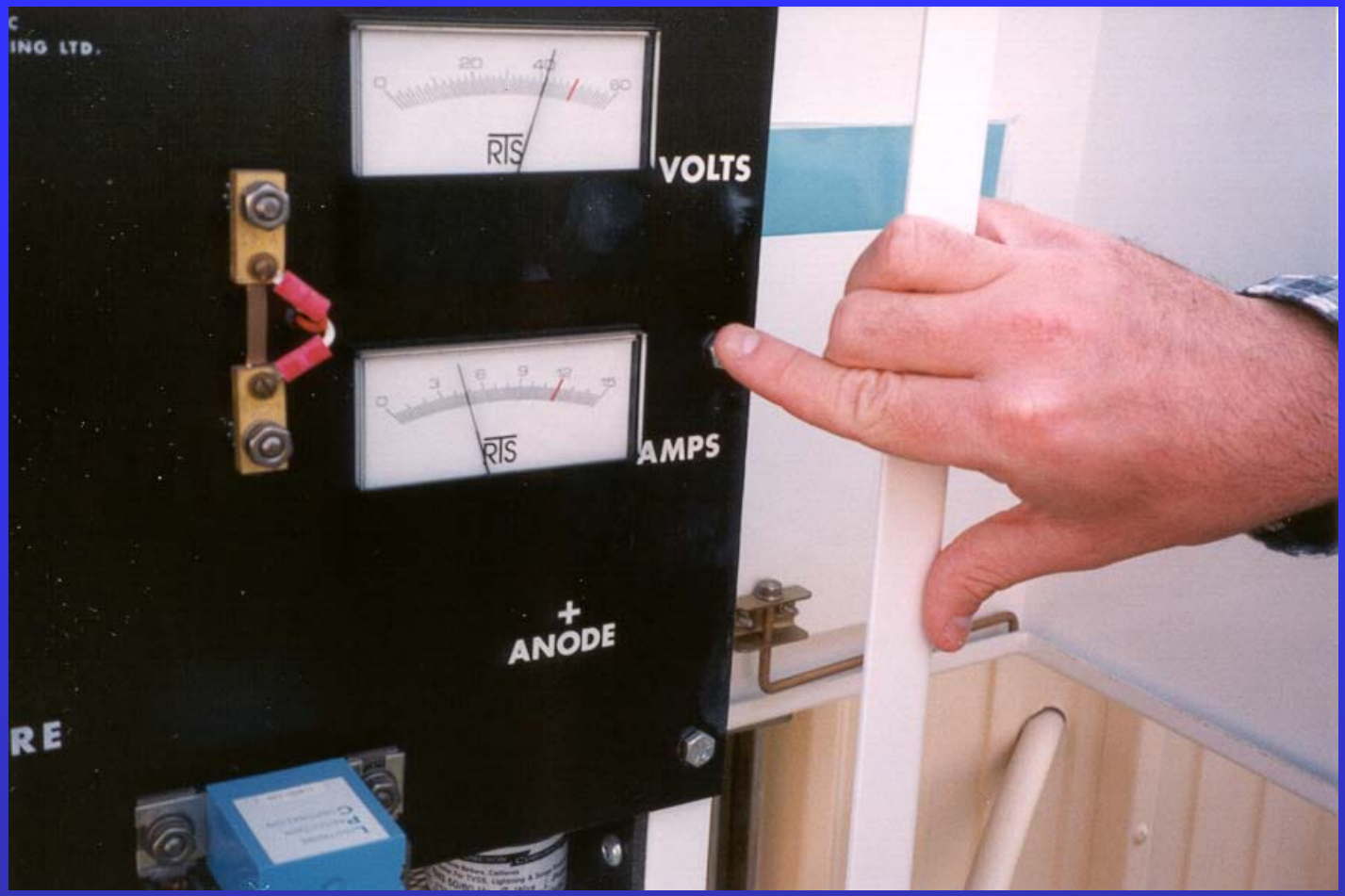
CP Installation on Double Bottom Tank

Installation of CP System on Lifted AST

Explosion Proof Unit

Reference Cell Placement Under Tank Bottom

Inspection of CP System



- Record Volts/Amps
- Compare values to target settings

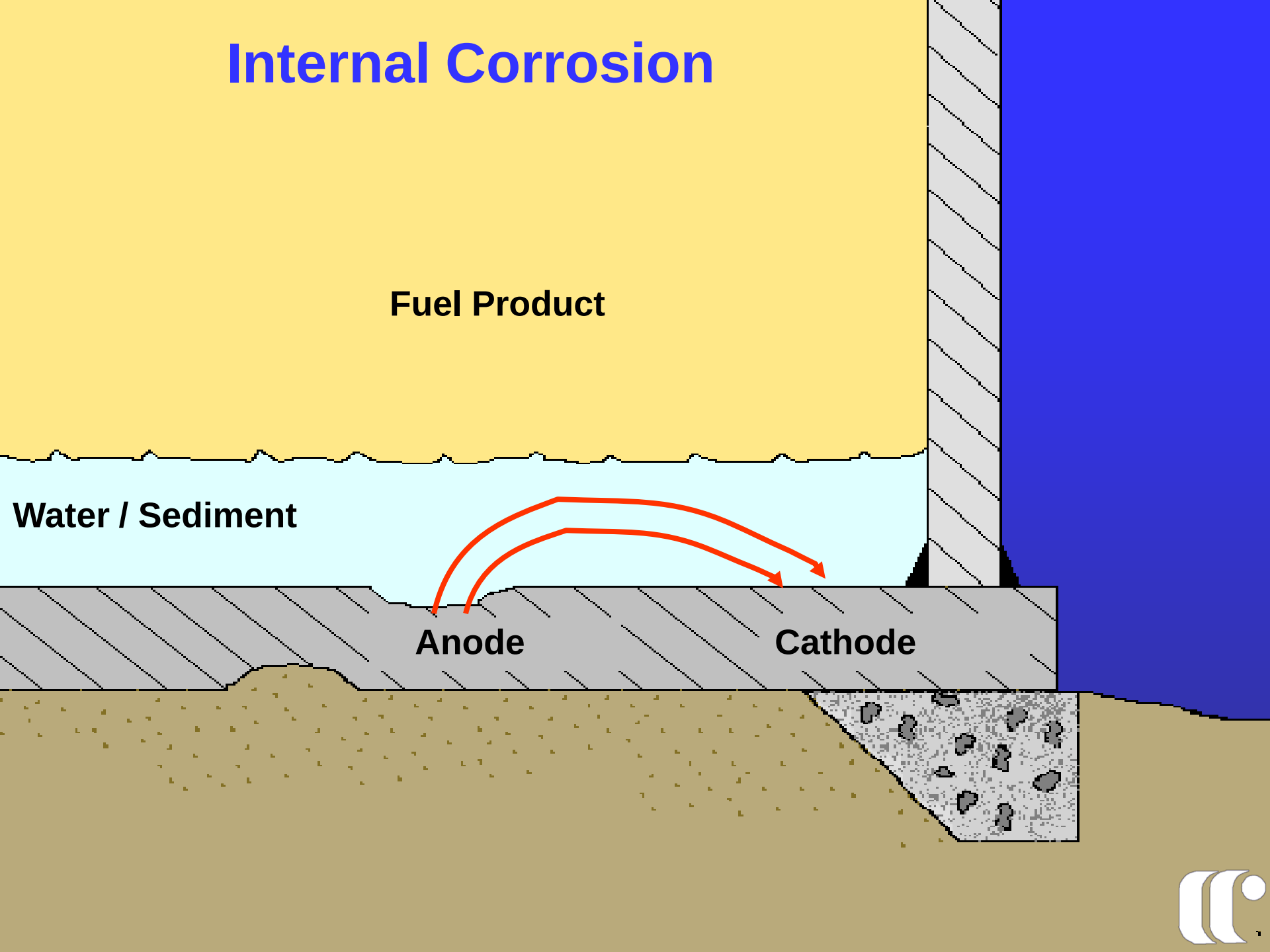
Cathodic Protection Monitoring

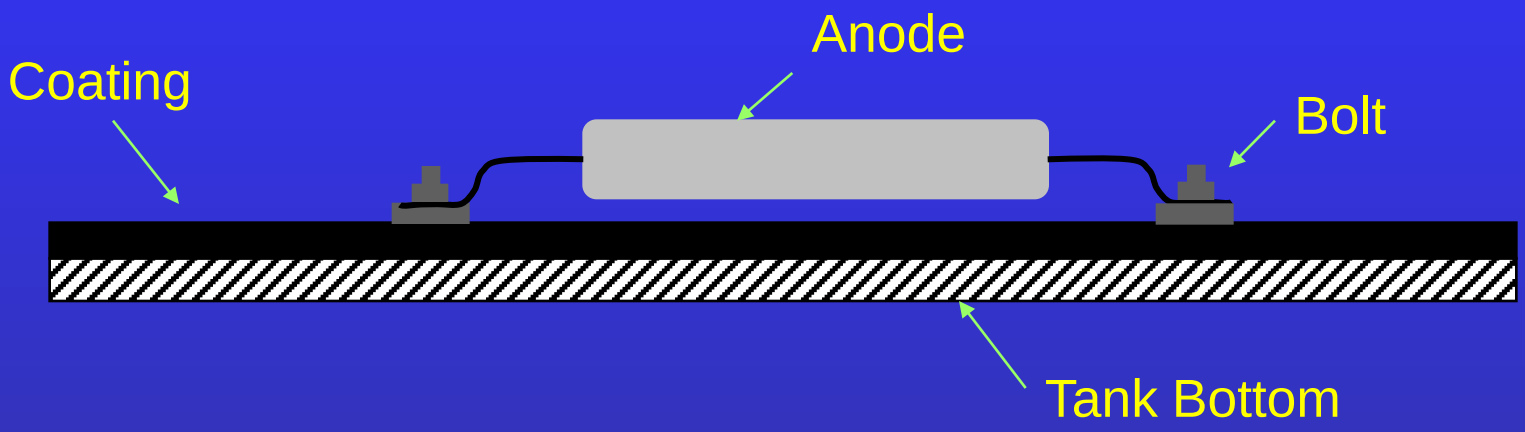
- **Read rectifiers every 60 days.**
- **Conduct annual inspection (obtain potentials) by NACE certified individuals.**

Annual Cathodic Protection Survey

Internal Corrosion

Internal Corrosion




Anode
Coating
Bolt
Tank Bottom

Hot Asphalt Tank Bottoms (require special CP design considerations due to heat)

Recommended Practices

API-651 - Cathodic Protection of Aboveground Petroleum Storage Tanks:

NACE RP0193-2001 - External Cathodic Protection of On-Grade Carbon Steel Tank Bottoms:

Recommended Practices

API-651 - Cathodic Protection of Aboveground Petroleum Storage Tanks:

"Galvanic anodes method is not practical for protection of large bare structures."

NACE RP0193-2001 - External Cathodic Protection of On-Grade Carbon Steel Storage Tank Bottoms:

"Galvanic protection systems can be applied to tank bottoms where the metallic surface area exposed to the electrolyte can be minimized through the application of a dielectric coating or the area is small due to the tank size or configuration."

Summary

- Be aware of all regulations that may pertain to your tanks and piping. When in doubt talk to the governing agencies.

- Engage NACE qualified & experienced personnel to engineer/maintain your cathodic protection system.

- Refer to NACE/API Standards for guidance.

Questions...

Thank You

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