1
0001,000 – 0005,000
Welcome. Just a little briefly about why we're doing this.
2
0005,000 – 0041,000
This is, as I said, the fourth installment of the webinar series. We just do this to give some information to our field colleagues and our design colleagues here in Denver, and to emphasize what's important about corrosion and cathodic protection and corrosion protection, things that you can look for on your structures when you are dealing with these issues. I am going to minimize myself and we'll get started.
3
0041,000 – 0054,000
That's me, I'm Jessica Torrey and today we are going to talk about the corrosion mitigation of gates. I'm in Denver as part of the TSC, the Materials Engineering Research Lab, or MERL. I'm part of the corrosion group.
4
0054,000 – 0110,000
Today's topic, as I said, is corrosion mitigation of gates. We will do a brief review of corrosion coatings and cathodic protection. We'll go into a little bit of why we want to protect submerged structures.
5
0110,000 – 0127,000
We'll visit the CP system components, typical gate protection designs and insulation overview, some of our testing and inspection guidelines, and then finally I'll wrap up with a research project that we're doing here.
6
0127,000 – 0148,000
It's MICA, which is a tele-application for data collection and the associated corrosion database that we're trying to do for all of our CP installations to make electronic data collections easier and storage of our historical records easier.
7
0148,000 – 0202,000
A little review of corrosion. This is corrosion reaction, it's an electro chemical reaction between a metal and an electrolyte. In most cases our metal is steel and the electrolyte for gates is going to be water.
8
0202,000 – 0223,000
There’re four required components to get corrosion. You need an anode, that's what corrodes. You need a cathode, that's what's protected. You need an electrolyte, our soil or water, and then a metallic return path. Corrosion mitigation is often blocking one or more of these components.
9
0223,000 – 0250,000
Here's some of the typical forms of corrosion that you can see on gates. Uniform or general attack is where you often have an uncoated surface and you just see a general rusting across the surface. Galvanic corrosion is if you have two dissimilar metals. For example, if you have a mild steel and a stainless steel in contact, the mild steel will actually corrode more readily.
10
0250,000 – 0255,000
Crevice corrosion, you see this a lot in joints. Pitting...
11
0255,000 – 0255,000
[error sound]
12
0255,000 – 0316,000
Oh, Windows is yelling at me. Sorry about that. Pitting, this is something that's fairly common on lots of surfaces. It's when you have pinholes, for example, holidays in your coating and you can get pits in them.
13

0316,000 – 0342,000
Then, erosion corrosion. We don't talk about this too much today. We do have, in our coatings group, a research project to try and identify and develop abrasion resistant coatings. We see this sometimes on gate structures, where you have a lot of, for example, particles or particulates/solids in your water.
14
0342,000 – 0355,000
What are the ways that we deal with these types of corrosion? First, we can create a barrier between the metal and the water. These are called coatings. This is primarily what we use in reclamation, which protects against corrosion.
15
0355,000 – 0409,000
We can also eliminate potential differences on a structure's surface, so positive and negative charges don't end up on a surface. This is called cathodic protection. That's what we'll be talking about today.
16
0409,000 – 0426,000
We also want to avoid use of dissimilar metals, especially large noble metals. If you have a large surface area of stainless steel and a smaller area of steel, you're going to corrode your mild steel much more quickly. We want to try and avoid those instances.
17
0426,000 – 0437,000
We want to eliminate crevices as best as we can. For example, one thing that we see a lot is skip welding. This really creates a problem with crevice corrosion.
18
0437,000 – 0451,000
For example, on gates we want to prevent standing water. This would mean, if we have some kind of cellular structure or a complex structure, we want to install drain holes where we might see standing water.
19
0451,000 – 0511,000
A little bit about coatings and then the two types of CPs. I'm just going to read this quote, "The total annual US cost for organic and metallic protective coating is $108.6 billion. 50 percent of all corrosion costs are preventable, and approximately 85 percent of these are in the area of coating."
20
0511,000 – 0525,000
That gives you an idea of how big an industry protective coatings are and how important they are in corrosion protection. Protective coatings, and this includes paints, are the primary means employed by Reclamation to control coating.
21
0525,000 – 0538,000
Coatings act as the barrier, as I said, between the metal and the water to isolate the metal electrically. It works really, really well in conjunction with cathodic protection, and we'll talk about that.
22
0538,000 – 0605,000
Some examples of coatings for immersion. Some of the old coating systems are no longer available, due to the organic compounds and the carcinogens that are released during application. Typically now, we us epoxy system. Also for moisture cure polyurethanes and siloxanes, and then of course we coat with galvanizer for metal.
23
0605,000 – 0629,000
What is cathodic protection? Very briefly, current flows through the electrolyte, so through the water from the anode to the gate. On a metal surface, as you can see in this diagram, naturally you'll form all these different areas of different charge. That different charge, causes regions of anodes and cathodes on a surface.
24
0629,000 – 0656,000

What we do with cathodic protection is provide an external current to polarize the structure, which evens out these charges and thereby prevents corrosion. That's what we're trying to do with either our rectifiers, or our sacrificial anodes. We provide a more active metal to be sacrificed, that's the galvanic anode, or be a rectifier to suppress current.
25
0656,000 – 0724,000
CP also works very well in conjunction with coatings to protect the structure at holidays, or at defects in your coating. Cathodic protection supplements your coating by preventing the undercutting of the coating or pitting at defects in the coating. The most effective corrosion protection system for buried and submerged structures involves a good bonded coating and cathodic protection.
26
0724,000 – 0750,000
Here's some examples of galvanic anode cathodic protection, also known as sacrificial anode cathodic protection. This is where the cathodic protection current is provided by a sacrificial material. Materials such as magnesium, or zinc, or aluminum as your anode material that corrodes more readily than your structure material, such as steel.
27
0750,000 – 0818,000
Both the structure and the anode must be in contact with the water, and as I said, magnesium, zinc, and aluminum are three primary anode materials. You can see here surface mounted anodes. This is on Palo Verde diversion dam, a radial gate. This is a newer anode, and this is what happens as the anodes are consumed. As you can see, it's a very visual change.
28
0818,000 – 0841,000
Galvanic anode systems are good for low current requirements. Typically to protect smaller surface areas, although you see this gate is quite large. No external power is needed, and low maintenance. We try as best we can if we're looking at designing cathodic protection for gates to use galvanic anode cathodic protection.
29
0841,000 – 0856,000
You can put the gate in the water and not see it for 10 years, and it'll still working with very low maintenance. These anodes are easily replaceable, by our field colleagues.
30
0856,000 – 0915,000
The second type of cathodic protection is in impressed current. This is where the cathodic protection current is provided from an external power source, and typically a rectifier. This is an example from Angostura Dam. You can barely, barely see the anodes here on the surface of the radial gates.
31
0915,000 – 0931,000
Now these anodes are out of the water. They're actually not doing anything, but you can see here this is one of the submerged anodes, mixed metal oxide anodes. Again, both the structure and the anodes have to be in contact with the water, or it's not working.
32
0931,000 – 0949,000
These types of systems are typically used where we have very high flow of water, we have high current requirements, or on very large structures. This is quite a large gate. It was a large surface area to cover, so it was much more efficient to use an impressed current system.
33
0949,000 – 1002,000
Some of the types of anodes in this case are graphite, mixed metal oxide, platinized anodes, or high silicone casting.
34
1002,000 – 1027,000

Why do we want to do this? I've shown this diagram before. It talks about over a 20 year life cycle the amount of money that can be saved by making an upfront investment in cathodic protection rather than continuing with incremental repairs or tiny doable replacement. This is about 38 percent less expensive than continuing with repairs.
35
1027,000 – 1053,000
As I mentioned before, the best corrosion protection for almost all systems is a good bonded coating and cathodic protection. Even though coatings are primary corrosion protection, a lot of the new types of coating such as the epoxy systems don't last as long as the old vinyl system that have traditionally been on a lot of our structures.
36
1053,000 – 1114,000
Therefore, the time between coating is decreasing and the cost of recoating is constantly increasing. By investing in cathodic protection, you'll extend the life of your coating, maximize the time between the coats, and also extend the life of your structure.
37
1114,000 – 1133,000
We really are trying to push using some of these systems and cathodic protection systems on our submerged structures such as gates but also to apply to trash racks, fish screens, submerged steel tanks, for example.
38
1133,000 – 1159,000
This is just one example of what you might get with protection versus no protection. On the left hand side here you see radial gates at Yellowtail dam spillway. This is an impressed current cathodic protection with mixed metal oxides, surface mounted anodes...you can see the anodes here along with down the side here.
39
1159,000 – 1223,000
This was recoated in 1984 and was one of first application and reclamation of the new epoxy based coating systems. These pieces also applied at that time. These photos are from 1994. 10 years after the application, you see that the coating looks great and now its 30 years after application and they still have not needed to be recoated.
40
1223,000 – 1243,000
You can see in this example the attractiveness of cathodic protection. We don't actually where this is from, but worst case scenario of what could happen if you don't coat and don't apply cathodic protection. Here you have a very leaky radial gate.
41
1243,000 – 1300,000
What are the components of a cathodic protection system? So, a slide on anodes, these are different types of anodes that we typically use. Magnesium anodes and zinc anodes are typically used for galvanic anode cathodic protection systems.
42
1300,000 – 1327,000
Magnesium is good in fresh water and it's a very lightweight material. You can see different forms that they can come in. Most of these materials can come in ribbon form, ribbon anodes or rod anodes. This is a whole mounted system. Here's the ribbon anode, here's a very low profile surface mount and this again is the rod system.
43
1327,000 – 1358,000
Zinc is a heavier material so we have to take weight into account when we design with zinc. It's good for both fresh and brackish water. This is a mixed metal oxide material. This out here is a dielectric shield material. Anode is right here in the middle. This is the interim impressed current system that is good in all types of water and as you can see it's very low profile so this is excellent on gates which have low coherence, for example.
44

1358,000 – 1416,000
This is platinized niobium anode which is installed in PVC tube and, again, it's good in all waters. The platinized anodes are very good at where you need high current density. This black is our dielectric shield material.
45
1416,000 – 1427,000
We also use aluminum graphite high silicone cast iron. We look at that on a case by case basis, what the structure looks like and what our current requirements are.
46
1427,000 – 1449,000
There's some other components I think most of you are familiar with these. From impressed current systems, we'll need a rectifier. This is how we get our power to the system. We also often have a junction box and you can see here we have each individual anode coming in across the shunt. We also often have variable resistors attached to them.
47
1449,000 – 1502,000
That lets us balance the current so that no one anode is pushing out too much current and maybe overprotecting one portion of the gate where some other part of the gate is under protected.
48
1502,000 – 1516,000
These are all things that are high molecular weight. Copper cable, variable resistors, as I mentioned, shunts at back side. For an impressed current system, you also have conduit, or mounting conduit.
49
1516,000 – 1535,000
This is the arm of a radial gate and you can see this is where it comes from the anodes which are mounted to that kind of gate and goes out to our rectifier. Then dielectric shield material and coating repair. This can be tape wrapped in a form of tape or as a bituminous coating.
50
1535,000 – 1605,000
Now we are going to go through some of what we look for when we design both new and retrofit systems. We want to emphasize that a lot of what we've seen recently have been new structures that are installing and we are adding cathodic protection to those. This also can also apply to existing structures where we add anodes after they've been in service life for a significant period.
51
1605,000 – 1617,000
When we design cathodic protection systems, we design them for a minimum 20 year service life. We want to take into consideration the ease of maintenance and replacement.
52
1617,000 – 1637,000
As I said, this is why we try to use galvanic anode cathodic protection where possible on gate structures because they're just as a much lower maintenance systems than impressed current. Although sometimes you'll need the impressed current system because you just have a very large structure.
53
1637,000 – 1656,000
We also try to provide uniformity across this site, uniformity in design. I'll bring up one that I recently worked on, a canal siphon in Washington state. Here we had several different gates, which were similar design but slightly different sizes.
54
1656,000 – 1717,000
What we did was we designed to the largest sized gate and then made sure that applied to all the other ones. So there was only one type of anode by one type of mounting procedure. We kept that uniformity across the whole site to make some maintenance and the isolation easier.
55

1717,000 – 1738,000
Some of the other the factors affecting design and a lot of these are fairly intuitive. A lot of these days we look at the size of the structure. Both their sizes and how many anodes we need, but also where do we put those anodes. Because the anodes must distribute the current to the entire submerged portion of the structure.
56
1738,000 – 1804,000
We look at our anode material, our structure material, the geometry of our anode structure and the weight of the anodes, as I said, zinc is quite heavy. It's very good with protection but you also have to take into account that it will add weight and sometimes that's OK, sometimes we need to go to magnesium to have a lighter structure.
57
1804,000 – 1823,000
We look at the geometry of the gate and the guide structure. For example, some gates have a very minimal clearance to open and close between the gate and the guide, so something like a ribbon anode or a low profile surface mount anode would be the best option.
58
1823,000 – 1854,000
We look at the design of the gate. A lot of times we have structural components such as a cellular structure or a radial gate on adjustment slings that will feel the current. I will show an example of this later and that might be a little bit clearer. Obviously, we also look at where water might collect when these are taken out of submersion. Those areas will require drain holes, as we do not want to have standing water.
59
1854,000 – 1912,000
Then we look at the operation of the gate. Is there a variable water level across the season? What's the storage plan? What's the anticipated availability for inspections and maintenance? We take all these into account when we do our design for cathodic protection.
60
1912,000 – 1942,000
I'm just going to go through a few examples of what some of our ICCP systems look like. I already showed this example, this is flush mounted anode. The photo at the top is Angostura Dam radial gates. These drawings are actually from Yellowtail Dam. This is an impressed current system. It's a very low profile anode. However, it does require drilling through the gate.
61
1942,000 – 2010,000
This part down here is a dielectric shield material, we have our anode. This is actually a skin plate of our gate. You will have to drill through the gate and then you'll have something like this coming out the backside that goes to your rectifier to provide the current. That's OK sometimes, sometimes we are not able to accommodate that in the structure of the gate.
62
2010,000 – 2034,000
As I said, it would have cables and attachments on the backside running to the rectifier. You also have to have a really good seal here to prevent leakage of water and also crevice corrosion. Just to note, as with all impressed current systems, the anodes will not visibly deplete. It will look like this for a long time.
63
2034,000 – 2047,000
The performance will diminish over time and so there'll need to be some testing of the system, so that you have an historical record keeping so that you can tell when your system needs to be replaced.
64
2047,000 – 2109,000
The next type of system we'll look at is the surface mounted anode. We've done this with a few designs recently. This is the slide gate from the Black Canyon project and this is the radial gate from a Canal Siphon project. This is an example of a galvanic anode system.
65

2109,000 – 2138,000
One thing to know is these outlying areas outside the anode represent a dielectric shield material. This is necessarily for magnesium because of the high current density that magnesium puts out. You don't want to blister and blow off the coating directly behind your anode. You will put an extra dielectric shield layer down.
66
2138,000 – 2201,000
We also tape wrap the anode right up the bracket to prevent consumption of the anode there. Because you can imagine if you start consuming the anode here, this will start wobbling around and that can become very mechanically unstable. These anodes works on an simple U bracket and weld stud for you to hold them onto the surface.
67
2201,000 – 2229,000
We want to ensure good metallurgical or mechanical bonds of the core to the gate. This is the anode material and then there's the rod material that runs the entire length of the anode and comes out each end. That needs to be welded to the skin plate of the gate. Then we do a coating repair over at the top to prevent corrosion.
68
2229,000 – 2250,000
One downside to this type of insulation is that the larger the profiles of the anodes means tighter tolerances. If you have tight tolerances on your gate opening and closing, you need to consider that in the design. A lot of times these anodes are maybe one to two inches diameter to give you an idea.
69
2250,000 – 2326,000
Then there are some additional spaces through the dielectric shield and the U brackets. In certain cases that you have a lot of turbulence or a lot of debris, you might consider these larger profiles and go to something like the ribbon anode.
70
2326,000 – 2332,000
Another thing is that I have a question about, why do we mount these horizontally rather than vertically? One thing is the profile of the gate. If you have a radial gate you often have some curvature in the face plate and then if you put longer anodes on, that might not be possible with these rod anodes.
71
2332,000 – 2351,000
Then the other reason is that if you have a variation in your water levels. We knew in this case that the water levels would change throughout the season and any portion of the anode that is out of the water is not going to be protecting your gate.
71
2351,000 – 2402,000
In this case, we have this mounted vertically, and this much is out of the water, the top half is out of the water, you would be using up your gate non uniformly.
71
2402,000 – 2430,000
Whereas, when you mount them horizontally and the top half is out of the water, you totally lose this anode protection but you don't need it because this part is out of the water, but you're still regularly consuming these bottom two anodes and they are providing full protection to the submerged portion of your gate. That's one reason why we might go with the horizontal mount rather than the vertical mounting.
72
2430,000 – 2447,000
Then you can see on the slide gate design, we actually protect all portions. We protected the frame, as well as the gate and the hydraulic plunger we put in the anode, on that as well.
73
2447,000 – 2523,000
A third type is compartment mounted. This can be very similar to the rod anode mounting that I showed you

earlier. I just wanted to show this is a bulkhead gate design and they often have this cellular structure. You can get current shielding in these complex structures. What I mean by that is, an anode that you put in one of these cells is not going to protect the next cell. You're not going to go across these metal structures and protect them.
74
2523,000 – 2546,000
In this case, we put an anode inside every single one of these compartments and along the top you just see this is seven different compartments. Each of those has a small anode in them. Then we also put it on the downstream skin plate to protect that as well.
75
2546,000 – 2603,000
As well, in this type of structure you want to ensure that you have drain holes in all of these compartments because as soon as your anode is out of the water, it's not doing anything anymore, even if the bottom part of your structure is still submerged.
76
2603,000 – 2629,000
I will say that these where directly mounted on the surface, to actually get the best protection of this whole area, you would maybe mount it in the center. You might also see some time, when the situation then is amenable, you would have an anode that's somewhat mounted off that, from the surface of your structure.
77
2629,000 – 2653,000
Here's is just a couple of other examples of different types of anode attachments. In this picture, the Laguna Inlet Gate, there's actually an anode hanging here off the front to protective gate behind. There is one in each of these compartments. This is an impressed current system and it's a very remote mounting.
78
2653,000 – 2706,000
In this case, at the Tracy Fish Collection Facility, we have a galvanic anode system. These are direct mounted and we are not exactly sure what we called them but we are calling them stub type anodes.
79
2706,000 – 2735,000
Here we have a hull mounted system. You see this very often. It's called hull mounted system because these are very typical of a ship hull. Then again, this is galvanic anode system here at Delta Mendota. You can see, these are, as I mentioned, offset mounting. They're not directly attached to the surface and in this case they did not set vertically.
80
2735,000 – 2805,000
This is another example of how you can use cathodic protection for hot spot repair. I think you heard the colleagues that sent me these photos. This is from the Nimbus Dam radial gates. In this case, they had a hoist rope assembly that had a galvanized steel hoist rope that had some stainless steel in here, it had some mild steel in here and all of those different types of metals can really cause a corrosion problem because of the dissimilar metals.
81
2805,000 – 2832,000
As well, these are moving joints. Here, this articulates, and it articulates down here as well. That strips the coating and exposes bare metal. Now, you have large bare surface area and as well, these joints would naturally have crevices and shielding. You have an anode out here, this part here shields anything behind it.
82
2832,000 – 2855,000
This is an example where they mounted anodes all round, you can see. I believe there was 9 or 10 anodes mounted on each of these assemblies and that will protect it from hot spot corrosion. As well, the weld here they recoated and then they applied a dielectric tape wrap to protect those from cathodic disbondment.
83
2855,000 – 2916,000

You can see this PVC canister here. It contains the reference electrode. This photo was taken during one of their testings of the system. That's another example of how you can use cathodic protection.
84
2916,000 – 2949,000
Just a note on some of the guidelines and specifications that we use. NACE, or the National Association of Corrosion Engineers. It has a standard SP 0169 and that's primarily what we use. You'll often hear us talk about the 850 millivolt criteria or the 100 millivolt shift criteria. That's all included in this standard document here. Those are the levels of protection that we try to achieve when we are designing cathodic protection systems.
85
2949,000 – 3003,000
I would say probably your first references is to give us a call. There is four of us here in the corrosion team. Then I just listed a couple of other documents that are also useful for submerged systems.
86
3003,000 – 3024,000
We are going to through just a real quick installation overview of steps. You'll recognize this from the diagram that I had before, and by no means this is the only way of doing this. Just to give an idea of how these types of systems might be installed. This would be a galvanic anode system.
87
3024,000 – 3049,000
Step one would be to apply your dielectric shield material, and that's what's in red here. You want to mark your anode location. You need to prepare your surface for coating and depending on the dielectric shield material that you are using, this could mean completely removing the coating and cleaning the surface, or you might just be able to roughen the surface of the underlying existing coating.
88
3049,000 – 3115,000
Then you apply your dielectric shield material. For example, this could be a capastic coating, a bituminous coating. These are often high strength, high dielectric strength, high build epoxy material, and a minimum thickness of 75 mils. Then, depending on the type of coating you're using, you may be required to apply a topcoat.
89
3115,000 – 3141,000
You can also use, for example, a sheet of plastic, but we've seen a lot of cases where those types of shields, just don't last for the full 20 year lifetime of the anode. They start curling up on the edges. You can get crevice corrosion. We recommend these capastic coatings or bituminous coating.
90
3141,000 – 3205,000
One note. As I mentioned when I was explaining from the anodes, the shield material is often built into impress current flash mounted anode, so you wouldn't have to do that as a separate step. Zinc anodes actually do not require the dielectric shield material due to their lower current output than magnesium anodes.
91
3205,000 – 3224,000
Step two would be to prepare to mount the anodes. The highlighted portions in red, you would remove the coating beneath the weld studs and the U bracket. Weld your bracket studs to the skin plate. Prepare that weld area. Then apply a dielectric tape wrap to the anode.
92
3224,000 – 3244,000
You could also use a sleeve of some kind, beneath where your bracket will be. That's to prevent consumption of the anode there, so that you can maintain a good mechanical stability of your anode through its lifetime.
93
3244,000 – 3311,000
Step three would be to mount the anode. Depending on the surface, exothermically weld each end of that core material to the skin plate. Secure those U brackets. You should also do an electrical continuity test between the

gate and the anode, just to make sure that your weld has been effective. Then cover those welds with approximately 20 mils of coating to prevent corrosion there. That's the simplest installation of these kinds of these kind of rod anode systems.
94
3311,000 – 3341,000
Some things to avoid. I already mentioned skip welding. You can see the nice welds, and they've got presence of corrosion here. These are bulkhead gates from Seminoe Dam. As well, they had some piping coming off the gate that they did not seal. They bolted them in but didn't seal it. You've got corrosion in those crevices as well.
95
3341,000 – 3412,000
Here at Palo Verde, there were no drain holes in the structure. Or there were drain holes, but they were in the incorrect places to actually allow the water to drain out. This actually used to look somewhat like this. It was two L plates bolted back to back, and it's completely corroded and gone, and no longer a supporting structural member of the gate.
96
3412,000 – 3431,000
These actually have anodes. This is an anode right here. This is an anode here. This had a drain hole, because there was some structure running through it. It had a hole where water could drain out, whereas, this gate, you can see how bad the coating looks.
97
3431,000 – 3451,000
These are the anodes. There were no drain holes. This is actually standing water. If you can imagine there's standing water here, but the anode is not in the water. It's no longer protecting that area, it's not doing anything. These were eaten up pretty good. This is actually only the core material that's left right here.
98
3451,000 – 3458,000
These are just some things to remember. No skip welds, use drain holes.
99
3458,000 – 3521,000
A little bit on testing submerged structures. Galvanic anode systems are very low maintenance, and fairly easy to operate. They should be inspected whenever the structure is removed for maintenance. If you know the gate is going to be pulled out of the water, have a look.
100
3521,000 – 3530,000
What is the condition of the coating? Do you see pinholes? Do you see crevice corrosion or pitting? What is the condition of the anode?
101
3530,000 – 3554,000
Here at Delta Mendota Canal, I showed these anodes back here, which looked good, except this. This is just the core material. These anodes are completely used up. It's time to replace them, but your coating looks pretty good. You're in a good position here. These will just be unbolted from the surface, and the new anode bolted back on and welded.
102
3554,000 – 3611,000
Are the brackets still providing sufficient mechanical support? You want to make sure your anodes aren't moving around every time the gate moves. Are the spot welds or mechanical bonds still intact? Do you still have electrical connectivity between your anodes and your gate?
103
3611,000 – 3630,000
I mentioned we hesitate to use some kind of rubber mat or plastic mat behind the anodes, because you can see in this case, over time it peeled and curled up. It's not really performing its job anymore.
104

3630,000 – 3648,000
Similarly, with impressed current systems, you need to do all those same inspections that you did for the galvanic system. Check the rectifier. We recommend trying to do that once a month, to just make sure that it's still providing power to your system.
105
3648,000 – 3709,000
Test the current at each anode in the junction box. I showed you the photo of the junction box with the shunts in it. You measure the voltage across the shunts. Then you unplug, and you can calculate your current. Balance those anodes to make sure one is not overprotecting and another underprotecting.
106
3709,000 – 3743,000
Occasionally, you can also test your off potential of your structure. You would install a current interrupter on your rectifier. Your reference electrode goes in the water. You can use one of these weighted canisters so it's not floating around. You want to position that close to your structure. Then you measure with a multimeter the potential between your structure and your reference electrode.
107
3743,000 – 3810,000
I presented this at the last webinar on testing, so we'll just go through it pretty quickly, just some things. You want to write the date, the time of the test, and your location. Measure your on and off potential, the polarity. Make sure you include units. The type of reference electrode that you use. I think the important point here is try to test your rectifiers monthly if possible. The rest of the system should be checked annually.
108
3810,000 – 3833,000
The raw numbers on cathodic protection systems do not always tell you the full picture. So, a good historical record keeping and a historical record of how those numbers are changing with time is the best way to determine the health of your cathodic protection system.
109
3833,000 – 3857,000
That segues me into the last part of the talk, which is a research project that we've been doing, with the Corps of Engineers. We've started to use MICA, which is the Mobile Information Collection Application. One of our motivations was that we have a lot of cathodic protection systems in Reclamation, that we don't have records of.
110
3857,000 – 3910,000
Either we just don't know they exist at all, or we don't have a good way of electronically keeping that historical data that I mentioned, that is so important in determining how well our system is doing.
111
3910,000
We, at the TSC, would like to try to find some way to have a corrosion mitigation database, where we could keep track of all our installations, catalog what type of protection they have, what are the successes and failures, and then as well, share that information with the Corps of Engineers. They have a lot of very similar structures to what we have.
112
3935,000 – 4006,000
The Corps has a big project right now, called "Corrosion Detection and Monitoring Systems," and we're partnering with them on that. They have funding to look at using finite element analysis to improve the efficiency of cathodic protection systems. They're specifically targeting water gates on their locks, which also has that cellular structure, or where they have components that produce shielding.
113
4006,000 – 4025,000
They're trying to develop finite element analysis methods where they can actually test different anode placements, using FEA, and see if they have shielding, if they're getting the best efficiency and best placement of their anodes, before they actually install them on the gate.

114
4025,000 – 4055,000
They're also developing a novel sensor system. It's going to not necessarily monitor corrosion on the structure but it will monitor the health of the coating, and the health of the cathodic protection system. We can tie that into a remote warning system, so that if problems are detected with your corrosion protection system, the facility people can be notified, and take note of that.
115
4055,000 – 4112,000
Within reclamation, the Corps has already done this. Within reclamation, we're conducting an inquiry to our operations colleagues, as to what are their most important corrosion related issues. This report is due at the end of FY14.
116
4112,000 – 4133,000
We're trying to make some phone calls, so if you get a phone call from one of us, and we want to ask you a whole bunch of probing questions about corrosion, I really would appreciate your cooperation. I think it will really help us target where we put our efforts in the future in cathodic protection and corrosion protection.
117
4133,000 – 4145,000
We are also part of the partnership with the Corps of Engineers. We're seeking a pilot test site here at Reclamation to test our monitoring system. This would be for FY16.
118
4145,000 – 4211,000
If you have a gate structure, and you know you want to have some upcoming recoating or cathodic protection installation, and you'd be willing to let us test out some of our research sensors, and remote monitoring systems, give us a call. We'd really appreciate knowing about that and trying to work something out.
119
4211,000 – 4234,000
As part of the electronic data collection, we are deploying this MICA. It's Mobile Information Collection Application. This was developed at the Corps for emergency management, but it really is a great way to collect all these different types of information on one device. We use it on smartphones or tablets.
120
4234,000 – 4304,000
It allows you to collect photos, video sketches, form data for example, testing data from your system and it tags all to a GPS location. It really eliminates paper form. You can also do real time updating to a web based system. We pilot tested this this summer at the Mini Washoni in South Dakota, on their Corps pipeline.
121
4303,000 – 4312,000
That was an impressed current system and galvanic anode system. It was over a hundred miles of pipeline. It really went very well.
122
4312,000 – 4345,000
I'll go back to the rest of that. This is an example of what the web interface looks like. Each of those blue and yellow dots is a series of points. The number inside tells you how many points there. Those are all individual test stations along a pipeline. You can see, now we have our pipeline GPS located, so next year when we go out and test, we don't have to worry about trying to find a two foot tall test station in three foot tall cornfields.
123
4345,000 – 4413,000
If you zoom in on each of those this is the Missouri River here each of these is one of our data points. This is what the app looks like. You can do routing. You can do a point collection, go back and edit your data. You can also do a scout mode, so if there's other people with one of these tablets that are close to you, and you're constantly syncing your data, you can actually see where your colleagues have already tested.
124

4413,000 – 4431,000
This is a form that I developed for rectifier testing. We are really excited about this. It worked really well up in the Mini Washoni site. We're trying to deploy this, so if you have some testing coming up, and you're interested in it, let us know.
125
4431,000 – 4446,000
Right now, it runs off Android tablets, but there's an iPad version. Of course, we can use the iPads here at Reclamation. There's an iPad version coming out in the fall, likely October November time frame.
126
4446,000 – 4508,000
Just to go back, the upcoming test for this is to expand the use of MICA to other departments across Reclamation. Some of our safety and emergency management groups are very interested in that. We're also going to be working with Steve Jabba from the PN Region, to develop a long term storage solution for storage and analysis of our data.
127
4508,000 – 4526,000
This will likely be using our [inaudible] site, that Reclamation already has and the FTS FIE data analysis and database structure, that was developed by the DOD. We're very excited about that for the upcoming year.
128
4526,000 – 4542,000
That wraps things up. To advertise ourselves, we have a couple of upcoming events. In October, we have our Coatings and Corrosion School. That will be here in Denver. It's three days long. Last year, unfortunately we had the furlough, so we had to cancel it. We're hoping we'll have good attendance this year. Registration should be open in August. You can contact myself or Allen Skaja is actually organizing it. I can put you in touch with him.
129
4552,000 – 4610,000
Our next corrosion webinar will tentatively be in February of 2015. We're very excited, because I've convinced some of our Coatings colleagues to do a webinar on coating field inspections. As always, if you have suggestions for future topics, please feel free to email me.
130
4610,000 – 4633,000
Here are our Coatings and Corrosion staff. There's Roger Turcotte, Lee Sears, myself, and Daryl Little. There's my contact information. When we send this webinar out, you'll have my information. There's our Coating staff. We have Rick Pepin, Dave Tordonato, Bobbi Jo Merten, and Allen Skaja. There's Allen's contact information if you have questions about coating.
131
4633,000 – 4646,000
That's the end. We're wrapping up. As the last thing, I would really like to thank all of you who helped by providing photos and information to support this webinar. I really appreciate it.
p.