



NACE INTERNATIONAL STANDARD PRACTICE SP0169
“Control of External Corrosion on Underground or Submerged Metallic Piping Systems”
(formerly RP0169)

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ABSTRACT

The NACE International Technical Coordination Committee (TCC) is responsible for the development and maintenance of technical documents which includes standards, test methods and state-of-the-art reports. The structure of the TCC membership (some 2500+ individuals) is divided into four basic Technology Management Groups (TMG), which then comprise of a varying number of Specific Technology Groups (STG). STG 35 is the industry group that is responsible for Pipelines, Tanks, and Well Casings and that STG re-affirmed the standard recommended practice RP0169-2002 at the September 2006 Corrosion Technology Week (CTW) meeting; and immediately formed a Task Group (TG) 360 to review the document which is now referred to as Standard Practice (SP) 0169 – 2007 (formerly RP0169), “Control of External Corrosion on Underground or Submerged Metallic Piping Systems”

Keywords: SP0169, RP0169, External Corrosion, CP Criterion

BACKGROUND / HISTORY

An STG 05 – Cathodic / Anodic Protection ad hoc committee on “Criteria Review in RP0169-1996” presented a report at Corrosion 2002 that stated:

- Section 6 could not be reaffirmed as it exists,
- Ambiguity exists between the -0.850 vs copper/copper sulfate (Cu/CuSO_4) electrode (CSE) current applied criterion and -0.850 vs (CSE) polarized criterion,
- There are other international criteria that should be considered,
- There is confusion regarding 100 mV formation and decay,
- More guidance is needed on cathodic protection (CP) criteria for controlling micro-biologically influenced corrosion and corrosion at elevated temperatures,
- Upper limits on CP criteria for coating damage and /or high strength steels are needed

STG 05 formed TG 285 to revise Section 6 in 2002 and that TG had numerous meetings, conference calls and gathered significant information but had not achieved their goal of getting out a ballot to the group and were disbanded in 2006; the task was turned over to TG 360 under STG 35 to review the entire document including Section 6. Part of the NACE and ANSI protocol requires all standards be revised or reaffirmed every 5 years.

TG 360 has had meetings at Corrosion 2007 in Nashville, CTW 2007 in Houston, Corrosion 2008 in New Orleans, CTW 2008 in Salt Lake, Corrosion 2009 in Atlanta and CTW 2009 in Houston; an additional Information Gathering Session was also held Nov 28th 2007 in Houston and a Panel Discussion Session at the AGA Phoenix May 2008 meeting. TG 360 has a conference call scheduled for 2 hours at least every second month to work the document. The task group developed a series of **Eight Questions & Answers** which the group felt would be beneficial to the industry and these were published in MP in December 2007 and February 2008; a copy of these is attached in this presentation.

TG 360 has determined a need to make revisions within the entire document with significant modifications and additions to Sections 5 and 6 and addition of an appendix that covers a review of International Standards. The entire working draft document is available on the NACE website as an attachment to the TG 360 minutes for each Corrosion and CTW meeting. In July

2009 the task group completed their revisions and the ballot pool for voting by NACE members was established. ANSI requires a balanced voting pool be established for processing the document and once that voting pool is formed it is closed. The voting pool for this document was 391 and the results of the first ballot which closed September 2, 2009 were:

	Total Eligible Voters	Number Voting	Percent Voting
All Voters	391	270	69.1 %
STG Voters	315	224	71.1 %

A return of more than 50 percent from the STGs is required to constitute a valid ballot for NACE documents.

Response Summary (All Voters)	Count	Percent	Notes
All Affirmative Votes	149	65.4 %	(Excludes abstaining)
All Negative Votes	79	34.6 %	(Excludes abstaining)
All Affirmative + Negative Votes	228	100.0 %	(Total used for percentages above)
All Abstaining Votes	42	15.6 %	(Percentage of total votes)
Response Summary (STG Voters)			
	Count	Percent	Notes
STG Affirmative Votes	124	65.3 %	(Excludes abstaining)
STG Negative Votes	66	34.7 %	(Excludes abstaining)
STG Affirmative + Negative Votes	190	100.0 %	(Total used for percentages above)
STG Abstaining Votes	34	15.2 %	(Percentage of total votes)

Interest Classification	Affirm comment	Affirm no comment	Negative comment	Negative no comment	Abstain comment	Abstain no comment	Total
User/Consumer	7	51	46	1	1	17	123
Manufacturer/Producer	4	7	3	0	0	2	16
General Interest	5	7	3	1	0	7	23
Consultant	14	33	15	1	0	6	69
Contractor	5	10	2	2	1	3	23
Government/Military	0	2	4	0	1	2	9
Research/Development/Testing	0	4	1	0	0	2	7
Totals	35	114	74	5	3	39	270

The critical number in the above tables is percentage affirmative of STG voters; it must be 2/3rd and **65.3%** is not 2/3rd. TG 360 members realized that a number of the negative votes were not in compliance of a negative vote and requested a ruling from TCC Management as to whether those votes were to be counted (this would have changed the percentage). TCC Management advised that 2/3rd was not achieved and the task group would have to go back and rework the document and go back to first ballot stage. TCC Management confirmed that the voting pool for this document has now been established and a new canvas would not be necessary. During the TG 360 meeting on September 22, 2009 at CTW 2009 in Houston the ballot results were presented (as a failed ballot) and the TG began re-working the various sections with consideration of all the comments received.

There were some 110 commentators with a total of just over 300 comments and about one third of the comments were on Section 6 criteria. It was also appeared that the majority of the Section 6 comments were on 'deletion of 850 On' although the task group had stated numerous times that the 850 On with voltage drop consideration was not being deleted and was part of the new third criteria which stated "*Criteria that have been shown to successfully control corrosion on piping systems can continue to be used on those piping systems.*" There were a significant number of individuals who stated they were using 850 On and they do not need to correct for voltage drop. All the comments received during the ballot are available on the NACE Web site at <http://web.nace.org/Departments/Technical/Balloting/BallotCommentList>

Some of the "**Negatives**" were:

- *I believe that the original section 6.2.2.1.1 where it states "A negative (cathodic) potential of at least 850mV with the CP applied. This potential is measured with respect to a saturated copper/copper sulfate reference electrode contacting the electrolyte. Voltage drops other than those across the structure-to-electrolyte boundary must be considered for valid interpretation of this voltage measurement" is a valid criterion. Williams Midstream has thousands of miles of pipeline that have been protected utilizing the current -.85mV current applied criteria and all of our leaks are caused by lack of adequate cathodic protection, shielding affects, interference, outside forces or internal corrosion. I suggest that you leave the -.85mV current applied criteria as is.*
- *I have used the -.850 criteria for 34 years on bare, disbonded, coal tar coated, and FBE coated pipe and have found that the on potentials are only a few mv different from the potentials taken at pipeline depth. When on readings were taken that were below the -.850 mv potential and 100 mv decay potentials were I have found that all passed without exception. Using the off potential criteria is not practical in shared multi-pipeline right of ways and inside large plant facilities.*
- *I want to thank the committee for their hard work on this issue.*
- *My objection to this revision is pertaining to the negative 850mV polarized potential becoming the "preferred" method of determining the level of protection on a structure. I believe that we have enough historical evidence to support the existing criteria to be sufficient. I also believe that the new criteria will encourage excessive levels of CP that can cause external coating disbondment and possible damage to high-strength steels as a result of hydrogen evolution.*
- *Section 6.2.2.1.1 should be left in the standard. It has proven to be reliable criterion.*
- *Section 6.2.4.1.1 - Delete: "corrected for voltage (IR) drops other than those across the structure/ electrolyte boundary. We currently use the -0.850 V "on" criteria and have used this criteria since the regulations were adopted. During the past 5 years of PIM we have excavated much of our transmission pipeline and have found very little external corrosion. at these locations that we have found external corrosion, the cause was interference from another pipeline company's impressed current system (2 locations) and inactive corrosion occurring prior to the application of CP (4 locations). There is nothing wrong with the current criteria - it has stopped corrosion on our systems.*
- *Add new reference EN 10288 Steel Tubes and Fittings for Onshore and Offshore Pipelines - External Two Layer Extruded Polyethylene Based Coatings to Tables 1 to 5 and in the Reference section as applicable and add ASTM D 1005 in each table where D 4138 is listed and add to the reference section.*

Some of the proposed changes in Section 6 of SP0169-2007 are (underlined text replaces ~~strikeout text~~):

6.1.2 The effectiveness of CP or other external corrosion control measures can be confirmed by visual observation, by measurements of pipe wall thickness, or by use of internal inspection devices. direct examination. It is important to distinguish between ongoing corrosion and corrosion that occurred previously. Available methods include, but are not limited to, visual observation and inspection, pipe wall thickness measurements, pH measurements, or use of internal inspection devices that detect metal loss. Because such methods sometimes are not practical, meeting any criterion or combination of criteria in this section is evidence that adequate CP has been achieved. ~~When excavations are made for any purpose, the pipe should be inspected for evidence of corrosion and coating condition.~~

6.2.1 It is not intended that ~~people~~ persons responsible for external corrosion control be limited to the criteria listed below any specific criteria. Criteria that have been successfully applied on existing piping systems can continue to be used on those piping systems. This section contains criteria; however, it is acknowledged that other approaches have been successful in the past. The use of any approach to achieve corrosion control through CP is the responsibility of the user. It is important that the user be able to provide empirical evidence for any approach that is taken. Any other criteria used must achieve corrosion control comparable to that attained with the criteria herein.

6.2.2 The two fundamental polarization criteria in this section have been proven empirically to reduce the average corrosion rate of steel to less than 25 $\mu\text{m}/\text{y}$ (1 mil/y) in soils and natural waters in the field at ambient temperatures.^{2,3,4} Situations may exist in which a single criterion for evaluating the effectiveness of CP may not be satisfactory for all conditions. A single criterion for evaluating the effectiveness of CP may not be satisfactory for all locations along a structure.

6.2.3 Steel and Cast Ductile Iron Piping

6.2.3.1 **External corrosion control can be achieved at various levels of cathodic polarization depending on the environmental conditions.** Any criterion selected must provide a reliable indication that the corrosion control objectives of the operator have been satisfied. However, ~~In the absence of specific data listed in Paragraph 6.1.2 that demonstrate that adequate CP has been achieved, at least one or more of the following shall apply:~~

6.2.3.1.1 A negative (cathodic) voltage of at least 850 mV as measured with respect to a saturated copper /copper sulfate reference electrode. This potential may be either a direct measurement of the polarized potential, or a current applied potential corrected for voltage (IR) drops other than those across the structure/electrolyte boundary.

6.2.3.1.2 A minimum of 100 mV of cathodic polarization. The formation or decay of polarization can be measured to satisfy this criterion.

6.2.3.1.3 Criteria that have been shown to successfully control corrosion on piping systems can continue to be used on those piping systems.

6.2.3.1.4 Other criteria that can be demonstrated to achieve the corrosion control objectives of the operator.

6.2.3.2 Special Conditions

There are some 10 Special Conditions listed that deal with issues such as MIC, elevated temperatures, high resistivity electrolyte, mill scaled steel, mixed metal piping, HVAC, weak acid environments, stress corrosion cracking, hydrogen embrittlement and blistering and electrical shielding.

Section 6 continues with criteria statements on; 6.2.4 Aluminum Piping, 6.2.5 Copper Piping, 6.2.6 Stainless Steel Piping, 6.3 Other Considerations and 6.4 Alternative Reference Electrodes.

PATH FORWARD

The TG 360 members have consideration of voter submissions and proposed revisions to the document. It is expected that the next "Ballot" will be sent to the established voting pool in January 2010 and the ballot results will not be known until just after the Northern Area Western Conference in February. The NACE International technical division established this voting pool in accordance with the Operating Manuals prior to the first ballot.

As of January 10, 2010 the task group members are holding a ballot to approve changes made during 5 conference call meetings since CTW 2009 to the review/revision of SP0169-2007. This ballot closes January 18th and proving 2/3rd of task group members approve the changes the document will be sent to STG Voting Pool with a 4 week balloting period. The results of that vote will determine the agenda for TG 360 at Corrosion 2010 in San Antonio.

NACE International TG 360 Question and Answer Article

In response to concerns about the current revision to NACE SP0169-2007 (formerly RP0169), "Control of External Corrosion on Underground or Submerged Metallic Piping Systems," Task Group 360 has developed its first installment of a Question and Answer sheet to address some frequently asked questions.

The answers to these questions were voted on by the Task Group and passed with a 2/3 affirmative vote from the voting members. **These answers are a committee consensus and do not reflect the opinions of any particular Task Group member or his or her company.**

Copies of the latest draft and the latest version of Section 6 with the Task Group's revisions (deletions in ~~strike through~~, additions in underlined text) are available as attachments to Task Group 360 minutes from CTW 2007.

If you have comments about SP0169 (the draft and/or Section 6) or the Question and Answer sheet, please e-mail the Task Group's secretary, Daniela Malakoff (daniela.malakoff@nace.org), and she will forward your comments to the committee members for review.

I HAVE AN OLD, POORLY COATED PIPELINE THAT HAS BEEN CATHODICALLY PROTECTED USING THE -850 mV CSE ON CRITERION SINCE CONSTRUCTION. IT HAS A HISTORY OF NO LEAKS, AND THE INTERNAL INSPECTION SURVEYS DO NOT INDICATE ANY SIGNIFICANT METAL LOSS DUE TO EXTERNAL CORROSION. WHY SHOULD I HAVE TO INVEST THE EXTRA COST TO INCREASE MY CATHODIC PROTECTION CURRENT TO OBTAIN A POLARIZED -850 mV CSE CRITERION?

If your conclusion is correct about the status of your pipeline, it would appear that the -850 mV CSE polarized criterion would be conservative for the situation. It is very likely that if you took a series of instant-off potentials and let the line depolarize, you would find that you are meeting the 100-mV polarization criterion. Once it has been demonstrated that you are achieving this criterion, you can use this data to establish on potentials that can be equated to the 100-mV criterion. For example, a native potential of -620 mV CSE plus 100 mV polarization plus 110 mV of IR drop results in an on potential of -830 mV CSE. There would not appear to be any reason for you to increase the level of cathodic protection on your pipeline. Paragraph 6.1.3 of SP0169-2007 provides that "criteria that have been successfully applied on existing piping systems can continue to be used on those piping systems, providing that the conditions under which the criteria were satisfied remain similar."

Leak history by itself is not an effective indication of corrosion control; however, in-line inspection with appropriate resolution with corresponding cathodic protection history can provide the basis for establishing a reliable range of residual corrosion rates within the pipe segment under consideration. If the maximum calculated corrosion rate does not exceed one mil per year, then the requirement of achieving "corrosion control comparable to that attained with the criteria herein" has been satisfied. Therefore, the potential values that have been historically established as corresponding to the acceptable corrosion rate may be used as long as the piping configuration and environmental factors remain similar. This finding would not necessarily extend to other pipeline segments.

The -850-mV CSE polarized (instant-off or IR-free) potential is conservative in perhaps the majority of situations. However, it is technically secure (unlike the -850 mV on value, which is proven by studies such as that by the PRCI criteria study, (T. Barlo, "Field Testing the Criteria for CP of Buried Pipelines" PRCI, PR-208-163, Final Report, February 1994) to be inadequate in a significant proportion of application), and it will cover the worst-case scenario that could be present in most cathodic protection applications, except, for example, elevated temperature and MIC/sulfate-reducing bacteria.

THE -850-mV CRITERION USED HISTORICALLY BY THE PIPELINE INDUSTRY APPEARS TO HAVE BEEN A READING TAKEN WITH THE CATHODIC PROTECTION CURRENT APPLIED (IN OTHER WORDS, AN ON READING.) WHY IS IT BEING QUESTIONED AFTER ALL THESE YEARS?

There is no intent to take away anything that has been historically available to pipeline operators and corrosion professionals. Proper application of an on-potential criterion, with appropriate supportive information to demonstrate effective corrosion control, has never been in question.

The -850-mV CSE current applied potential measurement, or the so-called on potential, has always required consideration of the significance of “voltage drops other than across the structure electrolyte boundary.” In practice, this generally means that the -850-mV CSE on-potential criterion, measured and recorded properly with proper consideration for the significance of IR errors, provides essentially the same level of protection as the -850-mV CSE instant-off or polarized potential. The difficulty is that the previous NACE RP0169 did not make this issue sufficiently clear. Many practitioners incorrectly considered the significance of the voltage drop, and hence, this criterion did not correlate well with effective corrosion control, as indicated in the PRCI criteria study, (T. Barlo, “Field Testing the Criteria for CP of Buried Pipelines” PRCI, PR-208-163, Final Report, February 1994). The -850-mV CSE on potential, without proper IR drop consideration, has no scientific basis because of its dependence on soil resistivity and current density, both of which can vary along a pipeline route (giving different errors at different measurement points).

ISN'T THIS PUSH FOR THE POLARIZED -850 mV CRITERION DRIVEN BY CONSULTANTS AND VENDORS TO SELL MORE OF THEIR SERVICES AND PRODUCTS?

Actually, it's driven by scientific evidence and by people concerned about public safety and protection of the environment. Although very few of these incidents involved injuries or death, 18.1% of all significant pipeline incidents in the US over the past 20 years have been attributed to corrosion. Though these incidents cannot be directly correlated to cathodic protection criteria or methods of considering IR drop, it is clear that corrosion can be a public safety concern and that continued improvement in corrosion control methodologies is beneficial.

It is also driven by the need for NACE to have a completely transparent, accurate, and technically secure criterion in SP0169 that is fully understood by all users.

*At this time, the Task Group 360 membership consists of:

Operating Company Representatives: Mark Brogger, Kimberly-Joy Harris, Jerry Holton, Naeem Khan, Richard Kochilla, Mark Lauber, Paul Nichols, Frank Perry, Marcel Roche, Travis Sera, Robert Vail
Consultants: Jim Chmilar, Bob Gummow, Brian Wyatt
Consultants/ Suppliers/ Manufacturers: David Kroon, Norman Moriber, Neil Thompson
Government: Joe Mataich

National Representation Breakdown (Total: 18 members):

US: 12

Canada: 2

UK: 1

France: 1

Saudi Arabia: 1

Malaysia: 1

WHAT CATHODIC PROTECTION CRITERIA ARE USED INTERNATIONALLY?

The latest edition of the ISO standard for onshore pipelines (ISO 15589-1) uses a single main criterion of a -850 mV CSE potential at metal-to-environment interface (i.e., the polarized potential). Instant-off measurement constitutes one of the methods given in Annex A.2.A to assess this polarized potential. -950 mV is required in the presence of significant sulfate-reducing bacteria; the standard does allow consideration of protection to less negative values in high resistivity soils and also a minimum of 100 mV of cathodic polarization measured IR free (but not at elevated temperatures or in SRB-containing soils). U.S.-based NACE members from major pipeline operating companies participated in the preparation of this standard.

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The European standard for buried pipelines (EN 12954), which is used in all of the European Union countries and some others is the basis for pipeline regulation with respect to corrosion control in some of these countries. This standard uses -850mV CSE IR free (-950mV CSE in anaerobic conditions or greater than 60°C) and -750 mV IR free in aerated sandy soils with resistivity in the range 10,000 to 100,000 Ohm-cm and -650mV with resistivity greater than 100,000 Ohm-cm. These less negative values are supported by less negative free corrosion ("natural") potentials.

The Australian National Standard SAA AS 2832.1 includes protection criteria incorporating an ER soil corrosion probe corrosion rate not exceeding approximately 0.005 mm/year (0.2 mils/year), in combination with an instantaneous off-potential of -850 mV CSE or 100 mV more negative than the depolarized potential. A review of International standards has been proposed by the task group for the Appendixes of SP0169. (Note: This listing above is not all-inclusive. These are examples. Various nations utilize a variety of criteria, including the current SP0169.)

These criteria have been developed over many years by experts and operators, many of whom are NACE members, using the same basis of data, technology, and science that is available in the revision of RP0169. There is no technical/scientific rationale for the NACE criteria to be different from those of ISO, EN or SAA. These other standards have been developed in an equally open standards development regime with well-balanced groups and final voting, including all sectors of the pipeline industry. Corrosion is international; the criteria for protection should be as well.

In response to interest in the current revision to NACE SP0169-2007 (formerly RP0169), "Control of External Corrosion on Underground or Submerged Metallic Piping Systems," Task Group 360 has developed its second installment of a Question and Answer sheet to address some frequently asked questions. The first installment was published in the December 2007 issue of MP.

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If you have comments about SP0169 or the Question and Answer sheet, please e-mail the Task Group's secretary, Daniela Malakoff (daniela.malakoff@nace.org), and she will forward your comments to the committee members for review.

WHERE IS THE EVIDENCE TO SHOW THAT THE -850-MV ON-POTENTIAL CRITERION IS NOT WORKING?

Correlation of the $-850 \text{ mV}_{\text{CSE}}$ on potential criterion with corrosion control was poor in the PRCI criteria study, (T. Barlo, "Field Testing the Criteria for CP of Buried Pipelines" PRCI , PR-208-163, Final Report, February 1994.) (i.e., external pipeline corrosion damage was found on pipelines supposedly protected to the $-850 \text{ mV}_{\text{CSE}}$ on criterion with no knowledge and action taken with respect to the IR errors implicit in the use of this), and many companies use a much more negative on-potential criterion as an allowance for IR drop error in the on-potential measurement. A factor in answering this question can be related to the numerous metal-loss corrosion anomalies identified each year in the pipeline industry through the use of in-line inspection (ILI) tools. The vast majority of these pipelines are using cathodic protection (CP), and a determination of active and nonactive corrosion, CP shielding, and other factors is involved in investigating these corrosion anomalies. Unfortunately, prior to the U.S. pipeline integrity rule, much of this detail had not been recorded.

WHAT RESEARCH WORK OR STUDY IS THERE TO SUPPORT THAT THE -850-mV POLARIZED (INSTANT-OFF OR IR FREE) CRITERION IS BETTER THAN THE -850-mV ON-CRITERION?

If the $-850\text{-mV}_{\text{CSE}}$ on-potential criterion is measured and recorded properly (taking into account measurement and correction of the IR errors other than those across the structure-to-electrolyte boundary in the soil), then there should be no difference. However, when the significance of voltage drop is not properly considered, the corrosion control correlation is poor, as shown in the PRCI criteria study, "Field Testing the Criteria for CP of Buried Pipelines" (PR-208-163). In addition, a technical paper published in the September 2004 issue of *Materials Performance* ("Using Failure Probability Plots to Evaluate the Effectiveness of Using 'Off' vs. 'On' Potential CP Criteria") used statistical analysis to demonstrate a five-fold, system-wide improvement in failure trends after implementing the $-850\text{-mV}_{\text{CSE}}$ polarized criterion when compared to the previous period using the $-850\text{-mV}_{\text{CSE}}$ on criterion.

HOW WILL I BE ABLE TO SHOW MY U.S. DOT PIPELINE AND HAZARDOUS MATERIALS SAFETY ADMINISTRATION (PHMSA) OR STATE REGULATOR THAT I HAVE MET THE -850-mV POLARIZED CRITERION IN THE REVISED SP0169 WHEN I HAVE BEEN USING THE -850 ON-CRITERION IN THE PAST AND I CANNOT DISCONNECT THE PROTECTIVE CURRENT?

NACE RP0169 has required consideration for voltage drops, except across the structure-electrolyte boundary, for almost 40 years. If this requirement has been ignored, then it is undoubtedly time to install coupons or use other means to find out how much voltage drop (IR) error is typically in the measurement. That should satisfy any regulator. It is fairly safe to assume that the requirement for consideration for IR drop has been very lax or informal in the past by much of this industry, despite the clear requirement to do so in the previous revisions of RP1069.

It would seem likely that the $-850\text{-mV}_{\text{CSE}}$ polarized potential (IR free) would not have been achieved in the past with a minimum on potential of $-850 \text{ mV}_{\text{CSE}}$. In one approach, the use of coupons could

determine a value for soil IR drop that is present. This, in turn, could be used to calculate the polarized potential at that particular location. The question, then, would be, has CP been achieved (i.e., an adequate control of corrosion rate) at this level of polarization? If a coupon test station were installed, this could also be used to determine whether the 100-mV criterion had been achieved. A valid approach might be to install coupon test stations at a number of selected locations that covered as many as possible of the most corrosive environments. The data from these installations could then be used to build a database to support the effectiveness of the $-850\text{-mV}_{\text{CSE}}$ CP on-potential using a 100-mV coupon depolarization test. At the same time, it would be helpful to start a program to install a considerable number of additional coupon test stations over a period of about five years.

A set or array of coupon test stations at representative locations of aggressive environments, distant from protective current sources, etc., would provide the opportunity to measure polarized potentials and the magnitudes of polarization as the foundation for evaluating CP effectiveness. Another method, as allowed in the Australian Standard (SAA AS 2832.1), would be to use corrosion (ER) probes. These can be effective and have a low cost.

CP practitioners outside North America may not have this issue, as they probably follow their national and/or ISO standard that only specifies the polarized potential criterion.

WE USE “OTHER CRITERIA,” AS ALLOWED IN PARAGRAPH 6.2.1 OF SP0169. HOW DO I DEMONSTRATE TO THE REGULATORY AGENCIES THAT OUR CRITERIA HAVE BEEN “SUCCESSFULLY APPLIED” AND ACHIEVE CORROSION CONTROL COMPARABLE TO THE SPECIFIC CRITERIA LISTED IN 6.2.2?

This will vary with regulatory agencies in different countries and jurisdictional areas.

In the U.S., this question was posed during the public comment period when Paragraphs 6.2 and 6.3 of RP0169-96 were adopted into the hazardous liquids pipeline regulations, 49 CFR 195: Transportation of Hazardous Liquids by Pipeline. This was done through an amendment to Part 195 (Docket No. RSPA-97-2762, Amendment 195-73), which was published in the Federal Register on January 27, 2002 and went into effect on January 28, 2002. The preamble to this amendment discusses comments pertaining to the use of other criteria that have been successfully used, such as the 300-mV shift and the E-Log-I criteria. This discussion, in part, is as follows:

“Furthermore, we explained that under Paragraph 6.2.1 of the NACE standard, operators may use any criteria which they can demonstrate achieves corrosion control comparable to Section 6 criteria. Also, operators may continue to use criteria that they have successfully applied to existing pipelines, on these pipelines [. . .] [W]e generally favor performance standards over specification standards because they encourage operators to develop and apply better alternatives. If, however, an operator chooses to use alternative criteria, we will carefully examine the operator’s rationale for determination that the criteria met the ‘comparable to’ or ‘successfully applied’ tests of Section 6.2.1 of the NACE standard.”

“Corrosion control that is comparable to the criteria” can be demonstrated in a variety of ways, depending on the situation. In cases in which a pipeline has been inspected by repeated ILI, a careful analysis of external corrosion rates as measured by the ILI technique can be done in conjunction with documentation of the pipe-to-electrolyte potentials over the intervening time. In using this technique, careful consideration would have to be taken regarding the accuracy and repeatability of the ILI techniques used.

In another case, if ILI has not been possible, soil corrosion probes could be used at locations selected to represent the locations where the most aggressive corrosion rates would likely exist. These locations would have to be carefully selected and the probes installed and properly maintained in order to approximate the corrosion rates that could occur on the pipe itself. The corrosion rates and pipe-to-electrolyte potentials would be recorded and analyzed together.

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Either of the above techniques can be used, regardless of the type of CP system used. They could be used in cases in which directly coupled galvanic anode systems are used or as an alternative to a variety of CP measurement techniques commonly used with impressed current systems.

In any of the above cases, if the external corrosion growth is confirmed to be within that which is allowed by the CP criteria in Paragraph 6.2.1, then "corrosion control that is comparable to the criteria" has been demonstrated. The documented pipe-to-electrolyte potentials would need to be maintained from that point forward.