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General Comment

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July 1, 2010

PILGRIM WATCH'S COMMENTS REGARDING GALL AMP XI.M41 BURIED AND UNDERGROUND PIPING & TANKS - NRC STAFF DRAFT REVISED AMP M41 (JUNE 18, 2010 VERSION)-Docket: NRC-2010-0180 www.regulations.gov

Pilgrim Watch's comments regarding the need for revision to the Aging Management Program for Buried and Underground Piping and Tanks to provide reasonable assurance to the public during license renewal reflect lessons learned from our participation in Pilgrim Station's license renewal adjudication process, Contention 1.

I. OVERVIEW

A. Probability- Corrosion Risk V. Corrosion Rate
The Draft and industry seem intent to classify all systems by numbers representing the probability of a corrosion event - calling it "corrosion risk" - and give it a number. Risk is defined as the product of impact times the probability of the event. It is important to understand the nature of the probability of a corrosion event (a leak in this case). Clearly there are areas of buried pipe that are more susceptible to localized attack than others. However, the probability of such attack is not constant with time and therefore cannot be characterized

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with a number and entered as such into a "Rule", like, if we inspected yesterday we don't need to inspect again for 10 years. First, corrosion is a rate process and the rate is NOT constant with time. Therefore, the probability would have to be adjusted with age, or the risk becomes a function of age. As a consequence, the entire risk management, which is now being introduced to the AMP, is totally misguided

B. Placement Above-Ground
A solution would be to place piping above ground so that leaks would be visible and overall inspection simplified. Requirements for protection from temperature changes would be important to prevent freezing and condensation.

C. Alternatively (if remaining in-ground) Buried and Underground Piping & Tanks AMP should include
1. Base-Line Data: It is critical that baseline data is required to be collected via a top to bottom examination of the buried/underground piping within scope prior to final license approval - in order to determine the current status of the piping necessary to assess an appropriate AMP and establish a corrosion rate going forward. Such an inspection must entail special attention to points of vulnerability – such as at elbows, welds, joints, and at any dead spaces where liquid can sit; and must include inspection both inside and outside. Special attention must also be given to those welds located upstream or downstream of a flow disturbance. Since it is not possible to assess possible damage below the coating in the pipe body, in addition all piping must be pressure tested to at least twice the operating pressure. Inability to perform pressure tests for any reason should not be cause for relief. Baseline data is critical so that trending is established. NUREG/CR 6876 states, at 32, "...it is evident that predicting an accurate degradation rate for buried piping systems is difficult to achieve..."

2. Cathodic Protection: All Applicants can and should implement a thorough Cathodic Protection Program on all buried/underground components. Corrosion pits from the outside diameter have been discovered in buried piping with far less than 60 years of operation. Buried pipe that is coated and cathodically protected is unaffected after 60 years of service. Operating experience from application of the NACE standards on non-nuclear systems demonstrates the effectiveness of this program. [GALL XI M-28, at 10, Operating Experience] To counter NEI's former misleading statements to Dr. Davis when the previous GALL was written (a matter of record in Pilgrim's adjudication, Testimony John Fitzgerald, Michigan) Cathodic Protection can be retrofitted and retrofitting cathodic protection is not dangerous. It may introduce strays currents; however this is a design issue, not a design constraint. Further, in order to retrofit cathodic protection, it requires a rectifier; if it malfunctions it does not necessarily require the reactor to automatically shut-down for repairs.

The Draft talks about a cathodic protection survey. The Draft is unclear. If a licensee read it, they would interpret it to say that since we have no CP in my plant we do not need any CP survey. The language should be that they should do a "potential survey" and other typical surveys to determine first if they need CP. Furthermore, the potential survey can pin point the hot spots (low potential) on buried pipe after time in the ground when the pipe was not CP protected. Additionally, a potential survey should be conducted to find possible stray currents. At Indian Point, for example, city water supply pipes cross the right of way of a major gas pipe line. The latter of course is cathodically protected. Possible interference must needs to be explored.

3. Monitoring Frequency & Coverage: PW believes that the Staff is approaching this incorrectly. Where do the numbers come from? For example: we believe that there is no justification for requiring inspection of 10% of buried carbon steel pipe - ASME Code Class Pipe - coated - every 10 years. Are those specs the same for newly buried pipe as for pipe that has been in the ground for 40 years? What effect does aging have on inspection frequency and the extent of the inspection? What does the 10% relate to and how are the 10% selected for inspection?
To minimize the size and frequency of leaks, the AMP should be augmented to require more frequent and more comprehensive inspections. Specifically a 100% internal visual inspection of all underground pipes and tanks must be implemented. If a baseline inspection immediately prior to license renewal does not indicate that more inspections are required, then the inspection cycle should be such that all pipes and tanks are inspected every ten years. The Applicant should be required to break the testing interval down such that one sixth of all pipes and tanks are inspected during each refueling outage. (This assumes 18 month refueling outages, or six every ten years.) The Applicant should be required to inspect one sixth of the lineal piping, one sixth of the elbows and flanges, and one sixth of the tank seams at each outage, even if such inspections lengthen the outage time. The Applicant should certify that each portion of the AMP on the pipes and tanks is accomplished in the order agreed upon and completed at every outage.

4. Monitoring Wells: A well designed monitoring well system could pick up a leak relatively quickly - approximately within weeks or months after the initiation of a leak, depending on the rates of groundwater flow and other factors. Groundwater monitoring networks are widely used to detect leaks at a variety of nuclear and non-nuclear sites. Well-established protocols exist for proper design of monitoring networks including well and

screen placement, sampling frequency and selection of sampled contaminants Sampling the wells is usually done about four times a year

Steps in Monitoring Network Design that NRC should require and evaluate:

a. *Determination of all plausible leak locations. This would include consideration of all piping segments and* tanks that are placed below the ground surface and are part of system components that are within scope. For purposes of monitoring network design, leaks from any of the plausible locations would be presumed to release water contaminated with radionuclides or oil. This step is similar those recommended in the NEI Guidance Document (Objective 1.2 Site Risk Assessment) where buried piping is described as being a credible mechanism for leaking materials to reach groundwater.
b. Identification of the specific contaminant species that would be present in the leaking water or oil from each of the system components. A set of indicator contaminants should be selected for each system component that can, if detected in groundwater, uniquely identify the component. Particular emphasis should be on those contaminants that are least likely to sorb and thus be most rapidly transported.
c. Consideration of the fate and transport of each indicator contaminant from each of the plausible leak locations.
(1) This analysis would include prediction of subsurface transport pathways from all identified source locations. This prediction would consider vertical migration of leaking water through the unsaturated zone to the water table. It would also account for the direction and rate of groundwater flow. Such predictions must be based upon understanding of groundwater behavior at the site derived from a recently-conducted detailed site characterization as recommended in the NEI Guidance Document (Objective 1.1 Site Hydrology and Geology). This is particularly important at reactors like PNPS where building, paving and changes to storm drainage may significantly affect local flow behavior.
(2) Transport of a particular contaminant along identified transport pathways must be analyzed. For each contaminant it is necessary to account for the initial concentration of the contaminant in the leaking liquid and the effects of dispersion, sorption, radioactive decay or other processes that may affect concentrations of the contaminant at the monitoring well.
(3) The NEI Guidance Document (Objective 1.3 On-Site Groundwater Monitoring) recommends a monitoring system that will "ensure timely detection" of leaks. This will be accomplished with placement of monitoring wells so that all predicted transport pathways are intercepted with a high degree of certainty. The placement of monitoring wells should consider both the areal (plan view) location and also the vertical location of the well screens. A complete monitoring system will also include up-gradient control wells which are intended to provide ambient groundwater conditions and help to confirm groundwater flow directions. Consideration must be given to topography and location of the sources of potential leak sites from a coast line or offsite boundary. For example, at Pilgrim, sources of potential leak sites are located only a short distance from the coast line (assuming that groundwater flow is generally towards the sea), the potential is high for a narrow transport pathway to convey contaminants between monitoring wells unless they are closely spaced. This suggests that a high density of monitoring wells will be needed to detect leaks with adequate assurance.
d. Understanding of the fate and transport of indicator contaminants can be used to determine the appropriate frequency of water sample collection at the monitoring wells and the required detection limits for analysis. In particular, the dilution of contaminated water as it mixes with ambient water during transport must be considered. Detection limits for contaminant analysis should be as low as practical so that dilution of contaminants does not mask the presence of leaks. Radionuclides in addition to Tritium need to be analyzed and reported. All findings must be required to be made public in a timely manner.

D. Ductile Iron Pipe- Fire System exemption at multi-unit sites:

Ductile Iron Pile: During the June 21, 2010 Teleconference call, NEI argued that ductile iron piping used in the fire protection system was considered resistant to corrosion & should be exempted. Not so. The impact of deterioration and failure of buried ductile iron pipelines due to external corrosion is very significant. Ductile iron piping is subject to corrosion mainly through grafitization and pitting. It is generally believed that the rate of external pitting attack on unprotected ferrous materials is governed primarily by the corrosivity of the environment, and the material type has no pronounced influence. It is also subject to galvanic corrosion, microbiologically induced corrosion and corrosion due to dissimilar electrolytes. Cathodic protection is the most powerful and cost-effective control method for existing ductile iron at locations where it is at risk from external corrosion. Leakage due to manufacturing errors; installation of unprotected pipe in corrosive soils; improper application of protection measures; improper installation of the pipe, stray current from grounding services, bi-metallic corrosion from stainless saddles; accidents from work performed nearby cannot be discounted.

Therefore we conclude that arguments made during the Teleconference (June 21, 2010) that ductile iron pipe used extensively in underground/buried fire protection systems should be exempt should be discounted. They have no scientific basis and are at bottom simply about saving industry money at the expense of public safety.

Fire Systems: NEI's rationale for exempting the fire protection buried components (presented during the Teleconference call) went further and became even more absurd by suggesting that the buried and underground piping fire system was somehow not functionally that important to require the same inspections and prevention in multi-unit sites. NRC seemed to imply that exemptions would be written in to the final document. It is clear that the underground & buried piping tanks associated with the fire protection system are critical to protect public safety. In a fire, it obvious that hoses and sprinklers must function as designed. Also not to be ignored is that fire protection piping and tanks may vary in their susceptibility to corrosion or breaks across the site. The piping segments or tanks may not be the same age across the site. Soils vary across a site. Manufacturing errors/defects and the history of damage from excavation near the piping or tanks once installed varies across a site. Example: Pilgrim NPS LR SER, at 3-37 described a leak in the fire water underground distribution system and that the probable cause was induced, "most likely by fabrication anomalies compounded by marginal installation leaks." This one example demonstrates that exemptions make no sense.

E. High Density Polyethylene & High Density Polypropylene

We have been advised that there should be reluctance to use polymeric piping in hot service and there is a pressure limitation that depends (like in steel pipe) on the wall thickness; it should never be used either of the materials in organic service (buried diesel or fuel oil lines) even though organic fluids are routinely transported in polyethylene or polypropylene totes; and that there is reason for concern about long term embrittlement (and eventual cracking) if used in buried structures. Another type of problem with buried polymeric pipe is the fact that when digging becomes necessary the polymeric pipe is cut that much more easily. If polymeric pipe (not really plastic pipe) are used for repairs, there are problems in the mating of steel pipes to polymeric ones. Bottom line, we are advised that there is not enough experience available to guarantee an additional 20 years of service.

II. XI.M41 BURIED AND UNDERGROUND PIPING AND TANKS
Comments Inserted in NRC Draft's Text in Italics

Program Description

This is a comprehensive program designed to manage the aging of the external surfaces of buried and underground piping and tanks

PW 1.While corrosion from the outer surface of buried pipes may be the dominant failure mechanism, there have been failures from the inside (supply water system e.g) which simply are not covered by other programs which deal almost exclusively with maintaining water chemistry. It makes no sense of excluding internal corrosion and verification of the effectiveness of alternate programs

It addresses piping and tanks composed of any material, including metallic, polymeric and cementitious materials. This program manages aging through preventive, mitigative and inspection activities. It manages all *applicable aging effects such as loss of material, cracking, and changes in material properties.*

Depending on the material, preventive and mitigative techniques include: the material itself, corrosion resistant coatings,

PW 2. "Corrosion resistant coatings" is incorrect. Coatings do not corrode, they deteriorate, whereupon water has access to the underlying metal and corrosion can start.

and the application of cathodic protection. Also, depending on the material, inspection activities include electrochemical verification of the effectiveness of cathodic protection, non-destructive evaluation of pipe or tank wall thicknesses, and visual inspections of the pipe or tank from the exterior as permitted by opportunistic or directed excavations.

Although this program considers the fluid inside the pipe or tank, and certain aspects of the program may be carried out from the inside of the pipe or tank, this program is designed to address only the degradation occurring on the outside of the pipe or tank. Aging of the inside of the pipe or tank is managed by another program (e.g. Open Cycle Cooling Water (AMP XI.M20), Treated Water (XIM.21A), Internal Inspection of Miscellaneous Piping and Ducts XI.MXX) or Water Chemistry (XI.M2). Additionally, this program does not address selective leaching. The selective leaching program (Chapter XI.M33) is applied in addition to this program for applicable materials and environments.

The terms "buried and underground are fully defined in Chapter IX of the GALL Report. Briefly, buried piping and tanks are in direct contact with soil or concrete (e.g., a wall penetration). Underground piping and tanks are below grade, but are contained within a tunnel or vault such that they are in contact with air and are located where access for inspection is restricted.

PW 3: I think it is essential to include underground piping - the deterioration evident in the tunnels in Indian Point is pretty bad and recent experience at EVY's AOG piping

Evaluation and Technical Basis

1. Scope of Program: This program is used to manage the effects of aging for buried and underground piping and tanks constructed of any material including metallic, polymeric and cementitious materials. The program addresses aging effects such as loss of material, cracking, and changes in material properties. Any system may contain buried and underground piping or tanks. Typical systems include service water piping and components, condensate storage transfer lines, fuel oil and lubricating oil lines, fire protection piping and piping components (fire hydrants), and storage tanks. The aging of bolting associated with piping systems within the scope of this program is also managed by this program.

PW 4 : add piping related to AOG system

2. Preventive Actions: Preventive actions utilized by this program vary with the material of the tank or pipe and the environment (air, soil, or concrete) to which it is exposed. These actions are outlined below

a. Preventive Actions, Buried Piping and Tanks

i. Preventive actions for buried piping and tanks are conducted in accordance with Table 2a and its accompanying footnotes

Table 2a, Preventive Actions for Buried Piping and Tanks

Material1 Coating2 Cathodic Protection4 Backfill
None Reqd. May be Reqd.3 Reqd. No Limit5 High Quality6 Fine7
Titanium X X
Super Austenitic Stainless9 X X
Stainless Steel X X8
Steel X X X
Copper X X X
Aluminum X X X
Cement X X8
Polymer X X

1. Materials classifications are meant to be broadly interpreted; e.g. all alloys of titanium which are commonly used for buried piping are to be included in the titanium category. Steel is as defined in chapter IX of this report. Polymer includes polymeric materials as well as composite materials such as fiberglass

2. When provided, coatings are in accordance with NACE SP0169-2007 or RP0285-2002.

3. Requirement for coating depends on environmental conditions. If coatings are not provided, a justification is provided in the LRA

4. Cathodic protection is in accordance with NACE SP0169-2007 or RP0285-2002. Attempts to demonstrate that cathodic protection is not required as discussed in Sections 1.2 and 3 of SP0169-2007 will not be considered.

PW 5: What does that mean? Does it mean that it will not be considered?

5. No limits are placed on backfill quality

6. Backfill is consistent with 49 CFR 195.252. Maximum size of aggregate or other material within 6 inches of pipe is ½ inch in diameter or less.

PW 6: There seems to be a conflict between 6 and 7. Sand is a lot finer than 1/2 inch. Crushed concrete of 1/2 inch diameter (?) can be quite jagged and do much damage while river bottom pebbles may be harmless. Also absent from the discussion on backfill material was the degree to which the material retained moisture

Corrosion cells develop on a piece of metal exposed to different electrolytes and it is a particularly common problem on underground structures 27. Potential differences develop, for example, on a long continuous pipeline that passes through different types of soils. One portion of the line might be laid in sandy loam while another lie in clay. Substantial natural pipeline currents ("long-line currents") may occur, which leads to corrosion cells as called "long line cells". In soils of low resistivity where such currents exit from the pipeline, causing the metal at the exit points is lost by anodic dissolution (corrosion). Anodes and cathodes may be miles apart.

7. Particle size for backfill within 6 inches of the pipe must not exceed that of sand grains

8. Backfill limits apply only if piping is coated.

9. e.g. Al6XN or 254 SMO

b. Preventive Actions, Underground Piping and Tanks

i. Preventive actions for underground piping and tanks are conducted in accordance with Table 2b and its accompanying footnotes

Table 2b, Preventive Actions for Underground Piping and Tanks

Material1 Coating2
None Reqd. May be Reqd.3 Reqd.
Titanium X
Super Austenitic Stainless4 X
Stainless Steel X
Steel X
Copper X
Aluminum X
Cement
Polymer X

1. Materials classifications are meant to be broadly interpreted; e.g. all alloys of titanium which are commonly used for buried piping are to be included in the titanium category. Steel is as defined in chapter IX of this report. Polymer includes polymeric materials as well as composite materials such as fiberglass

2. When provided, coatings are in accordance with NACE SP0169-2007 or RP0285-2002. A broader range of coatings may be used if justification is provided in the LRA.
3. Requirement for coating depends on environmental conditions. If coatings are not provided, a justification is provided in the LRA

4. e.g. Al6XN or 254 SMO

3. Parameters Monitored/Inspected: The aging effects addressed by this AMP are loss of material due to all forms of corrosion and, potentially, cracking due to stress corrosion cracking. Two parameters are monitored to detect and manage these aging effects: visual appearance of the exterior of the piping or tank; and wall thickness of the piping or tank, generally as determined by a non-destructive examination technique such as ultrasonic testing (UT). Two additional parameters, the pipe-to-soil potential and the cathodic protection current, are monitored to determine the effectiveness of cathodic protection systems and, thereby, the effectiveness of corrosion mitigation.

PW 7: This paragraph is downright primitive. "All forms of corrosion" is pretty broad. But again, monitoring/inspection is limited to visual and UT. One cannot detect cracking with these two methods. Pipe to soil potential surveys should be done independent of active CP as a means to detect "hot spots" on buried pipe.

4. Detection of Aging Effects: Methods and frequencies used for the detection of aging effects vary with the material and environment of the buried and underground piping and tanks. These methods and frequencies are outlined below.

a. Opportunistic Inspections

i. All buried and underground piping and tanks, regardless of their material of construction are opportunistically inspected by visual means whenever they become accessible for any reason.

PW 8: Opportunistic means that there has been a leak that needs to be repaired. Visual inspection is "stone age technology" There has to be a decision of how much more pipe to excavate and at least conduct some quantitative examinations.

b. Directed Inspections - Buried Pipe

i. Directed inspections for buried piping are conducted in accordance with Table 4a and its accompanying footnotes

ii. Directed inspections as indicated in Table 4a will be conducted during each 10 year period beginning 10 years prior to the entry into the period of extended operation.

PW 9: What evidence is there to justify a 10 year interval. This is the crux. One simply cannot squeeze all these situations into the same shoe box.

iii. Inspection locations are selected based on susceptibility to degradation. Issues such as coating type, coating condition, cathodic protection efficacy, backfill characteristics and soil resistivity are considered

PW 10: If in fact there are various degrees of susceptibility should there not also be varying degrees of inspection frequencies?

iv. Visual inspections are supplemented with surface and/or volumetric non-destructive testing (NDT) if significant indications are observed.[What's the definition of significant?

v. Opportunistic examinations may be credited toward these direct examinations if the location selection criteria in iii, above, are met

vi. At multi-unit sites, individual inspections of shared piping may not be credited for more than one unit.

PW 11: What is this? Is it the pipe that is corroding or the Unit?

vii. Visual inspections for polymeric materials are augmented with manual examinations to detect hardening, softening or other changes in material properties.[truly wonder if people ever think about what the reader may think when he read that??? What does manual examination tell you about the embrittlement of the pipe.

viii. The use of guided wave ultrasonics or other advanced inspection techniques is encouraged for the purpose of determining those piping locations that should be inspected but may not be substituted for those inspections.

Table 4a, Inspections of Buried Pipe

Material CP Survey1 Visual Inspections2 Minimum Inspections5
ASME Code Class Pipe Haz Mat Pipe3 Other Pipe4
Titanium
Super Austenitic Stainless10
Stainless Steel 2% 2% 1% 1
Steel X 10%6 5%6 1%6 2

Copper X 2%6 2%6 1%6 1
Aluminum X 5%6 2%6 1%6 1
Cement N/A7 N/A7 1% 1
HDPE8 1%11 1%11 1
Other Polymer9 2% 2% 1% 1

1. Cathodic protection survey in accordance with NACE SP0169-2007 [It really is not a CP survey but rather a potential survey to determine if CP is needed. Of course if CP is already installed then a potential survey will show whether if works

2. Numerical values under the visual inspection heading indicate the percentage in linear feet of piping of the category indicated which is to be excavated and visually inspected, i.e., if stainless steel piping is present in each of the three categories of piping a minimum of 3 excavations are required, one for each piping category. One or more excavations are conducted to inspect at least 2% of the code class piping; one or more excavations are conducted to inspect at least 2% of the Haz Mat piping; and one or more excavations are conducted to inspect at least 1% of the "other" piping. Alternatively, the entire length of stainless steel piping present in all three piping categories may be considered to be code class piping and inspected accordingly, i.e., one or more excavations are conducted to inspect at least 2% of the total length of stainless steel piping present.

3. Haz Mat pipe is pipe which, during normal operation, contains water contaminated with radioisotopes at levels greater than background or fluids other than water which, if released, would be detrimental to the environment e.g., diesel fuel.

4. Other pipe is pipe which is not code class pipe and which, during normal operations, contains only water which is not contaminated with radioisotopes at levels in excess of background.

5. Minimum inspections identify the minimum number of separate excavations which are required for each piping material. The minimum length for each excavation is 10 feet

6. Inspection of the prescribed length of piping may be eliminated when the installed cathodic protection system has been operating in accordance with NACE SP0169-2007 for 90% of the time since the pipe was originally installed or was visually inspected. The prescribed minimum number of visual inspections must still be met. Visual inspection as used here means visually inspecting a length of pipe equal to the amount indicated in the table, i.e., in order to eliminate the requirement to inspect 10% of buried steel code class piping, the installed cathodic protections system must have operated 90% of the time since that piping was installed or since 10% of it was visually inspected.

7. The use of cement piping in ASME code class and Haz Mat applications is not expected. If cement piping is used in these applications an inspection program is to be provided and justified in the LRA

8. HDPE pipe includes only HDPE pipe approved for use by the NRC for buried applications

9. Other polymer piping includes some HDPE pipe, and all other polymeric materials including composite materials such as fiberglass

10. e.g. Al6XN or 254 SMO

11. Refers to the percentage of welds (not linear length of pipe) which must be inspected. These inspections may be omitted if the pipe was volumetrically inspected when installed and no indications were noted and if the operating temperature of the pipe does not exceed 100o F

c. Directed Inspections – Underground Pipe

i. Directed inspections for Underground piping are conducted in accordance with Table 4b and its accompanying footnotes

ii. Directed inspections as indicated in Table 4b will be conducted during each 10 year period beginning 10 years prior to the entry into the period of extended operation

iii. Inspection locations are selected based on susceptibility to degradation. Issues such as coating type, coating condition, exact external environment, and flow characteristics within the pipe, are considered

PW 12: It is good to see consideration of internal corrosion, but it seems to me the document in not consistent

iv. Underground pipes are inspected visually to detect external corrosion and by UT to detect internal corrosion.

PW 13: That's another muddle: UT detects both internal and external corrosion –
Separation is tricky but can be done.

v. Opportunistic examinations may be credited toward these direct examinations if the location selection criteria in iii, above are met

vi. At multi-unit sites, individual inspections of shared piping may not be credited for more than one unit.

PW 14: This makes no sense.

vii. Visual inspections for polymeric materials are augmented with manual examinations to detect hardening, softening or other changes in material properties.

viii. The use of guided wave ultrasonics or other advanced inspection techniques is encouraged for the purpose of determining those piping locations that should be inspected but may not be substituted for those inspections.
[somebody really does not know what they are talking about.

Table 4b, Inspections of Underground Pipe

Material Visual and UT Inspections1 Minimum Inspections4
ASME Code Class Pipe Haz Mat Pipe2 Other Pipe3
Titanium
Super Austenitic Stainless7
Stainless Steel 2% 2% 1% 1
Steel 10% 5% 1% 2
Copper 2% 2% 1% 1
Aluminum 5% 2% 1% 1
Cement N/A5 N/A5 NA5 1
Polymer6 2% 2% 1% 1

1. Numerical values under the visual inspection heading indicate the percentage in linear feet of piping of the category indicated which is to be inspected using visual and ultrasonic
techniques, i.e., if stainless steel piping is present in each of the three categories of piping a minimum of 3 inspections are conducted, one for each piping category. One or more inspections are conducted to inspect at least 2% of the code class piping; one or more inspections are conducted to inspect at least 2% of the Haz Mat piping; and one or more inspections are conducted to inspect at least 1% of the "other" piping. Alternatively, the entire length of stainless steel piping present in all three piping categories may be considered to be code class piping and inspected accordingly, i.e., one or more inspections are conducted to inspect at least 2% of the total length of stainless steel piping present. All piping which is visually inspected to detect external corrosion is ultrasonically inspected to detect internal corrosion. UT inspection intervals will not exceed one foot. Particular attention is paid to elbows and the adjacent piping.

PW 15: Where do these numbers come from? Is there any evidence that 2% is statistically the correct number? Provide rationale in footnote.

2. Haz Mat pipe is pipe which, during normal operation, contains water contaminated with radioisotopes at levels greater than background or fluids other than water which, if released, would be detrimental to the environment, e.g., diesel fuel.

3. Other pipe is pipe which is not code class pipe and which, during normal operations, contains only water which is not contaminated with radioisotopes at levels in excess of background.

4. Minimum inspections identify the minimum number of separate inspection locations which are required for

each piping material. The minimum length for each inspection is 10 feet

5. The use of cement piping in ASME code class and Haz Mat applications is not expected. If cement piping is used in these applications an inspection program is to be provided and justified in the LRA

6. All polymeric materials including composite materials such as fiberglass. No distinction is drawn for underground piping between high density polyethylene approved for use by the NRC in buried applications and other polymeric piping materials.

7. e.g. Al6XN or 254 SMO

d. Directed Inspections - Buried Tanks

i. Directed inspections for buried tanks are conducted in accordance with Table 4c and its accompanying footnotes

ii. Directed inspections as indicated in Table 4c will be conducted during each 10 year period beginning 10 years prior to the entry into the period of extended operation

iii. Each buried tank constructed from a material for which an examination requirement is contained in Table 4c is examined

iv. Cathodic protection surveys are in accordance with NACE RP0285-2002

v. Examinations may be conducted from the external surface of the tank using visual techniques or from the internal surface of the tank using volumetric techniques. If the tank is inspected from the external surface a minimum 25% coverage is required. This area must include at least some of both the top and bottom of the tank. If the tank is inspected internally by UT, at least 1 measurement is required per square foot of tank surface. If the tank is inspected internally by another volumetric technique, at least 90% of the surface of the tank must be inspected

vi. Tanks that cannot be examined using volumetric examination techniques are examined visually from the outside [ow does one visually inspect a buried tank from the outside?

vii. Visual inspections for polymeric materials are augmented with manual examinations to detect hardening, softening or other changes in material properties.

viii. Opportunistic examinations may be credited toward these direct examinations

PW 16: Opportunistic examinations should not be credited toward anything, rather they should be used to indicate and classify targeted examination.

Table 4c, Inspections of Buried Tanks

Material CP Survey Visual/Volumetric Inspection
Titanium
Super Austenitic Stainless3
Stainless Steel X
Steel X X
Copper X X
Aluminum X X
Polymers1, 2 X

1. All polymeric materials including composite materials such as fiberglass. No distinction is drawn for underground piping between high density polyethylene approved for use by the NRC in buried applications and other polymeric piping materials.

2. Volumetric Inspection not required for polymeric materials

3. e.g. Al6XN or 254 SMO

e. Directed Inspections - Underground Tanks

i. Directed inspections for underground tanks are conducted in accordance with Table 4d and its accompanying footnotes

ii. Directed inspections as indicated in Table 4d will be conducted during each 10 year period beginning 10 years prior to the entry into the period of extended operation

iii. Each underground tank constructed from a material for which an examination requirement is contained in Table 4d is examined

iv. Examinations may be conducted from the external surface of the tank using visual techniques or from the internal surface of the tank using volumetric techniques. If the tank is inspected from the external surface a minimum 25% coverage is required. This area must include at least some of both the top and bottom of the tank. If the tank is inspected internally by UT, at least 1 measurement is required per square foot of tank surface. If the tank is inspected internally by another volumetric technique, at least 90% of the surface of the tank must be inspected

PW 17: A UT measurement covers about 0.5 square inches of surface area. There are 144 square inches in a square foot. Hence, one measurement per square foot covers about 100/288 percent of surface area.

v. Tanks that cannot be examined using volumetric examination techniques are examined visually from the outside

vi. Visual inspections for polymeric materials are augmented with manual examinations to detect hardening, softening or other changes in material properties.

vii. Opportunistic examinations may be credited toward these direct examinations

Table 4d, Inspections of Underground Tanks

Material Visual/Volumetric Inspection
Titanium
Super Austenitic Stainless3
Stainless Steel X
Steel X
Copper X
Aluminum X
Polymers1, 2 X

1. All polymeric materials including composite materials such as fiberglass. No distinction is drawn for underground piping between high density polyethylene approved for use by the NRC in buried applications and other polymeric piping materials.

2. Volumetric Inspection not required for polymeric materials

3. e.g. Al6XN or 254 SMO

f. Adverse findings

i. Adverse indications observed during monitoring of cathodic protection systems or during inspections are entered into the plant corrective action program. Adverse indications will result in an expansion of sample size. At a minimum, leaks, material thickness less than minimum, the presence of coarse backfill within 6 inches of a coated pipe or tank (see Table 2A Footnote 6), and general or local degradation of coatings so as to expose the base material are considered adverse indications.

ii Adverse indications which fail to meet the acceptance criteria described in element 6 below, will result in the repair or replacement of the affected component

iii. An analysis may be conducted to determine the potential extent of the degradation observed. Expansion of sample size may be limited by the extent of piping or tanks subject to the observed degradation mechanism

iv. If adverse indications are detected, sample sizes within the affected piping categories are doubled. If adverse indications are found in the expanded sample, the sample size is again doubled. This doubling of sample size continues as necessary.

5. Monitoring and Trending: For piping and tanks protected by cathodic protection systems, potential difference and current measurements are trended to identify changes in the effectiveness of the systems and/or coatings. Numerical measurements obtained from any inspections are trended to monitor corrosion rates and estimate the remaining life of piping and tanks.

6. Acceptance Criteria: The principal acceptance associated with the inspection contained with this AMP follow:

a. Criteria for soil-to-pipe potential are listed in NACE Standards RP0285 2002 and SP0169-2007.

b. For coated piping or tanks, there should be no evidence of coating degradation.

PW 15: During the teleconference call, it was recommended that "no evidence of coating degradation" be determined by a "NACE certified inspector" – inspector's judgment calls vary all over the map, absent specific criteria by NRC this is not an acceptable way to provide reasonable assurance.

c. If coated or uncoated metallic piping or tanks show evidence of corrosion, the remaining wall thickness in the affected area is determined to ensure that the minimum wall thickness is maintained. This may include different values for large area minimum wall thickness, and local area wall thickness.

d. Cracking or blistering of nonmetallic piping is evaluated.

e. Concrete piping may exhibit minor cracking and spalling provided there is no evidence of leakage or exposed rebar or reinforcing "hoop" bands.

f. Backfill is in accordance with specifications described in element 4 (above) of this AMP.

7. Corrective Actions: The site corrective actions program, quality assurance (QA) procedures, site review and approval process, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. The staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions, confirmation process, and administrative controls.
8. Confirmation Process: The confirmation process ensures that preventive actions are adequate to manage the aging effects and that appropriate corrective actions have been completed and are effective. The confirmation process for this program is implemented through the site's QA program in accordance with the requirements of 10 CFR Part 50, Appendix B.

9. Administrative Controls: The administrative controls for this program provide for a formal review and approval of corrective actions. The administrative controls for this program are implemented through the site's QA program in accordance with the requirements of 10 CFR Part 50, Appendix B.

10. Operating Experience: Operating experience shows that buried and underground piping and tanks are subject to corrosion. Corrosion of buried oil, gas, and hazardous materials pipelines have been adequately managed through a combination of inspections and mitigative techniques, such as those prescribed in NACE SP0169-2007 and NACE RP0285-2002. Given the differences in piping and tank configurations between transmission pipelines and those in nuclear facilities, it is necessary for applicants to evaluate both plant-specific and nuclear industry operating experience and modify its aging management program accordingly. The following industry experience may be of significance to an applicant's program:

a. On February 21, 2005, a leak was detected in a 4-inch condensate storage supply line. The cause of the leak was microbiologically influenced corrosion or under deposit corrosion. The leak was repaired in accordance with the American Society of Mechanical Engineers (ASME) Section XI, "Repair/Replacement Plan".

b. On September 6, 2005, a service water leak was discovered in a buried service water header. The header had been in service for 38 years. The cause of the leak was either failure of the external coating or damage caused by improper backfill. The service water header was relocated above ground.

c. In October 2007, degradation of essential service water piping was reported. This led to an NRC special inspection in February 2008. The Institute of Nuclear Power Operations issued a significant operating event report discussing the degradation of the essential service water piping and concluded the degradation was caused by exposure to extreme conditions (including being buried).

d. On August 19, 2008, a flexible PVC pipe ruptured in the service water system. The rupture was related to Tropical Storm Fay, which washed away the soil where the piping was buried and washed additional soil away beneath the piping. This caused the PVC piping to sag and break free at the connecting joints. This section of piping was repaired.

e. In February 2009, a leak was discovered on the return line to a CST

f. In April 2009, a leak was discovered in an aluminum pipe where it went through a concrete wall. The piping was for the condensate transfer system. The failure was caused by vibration of the pipe within its steel support system. This vibration led to coating failure and eventual galvanic corrosion between the aluminum pipe and the steel supports.

g. In May 2009, diesel/fuel oil odor was identified in the ground water near the diesel generator building. The area was excavated to find the source of the leak. [Why does a Diesel system spring a leak??

h. In June 2009, an active leak was discovered in underground piping associated with a condensate storage tank (CST). The leak was discovered because elevated levels of tritium were detected. There were similar leaks in buried piping in 2004 and 2006, and those sections of piping were replaced.

Respectfully submitted,

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Attachments

NRC-2010-0180-DRAFT-0007.1: Comment on FR Doc # N/A

PILGRIM WATCH – 148 WASHINGTON STREET – DUXBURY, MA 02332

July 1, 2010

PILGRIM WATCH'S COMMENTS REGARDING GALL AMP XI.M41 BURIED AND UNDERGROUND PIPING & TANKS - NRC STAFF DRAFT REVISED AMP M41 (JUNE 18, 2010 VERSION)-Docket: NRC-2010-0180 www.regulations.gov

Pilgrim Watch's comments regarding the need for revision to the Aging Management Program for Buried and Underground Piping and Tanks to provide reasonable assurance to the public during license renewal reflect lessons learned from our participation in Pilgrim Station's license renewal adjudication process, Contention 1.

I. OVERVIEW

A. Probability- Corrosion Risk V. Corrosion Rate

The Draft and industry seem intent to classify all systems by numbers representing the probability of a corrosion event - calling it "corrosion risk" - and give it a number. Risk is defined as the product of impact times the probability of the event. It is important to understand the nature of the probability of a corrosion event (a leak in this case). Clearly there are areas of buried pipe that are more susceptible to localized attack than others. However, the probability of such attack is not constant with time and therefore cannot be characterized with a number and entered as such into a "Rule", like, if we inspected yesterday we don't need to inspect again for 10 years. First, corrosion is a rate process and the rate is NOT constant with time. Therefore, the probability would have to be adjusted with age, or the risk becomes a function of age. As a consequence, the entire risk management, which is now being introduced to the AMP, is totally misguided

B. Placement Above-Ground

A solution would be to place piping above ground so that leaks would be visible and overall inspection simplified. Requirements for protection from temperature changes would be important to prevent freezing and condensation.

C. Alternatively (if remaining in-ground) Buried and Underground Piping & Tanks AMP should include

1. Base-Line Data: It is critical that baseline data is required to be collected via a top to bottom examination of the buried/underground piping within scope prior to final license approval - in order to determine the current status of the piping necessary to assess an appropriate AMP and establish a corrosion rate going forward. Such an inspection must entail special attention to points of vulnerability –

such as at elbows, welds, joints, and at any dead spaces where liquid can sit; and must include inspection both inside and outside. Special attention must also be given to those welds located upstream or downstream of a flow disturbance. Since it is not possible to assess possible damage below the coating in the pipe body, in addition all piping must be pressure tested to at least twice the operating pressure. Inability to perform pressure tests for any reason should not be cause for relief. Baseline data is critical so that trending is established. NUREG/CR 6876 states, at 32, "...it is evident that predicting an accurate degradation rate for buried piping systems is difficult to achieve..."

2. Cathodic Protection: All Applicants can and should implement a thorough Cathodic Protection Program on all buried/underground components. Corrosion pits from the outside diameter have been discovered in buried piping with far less than 60 years of operation. Buried pipe that is coated and cathodically protected is unaffected after 60 years of service. Operating experience from application of the NACE standards on non-nuclear systems demonstrates the effectiveness of this program. [GALL XI M-28, at 10, Operating Experience] To counter NEI's former misleading statements to Dr. Davis when the previous GALL was written (a matter of record in Pilgrim's adjudication, Testimony John Fitzgerald, Michigan) Cathodic Protection can be retrofitted and retrofitting cathodic protection is not dangerous. It may introduce strays currents; however this is a design issue, not a design constraint. Further, in order to retrofit cathodic protection, it requires a rectifier; if it malfunctions it does not necessarily require the reactor to automatically shut-down for repairs.

The Draft talks about a cathodic protection survey. The Draft is unclear. If a licensee read it, they would interpret it to say that since we have no CP in my plant we do not need any CP survey. The language should be that they should do a "potential survey" and other typical surveys to determine first if they need CP. Furthermore, the potential survey can pin point the hot spots (low potential) on buried pipe after time in the ground when the pipe was not CP protected. Additionally, a potential survey should be conducted to find possible stray currents. At Indian Point, for example, city water supply pipes cross the right of way of a major gas pipe line. The latter of course is cathodically protected. Possible interference must needs to be explored.

3. Monitoring Frequency & Coverage: PW believes that the Staff is approaching this incorrectly. Where do the numbers come from? For example: we believe that there is no justification for requiring inspection of 10% of buried carbon steel pipe - ASME Code Class Pipe - coated - every 10 years. Are those specs the same for newly buried pipe as for pipe that has been in the ground for 40 years? What effect does

aging have on inspection frequency and the extent of the inspection? What does the 10% relate to and how are the 10% selected for inspection?

To minimize the size and frequency of leaks, the AMP should be augmented to require more frequent and more comprehensive inspections. Specifically a 100% internal visual inspection of all underground pipes and tanks must be implemented. If a baseline inspection immediately prior to license renewal does not indicate that more inspections are required, then the inspection cycle should be such that all pipes and tanks are inspected every ten years. The Applicant should be required to break the testing interval down such that one sixth of all pipes and tanks are inspected during each refueling outage. (This assumes 18 month refueling outages, or six every ten years.) The Applicant should be required to inspect one sixth of the lineal piping, one sixth of the elbows and flanges, and one sixth of the tank seams at each outage, even if such inspections lengthen the outage time. The Applicant should certify that each portion of the AMP on the pipes and tanks is accomplished in the order agreed upon and completed at every outage.

4. Monitoring Wells: A well designed monitoring well system could pick up a leak relatively quickly - approximately within weeks or months after the initiation of a leak, depending on the rates of groundwater flow and other factors. Groundwater monitoring networks are widely used to detect leaks at a variety of nuclear and non-nuclear sites. Well-established protocols exist for proper design of monitoring networks including well and screen placement, sampling frequency and selection of sampled contaminants Sampling the wells is usually done about four times a year

Steps in Monitoring Network Design that NRC should require and evaluate:

a. Determination of all plausible leak locations. This would include consideration of all piping segments and tanks that are placed below the ground surface and are part of system components that are within scope. For purposes of monitoring network design, leaks from any of the plausible locations would be presumed to release water contaminated with radionuclides or oil. This step is similar those recommended in the NEI Guidance Document (Objective 1.2 Site Risk Assessment) where buried piping is described as being a credible mechanism for leaking materials to reach groundwater.
b. Identification of the specific contaminant species that would be present in the leaking water or oil from each of the system components. A set of indicator contaminants should be selected for each system component that can, if detected in groundwater, uniquely identify the component. Particular emphasis should be on those contaminants that are least likely to sorb and thus be most rapidly transported.

c. Consideration of the fate and transport of each indicator contaminant from each of the plausible leak locations.

(1) This analysis would include prediction of subsurface transport pathways from all identified source locations. This prediction would consider vertical migration of leaking water through the unsaturated zone to the water table. It would also account for the direction and rate of groundwater flow. Such predictions must be based upon understanding of groundwater behavior at the site derived from a recently-conducted detailed site characterization as recommended in the NEI Guidance Document (Objective 1.1 Site Hydrology and Geology). This is particularly important at reactors like PNPS where building, paving and changes to storm drainage may significantly affect local flow behavior.

(2) Transport of a particular contaminant along identified transport pathways must be analyzed. For each contaminant it is necessary to account for the initial concentration of the contaminant in the leaking liquid and the effects of dispersion, sorption, radioactive decay or other processes that may affect concentrations of the contaminant at the monitoring well.

(3) The NEI Guidance Document (Objective 1.3 On-Site Groundwater Monitoring) recommends a monitoring system that will "ensure timely detection" of leaks. This will be accomplished with placement of monitoring wells so that all predicted transport pathways are intercepted with a high degree of certainty. The placement of monitoring wells should consider both the areal (plan view) location and also the vertical location of the well screens. A complete monitoring system will also include up-gradient control wells which are intended to provide ambient groundwater conditions and help to confirm groundwater flow directions. Consideration must be given to topography and location of the sources of potential leak sites from a coast line or offsite boundary. For example, at Pilgrim, sources of potential leak sites are located only a short distance from the coast line (assuming that groundwater flow is generally towards the sea), the potential is high for a narrow transport pathway to convey contaminants between monitoring wells unless they are closely spaced. This suggests that a high density of monitoring wells will be needed to detect leaks with adequate assurance.

d. Understanding of the fate and transport of indicator contaminants can be used to determine the appropriate frequency of water sample collection at the monitoring wells and the required detection limits for analysis. In particular, the dilution of contaminated water as it mixes with ambient water during transport must be considered. Detection limits for contaminant analysis should be as low as practical so that dilution of contaminants does not mask the presence of leaks. Radionuclides in addition to Tritium need to be analyzed and reported. All findings must be required to be made public in a timely manner.

D. Ductile Iron Pipe- Fire System exemption at multi-unit sites:

Ductile Iron Pile: During the June 21, 2010 Teleconference call, NEI argued that ductile iron piping used in the fire protection system was considered resistant to corrosion & should be exempted. Not so. The impact of deterioration and failure of buried ductile iron pipelines due to external corrosion is very significant. Ductile iron piping is subject to corrosion mainly through grafitization and pitting. It is generally believed that the rate of external pitting attack on unprotected ferrous materials is governed primarily by the corrosivity of the environment, and the material type has no pronounced influence. It is also subject to galvanic corrosion, microbiologically induced corrosion and corrosion due to dissimilar electrolytes. Cathodic protection is the most powerful and cost-effective control method for existing ductile iron at locations where it is at risk from external corrosion.[1] Leakage due to manufacturing errors; installation of unprotected pipe in corrosive soils; improper application of protection measures; improper installation of the pipe, stray current from grounding services, bi-metallic corrosion from stainless saddles; accidents from work performed nearby cannot be discounted. Therefore we conclude that arguments made during the Teleconference (June 21, 2010) that ductile iron pipe used extensively in underground/buried fire protection systems should be exempt should be discounted. They have no scientific basis and are at bottom simply about saving industry money at the expense of public safety.

Fire Systems: NEI's rationale for exempting the fire protection buried components (presented during the Teleconference call) went further and became even more absurd by suggesting that the buried and underground piping fire system was somehow not functionally that important to require the same inspections and prevention in multi-unit sites. NRC seemed to imply that exemptions would be written in to the final document. It is clear that the underground & buried piping tanks associated with the fire protection system are critical to protect public safety. In a fire, it obvious that hoses and sprinklers must function as designed. Also not to be ignored is that fire protection piping and tanks may vary in their susceptibility to corrosion or breaks across the site. The piping segments or tanks may not be the same age across the site. Soils vary across a site. Manufacturing errors/defects and the history of damage from excavation near the piping or tanks once installed varies across a site. Example: *Pilgrim NPS LR SER, at 3-37 described a leak in the* fire water underground distribution system and that the probable cause was induced, "most likely by fabrication anomalies compounded by marginal installation leaks." This one example demonstrates that exemptions make no sense.

[1] See, for example, http://www.angelfire.com/pop/myfile/EXTDIPhtml.htm External **Corrosion** and Protection of **Ductile Iron Pipe** and references listed.

E. High Density Polyethylene & High Density Polypropylene

We have been advised that there should be reluctance to use polymeric piping in hot service and there is a pressure limitation that depends (like in steel pipe) on the wall thickness; it should never be used either of the materials in organic service (buried diesel or fuel oil lines) even though organic fluids are routinely transported in polyethylene or polypropylene totes; and that there is reason for concern about long term embrittlement (and eventual cracking) if used in buried structures. Another type of problem with buried polymeric pipe is the fact that when digging becomes necessary the polymeric pipe is cut that much more easily. If polymeric pipe(not really plastic pipe) are used for repairs, there are problems in the mating of steel pipes to polymeric ones. Bottom line, we are advised that there is not enough experience available to guarantee an additional 20 years of service.

II. XI.M41 BURIED AND UNDERGROUND PIPING AND TANKS

Comments Inserted in NRC Draft's Text in Italics

Program Description

This is a comprehensive program designed to manage the aging of the external surfaces of buried and underground piping and tanks

> *PW 1.While corrosion from the outer surface of buried pipes may be the dominant failure mechanism, there have been failures from the inside (supply water system e.g) which simply are not covered by other programs which deal almost exclusively with maintaining water chemistry. It makes no sense of excluding internal corrosion and verification of the effectiveness of alternate programs*

It addresses piping and tanks composed of any material, including metallic, polymeric and cementitious materials. This program manages aging through preventive, mitigative and inspection activities. It manages all applicable aging effects such as loss of material, cracking, and changes in material properties.

Depending on the material, preventive and mitigative techniques include: the material itself, corrosion resistant coatings,

> *PW 2. "Corrosion resistant coatings" is incorrect. Coatings do not corrode, they deteriorate, whereupon water has access to the underlying metal and corrosion can start.*

and the application of cathodic protection. Also, depending on the material, inspection activities include electrochemical verification of the effectiveness of cathodic protection, non-destructive evaluation of pipe or tank wall thicknesses, and visual inspections of the pipe or tank from the exterior as permitted by opportunistic or directed excavations.

Although this program considers the fluid inside the pipe or tank, and certain aspects of the program may be carried out from the inside of the pipe or tank, this program is designed to address only the degradation occurring on the outside of the pipe or tank. Aging of the inside of the pipe or tank is managed by another program (e.g. Open Cycle Cooling Water (AMP XI.M20), Treated Water (XIM.21A), Internal Inspection of Miscellaneous Piping and Ducts XI.MXX) or Water Chemistry (XI.M2). Additionally, this program does not address selective leaching. The selective leaching program (Chapter XI.M33) is applied in addition to this program for applicable materials and environments.

The terms "buried and underground are fully defined in Chapter IX of the GALL Report. Briefly, buried piping and tanks are in direct contact with soil or concrete (e.g., a wall penetration). Underground piping and tanks are below grade, but are contained within a tunnel or vault such that they are in contact with air and are located where access for inspection is restricted.

PW 3: *I think it is essential to include underground piping - the deterioration evident in the tunnels in Indian Point is pretty bad and recent experience at EVY's AOG piping*

Evaluation and Technical Basis

1. ***Scope of Program*****:** This program is used to manage the effects of aging for buried and underground piping and tanks constructed of any material including metallic, polymeric and
cementitious materials. The program addresses aging effects such as loss of material, cracking, and changes in material properties. Any system may contain buried and underground piping or tanks. Typical systems include service water piping and components, condensate storage transfer lines, fuel oil and lubricating oil lines, fire protection piping and piping components (fire hydrants), and storage tanks. The aging of bolting associated with piping systems within the scope of this program is also managed by this program.

PW 4 : add piping related to AOG system

2. ***Preventive Actions:*** Preventive actions utilized by this program vary with the material of the tank or pipe and the environment (air, soil, or concrete) to which it is exposed. These actions are outlined below

a. Preventive Actions, Buried Piping and Tanks

i. Preventive actions for buried piping and tanks are conducted in accordance with Table 2a and its accompanying footnotes

Table 2a, Preventive Actions for **Buried** Piping and Tanks

Material[1]	Coating[2]			Cathodic Protection[4]	Backfil l		
	None Reqd.	May be Reqd.[3]	Reqd.		No Limit[5]	High Qualit y[6]	Fine[7]
Titanium	X				X		
Super Austenitic Stainless[9]	X				X		
Stainless Steel		X				X[8]	
Steel			X	X		X	
Copper			X	X		X	
Aluminum			X	X		X	
Cement		X				X[8]	
Polymer	X						X

1. Materials classifications are meant to be broadly interpreted; e.g. all alloys of titanium which are commonly used for buried piping are to be included in the titanium category. Steel is as defined in chapter IX of this report. Polymer includes polymeric materials as well as composite materials such as fiberglass

2. When provided, coatings are in accordance with NACE SP0169-2007 or RP0285-2002.

3. Requirement for coating depends on environmental conditions. If coatings are not provided, a justification is provided in the LRA

4. Cathodic protection is in accordance with NACE SP0169-2007 or RP0285-2002. Attempts to demonstrate that cathodic protection is not required as discussed in Sections 1.2 and 3 of SP0169-2007 will not be considered.

   PW 5: What does that mean? Does it mean that it will not be considered?

5. No limits are placed on backfill quality

6. Backfill is consistent with 49 CFR 195.252. Maximum size of aggregate or other material within 6 inches of pipe is ½ inch in diameter or less.

   PW 6: There seems to be a conflict between 6 and 7. Sand is a lot finer than 1/2 inch. Crushed concrete of 1/2 inch diameter (?) can be quite jagged and do much damage while river bottom pebbles may be harmless. Also absent from the discussion on backfill material was the degree to which the material retained moisture

Corrosion cells develop on a piece of metal exposed to different electrolytes and it is a particularly common problem on underground structures [27]. Potential differences develop, for example, on a long continuous pipeline that passes through different types of soils. One portion of the line might be laid in sandy loam while another lie in clay. Substantial natural pipeline currents ("long-line currents") may occur, which leads to corrosion cells as called "long line cells". In soils of low resistivity where such currents exit from the pipeline, causing the metal at the exit points is lost by anodic dissolution (corrosion). Anodes and cathodes may be miles apart.

7. Particle size for backfill within 6 inches of the pipe must not exceed that of sand grains

8. Backfill limits apply only if piping is coated.

9. e.g. Al6XN or 254 SMO

b. Preventive Actions, Underground Piping and Tanks

   i. Preventive actions for underground piping and tanks are conducted in accordance with Table 2b and its accompanying footnotes

Table 2b, Preventive Actions for **Underground** Piping and Tanks

Material[1]	Coating[2]		
	None Reqd.	May be Reqd.[3]	Reqd.
Titanium	X		
Super Austenitic Stainless[4]	X		
Stainless Steel		X	
Steel			X
Copper	X		
Aluminum		X	
Cement			
Polymer	X		

1. Materials classifications are meant to be broadly interpreted; e.g. all alloys of titanium which are commonly used for buried piping are to be included in the titanium category. Steel is as defined in chapter IX of this report. Polymer includes polymeric materials as well as composite materials such as fiberglass

2. When provided, coatings are in accordance with NACE SP0169-2007 or RP0285-2002. A broader range of coatings may be used if justification is provided in the LRA.

3. Requirement for coating depends on environmental conditions. If coatings are not provided, a justification is provided in the LRA

4. e.g. Al6XN or 254 SMO

3. *Parameters Monitored/Inspected:* The aging effects addressed by this AMP are loss of material due to all forms of corrosion and, potentially, cracking due to stress corrosion cracking. Two parameters are monitored to detect and manage these aging effects: visual appearance of the exterior of the piping or tank; and wall thickness of the piping or tank, generally as determined by a non-destructive examination technique such as ultrasonic testing (UT). Two additional parameters, the pipe-to-soil potential and the cathodic protection current, are monitored to determine the effectiveness of cathodic protection systems and, thereby, the effectiveness of corrosion mitigation.

PW 7: This paragraph is downright primitive. "All forms of corrosion" is pretty broad. But again, monitoring/inspection is limited to visual and UT. One cannot detect cracking with these two methods. Pipe to soil potential surveys should be done independent of active CP as a means to detect "hot spots" on buried pipe.

4. *Detection of Aging Effects:* Methods and frequencies used for the detection of aging effects vary with the material and environment of the buried and underground piping and tanks. These methods and frequencies are outlined below.

a. Opportunistic Inspections

i. All buried and underground piping and tanks, regardless of their material of construction are opportunistically inspected by visual means whenever they become accessible for any reason.

PW 8: Opportunistic means that there has been a leak that needs to be repaired. Visual inspection is "stone age technology" There has to be a decision of how much more pipe to excavate and at least conduct some quantitative examinations.

b. Directed Inspections – Buried Pipe

i. Directed inspections for buried piping are conducted in accordance with Table 4a and its accompanying footnotes

ii. Directed inspections as indicated in Table 4a will be conducted during each 10 year period beginning 10 years prior to the entry into the period of extended operation.

PW 9: What evidence is there to justify a 10 year interval. This is the crux. One simply cannot squeeze all these situations into the same shoe box.

iii. Inspection locations are selected based on susceptibility to degradation. Issues such as coating type, coating condition, cathodic protection efficacy, backfill characteristics and soil resistivity are considered

PW 10: If in fact there are various degrees of susceptibility should there not also be varying degrees of inspection frequencies?

iv. Visual inspections are supplemented with surface and/or volumetric non-destructive testing (NDT) if significant indications are observed.[What's the definition of significant?

v. Opportunistic examinations may be credited toward these direct examinations if the location selection criteria in iii, above, are met

vi. At multi-unit sites, individual inspections of shared piping may not be credited for more than one unit.

PW 11: What is this? Is it the pipe that is corroding or the Unit?

vii. Visual inspections for polymeric materials are augmented with manual examinations to detect hardening, softening or other changes in material properties.[truly wonder if people ever think about what the reader may think when he read that??? What does manual examination tell you about the embrittlement of the pipe.

viii. The use of guided wave ultrasonics or other advanced inspection techniques is encouraged for the purpose of determining those piping locations that should be inspected but may not be substituted for those inspections.

Table 4a, Inspections of **Buried Pipe**

Material	CP Survey[1]	Visual Inspections[2]			Minimum Inspections[5]
		ASME Code Class Pipe	Haz Mat Pipe[3]	Other Pipe[4]	
Titanium					
Super Austenitic Stainless[10]					

Stainless Steel		2%	2%	1%	1
Steel	X	10%[6]	5%[6]	1%[6]	2
Copper	X	2%[6]	2%[6]	1%[6]	1
Aluminum	X	5%[6]	2%[6]	1%[6]	1
Cement		N/A[7]	N/A[7]	1%	1
HDPE[8]		1%[11]	1%[11]		1
Other Polymer[9]		2%	2%	1%	1

1. Cathodic protection survey in accordance with NACE SP0169-2007 [It really is not a CP survey but rather a potential survey to determine if CP is needed. Of course if CP is already installed then a potential survey will show whether if works

2. Numerical values under the visual inspection heading indicate the percentage in linear feet of piping of the category indicated which is to be excavated and visually inspected, i.e., if stainless steel piping is present in each of the three categories of piping a minimum of 3 excavations are required, one for each piping category. One or more excavations are conducted to inspect at least 2% of the code class piping; one or more excavations are conducted to inspect at least 2% of the Haz Mat piping; and one or more excavations are conducted to inspect at least 1% of the "other" piping. **Alternatively**, the entire length of stainless steel piping present in all three piping categories may be considered to be code class piping and inspected accordingly, i.e., one or more excavations are conducted to inspect at least 2% of the total length of stainless steel piping present.

3. Haz Mat pipe is pipe which, during normal operation, contains water contaminated with radioisotopes at levels greater than background or fluids other than water which, if released, would be detrimental to the environment e.g., diesel fuel.

4. Other pipe is pipe which is not code class pipe and which, during normal operations, contains only water which is not contaminated with radioisotopes at levels in excess of background.

5. Minimum inspections identify the minimum number of separate excavations which are required for each piping material. The minimum length for each excavation is 10 feet

6. Inspection of the prescribed length of piping may be eliminated when the installed cathodic protection system has been operating in accordance with NACE SP0169-2007 for 90% of the time since the pipe was originally installed or was visually inspected. The prescribed minimum number of visual inspections must still be met. Visual inspection as used here means visually inspecting a length of pipe equal to the amount indicated in the table, i.e., in order to eliminate the requirement to inspect 10% of buried steel code class

piping, the installed cathodic protections system must have operated 90% of the time since that piping was installed or since 10% of it was visually inspected.

7. The use of cement piping in ASME code class and Haz Mat applications is not expected. If cement piping is used in these applications an inspection program is to be provided and justified in the LRA

8. HDPE pipe includes only HDPE pipe approved for use by the NRC for buried applications

9. Other polymer piping includes some HDPE pipe, and all other polymeric materials including composite materials such as fiberglass

10. e.g. Al6XN or 254 SMO

11. Refers to the percentage of welds (not linear length of pipe) which must be inspected. These inspections may be omitted if the pipe was volumetrically inspected when installed and no indications were noted and if the operating temperature of the pipe does not exceed 100° F

c. Directed Inspections – Underground Pipe

   i. Directed inspections for Underground piping are conducted in accordance with Table 4b and its accompanying footnotes

   ii. Directed inspections as indicated in Table 4b will be conducted during each 10 year period beginning 10 years prior to the entry into the period of extended operation

   iii. Inspection locations are selected based on susceptibility to degradation. Issues such as coating type, coating condition, exact external environment, and flow characteristics within the pipe, are considered

      PW 12: It is good to see consideration of internal corrosion, but it seems to me the document in not consistent

   iv. Underground pipes are inspected visually to detect external corrosion and by UT to detect internal corrosion.

      PW 13: That's another muddle: UT detects both internal and external corrosion –
      Separation is tricky but can be done.

   v. Opportunistic examinations may be credited toward these direct examinations if the location selection criteria in iii, above are met

vi. At multi-unit sites, individual inspections of shared piping may not be credited for more than one unit.

PW 14: This makes no sense.

vii. Visual inspections for polymeric materials are augmented with manual examinations to detect hardening, softening or other changes in material properties.

viii. The use of guided wave ultrasonics or other advanced inspection techniques is encouraged for the purpose of determining those piping locations that should be inspected but may not be substituted for those inspections.[somebody really does not know what they are talking about.

Table 4b, Inspections of **Underground Pipe**

Material	Visual and UT Inspections[1]			Minimum Inspections[4]
	ASME Code Class Pipe	Haz Mat Pipe[2]	Other Pipe[3]	
Titanium				
Super Austenitic Stainless[7]				
Stainless Steel	2%	2%	1%	1
Steel	10%	5%	1%	2
Copper	2%	2%	1%	1
Aluminum	5%	2%	1%	1
Cement	N/A[5]	N/A[5]	NA[5]	1
Polymer[6]	2%	2%	1%	1

1. Numerical values under the visual inspection heading indicate the percentage in linear feet of piping of the category indicated which is to be inspected using visual and ultrasonic
techniques, i.e., if stainless steel piping is present in each of the three categories of piping a minimum of 3 inspections are conducted, one for each piping category. One or more inspections are conducted to inspect at least 2% of the code class piping; one or more inspections are conducted to inspect at least 2% of the Haz Mat piping; and one or more inspections are conducted to inspect at least 1% of the "other" piping. **Alternatively**, the entire length of stainless steel piping present in all three piping categories may be considered to be code class piping and inspected accordingly, i.e., one or more inspections are conducted to inspect at least 2% of the total length of stainless steel piping present. All piping which is visually inspected to detect external corrosion is ultrasonically inspected to detect

internal corrosion. UT inspection intervals will not exceed one foot. Particular attention is paid to elbows and the adjacent piping.

PW 15: Where do these numbers come from? Is there any evidence that 2% is statistically the correct number? Provide rationale in footnote.

2. Haz Mat pipe is pipe which, during normal operation, contains water contaminated with radioisotopes at levels greater than background or fluids other than water which, if released, would be detrimental to the environment, e.g., diesel fuel.

3. Other pipe is pipe which is not code class pipe and which, during normal operations, contains only water which is not contaminated with radioisotopes at levels in excess of background.

4. Minimum inspections identify the minimum number of separate inspection locations which are required for each piping material. The minimum length for each inspection is 10 feet

5. The use of cement piping in ASME code class and Haz Mat applications is not expected. If cement piping is used in these applications an inspection program is to be provided and justified in the LRA

6. All polymeric materials including composite materials such as fiberglass. No distinction is drawn for underground piping between high density polyethylene approved for use by the NRC in buried applications and other polymeric piping materials.

7. e.g. Al6XN or 254 SMO

d. Directed Inspections – Buried Tanks

    i. Directed inspections for buried tanks are conducted in accordance with Table 4c and its accompanying footnotes

    ii. Directed inspections as indicated in Table 4c will be conducted during each 10 year period beginning 10 years prior to the entry into the period of extended operation

    iii. Each buried tank constructed from a material for which an examination requirement is contained in Table 4c is examined

    iv. Cathodic protection surveys are in accordance with NACE RP0285-2002

    v. Examinations may be conducted from the external surface of the tank using visual techniques or from the internal surface of the tank using volumetric techniques. If the tank is inspected from the external surface a minimum 25% coverage is required. This area must include at least some of both the top and bottom of the tank. If the tank is inspected internally by UT, at least 1 measurement is required per square foot of tank surface. If the tank is inspected internally by another volumetric technique, at least 90% of the surface of the tank must be inspected

vi. Tanks that cannot be examined using volumetric examination techniques are examined visually from the outside [ow does one visually inspect a buried tank from the outside?

vii. Visual inspections for polymeric materials are augmented with manual examinations to detect hardening, softening or other changes in material properties.

viii. Opportunistic examinations may be credited toward these direct examinations

PW 16: Opportunistic examinations should not be credited toward anything, rather they should be used to indicate and classify targeted examination.

Table 4c, Inspections of **Buried Tanks**

Material	CP Survey	Visual/Volumetric Inspection
Titanium		
Super Austenitic Stainless[3]		
Stainless Steel		X
Steel	X	X
Copper	X	X
Aluminum	X	X
Polymers[1, 2]		X

1. All polymeric materials including composite materials such as fiberglass. No distinction is drawn for underground piping between high density polyethylene approved for use by the NRC in buried applications and other polymeric piping materials.

2. Volumetric Inspection not required for polymeric materials

3. e.g. Al6XN or 254 SMO

e. Directed Inspections – Underground Tanks

i. Directed inspections for underground tanks are conducted in accordance with Table 4d and its accompanying footnotes

ii. Directed inspections as indicated in Table 4d will be conducted during each 10 year period beginning 10 years prior to the entry into the period of extended operation

iii. Each underground tank constructed from a material for which an examination requirement is contained in Table 4d is examined

iv. Examinations may be conducted from the external surface of the tank using visual techniques or from the internal surface of the tank using volumetric techniques. If the tank is inspected from the external surface a minimum 25% coverage is required. This area must include at least some of both the top and bottom of the tank. If the tank is inspected internally by UT, at least 1 measurement is required per square foot of tank surface. If the tank is inspected internally by another volumetric technique, at least 90% of the surface of the tank must be inspected

PW 17: A UT measurement covers about 0.5 square inches of surface area. There are 144 square inches in a square foot. Hence, one measurement per square foot covers about 100/288 percent of surface area.

v. Tanks that cannot be examined using volumetric examination techniques are examined visually from the outside

vi. Visual inspections for polymeric materials are augmented with manual examinations to detect hardening, softening or other changes in material properties.

vii. Opportunistic examinations may be credited toward these direct examinations

Table 4d, Inspections of **Underground Tanks**

Material	Visual/Volumetric Inspection
Titanium	
Super Austenitic Stainless[3]	
Stainless Steel	X
Steel	X
Copper	X
Aluminum	X
Polymers[1, 2]	X

1. All polymeric materials including composite materials such as fiberglass. No distinction is drawn for underground piping between high density polyethylene approved for use by the NRC in buried applications and other polymeric piping materials.

2. Volumetric Inspection not required for polymeric materials

3. e.g. Al6XN or 254 SMO

f. Adverse findings

   i. Adverse indications observed during monitoring of cathodic protection systems or during inspections are entered into the plant corrective action program. Adverse indications will result in an expansion of sample size. At a minimum, leaks, material thickness less than minimum, the presence of coarse backfill within 6 inches of a coated pipe or tank (see Table 2A Footnote 6), and general or local degradation of coatings so as to expose the base material are considered adverse indications.

   ii Adverse indications which fail to meet the acceptance criteria described in element 6 below, will result in the repair or replacement of the affected component

   iii. An analysis may be conducted to determine the potential extent of the degradation observed. Expansion of sample size may be limited by the extent of piping or tanks subject to the observed degradation mechanism

   iv. If adverse indications are detected, sample sizes within the affected piping categories are doubled. If adverse indications are found in the expanded sample, the sample size is again doubled. This doubling of sample size continues as necessary.

5. ***Monitoring and Trending:*** For piping and tanks protected by cathodic protection systems, potential difference and current measurements are trended to identify changes in the effectiveness of the systems and/or coatings. Numerical measurements obtained from any inspections are trended to monitor corrosion rates and estimate the remaining life of piping and tanks.

6. ***Acceptance Criteria:*** The principal acceptance associated with the inspection contained with this AMP follow:

   a. Criteria for soil-to-pipe potential are listed in NACE Standards RP0285-2002 and SP0169-2007.

   b. For coated piping or tanks, there should be no evidence of coating degradation.

PW 15: During the teleconference call, it was recommended that "no evidence of coating degradation" be determined by a "NACE certified inspector" – inspector's judgment calls vary all over the map, absent specific criteria by NRC this is not an acceptable way to provide reasonable assurance.

c. If coated or uncoated metallic piping or tanks show evidence of corrosion, the remaining wall thickness in the affected area is determined to ensure that the minimum wall thickness is maintained. This may include different values for large area minimum wall thickness, and local area wall thickness.

d. Cracking or blistering of nonmetallic piping is evaluated.

e. Concrete piping may exhibit minor cracking and spalling provided there is no evidence of leakage or exposed rebar or reinforcing "hoop" bands.

f. Backfill is in accordance with specifications described in element 4 (above) of this AMP.

7. ***Corrective Actions:*** The site corrective actions program, quality assurance (QA) procedures, site review and approval process, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. The staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions, confirmation process, and administrative controls.
8. ***Confirmation Process:*** The confirmation process ensures that preventive actions are adequate to manage the aging effects and that appropriate corrective actions have been completed and are effective. The confirmation process for this program is implemented through the site's QA program in accordance with the requirements of 10 CFR Part 50, Appendix B.

9. ***Administrative Controls:*** The administrative controls for this program provide for a formal review and approval of corrective actions. The administrative controls for this program are implemented through the site's QA program in accordance with the requirements of 10 CFR Part 50, Appendix B.

10. ***Operating Experience:*** Operating experience shows that buried and underground piping and tanks are subject to corrosion. Corrosion of buried oil, gas, and hazardous materials pipelines have been adequately managed through a combination of inspections and mitigative techniques, such as those prescribed in NACE SP0169-2007 and NACE RP0285-2002. Given the differences in piping and tank configurations between transmission pipelines and those in nuclear facilities, it is necessary for applicants to evaluate both plant-specific and nuclear industry operating experience and modify its aging management program accordingly. The following industry experience may be of significance to an applicant's program:

a. On February 21, 2005, a leak was detected in a 4-inch condensate storage supply line. The cause of the leak was microbiologically influenced corrosion or under deposit corrosion. The leak was repaired in accordance with the American Society of Mechanical Engineers (ASME) Section XI, "Repair/Replacement Plan".

b. On September 6, 2005, a service water leak was discovered in a buried service water header. The header had been in service for 38 years. The cause of the leak was either failure of the external coating or damage caused by improper backfill. The service water header was relocated above ground.

c. In October 2007, degradation of essential service water piping was reported. This led to an NRC special inspection in February 2008. The Institute of Nuclear Power Operations issued a significant operating event report discussing the degradation of the essential service water piping and concluded the degradation was caused by exposure to extreme conditions (including being buried).

d. On August 19, 2008, a flexible PVC pipe ruptured in the service water system. The rupture was related to Tropical Storm Fay, which washed away the soil where the piping was buried and washed additional soil away beneath the piping. This caused the PVC piping to sag and break free at the connecting joints. This section of piping was repaired.

e. In February 2009, a leak was discovered on the return line to a CST

f. In April 2009, a leak was discovered in an aluminum pipe where it went through a concrete wall. The piping was for the condensate transfer system. The failure was caused by vibration of the pipe within its steel support system. This vibration led to coating failure and eventual galvanic corrosion between the aluminum pipe and the steel supports.

g. In May 2009, diesel/fuel oil odor was identified in the ground water near the diesel generator building. The area was excavated to find the source of the leak. [Why does a Diesel system spring a leak??

h. In June 2009, an active leak was discovered in underground piping associated with a condensate storage tank (CST). The leak was discovered because elevated levels of tritium were detected. There were similar leaks in buried piping in 2004 and 2006, and those sections of piping were replaced.

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