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Beyond Nuclear Comments
Regarding Generic Aging Lessons Learned (GALL) for Age Management Programs for Buried and Underground Pipes (XI.M41) as Referenced in Federal Register Notice May 18, 2010, (ID NRC-2010-0180)

To whom it may concern:

On behalf of Beyond Nuclear, I am submitting the following comments with regard to United States Nuclear Regulatory Commission's (NRC) stated aim to revise the Age Management Program (AMP) for Buried and Underground Pipes and Tanks as pertains to AMP XI.M41.

Beyond Nuclear supports and has signed onto to the comments of Pilgrim Watch as provided to the NRC for this comment period.

In particular, I wish to focus our comments on the statements made by the staff of the NRC and representatives of the Nuclear Energy Institute (NEI) at a public meeting on June 21, 2010 that regarding relieving the nuclear power industry of age management programs for ductile iron pipe, in particular, exempting operators from such programs at multiple unit sites.

NEI argued and NRC staff seemed to agree that buried pipe fabricated of ductile iron piping systems can be exempted because material can be considered resistant to corrosion. This exemption, NEI argues, can be extended to significant safety-related systems such as extensive applications of buried pipe for fire protection systems governing areas to include reactor safe shutdown systems as required under 10 CFR 50.48 and 10 CFR 50 Appendix R III.G.2.

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Beyond Nuclear disagrees with this proposed generic exemption under GALL. Extensive controversy surrounds corrosion control strategies of buried ductile iron piping. Where safety-related functions apply, the operator needs to assure that an Age Management Program is maintained and inspected for buried pipe systems, including those fabricated of ductile iron pipe.

See "EXTERNAL CORROSION AND PROTECTION OF DUCTILE IRON PIPE" at http://www.angelfire.com/pop/myfile/EXTDIPhtml.htm for an extensive list of reference documents.

The document supported by this extensive list of reference documents summarizes,

"The results of both experimental researches and practical case histories have concluded that ductile iron does not possess superior corrosion resistance to other pipe materials such as gray cast iron or carbon steel when exposed in corrosive underground service environments. This, coupled with its thinner wall thickness compared with that of gray cast iron, implies that ductile iron should be protected from external corrosion to the same degree as for pipes made of steel.

"The primary failure mode for buried ductile iron pipe is localized attack (pitting corrosion). Pitting rates obtained from ductile iron pipes of age less than 15 years are much higher than those obtained from gray cast iron of much older age. Pitting corrosion of ductile iron pipe may be exacerbated by a number of things such as residual oxide scale, casting marks, and poor quality zinc/bitumastic coatings.

"External corrosion of ductile iron pipe not only makes a significant impact on the loss of water resources but also the cost for repair or replacement."

Additionally,

"Graphitization of gray cast irons can be expected when soil conditions favor anaerobic bacterial growth, with the appropriate conditions of pH, dissolved salts, and organic content. The result is a matrix consisting of a mass of residual graphite flakes interspersed with oxides of iron, which have been referred to in this paper as the graphite-containing corrosion products." Adding, *"uncertainty exists over the contribution of the graphite-containing corrosion products in acting as a protective barrier to continued corrosion, especially in the case of corrosion products formed on ductile iron pipe. Subsequent pipe failures frequently come from a mechanical stress or a hydraulic shock (roadwork, transport damage, or ground movement). The pipe would likely not have failed had it not been weakened by corrosion-induced loss of wall thickness."*

Additionally,

"Pitting corrosion has been reported to be the primary mode of failure for ductile iron pipes. The National Research Council of Canada has recently presented a report of data collected on water main breaks during 1992 and 1993 from 21 Canadian cities [17]. The report shows that ductile iron pipe constitutes 24% of the water distribution network and the break rates for this material in 1992 and 1993 were 9.3 breaks/100 km/year and 9.8 breaks/100 km/year, respectively. Between 76% and 78% of the ductile iron pipes failures were reported to have failed as a result of holes or pits. In contrast, only approximately 20% of gray cast iron failures were reported to have failed due to pits or holes."

Additionally,

"Ductile Iron Pipe may also corrode because of galvanic reaction of dissimilar metals with copper services. The service piping used in North America is almost exclusively copper, with a small amount of lead and galvanized steel pipe being used in the older areas. When ductile iron and copper pipes are connected, the mixed metal system may accelerates corrosion where it is connected to iron piping which acts as the anode of a galvanic corrosion cell in which the copper acts as the cathode. While describing corrosion of municipal water mains in Detroit, Michigan, Gummow has suggested that copper has an undeserved good reputation for corrosion resistance in soil environments because in many instances copper receives current produced by corroding iron, thus having a reduced corrosion rate.

For example, it has been reported that in 1980, 6.2% of the 42 water main failures (per 100 km) in Calgary resulted from attack to service saddles that were joined to copper service lines. Stetler has reported that about 80% of the 23 failures of the ductile iron mains in Bayside, Wisconsin during 1972 and 1976 occurred within 1 m (3 feet) of a copper service pipe or a copper bond strap, and about 33% were reported to have occurred within 20 cm (8 inches) of a copper item. Nevertheless, in overall terms the number of failures from this cause is relatively low, and the proportion confirmed to have been due solely to a galvanic corrosion mechanism is even few."

Additionally,

"Buried ductile iron pipe can also be subject to microbiologically enhanced attack. Biological organisms fall under two groups based on the type of corrosion they engender: (a) anaerobic corrosion and (b) aerobic corrosion. Sulfate reducing bacteria (SRB) from the genera desulforvibrio are a typical example of anaerobic bacteria. If sulfides are found in the corrosion products, the presence of sulfate-reducing bacteria is possible, or even probable. The sulfide test is qualitative and is accomplished by introducing a solution of 3-percent sodium azide in 0.1N iodine into a test tube containing a small quantity of soil removed from pipe depth, preferably from the surface of the pipe. If sulfides are present, they catalyze a reaction between sodium azide and iodine with the release of

nitrogen, and this is indicative of the presence of SRB. Electrochemical techniques such as Zero Resistance Ammetry, Electrochemical Impedance Measurement and corrosion potential logging have been used to study the nature and mechanisms of microbiological influenced corrosion of ductile iron pipes in soils.

"Evans ascribed biological attack as resulting from anaerobes' ability to 'render the oxygen present in sulfates, nitrides, and carbonates available for the acceleration' of the cathodic reaction. This means that corrosion can proceed even in the absence of dissolved oxygen. He also indicated that the corrosion rate of iron under anaerobic conditions is as much as 19.5 times greater than that under sterile conditions. Microbacterial action can also promote local anodic attack.

"King and his associates tested blast-cleaned specimens of cast irons and concluded that both ductile iron and gray cast iron pipe can suffer extensive corrosion by sulfate reducing bacteria. Both ductile and gray iron pipes were observed to corrode at similarly high corrosion rates (50-60 mils/year) in SRB containing soils. They also reported that specimens that did not have the asphaltic coating and annealing oxide removed did not corrode at a high rate. However, during their investigation at WRc, De Rosa and Parkinson found that the deepest corrosion pit was produced on mill scale coated (non-blasted) ductile iron pipe after 250 days in SRB soil test exposure. The pit depth was approximately 0.7 mm (28 mils), equivalent to a rate of corrosion of 1mm/year (40 mils/year). This rate is similar to that reported for premature external corrosion failures on unprotected ductile iron mains in the U.K. under service exposure conditions in aggressive soils. According to a study in Australia, it was also estimated that 50% of all failures of buried metal were due to microbiological causes."

Additionally,

"The impact of deterioration and failure of buried ductile iron pipelines due to external corrosion is very significant:

- *It has been reported that, in 1992 and 1993, the total number of water main breaks in 21 Canadian cities was 3601 and 3773, respectively. Assuming an estimated cost for repair/break of $2500, the average annual total cost of repairs would be $9.2 million. The total number of breaks for 1992 and 1993 occurred in 21 cities representing 11% (3.14 million) of Canada's population. Extrapolating on a population basis, the average annual total national cost for water main repair is $82 million. Ductile iron pipe constitutes 24% of the water distribution network in the 21 cities. Breaks in ductile iron pipe accounted for 10.89% of the total number of water main breaks in 1992 and 10.97% in 1993. Ductile iron pipe for water main use was first manufactured in Canada around 1961 though significant use of ductile iron pipes probably began between 1963 and 1968.*

• *Ductile iron pipe was introduced in the UK in the mid 1960's and by the mid 1970's had displaced the use of gray cast iron pipe. Water companies were left with hundreds of poorly protected ductile iron mains installed between 1965 and 1984, facing more than 359 "premature" failures and the need for early replacement. Meanwhile increasing problems from leakage, repairs and interruptions to customer supplies also occurred. As much as 40% of the water entering the UK distribution system was lost by leakage before it got to the end user. Similar rates of water loss were reported more recently in Mexico.*

• *It was reported that as much as 190 million liters (50 million gallons) a day were leaking from the 10,000 km (6,200 miles) of water pipes under New York City. It was also reported that 114 million liters (30 million gallons) of water per day were leaking at a daily leaking rate of about 220 from the City of Houston's pipes in 1985. A quantity report in the June 1985 issue of Forbes' magazine outlined the extensive impact of replacing 12% of the 1,324,000 km (823,000 miles) of sewer pipe in the United States."*

According to studies reviewed by Beyond Nuclear, polyethylene coating used in conjunction with cathodic protection is determined to be the most effective age management and cost-effective control method for external corrosion of buried ductile iron pipes which are clearly within the scope of passive structures that require adequate Age Management Programs.

However, the most effective AMP for external corrosion of buried pipe systems is to abandon all buried and below-grade applications for replacement with above-grade, stainless steel and vaulted systems.

Therefore, the NRC should not provide an exemption from AMP for buried pipe systems fabricated of ductile iron.

Sincerely,

----/s/----

Paul Gunter, Director
Reactor Oversight Project
Beyond Nuclear