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Dan Cardozo
Adams, Broadwell, Joseph and Cardozo

Re: Environmental effects of California adoption of PEX for potable water.

Dear Mr. Cardozo:

The state of California is considering adopting a portion of the Uniform Plumbing Code (UPC) which would allow the use of plastic pipe manufactured from cross linked polyethylene (PEX) for potable water use inside dwellings. The installation and use of PEX could result in direct and indirect impacts on the physical environment. If approved, PEX plastic pipe could be installed in thousands of homes in California; because of the potential scope of usage of PEX, these impacts may be cumulatively considerable.

For these reasons, the Department of Housing and Community Development (HCD) needs to comply with the California Environmental Quality Act (CEQA) so that it is adequately informed about the environmental consequences of the proposed approval of PEX. In this letter I outline some of the areas of potential environmental impact. Because PEX is not widely used in the United States, information is not readily available from external sources. Clearly, the present record lacks sufficient information to allow the state to dismiss the potential for environmental impact. Thus HCD should use the CEQA process to gather the necessary information to determine whether or not the impact potential would be realized.

What is PEX?

Cross linked polyethylene is a member of the polyolefin family of polymers – along with normal polyethylene, polypropylene, and polybutylene. Normal polyethylene is unsuitable for use for hot water because it softens at elevated temperatures. Polypropylene and polybutylene have greater temperature resistance because of the higher molecular weight of their monomers and polybutylene can be used in the temperature range of domestic hot water supply.

For polyethylene to serve hot water use, the individual polymer chains must be cross linked together with supplemental chemical bonds. The three commercial methods of cross linking give rise to three classes of PEX:

PEX-A, the so-called Engel method where the polyethylene resin and a chemical additive are heated to produce cross linking;
PEX-B, the silane method which produces silicon-oxygen cross link bonds; and
PEX-C, where cross linking is initiated by gamma or electron beam radiation.

All types of PEX would be permitted under the proposed code as long as they met the requirements of relevant ASTM or NSF testing.
The different manufacturing processes produce slightly different products with different chemical and mechanical characteristics. Historically, the push to allow plastic pipe in California has come from one manufacturer seeking to expand its market. For PEX, the manufacturer pushing for approval represents only one of the three manufacturing methods and has supplied information of limited scope. For HCD to adequately consider the environmental impact of the code adoption, HCD needs to define the "project" under CEQA completely and obtain information about all three commercial forms of PEX.

The cross linking of polyethylene produces the chemical structure necessary to resist softening at elevated temperatures. The cross linking does not change the fundamental chemistry of polyolefin polymers, and hence PEX is susceptible to the same chemical attack from oxidants or ultraviolet light as are other polyolefins. For this reason, PEX resin used to manufacture pipe for plumbing has chemical additives such as antioxidants, ultraviolet blockers, fillers and pigments.

HCD will need to obtain information on all of these additives as well as the underlying manufacturing process and the chemicals that uses. The information is essential for HCD to be able to appraise the potential for chemical leaching and to evaluate factors that may affect mechanical stability and performance of the plumbing system.

Plastic Pipe History

HCD can draw on the past CEQA process for plastic pipe approvals to determine the kind of information which will be necessary to support its considerations of PEX. The CEQA process for plastic pipe considered polybutylene (PB) and chlorinated poly vinyl chloride (CPVC). Although PEX pipe existed in Europe and for certain specialty, non-potable water applications in the United States, PEX was not included in the EIR because of its greater cost relative to the other plastic pipe alternatives and because of the lack of PEX industry participation in the EIR or the chemical leaching tests that were conducted by the state. PEX was not exempted from the past EIR – it was not considered relevant to the California marketplace and hence was not part of the "project".

A proprietary system of PEX tubing and fasteners was proposed for local approval in Los Angeles in 1994, but was not adopted. In the Los Angeles proceeding, requests were made of the manufacturer for disclosure of the cross linking process and the additives in the pipe grade resin. As far as I am able to tell, none of this information was actually provided, and the local approval request was terminated.

During the HCD plastic pipe environmental review process, PB pipe was demonstrated to have significant mechanical stability defects. We developed some of the information

about oxidant degradation of polyolefins that was relevant to the exposure of PB pipe to high levels of residual chlorine and the potable water supply. The prediction of mechanical failure arose from the emphasis that we placed on disclosure of the antioxidant additives that needed to be included in the pipe resin to resist degradation.

Antioxidants function sacrificially. When the pipe resin containing the antioxidant is exposed to an oxidizer (chlorine or oxygen), the antioxidant molecules are preferentially degraded, thereby protecting the polymer molecule itself. Depending on the aggressiveness of oxidizer exposure and environmental conditions, the antioxidant additive in the pipe resin may be consumed rapidly. When the antioxidant is consumed, the polymer itself will be attacked with resulting polymer chain breakage, ensuing loss of strength and brittleness, and ultimately, premature mechanical failure.

This happened to PB pipe. Although touted by the manufacturer as having a lifetime of 50 years or more, some PB installations failed in 5 to 15 years with devastating results for the consumer. Shell Chemical, the major PB manufacture, pulled out of North America with liability exceeding one billion dollars. PEX manufacturers obviously seek to distance themselves from the PB pipe fiasco. HCD should insist, however, that PEX manufacturers provide full information about the antioxidant system used for PEX to show that the failures from PB could not happen with PEX. If the same antioxidant system is being used for PEX as was used for PB, then there needs to be an explanation. The state is being offered the same story with PEX as with PB: "this plastic pipe is used everywhere but California with no problems", but something in the environmental conditions in the arid lands from Southern California and Arizona to Texas caused failures that had not been experienced elsewhere.

Environmental Issues

Several environmental issues are readily identifiable that are relevant to plastic pipe and specifically to PEX. Foremost among these is the concern for public health which includes chemical leaching from the pipe and permeation of the pipe by contaminants in the environment. Based on the PB experience, there is a real concern for consumer protection and reliability of the pipe system. There are also potential issues for fire safety, solid waste management, and air and water quality.

Public Health

Chemical leaching is a complex problem to assess. Obviously, HCD would need to begin with a complete disclosure of the composition of all forms of PEX which may be used in California. This means PEX classes A, B, and C, as described above. HCD would need to identify the potential health risk associated with these chemicals and then assess their potential to be leached into the potable water carried by a PEX pipe. Chemical leaching would also need to take into account breakdown products from

antioxidants and other substances that may be formed in the pipe by reaction with chlorine in the water supply.

PEX plastic pipe manufacturers have not made a disclosure of the necessary information to the state. We can derive a sense of what the leaching problems may be from available sources, but these are not definitive. NSF International, a private code organization, uses ANSI/NSF Standard 61 to certify plumbing materials for health effects in drinking water. NSF certification does not to fulfill HCD's requirements for disclosure under CEQA, as explained later in this letter, but NSF does provide some insight into the chemical leaching potential for PEX.

NSF Table 3.1, Material-specific analyses,, has a "Required Analysis" for "cross linked polyethylene" that includes "GC/MS, VOCs, regulated metals, phenolics (by GC/MS base/acid scan), methanol, and tert-butyl alcohol" NSF 61 (adopted Feb 9, 2001), page 8, with a footnote, "tert-Butyl alcohol analysis is required for PEX materials except those cross-linked via e-beam methodology." (Published text corrected, pers. comm. Jane M. Wilson, M.P.H., Senior Project Manager, Water and Environmental Standards, NSF International, July 20, 2001).

NSF does not normally disclose the results of testing, therefore we have no idea of what compounds have actually been detected by NSF tests for chemical leaching from PEX. The material-specific analyses required give an indication of the kind of information which HCD should seek in order to define the potential public health impact of adopting PEX in California.

Advertising literature from PEX manufacturers also suggests chemical leaching issues. Manufacturers using the PEX-C irradiation process predictably cite the public health benefit of not requiring cross linking chemical additives. The manufacturers of Merflex PEX-C Riser/Supply Tube state, "We have adopted the proven European technology for cross-linking with radiation, avoiding the potential problem of toxicity that is a critical issue in regards to potable water." (http://www.mercuryplastics.com/merf.htm). On the other hand, a manufacturer using the PEX-B silane method claims, "There is available Witco declaration of silane utilised in XLPE [PEX] formulation approved for drinking water pipes unter Eu Directive 90/128/EEC concerning SILQUEST A-171 silane." (http://www.interplast.gr/En/products/como-pex).

Permeation is the phenomenon where relatively low molecular weight substances migrate through a seemingly solid polymer barrier. Permeation is a concern where the ground and groundwater are contaminated with petroleum compounds, with the gasoline additive MTBE, or with pesticides, particularly termiticides. Although most domestic plumbing will be within the structure itself, the approval considered by HCD includes external exposure from the water metered to the structure or under slab for

slab on grade home construction. The latter is a particular concern because of the requirement for treating the sub-slab soil with termiticides in some geographic locations. HCD should request and review laboratory or field test data for PEX permeation. Note that the different types of PEX have different chemical cross-linking characteristics and would be expected to have different permeation behavior.

Consumer Protection and Reliability

Premature mechanical failure of plastic pipe is both a consumer protection and an environmental issue. It is difficult, disruptive, and expensive to replace a plumbing system that has failed. The failed pipe system leaves a homeowner without water, may physically damage the structure and furnishings, and may create conditions in the walls leading to mold which can produce indoor air quality health impacts.

HCD needs to consider the mechanical reliability of the PEX systems that may be used in California. The different crosslinking mechanisms, PEX-A, B, and C, vary in the degree of crosslinking from 40 percent to 90 percent, with corresponding differences in mechanical stability. Although all of the pipe resins may pass ASTM when freshly manufactured, it is possible that different resin systems will react differently to antioxidant depletion and hence behave differently in actual use.

The PB experience is relevant here. Although PEX is not PB, the chemical similarities are enough that HCD should demand more than just marketing literature to assure that mechanical reliability will be adequate. PEX manufacturers apparently claim a 50-year product life, but offer no more than a ten-year warranty on the product.

Fire Safety

The substitution of a plastic product for a metal product poses the obvious concern for fire safety. The plastic pipe carrying water is not likely to be flammable, but exposed to heat in a fire, the plastic pipe will rapidly rupture, draining or de-pressurizing the system and creating openings in wall studs which may encourage fire spread.

The model code attempts to address some of these concerns by requiring fire stopping at pipe penetrations. It would be appropriate for HCD to seek comment by California fire officials on the likely efficacy of these fire prevention mechanisms, particularly in the light of the high seismic activity and associated risk of structure fire in most of the state.

Other Environmental Issues

Several other environmental issues warrant consideration. Solid waste management is important to California. Construction waste and demolition debris are a major portion of the waste stream and much effort has been made in the past 10 years to increase the

amount of construction materials that can be re-cycled and diverted from the landfill. Copper piping is eminently recyclable. There is currently no recycle market for PEX and due to the effect of crosslinking, is unlikely that PEX waste could be used in remanufacturing PEX pipe or any other useful product. Considering the extent of California solid waste legislation and regulation, this subject deserves explicit consideration by HCD.

A complete treatment under CEQA would also consider the air quality effects of manufacturing, installation, and use of plastic pipe and potential water quality effects of chemical leaching as well.

State CEQA Compliance

The state's past involvement in CEQA review of plastic pipe clearly identifies the subject material to be addressed. In addition, specific information about PEX shows that most of these areas of past concern also need present investigation. At a minimum, HCD needs to go through the initial steps of CEQA compliance: defining the project, gathering information and making a preliminary determination through a formal initial study.

Project definition will be difficult for HCD, particularly if there is little cooperation from PEX manufacturers. As noted earlier, it will be necessary for HCD to obtain information on all three primary forms of PEX in the potential California marketplace.

Although manufacturers and NSF International are logical sources of information, it will be necessary for HCD to establish its own capacity for independent review as required by CEQA. The state may be able to find much of the necessary expertise in California EPA; in some cases it may be necessary to obtain expertise outside of state government.

The potential environmental impact from chemical leaching or mechanical failure is obvious. Standards organizations and certification processes can help limit that potential impact, and HCD can make use of those third parties in devising its own requirements for mitigation. The obligation for mitigation, however, remains with HCD. For that reason HCD needs to make sure that it has adequate technical resources available to be able to independently verify that third party standards and certification are adequate.

State Cannot Rely on NSF Alone

NSF International (formerly the National Sanitation Foundation) has emerged as the premier private standards organization dealing with plumbing. NSF operates a voluntary certification program and grants participants the right to use the NSF logo on

their products. The NSF certification involves compliance with mechanical standards and health standards. For this reason, most code organizations require products to have the NSF certification.

The issue of the state of California relying on NSF has arisen in the past in the debate over the use of plastic pipe in California. NSF performs a valuable role, but the state of California cannot delegate to NSF its own obligation for public health and environmental protection. The state of California needs to exercise its independent judgment in the course of CEQA compliance. The state can obtain information from third parties, but the state alone needs to determine the sufficiency and accuracy of that information, and the state needs to make that information available to the public so that the public may be assured that the environmental process has been conducted completely and thoroughly.

The state cannot rely on the NSF certification process to assure the protection of public health because:

1) NSF disclaims responsibility and specifically disallows governmental reliance on its standards.
2) NSF does not release the results of tests on the materials it certifies.
3) NSF's testing protocols may not be adequate to determine the potential for chemical leaching.

NSF 61 contains strong disclaimers of responsibility:

"Disclaimers

"NSF International (NSF): in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of NSF represent its professional judgment. NSF shall not be responsible to anyone for the use of or reliance upon this standard by anyone. NSF shall not incur any obligations or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

"Participation in NSF's standards development activities by a representative of a regulatory agency (Federal, state, local) shall not be construed as the agency's endorsement of NSF, its policies, or any of its standards.

"NSF standards provide basic criteria to promote and protect public health. Provisions for safety have not been included in this standard because governmental agencies or other national standards-setting organizations provide safety requirements." (ANSI/NSF 61, page iii)

Standard 61 further advises, "Final acceptance of a product for drinking water application is the responsibility of the appropriate federal, state, or local regulatory agent." (NSF 61, Section 1.4, p. 3, Footnote 8). This disclaimer creates a logical inconsistency: the proposed code adoption would require PEX used in California to be an NSF listed product, but NSF 61 states that acceptance of the product is ultimately the responsibility of the state. In order for "final acceptance" to be the responsibility of the state, the state must have upon hand and available to the public all of the information on which that acceptance is based.

Although NSF is in a position to provide the needed information, the current corporate structure of NSF treats nearly all information on chemical leaching and health effects as confidential and does not make this information available to the public or the public agencies.

The same problem applies to the testing protocols themselves. NSF makes certain assumptions and limits the scope of its testing based on information submitted by manufacturers. This information, too, is maintained in secret so that the a public agency cannot determine for itself whether the testing conducted by NSF is indeed capable of detecting potential hazards to public health and they were present.

The state has substantial expertise in public health, toxicology, worker safety, and water quality. The citizens and the legislature have relied on state agencies to determine what standards should apply and frequently, California has set higher standards for health protection than were required by the federal government. Thus, it is appropriate for California to examine how NSF sets the Single Product Allowable Concentration (SPAC) for regulated and unregulated contaminants (Annex D of NSF 61), how the test results are scaled by assumptions of dilution in actual use, and how products exceeding the SPAC can still be certified. NSF's SPAC should be compared with California's own lists of action substances, such as those listed pursuant to California's Proposition 65, The Safe Drinking Water &;Toxic Enforcement Act of 1986.

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In closing, I offer the perspective of a CEQA practitioner since 1972. Governmental agencies frequently find themselves confronted with unusual projects and the need to comply with CEQA. The complexity of the project and the difficulty of obtaining information are challenges that can be successfully overcome. Sometimes the hardest part is for the agency to convince the private applicants, the ultimate beneficiaries of agency action, to cooperate fully in the process of public disclosure and assessment.

HCD needs to rapidly recognize CEQA's applicability to code approval of PEX and place the burden of disclosure squarely on industry and industry associates such as NSF. Lack of information, or, more particularly, lack of industry cooperation, is not a

valid reason to shortchange the CEQA process.

Sincerely,

Thomas S. Reid