Sengupta, Abhijit

From: Miller, Craig L [Craig.Miller@pgnmail.com]
Sent: Friday, January 22, 2010 8:53 AM
To: Lake, Louis; Thomas, George; Carrion, Robert; 'nausdj@ornl.gov'; Souther, Martin; 'trowe@wje.com'
Cc: Williams, Charles R.
Subject: FW: Failure Mode 5.3 Ready for Review
Attachments: FM 5.3.Maintenance.pdf; FM 5.3 Exhibit 3 - Item #101 - Purity of pressure washing water-1.pdf; FM 5.3 Exhibit 1 - Interviews regarding Maintenance -1.pdf; FM 5.3 Exhibit 2 - ACI 515.1R deleterious chemicals-1.pdf

Mr. Lake and others,

Attached for your review is the draft of FM 5.3 and its exhibits. If you have any questions, please contact Charles Williams or myself.

Thank you,

Craig Miller

From: Dave Brevig [mailto:dave.brevig@gmail.com]
Sent: Thursday, January 21, 2010 5:50 PM
To: Williams, Charles R.; Miller, Craig L
Cc: avi mor; patrick berbon; dave.brevig@cox.net; Gary Hughes
Subject: Failure Mode 5.3 Ready for Review

To Charles and Craig, Failure Mode 5.3 has been approved by Dr Chiu and is provided for Progress Energy review...dave

P/83

5.3 Chemicals Introduced During Routine Maintenance

Description:

Routine maintenance of industrial structures can involve the application of deleterious materials, including solvents, cleaning agents, or aggressive water.

ACI committee 515 compiled a list of potential deleterious materials, most of which are either harmless to good quality concrete, require high concentrations, will only attack porous concrete, and/or must be dissolved in water in order to penetrate the concrete. The issue of chemical attack is addressed in another Failure Mode (FM 5.8).

This document is intended to identify any materials used in maintenance of the concrete shell and determine if these materials could have damaged the concrete.

Data to be collected and Analyzed:

1. Interview maintenance personnel regarding practices that might affect the concrete (FM 5.3 Exhibit 1and 3).
2. Review and analyze information regarding possible deleterious materials (FM 5.3 Exhibit 2 is the comprehensive list of potential harmful chemicals compiled by ACI 515).

Verified Supporting Evidence: None

Verified Refuting Evidence:

a. Interviews with personnel of Crystal River 3 (CR3) reveal that no chemicals were applied to the concrete during regular maintenance.

Conclusion: Maintenance did not involve application of any chemicals to the concrete and was not a contributing factor to the delamination.

1 page

DRAFT 1

1 page

Item 101 – Water purity during pressure washing

Per discussion with Tommie Sassard (Maintenance/Facilities Supervisor), CR3 does not/has not pressure washed the outside of the reactor building.

1 page

1/20/2010 Interview with Richard Portmann(Tendon Engineer) and Richard Pipin(Maintenance Manager)

Interviewer: Gary Hughes PII

Maintenance Issues

- Added Linseed oil to the Dome when damaged in1976(Documents provided to Dr. Avi Mor)
- Have grease leaching out under equipment hatch- no idea where coming from and have not treated it- pictures in Concrete- tendon Interaction #74 Grease below equipment hatch.
- Wax initially in sleeves
- Do not power wash per PII information request 101 from Tommie Sassard.
- No PMs to do any cleaning of the containment

Grease Issues

- Add Visconorust 2090-p4 grease to tendons per F&Q 17.0 'Grease Replacement"
- F&Q 17.0 has provisions to report to the NRC if specifically add more grease than take out.
- Have grease leaching out under equipment hatch- no idea where coming from and have not treated it- pictures in Concrete- tendon Interaction #74 Grease below equipment hatch-work order has been written and will be worked soon
- Over the years adding higher density grease to reduce grease loss. Added more to vertical tendons a few years ago to make up for losses. Thought losses were grease settling at the bottom or oil separating from the grease

ACI 515.1 R-79
(Revised 1985)

A Guide to the Use of Waterproofing, Dampproofing, Protective, and Decorative Barrier Systems for Concrete

Reported by ACI Committee 515

Byron I. Zolin, Chairman

Warner K. Babcock
Arthur E. Blackman, Sr.
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The revising committee is listed at the end of the document.

This Guide updates and expands the scope of the committee report "Guide for the Protection of Concrete Against Chemical Attack by Means of Coatings and Other Corrosion Resistant Materials," which appeared in the December 1996 ACI JOURNAL. The previous Guide has been revised and is found in Chapter 6 of this Guide entitled "Protective Barrier Systems." In addition, there are new chapters on "Waterproofing Barrier Systems," "Dampproofing Barrier Systems," and "Decorative Barrier Systems." A separate chapter on conditioning and surface preparation of concrete is included because it is relevant to all the other chapters.

This Guide is not to be referenced as a complete unit.

Keywords: abrasive blasting; acid treatment (concrete); acid resistance; adhesion; asphalts; chemical attack; chemical cleaning; **coatings;** concrete bricks; concretes; detergents; emulsifying agents; epoxy resins; **finishes;** furan resins; glass fibers; inspection; joint sealers; latex (rubber); mortars [materials); paints; phenolic resins; plastics, polymers, and resins; polyester resins; polyurethane resins; **protective coatings;** repairs; sealers; silicates; sulfur; surfactants; temperature; tests; vaporbarriers; **waterproofing.**

Foreword

ACI Committee 515 was organized in 1936 and published a report "Guide for the Protection of Concrete Against Chemical Attack by Means of Coatings and Other Corrosion Resistant Materials," in the December 1966 ACI JOURNAL. William H. Kuenning was chairman when this Guide was published. Albert M. Levy was chairman from 1974 to 1977 when some of the information, found in the chapters on "Waterproofing Barrier Systems" and "Dampproofing Barrier Systems," was developed.

CONTENTS

Table 2.5.2-Effect of chemicals on concrete (see end of Table 2.5.2 for special notations)

Material	Effect
*Acetic acid, all concentrations	Disintegrates slowly
Acetone	Liquid loss by penetration. May contain acetic acid as impurity (which see)
Acid waters (pH of 6.5 or less) (a)	Disintegrates slowly. In porous or cracked concrete, attacks steel
*Alcohol	See ethyl alcohol, methyl alcohol
Alizarin	Not harmful
*Almond oil	Disintegrates slowly
*Alum	See potassium aluminum sulfate
Aluminum chloride	Disintegrates rapidly. In porous or cracked concrete, attacks steel
*Aluminum sulfate	Disintegrates. In porous or cracked concrete, attacks steel
*Ammonia, liquid	Harmful only if it contains harmful ammonium salts (see below)
Ammonia vapors	May disintegrate moist concrete slowly or attack steel in porous or cracked moist concrete
Ammonium bisulfate	Disintegrates. In porous or cracked concrete, attacks steel
Ammonium carbonate	Not harmful
*Ammonium chloride	Disintegrates slowly. In porous or cracked concrete, attacks steel
Ammonium cyanide	Disintegrates slowly
Ammonium fluoride	Disintegrates slowly
Ammonium hydroxide	Not harmful
Ammonium nitrate	Disintegrates. In porous or cracked concrete, attacks steel
Ammonium oxalate	Not harmful
*Ammonium sulfate	Disintegrates. In porous or cracked concrete, attacks steel
Ammonium sulfide	Disintegrates
Ammonium sulfite	Disintegrates
Ammonium superphosphate	Disintegrates. In porous or cracked concrete, attacks steel
Ammonium thiosulfate	Disintegrates
Animal wastes	See slaughter house wastes
Anthracene	Not harmful
Arsenious acid	Not harmful
Ashes	Harmful if wet, when sulfides and sulfates leach out (see sodium sulfate)
Ashes, hot	Cause thermal expansion
Automobile and diesel exhaust gases (n)	May disintegrate moist concrete by action of carbonic, nitric, or sulfurous acid
*Baking soda	See sodium bicarbonate
Barium hydroxide	Not harmful
Bark	See tanning bark
*Beef fat	Solid fat disintegrates slowly, melted fat more rapidly
*Beer	May contain, as fermentation products, acetic, carbonic, lactic, or tannic acids (which see)
Benzol (benzene]	Liquid loss by penetration
Bleaching solution	See specific chemical, such as hypochlorous acid, sodium hypochlorite, sulfurous acid, etc.
*Borax	Not harmful
*Boric acid	Negligible effect
*Brine	See sodium chloride or other salt
Bromine	Gaseous bromine disintegrates. Liquid bromine disintegrates if it contains hydrobromic acid and moisture
*Buttermilk	Disintegrates slowly
Butyl stearate	Disintegrates slowly
Calcium bisulfite	Disintegrates rapidly
*Calcium chloride	In porous or cracked concrete, attacks steel. (b) Steel corrosion may cause concrete to spall
*Calcium hydroxide	Not harmful
Calcium nitrate	Not harmful
*Calcium sulfate	Disintegrates concrete of inadequate sulfate resistance
Carbazole	Not harmful
Carbolic acid	See phenol
*Carbon dioxide	Gas may cause permanent shrinkage (see also carbonic acid)
*Carbon disulfide	May disintegrate slowly
*Carbon tetrachloride	Liquid loss by penetration of concrete
*Carbonic acid	Disintegrates slowly (c)

Table 2.5.2-(Continued)

Material	Effect
Castor oil	Disintegrates, especially in presence of air
Chile saltpeter	See sodium nitrate
China wood oil	Liquid disintegrates slowly.
Chlorine gas	Slowly disintegrates moist concrete
Chrome plating solutions (o)	Disintegrates slowly
Chromic acid, all concentrations	Attacks steel in porous or cracked concrete
Chrysen	Not harmful
*Cider	Disintegrates slowly (see acetic acid]
Cinders	Harmful if wet, when sulfides and sulfates leach out (see, for example, sodium sulfate)
Cinders, hot	Cause thermal expansion
Coal	Sulfides leaching from damp coal may oxidize to sulfurous or sulfuric acid, or ferrous sulfate (which see)
Coal tar oils	See anthracene, benzol, carbazole, chrysen; creosote, cresol, cumol, paraffin, phenanthrene, phenol, toluol, xylol
Cobalt sulfate	Disintegrates concrete of inadequate sulfate resistance
*Cocoa bean oil	Disintegrates, especially in presence of air
*Cocoa butter	Disintegrates, especially in presence of air
Coconut oil	Disintegrates, especially in presence of air
*Cod liver oil	Disintegrates slowly
Coke	Sulfides leaching from damp coke may oxidize to sulfurous or sulfuric acid (which see]
Copper chloride	Disintegrates slowly
Copper plating solutions (p)	Not harmful
Copper sulfate	Disintegrates concrete of inadequate sulfate resistance
Copper sulfide	Harmful if it contains copper sulfate (which see)
*Corn syrup	Disintegrates slowly
Corrosive sublimate	See mercuric chloride
*Cottonseed oil	Disintegrates, especially in presence of air
Creosote	Phenol present disintegrates slowly
Cresol	Phenol present disintegrates slowly
Cumol	Liquid loss by penetration
Deicing salts	Scaling of non-air-entrained or insufficiently aged concrete (b)
Diesel gases	See automobile and diesel exhaust gases
Dinitrophenol	Disintegrates slowly
Distiller's slop	Lactic acid causes slow disintegration
Epsom salt	See magnesium sulfate
*Ethyl alcohol	Liquid loss by penetration
*Ethyl ether	Liquid loss by penetration
*Ethylene glycol	Disintegrates slowly (d)
Feces	See manure
*Fermenting fruits, grains, vegetables, or extracts	Industrial fermentation processes produce lactic acid. (e) Disintegrates slowly (see lactic acid)
Ferric chloride	Disintegrates slowly
Ferric nitrate	Not harmful
Ferric sulfate	Disintegrates concrete of inadequate quality
Ferric sulfide	Harmful if it contains ferric sulfate (which see)
Ferrous chloride	Disintegrates slowly
Ferrous sulfate	Disintegrates concrete of inadequate sulfate resistance
Fertilizer	See ammonium sulfate, ammonium superphosphate, manure, potassium, nitrate, sodium nitrate
Fish liquor	Disintegrates (f)
*Fish oil	Disintegrates slowly
Flue gases	Hot gases (400-1100 F) cause thermal stresses. Cooled, condensed sulfurous, hydrochloric acids disintegrate slowly
Foot oil	Disintegrates slowly
*Formaldehyde, 37 percent	Formic acid, formed in solution, disintegrates slowly
Formalin	See formaldehyde

Table 2.5.2-(Continued)

Material	Effect
*Formic acid, 10 percent	Disintegrates slowly
*Formic acid, 30 percent	Disintegrates slowly
*Formic acid, 90 percent	Disintegrates slowly
*Fruit juices	Hydrofluoric, other acids, and sugar cause disintegration (see also fermenting fruits, grains, vegetables, extracts)
Gas water (g)	Ammonium salts seldom present in sufficient quantity to disintegrate
Gasoline	Liquid loss by penetration
*Glucose	Disintegrates slowly
*Glycerine	Disintegrates slowly
*Grain	See fermenting fruits, grains, vegetables, extracts
*Honey	Not harmful
Horse fat	Solid fat disintegrates slowly, melted fat more rapidly
Humic acid	Disintegrates slowly
*Hydrochloric acid, all concentrations	Disintegrates rapidly, including steel
Hydrofluoric acid, all concentrations	Disintegrates rapidly, including steel
Hydrogen sulfide	Not harmful dry. In moist, oxidizing environments converts to sulfurous acid and disintegrates slowly
Hypochlorous acid, 10 percent	Disintegrates slowly
Iodine	Disintegrates slowly
Kerosene	Liquid loss by penetration of concrete
*Lactic acid, 5-25 percent	Disintegrates slowly
*Lamb fat	Solid fat disintegrates slowly, melted fat more rapidly
*Lard and lard oil	Lard disintegrates slowly, lard oil more rapidly
Lead nitrate	Disintegrates slowly
Lead refining solutions (q)	Disintegrates slowly
Leuna saltpeter	See ammonium nitrate and ammonium sulfate
Lignite oils	If fatty oils are present, disintegrates slowly
*Linseed oils	Liquid disintegrates slowly. Dried or drying films are harmless
Locomotive gases (r)	May disintegrate moist concrete by action of carbonic, nitric or sulfurous acids (see also automobile and diesel exhaust gases)
Lubricating oil	Fatty oils, if present, disintegrate slowly
Lye	See sodium hydroxide
Machine oil	Fatty oils, if present, disintegrate slowly
*Magnesium chloride	Disintegrates slowly. In porous or cracked concrete, attacks steel
Magnesium nitrate	Disintegrates slowly
*Magnesium sulfate	Disintegrates concrete of inadequate sulfate resistance
Manganese sulfate	Disintegrates concrete of inadequate sulfate resistance
Manure	Disintegrates slowly
*Margarine	Solid margarine disintegrates slowly, melted margarine more rapidly
Mash, fermenting	Acetic and lactic acids, and sugar disintegrate slowly
Mercuric chloride	Disintegrates slowly
Mercurous chloride	Disintegrates slowly
Methyl alcohol	Liquid loss by penetration
Methyl ethyl ketone	Liquid loss by penetration
Methyl isobutyl ketone	Liquid loss by penetration
*Milk	Not harmful. However, see sour milk
Mine water, waste	Sulfides, sulfates, or acids present disintegrate concrete and attack steel in porous-or cracked concrete
*Mineral oil	Fatty oils, if present, disintegrate slowly
Mineral spirits	Liquid loss by penetration
*Molasses	At temperatures $\geq$ 120 F, disintegrates slowly
Muriatic acid	See hydrochloric acid
*Mustard oil	Disintegrates, especially in presence of air
Nickel plating solutions (v)	Nickel ammonium sulfate disintegrates slowly

Table 2.5.2-(Continued)

Material	Effect
Nickel sulfate	Disintegrates concrete of inadequate sulfate resistance
Niter	See potassium nitrate
Nitric acid, all concentrations	Disintegrates rapidly
*Oleic acid, 100 percent	Not harmful
Oleum	See sulfuric acid, 110 percent
*Olive oil	Disintegrates slowly
Ores	Sulfides leaching from damp ores may oxidize to sulfuric acid or ferrous sulfate (which see)
Oxalic acid	Not harmful. Protects tanks against acetic acid, carbon dioxide, salt water. Poisonous. Do not use with food or drinking water
Paraffin	Shallow penetration not harmful, but should not be used on highly porous surfaces like concrete masonry (u)
*Peanut oil	Disintegrates slowly
Perchloric acid, 10 percent	Disintegrates
Perchloroethylene	Liquid loss by penetration
Petroleum oils	Liquid loss by penetration. Fatty oils, if present, disintegrate slowly
Phenanthrene	Liquid loss by penetration
Phenol, 5-25 percent	Disintegrates slowly
*Phosphoric acid, 10-85 percent	Disintegrates slowly
*Pickling brine	Attacks steel in porous or cracked concrete
Pitch	Not harmful
*Poppy seed oil	Disintegrates slowly
*Potassium aluminum sulfate	Disintegrates concrete of inadequate sulfate resistance
*Potassium carbonate	Harmless unless potassium sulfate present (which see)
*Potassium chloride	Magnesium chloride, if present, attacks steel in porous or cracked concrete
Potassium cyanide	Disintegrates slowly
Potassium dichromate	Disintegrates
Potassium hydroxide, 15 percent	Not harmful (h)
Potassium hydroxide, 25 percent or over	Disintegrates concrete
*Potassium nitrate	Disintegrates slowly
Potassium permanganate	Harmless unless potassium sulfate present (which see)
Potassium persulfate	Disintegrates concrete of inadequate sulfate resistance
Potassium sulfate	Disintegrates concrete of inadequate sulfate resistance
Potassium sulfide	Harmless unless potassium sulfate present (which see)
Pyrites	See ferric sulfide, copper sulfide
*Rapeseed oil	Disintegrates, especially in presence of air
Rock salt	See sodium chloride
Rosin	Not harmful
Rosin oil	Not harmful
Sal ammoniac	See ammonium chloride
Sal soda	See sodium carbonate
Salt for deicing roads	See text. Also calcium chloride, magnesium chloride, sodium chloride
Saltpeter	See potassium nitrate
*Sauerkraut	Flavor impaired by concrete. Lactic acid may disintegrate slowly
Sea water	Disintegrates concrete of inadequate sulfate resistance. Attacks steel in porous or cracked concrete
Sewage	Usually not harmful (see hydrogen sulfide]
Silage	Acetic, butyric, lactic acids (and sometimes fermenting agents of hydrochloric or sulfuric acids) disintegrate slowly
Slaughter house wastes (w)	Organic acids disintegrate
Sludge	See sewage, hydrogen sulfide
Soda water	See carbonic acid
*Sodium bicarbonate	Not harmful
Sodium bisulfate	Disintegrates
Sodium bisulfite	Disintegrates
Sodium bromide	Disintegrates slowly

Table 2.5.2-(Continued)

Material	Effect
Sodium carbonate	Not harmful, except to calcium aluminate cement
*Sodium chloride	Magnesium chloride, if present, attacks steel in porous or cracked concrete. (b) Steel corrosion may cause concrete to spall
Sodium cyanide	Disintegrates slowly
Sodium dichromate	Dilute solutions disintegrate slowly
*Sodium hydroxide, 1-10 percent	Not harmful (h)
*Sodium hydroxide, 20 percent or over	Disintegrates concrete
Sodium hypochlorite	Disintegrates slowly
*Sodium nitrate	Disintegrates slowly
Sodium nitrite	Disintegrates slowly
Sodium phosphate (monobasic)	Disintegrates slowly
Sodium sulfate	Disintegrates concrete of inadequate sulfate resistance
Sodium sulfide	Disintegrates slowly
*Sodium sulfite	Sodium sulfate, if present, disintegrates concrete of inadequate sulfate resistance
Sodium thiosulfate	Slowly disintegrates concrete of inadequate sulfate resistance
*Sour milk	Lactic acid disintegrates slowly
*Soybean oil	Liquid disintegrates slowly. Dried or drying films harmless
Strontium chloride	Not harmful
*Sugar	Disintegrates slowly
Sulfite liquor	Disintegrates
Sulfite solution	See calcium bisulfite
*Sulfur dioxide	With moisture forms sulfurous acid (which see)
*Sulfuric acid, 10-80 percent	Disintegrates rapidly
*Sulfuric acid, 80 percent oleum	Disintegrates
Sulfurous acid	Disintegrates rapidly
Tallow and tallow oil	Disintegrates slowly
Tannic acid	Disintegrates slowly
Tanning bark	May disintegrate slowly if damp (see tanning liquor)
Tanning liquor	Disintegrates, if acid
*Tartaric acid solution	Not harmful
Tobacco	Organic acids, if present, disintegrate slowly
Toluol (toluene)	Liquid loss by penetration
*Trichloroethylene	Liquid loss by penetration
*Trisodium phosphate	Not harmful
Tung oil	Liquid disintegrates slowly. Dried or drying films are harmless
Turpentine	Mild attack. Liquid loss by penetration
*Urea	Not harmful
Urine	Attacks steel in porous or cracked concrete
Vegetables	See fermenting fruits, grains, vegetables, extracts
Vinegar	Disintegrates slowly (see acetic acid)
Walnut oil	Disintegrates slowly
*Whey	Disintegrates slowly (see lactic acid)
*Wine	Not harmful. Necessary to prevent flavor contamination
Wood pulp	Not harmful
Xylol (xylene)	Liquid loss by penetration
*Zinc chloride	Disintegrates slowly
Zinc nitrate	Not harmful
Zinc refining solutions (x)	Hydrochloric or sulfuric acids, if present, disintegrate concrete
Zinc slag	Zinc sulfate (which see) sometimes formed by oxidation
Zinc sulfate	Disintegrates slowly

Key to special notations-Table 2.5.2

*	Sometimes used in food processing or as food or beverage ingredient. Ask for advisory opinion of Food and Drug Administration regarding coatings for use with food ingredients.
a	Waters of pH higher than 6.5 may be aggressive if they also contain bicarbonates. (Natural waters are usually of pH higher than 7.0 and seldom lower than 6.0, though pH values as low as 0.4 have been reported. For pH values below 3, protect as for dilute acid.)
b	Frequently used as a deicer for concrete pavements. If the concrete contains too little entrained air or has not been aged more than one month, repeated application may cause surface scaling. For protection under these conditions, see "deicing salts."
c	Carbon dioxide dissolves in natural waters to form carbonic acid solutions. When it dissolves to extent of 0.9 to 3 parts per million it is destructive to concrete.
d	Frequently used as deicer for airplanes. Heavy spillage on runway pavements containing too little entrained air may cause surface scaling.
e	In addition to the intentional fermentation of many raw materials, much unwanted fermentation occurs in the spoiling of foods and food wastes, also producing lactic acid.
f	Contains carbonic acid, fish oils, hydrogen sulfide, methyl amine, brine, other potentially reactive materials.
g	Water used for cleaning coal gas.
h	However, in those limited areas of the United States where concrete is made with reactive aggregates, disruptive expansion may be produced.
n	Composed mostly of nitrogen, oxygen, carbon dioxide, carbon monoxide, and water vapor. Also contains unburned hydrocarbons, partially burned hydrocarbons, oxides of nitrogen, and oxides of sulfur. Nitrogen dioxide and oxygen in sunlight may produce ozone, which reacts with some of the organics to produce formaldehyde, peracylnitrates, and other products.
o	These either contain chromium trioxide and a small amount of sulfate, or ammonium chromic sulfate [nearly saturated) and sodium sulfate.
p	Many types of solutions are used, including (a) Sulfate-Contain copper sulfate and sulfuric acid. (b) Cyanide-Contain copper and sodium cyanides and sodium carbonate. (c) Rochelle-Contain these cyanides, sodium carbonate, and potassium sodium tartrate. (d) Others such as fluoborate, pyrophosphate, amine, or potassium cyanide.
q	Contains lead fluosilicates and fluosilicic acid.
r	Reference here is to combustion of coal, which produces carbon dioxide, water vapor, nitrogen, hydrogen, carbon monoxide, carbohydrates, ammonia, nitric acid, sulfur dioxide, hydrogen sulfide, soot, and ashes.
u	Porous concrete which has absorbed considerable molten paraffin and then been immersed in water after the paraffin has solidified has been known to disintegrate from sorptive forces.
v	Contains nickelous chloride, nickelous sulfate, boric acid, and ammonium ion.
w	May contain various mixtures of blood, fats and oils, bile and other digestive juices, partially digested vegetable matter, urine, and manure, with varying amounts of water.
x	Usually contains zinc sulfate in sulfuric acid. Sulfuric acid concentration may be low (about 6 percent in "low current density" process) or higher (about 22-28 percent in "high current density" process).