New AMR Line-items based on new ‘MEAP’ combinations:

- Aluminum/concrete/none/none
- Aluminum/dried air (int.)/none/none
- Aluminum/lubricating oil/reduction of heat transfer/XI.M39
- Aluminum/lubricating oil/loss of material/XI.M39
- Asbestos cement/raw water/cracking, loss of material, changes in material properties/XI.M20
- Asbestos cement/air-indoor/ cracking, loss of material, changes in material properties/XI.M36
- Asbestos cement/soil/ cracking, loss of material, changes in material properties/XI.M36
- Bolting Preload/various materials/various environments/loss of preload/XI.M18
- Copper alloy/air indoor uncontrolled (int.)/none/none
- Copper alloy/air outdoor (ext.)/ loss of material/XI.M36
- Copper alloy, stainless steel/potable water/loss of material/XI.M38
- Glass/various environments/none/none
- Nickel Alloys/air with borated water leakage/none/none
- Stainless steel/air indoor uncontrolled (int.)/none/none
- Stainless steel/air outdoor (absence saltwater or aggressive environment)/ none/none
- Stainless steel/air outdoor (saltwater or aggressive environment)/loss of material/XI.M36
- Stainless steel/air outdoor (saltwater or aggressive environment)/loss of material/XI.M18
- Steel (fire hydrants)/air-outdoor/loss of material/XI.M27
- Steel (Halon, CO2 components)/air-indoor/loss of material/XI.M26
- Steel/soil, concrete/loss of material/XI.M29
- Titanium/raw water/none/none
- Titanium/raw water/reduction of heat transfer/XI.M20
- Titanium/ air-indoor/none/none

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
VII.J-x, V.F-x	Piping, piping components and piping elements	Stainless steel	Air – Indoor uncontrolled (int)	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in NUREG-1801 Vol. 2 line item VII.J-15 stainless steel in an indoor, uncontrolled air (ext) environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. The only difference in this line item and the proposed line item is that the air is internal instead of external. The location of the environment has no impact on aging effects if the material is the same. This conclusion is also based on the fact that stainless steels are highly resistant to corrosion in dry atmospheres in the absence of corrosive species, (which would be reflective of indoor uncontrolled air) as cited in Metals Handbook, Volumes 3 (p. 65) and 13 (p. 555), Ninth Edition, American Society for Metals International, 1980and 1987. Components are not subject to moisture in a dry air environment (and indoor uncontrolled air would have limited humidity and condensation).

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
VII.J-x	Piping, piping components and piping elements	Copper Alloy	Air – Indoor uncontrolled (int)	None	None	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in NUREG-1801 Vol. 2 line item VIII.I-2 copper alloy in an indoor, uncontrolled air (ext) environment exhibits no aging effect and that the component or structure will therefore remain capable of performing its intended functions consistent with the CLB for the period of extended operation. The only difference in this line item and the proposed line item is that the air is internal instead of external. The location of the environment has no impact on aging effects if the material is the same. This conclusion is also based on the fact that comprehensive tests conducted over a 20-year period under the supervision of ASTM have confirmed the suitability of copper and copper alloys for atmospheric exposure as cited in Metals Handbook, Volume 13, Corrosion, American Society for Metals, 1987.
VII.J-x	Piping, piping components and piping elements	Aluminum	Dried air (int)	None	None	Aluminum has an excellent resistance to corrosion. On a surface freshly abraded and then exposed to air, the oxide film is only 5 to 10 nanometer thick but is highly effective in protecting the aluminum from corrosion (Hollingsworth and Hunsicker 1979). This conclusion is based on the fact that, on the basis of current industry research and operating experience, dry air on metal will not result in aging that will be of concern during the period of extended operation. Therefore, aluminum exposed to dried air environment does not have any applicable aging effect. Reference: Hollingsworth, E. H., and Hunsicker, H. Y. 1979. "Corrosion Resistance of Aluminum and Aluminum Alloys," Metals Handbook Ninth Edition, Volume 2, Properties and Selection: Nonferrous Alloys and Pure Metals, pp. 204-236.

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
VII.I-x	Piping, piping components and piping elements	Copper Alloy	Air – outdoor (external)	Loss of material/ pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring"	An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in JA FitzPatrick SER Section 3.3.2.3.13, the staff accepted the position that copper alloy in an outdoor air environment exhibits a loss of material aging effect and therefore recommends management by a program. The staff reviewed the applicant's External Surfaces Monitoring Program and its evaluation is documented in SER Section 3.0.3.2.9. The staff determined that it includes periodic inspections of external surfaces for components that will be effective for detecting loss of material for these components. The staff determined that these activities are adequate to manage aging for these copper alloy components exposed to air-outdoor (external). This additional AMR line-item is created to consider the corrosion of copper alloy piping components in outdoor air. AMP XI.M36 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
VII.J-x	Piping, piping components and piping elements	Stainless steel	Air – outdoor (external: absence of salt water spray or aggressive environment)	None	None	Corrosion of stainless steel requires an aggressive atmospheric environment (salt water spray or industrial pollutants) and concentrating mechanism to occur. Atmospheric environments in sea coast areas may contain high concentrations of salt and those in industrial areas may contain high concentrations of sulfur dioxide, acid rain etc. that promote an aggressive environment. External surfaces subjected to a concentrating mechanism and aggressive atmospheric environment are susceptible to pitting, crevice, as well as to SCC at temperatures above 140F. Aggressive species must be concentrated with alternate (cyclic) wetted and dried situations such as uninsulated components subject to sweating, tanks and components subject to cyclic condensation when filled frequently from an external source, and chronic leakage areas. Alternate wetting and drying resulting from rain has a tendency to "wash" the exterior surface material rather than concentrate contaminates (Ailor, *Atmospheric Corrosion*, 1982). There is no aging effect in the absence of a salt spray or aggressive environment.
VII.I-x	Piping, piping components and piping elements	Stainless steel	Air – outdoor (external: exposed to salt water spray or aggressive environment)	Loss of material/ pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring"	See technical basis for stainless steel in an outdoor environment with an absence of salt spray or aggressive environment. This additional AMR line-item is created to consider the aging of stainless steel piping components in outdoor air exposed to salt water spray or aggressive environment. AMP XI.M36 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
VII.K-x	Piping, piping components, and piping elements	Copper alloy, stainless steel, steel	Potable water	Loss of material/ general (steel only), pitting, and crevice corrosion	Chapter XI.M38, "inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	Potable water is water treated for drinking or other personnel uses. This additional AMR line-item is created to consider the aging of steel, stainless steel or copper alloy piping components in a potable water environment. Aging of stainless steel or copper alloy in a potable water environment is consistent with aging in other treated water environments such as demineralized water. The aging effect is also consistent with several recent industry precedents for aging of stainless steel or copper alloys in a potable water environment. AMP XI.M38 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.
VII.C1-x	Heat Exchanger components ALSO Piping, piping components, and piping elements	Titanium	Raw Water	None	None	Titanium has excellent corrosion resistance properties, specifically in chlorine-containing fluids with temperatures less than 160F. The corrosion resistance of titanium is a result of the formation of a continuous, stable, highly adherent protective oxide layer on the metal surface. Titanium and its alloys are fully resistant to all natural waters (raw, untreated fresh or salt water). For these reasons, loss of material due to general, pitting and crevice corrosion is not considered applicable. Stress corrosion cracking of titanium and its alloys is considered applicable in sea water or brackish raw water systems if the titanium alloy is not ASTM Grade 1, 2, 7, 11, or 12 and contains more than 5% aluminum or more than 0.20% oxygen or any amount of tin. (*Metals Handbook,* Ninth Edition, Volume 11, "Failure Analysis and Prevention," American Society of Metals International)

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
VII.C1-x	Heat Exchanger components	Titanium	Raw Water	Reduction of Heat Transfer due to Fouling	Chapter XI.M20, "Open-Cycle Cooling Water System"	Instances of macrofouling typically occur early in the service life of a component, and are corrected well before the end of the initial license period. However, macrofouling is an applicable Mechanism for degradation of metals exposed to raw water if there is a potential for recurrence. As such, macrofouling is considered to be an applicable aging mechanism for titanium and titanium alloys if there is a potential for macrofouling in the raw water environment and velocities are less than 5 ft/s.
VII.I-x	Heat exchanger components ALSO Piping, piping components, and piping elements	Titanium	Air – indoor uncontrolled or Air-outdoor	None	None	The corrosion resistance of titanium to indoor or outdoor air environments is a result of the formation of a continuous, stable, highly adherent protective oxide layer on the metal surface. The metal itself is very reactive, with a high affinity for oxygen, and reforms damage to this layer instantaneously. The oxide film on titanium and titanium alloys provides an effective barrier to attack by most gases in wet or dry conditions, including oxygen, nitrogen, NH3 CO2, CO, and H2S. This protection extends to temperatures in excess of 300ºF. The outstanding resistance of titanium and titanium alloys to rural, marine, and urban atmospheric exposure has been documented (*Metals Handbook,* Ninth Edition, Volume 13, "Corrosion," American Society of Metals International) An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Oyster Creek SER Section 3.3.2.3 page 3-370, the staff accepted the position that titanium in an outdoor air environment has no aging effects that require aging management.

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
VII.C1-x	Piping, piping components, and piping elements	Reinforced concrete, asbestos cement	Raw Water	Cracking/settling, Loss of material/abrasion, cavitation, aggressive chemical attack, and leaching, Changes in material properties due to aggressive chemical attack	Chapter X1.M20, "Open-Cycle Cooling Water System	Reinforced concrete and asbestos cement pipe/components are mechanical components in raw water have the same aging effects as structural concrete. An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Harris SER page 3-560, the staff accepted the position that cracking, loss of material and changes in material properties for reinforced concrete and asbestos cement pipe/components in a raw water environment can be managed with the Open Cycle Cooling Water AMP (XI.M20). AMP XI.M20 was developed to provide for proper management of the aging effects for this MEAP combination. Ref: ASTM C296, Standard Specification for Asbestos-Cement Pipe
VII.C1-x	Piping, piping components, and piping elements	Reinforced concrete, asbestos cement	Air - outdoor	Cracking/settling, Loss of material/ aggressive chemical attack, and leaching, Changes in material properties due to aggressive chemical attack	Chapter XI.M36, "External Surfaces Monitoring"	Reinforced concrete and asbestos cement pipe/components are mechanical components in an outdoor air environment have the same aging effects as structural concrete. An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Harris SER page 3-560, the staff accepted the position that cracking, loss of material and changes in material properties for reinforced concrete and asbestos cement pipe/components in an outdoor air environment can be managed with the External Surfaces AMP (XI.M36). AMP XI.M36 was developed to provide for proper management of the aging effects for this MEAP combination. Ref: ASTM C296, Standard Specification for Asbestos-Cement Pipe

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
VII.C1-x	Piping, piping components, and piping elements	Reinforced concrete, asbestos cement	soil	Cracking/settling, Loss of material/ aggressive chemical attack, and leaching, Changes in material properties due to aggressive chemical attack	Chapter XI.M34, "Buried Piping and Tanks Inspection"	Reinforced concrete and asbestos cement pipe/components are mechanical components buried in a soil environment have the same aging effects as structural concrete. An approved precedent exists for adding this material, environment, and aging effect combination to the GALL Report. As shown in Harris SER page 3-560, the staff accepted the position that cracking, loss of material and changes in material properties are appropriate aging effects for reinforced concrete and asbestos cement pipe/components buried in a soil environment. AMP XI.M34 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation. Ref: ASTM C296, Standard Specification for Asbestos-Cement Pipe

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
VII.J-x	Bolting	Stainless steel	Air – outdoor (external: absence of salt water spray or aggressive environment)	None	None	Corrosion of stainless steel requires an aggressive atmospheric environment (salt water spray or industrial pollutants) and concentrating mechanism to occur. Atmospheric environments in sea coast areas may contain high concentrations of salt and those in industrial areas may contain high concentrations of sulfur dioxide, acid rain etc. that promote an aggressive environment. External surfaces subjected to a concentrating mechanism and aggressive atmospheric environment are susceptible to pitting, crevice, as well as to SCC at temperatures above 140F. Aggressive species must be concentrated with alternate (cyclic) wetted and dried situations such as uninsulated components subject to sweating, tanks and components subject to cyclic condensation when filled frequently from an external source, and chronic leakage areas. Alternate wetting and drying resulting from rain has a tendency to "wash" the exterior surface material rather than concentrate contaminates (Ailor, *Atmospheric Corrosion*, 1982). There is no aging effect in the absence of a salt spray or aggressive environment.
VII.I-x	Bolting	Stainless steel	Air – outdoor (external: exposed to salt water spray or aggressive environment)	Loss of material/ pitting and crevice corrosion	Chapter XI.M18, Bolting Integrity	See technical basis for stainless steel in an outdoor environment with an absence of salt spray or aggressive environment. This additional AMR line-item is created to consider the corrosion of stainless steel bolting in outdoor air. AMP XI.M18 was developed to provide for proper management of the aging effects for this MEAP combination. This program provides an acceptable means of managing aging of these components. The implementation of this program provides reasonable assurance that the component's intended functions will be maintained within the CLB for the period of extended operation.

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
V.F-x VII.J-x VIII I-x	Piping Elements	Glass	Air with borated water leakage	None	None	No failure due to an aging effect of glass components in environments free of hydrofluoric acid, caustics, or hot water have been recorded in industry at the temperatures or during the time periods of concern for extended operation. The following cited items of NUREG-1833 have accepted the position that glass in the identified environment exhibits no aging effect: - Air environments: AP-48 and SP-33 (includes air outdoor and dry gas) - Treated water: AP-61, EP-29, and SP-35 - Treated borated water: AP-52 and EP-30 (similar to air with borated water leakage) - Raw water: AP-50, EP-28, and SP-34 (condensation is considered as raw water) Glass in a closed cycle cooling water environment is considered similar to glass exposed to raw water and treated water and no aging effect is identified for this MEAP. Precedents exist in the Beaver Valley SER for Air with borated water leakage, Closed cycle cooling water, and Condensation (internal/external). Waste Water environment is added to support Waste Water System evaluations and is consistent with prior raw water and treated water evaluations.
V.F-x VII.J-x VIII I-x	Piping Elements	Glass	Air - outdoor			
V.F-x VII.J-x VIII I-x	Piping Elements	Glass	Closed cycle cooling water			
V.F-x VII.J-x VIII I-x	Piping Elements	Glass	Condensation (internal/external)			
V.F-x VII.J-x VIII I-x	Piping Elements	Glass	Dry Gas			
VII.J-x	Piping Elements	Glass	Waste Water			
IV.E-x V.F-x VII.J-x VIII I-x	Piping, piping components, and piping elements	Nickel Alloys	Air with borated water leakage	None	None	The American Welding Society (AWS) "Welding Handbook," (Seventh Edition, Volume 4, 1982, Library of Congress) identifies that nickel chromium alloy materials that are alloyed with iron, molybdenum, tungsten, cobalt or copper in various combinations have improved corrosion resistance. The Staff's evaluation in the Beaver Valley SER concluded that nickel-alloy components exposed to an external air with borated water leakage environment are resistant to the phenomena of corrosion and oxidation.

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
VII.H2-x VIII.G-x	Heat Exchanger Components	Aluminum	Lubricating Oil	Reduction of Heat Transfer	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "one Time Inspection," for an acceptable verification Program.	Fouling is an applicable mechanism for reduction of heat transfer of heat exchangers in a lubricating oil environment as noted by GALL line V.D1-8. Aluminum has been added to account for an additional heat exchanger material susceptible to reduction of heat transfer due to fouling. The staff's evaluation in the Beaver Valley SER found the Lubricating Oil Analysis Program would maintain lubricating oil quality through treatment and testing. Additionally, any evidence of reduction of heat transfer would be effectively identified by the One-Time Inspection Program. .
VII.H2-x VIII.G-x	Heat Exchanger Components	Aluminum	Lubricating Oil	Loss of material/ pitting and crevice corrosion	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification Program.	Crevice corrosion and pitting corrosion of aluminum is strongly dependent on the presence of dissolved oxygen and an aggressive environment. In flowing systems, even if contaminated, water and contaminants cannot accumulate to a significant extent and crevice/pitting corrosion is not expected to be a significant aging concern under flowing conditions. Crevice and pitting corrosion are only a concern for aluminum under stagnant conditions where water contamination is present. The staff's evaluation in the Beaver Valley SER found the Lubricating Oil Analysis Program would maintain lubricating oil quality through treatment and testing. Additionally, any evidence of loss of material would be effectively identified by the One-Time Inspection Program.

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
VII.I-x	Halon/CO_2 fire suppression system piping, piping components and piping elements	Steel	Air – Indoor uncontrolled (external)	Loss of material / general	Chapter XI.M26 "Fire Protection"	This recommendation is specific to the external surfaces of Halon and carbon dioxide fire suppression system components. The steel, indoor air (external) and loss of material combination is consistent with other identical material, environment, and aging effects combinations for component external surfaces in NUREG-1801 Section I, "External Surfaces of Components and Miscellaneous Bolting". NUREG-1801Chapter XI.M36, External Surfaces AMP is replaced with NUREG-1801 Chapter XI.M26 Fire Protection AMP to be consistent with the recommendations for inspections of external surfaces of fire protection components such as Halon and carbon dioxide fire suppression system components in the Fire Protection AMP.
VII-X	Fire Hydrants	Steel	Air-outdoor	Loss of material / general corrosion	Chapter XI.M27, "Fire Water System"	This recommendation is specific to the external surfaces of Fire Hydrants in fire water systems. The steel, outdoor air (external) and loss of material combination is consistent with other identical material, environment, and aging effects combinations for component external surfaces in NUREG-1801 Section I, "External Surfaces of Components and Miscellaneous Bolting". NUREG-1801Chapter XI.M36, External Surfaces AMP is replaced with NUREG-1801 Chapter XI.M27 Fire Water System AMP to be consistent with the recommendations for inspections of external surfaces of fire hydrants in the Fire Water Systems AMP.
V.E-x, VII.I-x, VIII.H-x	Bolting	Stainless steel, copper alloy, nickel alloy	Air – indoor (external)	Loss of preload/ thermal effects, gasket creep, and self-loosening	Chapter XI.M18, Bolting Integrity	GALL addresses loss of preload for steel closure bolting in an air-indoor (external) environment (V.E-5, VII.I-5 and VIII. H-5) but does not address stainless steel, nickel alloy, or copper alloy bolting. GALL AMP XI.M18 provides for management of loss of pre-load, so this program can also be applied here.

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
V.E-x, VII.I-x, VIII.H-x	Bolting	Carbon steel, Stainless steel	Air – outdoor (external)	Loss of preload/ thermal effects, gasket creep, and self-loosening	Chapter XI.M18, Bolting Integrity	GALL addresses loss of preload for steel closure bolting in an air-indoor (external) environment (V.E-5, VII.I-5 and VIII. H-5) but does not address stainless steel bolting or an air-outdoor (external) environment. GALL AMP XI.M18 provides for management of loss of pre-load, so this program can also be applied here.
V.E-x, VII.I-x	Bolting	Nickel Alloy	Air with Borated water leakage	Loss of preload/ thermal effects, gasket creep, and self-loosening	Chapter XI.M18, Bolting Integrity	GALL addresses loss of preload for steel closure bolting in an air-indoor (external) environment (V.E-5, VII.I-5 and VIII. H-5) but does not address other materials and environments. GALL AMP XI.M18 provides for management of loss of pre-load, so this program can also be applied here.
V.E-x, VII.I-x	Bolting	Stainless steel	Raw water			
V.E-x, VII.I-x	Bolting	Stainless steel	Treated borated water			
V.E-x, VII.I-x	Bolting	Steel	Fuel oil			
V.E-x, VII.I-x	Bolting	Steel	Raw Water			
VIII.E-x, VIIIG-x	Tanks	Steel	Soil, concrete	Loss of material/general, pitting and crevice corrosion	Chapter XI.M29, "Aboveground Steel Tanks"	GALL AMP XI.M29 "Aboveground Steel Tanks", addresses corrosion of steel storage tanks at inaccessible locations such as tank bottoms supported on earthen or concrete foundations. These lines are proposed to address the aging management for corrosion of steel tanks bottoms noted in AMP.

New AMR Line-items based on new 'MEAP' combinations relevant to Mechanical Systems ("IV" for Reactor Coolant, "V" for Engineered Safety Features, "VII" for Auxiliary, and "VIII" for Steam and Power Conversion)						
Item	**Structure and/or Component**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Precedent and Technical Basis for New Line-Item**
III.B2-x	Conduit	Aluminum	Concrete	None	None	GALL addresses stainless steel embedded in concrete (VII.J-17 & VIII.I-11). An approved precedent exists for adding this material, environment, aging effect, and program combination to the GALL Report. As shown in Browns Ferry SER page 3-322, the staff accepted the position that aluminum alloy embedded or encased in concrete has no aging effect that requires aging management. Aluminum has an excellent resistance to corrosion. On a surface freshly abraded and then exposed to air, the oxide film is only 5 to 10 nanometer thick but is highly effective in protecting the aluminum from corrosion (Hollingsworth and Hunsicker 1979). Aluminum that is embedded/encased within concrete, loss of material is not considered an applicable aging effect. The concrete would first have to be degraded by other aging effects, which reduce the protective cover and potentially allow for the intrusion of aggressive ions causing a reduction in concrete pH. Aging management of concrete aging effects will manage the corrosion of the embedded/encased aluminum protective oxide layer. Concrete structures and components are designed in accordance with ACI standards and constructed using materials conforming to ACI and ASTM standards which provide foe a good quality, dense, well cured, and low permeability concrete. Cracking is controlled through arrangement and distribution of reinforcing bars.
VII.J-x	Piping, piping components, and piping elements					

Changes in Existing AMR Lines:

- **Steam and Power Conversion Systems**
- **Auxiliary Systems**
- **Engineered Safety Systems**

Changes in Existing AMR Line-Items related to Steam and Power Conversion System (Chapter VIII in GALL Vol. 2)								
Item	**Structure and/or Component**	**GALL Rev. 1 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**	**Basis for Change**
S-26	Heat Exchanger	VIII.G-4	Stainless Steel	Raw Water	Loss of Material/ pitting, crevice, and microbiological influenced corrosion, ~~and fouling~~	Chapter X1.M20, "Open-Cycle Cooling Water System"	No	Fouling is an aging mechanism associated with loss of heat transfer not loss of material.
SP-37	Piping, piping components, and piping elements	VIII.E-28 VIII.G-31	Stainless Steel	Soil	Loss of material/ pitting and crevice corrosion	~~A plant specific aging management program is to be evaluated.~~ **Chapter XI.M28, "Buried Piping and Tanks Surveillance," or** **Chapter XI.M34, "Buried Piping and Tanks Inspection"**	~~Yes, plant specific~~ **No** **Yes, detection of aging effects and operating experience are to be further evaluated**	The Buried Piping and Tanks programs currently only list carbon steel as the material being managed. However, past precedent has been accepted that this program will adequately manage stainless steel components in the FitzPatrick SER section 3.0.3.2.1. Proposed revision to XI.M28 and XI.M34 to include stainless steel since material is of no consequence for visual inspections of coatings or surface corrosion.
TBD	Piping, piping components, and piping elements	VIII.I-x	Copper alloy<15% Zn	Air with borated water leakage	None	None	No	Consistent with NUREG-1801 V.F-5
TBD	Piping, piping components, and piping elements	VIII.G-x	Stainless Steel	Condensation (internal/external)	Loss of material/ pitting and crevice corrosion	A plant specific aging management program is to be evaluated	No	Consistent with V.D1-29 and VII.F2-1

Changes in Existing AMR Line-Items related to Auxiliary Systems (Chapter VII in GALL Vol. 2)								
Item	**Structure and/or Component**	**GALL Rev. 1 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**	**Basis for Change**
A-65	Heat Exchanger Components	VII.C1-3	Copper alloy	Raw Water	Loss of Material/ pitting, crevice, and microbiological influenced corrosion, ~~and fouling~~	Chapter X1.M20, "Open-Cycle Cooling Water System"	No	Fouling is an aging mechanism associated with loss of heat transfer not loss of material.
A-64	Heat Exchanger Components	VII.C1-5	Steel	Raw Water	Loss of Material/ pitting, crevice, and microbiological influenced corrosion, ~~and fouling~~	Chapter X1.M20, "Open-Cycle Cooling Water System"	No	Fouling is an aging mechanism associated with loss of heat transfer not loss of material.
TBD	Heat Exchanger Components	VII.E1-x	Copper Alloy	Lubricating Oil	Reduction of heat Transfer/ fouling	Chapter XI.M39, "Lubricating Oil Analysis" The AMP is to be augmented by verifying the effectiveness of the lubricating oil analysis program. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification Program.	Yes, detection of aging effects is to be evaluated	Consistent with NUREG-1801 V.D1-8 for copper alloys in a lubricating oil environment

AP-74	Piping, piping components, and piping elements	VII.F1-14 VII.F2-12 VIIF3-14 VII.F-10	Aluminum	Condensation (internal or external)	Loss of Material/ pitting, and crevice corrosion	Chapter XI.M38, "inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components Or Chapter XI.M36, "External Surfaces Monitoring"	No	Deleted plant plant specific AMP and identified Internal and External AMPs to be consistent with proposed AMP changes.
AP-56	Piping, piping components, and piping elements	VII.C1-16 VII.C3-8 VII.G-20 VII.H1-7 VII.H2-19	Stainless Steel	Soil	Loss of material/ pitting and crevice corrosion	~~A plant-specific aging management program is to be evaluated.~~ **Chapter XI.M28, "Buried Piping and Tanks Surveillance," or** **Chapter XI.M34, "Buried Piping and Tanks Inspection"**	~~Yes, plant specific~~ **No** **Yes, detection of aging effects and operating experience are to be further evaluated**	The Buried Piping and Tanks programs currently only list carbon steel as the material being managed. However, past precedent has been accepted that this program will adequately manage stainless steel components in the FitzPatrick SER section 3.0.3.2.1. Proposed revision to XI.M28 and XI.M34 to include stainless steel since material is of no consequence for visual inspections of coatings or surface corrosion.

Changes in Existing AMR Line-Items related to Engineered Safety Features (Chapter V in GALL Vol. 2)								
Item	**Structure and/or Component**	**GALL Rev. 1 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**	**Basis for Change**
EP-18	Heat Exchanger	V.A-10	Steel	Raw Water	Loss of Material/ general, pitting, crevice, and microbiological influenced corrosion, ~~and fouling~~	Chapter X1.M20, "Open-Cycle Cooling Water System"	No	Fouling is an aging mechanism associated with loss of heat transfer not loss of material.
EP-20	Heat Exchanger	V.A-8	Stainless Steel	Raw Water	Loss of Material/ pitting, crevice, and microbiological influenced corrosion, ~~and fouling~~	Chapter X1.M20, "Open-Cycle Cooling Water System"	No	Fouling is an aging mechanism associated with loss of heat transfer not loss of material.
EP-34	Heat Exchanger	V.A-16	Stainless Steel; <u>nickel alloy</u>	Treated Water	Reduction of heat Transfer/ fouling	ChapterXI.M32, "Water Chemistry" This AMP is to be augmented by verifying the effectiveness of water chemistry control. See Chapter XI.M32, "One-Time Inspection," for an acceptable verification program.	Yes, detection of aging effects is to be evaluated	Fouling is an applicable Mechanism for reduction of heat transfer of heat exchangers in a treated water environment as noted by GALL line V.A-16. Nickel alloys have been added to account for an additional heat exchanger material susceptible to reduction of heat transfer due to fouling.

TBD	Piping, piping components, and piping elements	V.D1-X	Stainless Steel	Condensation (external)	Loss of material/ pitting and crevice corrosion	Chapter XI.M36, "External Surfaces Monitoring"	No	Consistent with NUREG-1801 V.A-26 for stainless steel in a condensate (internal) environment. Revisions to AMP XI.M36 were developed to provide for proper management of the aging effects for this MEAP combination.
EP-31	Piping, piping components, and piping elements	V.D1-26 V.D2-27	Stainless Steel	Soil	Loss of material/ pitting and crevice corrosion	~~A plant-specific aging management program is to be evaluated.~~ **Chapter XI.M28, "Buried Piping and Tanks Surveillance," or** **Chapter XI.M34, "Buried Piping and Tanks Inspection"**	~~Yes, plant specific~~ **No** **Yes, detection of aging effects and operating experience are to be further evaluated**	The Buried Piping and Tanks programs currently only list carbon steel as the material being managed. However, past precedent has been accepted that this program will adequately manage stainless steel components in the FitzPatrick SER section 3.0.3.2.1. Proposed revision to XI.M28 and XI.M34 to include stainless steel since material is of no consequence for visual inspections of coatings or surface corrosion.

Other NUREG-1801 Changes:

- **Addition of new section for Waste Water Systems**
- **Chapter IX new or revised definitions for:**
  - **Environments: Potable Water, Raw Water, and Waste Water**
  - **Materials: Titanium**
  - **Aging Mechanisms: Fouling**

E5. WASTE WATER SYSTEMS

Systems, Structures, and Components

This section discusses liquid waste systems such as liquid radioactive waste systems, oily waste systems, floor drainage systems, chemical waste water systems, and secondary waste water systems. Plants may include portions of waste water systems within the scope of license renewal based on the criterion of 10CFR 54.4.(a)(2).

Based on Regulatory Guide 1.26, “Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants,” radioactive-waste-containing portions of waste water systems are classified as Group C Quality Standards, with the exception of those forming part of the containment pressure boundary which are classified as Group B. Waste water systems that do not contain radioactive waste of form a part of the containment pressure boundary are classified as Group D.

Pump and valve internals perform their intended functions with moving parts or with a change in configuration. They are also subject to replacement based on qualified life or specified time period. Pursuant to 10 CFR 54.21(a)(1), therefore, they are not subject to an aging management review.

Aging management programs for the degradation of external surfaces of components and miscellaneous bolting are included in VII.I. Common miscellaneous material/environment combinations where aging effects are not expected to degrade the ability of the structure or component to perform its intended function for the extended period of operation are included in VII.J.

The system piping includes all pipe sizes, including instrument piping.

System Interfaces

Various other systems discussed in this report may interface with waste water systems.

VII. AUXILIARY SYSTEMS E5 Waste Water Systems								
Item	**Structure and/or Component**	**GALL Rev. 1 Item Number**	**Material**	**Environment**	**Aging Effect/ Mechanism**	**Aging Management Program (AMP)**	**Further Evaluation**	**Basis for Change**
TBD	Piping, piping components, and piping elements	VII.E5-1	Copper	Waste Water	Loss of Material/ pitting, crevice, and microbiological influenced corrosion	Chapter XI.M38, "inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	See Note 1
TBD	Piping, piping components, piping elements, and tanks	VII.E5-2	Stainless Steel; nickel alloys	Condensation (internal)	Loss of Material/ pitting, crevice, and microbiological influenced corrosion	Chapter XI.M38, "inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	See Note 1
TBD	Heat Exchanger Components	VII.E5-2	Stainless Steel; nickel alloys	Waste Water	Loss of Material/ pitting, crevice, and microbiological influenced corrosion	Chapter XI.M38, "inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	See Note 1
TBD	Piping, piping components, piping elements, and tanks	VII.E5-2	Stainless Steel; nickel alloys	Waste Water	Loss of Material/ pitting, crevice, and microbiological influenced corrosion	Chapter XI.M38, "inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	See Note 1
TBD	Piping, piping components, piping elements, and tanks	VII.E5-2	Steel	Condensation (internal)	Loss of Material/ pitting, crevice, and microbiological influenced corrosion	Chapter XI.M38, "inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	See Note 1

TBD	Piping, piping components, piping elements, and tanks	VII.E5-3	Steel	Waste Water	Loss of Material/ general, pitting, crevice, and microbiological influenced corrosion	Chapter XI.M38, “inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components	No	See Note 1

Note 1. New lines are proposed to be added to NUREG-1801 for aging management review of waste water systems. AMP XI.M38, “Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components”, is proposed for inspections of internal surfaces of metal components that are not covered by other aging management programs.

Chapter IX New and Revised Definitions

Section IX. C. Materials

Term	Definition as used in this document
Titanium	Titanium includes unalloyed titanium (ASTM grades 1-4) and alloys comprised of various alloys (ASTM grades 5, 7. 9, and 12). The corrosion resistance of titanium is a result of the formation of a continuous, stable, highly adherent protective oxide layer on the metal surface.

Add the following technical criteria to the introduction of Section IX.C

Temperature threshold of 160°F and alloy considerations for titanium: Titanium and titanium alloys are susceptible to crevice corrosion in saltwater environments at elevated temperatures (>160°F). Stress corrosion cracking of titanium and its alloys is considered applicable in sea water or brackish raw water systems if the titanium alloy is not ASTM Grade 1, 2, 7, 11, or 12 and contains more than 5% aluminum or more than 0.20% oxygen or any amount of tin.

Section IX. D. Environments

Term	Definition as used in this document
Potable Water (new)	Water that is treated for dinking or other personnel uses.
Raw Water (revised)	Raw, untreated fresh, salt, or ground water. Water for use in open-cycle cooling water systems. ~~Floor drains and reactor buildings and auxiliary building sumps may be exposed to a variety of untreated water that is thus classified as raw water, for the determination of aging effects.~~ ~~Raw water may contain contaminants, including oil and boric acid, depending on the location, as well as originally treated water that is not monitored by a chemistry program.~~
Waste Water (new)	Radioactive, potentially radioactive, or non-radioactive waters that are collected from equipment and floor drains. Waste waters may contain contaminants, including oil and boric acid, depending on location, as well as originally treated water that is not monitored by a chemistry program

Section IX. F. Aging Mechanisms

Term	Definition as used in this document
Fouling (revised)	An accumulation of deposits. This term includes accumulation and growth of aquatic organisms on a submerged metal surface and also includes the accumulation of deposits, usually inorganic, on heat exchanger tubing. Biofouling, as a subset of fouling, can be caused by either macro-organisms (such as barnacles, Asian clams, zebra mussels, and others found in fresh and salt water) or micro-organisms, e.g., algae. Fouling can also be categorized as particulate fouling (sediment, silt, dust, and corrosion products), marine biofouling, or macrofouling, e.g., peeled coatings, debris, etc. Fouling in a raw water system can occur on the piping, valves, and heat exchangers. Fouling can result in a reduction of heat transfer, ~~loss of material,~~ or a reduction in the system flow rate (this last aging effect is considered active and thus is not in the purview of license renewal).

Electrical Changes to Clarify SBO scoping:

- **NUREG-1801 Chapter VI.A**
- **NUREG-1800 Section 2.1.3.1.3**
- **NUREG-1800 Section 2.5.2.1.1**

Basis for the change:

To clarify that SBO scoping for license renewal is based on the plant-specific CLB as stated in the notice of withdrawal of proposed LR-ISG-2008-01on page 33479 of the July 13, 2009 Federal Register.

A. EQUIPMENT NOT SUBJECT TO 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION REQUIREMENTS

Systems, Structures and Components

This section addresses electrical cables and connections that are not subject to the environmental qualification requirements of 10 CFR 50.49, and that are installed in power and instrumentation and control (I&C) applications. The power cables and connections addressed are low-voltage (<1000V) and medium-voltage (2 kV to 35 kV). High voltage (>35 kV) power cables and connections have unique, specialized constructions and must be evaluated on an application specific basis.

This section also addresses components that are relied upon to meet the station blackout (SBO) requirements for restoration of offsite power. The plant system portion of the offsite power system relied upon in the plant-specific current licensing basis for compliance with 10 CFR 50.63, that is used to connect the plant to the offsite power source, is included in the SBO restoration equipment scope. This path typically includes the switchyard circuit breakers that connect to the offsite system power transformers (startup transformers), the transformers themselves, the intervening overhead or underground circuits between circuit breaker and transformer and transformer and onsite electrical distribution system (including bus ducts or cables), and associated control circuits and structures.

Electrical cables and their required terminations (i.e., connections) are typically reviewed as a single commodity. The types of connections included in this review are splices, mechanical connectors, fuse holders, and terminal blocks. This common review is translated into program actions, which treat cables and connections in the same manner.

Electrical cables and connections that are in the plant's environmental qualification (EQ) program are addressed in VI.B.

System Interfaces

Electrical cables and connections functionally interface with all plant systems that rely on electric power or instrumentation and control. Electrical cables and connections also interface with and are supported by structural commodities (e.g., cable trays, conduit, cable trenches, cable troughs, duct banks, cable vaults and manholes) that are reviewed, as appropriate, in the Structures and Components Supports section.

2.1.3.1.3 "Regulated Events"

For SBO, the reviewer verifies that the applicant's methodology would include those SSCs relied upon during the "coping duration" and "recovery" phase of an SBO event. In addition, because 10 CFR 50.63(c)(1)(ii) and its associated guidance in Regulatory Guide 1.155 include procedures to recover from an SBO that include offsite and onsite power, the plant system portion of the offsite power system that is used to connect the plant to the offsite power source should also be ~~included~~ considered within the scope of the rule. However, the staff's review is based on the plant-specific current licensing basis, regulatory requirements, and offsite power design configurations.

2.5.2.1.1 Components Within the Scope of SBO (10 CFR 50.63)

Both the offsite and onsite power systems are relied upon to meet the requirements of the SBO Rule. This includes the following:

- The onsite power system meeting the requirements under 10 CFR 54.4(a)(1) (safety related systems)

- Equipment that is required to cope with an SBO (e.g., alternate ac power sources) meeting the requirements under 10 CFR 54.4(a)(3)

- The plant system portion of the offsite power system that is used to connect the plant to the offsite power source meeting the requirements under 10 CFR 54.4(a)(3). This path typically includes the switchyard circuit breakers that connect to the offsite system power transformers (startup transformers), the transformers themselves, the intervening overhead or underground circuits between circuit breaker and transformer and transformer and onsite electrical distribution system, and the associated control circuits and structures. However, the staff's review is based on the plant-specific current licensing basis, regulatory requirements, and offsite power design configurations.