February 19, 2013

MEMORANDUM TO: Harold K. Chernoff, Chief
Operating Experience Branch
Division of Inspection and Regional Support
Office of Nuclear Reactor Regulation

FROM: John W. Thompson, Senior Reactor Operations Engineer ***/RA/***
Operating Experience Branch
Division of Inspection and Regional Support
Office of Nuclear Reactor Regulation

SUBJECT: IOEB ANALYSIS TEAM STUDY ON COMPONENT AGING - INSIGHTS FROM INSPECTION FINDINGS AND REPORTABLE EVENTS

Enclosed is the study on component aging with insights from inspection findings and reportable events. The study was briefed to the Office of Nuclear Reactor Regulation Executive Team on November 8, 2012.

Please contact me at 301-415-1011 or via email at John.Thompson@nrc.gov if there are any questions.

CONTACT: John Thompson, NRR/DIRS
(301) 415-1011

Attachment:
IOEB Analysis Team Study

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DATE	2/19/2013	2/20/2013

OFFICIAL AGENCY RECORD

IOEB Analysis Team Study

Component Aging Study (2007-2011) – Insights from Inspection Findings and Reportable Events

SUMMARY:

In March 2012, NRR's Operating Experience Branch (IOEB) completed a review of safety-related and important-to-safety "active" component failures and reportable events attributed to age-related degradation. The staff looked at operating experience (OpE) for the years 2007–2011, focusing on inspection findings, and reportable events (licensee event reports (LERs)). It was not the focus of this study to look at passive component failures or premature aging effects caused by environmental qualification issues.

The results of this study show that the number of inspection findings and LERs attributed to age-related degradation are relatively small (approximately 2 percent of all inspection findings/year). However, since 2009, there is a notable increase in the number of inspection findings and LERs involving highly reliable components whose failure was attributed to age degradation after being in service for over 15 years. Some of these failures appear to have resulted from licensees running their equipment to failure, and in other cases, the failures were caused by operating equipment beyond its qualified service life without appropriate justification. Though most of the affected systems and components are within the scope of the NRC's Maintenance Rule (10 CFR 50.65), with few exceptions, these failures do not rise to the level of being cited as Maintenance Rule violations. In some cases, inspectors were unable to identify a performance deficiency associated with the failure.

NRC Component Design Basis Inspections (CDBIs) were responsible for identifying many of the Appendix B violations cited in this study. Yet, very few (seven) of the datum identified in this study were cited as 10 CFR Part 50, Appendix B, Criterion III (Design Control) violations. It is interesting to note that in more than 75 percent of the 105 datum that were reviewed, it was determined that the System, Structure, or Component (SSC) either exceeded its recommended service life or was effectively run-to-failure. Thus, it is reasonable to question the oversight effectiveness of the baseline inspection program in this area.

It is difficult to ascertain the significance of age-related factors contributing to the SSC failures discussed in the inspection reports and LERs contained within this study. This may be attributed to the fact that failures involving components exceeding their qualified service life may not be the most significant causal factor contributing to the performance deficiency. It is also difficult to place in perspective the overall numbers of safety-significant SSCs that remain in service beyond qualified service life without adequate justification, given the current regulatory oversight emphasis on performance-based inspections.

Over the past several years, EPRI and the industry have issued reports that highlight this aging problem, albeit on a topic-specific basis. These reports tend to be focused on certain components (e.g., relays, power supplies), and they have not drawn attention to the broader component aging issue identified in this study. In an EPRI progress update report titled: "Relay Aging Management Guidelines Target Age-Related Degradation," dated July 2011, EPRI and the industry both acknowledged that relays were failing after being in service beyond the vendor's recommended service life. EPRI also recently released a progress update report on

"Control Relay Aging Management Guideline: Auxiliary, Control and Timing Relays" (EPRI Report 1022972). Another EPRI abstract report, "Plant Engineering: Instrument Power supply End-of-Expected-Life Guidance, dated May 2011, states that licensees who are practicing condition-based or predictive maintenance strategies should instead switch to a periodic, or time-based refurbishment/ replacement strategy because *age-related operating and design application stressors exacerbate failure*. Further, the NRC may wish to consider how inspectors could be better prepared to identify instances where licensees are operating SSCs beyond their reasonable expected service life without adequate engineering justification. Additional guidance and training could be used to alert more inspectors to how these issues can be pursued using 10 CFR Part 50, Appendix B criteria (Criterion III, Design Control).

IOEB believes the aging issue as described above will become more prevalent as plants continue to age.

ANALYSIS:

Categorization of Age-Related SSC Failures Identified by this Study

The majority of the SSC failures identified by this study (see the Appendix) contain electrical subcomponents such as circuit cards (capacitors/resistors), relays, transformers, fuses, and switches found in safety-related power supplies, battery chargers, inverters, and radiation monitors. Other SSCs that experience age-related failures resulting in plant trips and transients include molded case circuit breakers (MCCBs), snubbers, expansion joints on heating, ventilation and cooling equipment, and subcomponents on pumps and valves (e.g., O-rings and diaphragms).

IOEB staff also found examples where licensees have: 1) inappropriately operated safety-related equipment to failure, 2) operated safety-related (or important-to-safety) equipment beyond vendor recommended service life without adequate engineering justification, and 3) failed to incorporate industry operating experience regarding revised estimates of service life and preventive maintenance (PM) guidelines. As defined and used in this study, a run-to-failure designation is where a component had remained in service beyond expected qualified service life without adequate justification at the time of its failure and without any expectation of an ongoing preventive maintenance program or planned replacement/refurbishment (as gleaned from the report documentation).

Only three inspection findings are identified in this study as maintenance rule violations (identified at Waterford in 2011, during a Catawba CDBI inspection in 2009, and during a supplemental inspection at Brunswick in 2007).

It should be noted that these 105 inspection findings and LERs likely constitute a small percentage of the total population of SSC failures involving age-related degradation. For example, IOEB searched industry data for all 2011 relay failures and found that 60 out of 133 failures were attributed to age-related degradation. The review also found that a majority of the 133 relay failures were categorized as Maintenance Rule Functional Failures.

Many of the failure reports in the industry data do not reach the threshold of NRC reportability and do not involve performance deficiencies that rise to a level that would be documented in an inspection report. This study focused only on those inspection findings and LERs that met the criteria either for reportability or for a more than minor performance deficiency. IOEB determined that the majority of these failures occurred with components that typically are within the scope of the Maintenance Rule (see Figure 1 below).

A summary of key observations that pertain to age-related SSC failures documented in the inspection findings and LERs are:

- a reliance only on performance-based monitoring without considering the need for periodic/time-based replacement maintenance;
- mis-categorization of the SSC as a non-critical component; thus no refurbishment/replacement plan was put in place;
- lack of justification for the SSC remaining in service beyond expected service life based on a lack of understanding of the safety function;
- failure to maintain awareness by some licensees of available industry OpE that has bearing on qualified life of the SSC;
- failure of some licensees who have recognized the need to make improvements in their PM programs, but failed to follow through on implementation of these improvements, and
- failure of a subcomponent in an SSC that was not recognized as requiring periodic replacement/refurbishment.

Figure 1: 2007-2011 Inspection Findings/LERs for Age-Related Failures of Safety-Related and Important-to-Safety Equipment

[Note: No overall trend in the number of findings involving age-related failures of important-to-safety SSCs, but the number of findings involving failures of SSCs that has been in service for greater than 15 years since 2009 are increasing.]

One hundred and five (105) inspection findings and LERs were identified for the years 2007-2011 that involved age-related degradation of SSCs associated with safety-related and important-to-safety equipment (see the Appendix). Although the data set may not be statistically significant, the number of findings involving failures of SSCs that have been in service for 15-20 years or greater has been gradually increasing since 2009. About 50 percent of the 105 inspection findings and LERs involved SSCs that were known to have been in service for at least 15 years, with a majority in service for greater than 20 years, and some with in-service times approaching 40 years (see Figure 2 below). Although in-service time could not be determined for approximately 30 percent of the failures, it is probable that since the failures were all age-related, most of the components involved were in service for greater than 15 years.

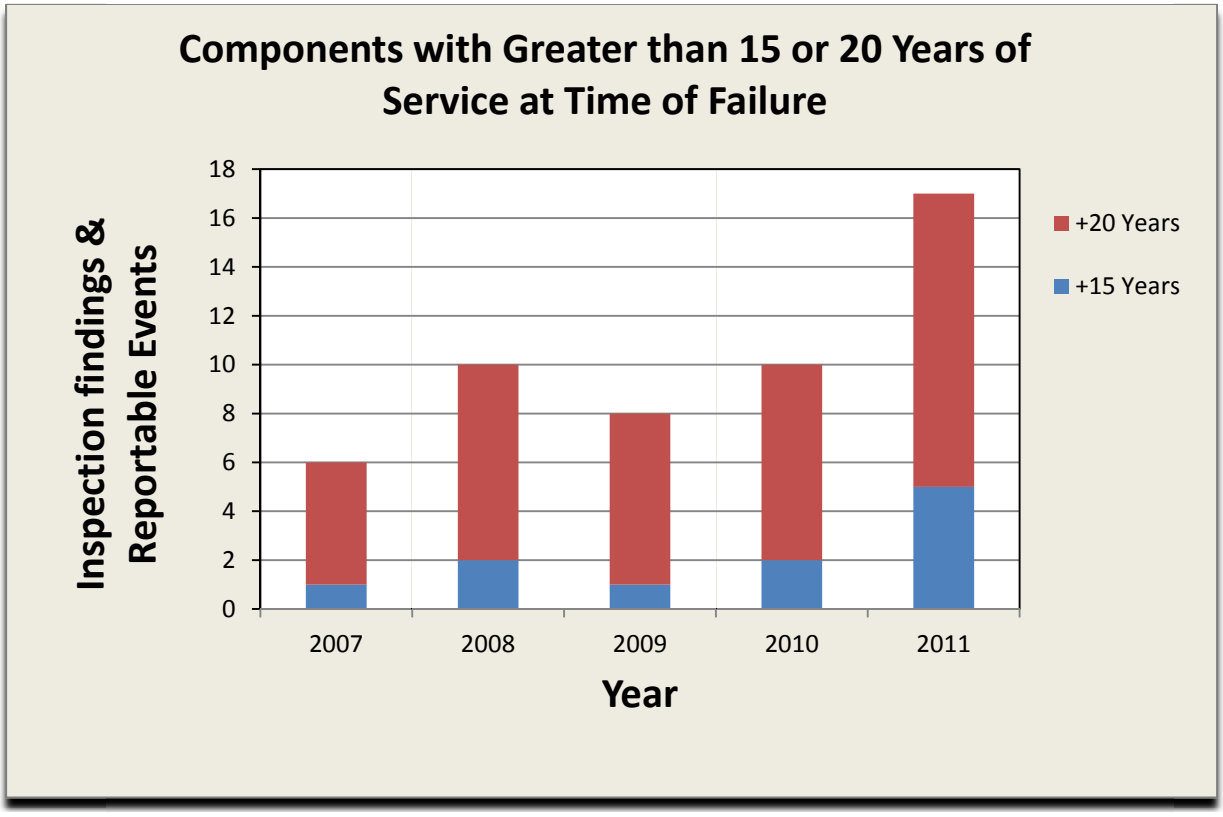


Figure 2: 2007-2011 Inspection Findings & LERs Involving SSCs with a Known In-Service Time of 15/20 Years or Greater

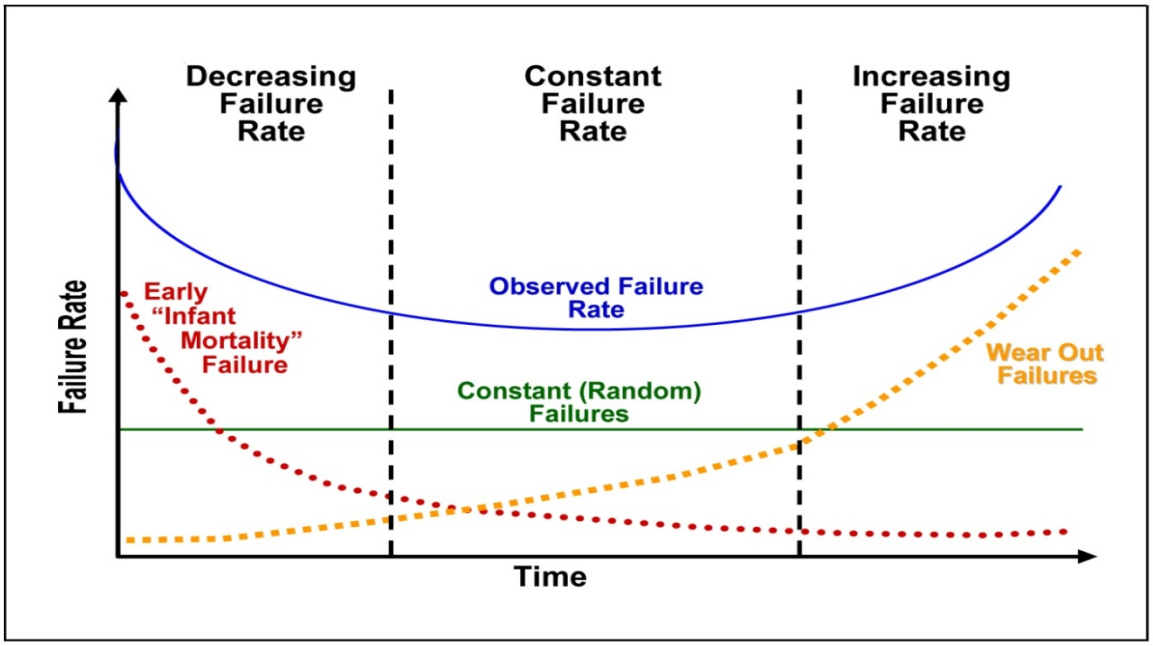
More than 70 percent (77 findings) of the 105 inspection findings and LERs involve age-related failures of SSCs that were in service beyond expected service life. Many of the SSCs left in

service beyond expected life did not have an adequate engineering justification for continued service. About 40 percent of the 77 inspection findings were also Appendix B related findings, but only seven were cited against Criterion III, Design Control. Appendix B, Criterion III requires licensees to verify or check the adequacy of design if safety-related equipment will remain in service beyond its qualified life. Thus, with greater than two-thirds of findings and events involving SSCs left in service well beyond expected service life, it is reasonable to question why NRC oversight programs are not more focused on aging management of active SSCs.

Performance-Based vs. Periodic (Time-Based) Maintenance

Performance-based maintenance is at the heart of the NRC's Maintenance Rule. Performance-based maintenance is typically performed on safety-related equipment, and several industry studies cite this strategy as best suited for monitoring SSC performance and maintaining component reliability. The bathtub curve occupies a place of considerable importance in reliability practice, although it is not without criticism, particularly with some of the underlying assumptions with infant mortality on the left side of the curve (see Figure 3 and IEEE Transactions on Reliability, Vol. 52, No. 1, March 2003).

But, for those SSCs operating beyond their qualified service life (i.e., on the right side of the bathtub curve), performance-based maintenance, if not used in conjunction with other preventive maintenance strategies, may not be enough to ensure continued reliability. Without an effective life cycle management program, it is likely that plants are, or soon will be, operating equipment in that portion of the Bathtub Curve where the probability of experiencing failures is notably increased. The data compiled by this study suggests that some licensees did not implement effective life cycle PM strategies, despite the fact that they were conducting performance-based maintenance in accordance with the Maintenance Rule. Life cycle management takes into account preventive and predictive measures, refurbishment intervals, and ultimately, equipment replacement. However, there are a growing number of plants approaching (and exceeding) 40 years of operation that still have equipment in service that dates to original plant startup.



(Graphic from Wikipedia: Bathtub curve)

Figure 3: Bathtub Curve Hazard Function

Station transformers are an example of how highly reliable components can fail when left in service without adequate life cycle maintenance, showing a decrease in reliability consistent with operation on the right side of the Bathtub Curve. In 2008, the industry identified an increasing trend in transformer failures from 1991-2001, and in 2009, IOEB conducted a review of large oil-cooled transformers failures from 2007-2008. Although many station transformers are not safety-related, they still fall within scope of the Maintenance Rule. The NRC staff found that some licensees were not maintaining station transformers in accordance with established PM practices as recommended by vendor and industry guidelines. The staff also noted that large transformer failures resulted in six declared events and that the primary contributors to the trend were: 1) over-reliance on contractors to perform maintenance, 2) equipment no longer supported by the original manufacturer, 3) non-standard designs, and 4) loss of technical knowledge on high voltage equipment. The industry noted that many transformer failures occur because *life cycle management* of transformers is a concept that has not been widely practiced.

NRC oversight programs could be better focused on aging management of (active) SSCs, and may not be able to effectively deal with an aging industry that potentially is experiencing an increase in age-related SSC failures.

There are several nuances to the Maintenance Rule relative to age-related degradation that affect the ability of inspectors to cite violations against it. If an SSC is deemed highly reliable, and there is no history of recent failures, then it may not be necessary for the performance of the SSC to be trended, regardless of its risk significance. Further, there is no Maintenance Rule requirement to have enhanced PM practices just because equipment is old. Even if it was known that a component was not within scope of the Maintenance Rule (and it should have

been), and the component failed, it still may not meet a more than minor threshold for inspection report documentation until there is a second failure (inadequate corrective action).

The License Renewal Rule excludes consideration of aging effects on active SSCs because it assumes the SSCs are included in an ongoing PM program. Baseline inspections of PM activities are heavily focused on Maintenance Rule implementation (performance-based strategies), thus there may be less focus on other types of PM (e.g., time-based/period replacement maintenance, or life cycle maintenance). The CDBI appears to be the most effective tool at identifying these issues, perhaps due to the focus on design requirements. However, CDBIs are infrequent and are of limited scope.

Training or additional guidance may be needed to assist inspectors in instances where they discover equipment that remains in service beyond its expected service life without justification, absent performance problems or failures. This situation can cause the SSC to lose its inherent reliability, such that it could give inspectors a basis for questioning continued compliance with the Maintenance Rule and Appendix B requirements. Appropriate training could give inspectors additional tools and the knowledge to pursue these issues. Awareness of available industry OpE may also be an issue for both licensees and inspectors.

Inspectors may also benefit from additional information on how to apply 10 CFR Part 50, Appendix B, Criterion III, Design Control, during routine inspections. Appendix B, Criterion III requires, in part, that measures shall be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety-related functions of SSCs. When an important-to-safety SSC remains in service beyond its qualified life, without an acceptable engineering evaluation, inspectors should question how this equipment remains capable of performing its safety function pursuant to the design basis specifications under this section of the regulations.

CONCLUSIONS:

1. Although the staff found there was no overall trend in the number of inspection findings and LERs involving age-related failures of important-to-safety SSCs, the overall number of these findings is of note. Inspection findings involving SSCs that have been in service for 15-20 years or more have been increasing year to year since 2009.

2. Based on the data contained in the Appendix, it appears that some licensees do not have effective life cycle PM programs (periodic or time-based PM strategies) for some important SSCs where industry and vendor experience has suggested this is necessary.

3. NRC oversight programs may not be focused on aging management of (active) SSCs, and these programs could be better prepared to effectively deal with an industry that potentially is experiencing notable occurrences of age-related SSC failures.

4. Guidance on how 10 CFR Part 50, Appendix B, Criterion III, Design Control, applies to situations where SSCs are in service beyond qualified service life without adequate justification could be improved among some inspectors.

RECOMMENDATIONS:

1. Issue an OpE COMMunication on this topic.

2. Present this issue to the NRR Executive Team, either as a Significant Topics Brief or as part of the periodic Operating Experience Overview and Analysis Report (OAR) briefing.

3. Consider issuance of a generic communication (e.g., Regulatory Issue Summary) to alert industry and staff that operating important-to-safety equipment beyond its qualified service life without adequate justification (with or without a failure history) is contrary to regulatory requirements and NRC expectations.

4. The NRC may wish to consider how inspectors could be better prepared to identify instances where licensees are operating SSCs beyond reasonable expected service life without adequate engineering justification. Additional guidance and training could be used to alert more inspectors on how these issues can be pursued using 10 CFR Part 50, Appendix B criteria.

5. Brief the regional CDBI branch chiefs and OpE contacts to alert them to the findings of this study.

6. Conduct a temporary instruction (containing examples) designed to evaluate whether licensees are documenting appropriate engineering justifications for SSCs in service beyond qualified service life. Results may inform further staff actions, such as enhancements to the baseline inspection program.

7. Consider engaging industry to propose a revision to Maintenance Rule Regulatory Guide 1.160 and NUMARC 93-01 to increase discussion of the validity of time-based (periodic refurbishment/replacement) PM and/or life cycle management.

#	Site	IR/LER Date	Inspection Type	Color - Brief Description	Expected Service Life/Actual Service Life	Regulatory Non-compliance	Failure or Deficiency
1	Pilgrim	1/30/2012	LER	Green. Entergy failed to recognize, fully document, and evaluate in their corrective action process that an installed diaphragm in the High Pressure Coolant Injection (HPCI) System exceeded its manufacturer-recommended service life. During a review of a related issue involving a manufacturing defect (Part 21 report from the vendor), the inspectors identified a degraded condition that Entergy documented in CR-PNP-2010-2500, specifically that the vendor specified this diaphragm design has a recommended service life of five years. The diaphragm currently installed in the HPCI system has been in service for seven years. This condition had not been identified or documented in a separate condition report. HPCI later failed on Nov 30, 2011 due to this condition. The LER states that a lack of periodic inspection is the reason the particulate was not discovered prior to failure of the remote servo mechanism. Since the diaphragm was installed and could not be completely inspected to verify reinforcing-fiber continuity, Entergy had scheduled the diaphragm to be replaced due to the Part 21 determination at the time of its failure.	5 years/7years	Green finding PI&R 4/15/2011 (issued prior to the HPCI failure)	Failure caused by exceeding vendor recommended service life

2	Diablo Canyon 1	12/16/2011	LER	On January 10, 2011, at 1321 PST, Diablo Canyon Power Plant (DCPP), Unit 2, entered Technical Specification Limiting Condition of Operation (TS LCO) 3.0.3 when both trains of auxiliary building ventilation system (ABVS) IVF] became inoperable following closure of Damper M-4A IDMPI and the ensuing loss of both ABVS Exhaust Fans E-1 and E-2. The cause of the loss of both trains of ABVS of Unit 2 was nonconforming single failure vulnerability in the ABVS design. The apparent cause of the Unit 2 ABVS Damper M-4A leakage past the damper actuator piston seal is presumed to be use of the seal beyond its defined service life, contrary to requirements of the DCPP preventative maintenance program for this seal. PG&E left the seal in service beyond its defined service life due to a 2007 personnel error which incorrectly closed the maintenance order to replace the seal.	unknown/unknown	Appendix B Criterion III Design Control for the single failure vulnerability, (not for exceeding service life)	Failure caused by exceeding vendor recommended service life

3	Quad Cites	12/5/2011	CDBI	Green. Inspectors noted that the vendor manual and Exelon's Performance Centered Maintenance (PCM) program specified periodic replacement of the electrolytic capacitors every ten years (the design service life), per qualifications to IEEE 323. However, procedure QCEMS 0210-02, "Battery Charger Testing for Safety-Related 125 VDC and 250 VDC Batteries," Revision 002, did not specify steps for the required periodic replacement of the electrolytic capacitors installed in four 125Vdc and in the three 250Vdc safety-related battery chargers. **A requirement for periodic replacement was removed in 1998** and replaced with a statement that because Quad Cities has redundant chargers, capacitors **may be run-to-failure**. The capacitors have not been replaced in the 1A, 2 and 2A (125Vdc) and in the ½ and 1 (250Vdc) battery chargers in about 17 years. The inspectors noted the licensee did not have an evaluation to justify not replacing the capacitors every ten years as required by the battery chargers vendor and the Exelon PCM program.	10 years/17 years	Appendix B, Criterion V, Instructions, Procedures, and Drawings, NCV, for the licensee's failure to have appropriate maintenance procedures or instructions in place for periodic replacement of the electrolytic capacitors in the 125Vdc and 250Vdc safety-re	Run to failure

4	Waterford	11/14/2011	Integrated	Green. The dry cooling tower process analog control (PAC) cards control the automatic operation of the DCT fans. The licensee deleted PM activities to replace critical PAC cards and did not take into account where practical, industry operating experience during the evaluation. These PAC cards perform a variety of control functions in various sequences for the automatic operation. Internal and industry-wide operating experience documented previous failures of process analog control cards due to age-related degradation after about 15 years of service. The licensee initially had PM activities to replace the cards on a 20 year interval; however the **PM activities were deleted in March of 2009.** Since the deletion of the PM activity to replace the PAC cards, the licensee experienced five PAC card failures. Each card was installed in 1985, making them 25 – 26 years old, not counting any shelf-life prior to installation. These failures resulted in unplanned entries into technical specifications and challenged system reliability.	20 years/26 years	Green finding of 10 CFR 50.65(a)(3) for failure to account for OpE related to PM activities for the DCT PAC cards.	Run to failure

5	North Anna	11/9/2011	Integrated	Green. On February 3, 2011, operators noticed a strong, acrid smell within the control room area. An investigation revealed flames approximately 2 - 4 inches in height coming from a circuit card in the Hathaway annunciator cabinet, 1-EICB-21. Previously, on June 27, 2010, the licensee experienced an annunciator problem and noticed a slight acrid smell in the control room. CA172487 was initiated for maintenance inspections that identified degraded resistors on annunciator cards causing enough heat to melt an adjacent plastic relay. The licensee identified that both events were caused by age related degradation that was occurring within the carbon resistors on the Hathaway annunciator cards. (see LER #338-2011-001)	unknown/unknown.	Green finding for failure to take adequate corrective action for degradation of annunciator card resistors IAW the CAP.	Failure caused by age related degradation
6	Harris	10/27/2011	Integrated	Green. The inspectors noted that UFSAR Tables 11.5.2-2 and 12.3.4-1 provides lists of radiation monitors that are included in the Radiation Monitoring System (RMS) for effluent monitoring and area monitoring. Included in these tables are three RAB exhaust effluent monitors (REM-01AV-3531, REM-01AV-3532A, and REM-01AV-3532B) and **61 area monitors that were designated as 'run-to-failure' in 2004 and were removed from the licensee's periodic calibration program.** (no actual failure)	unknown/unknown.	Green Non-cited Violation (NCV) of 10 CFR 20.1501 for the failure to periodically calibrate radiation monitoring equipment	Run to failure not prohibited by program (but no actual failure)

7	Columbia	10/25/2011	LER	No Finding. On August 27, the licensee experienced a loss of residual heat removal event following the spurious trip of a reactor protection system train B circuit card. The root cause (as identified in the LER) was that the licensee was not proactive in replacing older, obsolete logic boards with new models recommended by GE. GE issued Service Information Letter 496R1. GE also issued Supplement 1 to the letter in 1995 and Supplement 2 in 1997. These trips could cause ½ scrams or automatic valve isolations. These assemblies were used in the reactor protection system at Columbia Generating Station. GE provided no recommendations for plants whose logic cards and electric protection assembly breakers were working properly. Further, GE continued to offer the older style logic cards for purchase.	40 years/unknown.	IR 2011-008 Cards were still within the service life recommended by GE. No performance deficiency that would have required the cards replaced more frequently.	Failure caused by age related degradation
8	Point Beach 2	10/13/2011	2011-004-01	On June 13, 2011, Unit 2 scrammed while in Mode 2 when the nuclear source range detector high voltage power supply failed. **The root cause evaluation for this event determined a life cycle management plan had not been established for the periodic replacement of nuclear instrumentation high voltage power supplies**. The PM program has been revised to perform periodic replacement of the power supplies. Completion of the corrective actions to develop the life cycle management program and replace the high and low voltage power supplies is being tracked in the site corrective action program.	10 years/40 years	Open LER	Run to failure due to mis-classification

9	Browns Ferry-1	10/5/2011	LER	Green. The Unit 3 primary containment isolation system (PCIS) logic relays were allowed to exceed their service life expectancy of 15.83 years. Specifically, the licensee failed to replace numerous Unit 3 PCIS CR120A relays prior to exceeding their vendor-recommended service lifetime. **The licensee determined that since the PCIS relays would fail in a safe condition, they sought to continue operation with the relays beyond recommended service life (i.e., run-to-failure).**	15.83 years/16 years (applicable to 11 of 17 PCIS relays)	Appendix B, Criterion XVI violation, green finding	Run to failure
10	Calvert Cliffs 1 & 2	10/3/2011	LER	The No. 16 Battery Charger's sensing and current limit circuit board had overheated capacitor and resistors, and was providing no voltage output. The cause of the failure appears to be age related degradation of the electrolytic capacitor. The failed circuit board was in service greater than 16 years. The industry recommendation is to replace electrolytic capacitors in this type of circuit board every ten years. While the site had initiated a change request to modify the governing PM procedure to replace this electrolytic capacitor every ten years, the change was not incorporated. However, this change was previously made to the PM procedure of the site's station blackout diesel (OC DG) which is a similar diesel generator model as 1A DG. (1A & 2A DG to be inoperable). An NCV of Appendix B, Criterion V cited for failure to prescribe and accomplish procedures appropriate to the circumstances associated with safety related equipment (this is unrelated to the aging issue).	10 years/16 years	Appendix B, Criterion V violation (green finding)…unrelated to the aging issue.	Exceeded vendor recommended service life

11	Turkey Point	9/16/2011	CDBI	URI. Failure to establish a test program for safety-related molded case circuit breakers (MCCB) (120vac and 125vdc) to demonstrate these breakers would be able to reliably perform their intended safety functions, specifically protective tripping. The age range of approx. 511 safety-related MCCBs installed are twenty to forty years - some are original plant equipment, some were installed in the 1980s, and the remainder in the early 1990s. With the exception of bench testing prior to installation, no testing/maintenance has been performed on the breakers. Additionally, the team identified that the licensee failed to scope the protective tripping function of the MCCBs in the Maintenance Rule program.	20 years (likely)/20-40 years	potential for a maintenance rule violation.	Run to failure not prohibited by program (but no actual failure)
12	Prairie Island 1	8/23/2011	LER	On July 1, 2011, the right main turbine stop valve failed closed due to excessive oil leakage from a failed 0-ring. The licensee's inspection identified two primary issues. First, the 0-ring was flattened somewhat. There was not enough flattening to classify it as a true compression set however, this flattening was an abnormal indication. This flattening is most likely age induced deformation of the 0-ring. An age related compression set and slight extrusion near the outside contact surface resulted in the failed 0-ring. PM (PM) procedures will be revised to ensure that the 0-rings on the Stop Valves and Control Valves are replaced when the actuators are replaced. A contributing cause was that actuators do not have serial numbers to allow for tracking. Additionally, no tracking mechanism exists for spare turbine control actuators resulting in the installation of an actuator that had been last rebuilt in 1997.	unknown/14 years	no findings were identified relative to age degradation (IR 2011004).	Age related failure

13	Ft. Calhoun	8/11/2011	Integrated	Green. Finding cited (TS 5.8.1 violation for no procedural guidance to require replacement of power supplies, or an engineering justification for continued operation, once power supplies exceeded their vendor recommended life, and/or showed signs of failure and degradation). The resident inspectors at Ft. Calhoun determined that in 2009, the licensee had made changes to the reactor protective system maintenance rule documents, indicating that power supplies were not allowed to run-to-failure. The licensee scheduled replacement of some, but not all, of the reactor protective systems power supplies. However, this effort did not include an engineering justification for continued operation past vendor recommended lifetimes. **As individual power supplies began failing in 2010, there was no procedural guidance to perform evaluations on power supplies that had exceeded their vendor recommended lifetime.**	unknown/+ 30 years. Estimated service life varies, likely 30-40 years, with actual service life in excess of 30 years (Foxboro power supplies). 113 of 115 RPS power supplies were all past vendor recommended life.	TS 5.8.1 violation. A self-revealing noncited violation of Fort Calhoun Technical Specification 5.8.1, "Procedures."	Failure caused by exceeding vendor recommended service life

14	Harris	8/9/2011	CDBI	Green. The team determined that the failure to extend the qualified life of the installed Westinghouse MCCBs which were over 20 years old was a performance deficiency. The licensee confirmed during the inspection the continued reliance on this statement for the "run-to-failure" approach to circuit breaker design life that was a feature of the PM program for Westinghouse molded case circuit breakers. The licensee confirmed that Westinghouse breakers in excess of 20 years of age were installed in the plant, **and that no aging analysis had been performed to extend the design life.** There was no MCCB failure.	20 years/+ 24 years (Harris originally licensed in 1987, but underwent extremely long construction time, so MCCBs were likely installed before 1987).	Appendix B, Criterion III, "Design Control, NCV	Run to failure not prohibited by program (but no actual failure)
15	Wolf Creek	6/29/2011	LER	On April 30, 2011, during Refueling Outage 18, fuel was being loaded into the reactor vessel and the plant changed from a defueled condition to Mode 6. As the second fuel assembly was loaded next to source range detector SEN0031, the detector did not respond. Core alterations were suspended. A pulse shaper card required for source range detector operation had failed on April 14, 2011, and the failure was not detected at that time. The failed pulse shaper card was replaced later on April 30, 2011, and SEN0031 was declared operable and fuel loading resumed. The pulse shaper card had been in service since initial plant start up and failed after more than 26 years of acceptable performance.	Unknown/26 years	Open LER	Age related failure

16	River Bend	6/23/2011	PI&R	Green. During an equipment performance evaluation, the licensee discovered that during a PM optimization program in 2008, SWP-MOV55B had been misclassified as a non-critical component instead of a high-critical component. (According to licensee Procedure EN-DC 153, "PM Component Classification," the relay should have been classified as high-critical and high-duty-cycle.) The River Bend PM template for Gould J10 control relays had established a replacement interval based on not exceeding the expect service life for the given service conditions. (For relays the licensee had classified as high-critical, high-duty-cycle, they had established a 21-year replacement period.) Consequently, because the relay had been classified as non-critical, the licensee had not established a recurring preventive maintenance task to periodically replace the relay. The inspectors discovered that the subject relay had been in service for 26 years, well beyond its expected lifetime of 21 years.	21 years/26 years	Appendix B, Criterion XVI, "Corrective Actions, NCV green finding	Run to failure due to miss-classificati on
17	Indian Point 2	5/12/2011	Integrated	No Finding. Entergy personnel determined that the most probable cause of rod bottom bistable failures was age related degradation. In addition, Entergy personnel determined that electrolytic capacitors in the RPI circuitry were also susceptible to age related degradation, while the repetitive instrument drift was most probably related to analog circuitry design and calibration techniques.	unknown/38 years. The bistables were original equipment installed in 1973, making them 38 years old.	No findings.	Failure caused by age related degradatio n

18	FitzPatrick	5/4/2011	LER	No Finding. On October 23, 2010, the licensee noticed an acrid odor within the control room which was determined to be emanating from 23INV-79, the HPCI instrument power inverter. Entergy personnel replace the degraded inverter, a Topaz Electronics Model N250-GWR-125-60-115, with one of new design. The degraded inverter was supplied to FitzPatrick in February 1973 and had been refurbished and reinstalled in the plant on October 1, 2010, but not the transformer associated with the inverter. According to the Electric Power Research institute, EL-5036, Volume 2, “Power Transformers," the typical life expectancy of an energized and loaded transformer is between 30 and 40 years. However, transformers are generally considered beyond the usual scope of items replaced during preventive maintenance refurbishments.	30-40 years/39 years	No findings. Integrated	Run to failure
19	Palisades	5/4/2011	Integrated	Green. Since installation in 1998, the licensee had not recognized that the capacitors in the digital reference unit were susceptible to age-related degradation and that the vendor recommended refurbishment interval was approximately 10 years. When the inspectors raised the issue, the digital reference unit capacitors were approximately 4 years beyond the industry recommended refurbishment interval.	7-10 years/16 years	Appendix B, Criterion III, Design Control, for the failure to recognize and account for potential age-related degradation of capacitors in the EDG digital reference units design controls.	Failure caused by exceeding vendor recommended service life

20	Salem 1 & 2	4/4/2011	CDBI	Green. Inspectors identified a small tear in the expansion joint between the CREACS filter housing and the cooling coil and several wear spots and three additional small breaches on the Unit 1 and Unit 2 filter housing expansion joints... This deficiency potentially impacted both Salem operating units as the redundant Unit 1 and Unit 2 CREACS trains supply filtered air under accident conditions to a common control room. In addition, the expansion joint PCM template noted that a review of industry OE showed that the mean time to failure for rubber expansion joints is 12 to 15 years, and the filter housing expansion joints were most likely manufactured in 1975 and installed during initial construction. PSEG did not plan work activities to support long term equipment reliability by ensuring that maintenance scheduling was more preventive than reactive. Specifically, PSEG did not implement appropriate PMs on the CREACS filter expansion joints necessitating several reactive corrective maintenance (CM) activities.	12-15 years/36 years	Appendix B, Criterion XVI, "Corrective Action."	Run to failure due to deficiencies in the preventive maintenance program

21	Monticello	2/28/2011	LER	At 1250 on October 21, 2011, at the Monticello Nuclear Generating Plant, a 2R Auxiliary Transformer lockout unexpectedly occurred, causing off-site power to automatically transfer to the 1R Auxiliary Transformer, which resulted in a reactor scram. Root cause was found to be one cable of the "A" phase conductor supplying power from 2RS Transformer to 2R Transformer faulted to ground resulting in 3N4 breaker opening to protect 2RS Transformer and other equipment from fault and current damage. The insulation at the location of the fault had degraded such that it was unable to withstand either normal or transient conditions. Subsequent testing indicates the cable had suffered from environmental and age-related degradation. One of the three cable segments had been submerged in water. The entire 35kV feeder cable run was replaced with 750 kcmil copper cables with 133% insulation, employing a route designed to avoid cable submergence in water as part of improving the long term life cycle management of the sub-yard power feed to the site reserve 2R Transformer.	unknown/unknown	LER still open.	Age related failure

22	Brunswick	2/24/2011	CDBI	The licensee failed to include the Unit 1 and 2 isolation override switches associated with the hardened wet well (Torus) vents in the scope of the maintenance rule, and thus, did not ensure the circuitry was being monitored for functionality. Because the circuitry was not monitored, a relay in the Unit 1 circuitry degraded unacceptably without the licensee's knowledge. The licensee performed an extent of condition review that identified 4 isolation override switches associated with 14 valves on each unit that required testing. The testing in January 2011 revealed the failure of a Unit 1 relay (3-12) which adversely affected the override capability associated with Unit 1 valve CAC-V7-AO.	unknown/unknown.	Appendix B, Criterion XVI, "Corrective Action"	Run to failure due to deficiencies in the PM program
23	River Bend	2/14/2011	Integrated	Green. Inspectors discovered a condition that, if left uncorrected, had the potential to lead to a significant safety concern. In December 1985, the high pressure core spray pump with its lower motor bearing drain plug was placed into service. GE issued guidance (SIL 484) in 1989 and in 2001 stating that the o-ring needed periodic replacement. But, the licensee determined that there was no action required; and they had no PM program in place to periodically replace the o-ring in the high pressure core spray lower motor bearing drain plug. Degradation of the o-ring could allow a leak that would render HPCS inoperable. A GE SIL on this topic had been screened several times by the licensee and no action taken.	GE required periodic replacement, but did not specify time interval)/25 years	NCV of TS 5.4.1 failure to determine the appropriate PM strategy and task frequency for the O-ring.	Run to failure

24	Oyster Creek	2/8/2011	Integrated	Green. Exelon experienced 4 safety-related mechanical snubber failures during 1R23. All four snubbers had a history of repetitive failures. These snubbers had failed or were found degraded and replaced at intervals between 6 and 17 years, despite the 40 year rating. In 2004, PSA issued a tech bulletin modifying this service life to state that "appropriate maintenance and operation with rated load and environmental limits" must be performed to maintain 40 year service life. However, the licensee did not update their procedures to account for the PSA tech bulletin and did not change their maintenance program.	40 years with appropriate PM program/6 to 17 years.	TS 4.5.M.1.f, Snubber Service Life Monitoring (NCV)	Failure caused by exceeding vendor recommended service life based on additional vendor restrictions
25	TMI	2/3/2011	Integrated	Green. The ICS to digital turbine control system (DTCS) signal converter remained in operation past the vendor recommended service life and failed due to age related degradation, causing a Turbine trip and a plant power transient from 100 to 14 percent reactor power. The licensee's root-cause evaluation (RCE) determined the signal converter had been in service since original installation in 1995 (15 years service). The mean time between failures (MTBF), as determined by the vendor, was 10 years. No periodic PM (PM) requirements (e.g., calibration or replacement) had been implemented for the signal converter prior to this event.	10 years/15 years	FIN, failure to establish a periodic task to calibrate and/or replace the ICS to DTCS signal convertor, in accordance with procedures.	Run to failure

26	North Anna	1/28/2011	Integrated	Green. The failure to maintain an adequate PM (PM) procedure led to an age related failure of a motor starter (main contactor) causing a fire in safety related breaker cubicle J1 of motor control center (MCC) 1J1-2S which supplied power to the D control rod drive mechanism cooling fan, 01-HV-F-37D. This component was original equipment and in service approximately 35 years. Licensee procedures stated that “Routine PM (PM) shall be performed on all circuit breakers in the Dominion Circuit Breaker Program. A PM task shall be established for each circuit breaker in the Program.	unknown/35 years.	TBD. Failure to Maintain PM procedures for MCCBs current with industry information and OpE.	Run to failure due to deficiencies in the PM program
27	Summer	1/27/2011	Integrated	Green. On February 10, 2010, EDG excessive jacket water cooling pump seal leakage rendered the "A" EDG inoperable. The licensee determined the cause of the event was the sudden catastrophic failure of the mechanical seal due to age related degradation of the elastomeric material in the seal. The seal had never been replaced and degraded over the years of service. The licensee's PM program relied on periodic operator visual checks and was established in accordance with the Fairbank Morse Owners Group (FMOG) maintenance recommendations in lieu of a PM for periodic pump seal replacements. The inspectors determined that the licensee’s failure to take adequate corrective actions to identify and correct inadequacies in the EDG PM program for monitoring EDG engine driven pump seal leakage in accordance with vendor recommendations was a performance deficiency.	6 month visual inspection in lieu of periodic replacement program/20 years. Seal was original equipment at time of licensing (1982)	Appendix B, Criterion XVI, “Corrective Action", NCV	Run to failure due to deficiencies in the PM program

28	Cooper	12/3/2010	CDBI	Green. Licensee failed to provide adequate engineering justification for exceeding the vendor recommended service life of safety-related Agastat EGP series relays and ETR series timers. Amerace Corporation was in the process of developing a test program to extend the service life of the relays beyond the 4.5 years specified in IN 84-20 for normally energized relays. Licensee's analysis determined that expected lifetime was 12.6 years for their environment, and recommended replacement every 12 years. Licensee discounted the potential failure of a coil bobbin in the relay that was specified as a potential weak link by the vendor. When expected lifetime was re-calculated by inspectors while factoring in possible failure of the coil bobbin, it was reduced to 7.7 years. No actual failure occurred.	8 years/+12 years	Appendix B Criterion III Design Control	Failure caused by exceeding vendor recommended service life
29	LaSalle	11/24/2010	LER	Green. HPCS Div 3 swgr room supply fans stopped running. HPCS (single train sys) declared inoperable. Cause was age related failure of swgr cubicle control relay. Relay was miss-classified as low duty cycle and had no periodic replacement requirements (had been in service 10 yrs). Classification was changed to high duty cycle. The inspectors concluded that the failure to properly classify the Unit 2 Division 3 ventilation fan control relay in accordance with MA-AA-716-210, “Performance Centered Maintenance Process”, constituted a performance deficiency that warranted evaluation using the SDP.	unknown/10 years	Integrated. TS 5.4.1 Failure to follow performance centered monitoring process.	Run to failure due to mis-classification or other deficiency

30	Indian Point 3	11/8/2010	Integrated	Green NCV (self revealing). Loss of safety related power source to the Static Inverter due to blown fuse. Fuse failed due to 2 faulty commutation capacitors that had a service life of 9 years but had been left in service for 13 years. Licensee had discussed implementation of a capacitor replacement program following earlier failures, but initial CA's transferred to other CA's and eventually the initial intent of the program was misinterpreted (i.e., licensee thought it only applied to power supplies). In Jan 2009, procedure was implemented to required replacement of critical commutation capacitors in the inverter. Licensee did not effectively use vendor manual of a source to identify the 9-year replacement recommendation for the capacitors (missed opportunities)	9 years/13 years	Appendix B Criterion XVI	Failure caused by exceeding vendor recommended service life
31	Prairie Island	11/4/2010	PI&R	None. See 2009 entry for Foxboro H-Line modules. The licensee determined the cause of the loss of letdown and pressurizer heaters was an age related failure of Foxboro bistable 2LC-428D. This failed bistable caused the letdown valves to isolate and the pressurizer heaters to de-energize as designed. Long-term corrective actions for Foxboro bistable replacement were already underway.	unknown/unknown	No Finding	Age related failure

32	Indian Point 3	11/3/2010	LER	On September 24, 2009, during performance of IC-SI-18 (Full Power Alignment for the Gamma-Metrics Excore Nuclear Instrumentation System) channel N-38 could not be aligned and the power range was declared inoperable and Technical Specification (TS) 3.3.3 (Post Accident Monitors) entered. The apparent cause of a failed power supply was a lack of a recurring PM (PM) action to replace the low voltage power supply because N-38 was not included in the Indian Point Energy Center (IPEC) Power Supply PM Program or the IPEC Capacitor Replacement Program. PMs are created based on component classification that are input into the IPEC work control program. The initial N-38 classification was based on its TS AOT instead of its safety function. **From Inspection Report:** Green. Contrary to guidance, Entergy did not classify the N-38 neutron detector as a highly critical component. Detector not included in site PM program, which contributed to LVPS failure due to age-related degradation. The inspectors noted that the DC power supply and capacitor PM programs were implemented in 2008, in accordance with guidance provided in the Entergy Nuclear South PM template, which prescribed replacement of power supplies for high critical components every 12 years. When the power supply for N-38 failed, Entergy staff estimated it to be greater than 15 years old but the power supply had not previously been replaced.	12 years/+15 years	Integrated - Green NCV of Appendix B Criterion V	Run to failure due to miss-classificati on

33	North Anna 1	10/29/2010	Integrated	Green. CRDM Fan breaker cubicle. MCCB main contactor damage. The direct cause of the fire was overheating of the main contactor coil due to age related insulation degradation between the windings of the coil. This component was original equipment and in service approximately 35 years. The inspectors performed a search of industry programs to determine the availability of operations experience and PM program information relative to main contactors and identified several EPRI and Sandia reports that specifically addressed Klockner-Moeller breakers and related component failures. The inspectors concluded that licensee procedures did not contain guidance to test the main contactors to detect degradation of the respective coil winding, and that adequate time existed for the licensee to follow their aforementioned program requirements as stated in their procedures.	20 years (likely)/35 years.	Self-revealing, Breaker cubicle fire in SR breaker	Run to failure due to deficiencies in the PM program
34	ANO	9/27/2010	Security SIT	No Finding. A failed power supply and electrical perturbations led to loss of CAS and SAS computers. Inspectors observed that the security computer system is aged, the supply of spare parts is limited, and many electronic components are > 25 years old and past expected service life. The components are classified as run to failure.	unknown/+25 years	Loss of both CAS and SAS computers	Run to failure

35	Surry 1	9/10/2010	SIT	Green. NI cabinet fire due to age-related failures of R/C filters. Missed opportunity following similar problem in U2 in 2009. Review of the vendor manuals for the NI cabinets identified that the recommended PM was primarily limited to the upper half of the cabinets known as the drawer assembly. Recommended practices included inspection of the drawer assembly components for signs of overheating or deterioration. The lower half of the NI cabinets are known as the termination cabinets. The termination cabinets are where the RC filters are located. The inspectors noted that none of the documents reviewed explicitly addressed inspection of the termination cabinets for mechanical degradation or component deterioration.	unknown/+36 years capacitors were original equipment (see LER 05000280-2010-003)	Appendix B Criterion XVI. Small control room fire	Age related failure
36	Columb ia	9/9/2010	CDBI	Green. Specifically, as of June 10, 2010, the licensee's design control measures failed to verify or check the adequacy of design for the extension of qualified life for safety-related Tyco/Agastat E7000-series timing relays from 10 years to 40 years, by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Specifically, the licensee did not follow their station procedures for extending the service life and changing PM frequencies; did not account for some known modes of degradation; did not account for normal and abnormal operating conditions; and did not maintain a trending program to monitor for indication of impending end-of-life relay failures. 44/124 safety-related relays exceeded their 10 year qualified life.	10 years/+10 years	Appendix B Criterion III.	Exceeded vendor recommen ded service life restriction

37	Clinton	8/23/2010	LER	Green NCVs. The cause of the 1B21-F032A check valve to fail its leak rate test is considered to be age-related degradation of lubrication causing increased friction in the actuator, the same cause for the similar 1B21 F032B failure when tested in 2010 during refueling outage C1 R12. The actuator had not been re-lubricated since initial installation during a refueling outage that ended in May 1999. No PM activities existed to lubricate or overhaul the actuator. LER 2010-002 was submitted on this issue, then LER 2008-003 was submitted when licensee recognized the same thing had happened in 2008.	10 years/10 years (rebuild) 1 year on re-lubing (actual case was 10 years without re-lubing)	App B Criterion V, TS 3.6.1.3, and 50.73 violations for failure to submit LER from 2008, for excessive LLRT results in excess of TS limits, and for inadequate procedure guidance. All licensee identified.	Failure caused by age related degradation
38	Indian Point 3	8/10/2010	Integrated	Green. Contrary to guidance, Entergy did not classify the N-38 neutron detector as a highly critical component. Detector not included in site PM program, which contributed to LVPS failure due to age-related degradation. The inspectors noted that the DC power supply and capacitor PM programs were implemented in 2008, in accordance with guidance provided in the Entergy Nuclear South PM template, which prescribed replacement of power supplies for high critical components every 12 years. When the power supply for N-38 failed, Entergy staff estimated it to be greater than 15 years old but the power supply had not previously been replaced.	12 years/+15 years	None	Run to failure due to mis-classification or other deficiency

39	Hatch	7/30/2010	Integrated	Green NCV. Spurious LOCA and power reduction to 85% occurred due to trip of 2 drywell pressure ATTS cards. Cards tripped due to failure of ceramic capacitor. Previous failure in 2006 (capacitor age 24 years, "weakened by age"). Most recent failure 2010 (capacitor age 27 years). Corrective actions from 2006 failure were not successful in preventing 2010 failure.	unknown/24-27 years	Appendix B Criterion V.	Age related failure
40	Prairie Island 2	7/16/2010	LER	None (LER). Age-related failure of a pressure switch caused a trip of the only operating feed pump, and subsequent reactor trip from 32% power. The pressure switch had been installed since 1971 (39 yrs).	unknown/39 years	Reactor Trip - No PD. Closed out in IR 2010004	Age related failure
41	Calvert Cliffs 1 & 2	6/14/2010	SIT	White. Licensee did not implement a performance monitoring plan to justify exceeding vendor recommended service life for the Agastat E7000 series T3A time delay relay. 93001 inspection (4/29/2011) conducted.	10 years/13.5 years	T.S. 5.4.1. Failure of 2B EDG	Exceeded vendor recommended service life restriction

42	Wolf Creek	5/3/2010	LER	2 Greens. Reactor trip resulting from feed pump trip on loss of power to speed sensor because an inverter failed to transfer to its alternate power supply while replacing a light bulb. The inverter didn't transfer to its alternate power supply due to sticking of a reed relay on the static transfer switch ckt board. E51 **From Inspection Report:** The inspectors determined the licensee's root cause evaluation inappropriately identified the direct cause as the root cause and incorrectly stated the actions taken to replace the cards were sufficient such that no corrective actions to prevent recurrence were necessary. The NRC inspectors concluded that a contributing cause identified in the root cause evaluation, the decision to continue operating with equipment beyond its design life, was more appropriate as a root cause.	Unknown/unknown, although inverter life is typically 20 years. This age of this failure was likely greater than 20 years.	TS 5.4.1. Findings were related more to licensee's failure to follow root cause determination procedure, and failure to follow loss of MFP procedure.	Run to failure due to deficiencies in the PM program
43	Hatch	2/12/2010	Integrated	White. Failure to replace electrolytic capacitors prior to failure. As a result, between 2005 and 2009, the 2A, 2C and the 1B swing EDG experienced failures of the LOSP/LOCA circuitry, which were attributed to electrolytic capacitor age-related failures. On February 12, 2009 the Unit 2A EDG LOSP timer card was found in a failed state.	7-15 years PWR supplies (EPRI guidelines) & 10 years for EDG timer cards)/17 years	T.S. 5.4 "Procedures". Failure of LOSP/LOCA circuitry	Exceeded vendor recommended service life

44	San Onofre U3	2/10/2010	LER	Green NCV. A technician grounded a wire while performing maintenance on 'B' EDG rendering it inoperable. Per TS, licensee required to start 'A' EDG within 24 hours or else commence a TS req'd S/D. Train 'A' EDG failed to start. The Train A EDG failure was caused by an open capacitor in a power supply for the annunciator panel. The resulting voltage spikes caused a speed switch malfunction, locking out the start signal to the air motors. SONGS 3 commenced a TS req'd S/D and declared a UE. The power supplies are continually energized, and the capacitors had previously exhibited signs of age related degradation. No prior evidence of capacitor failure. Licensee determined the root cause to be latent manufacturing defect.	unknown/unknown	Appendix B Criterion XVI finding for failure to correct conditions adverse to quality.	Failure caused by age related degradation
45	Indian Point 3	2/9/2010	Integrated	NCV. A portion of the MCCBs in SR applications exceeded the 20-year lifetime recommended in Westinghouse TB-04-13. Some had been in service for 29 years. Inspectors determined that Entergy personnel did not take timely corrective actions to replace or evaluate qualification of breakers in service which already exceeded their 20 year design life. Three corrective actions were developed as a result of a failure occurring in 2006. The first was to replace and calibrate ATTS cards 2E41-N658B and 2E41-N658D. The second was to expand the contract service agreement with the vendor to include the replacement and/or refurbishment of all ATTS cards. The third corrective action was to develop a long range proposal on ATTS cards for engineering review board approval. However, the corrective actions were not effective in preventing the April 16, 2010 failure of an ATTS card.	20 years/29 years	Appendix B Criterion XVI. Intermittent SR breaker failures over past few years.	Age related failure

46	Prairie Island	2/8/2010	Integrated	Green. Loss of CW pump led to reactor trip. From previous OpE, and IN 2002-12, licensee determined CW pump cables were susceptible to becoming wetted. Implementation of underground cable monitoring plan was delayed 7 years.	unknown/unknown, but likely original equipment installed at time of licensing (1974) (36 years).	Self-revealing. Reactor Trip	Run to failure due to mis-classification or other deficiency
47	Callaway	2/4/2010	LER	None (LER). Age-related failure of the BOP ESFAS power supply resulted in a TS required shutdown. No periodic replacement strategy. No trending of PM performance data. Power supply was in place for 25 years and exceeded its recommended service life. It was allowed to run to failure without any time-based replacement plan.	unknown/25 years	TS required shutdown. No Findings	Run to Failure

48	Browns Ferry 2	11/24/2009	LER	On September 30, 2009, at approximately 0830 hours Central Daylight Time, Browns Ferry Nuclear Plant (BFN) Site Engineering personnel concluded that during a September 29, 2009, manual reactor scram, the Reactor Core Isolation Cooling (RCIC) system pump failed to inject into the reactor vessel in response to decreasing water level. The immediate cause of the event was a failed Woodward EG-M control box. Woodward personnel identified an age related failure of a timing capacitor within the EG-M. The root cause of this event was a failure to enter a condition adverse to quality into the corrective action program. On September 12, 2009, an Engineering Specialist noted the change in the output of the Woodward EG-M controller and notified the responsible System Engineer. Neither of these individuals entered the issue into the corrective action program.	7 years/34 years According to an EPRI study of terry turbines, they recommend replacing/refurbishing the control box every 5-7 years. This one was in service for 12632 days, or 34 years.	Green NCV of TS limiting condition for operation (LCO) 3.5.3 (Integrated 2009005)	Age related failure
49	Catawba	11/20/2009	CDBI	Licensee failed to inspect, test or perform preventative maintenance on Turbine Driven Auxiliary Feedwater Pump sump valves. During the inspection, the licensee performed performance test and one sump failed to stroke closed. After repairing the valves, the licensee re-categorized the valves in the discharge flow path from risk category C (run-to-failure) to risk category A (highly risk-significant) and enhanced procedural guidance to ensure a flow path will always be available from the Turbine Driven Auxiliary Feedwater Pump pit sump.	unknown/unknown	10 CFR 50.65(a)(1)	Run to failure due to mis-classification or other deficiency

50	Waterford	11/5/2009	SIT	The licensee inappropriately extended the service life of 322 safety-related Tyco/Agastat series E7000 time-delay relays without having an adequate technical basis. Vendor specifications list the qualified life of Agastat E7000-series relays as 25,000 operations or 10 years from the date of manufacture, whichever occurs first. The manufacturer recommends relay replacement at the end of this 10-year qualified life, and performance of periodic monitoring of relays during the 10-year life to monitor for substantial changes in timing delay which may indicate premature end-of-life. The licensee's engineering justification for extending the qualified life beyond the manufacturer-recommended 10 years considered only degradation due to thermal aging; it failed to consider other known modes of degradation in accordance with applicable industry standards. Further, the team identified that a performance monitoring program intended to assess any increased failure rate due to this change was inappropriately canceled. Specifically, only one of the identified relay failures had occurred beyond the recommended 10-year service life.	10 years/unknown (note, at Waterford, relay replacement is perform between 18 and 30 year intervals. The one failure noted was an Agastat relay that was more than 10 years old.)	Appendix B, Criterion III, "Design Control"	Failure caused by exceeding vendor recommended service life

51	Limerick	11/3/2009	Integrated	In 2004, Exelon inappropriately classified certain safety related 480 volt molded-case circuit breakers as run-to-failure in the Performance Centered Maintenance (PCM) process, which resulted in the breakers receiving no planned PM or testing. 61 safety-related 480 volt MCUs supplying non-safety-related loads from safety buses were classified as "run-to failure." Instead, the molded-case circuit breakers should have been classified as "critical" or "non-critical." **The installed molded case circuit breakers classified as run-to-failure had received no periodic planned maintenance or tests and were beyond the manufacturer's design life.** There were no significant failures.	20years/unknown (PM activities discontinued in 2004)	Appendix B, Criterion XI, "Test Control (Failure to establish a test program for all safety-related 480 volt motor control unit (MCU) circuit breakers to assure that necessary testing was performed to demonstrate that they would perform the safety-relate	Run to failure due to mis-classification
52	Davis Besse	10/21/2009	Integrated	Failure to implement a maintenance strategy to replace a capacitive coupled potential device (CCPD) in a timely manner. The CCPD had been installed beyond the 25-year life expectancy and failed catastrophically on June 25, 2009. Industry operating experience has shown that CCPDs tend to fail after 20 to 25 years of life. These devices have a potential to fail catastrophically if installed beyond the recommended life. The licensee was aware of the age-related failure potential after performing a review of operating experience in 2004. The philosophy at the time was to run the CCPDs to failure, as they were not considered critical components.	20-25 years/+30 years	Not a violation	Failure caused by exceeding vendor recommended service life

53	Prairie Island	9/25/2009	PI&R	failure to promptly correct a condition adverse to quality regarding the expired qualification of safety-related molded case circuit breakers. Specifically, the licensee failed to evaluate extending the service life of safety-related molded case circuit breakers beyond the 20 year life expectancy, a condition adverse to quality. At the time the Westinghouse bulletin was received in 2006, the breakers in question had been in service for 23 years. At the time of this inspection, those breakers had been in service for 26 years. Specifically, an unqualified safety-related molded case circuit breaker could lead to higher trip times and potential unavailability of safety-related components associated with the bus when a circuit fault is present.	20 years/23 years	Appendix B, Criterion XVI, “Corrective Actions"	Exceeded vendor recommended service life restriction

54	Salem	8/19/2009	PI&R	On July 22, 2006, following a failure of the 1B vital instrument bus inverter, Salem identified that certain components of the vital instrument bus inverters were susceptible to age-related degradation. Specifically, PSEG identified that components in these inverters exceeded their vendor-recommended 10-year service life and that there was no PM plan in place to replace these components prior to the end of service life. PSEG entered the issue into the corrective action program, proposed corrective actions, and developed a performance centered maintenance (PCM) template for the inverters. However, the station delayed implementation of the actions due to challenges in requisitioning new parts and refueling outage (RFO) scheduling issues. This delay resulted in more age-related degradation failures of the vital instrument bus inverters, specifically, the 1D vital instrument bus inverter failure on August 24, 2008, and the 2B/2C vital instrument bus inverter failures on December 31, 2008, and January 1, 2009, respectively. Although the components exceed their vendor-specified lifetime, failure of these components would not result in a complete loss of power to a vital bus due to the availability of two back-up sources of power, and therefore did not have a significant impact on plant operations.	10 years/+10 years	Not a finding	Failure caused by exceeding vendor recommended service life

55	IP-2	5/14/2009	Integrated	Licensee did not promptly identify and correct a degraded three-hour rated fire door on the west entrance of the 480 Volt switchgear room. The inspectors notified operations personnel of the non-functioning fire door and Entergy subsequently had a locksmith inspect the latch. The locksmith installed a new latch mechanism on March 3 and determined the latch issues observed were age-related due to interaction of wear products from the latch interfering with the moving portions of the latch, as a result of latching and unlatching door operations.	unknown/unknown	License Condition 2.K., fire protection program	Failure caused by age related degradation
56	Point Beach	5/8/2009	PI&R	The licensee failed to have steps in the routine maintenance procedure (RMP) 9036 series maintenance procedures for periodic replacement of the electrolytic capacitors in the SCI-model inverters as recommended by the vendor. Maintenance procedures for the SCI and Elgar inverters did not match with respect to the replacement of the capacitors. The Elgar inverters specified capacitor replacement every six years per the RMP 9045 series procedures. The SCI inverters did not have any requirements listed in the RMP 9036 series procedures to replace the capacitors. The vendor recommended the capacitors be replaced every 10 years. Review of the work order history for all six SCI inverters found that the capacitors have never been changed out since inverters were originally installed in the 1990s. **Additionally, no evaluation was found to justify not replacing the capacitors per the vendor recommendations.**	6 years (Elgar inverters)/10 years. 6-10 year (SCI inverters)/10 years	Appendix B, Criterion V, “Instructions, Procedures, and Drawings"	Exceeded vendor recommended service life restriction

57	Palo Verde	5/5/2009	Integrated	Between May 2006 and March 2009, corrective actions to replace degraded sodium hypochlorite valves with a more reliable chemical addition system were not taken resulting in the Unit 2 spray pond Train A chemistry pH level being out of specification high on two occasions. The failure on January 28, 2009, was the third failure of an essential spray pond chemical addition system valve since July of 2008. These valves were classified as "run to failure." The chemical addition system valves are diaphragm operated rising stem valves. This type of valve is used across the industry for applications associated with hypochlorite and other highly corrosive chemicals. A review of industry and Palo Verde operating experience identified a trend of issues associated with failure of the diaphragm valves, particularly if they are installed and used beyond their nominal five year shelf life. During their review, the inspectors noted that no PM was prescribed for these valves, the work orders did not contain instructions for torque values and travel stop settings, and did not reference the vendor technical document within the work order.	5 years/unknown	Appendix B, Criterion V, "Instructions, Procedures, and Drawings"	Run to failure due to mis-classification or other deficiency
58	Catawba	4/28/2009	Integrated	Failure to translate the design basis for the Component Cooling Water (KC) heat exchanger Nuclear Service Water (RN) outlet control valve and the vendor's construction drawings into maintenance procedures to ensure the valve would remain operable over the design lifetime of the component. More specifically, the valve's actuator arm assembly was not scoped into the licensee's maintenance procedures for replacement, despite the fact that the vendor drawing identified the assembly as a consumable.	unknown/unknown	Appendix B, Criterion III, "Design Control"	Run to failure due to deficiencies in the PM program

59	Palo Verde 1 & 2	3/20/2009	PI&R	The licensee failed to incorporate industry and vendor recommended preventative maintenance requirements to prevent the age related degradation of safety related inverter components. The inspectors reviewed the EPRI recommendations, and determined that several important maintenance practices were recommended but not implemented by the licensee, including: (1) detailed visual inspections and chemical cleaning of inverter subcomponent connections for oxidation or corrosion buildup, (2) twelve-year replacement interval for vital circuit boards, and (3) twelve-year replacement interval for silicon-controlled rectifiers. The inspectors learned that the inverter system engineers were aware of the existence of the EPRI guidance, but had failed to incorporate this industry standard into maintenance practices for the inverter system.	10-12 years/unknown. However, these inverters were likely original plant equipment. Unit 1/2 licensed in 1985/86, making these inverters 23 years old.	Appendix B, Criterion XVI, “Corrective Action"	Run to failure due to deficiencies in the PM program
60	Hatch	3/13/2009	SIT	(see also IR 366/2008-008) Since 1988, the licensee had observed cracks in the glands of the EDG couplings, but did not identify the cracking was an indication of coupling degradation. On July 12, 2008, the 1B EDG was manually shutdown due to excessive vibration and declared inoperable. Post-event inspections by the licensee identified several cracks of the rubber gland on both the diesel engine flywheel side and the generator side of the coupling. It was later determined that the cause of the excessive vibration was the age-related cracks in the rubber gland of the EDG coupling.	unknown/+20 years (note: this is likely original equipment and could be as old as 34 years (original plant licensing was in 1974)	Appendix B, Criterion XVI, Corrective Action	Failure caused by age related degradation

61	ANO 1	2/10/2009	LER	At 0855 CST, on December 12, 2008, and again at 1212 CST, on December 20, 2008, Arkansas Nuclear One, Unit-1, initiated a manual plant trip from power in response to receipt of asymmetric rod alarms and recognition of abnormal control rod group 7 movements. Testing and analysis determined that the probable root cause was degradation of two of the Control Rod Drive System Automatic Bus Transfer (ABT) relays as the result of inadequate PM. (From IR, “The licensee determined that these relays were original equipment and were degraded. Also, there were no PM tasks or replacement strategies associated with these relays.”) (see also IR 313/2009-005, no findings).	unknown/+35 years. The relay was original plant equipment (ANO licensed in 1974)	N/A	Run to failure due to deficiencies in the PM program
62	Point Beach	2/6/2009	Integrated	The licensee used a multi-detector gamma spectroscopy system to analyze liquid and gaseous samples to quantify its effluent releases to the environment. Lower limits of (LLDs) were required to be met. The inspectors identified that, from 2007 through October 2008, approximately 20 percent of the daily performance checks of the gamma spectroscopy system failed initial testing, but subsequently successfully met quality control standards after retesting or following instrument repair. The instability was attributed by the licensee to detector age-related degradation, including repetitive instances of detector vacuum seal leakage.	unknown/unknown	NCV of TS 5.4.1, "Procedures"	Failure caused by age related degradation

63	Oyster Creek	1/21/2009	LER	On November 28, 2008 at 2101 while operating at 98% power, a generator trip occurred due to a transformer differential relay actuation. The cause of the differential relay actuation is attributed to an electrical fault internal to the M1A Main Power Transformer. This transient led to a reactor automatic shutdown due to a load reject SCRAM. An electrical fault internal to the M1A Main Power Transformer led to a reactor automatic shutdown due to a load reject SCRAM. Main Power transformer electrical testing frequency was not increased from PCM template minimum frequency as appropriate for a transformer of M1A's age and one displaying M1A's other characteristics, as based upon the 2005 transformer assessment report recommendation and recent industry operating experience.	unknown/20 years	LER closed (Integrated 2009002)	Run to failure due to deficiencies in the PM program
64	Summer	1/7/2009	CDBI	In May 2008, Westinghouse advised the licensee that 3 out of the 4 reactor trip breakers sent in for refurbishment could not be refurbished because they had exceeded their service life of 4000 cycles. The 4000 cycle service life was clearly stated in the vendor manual but had not been captured in the maintenance procedure or otherwise evaluated as not applicable.	4000 cycles/+4000 cycles	Non-cited violation of TS 6.8.1, Procedures and Programs	Run to failure not prohibited by program (but no actual failure)
65	Limerick	12/30/2008	LER	On November 2, 2008, the Unit 1 HPCI system was rendered inoperable due to observed oscillations in the system flow indication. The condition was corrected by recalibration of a flow transmitter, replacement of a square root converter, and replacement of a degraded inverter in the HPCI turbine control system. A failure analysis determined the most probable cause of the inverter component failure to be age-related degradation.	unknown/unknown	LER closed, no findings (IR 2009-002)	Age related failure

66	Duane Arnold	11/4/2008	Integrated	Engineering initiated CAP 059812 identifying that EQ tasks to replace the motor bearings in 1VAC011-M and 1VAC012-M, the ECCS room cooler fan motors, were approaching their Drop Dead Dates (DDD) of September 1, 2008, and September 27, 2008, respectively. Duane Arnold's ACP 1208.3 requires that "effort should be made to both initiate and evaluate ARs [CAPs] prior to exceeding the …EQ DDD." This qualification record stated that the "motor bearings are qualified for 40 years provided that the grease is fully repacked after 12 years of service or the bearings are replaced every 12 years.	12 years/+12years	NCV of Technical Specification (TS) Section 5.4.1.a	age degradation (no actual failure)
67	River Bend	10/27/2008	CDBI	The licensee failed to implement a test program to assure that all installed safety-related molded-case circuit breakers would perform satisfactorily in service and failed to ensure that the molded-case circuit breaker PM program remained current with industry and NRC operating experience to ensure that the installed safety-related and important-to-safety molded case circuit breakers did not degrade and would perform satisfactorily in service... molded-case circuit breakers were not under a periodic test and PM program that assessed age-related degradation of electrical components in the breakers.	unknown/unknown	Appendix B, Criterion XI, "Test Control."	Run to failure not prohibited by program (but no actual failure)
68	Harris	10/17/2008	LER	A "rod control urgent" alarm was received upon initial withdrawal of Control Bank C. Local inspection revealed phase failure on the movable gripper in cabinet 1AC. A manual reactor trip was initiated at 0905. The cause of the loss of phase voltage was a blown control bus duct fuse due to aging. The root cause of this event was attributed to the existing PM not being adequate to prevent age related failures.	unknown/22 years	LER closed, no finding (IR 2008-005)	Run to failure due to deficiencies in the PM program

69	Harris	10/8/2008	LER	On August 10, 2008 the Harris Plant experienced an increase in condenser backpressure and changes in the Steam Generator secondary side chemistry. At approximately 21% power, the unit was manually tripped by operators due to reaching predetermined administrative limits. The increase in condenser backpressure was caused by a failure of the condenser exhaust boot seal due to aging. The root cause of exhaust boot seal failure was that past experience was not applied to the preparation of the preventative maintenance deferral of the condenser exhaust boot. (see also IR 400/2008-005, no findings).	unknown/unknown	LER closed, no finding (IR 2008-005)	Run to failure due to deficiencies in the PM program
70	Prairie Island 1	9/29/2008	LER	The equipment root cause for the failure of the F delta Q controller is attributed to the random failure of varactor diode (CR1) located inside the controller. Although this controller was refurbished in 1985, only the capacitors were routinely replaced as part of refurbishments. Therefore, CR1 was not replaced as part of the 1985 refurbishment. The organizational cause was found to be the inadequate prioritization by the site in the creation of a PM strategy for the analog components within the reactor protection and control system.	unknown/36 years (note plant licensed in 1973)	SIT (IR 2008-008), no findings; LER closed IR 2008-004	Run to failure due to deficiencies in the PM program
71	Brunswick	8/18/2008	LER	The most probable cause of this event was age related degradation causing intermittent operation of one or more of the components in the Control Building exhaust damper's control scheme. PM's will be generated to ensure limit switches, dampers, damper actuators, and relays relied upon to satisfy the Control Room envelope Technical Specification requirements, or provide verifying indications, have suitable PM routes.	unknown/unknown	LER closed, no finding (IR 2009-002)	Failure caused by age related degradation

72	Diablo Canyon	8/11/2008	LER	Plant engineers identified four nonsafety-related solenoid valves that could malfunction due to a low minimum operating pressure differential (MOPD) following a SBLOCA. These valves could misposition in an intermediate position such that upon reestablishing supply air pressure they could open their associated safety-related valve resulting in a loss of SIS accumulator inventory. It is believed that this was caused by age-related deterioration of the SV internal components. The SV had been in service over 23 years.	unknown/23 years	Closed LER, no finding (IR 2008-005)	Failure caused by age related degradation
73	LaSalle	8/8/2008	LER	On June 11, 2008, the supply fan for the Division 3 switchgear room ventilation system (VD) tripped unexpectedly. This event was also classified as a SSFF. During the apparent cause investigation, the licensee identified EPRI guidance that revealed that high duty cycle motors in low power applications, such as ventilation fans, have been known to show signs of electrical degradation beginning at approximately 20 years of service. As a corrective action, the licensee established a 20 year refurbishment/replacement criteria for the supply fan in question. The inspectors' review of the EPRI operating experience showed it to be general in nature, lacking the specificity that would reasonably cause the licensee to reevaluate previous vendor lifetime qualification data and as such the failure to establish a refurbishment/replacement criteria based on industry experience was not considered a performance deficiency.	40 years/25years (likely original plant equipment installed prior to initial startup in 1984.) Note, 40 years was vendor recommendation, but EPRI found the motors last only 20 yrs.	LER closed, no finding (IR 2008-004)	Failure caused by age related degradation

74	FitzPatrick	8/5/2008	Integrated	Surge or lightning arresters are devices installed to protect electrical equipment from damage due to high voltage transients. The surge arresters installed on 71T-3 were Silicon Carbide and were original 33 year old plant equipment. The Silicon Carbide surge arrester is vulnerable to progressive degradation mechanisms resulting in failure, and has a recommended replacement frequency on the order of 20 years. Entergy did not adequately implement maintenance program expectations outlined in EN-DC-324, “PM Program,” Revision 4 and ensure replacement of the surge arrester upon exceeding its reliable service life. The surge arrester failure contributed to a loss of offsite power.	20 years/33 years	N/A	Failure caused by exceeding vendor recommended service life
75	Nine Mile Pt 2	7/25/2008	Integrated	The Unit 2 Division I emergency diesel generator (EDG) service water (SW) return isolation valve failed to fully open following a start of the Division I EDG, thus challenging the EDG's ability to perform its safety function. The motor operated valve (MOV) malfunction was due to age-related failure of the J-10 relay in the MOV control circuit. The susceptibility of J- 10 relays to age-related failure had been previously identified; however, NMPNS did not take action to establish a maintenance strategy to replace these relays prior to failure.	unknown/unknown	Appendix B, Criterion XVI, "Corrective Action	Run to failure due to deficiencies in the PM program
76	Dresden	6/16/2008	LER	On April 15, 2008, a control room operator identified during an hourly panel walk down that the Unit 2 HPCI flow controller had failed which rendered the HPCI system inoperable. The flow controller apparently failed due to age related degradation. The examination of the failed controller identified the power supply had failed from aged electrolytic capacitors.	unknown/14-18 years	LER closed, no finding (IR 2009-003)	Failure caused by age related degradation

77	Palo Verde	5/20/2008	Integrated	Between February 12, 2007 and March 7, 2008, operations and engineering personnel failed to inspect or replace the emergency diesel generators fuel oil injection pump upper O-rings prior to the end of their service life resulting in fuel leakage and increased unavailability and unreliability of Unit 1 Train A, Unit 2 Train B, and Unit 3 Train B emergency diesel generators. It was determined the shelf life of the Buna-N O-rings was 13 to 15 years and Unit 1 Trains A and B EDGs had pumps with O-rings that were approximately 15 years old.	13-15 years/15 years	Non-cited violation of Technical Specification 5.4.1.a	Run to failure due to deficiencies in the PM program
78	St. Lucie 2	2/27/2008	LER	On December 29, 2007, St. Lucie Unit 2 was in Mode 3 returning from a scheduled refueling outage when a manual reactor trip was initiated. The control element drive mechanism (CEDM) system was not able to maintain five (5) control element assemblies (CEAs) in the withdrawn and aligned position. The most probable cause of the event was determined to be the aging Maintenance Hold Bus power supplies with a contributing factor being a voltage isolation card fault.	unknown/unknown	LER closed, no finding (IR 2008-004)	Failure caused by age related degradation

79	River Bend	2/13/2008	Integrated	The licensee failed to perform adequate PM for control panels associated with providing makeup water to the CWS. Adequate preventative maintenance was not performed on this system, resulting in failure, based on an inappropriate run to failure classification of this equipment. The failure of this system resulted in a significant unplanned reduction in reactor power to 20 percent. The subject control panel components were classified as run-to-failure even though a failure had the ability to cause a plant down power from a loss of the CWS. The inspectors noted that Entergy had no replacement strategy for the system cards. The failed cards had been in service for 20 years. Had the licensee properly classified this equipment, the preventative maintenance strategy would utilize a 12-year replacement interval for the control components.	12 years/20 years	N/A	Run to failure due to mis-classification
80	Prairie Island 1	2/12/2008	LER (updated - 1/19/2009)	The load sequencer failed the surveillance and the Unit 1 Train A emergency diesel generator (D1) was declared inoperable as a result. With both D1 and D2 inoperable, Technical Specifications requires the affected Unit to be shutdown. Shutdown to Mode 3 was completed at approximately 0700 on December 21, 2007. The causes of the Bus 15 load sequencer failure are: age related degradation of the input/output cards of the load sequencer, and no PM strategy established for the load sequencers and their subcomponents.	unknown/unknown	Appendix B Criterion V, IR 2008-004	Run to failure due to deficiencies in the PM program

81	Indian Point 2	2/8/2008	LER 247/2007-004	On February 28, 2007, a failed power supply to the feedwater low suction pressure transmitter resulted in reduction of main boiler feedwater pump speeds and subsequent lowering of steam generator water levels. In response to the indications of a loss of main feedwater, control room operators initiated a manual reactor trip. Entergy determined that the power supply failed due to failure of its filter capacitors as a result of age-related degradation. (see LER 247/2007-004)	unknown/unknown	Self-revealing Green finding, no violation (IR 2007-005)	Run to failure due to deficiencies in the PM program
82	Clinton	2/4/2008	Integrated	On April 29, 2007, at 1355, the RAT SVC automatically shutdown and RAT voltage increased from 4.2kV to 4.4 kV, outside its technical specification allowed limit of 4.3 kV. The licensee declared the RAT inoperable, entered a 72 hour LCO, and elevated plant risk level to Red. Troubleshooting revealed the trip was due to aging or overheating of components on the control power module in the Powerlogic Circuit Monitor.	unknown/unknown	Not a finding	Failure caused by age related degradation
83	Davis Besse	2/1/2008	Integrated	On November 15, 2007, EDG2 failed to start on the DA31 air-start side (side 2) during a monthly surveillance test. The licensee had not applied the 12-year rule to the EDG2 hoses in place at the time of the 2002 PM revision request. Some of the EDG2 air hoses had been in place since the 1980's or earlier and had neither replaced nor evaluated to assess their condition. Failure to replace EDG2 air start hoses after 12 years of service, as recommended, led to a significant leak due to aging on the lower air motor's hose feeding the pinion gear. This created a condition adverse to quality and resulted in EDG2 side 2 failing to start due to this leak.	12 years/+12-28 years	N/A	Run to failure due to deficiencies in the PM program

84	Oyster Creek	1/25/2008	Integrated	On July 17, 2007, Oyster Creek experienced an automatic reactor scram due to a low reactor water level following a trip of the 'C' reactor feedwater pump. The 'C' reactor feedwater pump tripped due to an electrical ground fault in the pump's motor. AmerGen determined that the ground fault was identified as an age related internal winding problem that developed after thirty years of service. AmerGen's investigation concluded that AmerGen did not adequately implement a PM program to refurbish/replace the motors on a ten-year frequency.	10 years/30 years	Not a finding	Run to failure due to deficiencies in the PM program
85	Fermi	12/6/2007	LER	Fermi 2 feedwater line check valves, B2100F010B and B2100F076B, failed their local leak rate test (LLRT). These failures occurred after plant operation over two complete operating cycles. It was also determined that the PM frequency of the B2100F076AJB and B2100F010A/B soft seat material was based on faulty data and did not include actual Fermi operational experience. This resulted in the soft seat material being used beyond its useful service life. the licensee did not replace the soft seat for B2100F076A during RF10 based primarily on an inadequate technical evaluation. The inspectors determined the licensee should have evaluated the effects of wear and erosion on the soft seat but failed to do so.	unknown/unknown.	Appendix B Crit XVI, IR 2007-004	Failure caused by exceeding vendor recommended service life based on additional vendor restrictions

86	Harris	10/29/2007	Integrated	For the identified CCW process monitors, the inspectors determined that the elimination of a periodic calibration surveillance program and subsequent classification of the equipment as 'run to failure,' in the absence of quantitative response check acceptance criteria, was a performance deficiency. The failure to assure accurate radiation measurements either through periodic calibrations or quantitative response checks could impair licensee actions to maintain acceptable radioactive material control activities by monitoring for the potential release of contamination materials into uncontaminated equipment or areas.	not applicable - periodic calibration interval eliminated	Non-cited violation (NCV) of 10 CFR 20.1101	Run to failure due to mis-classification
87	Brunswick	10/11/2007	Supplemental	In November 2004, EDG #3 experienced a fourth functional failure in 36 months, which exceeded the licensee's established maintenance rule performance criteria of three failures. The licensee performed an investigation for the four failures, which included... a failed relay coil due to aging caused by the deferral of a PM activity. At the time of the expert panel's decision to keep the EDG in (a)(2) status the site had:.. open corrective actions (AR 135289) to review the PM standards for critical components to properly address aging considerations on non-metallic parts such as elastomer parts.	unknown/unknown	Non-cited violation (NCV) of 10 CFR 50.65 (maintenance rule)	Run to failure due to mis-classification

88	Ft Calhoun	10/10/2007	Focused Baseline	The licensee failed to establish a procedure for proper lubrication of the auxiliary contact sliding mechanism, an activity that affected the performance of the emergency diesel generator. Predictive maintenance activities were not specified to analyze equipment performance to detect and develop trends so that appropriate corrective actions could be taken before the equipment was no longer capable of performing its intended function. A comprehensive PM activity was not established for these risk significant components. Failing to establish PM to preclude relay failures meant that the licensee had essentially implemented a “run to failure, then fix” approach for these components.	unknown/unknown	Apparent violation of Technical Specification 5.8.1.a (Procedures)	Run to failure
89	North Anna 2	8/27/2007	LER	An automatic turbine trip, reactor trip and Phase "A" Containment Isolation occurred due to an invalid Train "B" Safety Injection actuation. Following the trip, some Train "B" Safety Injection equipment would not reset from the Main Control Room. The cause of this event was the failure of zener diode CR34 on Universal card A313 [IMOD] located in Train "B" of the SSPS. This same failure also prevented the Train "B" of SI from being reset from the MCR, requiring local actions to be taken by the Operations and Maintenance staff. The most probable cause for the diode failure was age-related degradation. NRC inspectors identified an issue for the lack of an effective program to detect and correct degradations in the Unit 2 SSPS logic cards. Upon extensive review by NRC headquarters and regional inspectors, it was determined that there was no violation of NRC Requirements. (see also SIT IR 339/2007-009, no findings).	unknown/unknown	URI from SIT closed out 2008-004, no findings	Run to failure due to deficiencies in the PM program

90	Harris	8/13/2007	LER	During performance of "Control Rod and Rod Position Indicator Exercise Quarterly Interval Mode 1-3," while inserting Shutdown Bank A rods, a Rod Control Urgent Alarm activated, rendering the affected rods inoperable and initiating entry into TS 3.0.3. The cause was determined to be a failed Master Cycler Counter Card in the Westinghouse Rod Control System [AA] (Printed Wiring Assembly part number 3360C94G01, s/n WSN0595). The most likely mechanism for the Master Cycler Counter Card failure is aging of Z13 and Z15 logic chips. In addition to the completed corrective action of replacing the Counter Card, a planned corrective action is the establishment of a structured program of card replacements. The date code of the failed chip is 1972.	unknown/34 years.	LER closed, no finding (IR 2007-004)	Run to failure due to deficiencies in the PM program
91	Turkey Point	7/17/2007	Integrated	During periods of continued reactor operation from March 6, 2006 through May 3, 2006, one channel of pressurizer pressure instrumentation was inoperable due to high AC ripple, and the inoperable channel was not placed in the tripped condition. When identified by the licensee during a Surveillance Test on May 3, 2006, the affected channel was placed in the tripped condition. The problem was corrected by replacing a failed capacitor that had exceeded its recommended service life. (see also LER 250/2006-007).	unknown/unknown	LIV of Technical Specification Table 3.3-2, Functional Unit 1.d	Failure caused by exceeding vendor recommended service life

92	Kewaunee	6/1/2007	CDBI	The licensee failed to periodically energize the spare 125 Vdc safeguard battery charger for at least a half-hour every 18 months to ensure the operability of the electrolytic capacitor in the charger. The licensee had previously entered the vendor recommendation into its corrective action in 2002; however, the action was incorrectly closed without implementing the recommendation. The cause of the battery charger failure was due to age related defective printed circuit boards. The vendor indicated the boards had an expected in-service life of 10-15 years and a shelf life of 2-3 years after which the electrolytic capacitors on the boards have to be charged and reformed. This recommendation also applied to the filter capacitors installed in the charger, which have an expected in-service life of 7-10 years and a shelf life of 2-3 years after which time, should be rejuvenated by charging them.	unknown/unknown	Appendix B, Criterion XVI, “Corrective Action	Failure caused by exceeding vendor recommended service life based on additional vendor restrictions
93	Harris	5/8/2007	LER	During performance of Control Rod and Rod Position Indicator Exercise Quarterly Interval Mode 1-3," Shutdown Bank A stopped at approximately 220 steps causing a rod control urgent alarm rendering the affected rods inoperable and initiating an entry into TS 3.0.3. The cause was determined to be a failed Slave Cycler Logic Card in the Westinghouse Rod Control System [AA] (card model 3359C80G01 s/n 0210). The most likely mechanism for the Slave Cycler Logic Card failure is aging of a Z4 chip. A planned corrective action is to establish a structured program of card replacements. The date code of the failed chip is 1972.	unknown/35 years.	LER closed, no finding (IR 2007-003)	Run to failure due to deficiencies in the PM program

94	Hatch	5/7/2007	LER	The High Pressure Coolant Injection (HPCI) inboard isolation valve 1E41-F002 closed causing the HPCI system to be declared inoperable. The most probable cause of the valve closure was determined to be a faulty ATTS card, 1F41-N670A. Visual inspections of ATTS cards 1E41-N670A and penetration room high temperature MTU 1E41-N671A revealed damage to components on the cards. Furthermore, relays 1E21-K361C and 1E21-K362C, which are Agastat relays located in the logic circuitry downstream of 1E41-N670A and 1E41-N671A, respectively, were bench-tested and noise was seen across the voltage signal of the relays. This disturbance is an early indication of aging.	unknown/unknown	LER Closed, no finding (IR 2008-002)	Failure caused by age related degradation
95	Quad Cities 2	5/3/2007	Integrated	On the afternoon of January 23, Unit 2 operations personnel received an unexpected half Group I containment isolation signal due to a perceived main steam line low pressure condition. These time delay relays were installed in 1991 to mitigate spurious Group 1 containment isolation signals. Following the installation, the licensee should have established and implemented procedures describing the periodic replacement of these safety-related time delay relays. However, this was never performed. As a result, one of eight relays installed in 1991 was allowed to remain in operation until it failed. The Unit 2 main steam line low pressure time delay relay was allowed to run to failure due to failure to establish procedures for periodically replacing this component.	unknown/16 years	Appendix B, Criterion V, “Instructions, Procedures and Drawings.”	Run to failure due to deficiencies in the PM program

96	Clinton	4/27/2007	Integrated	A low main condenser vacuum alarm was received in the main control room. The alarm was caused by the failure of an electronic circuit card. This card failure also resulted in the main turbine bypass valves being interlocked closed (loss of safety function). A failure analysis completed by the vendor showed that the circuit card had degraded due a leaky electrolytic capacitor. The licensee's EACE identified that the electronic circuit card was approximately 27 years old and had approximately 22 years of actual service time. The circuit card replacement frequency in the PCM template for Moore model DCA cards is 30 years, and is in direct contrast to a PCM template created for power supplies, which addresses electrolytic capacitor aging, and has a replacement frequency of 7.5 years.	7.5 years/27 years	Appendix B, Criterion V	Failure caused by exceeding vendor recommended service life
97	North Anna 2	4/26/2007	LER	On November 16, 2006, an automatic reactor trip occurred on Unit 2 due to B steam generator (SG) low level coincident with a steam flow greater than feed flow mismatch which resulted from closure of the B MFRV. The root cause evaluation concluded that age related failure of one or more transistors in a power supply circuit of a 7300 system isolator card impacted the steam flow input to the B SG water level control circuit. **The inspectors also noted that both RCE000022 and the respective Condition Report CR004545 identified the card as 'run-to-failure' (RTF) with no preventative maintenance in accordance with the licensee's equipment reliability process.** (see also LER 339/2006-001)	15 year/30 years	Self-revealing Green Finding, no violation Integrated IR 2007-002	Run to failure

98	Perry	4/25/2007	Integrated	On September 13, 2005, the upper airlock had failed pressure testing due to a degraded 3-way ball valve and the licensee identified that the station had a history of airlock test failures due to aging and internally scored ball valves that had been installed in the airlock system since new construction (CR 05-06747). Following the September 13, 2005, upper airlock test failure, the licensee determined that the 3-way ball valves for both upper and lower airlocks were degraded and subject to premature failure, and established corrective actions intended to replace the ball valves on both airlocks. However, the licensee also determined that replacement ball valve housings were not readily available, and as a result, the corrective actions remained open, and the degraded ball valves remained in service as of the end of this inspection period.	unknown/unknown	Non-cited violation of Technical Specification 5.4, "Procedures,"	age degradation (no actual failure)
99	Crystal River	4/13/2007	LER 302/2007-002	An age-related failure of the multiplier module resulted in an automatic reactor trip. A refurbishment program was established for these types of modules. Four ICS multiplier modules with controlling functions, including module IC-384-IC, were replaced with ones that had been refurbished. During refueling outage R14 (Fall 2005), refurbished module IC-384-IC failed its calibration and was replaced by a module that had not undergone refurbishment. Since a refurbished multiplier module was not available, engineering approved the temporary installation of a non-refurbished module. Engineering did not ensure a tracking mechanism was put in place to obtain and install a refurbished module.	unknown/unknown	Self-Revealing Green Finding, no violation, IR 2007-002	Failure caused by age related degradation

100	Hatch	4/9/2007	LER	A control room operator was performing a control board walk-down when he noticed the position indicating light for the High Pressure Coolant Injection system's minimum flow control valve was extinguished. As a result, the minimum flow valve was incapable of operating, rendering HPCI inoperable. The likely cause of the failure of the minimum flow valve to open was a degraded resistor in the position indicating light circuit. The resistor on the back of the green open position indicating light was found blackened as if it had been burned. It is likely that this resistor had degraded with age.	unknown/unknown	LER Closed, no finding (IR 2008-003)	Failure caused by age related degradation
101	Palisades	2/13/2007	CDBI	The licensee failed to ensure that the molded-case circuit breaker (MCCB) testing program remained current with industry and NRC operating experience thus ensuring that the installed safety related and important-to-safety MCCBs did not degrade and would perform satisfactorily in service.	not applicable	Appendix B, Criterion XI, “Test Control,”	Run to failure not prohibited by program (but no actual failure)
102	River Bend	2/13/2007	Integrated	The licensee installed a pump coupling that exceeded vendor shelf- and service-life recommendations. This deficiency resulted in a RWCU Pump A coupling failure on November 28, 2006. The inspectors determined that the failure of the 10-year old flexible coupling 9 days after installation on RWCU Pump A was due to the failure to provide vendor manual instructions in the modification paperwork, allowing the use of these couplings on RWCU pumps and in the routine task work instructions used to generate the work order.	6-8 years/10 years	N/A	Failure caused by exceeding vendor recommended service life

103	Cooper	2/2/2007	Integrated	On October 29, 2006, operators discovered that the backwash mechanism on Service Water Discharge Strainer A would not rotate when the strainer was placed into the continuous backwash mode. A subsequent inspection of the strainer drive train revealed that a flexible rubber sleeve between the motor gear and a reduction gear had failed. SW Discharge Strainer A failed apparently due to age-related degradation of components in the motor coupling. This was documented in Condition Report CR-CNS-2006-08226, which was assigned Significance Category "C" or "broke-fix." This degradation was not identified during corrective maintenance on February 1, 2006, which required the identification and replacement of degraded components. The sleeve was approximately 10 years old when it failed, so it would have been reasonable for the licensee to identify and correct any age-related degradation during corrective maintenance performed only 8 months before the failure.	unknown/10 years	Appendix B, Criterion XVI, "Corrective Action,"	Run to failure
104	Dresden	2/1/2007	Integrated	On September 22, 2006, operations personnel attempted to start the 2/3 "B" SBGT train to support venting the U3 containment. The SBGT train flow started low (2700 scfm) and started to trend down and the heater turned off. The problem was identified as the "B" train flow controller. The licensee had identified the age of the controllers as an issue in 2004 when reviewing PM templates. The PM template review determined that the controller needed to be replaced every 15 years. The controller was already over 25 years old. Because the parts were not ordered and the seismic qualification of the parts was not completed in a timely manner, the work was pushed back to September 2007.	15 years/+25 years	Not a finding	Failure caused by exceeding vendor recommended service life

105	Indian Point 3	1/26/2007	Integrated	Entergy failed to take timely corrective actions for a condition adverse to quality associated with age-related degradation of the nuclear instrumentation system. Corrective action plans, which had been developed following repetitive equipment failures in 2003, had been deferred several times, resulting in the power range nuclear instrument 41 (N-41) over-temperature delta temperature reactor trip function being declared inoperable on March 20, 2006.	unknown/unknown	Appendix B, Criterion XVI, "Corrective Action."	Run to failure due to deficiencies in the PM program