Risk Information Matrix for
AP1000 Designs – Inspection Procedures
Date: 08/22/2017

Cornerstone			Inspectable Area	Performance Indicator	Frequency	Hours for 2-Unit Site per year	Level of Effort	Bases
REACTOR SAFETY CORNERSTONES (!=Initiating Events; M=Mitigating Systems; B=Barrier; X or a number indicates the Inspectable Area is mapped to that Cornerstone; When a number 1s present in a column, it represents the approximate percentage of the total hours of inspection to be performed for that Cornerstone)								
I 20	M 80	B	Adverse Weather Protection	None	As conditions require	24 to 30 hrs/yr regardless of the number of reactor units at the site	Prior to the high grid loading season, conduct 1 review of summer readiness of offsite and alternate AC power systems (section 02.01 of this procedure). In addition, evaluate a site's readiness for adverse weather (this includes weather conditions which may result in lasting effects - e.g., drought, icing, etc.). Conduct 1-2 reviews of a site's readiness for seasonal extreme weather conditions (section 02.02 of this procedure); and conduct 1-2 reviews of the readiness for impending adverse weather conditions (section 02.03 of this procedure). For sites where external flooding is a risk, conduct 1 review of the site's readiness to cope with external flooding prior to the onset of adverse weather that poses a risk of flooding (section 02.04 of this procedure).	Weather conditions leading to loss of offsite power (LOOP), freezing temperatures, high temperatures, and high winds dominate external risk. Adverse weather can lead to loss of multiple trains and loss of redundant equipment due to common causes. Lasting effects (e.g., drought, flood) can also result from adverse weather, which may impact the effectiveness of the ultimate heat sink. Flooding due to adverse weather and other external causes has been shown to be a significant contributor to risk at some facilities. Flooding has the potential to make multiple trains of equipment and support equipment inoperable. Flooding may also affect operator mitigation and recovery actions.
I 30	M 60	B 10	Equipment Alignment	None	Annually for both partial and full system walkdowns	68 to 92 hrs/yr regardless of the number of reactor units at the site	The goal is to perform 12 to 16 partial walkdowns and 2 complete walkdowns per calendar year, depending on the number of reactor units at a given site. Unit differences at a particular site may necessitate more walkdowns to adequately complete site specific inspection objectives at each unit.	Systems or components that are not properly aligned can lead to the initiation of an event and can impact the availability and functional capability of plant equipment, thereby significantly increasing the overall risk to the plant. Inspection activities would normally be performed following emergent work activities and planned removal of risk-significant systems for online maintenance..
I 10	M 90	B	Fire Protection Annual/Quarterly	None	Quarterly	35 hrs/yr	For quarterly inspections resident inspectors should focus on four to six areas important to safety. The resident inspectors may risk-inform the focus of their walkdowns by following the guidance provided below:	Estimated fire risk is comparable to many internal initiating events. If potential fire initiators, aids to propagation, or fire barrier breaches exist, safe shutdown of

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					Annual		• The selection of areas to be inspected is based on risk insights from a senior reactor analyst (SRA), NRC Significance Process (SDP) worksheets, or the plant specific PRA. Similar information may be readily available from the past triennial fire protection inspection reports (IP71111.05T) as well. • The selection of areas to be inspected factors in the plant configuration. In this regard, IP71111.04 "Equipment Selection" and IMC 2515, Appendix D provides insights on areas that are likely to result in risk-significant findings. • For example, if train A of a safety system is out of service, then any finding in fire areas containing components of cables of train B are likely to result in potentially risk significant findings. Also, if the fire detection or suppression systems of a particular fire area are degraded or out of service, then findings in areas that house cables or components of the redundant train are likely to result in potentially risk-significant findings. • For plants that have adopted a risk-informed, performance-based Fire Protection Program in accordance with 10CFR 50.48(c) and NFPA 805, the inspectors may use information developed by the licensee for understanding the risk insights for various plant areas. For the annual inspection the resident inspector evaluates the licensee's fire brigade performance. While the evaluation is an annual process, observation and evaluation of all the important drill activities as part of single drill may not be effectively accomplished. Therefore, inspectors may need to observe the conduct of several fire brigade drill segments (announced and unannounced) through the year to be able to formulate an appropriate assessment for the period.	the plant may not be possible due to the failures of the inspectable features and areas.
I 10	M 90	B	Fire Protection (Triennial)	None	Triennial	240 hours every 3 years regardless of the number of reactor units at the site	Every 3 years, an inspection team that includes inspectors who are knowledgeable in the areas of fire protection, reactor operations, and electrical inspections will conduct a design-based, plant-specific, risk-informed, onsite inspection of the DID elements used to mitigate the consequences of a fire. The review	Fire can be a significant contributor to plant risk. In many cases, the risk posed by fires is comparable to or exceeds the risk from internal events. The fire protection program (FPP) shall extend the

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							will include an assessment of the licensee's capability of problem identification and resolution of fire protection issues.	concept of defense-in-depth (DID) to fire protection in plant areas important to safety by the following means: (1) preventing fires from starting; (2)rapidly detecting, controlling, and extinguishing fires that do occur; and (3) providing protection for structures, systems, and components important to safety so that a fire that is not promptly extinguished by fire suppression activities will not prevent the safe shutdown (SSD) of the reactor Licensees are also expected to take reasonable actions to mitigate postulated events that could potentially cause loss of large areas of power reactor facilities due to explosions or fires. NRC Order EA-02-026, "Order for Interim Safeguards and Security Compensatory Measures" spanned a wide range of security-related actions required to be taken by power reactor licensees in response to the events of September 11, 2001. Section B.5.b of the Order dealt specifically with these postulated events. In response to this Order (and the subsequent requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.54 (hh)(2), licensees implemented alternative mitigating strategies intended to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities under such circumstances. These are

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								collectively referred to as B.5.b requirements.
I 10	M 90	B	Fire Protection - NFPA 805 (Triennial)	None	Triennial	240 hours every 3 years regardless of the number of reactor units at the site	Every 3 years, an inspection team will conduct an onsite inspection of the licensee's risk-informed, performance-based FPP relative to the elements for preventing and mitigating the consequences of a fire. The review should also examine the plant's capability to meet the requirements of the NRC-approved fire protection program, and the nuclear safety and radioactive release goals, objectives and performance criteria of National Fire Protection Association (NFPA) Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generation Plants," 2001 Edition. The effort will also include a review of the licensee's FPP problem identification and resolution. In addition, every 3 years inspectors trained to review alternative mitigating strategies will review several mitigating strategies to ensure they remain feasible. Additionally, inspectors will review the storage, maintenance, and testing of B.5.b related equipment.	Fire can be a significant contributor to plant risk. In many cases, the risk posed by fires is comparable to or exceeds the risk from internal events. The fire protection program (FPP) shall extend the concept of defense-in-depth (DID) to fire protection in plant areas important to safety by: (1) preventing fires from starting, (2) rapidly detecting, controlling, and extinguishing fires that do occur; and (3) providing protection for structures, systems, and components important to safety so that a fire that is not promptly extinguished by fire suppression activities will not prevent essential plant safety functions from being performed. Risk-informed, performance-based fire protection is based on established goals, objectives, and performance criteria against which the FPP is measured. Licensees are also expected to take reasonable actions to mitigate postulated events that could potentially cause loss of large areas of power reactor facilities as the result of explosions or fires. Interim Compensatory Measures Order EA-02-026 spanned a wide range of security-related actions required to be taken by power reactor licensees in response to the events of September 11, 2001. Section B.5.b of the Order dealt specifically with these postulated

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								events. In response to this Order (and the subsequent requirements of Title 10 of the Code of Federal Regulations (10 CFR) 50.54 (hh)(2)) licensees implemented alternative mitigating strategies intended to maintain or restore core cooling, containment, and spent fuel pool cooling capabilities under such circumstances. These are collectively referred to as B.5.b requirements.
I 40	M 60	B	Flood Protection Measures	None	Annually	17 to 23 hrs/yr regardless of the number of reactor units at the site	Annually, perform 2 samples for internal flooding. The internal flood area selected as part of the sample could consist of one or multiple rooms depending upon plant layout. If applicable, for sites with a history of cable degradation or failures due to submergence, perform an additional sample annually consisting of risk-significant cables located in areas susceptible to water accumulation for extended periods of time.	Flooding due to internal causes has been shown to be a significant contributor to risk at some facilities. Flooding has the potential to make multiple trains of equipment and support equipment inoperable. Flooding may also affect operator mitigation and recovery actions.
I 10	M 80	B 10	Heat Sink Performance	None	Annually Triennially	5 to 7 hrs/yr regardless of the number of reactor units at the site 34-46 hrs regardless of the number of reactor units at the site	Annually, review one or two heat exchanger and/or heat sink sample(s). Triennially, review two to four heat exchanger and/or heat sink samples.	Heat exchangers and heat sinks are required to remove decay heat, and provide cooling water for risk significant or safety related equipment. Degradation in performance can result in failure to meet system success criteria, and lead to increased risk primarily due to common cause failures.
I 45	M 10	B 45	Inservice Inspection Activities	None	Every refueling outage	30 to 42 hrs for each BWR unit 80 to 100 hrs for each PWR unit - PWR resources can be reduced to 40 hours minimum if Steam	Inspections are to be performed during each refueling outage at each reactor unit at a site. The level of ISI activities including steam generator inspections at each plant can vary significantly from outage to outage but typically should be as identified in this procedure. Since all activities are subject to outage availability, inspectors must make a reasonable effort to ensure that the inspection effort occurs during the time that the activities are scheduled. A Boric Acid Corrosion Control inspection is included in this inspection.	Inservice inspection (ISI) activities can detect precursors to pressure boundary failures in reactor coolant systems (RCS), emergency core cooling systems (ECCS), risk-significant piping and components, and containment systems. Degradation of pressure retaining components in these systems would result in a significant increase in risk. This inspection is

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							Generator and Reactor Head inspections are not required		intended to assess the effectiveness of the licensee's program for monitoring degradation of vital system boundaries.
I 10	M 70	B 10	EP 10	Licensed Operator Requalification Program and Licensed Operator Performance	None	Quarterly	4 hrs/yr regardless of the number of reactor units at the site	Quarterly Review by Resident Staff: A review of (1) licensed operator performance during requalification testing and training, (2) the ability of the facility licensee to conduct requalification testing and training, and (3) simulator performance, will be conducted quarterly by the resident staff. In addition, licensed operator performance in the actual plant/main control room will be observed and assessed quarterly/annually by the resident staff during periods of heightened activity or risk. At the discretion of Regional Management, this review may also be performed by a regional operator licensing examiner.	Human errors and failure to recover from accident events increase the significance of important events: Examples include failure to manually depressurize and failure to recover offsite power for BWRs and failure to switch from RWST to containment sump for PWRs.
						Annually	1 hr/yr regardless of the number of reactor units at the site	Annual Review by Regional Specialist: A review of licensed operator performance, as determined from requalification examination results, will be conducted annually by a regional operator licensing examiner. This review is expected to be conducted in-office by contacting the facility licensee.	
						Biennially	96 hr/insp regardless of the number of reactor units at the site	Biennial Review by Regional Specialist: A review of (1) licensed operator performance during requalification examinations, (2) the ability of the facility licensee to properly develop and administer requalification examinations, (3) the maintenance of individual operator licenses, (4) the performance of the control room simulator, and (5) the ability of the facility licensee to identify and resolve problems related to licensed operator performance, will be conducted biennially by an inspection team consisting of (1) a team leader who is a qualified operator licensing examiner on the facility licensee's vendor type, who, at a minimum, is also qualified as basic certified inspector; and (2) one or more additional examiners/inspectors . This review will also include the annual review of requalification examination results. The biennial review is expected to require a one-week on-site visit, plus additional in-office review. At the discretion of Regional Management, the	

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							biennial review may also include observation of licensed operator performance in the actual plant/main control room, provided there is an activity or evolution that occurs in the actual plant/main control room that is suitable to observe during the biennial inspection week.	
I 10	M 80	B 10	Maintenance Effectiveness	None	Quarterly	84 to 102 hrs/yr	Routine Maintenance Effectiveness Inspection: Review 8 to 10 maintenance effectiveness performance issues a year with emphasis on high-risk-significant issues. Although the number of required samples is an annual goal, available work activities should be inspected each quarter to ensure a reasonable distribution throughout the year. Review of a licensee's (a)(3) Periodic Evaluation can count as one of the required samples. For one to two samples, perform a review of quality control.	The Maintenance Rule (MR) requires licensees to monitor the performance or condition of structures, systems and components (SSCs) within the scope of the rule against licensee-established goals to provide reasonable assurance that these SSCs are capable of fulfilling their intended functions. These goals are to be commensurate with safety and, where practical, should take into account industry-wide operating experience.
I 10	M 80	B 10	Maintenance Risk Assessments and Emergent Work Control	None	Quarterly	80 to 100 hrs/yr	Sample maintenance activities before commencement, in progress, or completed, as available each calendar quarter. The goal is to inspect 14 to 24 maintenance activities including emergent work control activities in a year. The inspectors should include a mixture of scheduled and emergent work in selecting samples. Samples should take into account the relative plant risk and the prevalent type of work activities at the site. Although the number of required samples is an annual goal, available work activities should be inspected each quarter to ensure a reasonable distribution throughout the year. It is intended that (a)(4) inspection be integrated as much as practicable with other routine monitoring of plant activities and configuration.	Paragraph (a)(4) of 10 CFR 50.65, the Maintenance Rule (MR), requires licensees to assess and manage plant risk related to maintenance activities during all modes of plant operation. Risk is assessed and managed for both scheduled maintenance and emergent work. Risk management minimizes risk-significant configurations and initiating events and maximizes availability of mitigating systems and barriers to radiological releases.
I	M X	B	Operability Determinations and Functionality Assessments	None	Quarterly	One unit: 87 to 113 hrs/yr Two Units; 107 to 137 hrs/yr Three Units: 127 to 161 hrs/yr	Review the following sample sizes of operability determinations or functionality assessments of degraded and non-conforming conditions which impact mitigating systems and barrier integrity: 15 to 21 per year at one reactor unit sites; 19 to 25 per year at two reactor unit sites; and 22 to 30 per year at three reactor unit sites. Although the number of required samples is an annual goal, available operability determination or functionality assessment samples should be inspected each quarter to ensure a reasonable distribution	Improperly evaluated degraded and/or non-conforming conditions may result in continued operation with a structure, system, or component (SSC) that is not capable of performing its design function. Operator workarounds (OWAs) can adversely affect the functional capability of SSCs that may not be

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							throughout the year. At least one annual sample must include an OWA review	capable of performing design functions without operator intervention. An excessive number of OWAs or those requiring complex operator actions increase risk by reducing operator effectiveness in responding to transient conditions and increasing error opportunities.
I 10	M 80	B 10	Evaluations of Changes, Tests and Experiments and Permanent Plant Modifications	None	Triennially	172 to 212 hrs.	Triennially review 6 to 12 evaluations required by 10 CFR 50.59, 12 to 25 screenings and/or applicability determinations for 10 CFR 50.59, and 5 to 15 permanent plant modifications. This inspection should be performed by engineering specialists knowledgeable in the affected subject areas. Inspection staffing should consist of at least one electrical and one mechanical engineering inspector.	The inspection monitors the effectiveness of the licensee's implementation of changes to facility structures, systems, and components (SSCs), risk significant normal and emergency operating procedures, test programs, and the updated final safety analysis report (UFSAR) in accordance with the requirements of 10 Code of Federal Regulations (CFR) 50.59. The inspection provides assurance that required license amendments have been obtained. The inspection monitors the implementation of modifications to SSCs. Modifications to one system may also affect the design bases and functioning of interfacing systems as well as introduce the potential for common cause failures. Potential issues regarding the impact that changes have on security should be raised and addressed under the Security Inspection Program.
I 10	M 80	B 10	Plant Modifications	None	Annually	36 to 48 hrs/yr regardless of the number of reactor units at the site	Annually, review 3 to 7 temporary and/or permanent modifications.	Modifications to risk-significant structures, systems, and components (SSCs) can adversely affect their availability, reliability, or functional capability. Modifications to one system may

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								also affect the design bases and functioning of interfacing systems. Similar modifications to several systems could introduce potential for common-cause failures that affect plant risk. A temporary modification may result in a departure from the design basis and system success criteria. Modifications performed during increased risk configurations could place the plant in an unsafe condition. Potential issues regarding the impact that changes have on security should be raised and addressed under the Security Inspection Program.
I	M	B	Post Maintenance Testing	None	Quarterly	71 to 97 hrs/site/yr regardless of the number of reactor units at the site	Review 20-28 PMT activities in a year. Although the number of required samples is an annual goal, available PMT samples should be inspected each quarter to ensure a reasonable distribution throughout the year. For multi-unit sites, attempts should be made to evenly balance the PMT samples between each unit on site. Where special conditions or circumstances warrant, such as unit specific PMT deficiencies, deviations from evenly balanced PMT samples may be appropriate.	Inadequate maintenance activities and post-maintenance testing (PMT) can result in inoperable and non-functional equipment being returned to service. Significant risk can be accrued when inoperable and non-functional equipment remains unidentified for long periods of time.
I	M	B	Refueling and Other Outage Activities	None	Per outage when a containment is made	One unit: 56 to 86 hrs/RFO Two unit: 62 to 92 hrs/RFO Three unit: 66 to 97 hrs/RFO No more than 70 hrs/yr Non RFO and FO regardless of the number of reactor units at the site	The inspection is performed on an outage basis, whether the outage is for refueling or other activities. The inspection should focus on potential deficiencies with: RHR, containment isolation during reduced water inventory, mid loop operations (PWR), cooldown/heatup/startup, availability of alternate power sources/switchyard, personnel fatigue management, and refueling operations. All inspection sections are to be conducted for refueling outages, if possible. For non-refueling outages, the inspectors should perform applicable non refueling related sections consistent with the length and scope of the outage. The requirement to enter IP 71111.20 should be if any shutdown occurs that requires a plant cool down and/or	Shutdown risk can be high for deficiencies that occur when safety significant SSCs are not available. Due to potentially high number of out of¬ service SSCs during the fuel handling period of a refueling outage and the potential off normal plant configurations during non-fuel handling outage periods, the risk of deficiencies can be high. Times of reduced inventory are the most critical. An additional risk that must be considered is how the licensee manages fatigue during an outage. This is important since fatigue may constitute a risk to

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							if the containment is entered for a shutdown tour. If a non-complicated reactor trip occurs, and the licensee chooses to conduct a start up without entering the containment, then IP71153 should be utilized for inspection of the event, corrective actions, and start up activities. This distinction also applies to the Resource Estimate and Completion Status sections. Inspection resources are affected by the length of the outage, amount of risk significant work and the plant configuration. Some testing activities normally occur during refueling outages. These include physics testing, emergency diesel generator time response testing, RCS hydrostatic testing, control rod scram time testing, rod drop time testing, reactor trip breaker testing, and containment sump valve testing. Inspection of these activities that is not related to shutdown risk should be charged to IPs for post maintenance and surveillance testing (IP 71111.19 and IP 71111.22). IMC 2515, Appendix D, Plant Status, states that "during changing plant conditions (plant refueling or maintenance outages), the frequency and scope of plant status tours may be increased to tour areas not normally accessible and to observe equipment in an abnormal lineup." This effort should be charged to Code PS for plant status.	public health and safety or the common defense and security.
I 10	M 80	B 10	Component Design Bases Inspection	None	Triennial	347 to 470 hrs/insp.	Review 15-25 risk significant samples in the following categories: components and operating experience. The inspection involves a multi-disciplinary team comprised of team leader and two to three regional inspectors (operations/maintenance and engineering).	This inspection of component design bases verifies that plant components are maintained within their design basis. Additionally, this inspection provides monitoring of the capability of the selected components and operator actions to perform their design bases functions. As plants age, modifications may alter or disable important design features making the design bases difficult to determine or obsolete. The plant risk assessment model assumes the capability of safety systems and components to perform their intended safety function successfully. This inspectable area

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								verifies aspects of the Initiating Events, Mitigating Systems and Barrier Integrity cornerstones for which there are no indicators to measure performance.
I	M	B	Component Design Bases Inspection (Teams)	None	Triennially	265 to 359 hrs/insp.	Review 10-17 risk informed samples during the 2-week team inspection. Note that IP Attachment 71111.21N provides direction on conducting a 1-week engineering program inspection.	This inspection of component design bases verifies that plant components are maintained within their design basis. Additionally, this inspection provides monitoring of the capability of the selected components and operator actions to perform their design bases functions. As plants age, modifications may alter or disable important design features making the design bases difficult to determine or obsolete. The plant risk assessment model assumes the capability of safety systems and components to perform their intended safety function successfully. This inspectable area verifies aspects of the Initiating Events, Mitigating Systems and Barrier Integrity cornerstones for which there are no indicators to measure performance.
10	80	10						
I	M	B	Component Design Bases Inspection (Programs)	None	Triennially	82 to 110 hrs/insp.	Review one engineering program.	Licensees are required to establish and implement various programs to provide control over activities affecting the quality of the identified structures, systems, and components, to an extent consistent with their importance to safety. This inspection is intended to assess the effectiveness of one of the many licensee programs in the engineering area (e.g., environmental qualification) using the appropriate attachment to this inspection procedure.
10	80	10						

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I	M 80	B 20	Surveillance Testing	None	Quarterly	100 hrs./yr. regardless of the number of reactor units at the site	Review 14 to 22 surveillance tests per year regardless of the number of reactor units at the site.	Inspection activities in this area focus on evaluating the licensee's surveillance testing (including inservice testing) activities and their effectiveness in demonstrating that safety systems are capable of performing their intended safety function consistent with their design and licensing bases. Failure to identify and resolve performance degradation of structures, systems and components, could result in long periods of unknown equipment unavailability. This inspectable area verifies aspects of the associated cornerstones not measured by performance indicators.