July 1, 2005

Mr. Gordon Bischoff, Manager
Owners Group Program Management Office
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: DRAFT SAFETY EVALUATION FOR TOPICAL REPORT WCAP-15622, "RISK-INFORMED EVALUATION OF EXTENSIONS TO AC ELECTRICAL POWER SYSTEM COMPLETION TIMES" (TAC NO. MB2257)

Dear Mr. Bischoff:

By letter dated June 15, 2001 (OG-01-039), as supplemented by letters dated November 27, 2002 (OG-02-052), and December 10, 2003 (OG-03-653), the Westinghouse Owners Group (WOG) submitted Topical Report (TR) WCAP-15622, Revision 0, "Risk-Informed Evaluation of Extensions to AC Electrical Power System Completion Times," non-proprietary Class 3, to the NRC staff for review. Approval of the TR was requested for referencing by licensees seeking relief from current Technical Specifications where the completion times (CTs) are not long enough to address inoperabilities or to perform preventative maintenance at power of alternating current (AC) electric power systems.

Enclosed for the WOG's review and comment is a copy of the NRC staff's draft safety evaluation (SE) for the TR. You are requested to provide your comments on any factual errors or clarity concerns in the enclosed draft SE by letter within 20 days of the receipt of this letter. To facilitate the staff's review of your comments, provide (1) a marked-up copy of the draft SE showing the comments and proposed changes to the draft SE, and (2) a summary table which discusses the comments and proposed changes, and refers to the page and line numbers of the enclosed draft SE.

The final SE will be issued after making any necessary changes and will be made publicly available. The staff's disposition of your comments on the draft SE will be discussed in the final SE. Because the topical report does not contain proprietary information, we are not requesting a review of the draft SE for proprietary information, and this draft SE is being made publicly available.

In responses to RAIs on WCAP-15622, the WOG provided revised risk estimates for some of the participating utilities that reflected the use of compensatory measures, revised CTs (proposing times shorter than 7 days), and revised analysis assumptions. Because of the plant-specific nature of the methodology and analysis presented in the WCAP, the NRC staff finds that the plant-specific implementation of the proposed changes in CTs will require licensees to evaluate compensating features and actions (including possible revision to the proposed CTs) such that Regulatory Guides (RGs) 1.174 and 1.177 guidelines are satisfied. Therefore, licensees must provide the plant-specific information identified in Section 5.0 of the enclosed SE in their submittals implementing the WCAP-15622 methodology.

Based on its review of WCAP-15622, the NRC staff concludes that the WCAP provides guidance and specific analyses to assist licensees in evaluating changes to CTs for the AC electrical power and distribution systems. The staff finds the guidance included in the WCAP to be complementary to staff guidance provided in RGs 1.174 and 1.177, and in Chapters 16.1 and 19.0 of NUREG-0800. As such, WCAP-15622 provides an acceptable basis to evaluate the proposed diesel generator (DG) and vital AC distribution system CTs, when used in conjunction with the guidance provided by RGs 1.174 and 1.177, and the staff's conditions as outlined in the attached draft SE. However, the proposed CT extension for DG common cause evaluation or for performing the surveillance requirement to show the other DG is operable, from the current 24 hours to 72 hours is not approved.

Since many of the demonstration plant results did not meet the NRC acceptance guidelines in Regulatory Guides 1.174 and 1.177, plant-specific applications referencing WCAP-15622 may not result in approval of the proposed CT changes without further compensatory measures or justification.

In support of WCAP-15622, the Nuclear Energy Institute submitted TSTF-417, Revision 0, "AC Electric Power System Completion Times (WCAP-15622)," by letter dated September 5, 2001. TSTF-417 will be addressed by the NRC staff in a separate letter.

Sincerely,

/RA/

Robert A. Gramm, Chief, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: Draft Safety Evaluation for WCAP-15622

cc w/encl:
Mr. James A. Gresham, Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

Based on its review of WCAP-15622, the NRC staff concludes that the WCAP provides guidance and specific analyses to assist licensees in evaluating changes to CTs for the AC electrical power and distribution systems. The staff finds the guidance included in the WCAP to be complementary to staff guidance provided in RGs 1.174 and 1.177, and in Chapters 16.1 and 19.0 of NUREG-0800. As such, WCAP-15622 provides an acceptable basis to evaluate the proposed diesel generator (DG) and vital AC distribution system CTs, when used in conjunction with the guidance provided by RGs 1.174 and 1.177, and the staff's conditions as outlined in the attached draft SE. However, the proposed CT extension for DG common cause evaluation or for performing the surveillance requirement to show the other DG is operable, from the current 24 hours to 72 hours is not approved.

Since many of the demonstration plant results did not meet the NRC acceptance guidelines in Regulatory Guides 1.174 and 1.177, plant-specific applications referencing WCAP-15622 may not result in approval of the proposed CT changes without further compensatory measures or justification.

In support of WCAP-15622, the Nuclear Energy Institute submitted TSTF-417, Revision 0, "AC Electric Power System Completion Times (WCAP-15622)," by letter dated September 5, 2001. TSTF-417 will be addressed by the NRC staff in a separate letter.

Sincerely,
/RA/
Robert A. Gramm, Chief, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: Draft Safety Evaluation
for WCAP-15622

cc w/encl:
Mr. James A. Gresham, Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

DISTRIBUTION:
PUBLIC
PDIV-2 Reading
RidsNrrDlpmLpdiv (HBerkow)
RidsNrrDlpmLpdiv (RGramm)
RidsNrrLALFeizollahi
RidsNrrPMGShukla
RidsOgcRp
RidsAcrsAcnwMailCenter
MRubin CDoutt
RJenkins JKnox

EEIB and SPSB memos dated 09/17/04 and 02/22/05.

ADAMS Accession No.: ML050890476 **NRR-106**

OFFICE	PDIV-2/PM	PDIV-2/LA	EEIB/SC	SPSB/SC	PDIV-2/SC	PDIV/D
NAME	JDonohew	DBaxley	RJenkins	MRubin	RGramm	HBerkow
DATE	7/1/05	06/30/05	06/30/05	06/27/05	7/1/05	7/1/05

DOCUMENT NAME: E:\Filenet\ML050890476.wpd
OFFICIAL RECORD COPY

DRAFT SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

WCAP-15622, REVISION 0, "RISK-INFORMED EVALUATION OF EXTENSIONS TO AC ELECTRICAL POWER SYSTEM COMPLETION TIMES"

WESTINGHOUSE OWNERS GROUP

PROJECT NO. 694

1.0 INTRODUCTION

Licensees for nuclear power plants have Technical Specifications (TSs) in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.36, "Technical specifications," that govern the operation of the plants. These TSs have limiting conditions for operation (LCOs) that define which diesel generator (DG) and alternating current (AC) electrical power distribution systems (i.e., vital AC buses) must be operable and the applicable reactor modes of operation. If any of these required AC electric power systems are inoperable, the TSs specify the required actions to address the inoperability and the completion times (CTs). The U.S. Nuclear Regulatory Commission (NRC) improved standard TSs (ISTS) for Westinghouse plants is NUREG-1431, "Standard Technical Specifications for Westinghouse Plants," Revision 3, dated June 2004. A description of the applicable systems and components is given in Appendix D of this safety evaluation (SE).

By letter dated June 15, 2001, the Westinghouse Owners Group (WOG) submitted Topical Report (TR) WCAP-15622, Revision 0, "Risk-Informed Evaluation of Extensions to AC Electrical Power System Completion Times," non-proprietary Class 3, to the NRC staff for review. By letters dated November 27, 2002, and December 10, 2003, the WOG supplemented the information in the TR by providing responses to the NRC staff's requests for additional information (RAIs). The TR provides the technical justification for extending the CTs at power in Required Actions for Condition B, "One DG [diesel generator] inoperable," of TS 3.8.1, "AC Sources - Operating," and Condition B, "One AC vital bus inoperable," of TS 3.8.9, "Distribution Systems - Operating," in the ISTS.

In support of WCAP-15622, the Nuclear Energy Institute submitted TSTF-417, Revision 0, "AC Electric Power System Completion Times (WCAP-15622)," by letter dated September 5, 2001, to the NRC. This TSTF will be addressed by the NRC staff in a separate evaluation, and not in this SE.

Approval of the TR was requested for referencing by licensees seeking relief from current TSs where the CTs at power for inoperable AC electric power systems are not long enough to address inoperabilities or to perform preventative maintenance (where the equipment is declared inoperable until the equipment is returned to service). As stated in the TR, the proposed changes will improve plant operational safety, provide a more consistent risk basis for the regulatory requirements, and reduce unnecessary regulatory burden, as follows:

- increase the flexibility in the scheduling and performance of preventive maintenance, enabling additional planned maintenance at power,
- provide additional time to perform related maintenance tasks,
- provide better resource allocation, in that online maintenance provides flexibility to focus dedicated resources on required or elective maintenance,
- limit unplanned plant shutdowns and potential requests for notices of enforcement discretion,
- improve the DG and other equipment availability during shutdown modes, and
- risk-inform the DG and AC electric power distribution system CTs.

2.0 REGULATORY REQUIREMENTS AND GUIDANCE

Regulatory Requirements:

General Design Criterion (GDC) 17, "Electric Power Systems," in Appendix A to Title 10 of Part 50, "Domestic Licensing of Production and Utilization Facilities," of the *Code of Federal Regulations* (10 CFR Part 50), requires that nuclear power plants have an onsite electric power system and an offsite electric power system to permit the functioning of structures, systems, and components (SSCs) important to safety. The safety function of each system (assuming the other system is not functioning) is to provide sufficient capacity and capability to assure that (1) fuel design limits and design conditions of the reactor coolant boundary are not exceeded as a result of anticipated operational occurrences (AOOs) and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents. The onsite electric power supplies (including the batteries) and the onsite electric distribution system are required to have sufficient independence, redundancy, and testability to perform their safety functions, assuming a single failure. Electric power from the transmission network to the onsite electric distribution system is required to be supplied by two physically independent circuits designed and located so as to minimize the likelihood of their simultaneous failure. Each of these circuits is required to be designed to be available in sufficient time following a loss of all onsite AC power supplies and the other offsite electric power circuit, to assure that fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded. One of these circuits is required to be available within a few seconds following an accident to assure that core cooling, containment integrity, and other vital safety functions are maintained. In addition, GDC 17 requires provisions to minimize the probability of losing electric power from the remaining electric power supplies as the result of loss of power from the unit, the offsite transmission network, or the onsite power supplies.

Section 50.36 of 10 CFR, "Technical specifications," requires the TSs for a plant to be derived from the analyses and evaluation included in the Plant Final Safety Analysis Report. An LCO is required to be established for each SSC that is part of the primary success path and which functions or actuates to mitigate a design-basis accident (DBA) or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier. The LCOs specify minimum requirements on SSCs for ensuring the safe operation of the plant.

- Included with the LCOs are Surveillance Requirements (SRs) which provide requirements to assure that the necessary quality and performance required of systems and components are maintained and the LCOs are being met. When an LCO is not met, due to one condition such as either a component failure or maintenance outage, action is required within a specified time by the TSs to fix the condition by restoring

required equipment to an operable condition. This specified time to take action is referred to as the CT. The specific Condition for why the LCO is not being met, the required actions for that Condition, and the CTs for these required actions are specified in the TSs.

- A 24-hour extension of the CT is permitted by the ISTS to restore other required equipment discovered inoperable and subject to the same condition. And, a separate CT (i.e., the second CT) is applied by the ISTS when multiple conditions are discovered within a single LCO. The CT is a temporary relaxation of operability for required equipment, which provides a limited time to fix components and return required equipment to an operable status. Establishing this limited time to fix components is based, primarily, on the reliability of remaining operable required equipment (during the short time period of a CT) being judged commensurate with reliability when all required equipment is operable.

WCAP-15622 references the term "allowed outage time" (AOT) as used in the standard TSs (STS) which predate the ISTS in NUREG-1431. However, the LCO markups included in the WCAP use the ISTS term "CT." The AOT generally refers to the time given to accomplish a TS required action. To have a more specific meaning, an AOT can refer to additional time for activities such as repair, bypass, and shutdown. A CT, as used in the ISTS, has a broader meaning than an AOT, in that it also defines the time for other required actions such as equipment status or plant mode changes. The CT is intended to allow sufficient time to repair failed equipment while minimizing the risk associated with the loss of the component function. Although the term AOT appears to be used interchangeably with the term CT in the WCAP, the NRC staff uses only the term CT in this SE as it is used in the ISTS.

Applicable Regulatory Guidelines and Standards:

Regulatory Guide (RG) 1.9, "Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants," Revision 3, dated July 1993, provides recommendations or guidelines for satisfying GDC 17. Included in the RG is the Institute of Electrical and Electronic Engineers (IEEE) Standard 387-1984, "IEEE Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations," which provides design criteria and qualification, and testing guidelines that, if followed, will help ensure that DGs meet performance requirements.

RG 1.93, "Availability of Electric Power Sources," provides guidance with respect to operating restrictions (i.e., CTs) if the number of available AC power sources is less than that required by the TS LCO. In particular, this guidance prescribes a maximum CT of 72 hours for an inoperable AC power source.

Chapter 19.0 of the NRC Standard Review Plan (SRP), NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," provides general guidance for evaluating the technical basis for proposed risk-informed changes. Chapter 16.1, "Risk-Informed Decisionmaking: Technical Specifications," of the SRP, which includes CT changes as part of risk-informed Decisionmaking, provides more specific guidance related to risk-informed TS changes. Chapter 19.0 of the SRP states that a risk-informed application should be evaluated to ensure that the proposed changes meet the following key principles:

- The proposed change meets the current regulations, unless it explicitly relates to a requested exemption or rule change.
- The proposed change is consistent with the defense-in-depth philosophy.
- The proposed change maintains sufficient safety margins.
- When a proposed change increases core damage frequency or risk, the increase(s) should be small and consistent with the intent of the Commission's Safety Goal Policy Statement.
- The impact of the proposed change should be monitored using performance measurement strategies.

RGs 1.174 and 1.177 provide specific guidance and acceptance guidelines for assessing the nature and impact of licensing-basis changes, including proposed permanent TS changes in CTs, by considering engineering issues and applying risk insights. RG 1.177 identifies an acceptable 3-tiered risk-informed approach, which includes additional guidance specifically geared toward the assessment of proposed CT changes.

In addition, RG 1.177 outlines more specific methods and guidelines acceptable to the NRC for assessing risk-informed TS changes. Specifically, RG 1.177 provides recommendations for using risk information to evaluate changes to TS CTs and surveillance test intervals (STIs) with respect to the impact of the proposed change on the risk associated with plant operation. RG 1.177 also describes acceptable implementation strategies and performance monitoring plans to help ensure that the assumptions and analysis used to support the proposed TS changes will remain valid. Consistent with RG 1.174, risk-informed TS changes (including risk analysis techniques) are expected to meet a set of key principles. RG 1.177 includes the key principles of RG 1.174, as stated above, which also apply to TS changes.

The approach in WCAP-15622 is consistent with the NRC's approach for applying probabilistic risk assessment (PRA) to risk-informed plant-specific changes to the current licensing basis, as documented in RGs 1.174 and 1.177.

3.0 EVALUATION

3.1 Proposed Change to CTs

The NRC staff has reviewed the methodology for the proposed extensions of the CTs for the DGs, and the AC sources and distribution systems, as described in WCAP-15622. The proposed increases in CTs affect the following LCO requirements:

- Increase CT from 24 hours to 72 hours for an inoperable DG to confirm operability of the other DG.
    - LCO 3.8.1, Condition B, “One [required] DG inoperable,” to perform Required Action B.3.1, “Determine OPERABLE DG(s) is not inoperable due to common cause failure,” or Required Action B.3.2, “Perform SR 3.8.1.2 for OPERABLE DG(s)”

- Increase CT from 72 hours to 7 days (the licensee for Comanche Peak Steam Electric Station (CPSES) stated in WCAP-15622 that it would propose 14 days in its plant-specific application and the 14 days is not addressed in this SE) for an inoperable DG to restore the inoperable DG.

  — LCO 3.8.1, Condition B, “One [required] DG inoperable,” to perform Required Action B.4, “Restore [required] DG to OPERABLE status”

- Increase CT from 2 hours to 24 hours for an inoperable vital AC bus to restore the inoperable bus.

  — LCO 3.8.9, Condition B, “One or more AC vital buses inoperable,” to perform Required Action B.1, “Restore AC vital bus subsystems(s) to OPERABLE status”

The above proposed extension to CTs for TS 3.8.1 and 3.8.9 also includes (1) the identified extension of the second CTs (i.e., the time from the discovery of failure to meet the LCO) given in TS 3.8.1, Required Actions A.3 and B.4, and in TS 3.8.9, Required Actions A.1, B.1, and C.1, and (2) an implied extension to the CT for inoperable DG start instrumentation in ISTS 3.5.5, Required Action C.1. These are addressed in Sections 3.6 and 3.7, respectively, in this SE.

3.2 Summary of NRC Review

In summary, the NRC staff has concluded the following:

- The Tier 1 PRA capability and insights in WCAP-15622 are the plant-specific Tier 1 results that were submitted for the plants identified in Section A.1 of Appendix A of this SE and compiled in the TR for the plants. Because the TS changes proposed in WCAP-15622 for an inoperable DG or vital AC bus that were based on these Tier 1 results do not meet all the acceptance guidelines in RGs 1.174 and 1.177, the NRC staff concludes that the TR has not demonstrated that the proposed TS changes are acceptable without consideration of plant-specific Tier 2 and Tier 3 results. However, the methodology, procedures, and guidelines in WCAP-15622, with the additional plant-specific information identified in the conditions listed in Section 4.0 of this SE, provide a review methodology acceptable to the NRC staff for the evaluation of proposed DG and AC vital bus CTs for plant-specific applications and the TR can be referenced in such applications to the NRC staff. This is discussed in Section 3.4 of this SE.

- The proposed extension of the CT, from 24 hours to 72 hours, for an inoperable DG to either complete the common cause evaluation or SR 3.8.1.2 for the operable DGs is not supported by the TR. This is discussed in Section 3.3.1 of this SE.

- Additional information, beyond that stated above for Tier 2 and Tier 3 issues, will be needed in the plant-specific submittals, as discussed in Section 5.0 of this SE. This includes certain information that was identified in the responses to NRC staff's RAIs for its review of WCAP-15622 to be provided in the plant-specific submittals.

- The WCAP did not examine the sensitivity of each demonstration plant to the model used by the respective licensees for the reactor coolant pump (RCP) seal during a seal loss-of-coolant accident (LOCA). Licensees must document the RCP seal model used

in any plant-specific submittal based on WCAP-15622, as discussed in Appendix C of this SE.

- The proposed extension of the CT to restore an inoperable DG implies a similar extension in CT for a DG made inoperable because the loss-of-offsite power (LOOP) start instrumentation is inoperable. However, because this CT extension was not proposed in WCAP-15622, it was not considered part of the scope of NRC review of WCAP-15622 and, therefore, in the plant-specific applications, licensees must either (1) provide the impact on the DG CT and a basis for extending this DG CT for inoperable LOOP DG start instrumentation or (2) propose TS changes to separate the CT in the plant TSs for ISTS LCO 3.5.5, Condition C from the CTs in ISTS LCO 3.8.1, Condition B, as discussed in Section 3.7 of this SE.

- The proposed extension to the CT to restore an inoperable vital AC bus may change the plant-specific licensing basis if the plant TSs are based on the ISTS because the proposed CT extension implies the vital AC bus could be OPERABLE without a backup source of AC power from the direct current (DC) system battery through an inverter. This was not reviewed by the NRC staff as part of its review of WCAP-15622 and licensees need to address this in plant-specific applications.

- The extended CT for an inoperable DG is in part to allow sufficient time for more planned online DG maintenance because the DG is inoperable during the maintenance. The post-maintenance testing that would be required in the TSs to show the restored DG is operable must be addressed in the plant-specific application, including the following: (1) how the required testing meets the sufficient testability requirement of GDC 17 to show the DG is operable, (2) how performing the testing online does not prevent the plant from being able to perform its safety functions, and (3) what are the safety issues associated with testing the DG connected to the grid with the plant at power.

- In its review of the extended second CTs, the NRC staff concludes that the algebraic sum of (1) the proposed extended CTs for an inoperable DG (TS 3.8.1) or inoperable vital AC bus (TS 3.8.9) and (2) the CT for an inoperable offsite circuit (TS 3.8.1) or inoperable DC bus (TS 3.8.9) to determine the second CT is acceptable.

The above proposed increases in CTs were evaluated individually from both the deterministic approach and risk-informed prospective. The detailed description of the proposed changes is in Section 3.3 of this SE, the discussion of the NRC PRA review methodology is given in Section 3.4, and the evaluations of the proposed changes are given in Section 3.5.

3.3 Detailed Description of the Proposed CT Changes

Currently, Section 3.2.1 of the ISTS requires the restoration of an inoperable DG to operable status within 72 hours and confirmation that the operable DG(s) is/are not inoperable because of a common cause failure within 24 hours. In addition, the ISTS require that with one or more vital buses inoperable, the inoperable vital bus must be restored to operable status within

2 hours. The proposed changes would modify the ISTS CTs as outlined in Section 1.0 of this SE.

3.3.1 LCO 3.8.1, Required Actions B.3.1 and B.3.2, DG Common Cause Failure Evaluation

In accordance with the ISTS, the Class IE AC electrical distribution system sources consist of the offsite power sources and the onsite standby power sources. According to GDC 17, the design of the AC electrical power system must provide sufficient capacity, capability, independence, redundancy, and testability to ensure an available source of power to engineered safety feature (ESF) systems. The onsite standby power sources for each ESF bus include a dedicated DG. The DG starts automatically on a safety injection signal or ESF degraded voltage, or loss of voltage signal.

Condition B of LCO 3.8.1 defines the requirements for DG operability and provides an allowance to avoid testing of the operable DG. Required Actions B.3.1 and B.3.2 require that the licensee demonstrate that, with one required DG inoperable, the remaining DG(s) are not inoperable because of a common cause. If it can be shown that the cause of the inoperable DG(s) does not exist for the operable DGs, then the surveillance test on the operable DG(s) does not have to be performed. If not, the performance of the surveillance test would then provide assurance that the remaining DG(s) continue to be operable. If the cause is found to exist for the other DG(s), then the DG(s) would also be declared inoperable upon discovery and Condition E of LCO 3.8.1 entered. Currently, completion of either B.3.1 or B.3.2 actions is required within 24 hours.

The proposed CT extension applies for entrance into the LCO for DG unplanned corrective maintenance activities. As stated in the ISTS, if the inoperable DG is restored to operable status before completion of the common cause evaluation, the plant corrective action program would continue to evaluate the possibility of a common cause. Scheduled maintenance or testing would not exercise this LCO since a DG failure is not postulated with planned maintenance.

3.3.2 LCO 3.8.1, Required Action B.4, DG Extended CTs

The TR stated that operating experience has shown that the DG CT is the most demanding part of the DG TSs and included examples of scenarios in which the present 72-hour CT provided inadequate time to complete certain repairs. The proposed 7-day CT for LCO 3.8.1, Required Action B.4, does not affect the adequacy of the offsite circuits or the remaining operable DG(s) to supply power. As stated in the ISTS, the CT takes into account the capacity and capability of the remaining AC sources, a reasonable time for repairs, and the low probability of a DBA occurring during this period.

The LCO 3.8.1, Required Actions A.3 and B.4 contain a second CT that is also proposed to be extended in accordance with WCAP-15622. This is addressed in Section 3.6 of this SE.

3.3.3 LCO 3.8.9, Required Action B.1, Restore AC Vital Bus to Operable Status

As stated in the ISTS, the vital AC buses are arranged in two load groups per train. The vital AC buses are normally fed from inverters. The voltage-regulating transformers powered from the same train as the inverters generally supply the alternate power. The loads fed from the

vital AC buses generally consist of nuclear instrumentation, instrumentation/control power, reactor protection system protection racks, the solid-state protection system, and ESF actuation system slave, master relays, and instrument power supplies, as well as others.

Condition B of LCO 3.8.9 defines the requirements for vital AC bus operability. Required Action B.1 mandates the restoration of the vital bus to operable status within a CT of 2 hours. The WCAP proposes to increase the CT from 2 to 24 hours.

With one or more AC sources inoperable, the plant is much more vulnerable to a loss of all non-interruptible power. WCAP-15622 states that with one vital AC bus inoperable, the remaining operable vital AC buses can support the minimum functions required to shut down the unit. However, as stated above and as shown in WCAP-15622, Condition B provides the required actions for the inoperability of one or more vital AC buses. For Condition B, WCAP-15622 evaluates increasing the CT for only one inoperable vital AC bus. The proposed CT of 24 hours only applies to the first inoperable vital AC bus. Additional plant-specific calculations and justifications would be required to extend the CT of additional vital AC buses beyond the current CT of 2 hours.

LCO 3.8.9, Required Actions A.1 and C.1 contain a second CT that is also extended per WCAP-15622. This is addressed in Section 3.6 of this SE.

3.4 NRC Staff Conclusions on WCAP-15622 PRA Methodology

An evaluation of the WCAP-15622 PRA methodology is given in Appendix A to this SE. Based on its review of the proposed changes, the NRC staff finds that the methodology presented in WCAP-15622 follows the guidelines stated in RG 1.174, RG 1.177, and NRC review guidance as outlined in Chapter 16.1 and 19.0 of NUREG-0800. However, the NRC staff also finds that, for the demonstration plants, the impact on plant risk might be unacceptable in comparison to the NRC acceptance guidelines. For example, the NRC staff found the proposed CT for LCO 3.8.1 (Required Action B.4, 72 hours to 7 days) typically resulted in incremental conditional core damage probability (ICCDP) values greater than the RG 1.177 acceptance guidelines. In addition, for one plant, the change in core damage frequency (ΔCDF) did not meet the guidance for a small change. For three of the five plants that evaluated a revision to LCO 3.8.1 (Required Actions B.3.1 or B.3.2, 24 to 72 hours) and for four of the five plants that evaluated a revision to LCO 3.8.9 (Required Action B.1, 2 to 24 hours), the ICCDP values for repair also exceeded the RG 1.177 acceptance guidelines. Estimates for the change in large early release frequency (ΔLERF) and the incremental conditional large early release probability (ICLERP) were screened out of the WCAP-15622 analysis based on the assumed limited system CT impact on releases from containment, and therefore, were not provided in WCAP-15622.

In a response to an RAI, the WOG provided revised risk estimates for ΔCDF, ΔLERF, ICCDP, and ICLERP for some of the WCAP-15622 demonstration plants. The revised estimates reflected the use of compensatory measures, revised CTs, and revised analysis assumptions. The NRC staff found that these revised estimates were typically within the acceptance guidelines of RGs 1.174 and 1.177; however, because of the plant-specific nature of the methodology and analysis presented in WCAP-15622, the NRC staff finds that the plant-specific implementation of the proposed changes in CT will require licensees to evaluate compensating features and actions (including possible revision to the proposed CTs) to show

that the RGs 1.174 and 1.177 guidelines remain satisfied. Licensees must also evaluate changes in ΔCDF, ΔLERF, ICCDP and ICLERP on a plant-specific basis.

Therefore, the NRC staff concludes that the TS changes proposed by WCAP-15622 to extend the CTs for an inoperable DG or vital AC bus, do not always meet all the acceptance guidelines in RGs 1.174 and 1.177. Based on that, the NRC staff further concludes that it has not been demonstrated that the specific changes proposed by the TR will be acceptable; however, the methodology, procedures, and guidelines of the TR, and the additional conditions in Section 4.0 of this SE, provide a review methodology acceptable for the evaluation of the proposed DG and AC vital bus CTs for plant-specific applications and the TR can be referenced in such applications.

3.5 NRC Staff Evaluation of TS Changes

3.5.1 DG Common Cause Evaluation

WCAP-15622 proposes and provides justification for increasing the current CT in the ISTS to complete a DG common cause evaluation for an inoperable DG from 24 hours to 72 hours, based on a risk-informed approach. The NRC staff's evaluation of the WCAP-15622 PRA methodology is in Section 3.4 of this SE.

3.5.1.1 Background

In the STS, when one DG is inoperable, the TSs require that the availability of the remaining offsite and onsite AC power sources must be verified. For the offsite system, availability is verified within 1 hour and every 8 hours thereafter when one DG is inoperable. For the onsite system, availability is verified by starting the remaining operable DG(s) within 1 hour and once every 8 hours thereafter. These additional verifications are considered necessary by the NRC staff to provide assurance that the minimum required safety systems are supported by the remaining AC sources when one DG is inoperable.

In the ISTS, the TS requirements are that the following changes (or options) to the above verifications also provide assurance that the minimum required safety systems are supported by the remaining AC sources when one DG is inoperable. For the offsite system, availability is still verified within 1 hour and every 8 hours thereafter. For the onsite system, availability is verified by starting the remaining operable DG(s) within 24 hours. However, as an alternative to starting the DG, availability can be verified by reaching a no-common-cause finding between the inoperable DG and the remaining operable DG(s) within 24 hours. The DG start and load test (required to be performed every 31 days according to the TS) and the common cause evaluation finding that there is no similar failure to the inoperable DG provide assurance that the minimum required safety systems are supported by the remaining AC sources and safety systems will be capable of performing their required safety function when needed when one DG is inoperable.

3.5.1.2 Deterministic/Risk Evaluation

Appendix E of WCAP-15622 gives specific analysis guidance to licensees concerning LCO 3.8.1, Required Actions B.3.1 and B.3.2. Appendix E supplements Appendix C of the WCAP with additional detail and guidance for a specific TS change request when revising the

DG common cause evaluation CT. Appendix E provides guidance on evaluating the risk impact for the proposed CT extension. The proposed CT extension would increase the TS CT requirement to perform a common cause evaluation for the operable DG(s) from the current 24 hours to 72 hours for an inoperable DG condition. This appendix provides methods to evaluate the impact on CDF and ICCDP for the proposed 72-hour DG common cause evaluation CT for both the current 72-hour and 7-day DG CTs. It evaluates RGs 1.174 and 1.177 acceptance guidelines with data collection information specified for review and presentation. The methodology presented in the WCAP considers the duration of repair and maintenance activities and the treatment of common cause factors (CCFs) with respect to the extended DG CT and the common cause evaluation CT.

The WCAP stated that, based on the differences in plant design and modeling, the demonstration plant results indicate that the impact on CDF is small for the proposed DG common cause CT extension. The NRC staff notes that all the plant CDF estimates are within the acceptance guidelines given in RG 1.174 for internal events, but the ICCDP values for a number of the plants were not within the acceptance guideline of 5.0E-7 given in RG 1.177. In addition, WCAP-15622 does not provide details on external event risk or estimates for ΔLERF and ICLERP.

Moreover, the NRC staff is concerned that risk informing the CT for the common cause evaluation is not consistent with the intent of the TS requirements or assumptions. The current 24-hour CT for the common cause evaluation for the remaining operable DG(s) (required by LCO 3.8.1, Required Action B.3.1) provides a CT allowance to avoid testing of operable DG(s) by providing a reasonable time to perform the evaluation and still meet the intent of the RG 1.93 regulatory position for "immediate verification" of the availability and integrity of the remaining sources. If the common cause evaluation (required by Required Action B.3.1) concludes that the cause of the inoperable DG does not exist for the operable DG(s) then surveillance testing of the operable DG(s) does not have to be performed. The 24-hour CCF evaluation is considered to meet the regulatory position of "immediate verification" while providing a means to limit DG surveillance testing. In addition, the 24-hour CT is considered reasonable to confirm that the operable DG(s) is not affected by the same failure as the inoperable DG. The DG(s) can, therefore, be considered to have the necessary reliability (NUREG 1431/Generic Letter 84-15) to perform its safety function when needed. The purpose of the TS requirement is to assure sufficient testability of the operable DG(s) pursuant to GDC 17 when one DG is inoperable. With one DG inoperable for corrective maintenance, the functional test (performed on a plant refueling outage frequency) and the availability test (performed every 31 days) on the operable DG(s) do not meet the sufficient testability requirement of GDC 17. Based on this, the NRC staff concludes that risk informing the CCF evaluation is not consistent with the testability requirement of GDC 17.

RG 1.93 discusses the situation when the available AC power sources are one less than the LCO. This degradation level as described by RG 1.93 means that one of the required offsite or onsite AC sources is not available. Although neither the offsite nor the onsite sources have redundancy, both systems are capable of mitigating the effects of an DBA. The RG states that for this condition (which includes one required DG inoperable) operation can safely continue if the availability of the remaining sources is verified although a time limit (on the CT) is warranted due to LCO entry. The regulatory position of RG 1.93 also states that continued power operation may continue but be contingent on, (a) an immediate verification of the availability and integrity of the remaining sources, (b) reevaluation of the availability of the remaining DG(s)

at time intervals not to exceed 8 hours, (c) verification that the required maintenance activities do not further degrade the power system or in any way jeopardize plant safety, and (d) compliance with the additional conditions stipulated for each degradation level.

In addition, NUREG/CR-5460, "A Cause-Defense Approach to the Understanding and Analysis of Common Cause Failures" establishes a set of defensive tactics to decrease the likelihood of component or system unavailability. Among these are monitoring, surveillance testing, and inspection such that failures from any detectable cause are not allowed to accumulate, including tests performed on redundant components in response to observed failures. If the inoperable DG is restored to operable status prior to completing the common cause evaluation, the plant will continue to evaluate the common cause possibility, but the evaluation would be done under the plant corrective action program.

Based on this, the status of the operable DG(s) would be unknown until the common cause evaluation is completed under the corrective action program. Although the risk analysis provided by WCAP-15622 indicates that the acceptance guidance of RGs 1.174 and 1.177 may be met for some plants, the NRC staff finds the extension of the 24-hour CT for common cause evaluation of the operable DG(s) presents additional uncertainty to that of WCAP-15622, is not consistent with RG 1.93 regulatory positions and NRC staff guidance, and is therefore not justified per the evaluation provided by WCAP-15622 and should remain at 24 hours. In addition, a qualitative evaluation approach to the CT for the remaining operable DG(s) common cause evaluation introduces additional uncertainty to the common cause evaluations not quantified in the PRA or specifically addressed by RG CT positions or NRC staff guidance.

3.5.1.3 Conclusion

Based on the above evaluation of the proposed increase in the common cause evaluation CT for an inoperable DG and the evaluation of the WCAP-15622 PRA methodology in Section 3.4 of this SE, the NRC staff concludes that the proposed extension of the 24-hour DG common cause CT to 72 hours does not provide sufficient testability of the operable DG(s) pursuant to GDC 17, and is, therefore, not acceptable.

3.5.2 Extended CT for an Inoperable DG

3.5.2.1 Deterministic Approach

The WCAP-15622 methodology proposes and provides justification for increasing the current CT of 72 hours for an inoperable DG. The methodology is based on a risk-informed approach. The NRC staff's evaluation of the methodology for this change from a risk perspective is given in Section 3.4 of this SE.

The regulatory requirements that are applicable to the proposed extended CT for an inoperable DG are the following:

- GDC 17 requires, in part, that nuclear power plants have onsite and offsite electric power systems to permit the functioning of structures, systems, and components that are important to safety. The onsite system is required to have sufficient independence, redundancy, and testability to perform its safety function, assuming a single failure. The offsite power system is required to be supplied by two physically independent circuits

that are designed and located so as to minimize, to the extent practical, the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. In addition, this criterion requires provisions to minimize the probability of losing electric power from the remaining electric power supplies as a result of loss of power from the unit, the offsite transmission network, or the onsite power supplies.

- GDC 18, "Inspection and testing of electric power systems," requires that electric power systems that are important to safety must be designed to permit appropriate periodic inspection and testing.

- 10 CFR 50.36, "Technical Specifications," requires a licensee's TSs to establish LCOs, which include CTs for equipment that is required for safe operation of the facility.

- 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," requires that preventive maintenance activities must not reduce the overall availability of the SSCs.

None of these requirements prevent the CT for an inoperable DG from being extended from the current 72 hours in the TSs; however, there may be an elevated risk in allowing online maintenance and post-maintenance testing of a DG with the plant at power. This online maintenance would result in (1) the DG connected to the grid while the plant is at power and (2) the post-maintenance testing conducted to show the restored DG is operable would be conducted with the plant at power. Because the design and maintenance of the DGs are not being changed by the proposed extension of the CTs and only the CTs in the TSs are being changed, the proposed changes do not affect GDC 18, 10 CFR 50.35, and 10 CFR 50.65. These two issues are only within the requirements of GDC 17 and are discussed below:

- Common Mode Failure of DG and Offsite System

IEEE 387 and RG 1.9 recommend limiting (to approximately 1 hour each month) the time the DG can be connected to the offsite power system to permit load testing. As part of the licensing bases, this 1-hour limit: (1) minimizes the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies, and (2), therefore, meets the requirements of GDC 17.

Permitting online maintenance necessitates increasing (beyond this 1-hour limit) the time the DG is connected to the offsite power system and subject to common mode failure with the offsite system. The impact on regulatory requirements of the DG and offsite power sources being subject to a common mode failure for a longer period of time due to online maintenance should be addressed as part of the plant-specific evaluation for increasing the current CT of 72 hours.

WCAP-15622 indicates that TS mode restrictions (which allow most DG testing to be performed only when the plant is shutdown) have been removed from some plant TS for the DG 24-hour load, full load rejection, and largest load rejection tests. The removal of these mode restrictions allows operability to be demonstrated by monthly start and load tests followed by the 24-hour load, full load rejection, and/or largest load rejection tests with the plant online. Performing tests (e.g., the 24-hour load test) with the plant online extends (beyond this 1-hour limit) the

time the DG must be connected to the offsite power system to perform post- maintenance testing. The impact on regulatory requirements of the DG and offsite power sources being subject to common mode failure for a longer period of time should be addressed as part of the plant-specific evaluation for increasing the current CT of 72 hours.

To minimize the probability of loss of both offsite and onsite systems during surveillance testing pursuant to GDC 17, additional compensatory measures (e.g., operability of protective relaying) should be required as part of the licensing bases during surveillance testing. Compensatory measures and compliance with regulatory requirements should be addressed as part of the plant-specific evaluation.

- Post-Maintenance Testing Following Online DG Maintenance

IEEE 387 and RG 1.9 recommend that refueling outage and monthly start and load tests be utilized to demonstrate that the DG has adequate capacity and capability to perform its design function. As part of the licensing bases, the NRC staff concludes that refueling outage tests (with the plant shutdown) and the monthly start and load tests (with the plant online) will demonstrate sufficient capacity and capability (assuming the offsite system is unavailable) to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of AOOs and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents. The DG, therefore, has sufficient testability and meets the requirements of GDC 17.

WCAP-15622 indicates (based on engineering judgement and the type of online maintenance) that operability, the capacity and capability to perform its design function, is demonstrated by monthly start and load tests with the plant online. The refueling tests with the plant shutdown would not be performed following online maintenance to demonstrate DG operability; however, WCAP-15622 also indicates that TS mode restrictions (which allow most DG testing to be performed only when the plant is shutdown) have been removed from some plant TS for the DG 24-hour load, full load rejection, and largest load rejection tests. The removal of these mode restrictions allows operability to be demonstrated by the 24-hour load, full load rejection, and/or largest load rejection tests with the plant online, followed by monthly start and load tests. To demonstrate sufficient capacity and capability of the DG (i.e., sufficient testability), pursuant to GDC 17, surveillance testing following maintenance, as a minimum, should include starting, load acceptance, rated load, load rejection, and subsystem tests recommended by Section 6.5 of IEEE 387. The surveillance testing following DG maintenance and compliance with regulatory requirements should be addressed as part of the plant-specific evaluation.
Both of the above two issues need to be addressed in the licensees' plant-specific applications referencing WCAP-15622.

3.5.2.2 Risk-Informed PRA Approach

Appendix D of WCAP-15622 outlines specific analysis guidance to licensees concerning LCO 3.8.1, Required Action B.4, to increase the CT from 72 hours to 7 days. Appendix D supplements Appendix C of the WCAP with more detail and guidance specific to the TS change request. The additional guidance includes DG events, impact on the PRA model, DG modeling for LOOP events, and modifying the PRA with an extended DG CT. This WCAP appendix evaluates RG 1.174 and 1.177 acceptance guidelines with data collection information specified for review and presentation. It also includes an RAI, which is based on the NRC staff RAI to

another Owners Group for that groups' DG CT extension request. The additional information in Appendix D of WCAP-15622 that should be included in the plant-specific submittals is listed in Appendix E of this SE, under the heading Appendix D of WCAP-15622.

Appendix D of WCAP-15622 also recommends that realistic test and maintenance times be used for the extended CT and states that this is consistent with RG 1.177. However, RG 1.177 references the use of mean outage values when calculating the change in average CDF, but for ICCDP or ICLERP it is assumed that the full CT is used. In addition, for a DG in repair, the TR states that the common cause factor (e.g., the beta factor for two DGs) should be used for the available DG when estimating ICCDP for a DG in repair. Appendix D does not consider the reevaluation of the common cause factors due to the known DG failures or maintenance outage. The calculation of ΔLERF and ICLERP is stated to not be required for the DG CT extension as outlined in the WCAP. The NRC staff does not generically accept this WCAP position and will require, on a plant-specific basis, confirmation of conformance to the ΔLERF and ICLERP acceptance guidelines.

The ΔCDF for most of the demonstration plants was within the RG 1.174 acceptance guidelines for a small change in CDF of 1.0E-6/year. However, the ICCDP values for either a maintenance or repair DG CT of 7 days are all greater than the RG 1.177 acceptance guideline of 5.0E-7 and, therefore, do not meet the guidelines of RG 1.177. The results can vary significantly between plants, even those of similar design, based on individual plant characteristics, modeling assumptions, or vulnerabilities. Also note that WCAP-15622 does not provide the impact of internal flooding or external event risks. Differences in AC/DC electrical systems, alternate AC sources, DG reliability estimates, initiating event frequencies, and RCP-seal-LOCA models also contribute to the differences in plant results. Therefore, the allowances for the proposed 7-day DG CT may not be acceptable for plant-specific applications of the WCAP . See the discussion on the RCP seal LOCA models in Appendix C of this SE. It is expected that for a plant-specific DG CT extension submittal founded on WCAP-15622, a licensee will include plant-specific documentation on the RCP seal model employed and its conformance to NRC SE conditions for referencing WCAP-15603, Revision 1.

For shutdown risk, the evaluation is qualitative, in that most plants do not have a detailed shutdown risk model. The refueling outage duration and DG maintenance scheduling strongly influence the risk averted during shutdown (i.e., the various stages of an outage have different risk impacts). For example, the contribution to plant risk with respect to DG maintenance during the early stages of an outage with high decay heat, limited coolant inventory, and only electric pumps available is sensitive to DG unavailability. However, the risk impact can decrease substantially when maintenance is conducted during the later stages of an outage (e.g., during refueling). When DG maintenance is performed earlier in the outage, risk is higher and comparable to power operation (see NUREG/CR-5994, “Emergency Diesel Generator Maintenance and Failure Unavailability and Their Risk Impacts,” issued November 1994). Generally, taking an individual DG out for maintenance results in an increase in ICCDP of about an order of magnitude; but, as shown above, plant CDF is less sensitive to a DG in maintenance (see NUREG/CR-5994).

WCAP-15622 provided an evaluation based on the CPSES shutdown model and stated that performing a DG maintenance at power (assuming a 14-day CT) resulted in an ICCDP that was significantly smaller than if the maintenance had been performed during shutdown. The NRC staff disagreed with the TR approach because the WOG performed the comparison by

essentially summing the risk impact of various stages of the outage. Based on the analysis, the NRC staff determined that the performance of DG maintenance at power is essentially risk neutral with consideration given to maintenance scheduling at shutdown. With respect to performing DG maintenance at the beginning of an outage, as stated in the WCAP, performing DG maintenance online can provide a risk benefit, but this benefit is a result of reduced outage duration and DG maintenance scheduling by the licensee (i.e., higher risk configuration during shutdown). Therefore, with respect to the proposed 7-day DG CT, the shutdown risk averted may provide a qualitative risk benefit, but should not be credited in the risk evaluation presented in the plant-specific application.

These differences dictate that for a DG CT extension request, each licensee must submit a plant-specific analysis with regard to Tier 1, Tier 2, and Tier 3, as outlined in this SE and Sections 8.5 and 8.6 of WCAP-15622. Additionally, estimates of ΔLERF, ICLERP, external event risk, and cumulative risk, in accordance with the guidelines of RGs 1.174 and 1.177 are required for a plant-specific submittal.

For second CTs in TS 3.8.1, to limit the time a licensee could alternate between different LCO conditions (e.g., inoperable DG and inoperable offsite circuit), a second CT was established in the ISTS. This second CT was based on the combination of CTs for multiple condition entries. The extension of the second CT reflects the CT extension for DGs and vital AC buses. Therefore, the second CTs are deterministic in nature and were not reviewed by the NRC staff in terms of risk, which is consistent with previous NRC staff reviews concerning DG CT evaluations.

3.5.2.3 Conclusion

Based on its deterministic review of the proposed increase in the CT for an inoperable DG, the NRC staff concludes that the proposed change meets the requirements of GDC 17 subject to the resolution of safety issues involved with this change that are not covered by the WCAP-15622 methodology, and must be addressed as part of the plant-specific evaluations for increasing the current CT of 72 hours for an inoperable DG.

Based on the PRA review of the change and the evaluation of the WCAP PRA methodology in Section 3.4 of this SE, the NRC staff concludes that the TS changes proposed in WCAP-15622 to extend DG CTs do not always meet all the acceptance guidelines in RGs 1.174 and 1.177. Therefore, it has not been demonstrated that the specific changes proposed by the WCAP will be acceptable. However, the methodology, procedures, guidelines, and the additional conditions in Section 4.0 of this SE provide a review methodology acceptable for the evaluation of the proposed DG CT using the additional risk information that would be provided in the plant-specific application.

See Section 5.0 of this SE for the additional information needed in the licensees' plant-specific applications referencing WCAP-15622.

3.5.3 Increased CT for One Inoperable Vital AC Bus

The WCAP-15622 methodology proposes and provides justification for increasing the current CT of 2 hours for an inoperable AC vital bus. The methodology is based on a risk-informed

approach. The NRC staff's evaluation of the methodology for this change from a risk perspective is given in Section 3.3.3.2 of this SE.

3.5.3.1 Deterministic Approach

The statements in Section 3.5.2.1 of this SE on the regulatory requirements for extending the CT for an inoperable DG apply also to the proposed extension of the CT for an inoperable vital AC bus.

A typical onsite system design includes: (a) two independent and redundant AC system divisions (or trains) each with its associated onsite AC standby power supply, load group (or distribution subsystem), loss of power instrumentation, and automatic load sequencer, (b) four independent and redundant DC system divisions, each with its associated battery and battery charger power supplies and load group, and (c) four independent and redundant vital AC system divisions, each with its associated inverter AC vital power supply and load group (or vital AC bus). In accordance with the STS and ISTS, each vital AC bus is required to be energized from its associated inverter power supply, and the inverter power supply is required to be energized from the DC system power supply (through the DC load group) associated with the same DC and vital AC system division. When there is a loss of AC power, the vital AC bus (as part of the licensing bases) is expected to remain energized from the DC system battery power supply through the inverter.

With one AC vital bus not energized from its associated inverter or with the inverter not connected to its associated DC bus, the ISTS (through a TS required action) allows the AC vital bus to be re-energized (a) within 2 hours from an AC source that does not have a backup source of AC power from the DC system battery through an inverter and (b) within 24 hours from its associated inverter connected to its associated DC bus. The ISTS includes a CT of 2 hours (which is proposed in WCAP-15622 to be changed to 24 hours) to restore the AC vital bus to operable status. The bases for the ISTS state that the AC vital bus can be restored to operable status by powering the bus from an AC source that does not have a backup source of AC power from the DC system battery through an inverter. The STS, based on the definition of operability, requires the AC vital bus to be powered from an AC source that has a backup source of AC power to be considered operable. Operability of the AC vital bus when energized from an AC source that does not have a backup source of AC power from the DC system battery through an inverter is a change (based on the change to the definition of operability) from the STS to the ISTS, and could be a change to a plant-specific licensing basis. The impact on regulatory requirements should be addressed as part of the plant-specific evaluation for increasing the current CT of 2 hours if the plant TSs are based on the STS (Condition 3 of Section 4.0 of this SE).

3.5.3.2 Risk-Informed PRA Approach

Appendix F of WCAP-15622 provides specific analysis guidance to licensees concerning LCO 3.8.9, Required Action B.1. Appendix F gives additional detail and guidance with regard to a specific TS change to increase the CT time from 2 hours to 24 hours. It evaluates RGs 1.174 and 1.177 acceptance guidelines with data collection information specified for WOG review and presentation. Appendix F credits both sources of power to the vital AC buses (i.e., inverter and transformer) unless SBO events require credit only for the inverters. The appendix selects a mission time of 24 hours unless specific events use other mission times. The WCAP stated

that no test activity that causes the unavailability of a component for the vital AC power supply will be performed at power. The WCAP assumed that the vital AC bus is OPERABLE when supplied from the alternate source, which is consistent with the ISTS.

Based on the demonstration plant results, the proposed 24-hour loss of vital AC bus CT has a small impact on CDF but the estimates for ICCDP (in repair) typically exceed the acceptance guidelines of RG 1.177. V.C. Summer Nuclear Station (Summer) also does not meet the acceptance guidance for ICCDP (in maintenance). In addition, estimates for ΔLERF and ICLERP, vital AC bus repairs assumed per year, external events, and cumulative risk are required for a plant-specific submittal in accordance with the guidelines of RGs 1.174 and 1.177. The NRC will also require supplemental Tier 1, Tier 2, and Tier 3 evaluations on a plant-specific basis consistent with the guidance given in Sections 8.5 and 8.6 of WCAP-15622 (Item 1 of Section 5.0 of this SE).

3.5.3.3 Conclusion

Based on its deterministic review of the proposed increase in the CT for an inoperable AC bus, the NRC staff concludes that the proposed change meets the requirements of GDC 17 subject to the resolution of plant-specific safety issues involving whether the AC vital bus can be restored to operable status by powering the bus from an AC source that does not have a backup source of AC power from the DC system battery through an inverter. Operability of the AC vital bus when energized from an AC source that does not have a backup source of AC power from the DC system battery through an inverter may be a change to a plant licensing basis.

Based on the PRA review of the change and the evaluation of the WCAP PRA methodology in Section 3.2 of this SE, the NRC staff concludes that the TS changes proposed by WCAP-15622 to extend DG and vital AC bus CTs do not always meet all the acceptance guidelines in RGs 1.174 and 1.177. Therefore, it has not been demonstrated that the specific changes proposed by the WCAP will be acceptable. However, the methodology, procedures, guidelines, and the additional NRC conditions in Section 4.0 of this SE provide a review methodology acceptable for the evaluation of the proposed DG and AC vital bus CTs using the additional risk information that would be provided in plant-specific applications. See Section 5.0 of this SE for the additional plant-specific information needed.

3.6 Second CTs for an Inoperable DG and Vital AC Bus

CTs (See ISTS Section 1.3, "Completion Times,") are the amount of time allowed in the ISTSs for completing a Required Action and the "time zero" for the CT is normally the time of discovery of an abnormal situation, such as inoperable equipment or a variable not within limits, that requires entering an Action Condition for an LCO in the TSs, unless otherwise specified. If situations are discovered that require entry into more than one Action Condition, the Required Actions for each Condition must be performed within the associated CT. To avoid indefinitely entering and exiting multiple Conditions without restoring the system to meet the LCO, a second CT was established (See ISTS Example 1.3-3) to prevent indefinite continued operation while not meeting the LCO. This second CT allows for an exception to the normal "time zero" for beginning an CT, in that the "time zero" for the second CT is the time the LCO was initially not met, instead of when the associated Action Condition was entered. Because this second CT is based on the combination of CTs for multiple condition entries, the second CT is

deterministic in nature and was not reviewed by the NRC staff in terms of risk, which is consistent with previous NRC staff reviews related to proposed extensions of DG CTs.

Because WCAP-15622 has proposed to extend the CTs for an inoperable DG or vital AC bus, the second CTs in TSs 3.8.1 and 3.8.9 would also be extended. Therefore, WCAP-15622 also identified extended second CTs of (1) 10 days (from 6 days) for an extended CT of 7 days for an inoperable DG and (2) 32 hours (from 16 hours) for an inoperable vital AC bus. These extended second CTs for TSs 3.8.1 and 3.8.9 are addressed in Appendix F of this SE.

As discussed in Appendix F of this SE, the NRC staff concludes that the algebraic sum of (1) the proposed extended CTs for an inoperable DG (TS 3.8.1) or an inoperable vital AC bus (TS 3.8.9), and (2) the CT for an inoperable offsite circuit (TS 3.8.1) or an inoperable DC bus (TS 3.8.9) to determine the second CT is acceptable. Acceptable Technical Specification (TS) Bases statements for these second CTs are addressed in Appendix F of this SE.

3.7 Extended CT for LOOP Instrumentation

The typical electric system design includes LOOP instrumentation and automatic load sequencer support systems associated with each AC system division. The primary function of loss of power instrumentation is to assure the independence (or no common cause failure) between offsite and onsite systems.

ISTS LCO 3.3.5, "Loss of [Offsite] Power (LOOP) Diesel Generator (DG) Start Instrumentation," addresses the inoperable LOOP DG start instrumentation. In Condition C for ISTS LCO 3.3.5, where the required action and associated CTs are not being met for the inoperable LOOP instrumentation, the required action is for the licensee to declare the associated DG inoperable and enter the applicable conditions(s) and required actions for that DG in ISTS 3.8.1, Condition B. Because WCAP-15622 proposes to increase the 72-hour CT for an inoperable DG in ISTS 3.8.1, Condition B, the TR is, in effect, also proposing to extend the CT for inoperable LOOP DG start instrumentation.

Because WCAP-15622 did not address an extended CT for inoperable LOOP DG start instrumentation, the NRC staff did not consider such an extended CT and, therefore, the impact of an increase in this CT has not been addressed by the NRC staff in its review of the TR. Based on this, licensees must, in plant-specific applications based on WCAP-15622, either (1) provide the impact on the DG CT and a basis for extending this DG CT for inoperable LOOP DG start instrumentation, or (2) propose TS changes to separate the CT in the plant TSs for ISTS LCO 3.5.5, Condition C from the CTs in ISTS LCO 3.8.1, Condition B.

4.0 CONDITIONS FOR REFERENCING WCAP-15622

The following are conditions on the referencing of WCAP-15622 in any plant-specific application proposing an extended DG or vital AC bus CT:

1. Because, for LCO 3.8.9, Condition B, WCAP-15622 evaluates increasing the CT for only one inoperable vital AC bus, the proposed CT of 24 hours is only applicable to the first inoperable vital AC bus.

2. In proposing compensatory measures to support plant-specific submittals (e.g., for reduced LOOP event frequency), licensees must discuss in their submittals the incorporation of these compensatory measures into plant operating practices and procedures, and the plant PRA model. The discussion must include the modeling of the compensatory measures, human error probabilities for operator action, and the contribution of the proposed compensatory measures to CT risk.

3. The ISTS includes a CT of 2 hours (proposed to be changed to 24 hours) to restore the AC vital bus to operable status. The ISTS Bases state that the AC vital bus can be restored to operable status by powering the bus from an AC source that does not have a backup source of AC power from the DC system battery through an inverter. Operability of the AC vital bus when energized from an AC source that does not have a backup source of AC power from the DC system battery through an inverter may be a change to the plant licensing bases, if the plant TSs are based on the ISTS. The evaluation of this change for its impact on regulatory requirements must be addressed as part of the plant-specific evaluation for increasing the current CT of 2 hours. This is discussed in Section 3.5 of this SE.

4. With respect to the proposed 7-day DG CT, the shutdown risk averted may provide a qualitative risk benefit, but it should not be credited in the risk evaluation presented by licensees in their plant-specific applications referencing WCAP-15622. This is discussed in Section 3.5.2.2 of this SE.

5.0 ADDITIONAL INFORMATION NEEDED IN PLANT-SPECIFIC SUBMITTALS

To be acceptable, plant-specific submittals referencing the methodology in WCAP-15622 must provide additional information in the following areas (specific questions are in Appendix E to this SE) in proposing an extended CT for an inoperable DG or vital AC bus:

1. Appendix D of WCAP-15622
2. Plant PRA Quality, Tier 2, and Tier 3
3. Associated Extended CT for LOOP DG Start Instrumentation
4. Commitments Needed from Licensees
5. Alternative Power Sources and Cross-Connecting Safety Buses
6. RCP-Seal-LOCA Model
7. Post-Maintenance Testing Following Online Maintenance
8. Maintenance Rule and SBO

6.0 CONCLUSIONS

Based on its review of WCAP-15622, the NRC staff concludes that the proposed methodology in the TR, and the conditions in Section 4.0 of this SE, provide an acceptable review

methodology for the NRC staff to evaluate the proposed extensions in the CTs for an inoperable DG or an inoperable AC bus in plant-specific applications. However, for the proposed extension to the CT for the common cause evaluation for an inoperable DG, the methodology in the TR is not acceptable. In stating that plant-specific applications must provide the information identified in Section 5.0 of this SE, the NRC staff has concluded that this information must be reviewed as part of the NRC staff's evaluation of plant-specific applications because the NRC staff review of the demonstration plant information in WCAP-15622 indicates that an adequate basis for the identified CT changes has not been provided generically. The NRC staff will consider the requested extended CTs based on individual, plant-specific submittals, with reference to WCAP-15622 and updated plant-specific data as applicable. Since many of the demonstration plant results did not meet the NRC's acceptance guidelines, as discussed in this SE, plant-specific applications may not result in NRC approval of the proposed CT changes. The proposed changes or some portion may be approved with further compensatory measures and/or justification in licensees' plant-specific submittals.

Attachments: Appendix A, "Probabilistic Risk Assessment (PRA) Methodology of WCAP-15622"
Appendix B, "Requirements in General Design Criterion (GDC) 17 and Recommendations in Regulatory Guide (RG) 1.9"
Appendix C, "Reactor Coolant Pump (RCP) Seal Model"
Appendix D,"Description of Applicable Electrical Systems and Components"
Appendix E, "Additional Information Needed for Plant-Specific Applications"
Appendix F, "Second Completion Time (CT) for an Inoperable Diesel Generator (DG) or Vital Alernating Current (AC) Bus"

Principal Contributors: Cliff Doutt
John Knox

Date: July 1, 2005

APPENDIX A

PROBABILISTIC RISK ASSESSMENT (PRA) METHODOLOGY OF WCAP-15622

A.1 PRA Approach Taken in WCAP-15622

The approach used in WCAP-15622 is consistent with the NRC's approach for using PRA in risk-informed decisions on plant-specific changes to the current licensing basis for nuclear power plants as discussed in RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis" and RG 1.177, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications." The approach addresses the impact on defense-in-depth, safety margins, and plant operational risk. The risk evaluation considers the three-tier approach presented in RG 1.177. Tier 1, PRA capability and insights, assesses the impact of the proposed completion times (CTs) on core damage frequency (CDF), and incremental conditional core damage probability (ICCDP), large early release frequency (LERF), and incremental conditional large early release probability (ICLERP) and is addressed in WCAP-15622.

Tier 2, avoidance of risk-significant configurations (i.e., risk-significant plant operating configurations) and Tier 3, risk-informed configuration risk management, are not addressed in WCAP-15622. Tier 2 and Tier 3 will be addressed in the plant-specific application when the CT changes are implemented by a specific licensee on a specific plant.

In the TR approach, the Westinghouse Owners Group (WOG) stated that each utility interested in a specific CT change was required to evaluate the impact of the change on plant risk following a method developed as part of this program. Plant-specific calculations were required due to the differences between (1) plant designs, (2) component and system reliabilities, and (3) plant operating experience.

Although the proposed TS changes are intended to be generically applicable, the specific characteristics of each plant will require plant-specific evaluations of the proposed CTs, consistent with NRC guidance in RGs 1.174 and 1.177 with regard to additional Tier 1, 2, and 3 guidance, as outlined in this safety evaluation (SE). Thus, the NRC staff views the plant-specific information provided in WCAP-15622 as demonstrating the methodology, as opposed to supporting an NRC staff finding on the plant-specific results.

The methodology presented in WCAP-15622 requires each licensee requesting the change to evaluate the specific changes to plant risk on a plant-specific basis. As the WCAP notes, differences in plant design, components, reliability, operating history, vulnerabilities, and initiating events (external and internal) require a plant-specific evaluation. Licensee submittals, based on WCAP-15622, when used in conjunction with RGs 1.174 and 1.177 and the conditions and additional information, in Sections 4.0 and 5.0 of this SE, should enable a more limited review scope by the NRC staff than for plants not utilizing the WCAP.

The TR references the following plants as providing data and requesting the proposed extended CTs, although it is stated that not all plants requested all of the proposed CT extensions in the TR:

- Callaway Plant
- Catawba Nuclear Station
- Comanche Peak Steam Electric Station
- R.E. Ginna Nuclear Power Plant
- McGuire Nuclear Station
- Sequoyah Nuclear Plant
- Shearon Harris Nuclear Power Plant
- V.C. Summer Nuclear Station

As discussed above, the NRC staff views these plants as demonstrations of the methodology in WCAP-15622, but is not making any finding on the acceptability of these plants to implement the proposed changes. Each licensee will need to make a plant-specific license submittal requesting implementation of the methodology for any of the proposed changes.

A.2 NRC Staff PRA Review Methodology

The proposed changes are based on a risk-informed PRA approach using risk insights to justify changes to TS CTs. The risk measures used by the WCAP to evaluate the impact of the proposed changes are consistent with those presented in RGs 1.174 and 1.177.

In reviewing WCAP-15622, the NRC staff used a three-tier approach to evaluate the methodology developed to determine the risk associated with the proposed changes in CTs. The NRC staff based its approach on the guidance of RGs 1.174 and 1.177 and Chapters 16.1 and 19.0 of NUREG-0800. In the three-tier approach, the first tier assesses the licensee's PRA and impact of the proposed changes on plant operational risk, as estimated by the change in core damage frequency (ΔCDF) and the estimated change in large early release frequency (ΔLERF). The estimated change in risk is compared to the acceptance guidelines as stated in RG 1.174. The first tier also reviews the proposed change to ensure that plant incremental risk estimates for equipment taken out of service during the proposed CT satisfy the acceptance guidelines for ICCDP and ICLERP, as stated in RG 1.177. The Tier 1 review involves the evaluation of the validity of the plant-specific PRA model and its application to the proposed CT extension, as well as the evaluation of the PRA results and insights with respect to the extended CT.

Tier 2 identifies the need to preclude potentially high-risk plant configurations that could result if equipment, in addition to that associated with the proposed change, is taken out of service simultaneously, or if other risk-significant operational factors, such as concurrent system or equipment testing, are also scheduled. A Tier 2 review ensures that appropriate restrictions on dominant risk-significant plant configurations associated with the CT extension are in place.

Tier 3 provides for the establishment of a configuration risk management program (CRMP) and confirmation that the decisionmaking process incorporates its insights before equipment is taken out of service before or during the CT. The Tier 3 program ensures that programs and procedures are in place for the identification of risk-significant configurations resulting from maintenance or other operational activities and that appropriate compensatory measures are taken to avoid such configurations. Tier 3 provides additional coverage over Tier 2 for any other risk-significant configurations that may be encountered during maintenance scheduling over extended periods of plant operation. The Maintenance Rule (10 CFR 50.65(a)(4)), which requires a licensee to assess and manage the increase in risk that may result from activities

such as surveillance, testing, and corrective and preventive maintenance, can satisfy Tier 3 guidance as specified in RG 1.177, Section 2.3.7.1.

A.3 Tier 1, PRA Capability and Insights

WCAP-15622 presented an approach, in addition to that of RGs 1.174 and 1.177, that followed a defined methodology. The report sought to provide a method that would result in a consistent risk analysis among the demonstration plants, enabling direct comparisons of each plant's specific results. The general approach included the following activities:

- Identify the TS CT improvement.
- Determine the impact on plant safety.
- Identify the impact of the change on the plant PRA model.
- Modify the plant PRA model and associated CT.
- Identify the risk measures.
- Quantify the plant-specific model.
- Collect and discuss preliminary results.
- Collect and review final results.
- Identify the change requests.
- Prepare documentation.

WCAP-16522 identified three key aspects to the analysis methodology as (1) define the specific model and analysis requirements, (2) perform utility plant-specific evaluations, and (3) review the plant-specific results. The process outlined in Section 8.1 and the more detailed guidance given in Appendix C to the WCAP are similar to and complements the guidance provided by RGs 1.174 and 1.177, including guidance to help ensure consistent evaluations among plants.

The TR provides a Tier 1 discussion and partial quantitative evaluation for the proposed CT for electrical power system AC sources, DGs, and vital AC buses with respect to RGs 1.174 and 1.177 risk metrics for ΔCDF and ICCDP. However, WCAP-15622 does not address ΔLERF or ICLERP in the analysis, based on the argument that the proposed changes do not independently impact containment systems and do not generically apply to plants incorporating WCAP-15622. The NRC staff has not accepted this approach in previous DG extended-CT plant evaluations and has found that plant-specific results are generally needed to complete a review. Therefore, licensees must perform, on a plant-specific basis, ΔLERF and ICLERP evaluations for the proposed CTs.

The TR evaluates the impact of the proposed CT changes on CDF and ICCDP. The WCAP provides a process to evaluate plant-specific PRA models using a methodology described in Appendices C, D, E, and F. The methodology provides results consistent with the process described by WCAP-15622 and presents a comparison among the demonstration plants. The WCAP states that this approach is consistent with the guidance provided by RGs 1.174 and 1.177. Although WCAP-15622 provides a framework to evaluate the proposed CTs, licensees must evaluate their submittals with regard to the guidance and acceptance guidelines contained in RGs 1.174 and 1.177, including supplemental Tier 1 guidelines as described below, and submit plant-specific Tier 2 and 3 analyses.

Appendix C to the WCAP provides a general process for using a PRA to develop and evaluate the proposed CT changes in WCAP-15622, with reference to RGs 1.174 and 1.177. The

licensees would use this general process to identify the (1) TS requirements to be evaluated, (2) scope of the change with respect to the PRA, (3) PRA modifications, (4) risk metrics to be referenced, and (5) evaluation of Tier 1, 2, and 3 criteria, including the development of a risk-informed submittal and data collection.

(a) PRA Capability:

The PRA capability review determines whether the plant-specific risk assessments used in evaluating the proposed extended CTs are of sufficient scope and detail. Because the TR presents a methodology for performing an analysis using a plant-specific PRA, the capability of each licensee's PRA is not specifically addressed. The NRC staff reviewed the information provided in WCAP-15622 and, based on the above discussion, concludes that although the WCAP addressed the issue of capability, the methodology does not provide sufficient means to ascertain PRA quality for a plant-specific submittal requesting the proposed extended CTs and, therefore, each licensee referencing the TR must provide for NRC staff review a discussion of the plant-specific PRA quality justifying its acceptability for the application in accordance with the guidelines given in RG 1.174.

To ensure the applicability of WCAP-15622 to a licensee's plant, additional information on PRA quality is required by NRC in the following areas:

- Assurance that the plant-specific PRA reflects the as-built, as-operated plant.

- Assurance that the applicable PRA updates include the findings from the individual plant evaluation (IPE) and IPE for external events. External events may include seismic, high winds, fires, floods, or other related events applicable to each licensee.

- Assurance that conclusions from the peer review, including facts and observations (A and B), per NEI 00-02, "Probabilistic Risk Assessment (PRA) Peer Review Process Guidance," Revision A3 and American Society of Mechanical Engineers (ASME) RA-S-2002, "Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications," that are applicable to the proposed extended CTs were considered and resolved. If not resolved, justification for acceptability of conclusions (e.g., sensitivity studies showing negligible impact) was provided. The licensee should indicate the PRA revision that underwent the peer review and the PRA revision that was used in the plant-specific application.

- Assurance that there is PRA configuration control and updating, including PRA quality assurance programs, associated procedures, and PRA revision schedules.

- Assurance that there is PRA adequacy, completeness, and applicability with respect to evaluating the risk associated with the proposed CT extensions.

- Assurance that plant design or operational modifications that are related to or could impact the proposed CT extensions are reflected in the PRA revision used in the plant-specific application, or a justification is provided for not including these modifications in the PRA.

The additional information listed above on PRA quality is in Section E.2 of Appendix E of this SE.

(b) PRA Insights:

One approach to demonstrate the acceptability of the risk impact of a proposed change is to show that the licensing basis for the proposed change meets the key principles set forth in RG 1.174. One such principle involves demonstrating that when the proposed change results in an increase in CDF or risk, the increased risk is small. In addition, the impact of the proposed change should be monitored using performance measurement strategies. RGs 1.174 and 1.177 provide acceptance guidelines for meeting these principles. Specifically, those guidelines include ΔCDF, ΔLERF, ICCDP, and ICLERP. The risk metrics ICCDP and ICLERP provided in RG 1.177 are used in addition to the metrics outlined in RG 1.174 for the evaluation of CTs, because CTs are entered infrequently and are temporary in nature. As a result, the single CT risk may be significant even though the CDF and LERF estimates indicate little increase in risk.

Tables 8-1, 8-5, and 8-6 of WCAP-16522 summarize the risk impact of extending the CTs for the demonstration plants. The results show that the risk impact of the proposed CTs is generally within the acceptance guidelines for small changes in CDF given in RG 1.174. However, the results for ICCDP generally show that the RG 1.177 acceptance guidelines are exceeded for the proposed CTs. As stated earlier, the TR does not include estimates for LERF or ICLERP for the proposed extended CTs, which must be included in plant-specific submittals.

In addition, some of the licensees, those who provided plant-specific information as part of WCAP-15622, re-evaluated the proposed CT extensions. In the RAI responses, the licensees proposed changes to the plant-specific results/analysis provided in WCAP-15622 including:

- Revising the analysis based on updated PRA models.
- Crediting compensatory measures to reduce loss-of-offsite power (LOOP) frequencies during maintenance activities. The measures included restricted switchyard activities and the time of year maintenance is scheduled.
- Reducing the CT from that originally proposed in WCAP-15622.
- Reducing the number of CT extension requests.

As part of the reevaluation, the WOG suggested a revised methodology to credit compensatory measures by calculating a plant-specific LOOP frequency. Essentially, the approach is based on a review of LOOP events and the applicability of these events to a specific plant. Using the proposed compensatory measures to be implemented during DG maintenance, a number of LOOP events may be removed from the LOOP event frequency calculation. RG 1.177 provides guidance in this area and states that certain compensatory measures that balance the calculated risk increase caused by the CT changes would be considered by the NRC staff; however, it further states that compensatory measures considered as part of the analysis of the CT changes should (1) be included in the overall TS change, (2) not be relied upon to compensate for weaknesses in plant design, and (3) not be measures that the licensee has taken credit for in a previous licensing action. In addition, licensees proposing compensatory

measures in their plant-specific submittals should discuss the incorporation of these measures into the plant (1) operating practices and procedures, and (2) PRA model. The discussion should include how the measures are modeled, the human error probabilities for operator action, and the contribution of the proposed compensatory measures to CT risk. The NRC staff will consider this as Tier 2 information in its review of plant-specific submittals for plants implementing the proposed CT extensions.

In addition to the shutdown risk arguments presented for the DG CT extension request, WCAP-15622 also includes a general qualitative transition risk argument that the proposed DG CT extensions avoid transition risk. The NRC staff finds that the transition risk argument has merit for circumstances when unscheduled maintenance cannot be completed within the specified CT. In these cases, the decision to complete the repair at power or during shutdown should consider transition risk. However, based on the proposed CTs in WCAP-15622, the reason for the requested CT appears to include the operational flexibility to conduct additional scheduled maintenance activities at power where transition risk is not avoided.

In conclusion, as shown in the WCAP-15622 tables, the results for CDF and ICCDP are not consistently within the acceptance guidelines for RGs 1.174 and 1.177.

A.4 Tier 2, Avoidance of Risk-Significant Plant Configurations

Tier 2 information concerns the licensee's evaluation of risk-significant equipment outage configurations that may occur when plant equipment is out of service when the licensee enters the LCO related to the proposed TS change. WCAP-15622 does not specifically address Tier 2 because of the variation of demonstration plant system designs. Therefore, the WCAP stated that each individual licensee will include a Tier 2 assessment of the proposed CT changes in its plant-specific submittal. The licensee will evaluate plant equipment in combination with equipment included under the proposed CTs to identify any risk-significant configurations and necessary compensatory measures that may be required. Therefore, the NRC staff limited its review of Tier 2 with respect to WCAP-15622, except to note that WCAP-15622 states that Tier 2 will be addressed in the plant-specific submittal and evaluated per RG 1.177 guidelines.

In its appendices, WCAP-15622 provides minimal guidance on cumulative risk impacts, although risk impact is recognized as part of a risk-informed review. With respect to past submittals and the combined requests within WCAP-15622, cumulative risk should be evaluated on a plant-specific basis consistent with the guidance given in RG 1.174. In addition, licensees should consider the guidance given in RG 1.174 for combined change requests.

A.5 Tier 3, Risk-Informed Configuration Risk Management

Tier 3 involves the establishment of a CRMP to ensure the evaluation of the risk impact of out-of-service equipment before performing maintenance activities. The program should also ensure that the proposed CT extensions do not degrade operational safety over time. As part of this program, a licensee should have prior knowledge of high-risk configurations using a risk matrix, PRA analyses, and/or online monitoring. The licensee should have the ability to evaluate configurations and LCO condition risks as plant conditions, equipment, and grid conditions continue to change.

A CRMP ensures that while equipment is in an LCO condition, additional activities will not be performed that could further degrade the capabilities of the plant to respond to a condition normally mitigated by the inoperable equipment or system and, as a result, increase plant risk beyond that assumed by the WCAP analysis (RGs 1.174 and 1.177 guidelines). The risk-informed CRMP should: (1) ensure that, during equipment maintenance, additional maintenance does not increase the likelihood of an initiating event intended to be mitigated by the out-of-service equipment, (2) evaluate the effects of additional out-of-service equipment during the maintenance activity that would adversely impact CT risk, such as redundant systems or components, and (3) evaluate the impact of maintenance on equipment or systems assumed to remain operable by the CT analysis. The CRMP is a licensee-developed plant-specific program, and WCAP-15622 did not consider the program on a generic basis. Hence, the NRC staff did not review Tier 3 criteria with respect to WCAP-15622, except to note that WCAP-15622 states that a licensee's plant-specific submittal will address Tier 3 criteria.

Accordingly, a licensee should develop a CRMP to ensure that it appropriately evaluates the risk impact of out-of-service equipment before performing a maintenance activity. Licensees can implement the overall CRMP (as referenced in RG 1.177) through the Maintenance Rule (10 CFR 50.65(a)(4)), and the rule requires that, before performing any maintenance activity, the licensee must assess and manage the potential risk increase that may result from a proposed maintenance activity. A licensee's plant-specific submittal must discuss the licensee's CRMP for assessing the associated risk when equipment is removed from service and its conformance to the requirements of 10 CFR 50.65(a)(4), as it relates to the proposed CTs. This discussion should be consistent with the Tier 3 and CRMP guidelines that are outlined by RG 1.177, Section 2.3.7.1.

In addition, RG 1.174 also states that an implementation and monitoring plan should be developed to ensure that the impacts of the proposed changes continue to reflect the actual reliability and availability of the structures, systems, and components (SSCs) evaluated to support the proposed CT extensions. Monitoring performed in conformance with the maintenance rule of 10 CFR 50.65 can be used when such monitoring is sufficient for the SSCs affected by the risk-informed application. Because WCAP-15622 was based on generic plant characteristics, each licensee adopting the TR must confirm plant-specific implementation and monitoring in their plant-specific submittal. This includes the additional information on PRA quality identified in Section A.3 above.

A.6 Comparison with Regulatory Guidance

The NRC staff found the risk evaluation methodology in WCAP-15622 to be consistent with the guidance in RGs 1.174 and 1.177; however, the results of the demonstration plant evaluations indicate in a number of cases an increase in risk from the proposed extension of DG and vital AC bus CTs that was larger than the acceptance guidelines of the RGs. Each licensee adopting WCAP-15622 must submit a plant-specific analysis to account for the plant-specific characteristics, procedures, and practices, as identified by this SE. Since many of the demonstration plant results did not meet the NRC acceptance guidelines, using the TR, as approved by this SE, may not result in approval of the proposed CT changes.

APPENDIX B

REQUIREMENTS IN GENERAL DESIGN CRITERION (GDC) 17 AND RECOMMENDATIONS IN REGULATORY GUIDE (RG) 1.9

The GDC 17 requires that the onsite power system (i.e., the emergency DG) have (A) sufficient capacity and capability (assuming the offsite system is unavailable) to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents, (B) sufficient testability to perform their functions assuming a single failure, and (C) provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies.

In regard to periodic testing of DGs, Regulatory Position C.2.3.2, "Surveillance Testing," of RG 1.9 and Section 6.5, "Periodic Tests," of Institute of Electrical and Electronic Engineers Standard 387-1984 (IEEE 387) provide the following recommendations for satisfying GDC 17:

- Section 6.5 of IEEE 387 states that the DG is to be started and loaded at intervals of no longer than 1 month to the capacity recommended by the manufacturer.
    - Regulatory Position C.2.3.1 recommends that Section 6.5 of IEEE 387 is to be supplemented with a start and load-run tests at least once in 31 days with maximum allowable extension not to exceed 25 percent of the surveillance interval.
    - Regulatory Position C.2.3.2 recommends Section 6.5 of IEEE 387 is to be supplemented with a fast start and load-run tests once every 6 months.

  The start and load-run tests mentioned in the two bullets above are to demonstrate (1) proper startup from standby conditions and to verify that the required voltage and frequency is attained and (2) the DG can be loaded to 90 to 100 percent of the continuous rating, for an interval of not less than 1 hour and until temperature equilibrium has been attained, respectively. For the start tests, the emergency DG can be slow started and reach rated speed on a prescribed schedule that is selected to minimize stress and wear. The load-run test may be accomplished by synchronizing the DG with offsite power where the loading and unloading of a DG during this test should be gradual and based on a prescribed schedule that is selected to minimize stress and wear on the DG.

- Section 6.5 of IEEE 387 states the DG unit to be given one cycle of each of the following tests, at least once every 18 months, to demonstrate its continued capability of performing its required function:

- Starting test to demonstrate the capability to attain and stabilize frequency and voltage within the limits and time defined in the equipment specification.

- Load acceptance test to demonstrate the capability to accept the individual loads that make up the design load in the desired sequence and time duration and to maintain the voltage and frequency within the acceptable limits.

- Rated load test to demonstrate the capability of carrying the following loads for the indicated times without exceeding the manufacturer's design limits:

  - A load equal to the continuous rating for a time required to reach engine temperature equilibrium plus 1 hour.

  - Immediately following, the rated short-time load shall be applied for a period of 2 hours.

- Load rejection test to demonstrate the capability of rejecting short-time rated load without exceeding speeds or voltages which will cause tripping or component damage.

- Subsystem tests to demonstrate the capability of the control, surveillance, and protection systems to function in accordance with the requirements of the intended application.

- Regulatory Position C.2.3.3 recommends Section 6.5 of IEEE 387 to be supplemented with the following tests to demonstrate overall emergency DG unit design capability at every refueling outage:

  - Fast start test to demonstrate that each emergency DG unit starts from standby conditions and reaches required voltage and frequency within acceptable limits and time.

  - Loss-of-offsite power (LOOP) test to demonstrate (by simulating a loss of offsite power) that (1) the emergency buses are de-energized and the loads are shed from the emergency buses, and (2) the emergency DG starts on the autostart signal from its standby conditions, attains the required voltage and frequency and energizes permanently connected loads within acceptable limits and time, energizes the autoconnected shutdown loads through the load sequencer, and operates for greater than or equal to 5 minutes.

  - Safety injection actuation signal (SIAS) test to demonstrate that, on a SIAS, the emergency DG starts on the autostart signal from its standby conditions, attains the required voltage and frequency within acceptable limits and time, and operates on standby for greater than or equal to 5 minutes.

  - Combined SIAS and LOOP tests to demonstrate that the emergency DG can satisfactorily respond to a LOOP in conjunction with SIAS in whatever sequence they might occur.

- Single-Load Rejection test to demonstrate the emergency DG's capability to reject a loss of the largest single load while operating at power factor between 0.8 and 0.9 and verify that the voltage and frequency requirements are met and that the emergency DG will not trip on overspeed.

- Full-Load Rejection test to demonstrate the emergency DG's capability to reject a load equal to 90 to 100 percent of its continuous rating while operating at power factor between 0.8 and 0.9, and verify that the voltage requirements are met and that the emergency DG will not trip on overspeed.

- Endurance and Margin test to demonstrate full-load carrying capability at a power factor between 0.8 and 0.9 for an interval of not less than 24 hours, of which 2 hours are at a load equal to 105 to 110 percent of the continuous rating of the emergency DG, and 22 hours are at a load equal to 90 to 100 percent of its continuous rating and verify that voltage and frequency requirements are maintained.

- Hot Restart test to demonstrate hot restart functional capability at full-load temperature conditions (after it has operated for 2 hours at full load) by verifying that the emergency DG starts on a manual or autostart signal, attains the required voltage and frequency within acceptable limits and time, and operates for longer than 5 minutes.

- Synchronizing test to demonstrate the ability to (1) synchronize the emergency DG unit with offsite power while the unit is connected to the emergency load, (2) transfer this load to the offsite power, and (3) restore the emergency DG to ready-to-load status.

- Protective Trip Bypass test to demonstrate that all automatic emergency DG trips (except engine oversewed, generator differential, and those retained with coincident logic) are automatically bypassed upon an SIAS.

- Test Mode Change-Over test to demonstrate that, with the emergency DG operating in a test mode while connected to its bus, a simulated SIAS overrides the test mode by (1) returning the emergency DG to standby operation and (2) automatically energizing the emergency loads from offsite power.

APPENDIX C

REACTOR COOLANT PUMP (RCP) SEAL MODEL

The use of a particular model for a RCP seal loss-of-coolant accident (LOCA) is not addressed in Appendix D of WCAP-15622, which provides the specific analysis requirements for evaluating changes to completion times (CTs). To address the impact of different RCP seal LOCA models, WCAP-15622 looked at the sensitivity of the V.C. Summer Nuclear Station (Summer) base case probabilistic risk assessment (PRA) by replacing the WCAP-15622 RCP seal model with the "Brookhaven" RCP seal model (with additional modifications) and, in response to a NRC staff request for additional information, included additional sensitivity studies using other RCP seal models (e.g., the Rhodes model discussed below). The Westinghouse Owners Group (WOG) stated it chose the Summer model because this plant has the largest station blackout (SBO) contribution to core damage frequency (CDF) of all the demonstration plants included in WCAP-15622. However, WCAP-15622 did not examine the sensitivity of each demonstration plant to the RCP seal model used by the licensee.

In the closeout of Generic Safety Issue 23, "Reactor Coolant Pump (RCP) Seal Failure," the NRC staff stated that until better models were developed to support future risk-informed licensing decisions, the NRC staff would use the Rhodes model, which is described in Appendix A to NUREG/CR-5167, to determine the contribution to CDF from RCP seal LOCAs. The WOG submitted WCAP-15603, "WOG 2000 Reactor Coolant Pump Seal Leakage Model for Westinghouse PWRs," which presents a consensus RCP seal leakage model (referenced as the WOG 2000 RCP seal model) for plants that use the Westinghouse seal package with O-rings qualified for high temperature, and the NRC staff issued its safety evaluation (SE) for WCAP-15603, Revision 1, on April 4, 2003.

The NRC staff noted in its SE for WCAP-15603, Revision 1, that licensees currently use several different models for RCP seal cooling. The variations in models and assumptions have led to modeling inconsistencies in PRAs and raised NRC staff concerns when these PRAs are used to support risk-informed licensing actions. The NRC found in its SE that WCAP-15603, Revision 1, is acceptable for referencing in licensing and other applications, to the extent specified and under the limitations delineated in the WCAP and the NRC SE for those plants using high-temperature O-rings. For plants using the "old" O-rings, the NRC SE stated that the NRC staff expects licensees to use the Rhodes model for Westinghouse seal packages. The NRC SE also cautions that, for plants using RCP models other than the Rhodes model (for plants equipped with “old” O-rings) or WOG-2000 RCP seal model (for plants equipped with O-rings qualified for high temperature), a licensee must provide justification for its model, including any additional supporting analyses and related bases that are necessary to verify the appropriateness of the model used in licensee PRA documentation.

Based on the above, it is expected that, for a plant-specific CT extension application referencing WCAP-15622, the licensee should include documentation on the RCP seal model employed at the plant.

APPENDIX D

DESCRIPTION OF APPLICABLE ELECTRICAL SYSTEMS AND COMPONENTS

AC Electric Power Systems:

According to the improved standard Technical Specifications (ISTS), the Class 1E alternating current (AC) electrical power system sources consist of the offsite power sources (i.e., preferred power sources, normal and alternate(s)) and the onsite standby power sources (e.g., emergency diesel generators (DGs)). As required by General Design Criterion (GDC) 17, the design of the AC electrical power system must provide independence and redundancy to ensure an available source of power to the engineered safety feature (ESF) system.

The onsite Class 1E AC distribution system is typically divided into redundant load groups (trains) so that the loss of any one group does not prevent the performance of minimum safety functions. Each group typically has connections to two preferred offsite power sources and a single DG. Transmission lines supply offsite power from the transmission network to the unit switchyard. From the switchyard, two physically separated circuits that can be electrically separated are provided from a transmission network provide AC power to the 4.16 kV ESF buses.

An offsite circuit consists of all breakers, transformers, switches, interrupting devices, cabling, and controls required to transmit power from the offsite transmission network to the onsite Class 1E ESF bus(es). Certain required unit loads are returned to service in a predetermined sequence to prevent overloading the transformer supplying offsite power to the onsite Class 1E distribution system. After receipt of an initiating signal, all automatic and permanently connected loads needed to recover the unit or maintain it in a safe condition are returned to service via the automatic load sequencer.

A dedicated DG typically serves as the onsite standby power source for each 4.16-kv ESF bus. A DG starts automatically on a safety injection (SI) signal (e.g., low pressurizer pressure or high containment pressure signals) or on an ESF bus degraded voltage or undervoltage signal. After the DG has started, it will automatically tie to its respective bus after offsite power is tripped as a consequence of an ESF bus undervoltage or degraded voltage, independent of or coincident with a SI signal. The DGs will also start and operate in the standby mode without tying to the ESF bus on a SI signal alone. Following a loss-of-offsite power (LOOP) trip, nonpermanent loads are stripped from the ESF bus. When the DG is tied to the ESF bus, loads are then sequentially connected to its respective ESF bus by the automatic load sequencer.

The operability of the AC electrical power sources is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the unit. This results in maintaining at least one train of the onsite or offsite AC sources operable during accident conditions in the event of (1) an assumed LOOP, or loss of all onsite AC power, and (2) a worst-case single failure.

AC Electric Power Distribution Systems:

The onsite Class 1E AC, direct current (DC), and AC vital bus electrical power distribution systems are divided by train into redundant and independent AC, DC, and AC vital electrical power distribution buses and their subsystems.

The AC electrical power subsystem for each train consists of a primary ESF bus and secondary buses, distribution panels, motor control centers, and load centers. Each ESF bus has an offsite source of power as well as a dedicated onsite DG source. Each ESF bus is either normally connected to a preferred offsite source or the preferred offsite source is available within a few seconds following a trip of the main unit DG. After a loss of the preferred offsite power source to an ESF bus, a transfer to the alternate preferred offsite source may be initiated. If all offsite sources are unavailable, the onsite emergency DG supplies power to the ESF bus. The Class 1E DC system buses supply control power for their associated AC buses.

The 120 volts AC (Vac) vital buses are arranged in two load groups per train and are normally powered from inverters. The alternate power supplies for the vital buses if included as part of the design are generally constant voltage source transformers.

The initial conditions of design-basis accidents and transient safety analyses assume that the ESF system is operable. The AC, DC, and AC vital bus electrical power distribution systems are designed to provide sufficient capacity, capability, independence, redundancy, and reliability to ensure the availability of necessary power to the ESF system so that the fuel, reactor coolant system, and containment design limits are not exceeded.

The operability of the AC, DC, and AC vital bus electrical power distribution systems is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the unit. This includes maintaining power distribution systems operable during accident conditions in the event of (1) an assumed loss of all offsite power or all onsite AC electrical power and (2) a worst case single failure. The distribution systems satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

APPENDIX E

ADDITIONAL INFORMATION NEEDED FOR PLANT-SPECIFIC APPLICATIONS*

E.1 Plant-Specific Information Identified in Appendix D of WCAP-15622:

1. Provide the loss-of-offsite power (LOOP) initiating event frequency and basis.

2. Provide a short discussion of the LOOP events that have occurred at the plant and compare this frequency to the LOOP frequency used in the PRA model.

3. If the plant can cross-connect the redundant ESF buses, explain how the probabilistic risk assessment (PRA) models this. How long does it take to establish the crosstie? How much credit is taken? (This can be shown via a sensitivity study to determine the impact of crediting the crosstie on core damage frequency (CDF).)

4. If the plant has an alternate alternating current (AC) source, is it covered under the Maintenance Rule (10 CFR 50.65) program? If not, explain why. Is the alternate AC source hardened against severe weather? How much credit has been taken with respect to the alternate AC source's ability to decrease CDF? (This can be shown via a sensitivity study to determine the impact of crediting the alternate AC source on CDF).

5. Provide the CDF for station blackout (SBO) events as reported for the individual plant evaluation (IPE). Provide the failure rates for DG failure to start (per demand) and failure to run (per hour), as well as the LOOP initiating event frequency used in the IPE.

6. Provide the CDF for SBO events as calculated for this study and explain the difference between this value and the value reported in the IPE. Consider revised LOOP initiating event frequency, credit for alternate AC sources, credit for crossties, and the completion time (CT) change.

E.2 Probabilistic Risk Assessment (PRA) Quality, and Plant Tier 2 and Tier 3:

1. To address the applicability of WCAP-15622 to a licensee's plant, additional information on the plant-specific PRA is required in the following areas:

   (a) Assurance that the plant-specific PRA reflects the as-built, as-operated plant.

   (b) Assurance that the applicable PRA updates include the findings from the individual plant evaluation (IPE) and IPE for external events. External events may include seismic, high winds, fires, floods, or other related events applicable to each licensee;

(c) Assurance that conclusions from the peer review, including facts and observations (A and B), per NEI 00-02, "Probabilistic Risk Assessment (PRA) Peer Review Process Guidance," Revision A3 and American Society of Mechanical Engineers (ASME) RA-S-2002, "Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications," that are applicable to the proposed extended CTs were considered and resolved. If not resolved, justification for acceptability of the conclusions (e.g., sensitivity studies showing negligible impact) was provided. The licensee should indicate the PRA revision that underwent the peer review and the PRA revision that was used in the plant-specific application.

(d) Assurance that there is PRA configuration control and updating, including PRA quality assurance programs, associated procedures, and PRA revision schedules.

(e) Assurance that there is PRA adequacy, completeness, and applicability with respect to evaluating the risk associated with the proposed CT extensions.

(f) Assurance that plant design or operational modifications that are related to or could impact the proposed CT extensions are reflected in the PRA revision used in the plant-specific application, or a justification is provided for not including these modifications in the PRA.

(g) An evaluation of the change in large early release frequency (ΔLERF) or incremental conditional large early release probability (ICLERP) for the proposed extended CTs, and address the impact of the proposed CT on dominant accident sequences with respect to risk outliers;

(h) With respect to previous submittals and the extended CTs in WCAP-15622, licensees will evaluate cumulative risk on a plant-specific basis consistent with the guidance given in RG 1.174. In addition, licensees will address the guidance for combined change requests provided in RG 1.174.

2. Licensees should provide supplemental Tier 1, 2, and 3 evaluations on a plant-specific basis consistent with the guidance given in sections 8.5 and 8.6 of the WCAP and the acceptance guidance of RGs 1.174 and 1.177.

3. Licensees should confirm that, when evaluating the proposed CT extensions, the diesel generator (DG) PRA model repair/recovery has been modified with respect to the increased DG CT.

E.3 Associated Extended CT for LOOP DG Start Instrumentation:

- The NRC staff did not consider an associated CT for the LOOP DG start instrumentation as part of its review of WCAP-15622. If such an association exists with the CTs for this instrumentation as part of the plant-specific application, the licensee must provide the impact and basis for such an

association, or propose TS changes to separate the CT in the plant Technical Specifications (TSs) for ISTS LCO 3.5.5, Condition C from the CTs for an inoperable DG.

E.4 Commitments Needed From Licensees:

These commitments should be addressed by the licensee in the appropriate Technical Specification (TS) Bases for the plant-specific TS license amendment request.

1. Licensees should commit to evaluate weather conditions before entering the extended CT for voluntary planned maintenance. An extended CT will not be entered for voluntary planned maintenance purposes if official weather forecasts are predicting severe weather conditions.

2. Licensees should commit to evaluate the condition of the offsite power supply and switchyard, including grid stability/reliability, before entering an extended CT (see also Regulatory Issue Summary 2004-05, "Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power"). An extended CT would not be entered if the evaluation indicated an unacceptable potential for losing offsite power.

3. Licensees should commit to assuring that no discretionary switchyard maintenance or discretionary maintenance on the main or startup transformers associated with the unit will be performed during entry into an extended CT.

4. Licensees should commit to assuring that no maintenance or testing that affects the operable train associated with the operable DG/vital AC bus will be scheduled during entry into an extended CT.

5. Licensees should discuss the restrictions, commitments, or limitations on CT entry during an operating cycle, consistent with the PRA analysis.

E.5 Alternative Power Sources, Cross-connecting Safety Buses, and Other Compensatory Measures:

1. If alternate power sources, cross-connecting safety buses, or other compensatory measures are provided to support the plant-specific application, the licensee should provide a design description and analyses demonstrating compliance of the electrical design with General Design Criterion (GDC) 17, for the cases of when the compensatory measures are (1) being used and (2) not being used.

2. For alternate power sources, licensees should discuss the resistance to external events (including weather-related events), environmental protection, and operational parameters, such as the ability to supply safety-related and/or nonsafety-related loads. The alternate source's availability, reliability (including any black-start capability), and surveillance requirements, as related to maintenance activities, should be provided. Required operator actions and their human error probabilities should be provided, as well as procedural modifications

or requirements. Finally, a discussion of the applicability of Information Notice 97-21, "Availability of Alternate AC Power Source Designed for Station Blackout Event," dated April 18, 1997, should also be provided. The information notice alerted licensees to the potential unavailability of an alternate AC power source during a SBO event.

3. For a crosstie or cross-connecting safety buses and other compensatory measures, licensees should provide information on the required operator actions, the human error probability, and the operator training, including procedures and demonstrated operator action capability.

E.6 Reactor Coolant Pump Seal Model:

C For a plant-specific DG CT extension submittal based on WCAP-15622, licensees should include plant-specific documentation on the RCP seal model employed.

E.7 Post-Maintenance Testing Following Online DG Maintenance:

1. As discussed in the SE, Section 3.5.2.1, having an extended CT to permit online DG maintenance requires conducting post-maintenance testing of the DG online to demonstrate that the DG is operable. Online post-maintenance testing, as required in the TSs, should be addressed in the plant-specific application with respect to (1) showing the DG is operable and can perform its safety functions; (2) being consistent with the recommended tests in RG 1.9 and Section 6.5 of Institute of Electrical and Electronics Engineers (IEEE) Standard 387, which demonstrate compliance with GDC 17; and (3) performing tests online that do not prevent the DG from performing its safety functions and do not cause the risk associated with testing the DG connected to the grid to be unacceptable, including the following:

(a) The impact of the DG and offsite power sources being connected and subject to a common mode failure for a longer period of time due to online maintenance. Compensatory measures and compliance with regulatory requirements should be addressed.

(b) Discuss the testing that is used following online maintenance activities to demonstrate DG operability.

(c) Confirm that the DG would be disconnected from the plant electrical system during online preventive maintenance activities.

(d) The precautions taken to ensure that plant electrical distribution system transients that could impact plant operation do not occur during maintenance activities or post-maintenance testing.

2. Licensees should describe its program to manage the risk of DG and vital AC bus maintenance evolutions with online maintenance programs and in-place procedures to implement 10 CFR 50.65(a)(4) and the guidance contained in

RG 1.182, consistent with the Tier 3 and configuration risk management program (CRMP) guidelines outlined by RG 1.177.

E.8 Maintenance Rule and SBO:

- The licensees' plant-specific submittals should provide the following information regarding Maintenance Rule implementation and monitoring goals, and a comparison of actual DG performance with SBO commitments (including alternate AC sources, if applicable):

  — DG failure-to-start and failure-to-run probabilities

  — DG maintenance unavailability with a 3-day and a 7-day CT

  — alternate AC source failure probability values (if applicable)

  — alternate AC source maintenance unavailability (if applicable)

  — a discussion of the above values with respect to Maintenance Rule goals, actual DG performance, and SBO commitments, ensuring that the proposed CT meets the objectives of the Maintenance Rule (10 CFR 50.65) and the SBO Rule (10 CFR 50.63).

---

* Note that the staff review of a plant-specific application referencing WCAP-15622 might identify the need for additional information not addressed in this appendix.

APPENDIX F

SECOND COMPLETION TIME (CT) FOR AN INOPERABLE DIESEL GENERATOR (DG) OR VITAL ALTERNATING CURRENT (AC) BUS

Because WCAP-15622 has proposed to extend the CTs for an inoperable DG or vital AC bus, the second CTs in Technical Specifications (TSs) 3.8.1 and 3.8.9 would also be extended. Therefore, WCAP-15622 also identified extended second CTs of (1) 10 days (from 6 days) for an extended CT of 7 days for an inoperable DG and (2) 32 hours (from 16 hours) for an inoperable vital AC bus. Second CTs are to deal with multiple concurrent entries into required action statements for limiting conditions for operation (LCOs) and are addressed in Section 3.6 of this SE.

F.1 Limiting Condition for Operation (LCO) 3.8.1

The LCO 3.8.1, Required Actions A.3 and B.4 contain a second CT that is also proposed to be extended in accordance with WCAP-15622. This CT establishes a limit on the maximum time allowed for any combination of required AC power sources to be inoperable during a single contiguous occurrence to meet the LCO. This CT limits the time allowed in a specific condition after the discovery of a failure to meet the LCO. The second CT of 6 days is extended to 10 days, consistent with the proposed DG CT and consistent with the intent of the improved standard TSs (ISTS) in that the proposed 10-day CT is a combination of Required Action A.3, "Restore Offsite Circuit to Operable Status," and B.4, "Restore DG to Operable Status," CTs and not based on a risk-informed approach. Both conditions apply simultaneously, and the more restrictive CT must be met.

The second CT of 10 days (proposed to be changed from 6 days), establishes a limit on the maximum time allowed for any combination of an offsite circuit and DG being inoperable during any single contiguous occurrence of failing to meet LCO 3.8.1. For example, if the CT of 72 hours for an inoperable offsite circuit is entered during the CT of 7 days (proposed to be changed from 3 days) for an inoperable DG that is returned to operable status, the LCO may already have been not met for up to the CT of 7 days for an inoperable DG. This could lead to a total of 10 days from the initial failure to meet the LCO due to an inoperable DG, to restore the offsite circuit to operable status. At this time, a DG could again become inoperable and an additional CT of 7 days for the inoperable DG could be allowed prior to complete restoration of the LCO. This could continue indefinitely if not limited. The second CT of 10 days (proposed to be changed from 6 days) limits the time the plant can alternate between the conditions of an inoperable offsite circuit, an inoperable DG, and the combined inoperability of an offsite circuit and DG without meeting the LCO.

No second CT was established in the standard TSs (STS), but the ISTS established a second CT to limit the time a plant can alternate between the condition of an inoperable offsite circuit, an inoperable DG, and the combined inoperability of an offsite circuit and DG without meeting the LCO. The ISTS states that a 6-day time limit, which would be based on the sum of the CTs for multiple conditions - a CT of 3 days for an inoperable offsite circuit plus a CT of 3 days for an inoperable DG, is considered reasonable for this second CT.

Based on this, the NRC staff concludes that the algebraic sum of the extended CT for an inoperable DG and the CT for an inoperable offsite circuit to determine the second CT for an inoperable DG is acceptable. The individual CTs would be approved separately, but the second CT would be the sum of the individual CTs.

F.2 LCO 3.8.9

LCO 3.8.9, Required Actions A.1 and C.1 contain a second CT that is also extended per WCAP-15622. This CT establishes a limit on the maximum time allowed for any combination of required AC power sources to be inoperable during a single contiguous occurrence to meet the LCO. This CT limits the time allowed in a specific condition after the discovery of a failure to meet the LCO. The second CT of 16 hours is extended to 34 hours, consistent with the proposed DG CT and consistent with the intent of the ISTS in that the proposed 34-hour CT is a combination of the AC vital bus , AC power distribution system, and DC power distribution subsystem CTs and not based on a risk-informed approach. The conditions apply simultaneously, and the more restrictive CT must be met. WCAP-15622 states that licensees do not conduct any testing or scheduled maintenance on the vital buses during power operation that would make the bus unavailable. The WCAP stated that an extension of the current vital AC bus 2-hour CT to 24 hours would not change the scope of work normally performed online.

The CT of 34 hours, proposed to be changed from 16 hours, establishes a limit on the maximum time allowed for any combination of AC, DC, and AC vital bus electrical power distribution subsystem being inoperable during any single contiguous occurrence of failing to meet LCO 3.8.9. For example, if the CT of 8 hours for an inoperable AC bus is entered during the CT of 24 hours (proposed to be changed from 2 hours) for an inoperable AC vital bus that is returned to operable status, the LCO may already have been not met for up to the CT of 24 hours for an inoperable AC vital bus. This could lead to a total of 32 hours from the initial failure to meet the LCO due to an inoperable AC vital bus, to restore the AC bus to operable status. At this time, the same or another AC vital bus could again become inoperable and an additional CT of 24 hours for the inoperable AC vital bus would be allowed prior to complete restoration of the LCO. This could continue indefinitely if not limited. The CT of 34 hours (proposed to be changed from 16 hours) limits the time the plant can alternate between the conditions of an inoperable AC bus, an inoperable DC bus, an inoperable AC vital bus, and some combination of an inoperable AC, DC, or AC vital bus without meeting the LCO.

No CT was established as part of the licensing bases to limit the time plants can alternate between the condition of an inoperable AC bus, an inoperable DC bus, an inoperable AC vital bus, and some combination of an inoperable AC, DC, or AC vital bus without meeting the LCO. The occurrence of independent random failures of equipment (e.g., the random failure of an AC vital bus, an AC bus, and another failure of an AC vital bus occurring at about the same time) was considered incredible. Thus, an explicit TS CT was not established as part of the licensing bases to limit the time plants could alternate between the condition of an inoperable AC bus, an inoperable DC bus, an inoperable AC vital bus, and some combination of an inoperable AC, DC, or AC vital bus without meeting the LCO.

No second CT was established in the STS, but the ISTS established a second CT to limit the time a plant can alternate between the condition of an inoperable AC bus, an inoperable DC bus, an inoperable AC vital bus, and some combination of an inoperable AC, DC, or AC vital

bus without meeting the LCO. The ISTS states that the second CT for an inoperable vital AC bus is the sum of the CTs for the multiple conditions.

Based on this, the NRC staff concludes that the algebraic sum of (1) the proposed extended CT for an inoperable vital AC bus and (2) the CT for an inoperable DC bus to determine the second CT for an inoperable vital AC bus is acceptable. The individual CTs would be approved separately, but the second CT would be the sum of the individual CTs.

F.3 Acceptable TS Bases Statement for Second CTs

A discussion on the second CTs for an inoperable DG or vital AC bus is given above. The following addresses acceptable TS Bases statements for these second CTs.

F.3.1 LCO 3.8.1

WCAP-15622 proposes (for improved readability and understanding) that the portion of the ISTS Bases relating to the second CT for Required Action A.3 - "[10] days from discovery of failure to meet LCO" (and similarly for the second CT for Required Action B.4), should be replaced with the following TS Bases statements:

> "The second Completion Time for Required Action A.3 also establishes a limit on the maximum time allowed for any combination of required AC power sources to be inoperable during any single contiguous occurrence of failing to meet the LCO. If Condition A is entered while, for instance, a DG is inoperable and that DG is subsequently returned OPERABLE, the LCO may already have not been met for up to [7 days]. This could lead to a total of [10 days], since initial failure to meet the LCO, to restore the offsite circuit. At this time, a DG could again become inoperable and an additional [7 days] allowed prior to complete restoration of the LCO. This could continue indefinitely if [it is] not limited. The [10]-day Completion Time provides a limit on the time allowed in a specified condition after discovery of failure to meet the LCO. This limit is considered reasonable for situations in which Conditions A and B are entered concurrently. This limits the time the plant can alternate between Conditions A, B, and D (see Completion Time Example 1.3-3). The "AND" connector between the 72-hour and [10]-day Completion Times means that both Completion Times apply simultaneously, and the more restrictive Completion Time must be met.
>
> Tracking the [10]-day Completion Time is a requirement for beginning the Completion Time "clock" that is in addition to the normal Completion Time requirements. With respect to the [10]-day Completion Time, the "time zero" is specified as beginning at the time LCO 3.8.1 was initially not met. Refer to Section 1.3, "Completion Times," for a more detailed discussion of the purpose of the "from discovery of failure to meet the LCO" portion of the Completion Time."

The NRC staff agrees that the revised wording proposed for inclusion in the ISTS Bases for the required action - "[10] days from discovery of failure to meet the LCO," - improves the readability and understanding of the required action. The NRC staff therefore concludes that the proposed revised wording is acceptable.

F.3.2 LCO 3.8.9

The WCAP-15622 proposes (for improved readability and understanding) that the portion of the ISTS Bases relating to the second CT for Required Action A.1 - "[34] hours from discovery of failure to meet LCO" (and similarly for the second and third CTs conveyed by Required Actions B.1 and C.1), should be replaced with the following TS Bases statements:

> "The second Completion Time for Required Action A.1 also establishes a limit on the maximum time allowed for any combination of required distribution subsystems to be inoperable during any single contiguous occurrence of failing to meet the LCO. If Condition A is entered while, for instance, a DC bus is inoperable (Condition C) and subsequently restored OPERABLE, the LCO may already have not been met for up to 2 hours. This could lead to a total of 10 hours, since initial failure to meet the LCO, to restore the AC distribution system. At this time, a vital bus could become inoperable and an additional [24] hours allowed prior to complete restoration of the LCO, for a total of [34] hours. This could continue indefinitely if not limited.
>
> The [34]-hour Completion Time provides a limit on the time allowed in a specified condition after discovery of failure to meet the LCO. This limit is considered reasonable for situations in which Conditions A, B, and C are entered concurrently. The "AND" connector between the 8-hour and [34]-hour Completion Times means that both Completion Times apply simultaneously, and the more restrictive Completion Time must be met.
>
> Tracking the [34]-hour Completion Time is a requirement for beginning the Completion Time "clock" that is in addition to the normal Completion Time requirements. With respect to the [34]-hour Completion Time, the "time zero" is specified as beginning at the time LCO 3.8.9 was initially not met, instead of at the time Condition A was entered. This results in the requirement, when in this Condition, to track the time elapsed from both the "time zero" [when Condition A was entered] and the "time zero" when LCO 3.8.9 was initially not met. Refer to Section 1.3, "Completion Times," for a more detailed discussion of the purpose of the "from discovery of failure to meet the LCO" portion of the Completion Time."

The NRC staff agrees that the revised wording proposed for inclusion in the ISTS Bases for the required action - "[34] hours from discovery of failure to meet the LCO," - improves the readability and understanding of the required action. The NRC staff therefore concludes that the proposed revised wording is acceptable.