

7.0 INSTRUMENTATION AND CONTROLS

Nuclear power plant instrumentation senses various plant parameters and transmits appropriate signals to the control systems during normal operation and to the reactor trip and engineered safety feature systems during abnormal and accident conditions. The information provided in this chapter emphasizes those instruments and associated equipment that constitute the protection and safety systems.

7.1 Introduction

7.1.1 Introduction

Westinghouse Electric Company (Westinghouse) proposed to revise the AP1000 Design Control Document (DCD) to address final setpoint calculations for protective functions. These proposed changes to the DCD impact the AP1000 combined license (COL) applications.

7.1.2 Summary of Application

Section 7.1 of the Levy Nuclear Plant (LNP) COL Final Safety Analysis Report (FSAR) Revision 9, incorporates by reference Section 7.1 of the AP1000 DCD, Revision 19.

In addition, the applicant proposed the following:

AP1000 COL Information Item

- STD COL 7.1-1

In a letter dated March 8, 2010, Westinghouse proposed to revise the AP1000 DCD by adding COL Information Item 7.1-1 to address final setpoint calculations. In a letter dated September 23, 2010, the applicant proposed a revision to the LNP COL FSAR by adding Standard (STD) COL 7.1-1, "Setpoint Calculations for Protective Functions" to reflect the above.

7.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793, "Final Safety Evaluation Report [FSER] Related to Certification of the AP1000 Standard Design," and its supplements.

In addition, the acceptance criteria associated with the relevant requirements of the Commission regulations for Instrumentation and Controls are in Section 7.1 of NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants."

The applicable regulatory requirements for the information being reviewed in this section are:

- Title 10 of the *Code of Federal Regulations* (10 CFR) 50.36, "Technical specifications"
- 10 CFR 52.79(a)(30)

7.1.4 Technical Evaluation

The Nuclear Regulatory Commission (NRC) staff reviewed Section 7.1 of the LNP COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.¹ The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to safety-related display information. The results of the NRC staff's evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this safety evaluation report (SER) provides a discussion of the strategy used by the NRC to perform one technical review for each standard issue outside the scope of the design certification (DC) and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (Vogtle Electric Generating Plant (VEGP), Units 3 and 4) were equally applicable to the LNP Units 1 and 2 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5 to the LNP COL FSAR. In performing this comparison, the staff considered changes made to the LNP COL FSAR (and other parts of the COL application, as applicable) resulting from requests for additional information (RAIs).
- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed.
- The staff verified that the site-specific differences were not relevant.

The staff has completed its review and found the evaluation performed for the standard content to be directly applicable to the LNP COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting. Section 1.2.3 of this SER provides an explanation of why the standard content material from the SER for the reference COL application (VEGP) may include evaluation material from the SER for the Bellefonte Nuclear Plant (BLN), Units 3 and 4 COL application.

The following portion of this technical evaluation section is reproduced from Section 7.1.4 of the VEGP SER:

*The applicant, in its letter dated May 21, 2010, proposed to incorporate the Setpoint Program (SP) that will be added to the AP1000 DCD into the VEGP Technical Specifications (TS). This proposal was made to address Open Item 16.1-1. In Chapter 16 of this safety evaluation report (SER), the staff concludes that the response to Open Item 16.1-1 is acceptable. The incorporation of this program into the VEGP TS in a later revision is being tracked as **Confirmatory Item 16.1-1**. The closure of this Confirmatory Item is provided in SER Section 16.1*

¹ See Section 1.2.2 for a discussion of the staff's review related to verification of the scope of information to be included in a COL application that references a design certification (DC).

In addition, in a letter dated June 4, 2010, the applicant proposed adding STD COL 7.1-1 as a new COL information item addressed in the VEGP COL FSAR.

AP1000 COL Information Item

- STD COL 7.1-1

The applicant proposed adding a new line item to VEGP COL FSAR Table 1.8-202 to address COL Information Item 7.1-1. The applicant also proposed the following addition to VEGP COL FSAR Section 7.1:

7.1.6.1 Setpoint Calculations for Protective Functions

The Setpoint Program described in Technical Specifications Section 5.5 provides the appropriate controls for update of the instrumentation setpoints following completion of the calculation of setpoints for protective functions and the reconciliation of the setpoints against the final design.

The applicant states that the TS program identified in the proposed Section 7.1.6.1 was that addressed in the VEGP revised response to Bellefonte Nuclear Plant (BLN) Open Item 16.1-1, dated May 21, 2010, and that the calculation and reconciliation of the setpoints discussed is required by the AP1000 Inspections, Tests, Analyses and Acceptance Criteria (ITAAC) included in AP1000 DCD Tier 1, Table 2.5.2-8, Item 10. In Chapter 16 of this SER, the staff concludes that the May 21, 2010, response to BLN Open Item 16.1-1 is acceptable.

*Based on the ITAAC in Table 2.5.2-8, Item 10 and the TS controls in Section 5.5, the staff finds there are adequate controls for updating the instrumentation and controls (I&C) setpoints. Therefore, the staff finds STD COL 7.1-1 acceptable. The incorporation of the changes associated with proposed STD COL 7.1-1 into a future revision of the VEGP COL FSAR is **Confirmatory Item 7.1-1**.*

Resolution of Standard Content Confirmatory Item 7.1-1

Confirmatory Item 7.1-1 is an applicant commitment to revise its FSAR Table 1.8-202 and Section 7.1 to address COL Information Item STD COL 7.1-1. The staff verified that the VEGP COL FSAR was appropriately revised. As a result, Confirmatory Item 7.1-1 is now closed.

7.1.5 Post Combined License Activities

There are no post-COL activities related to this section.

7.1.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to setpoint calculations for protective functions, and there is no outstanding information expected to be addressed in the LNP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

In addition, the staff has compared the application to the relevant NRC regulations and other NRC regulatory guides and concludes that, the applicant is in compliance with the NRC regulations. The staff based its conclusion on the following:

- STD COL 7.1-1, the applicant provided a program for setpoint calculations for protective functions in accordance with the requirements of 10 CFR 50.36 and 10 CFR 52.79(a)(30).

7.2 Reactor Trip

Section 7.2 of the LNP COL FSAR, Revision 9, incorporates by reference, Section 7.2, "Reactor Trip," of Revision 19 of the AP1000 DCD. In addition, in the LNP COL FSAR, the applicant provided the following:

Departures

- LNP DEP 6.4-2

The applicant provided additional information in Section 7.2 of the LNP COL FSAR about LNP DEP 6.4-2 related to design changes affecting how the temperature and humidity in the main control room are maintained within the limits for reliable human performance. This information, as well as related LNP DEP 6.4-2 information appearing in other chapters of the FSAR, is reviewed in Section 21.3 of this SER.

- LNP DEP 7.3-1

The applicant provided additional information in Table 7.2-201 of the LNP COL FSAR about LNP DEP 7.3-1 related to required design changes for the protection and safety monitoring system (PMS) source range neutron flux doubling logic to comply with the requirements of IEEE Std. 603-1991, Clause 6.6. This information, as well as related LNP DEP 7.3-1 information appearing in other chapters of the FSAR, is reviewed in Section 21.5 of this SER.

The NRC staff reviewed Section 7.2 of the LNP COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this section. The NRC staff's review confirmed that the applicant addressed the required information to satisfy the evaluation criteria. There is no outstanding

information expected to be addressed in the LNP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

7.3 Engineered Safety Features

Section 7.3 of the LNP COL FSAR, Revision 9, incorporates by reference, Section 7.3, "Engineered Safety Features," of Revision 19 of the AP1000 DCD. In addition, in the LNP COL FSAR, the applicant provided the following:

Departures

- LNP DEP 6.4-1

The applicant provided additional information in Section 7.3.1.2.17 of the LNP COL FSAR about LNP DEP 6.4-1 related to design changes affecting habitability of the main control room and changes to the calculated doses to control room operators. This information, as well as related LNP DEP 6.4-1 information appearing in other chapters of the FSAR, is reviewed in Section 21.2 of this SER.

- LNP DEP 6.4-2

The applicant provided additional information in Section 7.3.1.2.17 of the LNP COL FSAR about LNP DEP 6.4-2 related to design changes affecting how the temperature and humidity in the main control room are maintained within the limits for reliable human performance. This information, as well as related LNP DEP 6.4-2 information appearing in other chapters of the FSAR, is reviewed in Section 21.3 of this SER.

- LNP DEP 7.3-1

The applicant provided additional information in Section 7.3.1.2.14 of the LNP COL FSAR about LNP DEP 7.3-1 related to required design changes for the PMS source range neutron flux doubling logic to comply with the requirements of IEEE Std. 603-1991, Clause 6.6. This information, as well as related LNP DEP 7.3-1 information appearing in other chapters of the FSAR, is reviewed in Section 21.5 of this SER.

The NRC staff reviewed Section 7.3.1.2 of the LNP COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this section. The NRC staff's review confirmed that the applicant addressed the required information to satisfy the evaluation criteria. There is no outstanding information expected to be addressed in the LNP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

In RAI 1-4, issued to the applicant for the BLN, Units 3 and 4, the staff questioned how the applicant would verify that the as-built I&C system configuration conformed to schematics. In its response to RAI 1-4, the BLN applicant indicated that it or a designee would verify I&C cabinets as-built against the design drawings during manufacturing and would functionally test each system. In addition, the BLN applicant's response indicated that the I&C cabinets would be

tested during preoperational testing and in accordance with several ITAAC related to the I&C system. The BLN response to RAI 1-4 was endorsed as standard for LNP by the applicant in its letter dated December 15, 2008.

The staff notes that vendor qualification testing, which may be done offsite, and preoperational testing fall under the applicant's quality assurance program. Any anomalies found during the testing or any problems identified from the time the testing is complete until the components are installed at the site would be corrected in accordance with the applicant's quality assurance program. The staff finds the verification of the as-built I&C system configuration against schematics using a combination of vendor and onsite testing that falls under the applicant's quality assurance program acceptable. In addition, the staff finds that adequate program controls exist to ensure that once the testing was complete, the I&C system configuration would be maintained as valid throughout the life of the plant. Based on the above, the staff finds the response to BLN RAI 1-4 and the applicant endorsement of that response acceptable.

7.4 Systems Required for Safe Shutdown

Section 7.4 of the LNP COL FSAR, Revision 9, incorporates by reference Section 7.4, "Systems Required for Safe Shutdown," of Revision 19 of the AP1000 DCD. In addition, in the LNP COL FSAR, the applicant provided the following:

Departures

- LNP DEP 6.3-1 and LNP DEP 3.2-1

The applicant provided additional information about LNP DEP 6.3-1 and LNP DEP 3.2-1 in Section 7.4.1.1 of the FSAR related to extended operation of the PRHR-HX, the ability to maintain safe shutdown conditions, changing the indefinite duration to at least 72 hours, and operator directed actions to preserve battery capability. This information, as well as related LNP DEP 6.3-1 and LNP DEP 3.2-1 information appearing in other chapters of the FSAR, is reviewed in Section 21.1 of this report.

The NRC staff reviewed Section 7.4.1.1 of the LNP COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this section. The NRC staff's review confirmed that the applicant addressed the required information to satisfy the evaluation criteria. There is no outstanding information expected to be addressed in the LNP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements. Section 21.1 of this report evaluates the departures from the DCD provided in LNP DEP 6.3-1 and LNP DEP 3.2-1.

7.5 Safety-Related Display Information (Related to RG 1.206, Section C.III.1, Chapter 7, C.1.7.5, "Information Systems Important to Safety")

7.5.1 Introduction

Safety-related display information includes equipment that processes safety-related information and displays it for use by the operator to monitor and maintain the safety of the AP1000

throughout operating conditions that include anticipated operational occurrences and accident and post-accident conditions.

7.5.2 Summary of Application

Section 7.5 of the LNP COL FSAR, Revision 9, incorporates by reference Section 7.5 of the AP1000 DCD, Revision 19. In a letter dated May 26, 2010, in response to DCD Open Item OI-SRP7.5-ICE-01, Westinghouse proposed to revise the AP1000 DCD adding COL Information Item 7.5-1 for site-specific post accident monitoring variables. Westinghouse created a new COL Information Item (COL 7.5-1), which was incorporated into Revision 18 of the DCD.

In addition, in LNP COL FSAR Section 7.5, the applicant provided the following:

Departure

- LNP DEP 6.4-2

The applicant provided additional information in Section 7.5 of the LNP COL FSAR about LNP DEP 6.4-2 related to design changes affecting how the temperature and humidity in the main control room are maintained within the limits for reliable human performance. This information, as well as related LNP DEP 6.4-2 information appearing in other chapters of the FSAR, is reviewed in Section 21.3 of this SER.

AP1000 Information Items

- LNP COL 7.5-1 and STD COL 7.5-1

The applicant provided additional information in LNP COL FSAR Section 7.5, "Safety-Related Display Information," describing the FSAR Table 7.5-201 supplement to DCD Table 7.5-1 and providing variable data shown in the DCD table as "site specific."

The applicant also provided additional information in LNP COL FSAR Section 7.5, describing the FSAR Table 7.5-202 supplement to DCD Table 7.5-8 and providing variable data shown in DCD Table 7.5-8 as "site specific."

7.5.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793 and its supplements.

In addition, the acceptance criteria associated with the relevant requirements of the Commission regulations for the information systems important to safety are given in Section 7.5 of NUREG-0800.

The applicable regulatory requirements, guidelines, and related acceptance criteria for the supplemental information item are as follows:

- General Design Criterion (GDC) 13, "Instrumentation and Control"

- GDC 64, "Monitoring Radioactivity Releases"

The regulatory bases require, in part, that instrumentation be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to ensure adequate safety. Monitoring should include checking the plant environs for radioactivity that may be released from postulated accidents.

7.5.4 Technical Evaluation

The NRC staff reviewed Section 7.5 of the LNP COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.¹ The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to safety-related display information. The results of the NRC staff's evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

The staff reviewed the information in the LNP COL FSAR:

AP1000 Information Items

- LNP COL 7.5-1 and STD COL 7.5-1

The AP1000 DCD references and commits to Regulatory Guide (RG) 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident," Revision 3, as the method of complying with GDC 13 and GDC 64.

Appendix 1AA of the LNP COL FSAR took exception to Revision 4 of RG 1.97. The applicant, instead, stated conformance to Revision 3 of RG 1.97. The applicant stated, "Portable equipment outside the DCD scope conforms to Revision 3 of this Regulatory Guide for consistency with DCD scope since Revision 4 indicates that partial implementation is not advised." The staff discusses the acceptability of Revision 3 of RG 1.97 in Section 12.1 of this SER.

Revision 3 of RG 1.97 states that the variable and range information should be provided for environs radiation and radioactivity, and meteorological instrumentation.

The staff issued RAI 7.5-1 requesting information on boundary environs radiation and meteorological instrumentation. The staff finds that the range of the boundary environs radiation instruments is necessary to ensure that the instruments are adequate for monitoring radioactivity that may be released from a postulated accident. The applicant provided a supplemental response to RAI 7.5-1 with sufficient meteorological range and accuracy information for wind direction, wind speed, and differential temperature. In addition, the revised LNP COL FSAR Table 7.5-201 included the boundary environs radiation variable and the required range information for the post-accident monitoring system. The supplemental information conforms to the guidance of Revision 3 of RG 1.97. The staff confirmed that the LNP COL FSAR, Revision 5, incorporates the instrumentation supplemental information. The staff finds the response acceptable and considers RAI 7.5-1 closed.

In a letter dated May 26, 2010, WEC proposed a change to the AP1000 DCD to add COL Information Item 7.5-1 requiring that COL applicants provide information for variables listed as “site specific” in DCD Tables 7.5-1 and 7.5-8. Although this information was provided for LNP as part of LNP SUP 7.5-1 and incorporated in the LNP COL FSAR, the identification of COL Information Item 7.5-1 in the DCD required that the applicant address this information with a COL identifier rather than as supplemental information. Accordingly, the applicant’s letter dated September 23, 2010, proposes to replace LNP SUP 7.5-1 with STD COL 7.5-1 (for standard information) and LNP COL 7.5-1 (for LNP-specific information). This change of identifiers does not impact the staff’s conclusion regarding the instrumentation information added to the LNP COL FSAR. The incorporation of the changed identifiers into the LNP COL FSAR is **Confirmatory Item 7.5-1**.

Resolution for Confirmatory Item 7.5-1

Confirmatory Item 7.5-1 is an applicant commitment to replace LNP SUP 7.5-1 with STD COL 7.5-1 (for standard information) and LNP COL 7.5-1 (for LNP-specific information). The staff verified that the LNP COL FSAR was appropriately revised. As a result, Confirmatory Item 7.5-1 is now closed.

7.5.5 Post Combined License Activities

There are no post-COL activities related to this section.

7.5.6 Conclusion

The NRC staff reviewed the application and checked the referenced DCD. The NRC staff’s review confirmed that the applicant addressed the required information relating to safety-related display information, and there is no outstanding information expected to be addressed in the LNP COL FSAR related to this section. The results of the NRC staff’s technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

In addition, the staff has compared the application to the relevant NRC regulations and other NRC RGs and concludes that the applicant is in compliance with the NRC regulations. The applicant has satisfactorily addressed the guidance of Revision 3 of RG 1.97 through the response to RAI 7.5-1. The staff based its conclusion on the following:

- LNP DEP 6.4-2, related to design changes affecting how the temperature and humidity in the main control room are maintained within the limits for reliable human performance, is reviewed and found acceptable by the staff in Section 21.3 of this SER.
- LNP COL 7.5-1 and STD COL 7.5-1 provided sufficient information regarding the safety-related display information, and is, therefore, acceptable in accordance with the requirements of 10 CFR Part 50, Appendix A, GDC 13 and GDC 64.

7.6 Interlock Systems Important to Safety

Section 7.6 of the LNP COL FSAR, Revision 9, incorporates by reference, with no departures or supplements, Section 7.6, "Interlock Systems Important to Safety," of Revision 19 of the AP1000 DCD. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review.¹ The NRC staff's review confirmed that there is no outstanding issue related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

7.7 Control and Instrumentation Systems (Related to RG 1.206, Section C.III.1, Chapter 7, C.I.7.7, "Control Systems Not Required for Safety")

Section 7.7 of the LNP COL FSAR, Revision 9, incorporates by reference, with no departures or supplements, Section 7.7, "Control and Instrumentation Systems," of Revision 19 of the AP1000 DCD. The NRC staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remained for review.¹ The NRC staff's review confirmed that there is no outstanding issue related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.