

## 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

The Westinghouse AP1000 Design Control Document (DCD) contains Combined License (COL) Information Item 7.1-1 that requires the COL applicant to address setpoint calculations for protective functions.

#### 7.1.2 Summary of Application

Section 7.1 of the Turkey Point Units 6 and 7 COL Final Safety Analysis Report (FSAR), Revision 7 incorporates by reference Section 7.1 of the AP1000 DCD, Revision 19.

In addition, the applicant provided the following to address COL Information Item 7.1-1:

#### AP1000 COL Information Item

- STD COL 7.1-1

Standard (STD) COL 7.1-1 addresses setpoint calculations for protective functions.

#### 7.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793, "Final Safety Evaluation Report 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 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
- 10 CFR 52.79(a)(30)

#### 7.1.4 Technical Evaluation

The Nuclear Regulatory Commission (NRC) staff reviewed Section 7.1 of the Turkey Point Units 6 and 7 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.<sup>1</sup> The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to setpoint calculations for protective functions. The results of the NRC staff's evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 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 Turkey Point Units 6 and 7 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5 to the Turkey Point Units 6 and 7 COL FSAR. In performing this comparison, the staff considered changes made to the Turkey Point Units 6 and 7 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 Turkey Point Units 6 and 7 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.*

*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.*

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<sup>1</sup> 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).

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 staff's review confirmed that the applicant has addressed the relevant information relating to this section, and no outstanding information related to this section remains to be addressed in the Turkey Point Units 6 and 7 COL FSAR. The results of the NRC staff's technical evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 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 Turkey Point Units 6 and 7 COL FSAR incorporates by reference, Section 7.2, "Reactor Trip," of Revision 19 of the AP1000 DCD. In addition, in the Turkey Point Units 6 and 7 FSAR (letters dated May 6, 2016 (ADAMS Accession No. ML16131A674) and April 29, 2016 (ADAMS Accession No. ML16124A921)), the applicant provided the following:

### Departures

- PTN DEP 6.4-2

The applicant provided additional information in Section 7.2 of the Turkey Point Units 6 and 7 COL FSAR (letter dated May 6, 2016 (ADAMS Accession No. ML16131A674)) about PTN 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 PTN DEP 6.4-2 information appearing in other chapters of the FSAR (letter dated May 6, 2016 (ADAMS Accession No. ML16131A674)), is reviewed in Section 21.3 of this SER.

- PTN DEP 7.3-1

The applicant provided additional information in Table 7.2-201 of the Turkey Point Units 6 and 7 COL FSAR (letter dated April 29, 2016 (ADAMS Accession No. ML16124A921)) about PTN 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 PTN DEP 7.3-1 information appearing in other chapters of the FSAR (letter dated April 29, 2016 (ADAMS Accession No. ML16124A921)), is reviewed in Section 21.5 of this SER.

The NRC staff reviewed Section 7.2 of the Turkey Point Units 6 and 7 COL FSAR (letters dated May 6, 2016 (ADAMS Accession No. ML16131A674) and April 29, 2016 (ADAMS Accession No. ML16124A921)) and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of the information relating to this section.<sup>1</sup> The staff's review confirmed that the applicant has addressed the relevant information relating to this section, and no outstanding information related to this section remains to be addressed in the Turkey Point Units 6 and 7 COL FSAR (letters dated May 6, 2016 (ADAMS Accession No. ML16131A674) and April 29, 2016 (ADAMS Accession No. ML16124A921)). The results of the NRC staff's technical evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 COL application are documented in NUREG-1793 and its supplements.

### 7.3 Engineered Safety Features

Section 7.3 of the Turkey Point Units 6 and 7 COL FSAR incorporates by reference, Section 7.3, "Engineered Safety Features," of Revision 19 of the AP1000 DCD. In addition, in the Turkey Point Units 6 and 7 FSAR (letters dated May 6, 2016 (ADAMS Accession No. ML16131A674); April 29, 2016 (ADAMS Accession No. ML16124A921); and May 16, 2016 (ADAMS Accession No. ML16140A087)), the applicant provided the following:

#### Departures

- PTN DEP 6.4-1

The applicant provided additional information in Section 7.3.1.2.17 of the Turkey Point Units 6 and 7 COL FSAR (letter dated May 16, 2016 (ADAMS Accession No. ML16140A087)) about PTN 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 PTN DEP 6.4-1 information appearing in other chapters of the FSAR (letter dated May 16, 2016 (ADAMS Accession No. ML16140A087)), is reviewed in Section 21.2 of this SER.

- PTN DEP 6.4-2

The applicant provided additional information in Section 7.3.1.2.17 of the Turkey Point Units 6 and 7 COL FSAR (letter dated May 6, 2016 (ADAMS Accession No. ML16131A674)) about PTN 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 PTN DEP 6.4-2 information appearing in other chapters of the FSAR (letter dated May 6, 2016 (ADAMS Accession No. ML16131A674)), is reviewed in Section 21.3 of this SER.

- PTN DEP 7.3-1

The applicant provided additional information in Section 7.3.1.2.14 of the Turkey Point Units 6 and 7 COL FSAR (letter dated April 29, 2016 (ADAMS Accession No. ML16124A921)) about PTN 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 PTN DEP 7.3-1 information appearing in other chapters of the FSAR (letter dated April 29, 2016 (ADAMS Accession No. ML16124A921)), is reviewed in Section 21.5 of this SER.

The NRC staff reviewed Section 7.3.1.2 of the Turkey Point Units 6 and 7 COL FSAR (letters dated May 6, 2016 (ADAMS Accession No. ML16131A674); April 29, 2016 (ADAMS Accession No. ML16124A921); and May 16, 2016 (ADAMS Accession No. ML16140A087)) 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.<sup>1</sup> The staff's review confirmed that the applicant has addressed the relevant information relating to this section, and no outstanding information related to this section remains to be addressed in the Turkey Point Units 6 and 7 COL FSAR (letters dated May 6, 2016 (ADAMS Accession No. ML16131A674); April 29, 2016 (ADAMS Accession No. ML16124A921); and May 16, 2016 (ADAMS Accession No. ML16140A087)). The results of the NRC staff's technical evaluation of the information

incorporated by reference in the Turkey Point Units 6 and 7 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 Turkey Point Units 6 and 7 by Florida Power & Light Company in its letter dated October 5, 2009.

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 Florida Power & Light Company endorsement of that response acceptable.

#### **7.4 Systems Required for Safe Shutdown**

Section 7.4 of the Turkey Point Units 6 and 7 COL FSAR incorporates by reference, Section 7.4, "Systems Required for Safe Shutdown," of Revision 19 of the AP1000 DCD. In addition, in the Turkey Point Units 6 and 7 FSAR (letter dated May 9, 2016 (ADAMS Accession No. ML16132A293)), the applicant provided the following:

##### Departures

- PTN DEP 6.3-1 and PTN DEP 3.2-1

The applicant provided additional information for PTN DEP 6.3-1 and PTN DEP 3.2-1 in Turkey Point Units 6 and 7 COL FSAR Section 7.4.1.1 (letter dated May 9, 2016 (ADAMS Accession No. ML16132A293)) 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 PTN DEP 6.3-1 information appearing in other chapters of the FSAR (letter dated May 9, 2016 (ADAMS Accession No. ML16132A293)), is reviewed in Section 21.1 of this SER.

The staff reviewed Turkey Point Units 6 and 7 COL FSAR Section 7.4.1.1 (letter dated May 9, 2016 (ADAMS Accession No. ML16132A293)) and checked the referenced DCD to ensure that the combination of the DCD and the Turkey Point Units 6 and 7 COL application represents the complete scope of information relating to this section. The staff's review confirmed that the applicant has addressed the relevant information relating to this section, and no outstanding information related to this section remains to be addressed in the Turkey Point Units 6 and 7 COL FSAR (letter dated May 9, 2016 (ADAMS Accession No. ML16132A293)). The results of the staff's technical evaluation of the information incorporated by reference in the Turkey Point

Units 6 and 7 COL application are documented in NUREG-1793 and its supplements. Section 21.1 of this report evaluates the departures from the AP1000 DCD provided in PTN DEP 6.3-1 and PTN 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.

The AP1000 DCD contains COL Information Item 7.5-1 that requires the COL applicant to address post accident monitoring variables listed as site specific in DCD Tables 7.5-1 and 7.5-8.

### **7.5.2 Summary of Application**

Section 7.5 of the Turkey Point Units 6 and 7 COL FSAR, Revision 7 incorporates by reference Section 7.5 of the AP1000 DCD, Revision 19.

In addition, in the Turkey Point Units 6 and 7 FSAR (and in a letter dated May 6, 2016 (ADAMS Accession No. ML16131A674)), the applicant provided the following:

#### Departure

- PTN DEP 6.4-2

The applicant provided additional information in Section 7.5 of the Turkey Point Units 6 and 7 COL FSAR (letter dated May 6, 2016 (ADAMS Accession No. ML16131A674)) about PTN 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 PTN DEP 6.4-2 information appearing in other chapters of the FSAR (letter dated May 6, 2016 (ADAMS Accession No. ML16131A674)), is reviewed in Section 21.3 of this SER.

#### AP1000 Information Items

- STD COL 7.5-1 and PTN COL 7.5-1

The applicant provided additional information in Turkey Point Units 6 and 7 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 Turkey Point Units 6 and 7 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 the Final Safety Evaluation Report related to the DCD.

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 Turkey Point Units 6 and 7 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.<sup>1</sup> 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 Turkey Point Units 6 and 7 COL application are documented in NUREG-1793 and its supplements.

The staff reviewed the information in the Turkey Point Units 6 and 7 COL FSAR:

#### Supplemental Information

- STD COL 7.5-1 and PTN 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 Turkey Point Units 6 and 7 COL FSAR takes exception to Revision 4 of RG 1.97. The applicant, instead, states conformance to Revision 3 of RG 1.97. The applicant states, "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 Turkey Point Units 6 and 7 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 Turkey Point Units 6 and 7 COL FSAR was updated to incorporate the instrumentation supplemental information. The staff finds the response acceptable and considers RAI 7.5-1 closed.

Additionally, the applicant identified a typographical error in FSAR Table 7.5-201, with respect to the range of the wind direction parameter. In its letter dated January 28, 2013, the applicant identified the proposed change for the wind direction range, from 0 - 36° to 0 - 360°. This proposed change will be tracked as **Confirmatory Item 7.5-1**.

#### **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 staff's review confirmed that the applicant has addressed the relevant information relating to this section, and no outstanding information related to this section remains to be addressed in the Turkey Point Units 6 and 7 COL FSAR. The results of the NRC staff's technical evaluation of the information incorporated by reference in the Turkey Point Units 6 and 7 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, pending closure of **Confirmatory Item 7.5-1**, 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:

- PTN 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.
- STD COL 7.5-1 and PTN COL 7.5-1 provided sufficient information regarding the safety-related display information, which 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 Turkey Point Units 6 and 7 COL FSAR 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.<sup>1</sup> 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 Turkey Point Units 6 and 7 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 Turkey Point Units 6 and 7 COL FSAR 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.<sup>1</sup> 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 Turkey Point Units 6 and 7 COL application are documented in NUREG-1793 and its supplements.