



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

June 6, 2014

Mr. Thomas D. Gatlin  
Vice President, Nuclear Operations  
South Carolina Electric & Gas Company  
Virgil C. Summer Nuclear Station  
Post Office Box 88, Mail Code 800  
Jenkinsville, SC 29065

SUBJECT: VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1 – STAFF ASSESSMENT OF THE FLOODING WALKDOWN REPORT SUPPORTING IMPLEMENTATION OF NEAR-TERM TASK FORCE RECOMMENDATION 2.3 RELATED TO THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT (TAC NO. MF0285)

Dear Mr. Gatlin:

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a request for information letter per Title 10 of the *Code of Federal Regulations*, Section 50.54(f) (50.54(f) letter). The 50.54(f) letter was issued to power reactor licensees and holders of construction permits requesting addressees to provide further information to support the NRC staff's evaluation of regulatory actions that may be taken in response to lessons learned from Japan's March 11, 2011, Great Tōhoku Earthquake and subsequent tsunami. The request addressed the methods and procedures for nuclear power plant licensees to conduct flooding hazard walkdowns to identify and address degraded, nonconforming, or unanalyzed conditions through the corrective action program, and to verify the adequacy of the monitoring and maintenance procedures.

By letter dated November 26, 2012, South Carolina Electric & Gas Company (SCE&G) submitted a Flooding Walkdown Report as requested in Enclosure 4 of the 50.54(f) letter for the Virgil C. Summer Nuclear Station, Unit 1 (VCSNS). By letter dated January 31, 2014, SCE&G provided a response to the NRC request for additional information for the staff to complete its assessment. The NRC staff reviewed the information provided and, as documented in the enclosed staff assessment, determined sufficient information was provided to be responsive to Enclosure 4 of the 50.54(f) letter.

T. Gatlin

- 2 -

If you have any questions, please contact me at (301) 415-1009 or by e-mail at [Shawn.Williams@nrc.gov](mailto:Shawn.Williams@nrc.gov).

Sincerely,

A handwritten signature in black ink that reads "Shawn Williams". The signature is written in a cursive style with a long horizontal flourish at the end.

Shawn A. Williams, Project Manager  
Plant Licensing Branch II-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-395

Enclosure:  
Staff Assessment of Flooding Walkdown Report

cc w/encl: Distribution via Listserv

STAFF ASSESSMENT OF FLOODING WALKDOWN REPORT  
NEAR-TERM TASK FORCE RECOMMENDATION 2.3 RELATED TO  
THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT

SOUTH CAROLINA ELECTRIC & GAS COMPANY

VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1

DOCKET NO. 50-395

1 INTRODUCTION

On March 12, 2012,<sup>1</sup> the U.S. Nuclear Regulatory Commission (NRC) issued a request for information per Title 10 of the *Code of Federal Regulations*, Section 50.54(f) (50.54(f) letter) to all power reactor licensees and holders of construction permits in active or deferred status. The request was part of the implementation of lessons learned from the accident at the Fukushima Dai-ichi nuclear power plant. Enclosure 4, "Recommendation 2.3: Flooding,"<sup>2</sup> to the 50.54(f) letter requested licensees to conduct flooding walkdowns to identify and address degraded, nonconforming, or unanalyzed conditions using the corrective action program (CAP), verify the adequacy of monitoring and maintenance procedures, and report the results to the NRC.

Enclosure 4 of the 50.54(f) letter requested licensees to include the following:

- a. Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress.
- b. Describe protection and migration features that are considered in the licensing basis evaluation to protect against external ingress of water into structures, systems, and components (SSCs) important to safety.
- c. Describe any warning systems to detect the presence of water in rooms important to safety.
- d. Discuss the effectiveness of flood protection systems and exterior, incorporated, and temporary flood barriers. Discuss how these systems and barriers were evaluated using the acceptance criteria developed as part of Requested Information item 1.h.
- e. Present information related to the implementation of the walkdown process (e.g., details of selection of the walkdown team and procedures) using the documentation template discussed in Requested Information item 1.j, including actions taken in response to the peer review.
- f. Results of the walkdown including key findings and identified degraded, nonconforming, or unanalyzed conditions. Include a detailed description of the actions taken or planned to address these conditions using guidance in Regulatory Issues Summary 2005-20, Revision 1, Revision to the NRC Inspection Manual Part 9900 Technical Guidance,

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<sup>1</sup> Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340.

<sup>2</sup> ADAMS Accession No. ML12056A050.

- g. "Operability Conditions Adverse to Quality or Safety," including entering the condition in the corrective action program.
- h. Document any cliff-edge effects identified and the associated basis. Indicate those that were entered into the corrective action program. Also include a detailed description of the actions taken or planned to address these effects.
- i. Describe any other planned or newly installed flood protection systems or flood mitigation measures including flood barriers that further enhance the flood protection. Identify results and any subsequent actions taken in response to the peer review.

In accordance with the 50.54(f) letter, Enclosure 4, Required Response Item 2, licensees were required to submit a response within 180 days of the NRC's endorsement of the flooding walkdown guidance. By letter dated May 21, 2012<sup>3</sup>, the Nuclear Energy Institute (NEI) staff submitted NEI 12-07, Revision 0 A, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features" to the NRC staff to consider for endorsement. By letter dated May 31, 2012<sup>4</sup>, the NRC staff endorsed the walkdown guidance.

By letter dated November 26, 2012<sup>5</sup>, South Carolina Electric & Gas Company (SCE&G, the licensee), provided a response to Enclosure 4 of the 50.54(f) letter Required Response Item 2, for the Virgil C. Summer Nuclear Station, Unit 1 (VCSNS). The NRC staff issued a request for additional information (RAI) to the licensee regarding the available physical margin (APM) dated December 23, 2013<sup>6</sup>. The licensee responded by letter dated January 31, 2014<sup>7</sup>.

The NRC staff evaluated the licensee's submittals to determine if the information provided in the walkdown report met the intent of the walkdown guidance and if the licensee responded appropriately to Enclosure 4 of the 50.54(f) letter.

## 2 REGULATORY EVALUATION

The SSCs important to safety in operating nuclear power plants are designed either in accordance with, or meet the intent of Appendix A to 10 CFR Part 50, General Design Criteria (GDC) 2: "Design Bases for Protection Against Natural Phenomena;" and Appendix A "Seismic and Geological Criteria for Nuclear Plants," to 10 CFR Part 100,. GDC 2 states that SSCs important to safety at nuclear power plants shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions.

For initial licensing, each licensee was required to develop and maintain design bases that, as defined by 10 CFR 50.2, identify the specific functions to be performed by an SSC, and the specific values or ranges of values chosen for controlling parameters as reference bounds for the design.

The design bases for the SSCs reflect appropriate consideration of the most severe natural phenomena that have been historically reported for the site and surrounding area. The design

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3 ADAMS Package Accession No. ML121440522.

4 ADAMS Accession No. ML12144A142.

5 ADAMS Accession No. ML12332A203.

6 ADAMS Accession No. ML13325A891.

7 ADAMS Accession No. ML14035A227.

bases also reflect sufficient margin to account for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

The current licensing basis (CLB) is the set of NRC requirements applicable to a specific plant, and a licensee's written commitments for ensuring compliance with, and operation within, applicable NRC requirements and the plant-specific design basis, that are in effect.

### 3 TECHNICAL EVALUATION

#### 3.1 Design Basis Flooding Hazard for the Virgil C. Summer Nuclear Station

The licensee reported that the design basis flood hazard for the site is based on three potential scenarios. The controlling design basis flooding event is a probable maximum flood (PMF) as a result of flooding from Monticello Reservoir in combination with wind storm surge and wave setup. The normal still water level of the reservoir is 425 ft above mean sea level (MSL) while the maximum water level during PMF with wind storm surge and wave setup is interpreted in the report as 436.6 ft MSL. The Monticello Reservoir PMF assumes no water is released from the Fairfield Hydro station dam. The plant grade, North Berm, adjacent to the Monticello reservoir is at an elevation of 438 ft MSL. The licensee states the VCSNS site is the equivalent of a dry site as defined in RG 1.102.

Additional design basis flooding events considered in the walkdown report include: flooding from the Service Water Pond (SWP) PMF with wind storm surge and wave setup and a local intense precipitation event (LIP). The licensee reported that a design basis flooding event as a result of SWP PMF results in a maximum water level of 433.6 ft MSL. The licensee stated that the embankment adjacent to the SWP, West Embankment, is at a design elevation of 435.0 ft MSL. The licensee stated that other dams forming the SWP have a top elevation of 438 ft MSL. The licensee reported that the LIP event, defined as the greatest hourly depth of rainfall during a 6-hour probable maximum precipitation (PMP), results in a flood elevation of 436.15 ft MSL. The LIP event assumes storm inlets and the sewer pipe system is blocked.

The licensee reported that the Parr Reservoir on the Broad River is 150 ft below the site grade. As a result, flooding from the Broad River was not considered as a potential design basis flooding mechanism. Groundwater ingress was also not considered part of any design basis flooding mechanism.

Based on the NRC staff's review, the licensee appears to have described the design basis flood hazard level(s) as requested in the 50.54(f) letter and consistent with the walkdown guidance.

#### 3.2 Flood Protection and Mitigation

##### 3.2.1 Flood Protection and Mitigation Description

The licensee reported that the VCSNS has incorporated exterior barriers in place to prevent flooding on site from a design basis flooding event. The licensee stated that the current licensing basis (CLB) calls for flood protection to varying elevations depending on the location of the design basis flooding event. A PMF event resulting from flooding along the Monticello Reservoir calls for flood protection to an elevation of 437.5 ft MSL at the North Berm. A PMF as

a result of flooding from the SWP calls for flood protection to an elevation of 435 ft MSL at the West Embankment. The site grade is at an elevation of 435.5 ft MSL. According to the VCSNS Final Safety Analysis Report, the SSCs important to safety are at an elevation of 436.5 ft MSL. The licensee stated that no duration is considered as a part of any design basis flooding event.

### 3.2.2 Incorporated and Exterior Barriers

The licensee reported that the CLB flood protection relies on five main incorporated or exterior features: dams (and berms), site grade, exterior building walls, floor slabs, and roofs. The minimum top dam and berm elevations prevent Monticello Reservoir or the Service Water Pond from flooding the site during PMF and PMP events. The licensee indicated that the site grade was designed such that rainfall runoff during PMP event flows overland to prevent flooding of buildings, exterior equipment, and systems. The walls protect buildings from infiltration of flood waters during PMP/PMF, and penetrations are included in their respective wall. Below-grade penetrations are sealed and thick concrete walls are protected on their outside surfaces by a continuous waterproofing membrane. Slabs protect buildings from infiltration of flood waters during PMP and PMF events and finally, the roofs protect buildings from infiltration of flood waters from local intense precipitation PMP.

### 3.2.3 Temporary Barriers and Other Manual Actions

The licensee's walkdown report indicates there are no flood mitigation features credited in the CLB. In addition there are no plant procedures requiring actions in the VCSNS CLB that provide for flood protection or mitigation. However, the licensee stated that flood protection features whose conditions prevent the flood protection feature from performing its function during a design basis external flooding event are reported as deficiencies in their Corrective Action Program (CAP).

### 3.2.4 Reasonable Simulation and Results

Since no manual actions are required, the walkdown report did not describe simulations.

### 3.2.5 Conclusion

Based on the NRC staff's review, the licensee appears to have described protection and mitigation features as requested in the 50.54(f) letter and consistent with the walkdown guidance.

## 3.3 Warning Systems

There is no formal flood warning system in place to warn of potential flooding at the VCSNS site. However procedures and systems do exist to warn of extreme weather events.

Based on the NRC staff's review, the licensee appears to have provided information to describe any warning systems as requested in the 50.54(f) letter and consistent with the walkdown guidance.

### 3.4 Effectiveness of Flood Protection Features

Flood protection features whose conditions prevent the flood protection feature from performing its function during a design basis external flooding event were reported as deficiencies by the licensee and entered into the CAP. Key findings from the licensee's walkdown report are noted in Section 3.6.2.

Based on the NRC staff's review, the licensee appears to have discussed the effectiveness of flood protection features as requested in the 50.54(f) letter and consistent with the walkdown guidance.

### 3.5 Walkdown Methodology

By letter dated June 7, 2012<sup>8</sup> the licensee responded to the 50.54(f) letter that it intended to utilize the NRC endorsed walkdown guidelines contained in NEI 12-07, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features."<sup>9</sup> The licensee's walkdown submittal dated November 26, 2012, indicated that the licensee implemented the walkdowns consistent with the intent of the guidance provided in NEI 12-07. The licensee did not identify any exceptions from NEI 12-07.

Based on the NRC staff's review, the licensee appears to have presented information related to the implementation of the walkdown process as requested in the 50.54(f) letter and consistent with the walkdown guidance.

### 3.6 Walkdown Results

#### 3.6.1 Walkdown Scope

The licensee performed walkdowns of 62 flood protection features recorded on Walkdown Record Forms and available at the plant site for review.

The licensee used acceptance criteria consistent with the intent of NEI 12-07.

#### 3.6.2 Licensee evaluation of flood protection effectiveness, key findings, and identified deficiencies

The licensee performed an evaluation of the overall effectiveness of the plant's flood protection features. The report indicates that the walkdowns were performed to verify that plant flood protection features attributed to the CLB for protection and mitigation from external flood events. These features are functional, available, and well maintained to ensure the operation of safety systems in the event of a flood event.

NEI 12-07 defines a deficiency as follows: "a deficiency exists when a flood protection feature is unable to perform its intended function when subject to a design basis flooding hazard." The licensee identified deficiencies during the course of the flood walkdowns; these were

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<sup>8</sup> ADAMS Accession No. ML12160A347.

<sup>9</sup> ADAMS Accession No. ML12173A215.

summarized in Section 4.6 of the walkdown report. The deficiencies include differences in elevation between the top berm and the CLB in three areas. Other deficiencies include door thresholds below the CLB flood elevation in the auxiliary building, fuel handling building, diesel generator building, intermediate and control building. Other deficiencies include groundwater inleakage/seepage and wet areas on walls, through wall penetrations and around embedded conduits. Other deficiencies include site grading and grading at refueling water storage tank.

NEI 12-07 specify that licensees identify observations/potential deficiencies in the CAP that were not yet dispositioned at the time the walkdown report was submitted. SCE&G identified reported observations awaiting disposition. In the control building, a portion of the Electric Manhole 1 (EMH-1) could not be inspected due to a support from existing scaffolding being erected over the top of the access panel to EMH-1. The licensee indicated that EMH-1 is inspected every 28 days for any water, and no water has been found in the past quarter. The licensee performed the inspection after the scaffolding was removed and found no water in the manhole.

#### Flood Protection and Mitigation Enhancements

The licensee did not implement or plan enhancements to improve or increase flood protection or mitigation.

#### 3.6.3 Planned or newly installed features

The licensee determined that changes were necessary by the flood walkdowns. Section 3.6.4 (below), describes the actions taken to address deficiencies and completion schedule.

#### 3.6.4 Deficiencies Noted and Actions Taken or Planned to Address

The licensee noted the following deficiencies and actions taken or planned to address the deficiencies: differences in the design elevation of the North Berm (437.7 ft), SWP North Dam (437.1 ft) and SWP East Dam (437.5 ft). These features have a design elevation of 438 ft. The report indicates that although the Dam/Berm crest elevations are below 438 ft, there is still available physical margin between the current Dam/Berm crest elevation and the maximum wave run-up elevation.

The licensee also noted a discrepancy between the FSAR stated site maximum ponding level and the Nuclear Safety Related building flood protection features. The report indicates that ES-120 Operability Recommendation has been completed and that interim actions include a general visual inspection to be performed on each catch basin for catch basin manhole inlet blockage as well as for potentially transportable materials in the immediate vicinity that could result in manhole blockage.

Other deficiencies noted in the report are active groundwater in-leakage/seepage above the 408 ft elevation of the Tendon Access Gallery in the Reactor Building and 8 small conduit penetrations at elevation 436.19 ft, which is above the maximum site ponding elevation of 436.15 ft. The licensee indicated that the groundwater inleakage is considered to be very minimal and have no impact on plant equipment. In addition, the licensee indicated that the Tendon Gallery Sump pumps located below 388 ft provide sufficient capability to pump down



the minor groundwater ingress. A work order (WO# 1210857) has been written for maintenance to rework the seal. Another work order (WO# 1210858) has been written for electrical maintenance to install removable conduit cap on the 8 small conduits located on removable slab sections of the Tendon Gallery on the East Side of the Reactor Building.

The walkdown report indicates that on both the West and North wall of the Diesel Generator Building minor inleakage was noted, however due to the low leakage rate and sump pump capability; there is no adverse consequence to essential equipment. The licensee issued two work orders: WO# 1210860 to seal the rattle space and WO# 1210861 to investigate the cause of and repair leakage.

The walkdown report stated that ground water infiltration was noted through penetrations in the Service Water Pumphouse, the licensee noted that this issue had been previously identified by plant personnel prior to the flooding walkdowns and was entered into the CAP at that time and concluded that the amount of water infiltration is minimal and will have no adverse effect on design flood levels.

Finally, the walkdown report stated that water was observed dripping in the room adjacent to the sump pumps and 'C' switchgear. Water was apparently coming from the packing material around the duct bank and falling into the sump pump trench. The licensee indicated that the amount of water infiltration is minimal and WO# 1209247 was written to inspect and repair gasket/filler material.

### 3.6.5 Staff Analysis of Walkdowns

Staff reviewed the licensee walkdown report dated November 26, 2012. The walkdown revealed several deficiencies considered entered into the CAP. The NRC staff noted that most of the deficiencies require minimal action.

Based on the NRC staff's review, the licensee appears to have provided results of the walkdown and described any other planned or newly installed flood protection systems or flood mitigation measures as requested in the 50.54(f) letter and consistent with the walkdown guidance. Based on the information provided in the licensee's submittals, the NRC staff concludes that the licensee's implementation of the walkdown process meets the intent of the walkdown guidance.

### 3.6.6 Available Physical Margin

The NRC staff issued a request for additional information (RAI) to the licensee regarding the available physical margin (APM) dated December 23, 2013<sup>10</sup>. The licensee responded with a letter dated January 31, 2014<sup>11</sup>. The licensee has reviewed their APM determination process, and entered any unknown APMs into their CAP. The NRC staff reviewed the response, and concluded that the licensee met the intent of the APM determination per NEI 12-07.

Based on the NRC staff's review, the licensee appears to have documented the information requested for any cliff-edge effects, as requested in the 50.54(f) letter and consistent with the

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<sup>10</sup> ADAMS Accession No. ML13325A891.

<sup>11</sup> ADAMS Accession No. ML14035A227.

walkdown guidance. Further, the NRC staff reviewed the response, and concludes that the licensee met the intent of the APM determination per NEI 12-07.

### 3.7 NRC Oversight

#### 3.7.1 Independent Verification by Resident Inspectors

On June 27, 2012, the NRC issued Temporary Instruction (TI) 2515/187 "Inspection of Near-Term Task Force Recommendation 2.3 Flooding Walkdowns." In accordance with the TI, NRC inspectors independently verified that the VCSNS licensee implemented the flooding walkdowns consistent with the intent of the walkdown guidance. Additionally, the inspectors independently performed walkdowns of a sample of flood protection features. The inspection report dated May 6, 2013<sup>12</sup>, documents the results of this inspection. The inspection report noted, as part of the licensee identified violations, during original unit construction the licensee failed to assure protective measures against floods up to elevation 436.15 ft were correctly translated into specifications and drawings for entrances into those buildings containing safety class SSCs to ensure that floods would not have an adverse impact. This violation was designated as a "Green" finding and will be processed in accordance with NRC Enforcement Policies.

## 4 SSCS NOT WALKED DOWN

The licensee identified one restricted access feature but no inaccessible features.

### 4.1 Restricted Access

Section 4.6.7.1 of the walkdown report states that a portion of Electric Manhole 1 (EMH-1) could not be inspected due to a support from existing scaffolding being erected overtop of the access panel to EMH-1. The licensee performed the inspection after the scaffolding was removed and found no water in the manhole.

### 4.2 Inaccessible Features

The licensee did not identify any inaccessible features.

## 5 CONCLUSION

The NRC staff concludes that the licensee's implementation of flooding walkdown methodology meets the intent of the walkdown guidance. The NRC staff concludes that the licensee, through the implementation of the walkdown guidance activities and, in accordance with plant processes and procedures, verified the plant configuration with the current flooding licensing basis; addressed degraded, nonconforming, or unanalyzed flooding conditions; and verified the adequacy of monitoring and maintenance programs for protective features. Furthermore, the licensee's walkdown results, which were verified by the NRC staff's inspection, identified no immediate safety concerns. The NRC staff reviewed the information provided and determined that sufficient information was provided to be responsive to Enclosure 4 of the 50.54(f) letter.

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<sup>12</sup> ADAMS Accession No. ML13127A132.

T. Gatlin

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If you have any questions, please contact me at (301) 415-1009 or by e-mail at [Shawn.Williams@nrc.gov](mailto:Shawn.Williams@nrc.gov).

Sincerely,

/RA/

Shawn A. Williams, Project Manager  
Plant Licensing Branch II-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-395

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Staff Assessment of Flooding Walkdown Report

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