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

July 18, 2017

LICENSEE: Duke Energy Carolinas, LLC

FACILITY: Oconee Nuclear Station, Units 1, 2, and 3

SUBJECT: SUMMARY OF JUNE 27, 2017, MEETING WITH DUKE ENERGY CAROLINAS, LLC TO DISCUSS PROPOSED LICENSE AMENDMENT REQUEST FOR OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3 REGARDING THERMAL MARGIN FOR THE STANDBY SHUTDOWN FACILITY (CAC NOS. MF9754, MF9755, AND MF9756)

On June 27, 2017, the U.S. Nuclear Regulatory Commission (NRC) staff held a Category 1 public meeting with representatives from Duke Energy Carolinas, LLC (the licensee) at NRC Headquarters, One White Flint North, 11555 Rockville Pike, Rockville, Maryland. The purpose of the meeting was to discuss a proposed license amendment request regarding thermal margin for the Standby Shutdown Facility (SSF) at the Oconee Nuclear Station, Units 1, 2, and 3 (Oconee). The meeting notice and agenda, dated June 14, 2017, are available in NRC's Agencywide Documents Access and Management System under Accession No. ML17165A377. A list of attendees and the meeting presentation material are enclosed.

The licensee gave a presentation of its planned license amendment request to modify the Oconee Updated Final Safety Analysis Report (UFSAR). Enclosure 2 of this meeting summary contains the presentation slides, proposed UFSAR changes, and other background information that the licensee provided to the NRC staff. The licensee gave a brief overview of the purpose and requirements of the SSF. The licensee explained that during a review of the SSF in 2011, it identified that an unanalyzed condition exists during some limited operating conditions that exist during startup and shutdown (i.e., in conditions involving lower decay heat or low reactor coolant system temperature and high decay heat) in plant modes when operability of the SSF is required by Technical Specifications. During those conditions, one of the UFSAR success criteria for use of the SSF cannot be met, and the licensee has to declare the SSF inoperable per its Technical Specifications. The licensee proposes to use previously approved thermal-hydraulic methodologies to justify revising the UFSAR success criteria to permit water solid conditions in the pressurizer without water relief through the pressurizer safety valves and to credit reactor coolant system ambient losses, and reactor coolant system makeup and letdown (after plant modifications to enhance letdown capability) for decay heat removal. The licensee also stated that it wishes to use operation of atmospheric dump valves, when available, to enhance SSF event mitigation. The licensee also discussed plant modifications to support SSF capability during a turbine building flooding event. The licensee stated that it was not proposing any changes to the Technical Specifications, including those for the atmospheric dump valves.

The NRC staff asked the licensee questions about its ability to safely shut down the plant during water solid conditions in the reactor coolant system and whether pressurizer safety relief valves were qualified for liquid discharge. The staff also asked the licensee how it intends to use thermal-hydraulic analyses in its justification of the proposed changes. The licensee stated that thermal-hydraulic analyses would be performed using NRC-approved RETRAN-3D models for Oconee, and that the RELAP5/MOD2-B&W (Babcock and Wilcox) analysis will serve as a benchmark of the RETRAN-3D analyses. The intent of the benchmark is to provide additional support for RETRAN-3D analyses that result in water-solid conditions in the pressurizer. The licensee stated it would support a staff audit of such analyses, as needed. The staff also asked the licensee whether the bases for any Technical Specifications requirements (e.g., limiting conditions for operation, surveillance requirements, or completion times) would be affected by the proposed changes.

The licensee plans to submit its license amendment request in August 2017 and request the NRC staff to complete its review in 12 to 18 months from the submittal date. The staff will provide its projected review schedule as part of its acceptance review of the submittal. The staff did not make any regulatory decisions or commitments at the meeting. No members of the public were in attendance at the meeting nor announced over the telephone.

Any inquiries can be directed to me at 301-415-0489 or via e-mail at Audrey.Klett@nrc.gov.

Audrey L. Klett, Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270, and 50-287

Enclosures:
1. List of Attendees
2. Meeting Presentation Material

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LIST OF ATTENDEES

JUNE 27, 2017, MEETING WITH DUKE ENERGY CAROLINAS, LLC

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

PROPOSED LICENSE AMENDMENT REQUEST REGARDING

THERMAL MARGIN FOR THE STANDBY SHUTDOWN FACILITY

**U.S. Nuclear Regulatory Commission**
Michael T. Markley
Eric Oesterle
Reed Anzalone
Robert Beaton
Jerome Bettle
Matthew Hamm
Audrey Klett

**Duke Energy Carolinas, LLC**
Chris Wasik
Boyd Shingleton
Philip North
Greg Byers
Adam Bingham
David Wilson
Dave Baxter
Tracy Saville*
Mark Handrick*
Scott Thomas*
Jeff Abbott*
Lee Kanipe*
Ken Grayson*
Paul Mabry*
Tim Brown*
Jeremy Moyer*

*Participated by phone

# Meeting Presentation Material

Enclosure 2

# Oconee Nuclear Station

Pre-application Meeting – June 27, 2017

Standby Shutdown Facility Thermal Margin LAR

DUKE ENERGY®

# Attendees

- Dave Baxter, Leader, Oconee Regulatory Projects
- Chris Wasik, Manager, Oconee Regulatory Affairs
- Boyd Shingleton, Licensing Engineer, Oconee Regulatory Affairs
- Phil North, Manager, Oconee Regulatory Projects Engineering
- Greg Byers, Principal Engineer, Safety Analysis
- Adam Bingham, Senior Engineer, Safety Analysis
- David Wilson, Manager, Oconee Mechanical Design Basis Engineering

# Agenda

- Opening Remarks
- SSF Design and Licensing Basis
- SSF Thermal Margin
- SSF Thermal Margin Resolution
- Thermal-Hydraulic Analysis Methodology
- UFSAR Changes
- Closing Remarks

# Opening Remarks

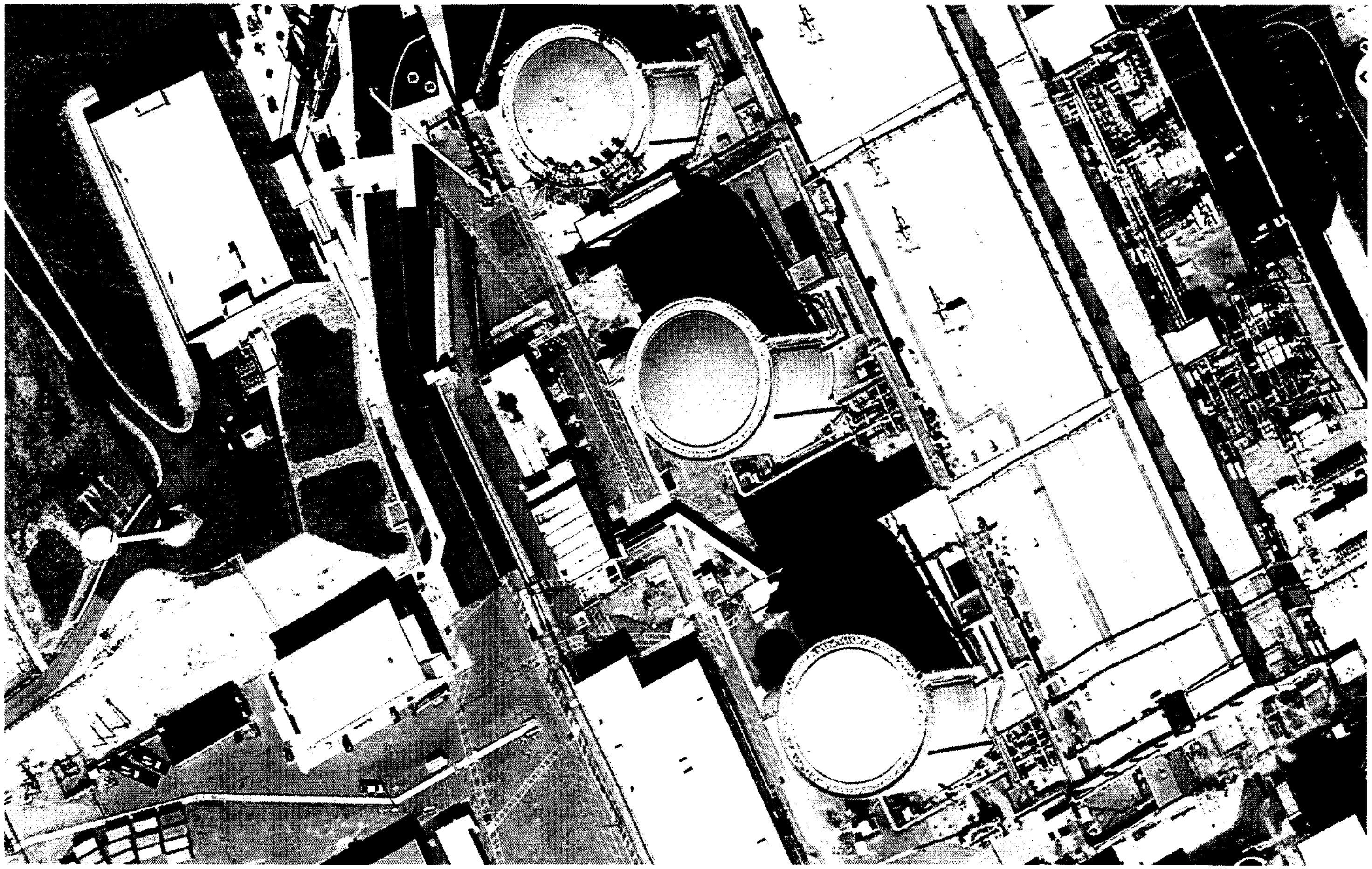
**Dave Baxter - Leader, Oconee Regulatory Projects**

# SSF Design & Licensing Basis

## Licensing Basis

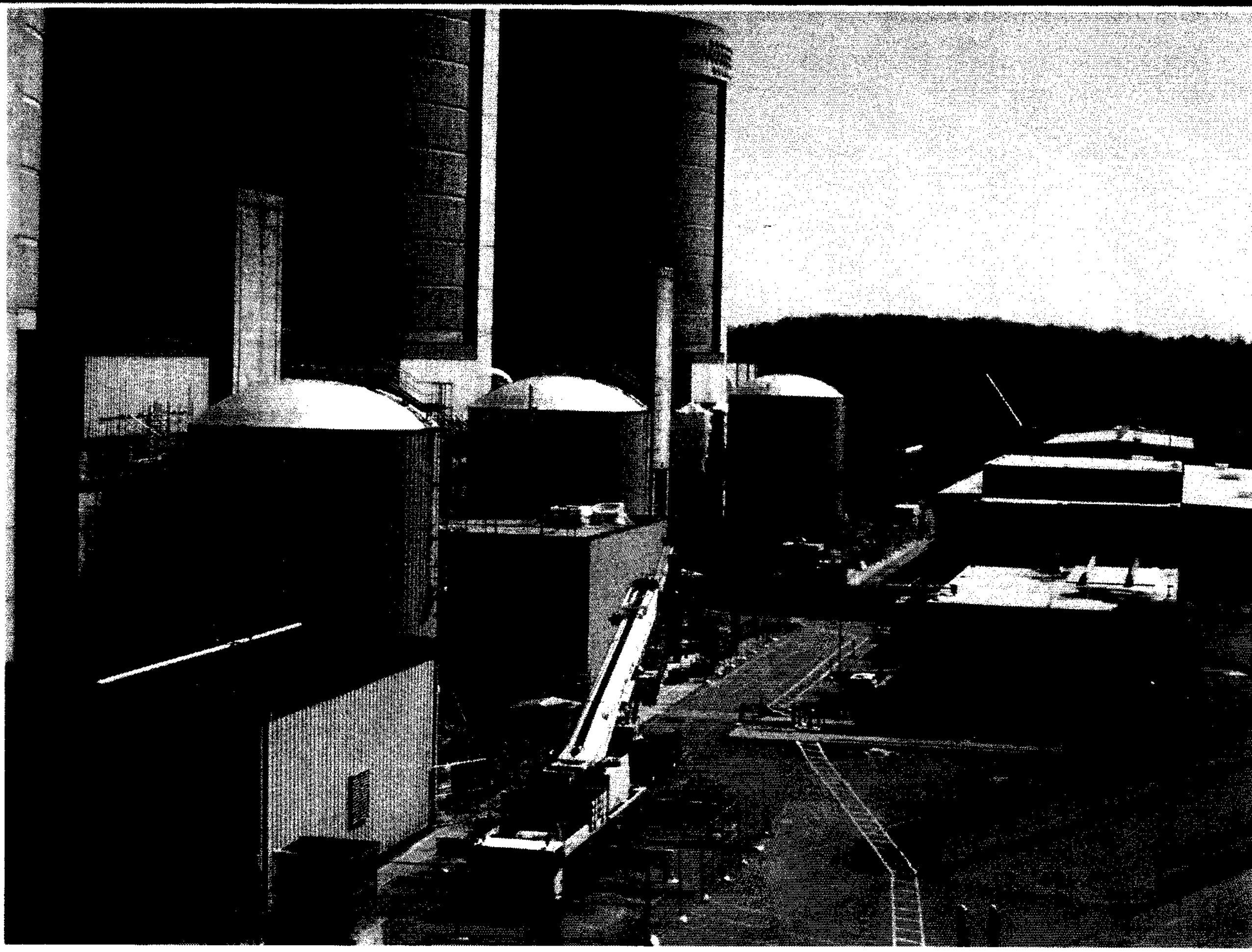
- The Standby Shutdown Facility (SSF) is included in Technical Specifications in accordance with 10 CFR 50.36 Criterion 4.
- The SSF is required to be OPERABLE when > 250°F per TS 3.10.1. (MODES 1, 2, and 3).
- The SSF is credited for fire, turbine building (TB) flood, station blackout (SBO), and security events as described in UFSAR Section 9.6.
- The SSF is not credited for UFSAR Chapter 15 events.

# SSF Design & Licensing Basis



FOR INFORMATION ONLY

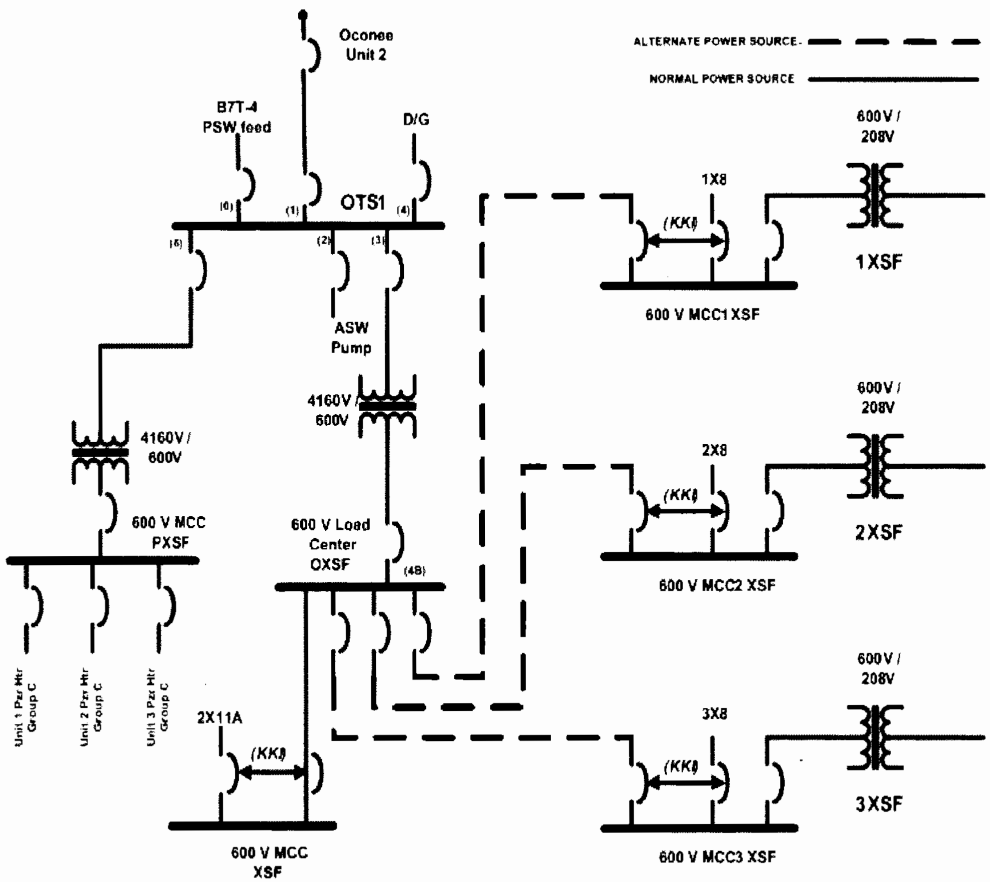
# SSF Design & Licensing Basis



FOR INFORMATION ONLY

# SSF Design & Licensing Basis

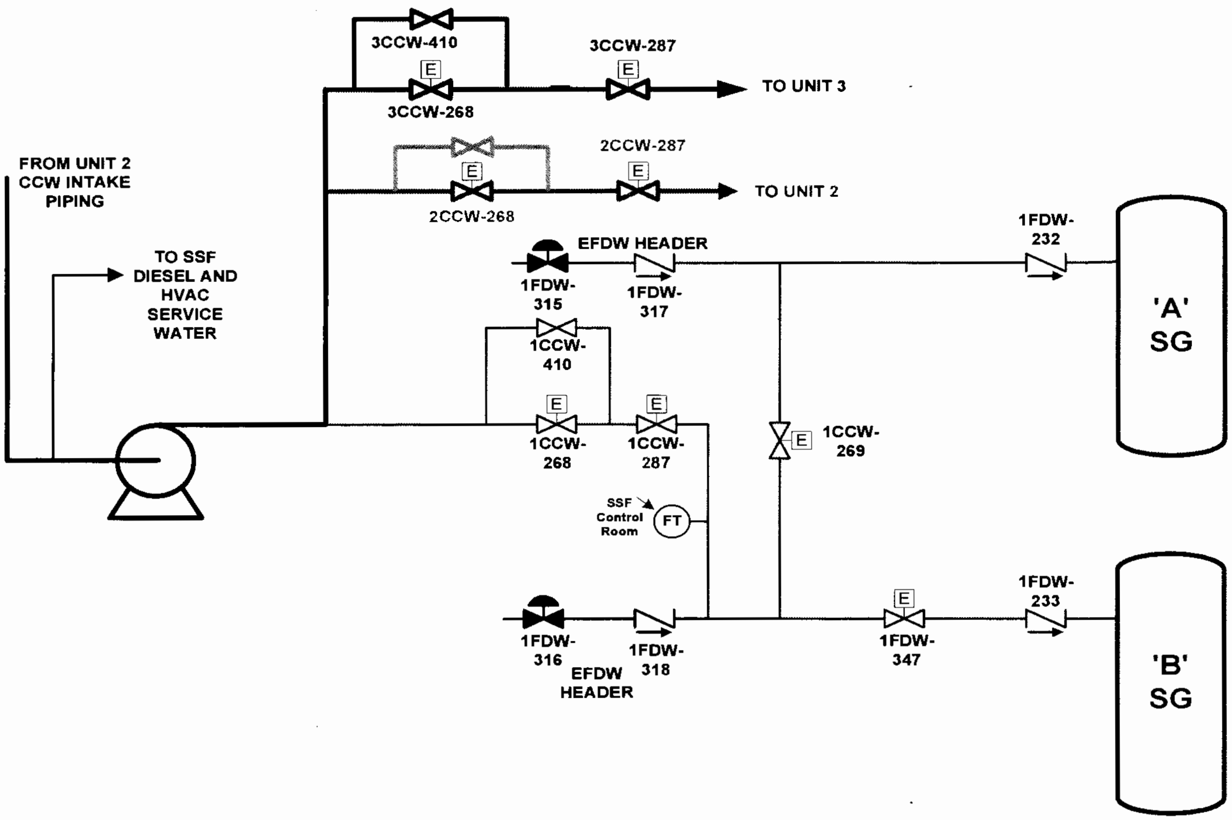
## SSF Electrical




FOR INFORMATION ONLY

# SSF Design & Licensing Basis

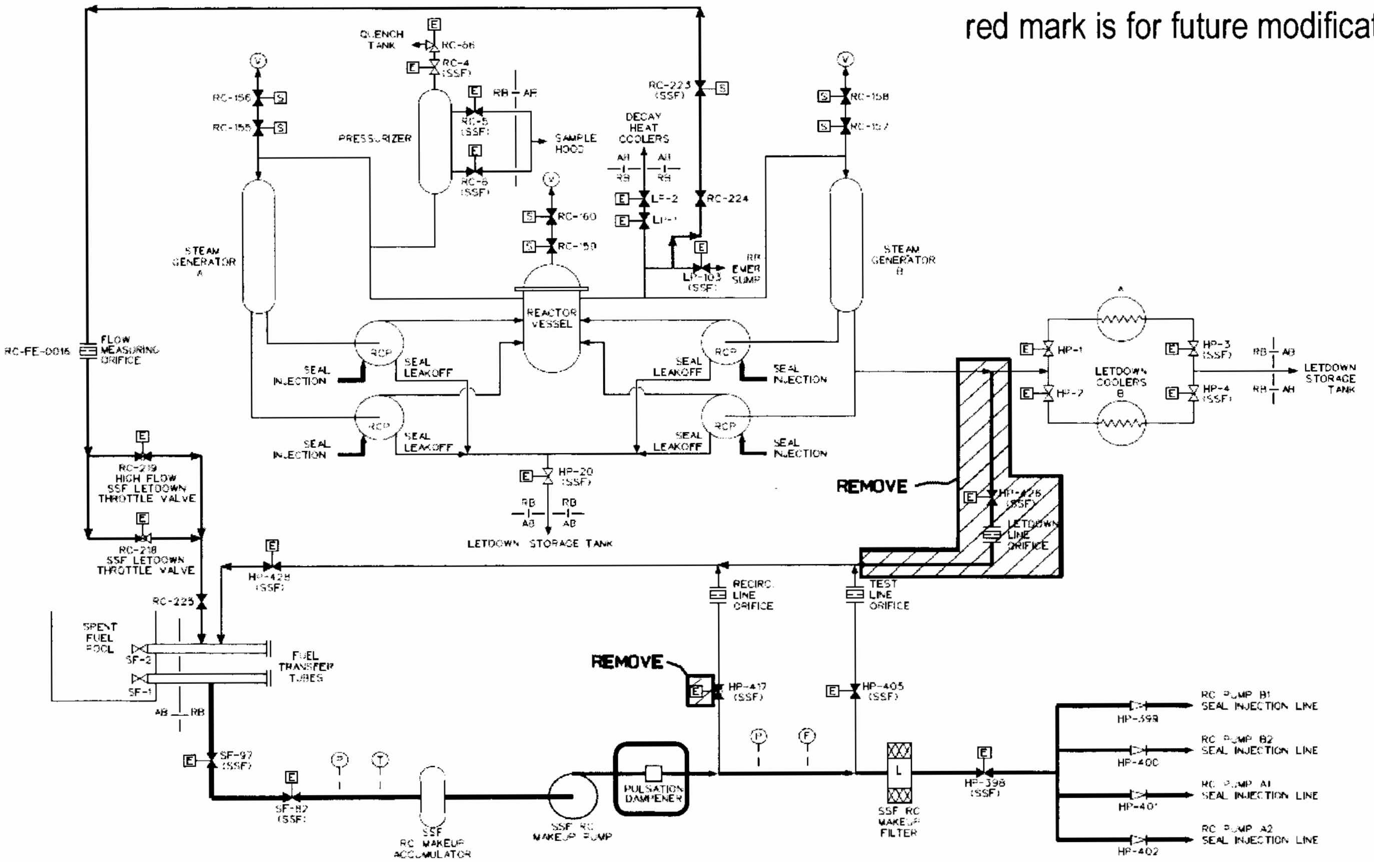
## SSF Auxiliary Service Water




FOR INFORMATION ONLY

## SSF Reactor Coolant Makeup

red mark is for future modifications




FOR INFORMATION ONLY

# SSF Thermal Margin

- Supporting thermal-hydraulic (T-H) analyses were historically performed from a nominal full power condition for fire and SBO. No T-H analyses had previously been performed for the TB flood event.
- Current UFSAR success criteria for TB flood includes:
  - Maintain the reactor in a safe shutdown condition for a period of 72 hours,
  - Maintain at least 1% $\Delta k/k$ shutdown margin with most reactive rod fully withdrawn,
  - Assure natural circulation and core cooling by maintaining a sufficient level in the pressurizer while maintaining sufficient secondary side cooling.
- Events analyzed with some off-nominal initial conditions (low decay heat, low initial temperature) may not meet all the current UFSAR success criteria. This was reported in LER 269/2012-01.
- SSF is declared inoperable during off-nominal conditions of unit startup and shutdown.

# SSF Thermal Margin

**T-H Analyses - Low Decay Heat (Current)**

- Early in the event, excessive steam flow may challenge acceptance with respect to pressurizer (PZR) level.
- Later in the event, water solid conditions (without liquid relief) may develop in the PZR as cold insurges overcome heater capacity.
- Later in the event, ambient heat losses, makeup and letdown cool the primary (rather than heat rejection to steam generators (SGs)).
- This condition exists until sufficient decay heat is established.

# SSF Thermal Margin

**T-H Analyses - Low Initial Temperature with High Decay Heat (Current)**

- PZR insurge due to heatup to ~550°F results in a water solid Reactor Coolant System (RCS) and creates the potential for water relief from pressurizer safety valves (PSVs).
- This condition exists during a limited window: Cooldown from ~450°F to 250°F.

# SSF Thermal Margin Resolution

**License Amendment Request**

- Perform T-H analyses for TB flood events with off-nominal initial conditions; proposing off-nominal success criteria via LAR.
- Based on T-H analysis results and LAR approval, revise UFSAR Section 9.6 to document off-nominal success criteria:
  - Permit water solid conditions without water relief, and
  - Credit ambient losses, makeup and letdown for decay heat removal.
- Allow operation of Atmospheric Dump Valves (ADVs), if available, to enhance SSF event mitigation.
- Submittal planned for August 2017.

# SSF Thermal Margin Resolution

**Modifications per 10 CFR 50.59**

- Modify the SSF letdown line to provide throttling capability and increase capacity to support off-nominal success criteria.
- Replace the existing SSF Reactor Coolant Makeup (RCMU) pulsation dampener with a passive design which is effective over the full range of RCS pressure.

# SSF Thermal Margin Resolution

## T-H Analyses - Low Decay Heat (Future)

- Early in the event, excessive steam flow may challenge acceptance with respect to PZR level (no change).
- Later in the event, water solid conditions are not expected to develop in the PZR due to the ability to throttle letdown flow.
- Later in the event, ambient heat losses, makeup and letdown cool the primary, rather than heat rejection to SGs (no change).

# SSF Thermal Margin Resolution

**T-H Analyses - Low Initial Temperature with High Decay Heat (Future)**

- PZR insurge due to heatup to ~550°F may result in a water solid RCS; however, water relief from the PSVs will not occur.
  - This condition exists during a limited window: Cooldown from ~450°F to 250°F.
  - New mitigation strategy will keep RCS subcooled under water solid conditions without water relief. Use of the PZR heaters allows a steam bubble to be re-established.

# Thermal-Hydraulic Analysis Methodology

- T-H analyses for SSF-mitigated TB flood performed with Duke Energy's RETRAN-3D Oconee thermal-hydraulic model.
- Analyses are based on T-H model described in Duke Methodology Report DPC-NE-3000-PA.
  - Approved by NRC for use in ONS UFSAR Chapter 15 non-LOCA accident analyses, and UFSAR Chapter 6 steam line break mass and energy release analyses.
- Model modified in the TB flood analyses to capture important phenomena in the RCS and pressurizer for longer-duration SSF events:
  - Ambient heat losses from the RCS and PZR to the Reactor Building environment, and
  - Thermal stratification of fluid in the PZR for large or prolonged insurges & outsurges.

# Thermal-Hydraulic Analysis Methodology

- Confirmatory T-H analyses performed with Duke Energy's RELAP5/MOD2-B&W Oconee thermal-hydraulic model for cases that transition to a water-solid RCS condition.
- Analyses are based on T-H model described in Duke Methodology Report DPC-NE-3003-PA.
  - Approved by NRC for use in the ONS UFSAR Chapter 6 LOCA mass and energy release analyses.
- Model modified in the TB flood analyses to capture or improve existing modeling capabilities for important phenomena in the RCS and pressurizer for longer-duration SSF events:
  - Ambient heat losses from the RCS and pressurizer to the Reactor Building environment, and
  - Thermal stratification of fluid in the PZR for large or prolonged insurges & outsurges.

# UFSAR Changes

## UFSAR Section 9.6 Revision – Off-Nominal Success Criteria

- In cases where the pressurizer goes water solid, there is no liquid relief through the PSVs.
- During periods of very low decay heat the SSF will be used to establish conditions that support subcooled natural circulation between the core and the SGs.
- Natural circulation involving the SGs may not occur if the amount of decay heat available is ≤ heat removed by ambient losses to containment and/or by other means, e.g., makeup and letdown of SSF reactor coolant makeup. When these heat removal mechanisms are sufficient to remove core decay heat, they are considered adequate to meet the core cooling function and systems supporting SG decay heat removal, although available, are not necessary for core cooling.
- Minimum water level above the reactor core will be maintained.

# UFSAR Changes

- UFSAR Section 9.6 revised to allow use of the Main Steam (MS) Atmospheric Dump Valves (ADVs), when available, to enhance mitigation of SSF events.

# Questions

# Closing Remarks

**Dave Baxter - Leader, Oconee Regulatory Projects**

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# 9.6 Standby Shutdown Facility

## 9.6.1 General Description

The Standby Shutdown Facility (SSF) houses stand-alone systems that are designed to maintain the plant in a safe and stable condition following postulated emergency events that are distinct from the design basis accidents and design basis events for which the plant systems were originally designed. The system provides additional "defense in-depth" protection for the health and safety of the public by serving as a backup to existing safety systems. The original licensing basis of the SSF provided an alternate means to achieve and maintain mode 3 with an average Reactor Coolant temperature ≥ 525°F (RCS cold leg temperature ≤ 555°F and RCS pressure ≃ 2155 psig) following postulated fire, security-related, or turbine building flood events, and is designed in accordance with criteria associated with these events.

TB Flood does not occur with any other concurrent event. The loss of all other non-SSF power is a design criteria applied to the SSF design to ensure that the SSF can independently mitigate the event over the long term. A loss of offsite power (LOOP) is not postulated to occur at event initiation, however it could occur as a consequence of the flooding event. (References 36 and 37)

In the time since the SSF was licensed and build, various new licensing issues have broadened and re-defined the SSF licensing requirements. In the early 1980's soon after the TMI event, NRC took steps to ensure the Emergency Feedwater System was adequately designed, GL 81-14 was issued to ensure the EFW System was designed seismically. When EFW vulnerabilities were identified, the SSF was credited as an acceptable alternate heat removal system with the required seismic design (Reference 34). Similarly, the ability of the EFW System to withstand tornado missiles was questioned by NRC. The SSF was credited as an acceptable heat removal system with adequate tornado missile protection (Reference 4). When the Station Blackout Rule was issued, the SSF was credited as the alternate AC (AAC) power source and the source of decay heat removal required to demonstrate safe shutdown during the required station blackout coping duration (References 2 and 3). A June 11, 2002, license amendment credited the SSF as one of multiple, alternate paths that can be used to mitigate certain EFW single failure vulnerabilities (Reference 35). Adoption of the NFPA 805 changed the SSF licensing basis from what was originally committed for Fire to a new set of rules. Key differences are the elimination of the "ten minute rule" and the elimination of 72 hours as a required time to be at cold shutdown (See Section 9.5.1.3.2)

The SSF had certain design criteria and rules that were applied to it as part of the original licensing action that apply to those events for which the SSF was originally licensed. As the scope of issues for which SSF was credited broadened, it is important to realize that original SSF design criteria may or may not apply to these new scenarios. It is necessary to review the specific licensing correspondence for the specific issue to determine the applicable design criteria and other requirements.

Per the licensing correspondence which documented the SSF design criteria, SSF-designated events are not postulated to simultaneously occur with standard design basis events such as an earthquake or LOCA; therefore, the single failure criterion is not applicable or required. However, SSF systems are required to be designed such that a failure of an SSF component would not result in failures or inadvertent operation of existing plant systems that would prevent existing plant systems from performing their intended function. SSF ties to the existing plant are such that no SSF failure will result in consequences more severe than those analyzed in the UFSAR. The SSF requires manual activation that would occur under adverse fire, flooding or sabotage events when normal plant systems may have been damaged or have become unavailable.

Per the original SSF licensing correspondence as documented in the April 28, 1983 SER and corresponding Duke Energy submittals (fire and TB flood) the SSF is designed to:

1. Maintain a minimum water level above the reactor core, with an intact Reactor Coolant System, and maintain Reactor Coolant Pump Seal cooling.
2. Assure natural circulation and core cooling by maintaining the primary coolant system filled to a sufficient level in the pressurizer while maintaining sufficient secondary side cooling water.
3. Transfer decay heat from the fuel to an ultimate heat sink.
4. Maintain the reactor 1% shutdown with the most reactive rod stuck fully withdrawn, after all normal sources of RCS makeup have become unavailable, by providing makeup via the Reactor Coolant Makeup Pump System which always supplies makeup of a sufficient boron concentration. (The stuck rod requirement was eliminated for fire events when NFPA 805 was adopted. See Section 9.6.2)

The SSF consists of the following:

1. SSF Structure
2. SSF Reactor Coolant Makeup (RCM) System
3. SSF Auxiliary Service Water (ASW) System
4. SSF Electrical Power
5. SSF Support Systems

System Main Components are listed in Table 9-14. SSF Primary Valves are listed in Table 9-15. SSF Instrumentation is listed in Table 9-16.

## 9.6.2 Design Bases

**FIRE EVENT (NFPA 805 Fire which supersedes the original SSF Fire Design Requirements)**

Oconee transitioned to NFPA 805, Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, 2001 Edition, in accordance with 10CFR50.48(c). NFPA 805 establishes a nuclear safety goal that requires reasonable assurance that a fire during any operational mode or plant configuration will not prevent the plant from being maintained in a safe and stable condition. Safe and stable is defined as maintaining $K_{eff}$<0.99 with the RCS at or below the requirements for hot standby.

To accomplish this goal, fire protection systems and features must be capable of ensuring at least one success path of equipment remains free of fire damage following a fire in a single fire area. For one fire area of Oconee, the SSF provides the single success path necessary to achieve the NFPA 805 nuclear safety goal.

The nuclear safety goal of NFPA 805 does not prescribe a transition to cold shutdown within 72 hours following a fire; rather, only that the plant be maintained safe and stable in hot standby ($K_{eff}$ <0.99 and RCS temperature >/= 250°F for up to a 72 hour coping duration while repairs are made to achieve a licensed end state of hot shutdown ($K_{eff}$ <0.99 and RCS temperature below 250°F but above 200°F) (Reference 9.5.1.3.2). For the most limiting fire scenarios, it is anticipated that the end state of the cooldown would be an RCS temperature of approximately 250°F with a long term strategy for reactivity, decay heat removal and inventory/pressure control. Long-term subcooled natural circulation decay heat removal is provided by supplying lake water to the steam generators and steaming to atmosphere. The extended coping period at these conditions is based on the significant volume of water available for decay heat removal and reduced need for primary makeup to only match nominal system losses. A stuck rod is not required to be postulated for this event. Initial conditions are 100% power with sufficient decay heat such that natural circulation can be achieved. The hypothesized fire is to be considered an "event", and thus need not be postulated concurrent with non-fire-related failures in safety systems, other plant accidents, or the most severe natural phenomena (Reference 31).

Deleted Paragraph(s) per 2015 update.

Deleted Paragraph(s) per 2012 update.

**TURBINE BUILDING FLOOD EVENT**

The Turbine Building Flood was one of the events that was identified in the original SSF licensing requirements. The SSF is designed to maintain the reactor in a safe shutdown condition for a period of 72 hours following a TB Flood. No other concurrent event is assumed to occur. The success criteria for this event is to assure natural circulation and core cooling by maintaining the primary coolant system filled to a sufficient level in the pressurizer while maintaining sufficient secondary side cooling. The reactor shall be maintained at least 1% $\Delta k/k$ with the most reactive rod fully withdrawn. (Reference 1, 10)

**SECURITY-RELATED EVENT**

A Security Related Event was one of the events that was identified in the original SSF licensing requirements. The SSF is designed to achieve and maintain a safe shutdown condition for this event. No other concurrent event is assumed to occur. (Reference 1) The success criteria for this event is to assure the core will not return to criticality, the active fuel will not be uncovered, and long-term natural circulation will not be halted. (Reference 41)

**STATION BLACKOUT EVENT**

This event was licensed after the design of the SSF was completed and approved by NRC. The SSF was credited as the method the plant would employ to mitigate a SBO event. (References 38 and 39) The success criteria is to maintain the core covered for 4 hours. No stuck rod is assumed for this event. Initial conditions are 100% power and 100 days of operation. (Reference 40)

**SSF TORNADO DESIGN CRITERIA**

This is a design criterion for the SSF that was committed to as part of the original SSF licensing correspondence. All parts of the SSF itself that are required for mitigation of the SSF events are required to be designed against tornado winds and associated tornado missiles. This requirement is satisfied through appropriate design of the SSF structure. This requirement does not extend to SSCs that were already part of the plant which SSF relies upon and interfaces with for event mitigation. It is important to note that the SSF was not licensed to mitigate a tornado event or a tornado missile event (Reference 1). Tornado design requirements for the plant itself are addressed in Section 3.2.2. A subsequent issue related to crediting SSF ASW as an alternative for EFW tornado missile protection vulnerabilities is discussed below (see EFW Tornado Missile Design Criteria).

**EFW SEISMIC DESIGN CRITERIA (GL 81-14)**

During the seismic qualification review of the Oconee EFW system in the 1980s, the NRC postulated that a seismic event could break a pipe and potentially cause a flood of the turbine building thereby submerging and failing the EFW pumps. The NRC wanted to ensure that the EFW System was seismically designed and could withstand a single failure, as well. As an alternative to upgrading the EFW System, NRC credited the use of the SSF ASW System and HPI Feed & Bleed (Reference 34). These two decay heat removal systems are seismically designed and independent from each other. The event postulated by GL 81-14 (a seismic break) was a special condition imposed on ONS to evaluate the EFW design. It was not intended to re-define the SSF mitigated TB Flood (which does not concurrently consider a seismic event, nor does it impose a single failure). Although both "events" are TB Floods, they are two separate licensing actions with different scopes, different acceptance criteria, and different purposes. The GL 81-14 flood does not have specified initial conditions, other mitigation assumptions, or success criteria to be considered because it is not an event, only an EFW design criterion (Reference 34).

**EFW TORNADO MISSILE DESIGN CRITERIA**

An additional issue that arose after TMI was the capability of the EFW System to withstand the effects of tornado missiles. The design of the EFW System did not include this capability, therefore, Duke Energy requested and NRC approved crediting the SSF Auxiliary Service Water (SSF ASW) System as an acceptable alternative (even though it was recognized that SSF ASW System itself is not completely protected from all tornado missiles). It is important to note that this licensing action did not specify a tornado missile event or define a tornado missile mitigation strategy. Using a probabilistic approach, it solely focused on ensuring that a secondary side heat removal path is adequately designed to withstand the effects of tornado missiles (Reference 4).

**EFW SINGLE FAILURE VULNERABILITIES**

During the 1990's and early 2000's, the NRC again focused on the design capabilities of the EFW System. Certain single failure vulnerabilities were identified after reviews by both Duke Energy and NRC. NRC accepted these vulnerabilities by crediting the existence of multiple alternate paths that could also provide secondary side heat removal. SSF Auxiliary Service Water (SSF ASW) was one of the paths credited for this function (Reference 35).

Deleted Per 2014 Update.

The reactor building spray pumps are described with respect to the waterproofing of the walls between the auxiliary building and the turbine building. However, Duke did not credit the reactor building spray pumps in the mitigation of the turbine building flood. In addition, the NRC did not credit the reactor building spray pumps for the mitigation of the turbine building flood event in the licensing basis or backfit analysis.

**ELECTRICAL SEPARATION CRITERIA**

Selected motor operated valves and selected pressurizer heaters are capable of being powered and controlled from either the normal station electrical systems or the SSF electrical system. Suitable electrical separation is provided in the following manner. Electrical distribution of the SSF is identified in Figure 9-40 and Figure 9-41 is provided by the SSF motor control centers (MCC's). Loads fed from MCC's 1XSF, 2XSF, 3XSF, and XSF are capable of being powered from either an existing plant load center or the SSF load center through key interlocked breakers at the MCC's. These breakers provide separation of the power supplies to the SSF loads.

Loads fed from MCC PXSF are capable of being powered from either Unit 2 B2T or the SSF Diesel or the alternate PSW B7T via switchgear OTS1. Breakers feeding OTS1 are electrically interlocked and provide separation of the power supplies to the SSF loads.

During normal operation, these loads are powered from a normal (non-SSF) load center via the SSF MCC's 1XSF, 2XSF, 3XSF (Group B) or switchgear OTS1 via SSF MCC PXSF (Group C).

During operation of the SSF, these loads are powered from the SSF diesel generator via the SSF load center/switchgear and SSF MCC's.

## 9.6.3 System Descriptions

### 9.6.3.1 Structure

The Standby Shutdown Facility (SSF) is a reinforced concrete structure consisting of a diesel generator room, electrical equipment room, mechanical pump room, control room, central alarm station (CAS), and ventilation equipment room. The general arrangement of major equipment and structures is shown in Figure 9-30, Figure 9-31, Figure 9-32, Figure 9-33 and Figure 9-34.

The SSF has a seismic classification of Category 1. The following load conditions are considered in the analysis and design:

1. Structure Dead Loads
2. Equipment Loads
3. Live Loads
4. Normal Wind Loads
5. Seismic Loads
6. Tornado Wind Loads
7. Tornado Missile Loads
8. High Pressure Pipe Break Loads
9. Turbine Building Flooding Potential

**WIND AND TORNADO LOADS**

The design wind velocity for the SSF is 95 mph, at 30 ft. above the nominal ground elevation. This velocity is the fastest wind with a recurrence interval of 100 years. A gust factor of unity is used for determining wind forces. The design tornado used in calculating tornado loadings is in conformance with Regulatory Guide 1.76, Revision 0, with the following exceptions:

1. Rotational wind speed is 300 mph.
2. Translational speed of tornado is 60 mph.
3. Radius of maximum rotational speed is 240 ft.
4. Tornado induced negative pressure differential is 3 psi, occurring in three seconds.

The spectrum and characteristics of tornado-generated missiles are covered later in this section.

Revision 1 to Regulatory Guide 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," was released in March 2007. Revision 1 to Regulatory Guide 1.76 was incorporated into the SSF licensing basis in the 4th quarter of 2007. The design of all future changes to and/or analysis of SSF-related systems, structures, and components subject to tornado loadings will conform to the tornado wind, differential pressure, and missile criteria specified in Regulatory Guide 1.76, Revision 1.

**FLOOD DESIGN**

Flood studies show that Lake Keowee and Jocassee are designed with adequate margins to contain and control floods. The first is a general flooding of the rivers and reservoirs in the area due to a rainfall in excess of the Probable Maximum Precipitation (PMP). The FSAR addresses Oconee's location as on a ridgeline 100' above maximum known floods. Therefore, external flooding due to rainfall affecting rivers and reservoirs is not a problem. The SSF is within the site boundary and, therefore, is not subject to flooding from lake waters.

The grade level entrance of the SSF is 797.0 feet above mean sea level (msl). In the event of flooding due to a break in the non-seismic condenser circulating water (CCW) system piping located in the Turbine Building, the maximum expected water level within the site boundary is 796.5 ft. Since the maximum expected water level is below the elevation of the grade level entrance to the SSF, the structure will not be flooded by such an incident.

The SSF will stabilize the plant at mode 3 with an average Reactor Coolant temperature ≥ 525°F. As a PRA enhancement the SSF is provided with a five foot external flood wall which is equipped with a water tight door near the south entrance of the SSF. A stairway over the wall provides access to the north entrance. The yard elevation at both the north and the south entrance to the SSF is 796.0 feet above mean sea level (msl). Based on the as-built configuration of the 5' flood wall provided at the north entrance and a flood wall at the south entrance to the SSF, SSF external flood protection is provided for flooding that does not exceed 801 feet above mean sea level.

**MISSILE PROTECTION**

The only postulated missiles generated by natural phenomena are tornado generated missiles. The SSF is designed to resist the effects of tornado generated missiles in combination with other loadings. Table 9-17 lists the postulated tornado generated missiles.

Penetration depths are calculated using the modified NDRC formula and the modified Petry formula.

Modified N.D.R.C Formula:

$$\text{Penetration depth},(x) = \sqrt{4KNWd\left(\frac{v_o}{1{,}000d}\right)^{1.80}} \text{ for } x/d \le 2.0$$

$$= \sqrt{KNWd\left(\frac{v_o}{1{,}000d}\right)^{1.80}} + d \text{ for } x/d > 2.0$$

Where:

N = missile shape factor = 0.72 for flat nosed bodies, 1.14 for sharp nosed bodies

K = concrete penetrability factor = $\frac{180}{\sqrt{f_c}}$

W = Weight in pounds

$v_o$ = striking velocity

D = effective projectile diameter = $\sqrt{4Ac/\pi}$

$A_c$ = projectile contact Area in $in^2$

Modified Petry Formula:

Penetration depth,(x) $= 12K_pA_p \log_{10}(1 + V^2/215{,}000)$

Where:

$K_p$ = a coefficient depending on the nature of the concrete

= 0.00426 for normal reinforced concrete

$A_p$ = weight of missile per unit of impact area

= $W/A_c$

$A_c$ = Impact Area

V = striking velocity of projectile

Table 9-18 lists the calculated penetration depths and the minimum barrier thicknesses to preclude perforation and scabbing, hence eliminating secondary missiles.

Revision 1 to Regulatory Guide 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," was released in March 2007. Revision 1 to Regulatory Guide 1.76 was incorporated into the SSF licensing basis in the 4th quarter of 2007. The design of all future changes to and/or analysis of SSF-related systems, structures, and components subject to tornado loadings will conform to the tornado wind, differential pressure, and missile criteria specified in Regulatory Guide 1.76, Revision 1.

**SEISMIC DESIGN**

The design response spectra correspond to the expected maximum bedrock acceleration of 0.1 g. The design response spectra were developed in accordance with the procedures of Reg. Guide 1.60. The seismic loads as a result of a base excitation are determined by a dynamic analysis. The dynamic analysis is made utilizing the STRUDL-DYNAL computer program. The base of the structure is considered fixed.

With the geometry and properties of the model defined, the model's influence coefficients (the flexibility matrix) are determined. The contributions of flexure as well as shearing deformations are considered. The resulting matrix is inverted to obtain the stiffness matrix, which is used together with the mass matrix to obtain the eigenvalues and associated eigenvectors.

Having obtained the frequencies and mode shapes and employing the appropriate damping factors, the spectral acceleration for each mode can be obtained from Design Ground Motion response spectra curves. The standard response spectrum technique is used to determine inertial forces, shears, moments, and displacements for each mode. The structural response is obtained by combining the modal contributions of all the modes considered. The combined effect is represented by the square root of the sum of the squares.

The analytical technique used to generate the response spectra at specified elevations is the time history method. The acceleration time history of each elevation is retained for the generation of response spectra reflecting the maximum acceleration of a single degree of freedom system for a range of frequencies at the respective elevation. The structure will withstand the specified design conditions without impairment of structural integrity or safety function.

### 9.6.3.2 Reactor Coolant Makeup (RCM) System

The SSF RCM System is designed to supply borated makeup to the Reactor Coolant System (RCS) to provide Reactor Coolant Pump Seal cooling and RCS inventory. An SSF RCM Pump located in the Reactor Building of each unit will supply makeup to the RCS should the normal makeup system and the reactor coolant pumps become inoperative because of a station blackout condition caused by the loss of all other on-site and off-site power. The system is designed to ensure that sufficient borated water is available from the spent fuel pools to allow the SSF to maintain mode 3 with an average Reactor Coolant temperature ≥ 525°F (the initiating event may cause average RCS temperature to drop below 525°F) for all three units for approximately 72 hours. This time period is based on drawing the water level in the spent fuel pool down to a minimum of one foot above the top of the spent fuel racks. The SSF RCM System is operated and/or tested from the Standby Shutdown Facility. The SSF RCM System is shown on Figure 9-35. The SSF RCM Pump is capable of delivering borated water from the Spent Fuel Pool to the RC pump seal injection lines. A portion of this seal injection flow is used to makeup for RC pump seal leakage while the remainder flows into the RCS to makeup for other RCS leakage.

The SSF RCM Pump is a positive displacement pump driven by an induction motor, powered from the SSF Power System. The pump is located in the Reactor Building basement sufficiently below the spent fuel pool water level to assure that adequate net positive suction head is available.

A SSF RCM Filter is supplied downstream of the SSF RCM Pump to collect particulate matter larger than five microns that could be harmful to the seal faces. The filter is sized to accept three times the flow output of the SSF RCM Pump. Fouling of this filter is not considered to be a problem since the filter has been conservatively sized.

SSF controlled pressurizer heaters support achieving and maintaining RCS natural circulation flow by offsetting pressurizer heat loss due to ambient heat loss from the pressurizer and pressurizer steam space leakage. Pressurizer heater Group B, Bank 2 that is normally controlled from the main unit's control room may be controlled from the SSF Control Panel during SSF events. Pressurizer heater Group C, Bank 2 can only be controlled from the SSF Control Panel. Pressurizer level control can be accomplished from proper control of ASW flow to the steam generators, and proper control of the SSF RC letdown line flow. Additional RCS inventory control can be accomplished using the RV head vent. SSF D/G power can be connected to the RV head vent valves. Control of the RV head vent valves will be accomplished using a portable control panel.

During an accident that requires operation of the SSF, the following RCS isolation valves are closed to preserve RCS inventory once control of these valves is transferred to the SSF (Reference Table 9-15):

1,2,3HP-3
1,2,3HP-4
1,2,3HP-20
1,2,3RC-4
1,2,3RC-5
1,2,3RC-6

### 9.6.3.3 Auxiliary Service Water (ASW) System

The SSF ASW System is designed to cool the RCS during a station blackout and in conjunction with the loss of the normal and Emergency Feedwater System by providing steam generator cooling.

The SSF ASW pump is the major component of the system. One motor driven SSF ASW pump, powered from OTS1 Switchgear, serves all three units and is located in the SSF. The suction supply for the SSF ASW pump, the SSF HVAC service water pumps, and the SSF DSW pump is lake water from the embedded Unit 2 condenser circulating water piping. A portable submersible pump that can be installed in the intake canal and powered from the SSF is available to replenish the water supply in the embedded CCW pipe if both forced CCW and siphon flow through the CCW pipe are lost.

The SSF ASW flow rate provided to each unit's steam generators is controlled using the motor operated valves on each unit's SSF ASW supply header. Manually operated bypass valves, installed in parallel with the motor-operated valves, are also available to:

1. Provide SSF ASW Flow control at low SSF ASW Flow rates.
2. Provide more precise SSF ASW Flow control when used in parallel with the motor-operated valves.

The SSF ASW pump is sized to provide enough flow to all 3 Oconee units to adequately remove decay heat from the RCS and maintain natural circulation in the RCS. An SSF ASW pump minimum flow line is provided to ensure that the pump minimum flow requirements are met. The SSF ASW system, pump and valves are operated and tested from the SSF only. The SSF ASW system is shown on Figure 9-36.

Auxiliary service water enters the steam generators via the normal emergency feedwater ring headers.

The SSF ASW System provides the motive force for the SSF ASW suction pipe air ejector. The air ejector is needed to maintain siphon flow to the SSF HVAC service water pump, the SSF DSW pump, and the SSF ASW pump when the water level in the U2 CCW supply pipe becomes too low.

The SSF ASW System provides adequate SG cooling to reduce and maintain RCS pressure below the pressure where the SSF RC makeup pump discharge relief valve, HP-404, begins to pass flow. Therefore, full SSF RC Makeup System seal injection flow will be provided to the RC pump seals in time to prevent seal degradation or failure.

Though not a requirement for operability, the SSF diesel generator should be aligned to carry SSF loads and the SSF ASW pump should be operated to provide a large enough load so that diesel souping concerns are not a problem when the Emergency Start pushbutton is used to start the SSF diesel engines and continued operation of the SSF diesel engines is desired. While continued operation of the SSF diesel engines when they are lightly loaded is possible (i.e. one, two or three SSF RC makeup pumps operating without operating the SSF ASW pump), lightly loading the engines in this manner is not preferred due to the potential for a fire in the diesel exhaust if a large load is added after souping of the engine occurs.

Portions of the SSF ASW system are credited to meet the Extensive Damage Mitigation Strategies commitments per NEI 06-12 (B.5.b) and NEI 12-06 (FLEX). Some of these commitments have been incorporated into the Oconee Nuclear Station operating license Section H - Mitigation Strategy License Condition.

### 9.6.3.4 Electrical Power

#### 9.6.3.4.1 General Description

The Standby Shutdown Facility (SSF) Electrical Power System includes 4160VAC, 600VAC, 208VAC, 120VAC, and 125VDC power. This system supplies power necessary to maintain mode 3 with an average Reactor Coolant temperature ≥ 525°F for the reactors of each unit, in the event of loss of power from all other power systems. It consists of switchgear, load center, motor control centers, panelboards, batteries, battery chargers, inverters, a diesel-electric generator unit, relays, control devices, and interconnecting cable supplying the appropriate loads.

The 120VAC power system in conjunction with the 125VDC instrumentation and control power system supplies continuous control power to all loads that are required for achieving mode 3 with an average Reactor Coolant temperature ≥ 525°F of each reactor.

Following the loss of all normal and emergency power, on-site and off-site, the diesel-electric generating unit will be manually started by initiating its start signal from the SSF Control Panel in the SSF. SSF Systems cannot operate without receiving power from the diesel for SSF scenarios when power from the Unit 2 Main Feeder Bus or the PSW (B7T-4) are not available. The diesel generator and its associated auxiliaries are housed in a Class 1 structure and are protected against seismic events.

The 4160VAC SSF Power System bus will then be connected to its diesel-electric, backup source of power by manually closing the appropriate 4160VAC generator breaker.

Schematics of the SSF electrical system are shown on Figure 9-40 and Figure 9-41.

#### 9.6.3.4.2 Diesel Generator

The SSF Power System is provided with standby power from a dedicated diesel generator. This SSF diesel generator is rated for continuous operation at 3500 kW, 0.8 pf, and 4160 VAC. The SSF electrical design load does not exceed the continuous rating of the diesel generator. The auxiliaries required to assure proper operation of the SSF diesel generator are supplied entirely from the SSF Power System. The SSF diesel generator is provided with manual start capability from the SSF only. It uses a compressed air starting system with four air storage tanks. Each set of two tanks will provide sufficient air to start the diesel unit three successive times. An independent fuel system, complete with a separate underground storage tank, duplex filter arrangement, a fuel oil transfer pump, and one-hour day tank, is supplied for the diesel-electric generating unit.

The diesel generator protection system initiates automatic and immediate protective action to prevent or limit damage to the SSF diesel generator. The following protective trips are provided to protect the diesel generator at all times and are not bypassed when the diesel generator is in the emergency mode:

1. Engine Overspeed
2. Generator Differential Protection
3. Low-low Lube Oil Pressure
4. Generator Overcurrent

### 9.6.3.5 Instrumentation

#### 9.6.3.5.1 SSF Reactor Coolant Makeup System Instrumentation

Each unit is provided with instrumentation to monitor RCM System flow, pressure and temperature; RC Loop A and B pressure and temperature; pressurizer level and pressure; and reactor incore temperature. Five (5) Incore Thermocouples per unit may be used to monitor the incore temperature. Six (6) RTD's per unit will be used to monitor Loop A and B RC System Hot & Cold Leg temperature. Readout is displayed on the SSF control panel. Table 9-16 provides a listing of instrumentation.

#### 9.6.3.5.2 SSF Auxiliary Service Water Instrumentation

Each unit is provided with Steam Generator A & B level instrumentation labeled as listed in Table 9-16. Readout is displayed on the SSF control panel. Each unit's SSF ASW piping is also provided with instruments to monitor SSF ASW System flow and pressure. Each unit's flow is displayed on the SSF control panel. The SSF ASW pump recirculation piping is provided with instrumentation to monitor SSF ASW System recirculation flow and pressure. The recirculation flow is displayed on the SSF control panel.

### 9.6.3.6 Support Systems

The Standby Shutdown Facility (SSF) Support Systems are designed to provide for the SSF:

1. Lighting
2. Fire Protection
3. Fire Detection
4. Service Water
5. Heating Ventilation and Air Conditioning (HVAC)
6. Sump Drainage
7. Potable Water

The diesel engine service water and the HVAC service water piping are designed in accordance with ASME Section III, Class 3, which includes seismic design. The fire protection water, carbon dioxide, potable water, and sewage piping systems are seismically restrained in areas above seismically designed equipment. Portions of the SSF Sump System are seismically restrained to prevent flooding of the SSF Pump Room. The lighting system and the fire detection system are not seismically designed. The water and carbon dioxide fire protection systems and the fire detection system are designed and constructed to meet or exceed National Fire Codes.

#### 9.6.3.6.1 SSF Lighting System Description

Normal lighting for the SSF is provided by fluorescent and HID lighting units. These lighting units are located to provide adequate levels of light with good distribution throughout the structure.

Emergency AC lighting for the SSF is provided. These units are located to provide adequate levels of lighting in all areas of the structure.

Emergency DC lighting for the SSF is provided by self-contained 12VDC battery pack lighting units. These units are located to provide adequate levels of lighting for control panel operation and for entering and leaving the structure. These battery pack lights are energized automatically upon an undervoltage in the normal lighting system power supply.

#### 9.6.3.6.2 SSF Fire Protection and Detection

The SSF contains two fire protection systems, a water system and a carbon dioxide system.

The water system is provided with manually valved hose reels in the stairwell at each floor elevation and inside the entrance to the diesel room. From these locations the hose lengths are such that the entire SSF can be served by the primary fire protection system.

The low pressure carbon dioxide system provided is actuated by thermal detectors to automatically flood the diesel area. Carbon dioxide is stored in a refrigerated storage tank in sufficient quantity to provide twice the required coverage for the area.

Portable carbon dioxide extinguishers are also provided.

Detection devices are located throughout the SSF and will annunciate with a single alarm to the Unit Control Rooms, SSF Control Room and Security. Specific alarms annunciate on the Fire Alarm Control Unit located in the SSF vestibule.

#### 9.6.3.6.3 SSF Service Water

The SSF Service Water System consists of two subsystems: The HVAC Service Water System and the Diesel Engine Service Water System.

The HVAC Service Water System, which operates continuously, contains two pumps and supplies cooling water to the HVAC condensers. Only one pump will operate at any given time with the other idle pump acting as a backup.

The Diesel Engine Service Water System, which normally operates only when the diesel is operating or when system components are being tested, contains one pump and provides service water to the diesel engine jacket water heat exchangers.

This flow is monitored during periodic operational test or emergency operation. All three pumps take their suction from the embedded CCW piping and return the flow to the CCW piping after passing through their respective system. SSF Diesel Engine Service Water is diverted to the yard drain during an SSF event to avoid overheating the water contained in the SSF ASW supply piping.

The SSF Diesel Engine Service Water System is shown on Figure 9-37.

#### 9.6.3.6.4 Heating Ventilation and Air Conditioning

The SSF HVAC system consists of two subsystems, a ventilation system and an air conditioning system. Both systems are powered by the SSF Power System. Sections of each system are shut down in event of fire in the area served. The SSF HVAC System supports operation of systems and equipment located in the SSF by maintaining temperature in the SSF within design limits.

**VENTILATION SYSTEM**

The diesel generator room, switchgear room, pump room, and HVAC room do not require close control of temperature, and the relatively high heat loads are dissipated with a variable volume ventilation system. The purpose of the ventilation system is to provide filtered outside air which is tempered if necessary to maintain a minimum temperature of 60°F and a maximum temperature as follows:

1. HVAC Room 120°F
2. Switchgear Room 120°F
3. Pump Room 120°F
4. Diesel Generator Room 125°F

**AIR CONDITIONING SYSTEM**

Certain rooms in the SSF require close control of temperature and have year-round heat loads of such magnitude to necessitate mechanical refrigeration. Normal operating conditions for these rooms are 72°F and 50 percent RH with a minimum of outside air for ventilation. During an SSF event, air conditioned rooms are maintained within the following design temperature limits:

1. SSF Control Room 100°F
2. SSF Battery Rooms 113°F
3. Computer Room (no limit for SSF power system operability)

The air conditioning system supplies each area with a constant volume of air. A heating coil located in each area with a local control tempers the air as required to maintain the desired temperature.

#### 9.6.3.6.5 SSF Sump System

The SSF Sump System provides a collection and discharge function for normal equipment drainage within the SSF. The main components of the system are the sump and two sump pumps which handle the flow routed to the sump via the floor drain system located throughout the SSF.

## 9.6.4 System Evaluations

### 9.6.4.1 General

The design of the SSF was reviewed to meet the requirements of Appendix R of 10CFR 50, Sections III.G.3 and III.L, and those requirements applicable for flooding and seismic events. Since the transition to NFPA 805, some original SSF design criteria for fire events only no longer align with Appendix R.

The SSF, the associated mechanical and electrical systems and power supplies meet or exceed the applicable criteria contained in the Oconee FSAR Chapter 3. Additionally, ASME and IEEE codes are utilized as appropriate, in the design of various subsystems and components. The SSF and systems/components needed for safe shutdown are designed to withstand the Safe Shutdown Earthquake

(SSE). The SSF systems required for safe shutdown are designed with adequate capacity to achieve and maintain mode 3 conditions with an average Reactor Coolant temperature ≥ 525°F (the initiating event may cause average RCS temperature to drop below 525°F) of all three Oconee units.

The SSF power system is designed with adequate capacity and capability to supply the necessary loads, and is physically and electrically independent from the station electrical distribution system power supply. Additionally, the AC and DC power systems and equipment required for the SSF essential functions have been designed and installed consistent with the Oconee QA program for Class 1E equipment.

These systems are not designed to meet the single failure criterion, but are designed such that failures in the systems do not cause failures or inadvertent operations of existing plant systems. The electrical systems in the SSF are manually initiated, that is, multiple actions must be performed to provide flow to existing plant safety systems.

### 9.6.4.2 Structure Design

The SSF is statically and dynamically analyzed and designed as a three-dimensional space frame subjected to the applicable loads summarized in Section 9.6.3.1. The Structural Design Language (STRUDL) computer program is used to perform the analyses. The design is in accordance with the codes and criteria listed in Table 9-19. Design loads and loading combinations are in accordance with the NRC Standard Review Plan, Section 3.8.4.

The SSF is designed to withstand the effects of wind and tornado loadings, without loss of capability of the systems to perform their safety functions. The basis for the selected wind velocity is reference 1 of Section 3.3. Buildings and structures with a height to minimum horizontal dimension ratio exceeding five should be dynamically analyzed to determine the effect of gust factors (ref. American National Standard, "Building Code Requirements for Minimum Design Loads in Buildings and Other Structures," ANSI A58.1-1972, New York, New York). The SSF has a height/width ratio of less than five, and therefore, the gust factor of unity is used for determining wind forces. The design tornado used in calculating tornado loadings is in conformance with Regulatory Guide 1.76 except as noted in Section 9.6.3.1.

The relatively small surface area of the structure and its location result in an extremely low probability that a turbine missile would strike the facility. Turbine missile impact is not considered a viable load condition due to the location of the SSF with respect to the turbine. All postulated missiles are per the NRC Standard Review Plan Section 3.5.1.4 Rev. 1 and Regulatory Guide 1.76, Revision 0. The barrier thicknesses for the structure are such that they preclude any perforation and/or scabbing from the postulated tornado generated missiles. Minimum barrier thickness is three times the postulated missiles calculated depths of penetrations (see Table 9-18).

See Section 9.6.3.1 for information regarding Regulatory Guide 1.76, Revision 1, and future changes to and/or analysis of SSF-related systems, structures, and components subject to tornado loadings.

The dynamic analysis is made utilizing the STRUDL-DYNAL computer program. The design response spectra were developed in accordance with the procedures of Regulatory Guide 1.60. It corresponds to the expected maximum bedrock acceleration of 0.1g. Damping values are per Regulatory Guide 1.61.

The structure will withstand the specified design conditions without impairment of structural integrity or safety function.

### 9.6.4.3 Seismic Subsystem Analysis

The seismic analysis of Category I pipe is performed using dynamic modal analysis techniques. No static seismic analysis is used for SSF ASME Code piping. Modal response spectrum methods are used. Response of individual modes is combined by the Grouping Method of Regulatory Guide 1.92. An adequate number of masses or degrees of freedom are included in the model to determine the response of

To verify SSF performance criteria, thermal-hydraulic (T/H) analysis was performed to demonstrate that the SSF can achieve and maintain safe shutdown following postulated turbine building floods. The analysis evaluates RCS subcooling margin using inputs that are representative of nominal full power end of cycle plant conditions. The analysis uses an initial core thermal power of 2619 MWth (102% of 2568 MWth) and accounts for 24 month fuel cycles. The consequences of the postulated loss of main and emergency feedwater were analyzed as a RCS overheating scenario. For the examined overheating scenario, an important core input is decay heat. High decay heat conditions were modeled that were reflective of maximum, end of cycle conditions. The high decay heat assumption was confirmed to be bounding with respect to the RCS subcooling response. The results of the analysis demonstrate that the SSF is capable of meeting

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**TURBI...**

The Turbine Building Flood was one of the events that was identified in the original SSF licensing requirements. The SSF is designed to maintain the reactor in a safe shutdown condition for a period of 72 hours following a TB Flood. No other concurrent event is assumed to occur. The success criteria for this event ~~is~~ to assure natural circulation and core cooling by maintaining the primary coolant system filled to a sufficient level in the pressurizer while maintaining sufficient secondary side cooling. The reactor shall be maintained at least 1% $\Delta k/k$ with the most reactive rod fully withdrawn. (Reference 1, 10)

**SECURITY-RELATED EVENT**

A Security Related Event was one of the events that was identified in the original SSF licensing requir... No other c... ure the co... ural circula...

During periods of very low decay heat the SSF will be used to establish conditions that support the formation of subcooled natural circulation between the core and the SGs; however, natural circulation involving the SGs may not occur if the amount of decay heat available is less than or equal to the amount of heat removed by ambient losses to containment and/or by other means, e.g., letdown of SSF reactor coolant makeup. When these heat removal mechanisms are sufficient to remove core decay heat, they are considered adequate to meet the core cooling function and systems supporting SG decay heat removal, although available, are not necessary for core cooling.

Regarding operation in MODES 1, 2, and 3 at other than nominal full power, T-H analyses were also performed to demonstrate that the SSF could achieve and maintain safe shutdown following postulated turbine building floods. A nominal full power condition is defined as a unit at 100% power for approximately 4 days of operation which provides the decay heat required to meet the nominal SSF success criteria. The results of the analyses demonstrate that for this range of initial conditions the SSF is capable of meeting the specified success criteria: 1) to maintain the reactor at least 1% $\Delta k/k$ shutdown with the most reactive rod fully withdrawn, and 2) maintain a minimum water level above the reactor core and conditions that support the formation of subcooled natural circulation between the core and SGs such that there is no water relief through the pressurizer safety valves. In some cases that initiated with low decay heat, pressurizer level was not maintained on scale, however:

- a minimum water level above the reactor core was maintained and conditions that support the formation of subcooled natural circulation between the core and the SGs were maintained.
- In cases where the pressurizer did go water solid, there was no liquid relief through the pressurizer safety valves.

**STAT...**

This e... was credite... The succes... tial conditi...

**SSF T...**

This i... ing corres... red to be ... ied through appropriate design of the SSF structure. This requirement does not extend to SSCs that were already part of the plant which SSF relies upon and interfaces with for event mitigation. It is important to note that the SSF was not licensed to mitigate a tornado event or a tornado missile event (Reference 1). Tornado design requirements for the plant in general are addressed in Section 3.2.2. A subsequent issue related to crediting SSF ASW as an alternative for EFW tornado missile protection vulnerabilities is discussed below (see EFW Tornado Missile Design Criteria).



**EFW SEISMIC DESIGN CRITERIA (GL 81-14)**

During the seismic qualification review of the Oconee EFW system in the 1980s, the NRC postulated that a seismic event could break a pipe and potentially cause a flood of the turbine building thereby submerging and failing the EFW pumps. The NRC wanted to ensure that the EFW System was seismically designed and could withstand a single failure, as well. As an alternative to upgrading the EFW System, NRC credited the use of the SSF ASW System and HPI Feed & Bleed (Reference 34). These two decay heat removal systems are seismically designed and independent from each other. The event postulated by GL 81-14 (a seismic break) was a special condition imposed on ONS to evaluate the EFW design. It was not intended to re-define the SSF mitigated TB Flood (which does not concurrently consider a seismic event, nor does it impose a single failure). Although both "events" are TB Floods, they are two separate licensing actions with different scopes, different acceptance criteria, and different purposes. The GL 81-14 flood does not have specified initial conditions, other mitigation assumptions, or success criteria to be considered because it is not an event, only an EFW design criterion (Reference 34).

**EFW TORNADO MISSILE DESIGN CRITERIA**

A SSF RCM Filter is supplied downstream of the SSF RCM Pump to collect particulate matter larger than five microns that could be harmful to the seal faces. The filter is sized to accept three times the flow output of the SSF RCM Pump. Fouling of this filter is not considered to be a problem since the filter has been conservatively sized.

SSF controlled pressurizer heaters support achieving and maintaining RCS natural circulation flow by offsetting pressurizer heat loss due to ambient heat loss from the pressurizer and pressurizer steam space leakage. Pressurizer heater Group B, Bank 2 that is normally controlled from the main unit's control room may be controlled from the SSF Control Panel during SSF events. Pressurizer heater Group C, Bank 2 can only be controlled from the SSF Control Panel. Pressurizer level control can be accomplished from proper control of ASW flow to the steam generators, and proper control of the SSF RC letdown line flow. Additional RCS inventory control can be accomplished using the RV head vent. SSF D/G power can be connected to the RV head vent valves. Control of the RV head vent valves will be accomplished using a portable control panel.

During an accident that requires operation of the SSF, the following RCS isolation valves are closed to preserve RCS inventory once control of these valves is transferred to the SSF (Reference Table 9-15):

1,2,3HP-3
1,2,3HP-4
1,2,3HP-20
1,2,3RC-4
1,2,3RC-5
1,2,3RC-6

Main Steam pressure is controlled automatically by the main steam relief valves or manually by the atmospheric dump valves (ADVs). When the ADVs are operated in this manner, communication with the SSF Control Room is in place to coordinate main steam pressure control with RCS pressure/temperature parameters. Local main steam pressure indication is also available.

### 9.6.3.3 Auxiliary Service Water (ASW) System



The SSF ASW System is designed to cool the RCS during a station blackout and in conjunction with the loss of the normal and Emergency Feedwater System by providing steam generator cooling.

The SSF ASW pump is the major component of the system. One motor driven SSF ASW pump, powered from OTS1 Switchgear, serves all three units and is located in the SSF. The suction supply for the SSF ASW pump, the SSF HVAC service water pumps, and the SSF DSW pump is lake water from the embedded Unit 2 condenser circulating water piping. A portable submersible pump that can be installed in the intake canal and powered from the SSF is available to replenish the water supply in the embedded CCW pipe if both forced CCW and siphon flow through the CCW pipe are lost.

The SSF ASW flow rate provided to each unit's steam generators is controlled using the motor operated valves on each unit's SSF ASW supply header. Manually operated bypass valves, installed in parallel with the motor-operated valves, are also available to:

1. Provide SSF ASW Flow control at low SSF ASW Flow rates.
2. Provide more precise SSF ASW Flow control when used in parallel with the motor-operated valves.

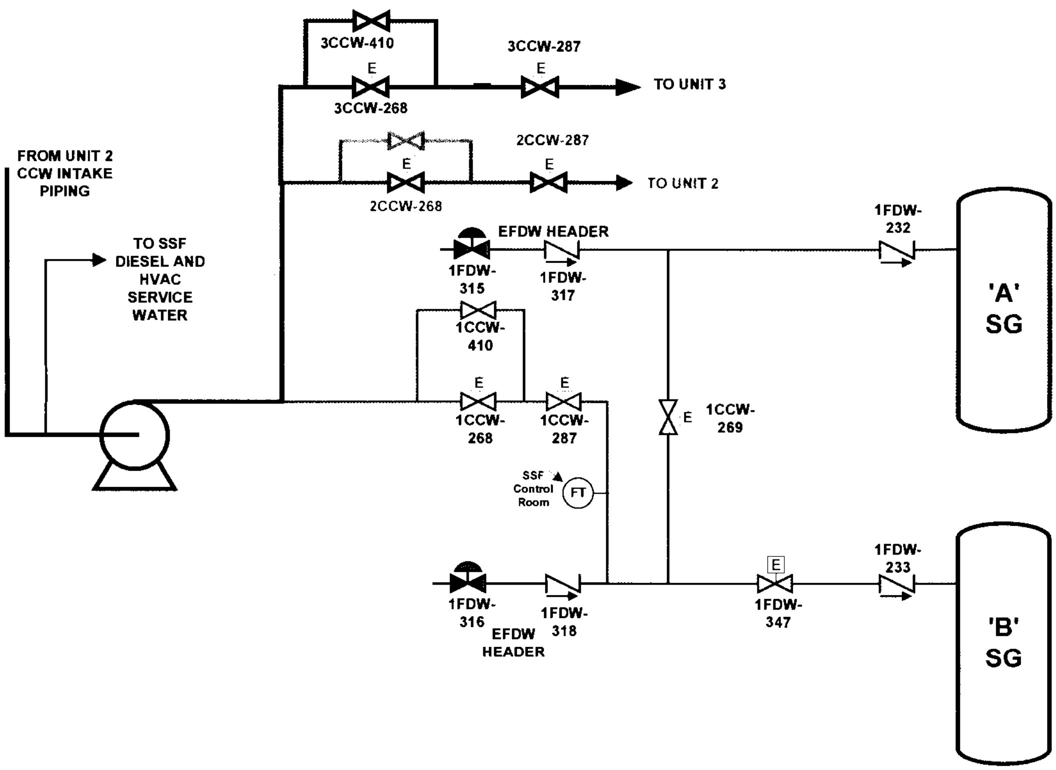
The SSF ASW pump is sized to provide enough flow to all 3 Oconee units to adequately remove decay heat from the RCS and maintain natural circulation in the RCS. An SSF ASW pump minimum flow line is provided to ensure that the pump minimum flow requirements are met. The SSF ASW system, pump and valves are operated and tested from the SSF only. The SSF ASW system is shown on Figure 9-36.

Auxiliary service water enters the steam generators via the normal emergency feedwater ring headers.

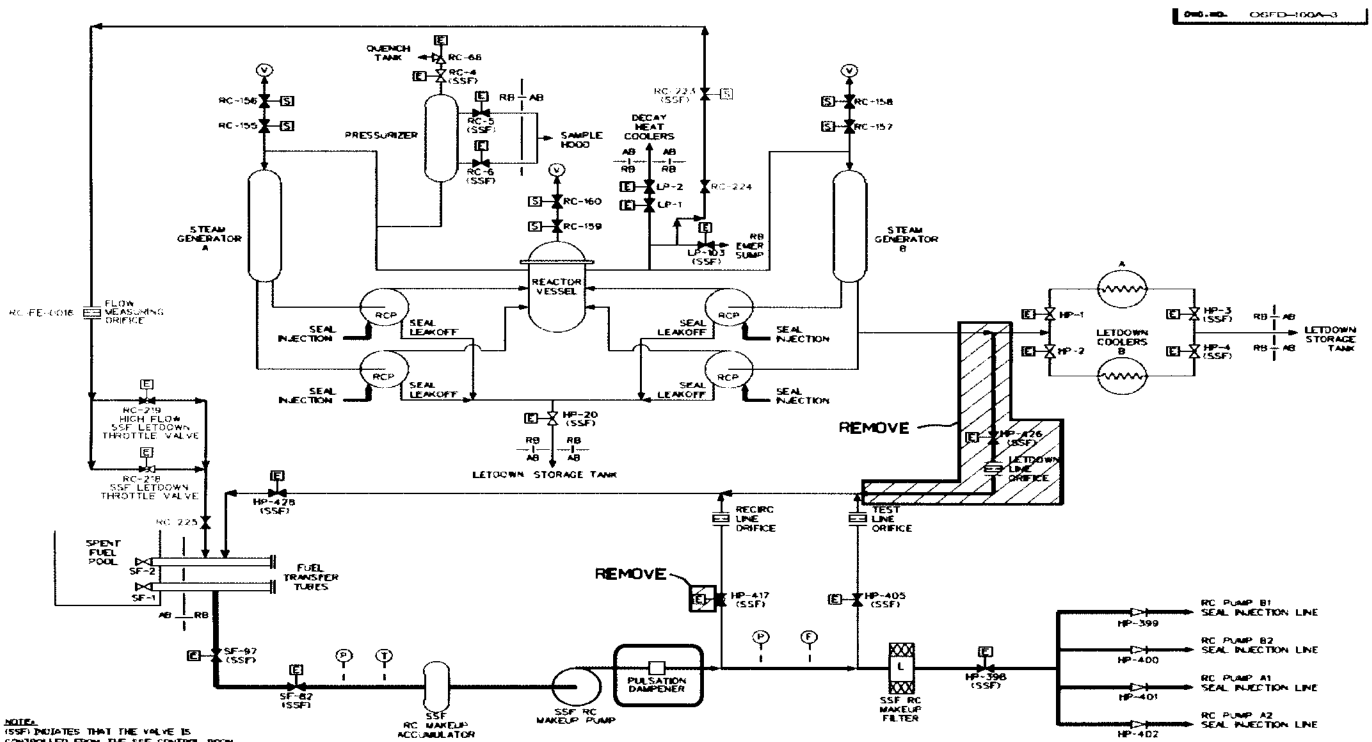
The SSF ASW System provides the motive force for the SSF ASW suction pipe air ejector. The air ejector is needed to maintain siphon flow to the SSF HVAC service water pump, the SSF DSW pump, and the SSF ASW pump when the water level in the U2 CCW supply pipe becomes too low.

**SSF Auxiliary Service Water System**

**(For Information Only)**



## SSF Reactor Coolant Makeup System
## (For Information Only)




NOTE:
(SSF) INDICATES THAT THE VALVE IS CONTROLLED FROM THE SSF CONTROL ROOM

SUBJECT: SUMMARY OF JUNE 27, 2017, MEETING WITH DUKE ENERGY CAROLINAS, LLC TO DISCUSS PROPOSED LICENSE AMENDMENT REQUEST FOR OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3 REGARDING THERMAL MARGIN FOR THE STANDBY SHUTDOWN FACILITY (CAC NOS. MF9754, MF9755, AND MF9756) DATED JULY 18, 2017

**DISTRIBUTION:**
PUBLIC
LPL2-1 R/F
RidsACRS_MailCTR Resource
RidsNrrDorlLpl2-1 Resource
RidsNrrDorlDpr Resource
RidsRgn2MailCenter Resource
RidsNrrPMOconee Resource
RidsNrrLAKGoldstein Resource
RidsNrrDssStsb Resource
RidsNrrDssSrxb Resource
RidsNrrDssSnpb Resource
RidsNrrDssSbpb Resource
M. Hamm, NRR/DSS
R. Anzalone, NRR/DSS
J. Bettle, NRR/DSS
R. Beaton, NRR/DSS

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| NAME | AKlett | KGoldstein (PBlechman for) | EOesterle | RLukes |
| DATE | 7/17/17 | 7/17/17 | 6/29/17 | 6/29/17 |
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| NAME | RDennig | JWhitman | MMarkley | AKlett |
| DATE | 6/29/17 | 6/29/17 | 7/18/17 | 7/18/17 |

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