St. Lucie Unit 1
Docket No. 50-335
Proposed License Amendment
Emergency Bus Undervoltage
Relay Setpoint Changes

ATTACHMENT 1

St. Lucie Unit 1 Marked-up Technical Specification Pages

3/4 3-11, 3/4 3-15, 3/4 3-19

TABLE 3.3-3 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION

FUNCTIONAL UNIT	TOTAL NO. OF CHANNELS	CHANNELS TO TRIP	MINIMUM CHANNELS OPERABLE	APPLICABLE MODES	ACTION
5. CONTAINMENT SUMP RECIRCULATION (RAS)					
a. Manual RAS (Trip Buttons)	2	1	2	1, 2, 3, 4	8
b. Refueling Water Tank - Low	4	2	3	1, 2, 3	9#
6. LOSS OF POWER					
a. 4.16 kv Emergency Bus Under-voltage (Loss of Voltage)	2/Bus	2/Bus	1/Bus	1, 2, 3	12
b. 4.16 kv Emergency Bus Under-voltage (Degraded Voltage)	2/Bus	2/Bus	1/Bus	1, 2, 3	12
~~(1) Undervoltage Device #1~~	~~2/Bus~~	~~2/Bus~~	~~1/Bus~~	~~1, 2, 3~~	~~12~~
~~(2) Undervoltage Device #2~~	~~2/Bus~~	~~2/Bus~~	~~1/Bus~~	~~1, 2, 3~~	~~12~~
c. 480 V Emergency Bus Under-voltage (Degraded Voltage)	2/Bus	2/Bus	1/Bus	1, 2, 3	12
7. AUXILIARY FEEDWATER (AFAS)					
a. Manual (Trip Buttons)	4/SG	2/SG	4/SG	1, 2, 3	11
b. Automatic Actuation Logic	4/SG	2/SG	3/SG	1, 2, 3	8
c. SG Level (1A/1B) - Low	4/SG	2/SG	3/SG	1, 2, 3	13#, 14
8. AUXILIARY FEEDWATER ISOLATION					
a. SG 1A - SG 1B Differential Pressure	4/SG	2/SG	3/SG	1, 2, 3	13#, 14
b. Feedwater Header SG 1A - SG 1B Differential Pressure	4/SG	2/SG	3/SG	1, 2, 3	13#, 14

insert

delete

TABLE 3.3-4 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION TRIP VALUES

FUNCTIONAL UNIT	TRIP VALUE	ALLOWABLE VALUES
6. LOSS OF POWER		
a. ~~(1)~~ 4.16 kv Emergency Bus Undervoltage (Loss of Voltage)	≥ 2900 ~~± 29~~ volts with a 1 ± .5 second time delay	≥ 2900 ~~± 29~~ volts with a 1 ± .5 second time delay
b. 4.16 kv Emergency Bus Undervoltage (Degraded Voltage)	≥ 3831 volts with a 18 ± 2 second time delay	≥ 3831 volts with a 18 ± 2 second time delay.
~~(1) Undervoltage Device #1~~	~~3675 ± 36 volts with a 7 ± 1 minute time delay~~	~~3675 ± 36 volts with a 7 ± 1 minute time delay~~
~~(2) Undervoltage Device #2~~	~~3592 ± 36 volts with a 18 ± 2 second time delay~~	~~3592 ± 36 volts with a 18 ± 2 second time delay~~
c. 480 volts Emergency Bus Undervoltage (Degraded Voltage)	≥ 415 ~~429 ± 5 0~~ volts with a ≤ 9 ~~7 ± 1~~ second time delay	≥ 415 ~~429 ± 5 0~~ volts with a ≤ 9 ~~7 ± 1~~ second time delay
7. AUXILIARY FEEDWATER (AFAS)		
a. Manual (Trip Buttons)	Not Applicable	Not Applicable
b. Automatic Actuation Logic	Not Applicable	Not Applicable
c. SG 1A & 1B Level Low	≥19.0%	≥18.0%
8. AUXILIARY FEEDWATER ISOLATION		
a. Steam Generator ΔP-High	≤275 psid	89.2 to 281 psid
b. Feedwater Header High ΔP	≤150.0 psid	56.0 to 157.5 psid

TABLE 4.3-2 (Continued)

ENGINEERED SAFETY FEATURE ACTUATION SYSTEM INSTRUMENTATION SURVEILLANCE REQUIREMENTS

FUNCTIONAL UNIT	CHANNEL CHECK	CHANNEL CALIBRATION	FUNCTIONAL TEST	MODES IN WHICH SURVEILLANCE REQUIRED
6. LOSS OF POWER				
a. 4.16 kv Emergency Bus Undervoltage (Loss of Voltage)	S	R	M	1, 2, 3
b. 4.16 kv Emergency Bus Undervoltage (Degraded Voltage)	S	R	M	1, 2, 3
~~(1) Undervoltage Device #1~~	~~S~~	~~R~~	~~M~~	~~1, 2, 3~~
~~(2) Undervoltage Device #2~~	~~S~~	~~R~~	~~M~~	~~1, 2, 3~~
c. 480 V Emergency Bus Undervoltage (Degraded Voltage)	S	R	M	1, 2, 3
7. AUXILIARY FEEDWATER (AFAS)				
a. Manual (Trip Buttons)	N.A.	N.A.	R	1, 2, 3
b. SG Level (A/B) - Low	S	R	M	1, 2, 3
c. Automatic Actuation Logic	N.A.	N.A.	M	1, 2, 3
8. AUXILIARY FEEDWATER ISOLATION				
a. SG Level (A/B) - Low and SG Differential Pressure (BtoA/AtoB) - High	N.A.	R	M	1, 2, 3
b. SG Level (A/B) - Low and Feedwater Header Differential Pressure (BtoA/AtoB) - High	N.A.	R	M	1, 2, 3

insert

delete

ST. LUCIE - UNIT 1

3/4 3-19

Amendment No. 37, 68, 72, 102

St. Lucie Unit 1
Docket No. 50-335
Proposed License Amendment
Emergency Bus Undervoltage
Relay Setpoint Changes

ATTACHMENT 2

SAFETY ANALYSIS

Introduction

The proposed amendment to St. Lucie Unit 1 Technical Specifications (TS) will permit changes to the emergency bus undervoltage protection scheme relay settings at the 480 volt and 4160 volt system levels. These protection relays are installed to initiate separation of the emergency buses from the offsite power system and prevent damage to Class 1E equipment loads during sustained low voltage grid conditions. The relaying scheme provides detection of loss of offsite power and a second level of undervoltage protection (degraded voltage) at predetermined voltage vs. time setpoints.

The existing relay settings are expected to be difficult to maintain in the field due to very narrow tolerances produced from application of the latest setpoint calculation methodology. Consequently, Florida Power and Light Company (FPL) conducted recent analyses of St. Lucie Unit 1 system response to degraded grid voltage conditions. It was concluded from these analyses that changes to TS Tables 3.3-3, 3.3-4, and 4.3-2 as shown in Attachment 1 to this application would: (a) enhance undervoltage protection for the class 1E system equipment and (b) provide for field specification of conservative calibration tolerances that would not be difficult to maintain.

The proposed Trip and Allowable Values are provided in a "greater than/equal" or "lesser than/equal" format to specify only the limiting values for the undervoltage/degraded voltage protective function. This type of value specification duplicates the format presently used in corresponding Technical Specifications for St. Lucie Unit 2.

Discussion

The present St. Lucie Unit 1 undervoltage protection design, setpoints, and methodology were approved by the NRC and were developed between FPL and the NRC in a series of questions, responses, and commitments dating from 1976 through 1983. The

protection scheme for the safety related electrical distribution system consists of dedicated relays at the 4.16 kv and 480 volt system levels. Trip and Allowable Values are specified in TS Table 3.3-4. The design relay setpoints and tolerances employed in the field are calculated and included in controlled engineering drawings.

At the 4.16 kv level, each Class 1E bus has three sets of two (2) relays each of solid state undervoltage definite time relays in conjunction with solid state timers. One set provides a "loss of voltage" function (trip at 2900 ± 29 volts, 1 ± 0.5 seconds) and the other two sets (Undervoltage Device #1 and Undervoltage Device #2) serve as "degraded voltage" sensors (trip at 3675 ± 36 volts, 7 ± 1 minutes; and 3592 ± 36 volts, 18 ± 2 seconds, respectively). Each of the sets provides, upon reaching the voltage and time setpoints, a coincident logic trip signal which separates the Class 1E system from off-site power, strips the busses, and starts/enables connection of the diesel-generator sets. This design provides undervoltage/degraded voltage protection for the 4160 and 480 volt systems equipment under non-accident conditions.

At the 480 volt level, each Class 1E bus has one set of two (2) solid state undervoltage relays with internal adjustable timers providing "degraded voltage" protection for the 4160 and 480 volt systems equipment during accident conditions. Upon reaching the voltage and time setpoints (429 +5, -0 volts; 7 ± 1 seconds) coincident with a safety injection actuation signal (SIAS), bus separation occurs as previously described.

During recent completion of the protective relay setpoint drawings (controlled engineering drawings), a new relay setpoint methodology was applied to the development of specified field settings. Based upon this methodology, very narrow calibration tolerance ranges were calculated. To determine if relief could be provided in the calculated field tolerance ranges, FPL reanalyzed the response of St. Lucie Unit 1 electrical systems during sustained, degraded grid voltage conditions. These analyses utilized a conservative analytical approach and demonstrated that the relay setpoint ranges and the protective relaying scheme could be revised while maintaining an acceptable level of protection.

The reanalyses indicate that the distinct trip points for 4.16 kv Undervoltage Device #1 and Undervoltage Device #2 described in the St. Lucie Unit 1 Updated Final Safety Analysis Report (UFSAR) as being required for equipment protection are no longer required. Rather, a single setpoint is sufficient to assure that acceptable voltages are available to class 1E equipment during non-accident conditions of degraded grid voltage. Therefore, the relays identified as Undervoltage Device #1 will be modified to provide an alarm function only in the main control room (a warning not

presently available with the existing design). The relay sets identified as Undervoltage Device #2 will be set to trip at not less than 3831 volts with no change to the existing time delay range of 18 ± 2 seconds. The third set of relays at the 4.16 kv level provides the loss of voltage trip function and will trip at not less than 2900 volts with no change to the existing time delay of 1 ± 0.5 seconds.

For accident conditions, the degraded voltage sensors at the 480 volt level would be set to trip at not less than 415 volts after a time delay of not more than 9 seconds and coincident with a SIAS.

Safety Assessment

The proposed change to the emergency bus undervoltage protection relaying scheme establishes new setpoint ranges to provide adequate class 1E electrical system equipment protection during both non-accident and accident conditions. To arrive at the new relay setpoints, the latest known equipment operating characteristics were employed to establish plant systems response with a "lowest expected" offsite grid voltage of 230 kv. This value was assumed in order to be consistent with the analyses for the existing design although experience has shown that system improvements over the past 10 years have resulted in a normal range of transmission system voltages above 236 kv. The review of voltages considered steady-state operation, transients (starting and run-through), and operability of the controls and non-motor loads. Minimum voltage levels at which prolonged operation of the equipment could lead to possible damage were established. System and equipment voltages were analyzed for both steady-state and transient conditions to determine the required relay setpoints.

Ebasco Services Incorporated Computer Program AUXSYS4078-12/31/1989 was used in a conservative "constant kva" approach to station auxiliary system computer modeling. Analysis of the "Arkansas Scenario" (NRC Information Notice 79-04), which postulates starting all SIAS initiated loads with the auxiliary system under full-power operation, was performed in two stages: (1) the first stage assumed simultaneous start of all SIAS loads. The results were used to evaluate the adequacy of system voltages for starting large 4000 volt and 460 volt motors and to verify that voltages at the 480 volt motor control centers (MCC) did not reach contactor dropout levels. The time period of the first stage was considered to be approximately 5 seconds (based on manufacturer's acceleration time data for the large motors); (2) the second stage examined the start of smaller 460 volt motors after system voltages had stabilized following start of the large motors.

Based on these analyses, the limiting values for undervoltage protection will be specified as TS Limiting Conditions for Operation (LCO). In conjunction with the LCO, an administrative upper range value is established by the analyses and assures that premature/spurious trips do not occur during anticipated operating transients. Nominal setpoints and tolerances that consider Test Instrument, Relay, and Potential Transformer errors are calculated for the relay settings in the field and will be specified in controlled engineering drawings. These settings are bounded by the TS LCO and the administrative upper range value. The appropriate relay ranges are defined as follows:

1. The "loss of voltage" relays are set at approximately 70% of the rated bus voltage of 4.16 kv per the existing design. The administrative upper range value is based on the 4.16 kv bus voltage drop that results from starting the largest motor (4000 HP condensate pump during full load conditions at 230 kv transmission system voltage) and assures that relay actuation would not occur for expected transients.

2. The lower limit of the operating range for 4.16 kv "degraded voltage" relaying is conservatively defined as a voltage level at or above which operation of all the station auxiliary equipment under non-accident conditions is assured. This level is defined as 3831 volts (equivalent to 415 volts at the 480 volt Load Center bus under normal operating load conditions and minimum expected transmission system voltage of 230 kv). The time delay range allows start of the largest 4000 volt motor (4000 HP condensate pump) on the fully loaded auxiliary system (a very conservative and operationally unlikely scenario) without causing a spurious trip. These settings assure that the Class 1E equipment will not be subject to sustained injurious voltages.

The administrative upper range value is based on minimum system voltages that would exist for normal load operating conditions at a transmission system voltage of approximately 225 kv (well below expected normal operating grid values of more than 236 kv).

3. The lower limit of the operating range for the 480 volt system relays assures adequate starting voltage and continued safe operation of all the equipment under accident conditions (415 volts at the 480 volt Load Center which corresponds to 3850 volts on the 4.16 kv bus coincident with SIAS). The time delay range (7-9 seconds) is sufficiently long to allow bus voltage recovery following start of all required safety injection equipment (minimum transient voltage is achieved within approximately 5 seconds) and does not exceed the time delay assumed in UFSAR accident analyses for connecting the emergency bus to the diesel generators.

The administrative upper range value is dictated by the voltage recovery (at the 480 volt level) that occurs within 1 minute after receiving the SIAS. This is a period of increased loading due to all emergency loads, including valves, operating. After 1 minute, all the valves will have completed their design functions and the voltage recovers to a higher steady state value. Therefore, the administrative upper range value is defined as that value which assures relay pickup (reset) at the voltage level available within the 5-60 second time period after SIAS and not cause an unwanted emergency bus separation from offsite power.

4. The present "Undervoltage Device #1" relays will be modified to alarm undervoltage conditions in the main control room. The setpoint will accomodate the lowest expected voltage at the 4.16 kv bus for normal operation at 230 kv grid voltage and a time delay will prevent relay actuation prior to bus voltage recovery from the longest expected equipment starting transients. Thus, operators will be provided an early warning of sustained grid voltage disturbances.

FPL also evaluated the proposed change with respect to overload protection of systems and motors. It was determined that the setpoint changes will not result in inadvertent actuation of overload protective devices for the individual loads or for the system connections. With the new settings, all the 480 volt system motors will be operating with terminal voltages not less than 400 volts (not more than 115% of rated current) and since the St. Lucie methodology of matching drives with mechanical loads assures that the motors generally do not operate within their service factor, only the current increase due to lower voltage needs to be considered. Further, since choice of the overload protection devices is based on selection of the overload devices with rated currents not less than motor full load currents, the chosen overload heaters will not trip until approximately 125% of the overload heater rated current is reached. This reflects the methodology of overload protection of General Electric, vendor of the St. Lucie MCC's. The 4.16 kv system motors will operate with voltages in a normal operating range (more than 90% available) and are therefore not affected. As for the system connections, the overload protection is based on equipment capabilities, i.e., transformer capacities, main bus ampacities, etc. which are not approached by the actual loading of the plant.

The proposed change simplifies the relaying scheme and establishes setpoint ranges which should be easily achievable in the field. FPL has concluded that these new setpoint ranges offer full protection to the Class 1E systems and equipment for both non-accident and accident conditions and are based on assumptions and

calculation methodology more conservative than the existing design. The degraded voltage protective relaying scheme will alert plant operators to sustained undervoltage conditions and will initiate separation from off-site power and transfer to the on-site sources if the voltage does not recover to acceptable levels within the allotted time periods. The time delay ranges assure that no momentary spurious initiation or short term system disturbance will cause transfer of power from the off-site to the on-site sources when actually not required.

St. Lucie Unit 1
Docket No. 50-335
Proposed License Amendment
Emergency Bus Undervoltage
Relay Setpoint Changes

ATTACHMENT 3

DETERMINATION OF NO SIGNIFICANT HAZARDS CONSIDERATION

The Commission has provided a standard for determining whether a significant hazards consideration exists (10 CFR 50.92(c)). A proposed amendment to an operating license for a facility involves no significant hazards consideration if operation of the facility in accordance with the proposed amendment would not (1) involve a significant increase in the probability or consequences of an accident previously evaluated; or (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety. Each standard is discussed as follows:

1. **Operation of the facility in accordance with the proposed amendment would not involve a significant increase in the probability or consequences of an accident previously evaluated.**

   The proposed change will result in a better overall posture of the plant under degraded voltage conditions. The new settings will result in improved protection for the equipment at all voltage levels while at the same time minimizing the possibility of unnecessary challenges to the safety systems. Namely, the higher settings at the 4160 volt electrical system level will enhance protection offered to the 480 volt system equipment under all operating modes and the lower settings of the 480 volt system protective relays will not initiate the transfer of power to the on-site sources under accident conditions until the level of voltage may become injurious to the equipment. Therefore, the proposed change does not increase the probability of accidents previously analyzed.

   Since the time interval assumed in the safety analyses for connection of the safety-related buses to the emergency diesel-generators is not exceeded by the new settings, the proposed change does not increase the consequences of an accident previously analyzed.

2. **Operation of the facility in accordance with the proposed amendment would not create the possibility of a new or different kind of an accident from any accident previously evaluated.**

The proposed change does not change the operation, function or modes of plant operation. The ability of the degraded grid voltage protection scheme to detect the degraded voltage at any of the busses and to transfer the power from the off-site to the on-site sources is being maintained. No new hazards are created or postulated which may cause an accident different from any accident previously analyzed. The new relay settings represent an enhancement resulting in a more sensitive protective scheme allowing continuous operation without unnecessary challenges to the safety systems while offering an adequate protection to all the safety equipment.

3. **Operation of the facility in accordance with the proposed amendment would not involve a significant reduction in a margin of safety.**

The ability of the degraded grid voltage detection system is enhanced by the changes being proposed and is confirmed by the existing surveillance requirements. The new settings will result in a more sensitive detection and reduce possibility of spurious actuation, therefore the margin of safety is being increased. Further, the new settings will also result in enhancing the maintenance/calibration activities. The associated bases of the design are not affected since the new relay settings allow a better fulfillment of the original criteria of protecting the Class 1E equipment from damage due to prolonged exposure to degraded voltage, and, therefore, the proposed amendment does not involve a reduction in the margin of safety.

Based on the above, FPL has determined that the proposed license amendment does not (1) involve a significant increase in the probability or consequences of an accident previously evaluated, (2) create the possibility of a new or different kind of an accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety; and therefore does not involve a significant hazards consideration as defined in 10 CFR 50.92.