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FLORIDA POWER & LIGHT COMPANY

October 20, 1980
L-80-347

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Office of Nuclear Reactor Regulation
Attention: Mr. Robert L. Tedesco
Assistant Director for Licensing
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Tedesco:

Re: St. Lucie Unit 2
Docket No. 50-389
ATWS Procedure

Florida Power & Light has reviewed the NRC letter dated August 25, 1980 concerning the above subject and has determined that it would not be appropriate to prepare a formal emergency operating procedure for the Anticipated Transients Without Scram (ATWS) event at this time. The St. Lucie staff is just now beginning to prepare operating procedures to support the Unit 2 start up in 1983, and we feel that this complicated emergency procedure should only be prepared after the plant design is in its final form and after the normal operating procedures are well understood.

When the ATWS procedure is prepared, we will consider the guidelines we have received from our NSSS vendor on the subject. A copy of these guidelines is attached.

Very truly yours,

J. A. DeMastry for

Robert E. Uhrig
Vice President
Advanced Systems & Technology

REU/PLP/pah

cc: J. P. O'Reilly, Region II
Harold F. Reis, Esquire

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ATTACHMENT

Re: St. Lucie Unit 2
Docket No. 50-389
ATWS Procedure

REACTOR PROTECTION SYSTEM (RPS) FAILURE GUIDELINE

Symptoms

A. No NSSS transient in progress.
RPS failure detected (during normal CEA adjustments or RPS testing) that would prevent reactor trip on demand.

B. NSSS transient in progress.

A manual has been inserted or any of the following parameters have exceeded the reactor trip setpoint value on two or more safety grade instrument channels, with or without a reactor trip alarm annunciation:*

1. Pressurizer pressure.

2. Steam generator pressure.

3. Steam generator level.

4. Containment pressure.

5. Linear power.

6. Logarithmic power.

7. RCS flowrate.

and one or more of the following:

1. More than ten of the CEA positions indicate fully or partially withdrawn.

2. More than ten of the rod bottom lights not lit.

3. Scram breakers not open.

4. CEDM power UV lights not lit.

5. No large reactor power step-decrease normally associated with post-trip indications of power; reactor power may be moderately increasing or decreasing.

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*Plant specific listing of reactor trip parameters.

Immediate Actions

A. No NSSS transient in Progress.

1. Commence emergency RCS boration* at the maximum possible rate and reduce turbine power to maintain Tavg commensurate with the reduction in reactor power. Take extreme care not to create a reactor or turbine trip condition within the NSSS.

2. If a reactor trip condition should occur during power reduction, verify that the reactor trips automatically. If not and the reactor trip condition remains, manually trip the reactor and revert to the Immediate Actions Transient In Progress portion of this guideline.

3. When the reactor is shut down due to boron injection or if the RPS failure will not preclude more than 10 CEAs from dropping if deenergized, manually trip the reactor.

   a. If less than 10 CEAs fail to drop into the core, revert to the Reactor Trip Guidelines.

   b. If more than 10 CEAs fail to drop into the core, proceed with the Follow-Up Actions of this guideline.

B. NSSS Transient in Progress.

1. Attempt to manually insert the CEA's into the core**.
   a. Push manual trip buttons at Main Control Board.
   b. Open scram breakers.
   c. Turn off control rod drive power by:
      1. opening both motor-generator (M-G) output breakers, or
      2. opening both M-G power supply breakers, or
      3. deenergizing that portion of the site electrical distribution systems that supplies the M-G sets.
   d. Manually drive the CEA's into the core using the normal rod motion controls.
   e. Upon verification of less than 10 CEAs withdrawn, reactor power less than 5%, and all secondary safety valves have closed, revert to the appropriate procedure for the present plant conditions.

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* plant specific

** plant specific listing of available methods, prioritized by the fastest methods.

2. If main feedwater flow is lost and the turbine is not being runback automatically, manually trip the turbine. (For any other conditions, do not trip the turbine until the reactor is shut down).

3. Attempt to maintain steam generator level:
   a) Manually regulate main feedwater system flow rate (if available). Override the automatic post-trip main feedwater flow rampdown, if actuated.
   b) Initiate auxiliary feedwater flow, if necessary.
   c)* If steam generator water level continues to decrease, quickly reduce steam flow to the turbine/condenser by stopping or blocking operation of the turbine bypass valves and spinning down the turbine load limiter until the secondary safety valves open. When the secondary safety valves open, slowly increase the turbine load limiter until the secondary safety valves close.

4. Manually initiate SIAS. Commence Emergency Boration Procedure** at maximum possible boron concentration. Verify operating or manually start all charging pumps taking suction from the high boron water source.

5. Verify Containment Isolation Actuation Signal (CIAS) activation on high containment pressure; if not, manually initiate. Initiate CIAS upon high containment radiation indication.

6. Verify that containment depressurization systems (i.e., containment spray, etc.) are activated on high containment pressure; if not, manually initiate.

7. If steam generator pressure is less than (**), verify that a main steam isolation signal has been initiated. If not, manually initiate and verify closure of main steam isolation valves.

8. If secondary safety valves have opened following a primary temperature excursion, manually operate the turbine bypass or atmospheric dump valves to maintain a stable Tavg only after the secondary safety valves have reseated.

9. If no primary temperature excursion is occurring due to the initiating transient, regulate turbine power to maintain Tavg commensurate with the reduction in reactor power due to boron injection.

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* Plant specific (action to be included only if steam flow reduction decreases the steam/feedwater mismatch).

** Plant specific

Follow-Up Actions

1. Continue efforts by means available to insert all the CEA's into the core.

2. Continue emergency boration until cold shutdown boron concentration*is achieved in the RCS. Maintain primary temperature at the hot zero power value by operating the turbine bypass valves or atmospheric dump valves.

3. Maintain steam generator water levels with the main feedwater system or auxiliary feedwater system.

4. Verify that the CVCS is functioning to restore proper pressurizer level. If necessary, manually operate charging and letdown to restore and maintain pressurizer level. If available charging pump capacity falls below the RCS leakage rate, continue emergency boration and revert to LOCA procedures.

5. Verify that the pressurizer pressure control system is functioning to restore pressure to the hot zero power value. If necessary, manually control heaters or spray to maintain pressurizer pressure.

6. After any SIAS, operate the Safety Injection System until hot and cold leg temperatures are at least 50°F below saturation temperature for the RCS pressure and a pressurizer level is indicated. If 50°F subcooling cannot be maintained after the system has been stopped, the high pressure safety injection must be restarted.

7. Following verification of cold shutdown boron concentration within the RCS, cool down the plant using forced or natural circulation and the turbine bypass valves (preferred) or the atmospheric dump valves. In the event that the atmospheric dump valves are used, monitor and maintain condensate storage inventory. If condensate supplies become limited, commence plant cooldown immediately following verification of cold shutdown boron concentration level within the RCS.

*Plant specific (accounts for added positive reactivity due to withdrawn CEAs).

Precautions

1. Do not begin manual plant cooldown to cold shutdown conditions until a cold shutdown boron concentration level*is verified in the RCS.

2. If the power operated relief valves (PORVs) have automatically actuated, verify that both PORVs reseat when pressurizer pressure decreases below 2300 psia. Isolate the PORVs by shutting the block valves if they fail to reseat.

3. Monitor primary system temperature and pressure to avoid overfeeding the steam generators and causing a cooldown of the RCS below the hot zero power value until cold shutdown boron concentration is established.

4. Trip the reactor coolant pumps if cavitation is suspected.

5. If the reactor coolant pumps have been tripped, implement the Natural Circulation Guidelines.

6. If the reactor coolant pumps have been tripped, they may be restarted if:
   a. A LOCA has not occurred.
   b. Pump services can be restored.
   c. RCS pressure and temperature conditions permit restart in accordance with normal reactor coolant pump start procedures.

7. If a bubble in the reactor vessel head is suspected following a re-establishment of subcooled conditions within the RCS by noting abnormal pressurizer charging and spray operation, increase pressurizer pressure to eliminate any condensable voids and operate the reactor vessel head vent to eliminate any non-condensable voids.

8. Lengthy operation of the containment spray may jeopardize the operation of equipment which would be desirable to mitigate the consequences of the event. If the containment pressure has returned to below the actuation setpoint, the system may be stopped. The spray system must be realigned for automatic actuation.

* Plant specific (accounts for added positive reactivity due to withdrawn CEAs).

9. If natural circulation cannot be maintained after trying to establish natural circulation core cooling in accordance with immediate actions, the RCP's cannot be restarted, and shutdown cooling cannot be implemented, initiate HPSI flow to the RCS cold legs, and open the PORV's (if available) to maintain core cooling until the secondary heat sink can be restored.

10. Adverse containment environment may increase instrumentation inaccuracies. Do not rely on a single parameter indication to evaluate plant conditions. Utilize all indications and combinations of indications available to verify plant status.

11. Upon verification of less than 10 CEAs withdrawn (or cold shutdown boron concentration has been verified within the RCS), reactor power less than 5%, and all secondary safety valves have closed, revert to the appropriate procedure for the present conditions.

## REACTOR PROTECTION SYSTEM FAILURE GUIDELINE

Bases

A Reactor Protection System (RPS) failure is an unexpected loss of ability to drop all Control Element Assemblies (CEAs) fully into the core upon demand. A transient may or may not be in progress during an RPS failure condition. Some possible causes for an RPS failure include:

1) Failure in the RPS sensors.
2) Electrical failure in the RPS transmitters.
3) Electrical failure in the RPS logic.
4) Electrical failure in the RPS trip circuit relays.
5) Failure in the RPS trip circuit breakers.
6) Mechanical failure in the CEA mechanisms.
7) Mechanical binding in the CEA travel ability.

A malfunction of the RPS that is suspected to prevent CEA insertion may be noticed during normal steady state power operation while making CEA adjustments or performing RPS testing. The main task for operator action in this case is to shut down the plant without causing any condition which would require the use of the RPS. If conditions are created which call for RPS actuation in this plant situation, the RPS may not function adequately and an otherwise preventable Anticipated Transient Without Scram (ATWS) event may have been created. Thus the operator is directed to bring the reactor to a condition where action from the RPS is not needed by commencing a reactor shut down using emergency boration. When the reactor is shut down on boron concentration alone or if the failure is verified to not preclude no more than ten of the CEAs from dropping when deenergized, then and only then the operator will test the RPS actuation by inserting a manual scram.

A malfunction of the RPS which does not drop over ten of the CEAs fully into the core upon demand may be observed following the start of an anticipated transient. This situation is an ATWS. An ATWS can be identified by indication on two or more instrument channels that a plant parameter has exceeded its normal reactor trip setpoint or a manual scram has been inserted <u>and</u> over ten of the CEAs have not fully dropped into the core. Primary and secondary key parameters (i.e. pressurizer pressure, steam generator pressure, etc.) may be rapidly or slowly increasing or decreasing, depending upon the initiating transient which started the ATWS. However, whenever such conditions

are recognized, the RPS Failure Guidelines should be implemented with all other emergency procedures superceded since the initiating transient need not be identified. The RPS Failure Guideline is written to stand by itself and references other procedures when necessary.

The first operator action during an ATWS is directed towards inserting the CEAs into the core by all manual methods available. Since the Control Element Drive Mechanisms (CEDMs) must be energized to hold the CEAs withdrawn from the core, all methods (plant specific) of deenergizing the CEDMs should be pursued. If the CEDMs can not be deenergized or the CEAs will not drop, the CEAs should be driven into the core using the normal rod motion controls. The order of manual methods to insert the CEAs should be prioritized based on the most rapid means to accomplish that method on a plant specific basis.

Primary temperature and pressure will not rise dramatically unless the steam generators' secondary water inventory is significantly depleted. Thus the next several actions of the operator are directed to maintain the secondary water volume. The main feedwater system should be used (if available) to maintain the steam generator water levels. This may require that the operator override the normal post-trip ramp down function of the main feedwater system since this feature of an RPS trip signal may have been automatically initiated (even though the CEAs did not fully insert). If an adequate secondary inventory is maintained by keeping the feedwater flowrate in balance with the steam flow (which is dependent on the reactor power level), the reactor coolant system will not be subjected to a significant overpressurization. The reactor may still be uncontrollably at power in this situation and incapable of being rapidly shut down. However, continued steaming from the steam generators (possibly through the safety valves) will prevent a gross heat transfer imbalance between the reactor heat generation and the reactor coolant system heat removal, thus minimizing primary temperature and pressure increases.

If main feedwater is not available or is not sufficient to keep up with the steam flow, auxiliary feedwater should be actuated. Because the design flowrate for the Auxiliary Feedwater System is based on decay heat removal (less than 10% rated power), the steam generators will still dry out for any higher reactor power level with main feedwater totally unavailable, regardless of the time of auxiliary feedwater initiation. However, the operator must verify that auxiliary feedwater flow has been initiated in order to ensure that the secondary heat sink is available following the moderator induced reactor shutdown. Once the secondary heat sink is re-established to remove core decay heat following the peak ATWS pressure, the Power Operated Relief Valves (PORVs) and the Pressure Safety Valves will shut and thus limit the loss of the primary inventory, which ensures that the core remains covered with water. If auxiliary feedwater were not initiated, the PORVs and/or pressurizer safety valves would open to remove the reactor decay heat. This would deplete the RCS inventory with the possibility of eventually uncovering the core.

Another manual action to preserve the secondary inventory is to force Tavg to increase by reducing turbine steam flow and by stopping or blocking turbine bypass steam flow. Increasing Tavg reduces reactor power through the moderator coefficient effect. The reactor power reduction causes a corresponding steam flow reduction from the steam generators to remove the lessor amount of generated core heat. However, increasing Tavg will also increase secondary pressure which may cause available feedwater flow to diminish, dependent upon plant specific feedwater system design and operating mode. Whenever the steam flow would decrease more than the feedwater flow as a result of increasing Tavg, this operator action would be useful. Plant specific evaluation will be necessary to develop plant specific recommendations regarding this action.

If manual actions are not able to preclude the dryout of the secondary side of the steam generators while the reactor is at power, the plant will still be able to be safely shut down following the primary pressure excursion.

During an ATWS which leads to the steam generators drying out while the reactor is at power, the reactor will be shut down initially by the negative moderator reactivity added by the increasing primary temperature. Until the temperature rises high enough to effectively shut down the reactor, the operator should not try to dump secondary steam to try to control primary temperature. By dumping secondary steam before the reactor is shut down, the operator will be making the situation worse by hastening the dry out of the steam generators which will increase the consequences of the ATWS when the steam generators do dry out.

Emergency boration is needed to add negative reactivity to the reactor. Implementation of emergency boration will not significantly affect the magnitude of the ATWS peak pressure for those ATWS events which quickly dry out the steam generators while the reactor is at power. Since the amount of boron that can be added by the charging system and actually reach the core in the first few minutes is small, reactor power will be reduced very little before the steam generators dry out and a primary pressure excursion occurs. There is no boron contribution from the High Pressure Safety Injection (HPSI) system because primary pressure is above the shutoff head of the HPSI pumps. However for some ATWS events (such as CEA withdrawal) where the steam/feedwater flow imbalance in the steam generators is much smaller and more time is available , emergency boration can be instrumental in preventing steam generator dryout. The addition of boron reduces the reactor power and thus the required steaming rate, aiding in restoring the secondary water inventory.

For any ATWS, emergency boration is also important because sufficient boron must be added to the RCS before the plant can be cooled down to cold shutdown conditions. A cold shutdown boron concentration within the RCS should be attained as soon as possible. Hence boration should be started early since only the charging system may be available due to high primary pressure.

Some ATWS events may not lead to a dryout of the steam generators and will not experience a rapid overpressurization. In these situations, primary temperature may decrease or remain steady. Primary pressure may decrease low enough to allow HPSI flow which will increase the effect of early boration on the ATWS consequences. Main steam isolation should be verified for ATWS events with decreasing secondary pressure. Some ATWS events will tend to stabilize at a quasi-equilibrium state until emergency boration is initiated. When the injected boron reaches the core, the reactor will start to slowly shut down as the boron concentration increases, decreasing the primary temperatures. In these situations, no major primary pressure transient will occur since higher primary temperatures are not needed to shut down the reactor.

Follow-up operator action is directed toward maintaining plant control while proceeding toward eventual plant shutdown and cooldown. Adequate core cooling should be ensured by maintaining secondary water inventories in the steam generators and by verifying natural circulation or forced flow in the RCS. Pressurizer level should be restored through the use of charging, letdown and safety injection to maintain primary inventory. Pressurizer heaters should be energized as needed to maintain a bubble in the pressurizer. If core cooling can not be established using the steam generators, HPSI flow should be initiated to the RCS cold legs and the PORVs opened only as a last resort for cooling the core. This method of core cooling should be a temporary measure only until the secondary heat sink can be restored.

/jcp