THE BABCOCK & WILCOX COMPANY
POWER GENERATION GROUP

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To
B. A. Karrasch, Manager, Plant Integration

From
L. R. Cartin, Plant Integration (2835)

BDS 663.5

Cust.

File No.
or Ref.

Subj.
TECo - B&W Meeting Minutes

Date
November 29, 1978

This letter to cover one customer and one subject only

Re: 1) E. W. Swanson to W. H. Spangler, "Auxiliary Feedwater Setpoints," NSS-14, November 15, 1978.

2) L. R. Cartin to W. H. Spangler, "TECo Operating Instructions," T3.3.1, November 28, 1978.

On Novmeber 27, 1978 a meeting was held between TECo and B&W personnel (listing of attendees is given in Attachment 1) to discuss the design and requirements for DB-1 AFW System operation. This meeting was required to identify and resolve present problems associated with establishing steam generator level control setpoints which:

1. Maintain indicated pressurizer level during normal reactor trip events.

2. Maintain pressurizer level during moderate frequency events.

3. Provide secondary system performance consistent with LOCA and other DBA event analysis assumptions.

The above problems have arisen from TECo's need to reduce the steam generator level setpoints (to 35") for natural circulation and maintenance of indicated pressurizer level and B&W's need to maintain a high steam generator level (at least 10 feet) because of small LOCA requirements. Reference 1 provides a summary of activities that preceded the 11/27/78 meeting.

Attachment 2 provides the meeting agenda. To provide an orderly and concise summary of the discussions which took place, a synopsis of each major agenda section is provided below:

Section I: Definition of the Problem

Table 1 provides a listing of the principal (primarily technical) problems identified. In the short term, effort to resolve Items 7 and 8 to NRC's satisfaction is of primary importance so as to achieve continued operation of DB-1. Followon work will be required to implement permanent design changes and to finalize ECCS concerns.

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Further discussion of short and long term activities to resolve identified problems is presented below.

Section II: Auxiliary Feedwater (AFW) System Description

Fred Miller (TECo) provided a description of the major components of AFW System, the SFRCS which actuates and controls AFW, and possible AFW/SFRCS operating modes.

1. AFW System: Figure 1 is a simplified sketch of the AFW System assuming AFW addition to both steam generators. Two steam driven AFW pumps are supplied. Steam to drive the pump turbines is extracted from the main steam lines upstream of the MSIV's. Cross-connection for the steam supplies to the pump turbines and for AFW injection lines downstream of the AFW pumps are also provided to achieve FOGG capabilities during steam and feedwater line breaks. **Each AFW pump is designed to deliver 800 gpm at 1050 psig (actual delivery is approximately 1200 gpm at 900 psig).**

2. Steam and Feedwater Line Rupture Control System (SFRCS): The design goals of the SFRCS are:

   a. Prevent release of high energy steam.

   b. To automatically start AFW in the event of a steam or feedwater line, loss of both main feed pumps, or the loss of all four RC pumps.

   c. To ensure adequate AFW to remove decay heat during periods when the normal feedwater supply and/or electric power supply to essential auxiliaries has been lost.

   d. To provide essential steam generator level control when AFW is required.

   Station variables which require actuation of AFW are:

   a. Low steam line pressuer (< 591.6 psig).

   b. Low steam generator level (≤ 17 inches).

   c. Steam generator pressure greater than main feedwater line pressure by 197.6 psi.

   d. Loss of all RC pumps as indicated by the RC pump monitors.

   For all actuation signals except the loss of all RC pumps, the SFRCS will close both main steam isolation valves, close both main feedwater control and stop valves, initiate AFW and control AFW addition to **maintain a 120" level in the steam generators**. Furthermore, if one steam generator remains depressurized (<591.6 psig) the SFRCS will also align both the AFW pump turbines and AFW injection lines to the pressurized steam generator (SLB and FWLB). If **a loss of all RC pumps** (only signal) signal occurs, **the SFRCS only initiates AFW**; steam and feedwater isolation is not actuated.

3. AFW/SFRCS Operational Aspects: Following SFRCS actuation and AFW system alignment (FOGC), steam generator level control is achieved by controlling the AFW pump turbine speed. No changes in valve position are instigated by SFRCS to achieve level control. TECo indicated that level control within ± 6" of the setpoint is typically encountered. TECo further indicated that reductions seen in steam generator pressure following AFW actuation are due to the large quantity of cold AFW introduced into the steam generators and are not due to steam usage by the AFW pump turbines.

Section III: Criteria for Pressurizer Sizing

The need to maintain pressurizer level during normal accident conditions was discussed at length. Table 2 presents, for condition I-IV events, criteria for pressurizer level and the required steam generator level control setpoints. Both B&W and TECo agreed that these conditions would allow safe operation of the plant without violation of Safety An lyses assumptions. This position is to serve as a basis to counteract NRC's inquiry (GDC-13) about TECo's ability to maintain indicated pressurizer level during normal and upset conditions. Also noted on Table 2 are action items to provide analysis support to the AFW/pressurizer level position.

TECo indicated that the position reflected in Table 2 would probably satisfy the regional reviewer; however, they were not so optimistic about DOR acceptance. If DOR insists that indicated pressurizer level be maintained for both condition I and II events, additional design changes such as reducing the rate of AFW addition may have to be pursued.

Section IV: Interim Actions

In the interim, site instructions will be prepared to direct the operator to assume manual control of the AFW when actuated by SFRCS and maintain 35 inches (indicated) on the startup range instrumentation when no ESFAS actuation of HPI occurs. For SFRCS actuations followied by ESFAS actuation of the HPI system, the operator shall ensure automatic control of AFW by SFRCS to 120 inches (96 inches indicated) on the startup range instrumentation. No operator actions are required if main feedwater remains available following a reactor trip event, even with ESFAS actuation of the HPI. The revised site instructions are provided in Reference 2 and are consistent with the AFW/pressurizer level position given in Table 2.

An alternative to the above was discussed. This was simply to change the present SFRCS setpoint (10 feet) to 35 inches and to rely on operator action to manually control AFW at 10 feet if post LOCA conditions are present (HPI actuation). This alternative was not adopted because: 1) NRC acceptance of a timely and continuous manual control function to mitigate a LOCA may be difficult to obtain, and 2) the preferred interim measures are more similar to present operating procedures.

Action items for B&W to supply analysis and/or test data to support the interim site operating instructions from a safety standpoint are given in Table 2.

Section V: Criteria for Design of AFW Systems

The present problem on TECo is a clear indication that the AFW system now performs many more functions than its original design purpose of decay heat removal. An internal review (generic) of B&W requirements on the AFW system may be desirable to eliminate similar problems in the future. Of particular interest would be to limit dependence on steam generator performance for LOCA mitigation.

Section VI: Permanent Design Change (Long Term)

The dual setpoint concept for SFRCS control of AFW (automation of interim site instructions) was deemed the most desirable permanent fix. Several modifications were noted, however, to provide greater protection from loss of pressurizer level. These included the possible use of a 10 foot level only if: 1) SFRCS-ESFAS-RC pumps off only or, 2) SFRCS-ESFAS (4 psig and 1600 psig) where both ESFAS signals are required to indicate the existence of a small break. These considerations will be reviewed in the long term.

TECo indicated that their next planned outage is March, 1980 and any permanent design changes would be made at that time because the incorporation of a dual setpoint will require plant shutdown. This long lead time is advantageous for design of a permanent solution, however, the NRC may not accept this schedule which would rely on operator action for over one year to meet GDC-13.

If the NRC inquires about plans for a permanent fix in the short term, it was decided to indicate an automatic control scheme similar to the present site instructions would be implemented. This approach will allow review and possible use of the modifications noted above.

To summarize discussions in previous sections, Table 3 has been developed to illustrate TECo's present AFW control schemes and the proposed modifications during several accident situations.

Note: If the NRC does not accept the proposed position on GDC-13 (Pressurizer Level Indication) in Table 2, additional design changes may be required. One possible change would be to limit AFW flow rates.

Section VII: Licensing Concerns

Although not specifically addressed, the small LOCA concern (32 foot steam generator level in Topical compared to present SFRCS design which will allow only 10 feet) is not considered to be a PSC. B&W will supply technical arguments to support the adequacy of the 10 foot level if required.

For the past year, TECo site operators have been instructed to manually control AFW at the 35 inch level following all SFRCS actuations. Since B&W site instructions will require the achievement of a 10 foot level for SFRCS-HPI events, the present site instructions are considered to be inconsistent with Safety Analysis assumptions, but not considered to be a safety problem. This inconsistency is interpreted to be an unreviewed safety issue. At

the time TECo revises their site procedures, they will also inform the NRC of the unreviewed safety issue. It is hoped that NRC will accept this report as a mere formality to document measures to assure future plant operation consistent with past safety analysis assumptions.

Section VIII: Schedule/Plan for Problem Resolution

TECo is to contact the NRC on 11/28/78 and present the revised site instuctions and position on GDC-13 given in Table 2. Action items noted in Table 2 are to proceed on an "as soon as possible" schedule to provide TECo support to anticipated NRC questions. Plant Integration will coordinate these short term activities.

NRC's reaction to TECo proposals will ultimately control any short or long term activities schedules. For the long term, work activities and schedules will be developed following receipt of feedback from TECo.

LRC:dh
Attach
cc: B. M. Dunn
R. C. Luken
W. H. Spangler
E. W. Swanson
R. O. Vosburgh/D.W. Labelle
R. W. Winks
E. A. Womack
J. D. Carlton

TABLE 1: PRINCIPLE PROBLEMS ASSOCIATED WITH
STEAM GENERATOR LEVEL CONTROL SETPOINT

1. Pressurizer level indication will be lost for normal and upset conditions with SFRCS actuation and control of AFW to 10 foot level. (NRC GDC-13 concern.)

2. Pressurizer drains with addition of 4 feet (steam generator level) of AFW at low power levels ($\leq$15%) with the RC pumps on.

3. ECCS requires at least 10 feet (steam generator level of AFW for small breaks when LOOP assumed (RC pump off). Limited analysis is available assuming a 10 foot level.

4. Small LOCA's have not been analyzed assuming main feedwater, controlled at 2 foot level by the ICS, and RC pumps operative (no LOOP).

5. If a loss of pressurizer level occurs due to addition of AFW to a 10 foot steam generator level, the effect of displacing the pressurizer steam bubble into the loops is unanalyzed. Outstanding concerns include: a) the ability to regain pressurizer level with the low head HPI system, and b) the ability to maintain natural circulation for LOOP events.

6. Transients that constitute the design basis for pressurizer sizing and level indication requirements need to be defined so that present or future steam generator level setpoints can be justified.

7. Present TECo operating procedures instruct the operator to limit (manually) AFW addition to 35 inches on the startup range, level instrumentation. Revised instructions to acquire a 10 foot steam generator level for ESFAS events (small LOCA mitigation) may represent an unreviewed safety problem.

8. TECo must contact the NRC on 11/28/78 and provide a compliance position on GDC-13 and assurance that no safety analyses are violated.

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TABLE 2

	Condition I Events	Condition II Events			Condition III & IV Events	[illegible]
	Normal Trip	LOOP	Stuck Open Relief Valve	LOMFW (RCP on)	DBAs (HPI Initiated)	Small Break
[illegible] For Pressurizer Level	Pressurizer Level Indication Must Be Maintained.	1. Can Loose Prz. Level Indication 2. Don't Drain Prz. 3. Must Restore Level Indication For Maintainance of Hot S/D. 4. Don't Actuate HPI on Low RC Pressure			Prz. Level Is Not Pre[illegible]; Safety Analysis Is Measured By Other Parameters	Loss of Prz Level Is Natural Consequence of The Accident.
[illegible] Factor For Control [illegible] Req'd	2 FEET By ICS	25" By SFRCS	35" By SFRCS	35" By SFRCS	10 FEET By SFRCS	10 FEET By SFRCS
Analysis/Test To Provide Backup (Action Items)	B&W To Prepare [illegible] Summary of Reactor Trip Events From Low Power to Demonstrate Maintainance of Indicated Prz Level (B&W) Control Anal.)	B&W To Perform Analysis Using [illegible] [illegible] [illegible] ([illegible] Data) To Demonstrate That the Prz. [illegible] Not Drain and ESFAS Is Not Activated. (B&W - Control Analysis)	No Short Term Action Will Be Taken For This Event Since NRC Questions Are Not Expected.	B&W To Summarize Analysis Performed At 15% Power With The Pumps On To Demonstrate That The Prz. Does Not Drain & ESFAS Is Not Actuated (B&W - Control Analysis)	No Short Term Action Because This Event Remains Within the Acceptance Criteria In Place At Time of Submittal & Approval By NRC. For Long Term, B&W To Prepare Analysis on Effect of Prz Drain on SIB (Steam Bubbling) w/ and w/o RC Pumps (LRC - PI)	B&W To Gather Data Information In Support of Ho[illegible] Level. In Case An NRC Submittal Is Req'd. Be Prepared To Perform Additional Analyses In Long Term, But To Address Concern of Concern of [illegible] Mitigation With MFW & RC Pumps Available. (B&W - E[illegible])

TABLE 3 FEEDWATER CONTROL ACTIONS FOR NORMAL REACTOR TRIP EVENTS AND ACCIDENT CONDITIONS

CASE No	DESCRIPTION	EXISTING CONTROL SEQUENCE	PROPOSED SG CONTROL SEQ.	ANALYSIS REQ'T	COMMENTS
1.	Rx Trip From Any Power Level RC Pumps Operative MFW Operative No SFRCS Actions No ESFAS (No LOOP)	ICS Control of MAIN/SU Feedwater Flow To Maintain Low Level (~26" on SU Range) To OTSG	No Change	Best To Provide Analysis and/or Test Backup That Pzr level indication is maintained at low power levels	Normal Trip.
2.	Rx Trip From Any Power Level RC Pump Operative MFW Not Operative No ESFAS (No LOOP) SFRCS Actuations of AFW on Low SG level or MS/SG ΔP	SFRCS isolation of Main and MF lines, SFRCS actuation and control of AFW to 120" on SU Range To OTSG.	Same as existing design except control setpt. should be 35" on the SU Range.	Best to provide analysis to demonstrate that the PZR does not drain and that ESFAS is not actuated for a LOMFW at 15% power.	Interim design requires the operator to assume immediate control of AFW and to manually control SG level to the 35" level. (LOMFW or ESFAS Outside Cont.)
3.	Rx Trip From Any Power Level RC Pumps Not Operative MFW Not Operative No ESFAS (No LOOP) SFRCS Actuations of AFW on Low SG level, MS/SG ΔP, or RC Pump Monitors	Same as Case #2	Same as Case #2	Best to provide analysis that demonstrates maintenance of Pzr level and no ESFAS initiation for a LOOP at Low Power (15%)	Same as Case #2 (LOOP)

Table 2 (Cont.)

Case No.	Description	Existing Control Seq.	Proposed Control Seq.'	Analysis Req'T	Comments
4.	Rx Trip from Any Power Level RC Pump Operative MFW Operative No SFRCS Action ESFAS Actuation (No FOGG)	ESFAS Act of ECCS, ESFAS Isol of MU & Letdown. ICS Control of Main/SU Feedwater Flow to Maintain Low Level (~26" on SU Range) in OTSG.	ESFAS Act of ECCS, Isol of Normal MU & Letdown. ESFAS Act of SFRCS which 1 Isol. MFW 2. Isol SL 3 Act & Controls AFW to 120" on SU Range	Reanalysis of Small Break May Possibly Be Req'd. This is a generic 177FA Plant Concern	No Inservice Operat[illegible] actions required [illegible] LOCA until these conditions Is Believed To Be SAFE. (Small LOCA)
5.	Rx Trip from Any Power Level RC Pumps Not Operative MFW Not Operative ESFAS Actuation SFRCS Act of AFW on Low SG Level, MFW/SG ΔP, or RC Pump Monitors (No FOGG)	ESFAS Act of ECCS, ESFAS Isol of MU & Letdown. SFRCS Isol of Steam & FW Lines, SFRCS Act & Control of AFW To 120" on SU Range In OTSG	Same As Existing Design Except ESFAS Input To SFRCS May Be Req'D	Reanalysis of Small Break May Possibly Be Req'D To Demonstrate Adequacy of 10-ft Level.	FOGG [illegible] [illegible] upset of [illegible] value & small LOCA)
6.	Rx Trip from Any Power Level RC Pump Operative MFW Operative SFRCS Act on Low SG Press. (FOGG) ESFAS Actuation	ESFAS Act. of ECCS & Isol of MU & Letdown SFRCS Isol of Steam & FW Lines, SFRCS Act & Control of AFW To 120" on SU Range In Pressurized SG	Same As Existing Design Except That ESFAS Input To SFRCS May Be Req'D.	Bias To Des Position on Need To Regain Prz Level To Maintain Hot S/D For A SLB.	(SLB)

Table 3 (contd.)

Case No.	Description	Existing Control SEQ.	Proposed Control SEQ.'	Analysis Req'd	Comments
7.	Rx Trip from Any Power Level RC Pump Operation MFW Not Operative ESFAS Actuations (4 psig) EFRCS Act on Low SG Level and Low SG Pressure (F066)	ESFAS Act of ECCS & Isol. of MU & Letdown EFRCS Isol of Steam Fw Lines, EFRCS Act And Control of AFW To 120" on SU Range In Press OTSG	Same As Existing Design EXCEPT THAT ESFAS INPUT TO EFRCS MAY BE REQUIRED	N/A	(FW LB Inside Cont. (1 SG.)
8.	Rx Trip from Any Power Level RC Pumps Not Operative MFW Not Operative ESFAS Actuation EFRCS Act on 1) Low SG Level Loss of 4 RCP Monitors, and 2) Low SG Pressure (F066)	Same as Case #7	Same as Case #7	B&W To Develop Position on Effect of Loss of PRZ Bubble on Natural Circulation And on The Need And Ability To Regain PRZ Level.	(SLB with LOOP)

NOTE: 1 It is assumed here that a dual setpoint is to be adopted. That is, EFRCS will initiate and control AFW to 35" when no ESFAS actuation is present & to 10.H when an ESFAS is actuated

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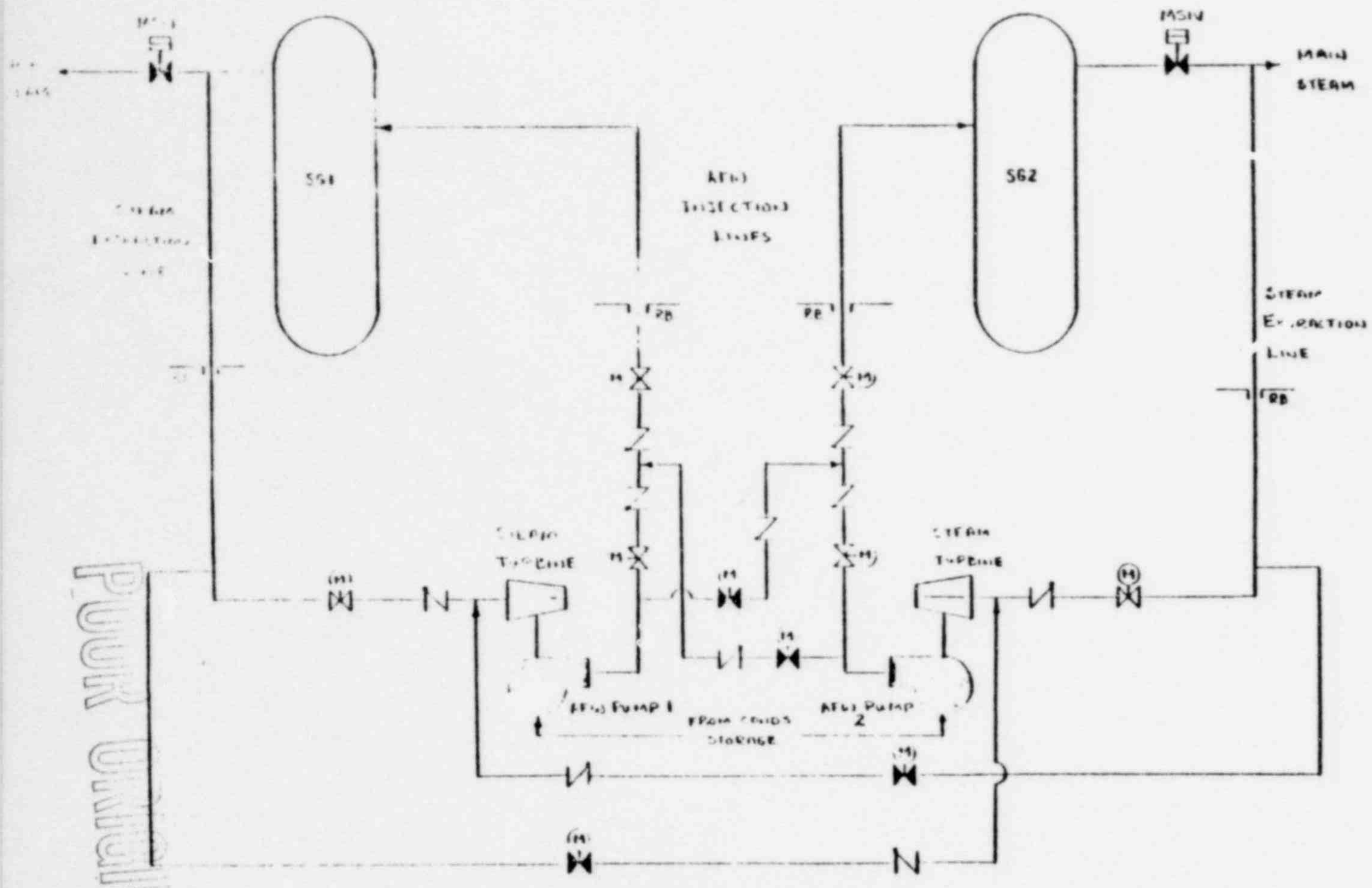
Figure 1. TFS AFW SYSTEM



Comments

1. [illegible] AFW Injection to both SGs.
2. Valves [illegible] Operation.
3. If both AFW Pumps are [illegible] to inject to one SG, one pump will control to 105' and one pump will control to 120". This [illegible] prevents excessive SG level overshoot and allows [illegible] to prevent SG overfill.
4. AFW Pump turbines are designed to develope sufficient Hp to drive pumps with a steam backpressure of ~50 psig
5. AFW Pump design flow rate: 1200 gpm

ATTACHMENT 1

Babcock & Wilcox

11/27/78 Meeting on Control of Steam Generator Level and Associated Pressurizer Level at Lynchburg Davis-Besse Unit 1

NAME	Organization	Title
CHUCK DUNECK	TECO	DEI Nuclear Project Engineer
Fred F. Wilson	"	Vice Pres. Engr.
Terry D Murray	TECO	Station Supt.
Lou CARTIN	B&W	PLANT INTEGRATION
Bob Winks	B&W	Control Analysis
Ron Davis	"	"
Bert Dunn	B&W	ECCS Analysis
RAY LUKEN	B&W	PROJ MGR/SERVICE MGR
Ken Finnicum	B&W	Licensing
E.A. NOMACK	GTN	Engineering Plant Design
[illegible]	"	Plant Integration
ERIC SWANSON	B&W	PLANT DESIGN Integra

ATTACHMENT 2.

PROPOSED AGENDA FOR TECO - B&W

MEETING ON NOVEMBER 27, 1978

I. Definition of the Problem(s) (TECO)

A. TECO Perception of Problems

1. Recent Operational Occurrances

2. Testing Requirements

3. NRC Involvement

a. NRC Positions on SG Level Control Setpoints

b. Summary of Recent NRC-TECO Discussions

c. Level of Problem Escalation Within the NRC

d. TECO Commitments, if any, to Supply the NRC Information

e. Time Restraints

B. B&W Perception of the Problem

1. Loss of Pressurizer Level Indication (NRC concern)

2. Loss of Level (pressurizer draining)

3. Potential for Spurious Initiation of ESFAS on Loss of Level

4. Needs for Steam Generator High Level for ECCS

5. Need to Maintain Natural Circulation

II. Auxiliary Feedwater (AFW) System Description (TECO)

A. Physical Layout - Major Components

B. Present System Modes of Operation

1. Initiating Signals (SFRCS, ICS, etc.)

2. SG Level Control Setpoints

3. Expected Flow Rates

C. System Operation

1. AFW System Operation to Achieve and Control SG Level (Interaction of Pump Speed Controls and AFW Injection Valve Operation; with SG Level Control and FW Demand Signals; System Response Times; Sequence of Control Events; etc.)

2. AFW - Secondary Side Interaction

a. Impact of AFW System Operation on SG Pressure

b. Level Control Stability with Off-On AFW Operation

III. Criteria for Pressurizer Sizing (B&W)

A. Need to Maintain Indicated Level for:

1. Normal Reactor Trip Events

2. Upset Condition (LOMFW, Secondary Side Steam-Feedwater Malfunction, etc)

3. Design Basis Events (SLB, LOCA, etc.)

B. Past and Present NRC Positions on Criteria 13.

Following this discussion, a position will be developed by TECO/B&W for future use in NRC discussions.

IV. Interim Actions to Achieve Pressurizer Level Control and to Maintain Validity of Safety Analysis (Short Term)

A. Discussion of Recent Site Instructions

1. Situations Requiring Op. Action to Control SG Level

2. Basis for Operator Intervention -

- Maintenance of Pressurizer Level
- LOCA Mitigation
- Etc.

B. Probability of Success Based on Operation Exp.

C. Anticipated NRC Reaction to Proposed Administrative Procedures

PROPOSED AGENDA (CONTINUED)

V. Criteria for Design of AFW System

A. At the Time of TECO Design

1. Decay Heat Removal (LOFW)

2. Establish Natural Circulation

B. Present (in addition to A)

1. Maintain Hot Shutdown Decay Heat Removal After Abnormal Transients

2. Small Break LOCA Mitigation

C. Future (Possibles in addition to A and B)

1. Loss of All AC Power

2. Safety Grade Cooldown

VI. Permanent Design Change Alternatives (Long Term)

A. Dual Setpoints - Control of SG Level at 120" for ESFAS Transients Only

B. AFW Flow Rate Reduction

1. Injection Valve Throttling

2. Pump Speed Reduction

3. Increased Bypassed Flow

C. Other Alternatives

VII. Licensing Concerns

A. Present NRC Commitments - FSAR, Verbal, etc.

B. Is Problem A Preliminary Safety Concern?

C. Licensing Action to Implement Permanent Design Change

VIII. Development of Schedule and Program Plan for Problem Resolution

A. Short Term TECO & B&W Actions

B. Long Term TECO & B&W Actions