THE BABCOCK & WILCOX COMPANY
POWER GENERATION GROUP

C

To
W. H. Spangler, Nuclear Service

From
E. W. Swanson, Plant Integration

BDS 661.5

Cust.
Toledo-NSS-14

File No. or Ref.

Subj.
Auxiliary Feedwater Setpoints

Date
November 15, 1978

This letter to cover one customer and one subject only.

Our recent discussions with Toledo personnel regarding their need to reduce the steam generator level setpoint for natural circulation, and B&W's need to maintain a high level because of ECCS small break have led to an impasse.

Both B&W and Toledo are in a "risk" position because the Toledo small break topical was based on a 32' level position; any change to that position may require re-analysis and re-licensing. Nevertheless, a steam generator level value has not been reported to NRC, and the ECCS Unit believes that a 10' level setpoint will be adequate.

Toledo's needs to lower the setpoint are genuine and I offer the following suggestion which you should pursue with Toledo:

1. Alter the control logic of the SFRCS so that it will provide two setpoints. Since a control function cannot be readily placed in an ESFAS system, the SFRCS must be modified. In the presence of an ESFAS signal, the ESFAS sets a priority for operation over any SFRCS signal and directs the SFRCS to provide a high setpoint level control. In the absence of an ESFAS signal, but with an SFRCS generated signal, the SFRCS control setpoint is directed to a low level. A general schematic is attached; other methods of implementing are possible, but this purveys the concept.

2. ESFAS could also initiate auxiliary feedwater and isolate main feedwater. Further investigation needs to be made as to the actual sequence of events. I believe it is now possible for two conditions to exist because the TECo systems do not initiate AFW by ESFAS. These are:

Current Design

Site Condition	Systems Sequence	Control Setpoint
1. Offsite Power Available	ESFAS ⟶ ICS	2' (Main Feedwate
2. Offsite Power Unavailable	ESFAS ⟶ SFRCS	10' (Aux. Feedwater)

If my reasoning is correct, the first condition will only provide a 2' control (of main feedwater); no SFRCS signal will occur and the ICS will control. The other condition will cause the SFRCS to respond to a loss of level (most likely) or to a loss of pump power. At any rate, SFRCS will initiate AFW and control to the nigh setpoint.

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The first condition may or may not be acceptable to ECCS Analysis; they have not investigated small breaks with RC pumps running. If such an analysis were to be made, the results would probably be unfavorable.

I suggest that TECo confirm that the above sequences are correct before a decision is made to initiate AFW with ESFAS.

3. I believe that further analytical effort will probably be needed by ECCS to confirm that the 10' setpoint is acceptable even though their judgement says it is. I think that some documentation on file will be required to substantiate their claim, but I do not recommend analyses at this time.

4. An additional thought might be considered for limiting the pressurizer draining. Recent investigations for the 205 plants have shown us that the rate of addition of feedwater has a substantial effect on RC temperature drop. The Toledo plant power level only requires about 500 gpm (at about 30-40 seconds after trip) to remove decay heat. Yet the pumps are capable (at design) of about 800 gpm each; with reduced steam generator pressure the addition rate increases by about 25% to 30%. The total flow rate possible tends to introduce subcooled water into the generator, fill to a preset level (possibly as a subcooled inventory--I don't know the effect of heat pickup as the water falls through the tube nest), and then heat up to boiling. A more preferable mode would be to introduce flow at a rate more equal to the decay heat load. An investigation into rate limiting (valve opening restrictions, cavitating venturis) may be worthwhile. Rate limiting may be a full or partial tradeoff for level limiting.

5. Further discussions with TECo about these suggestions are desirable; we will support efforts in this area.

EWS:dh
Attach
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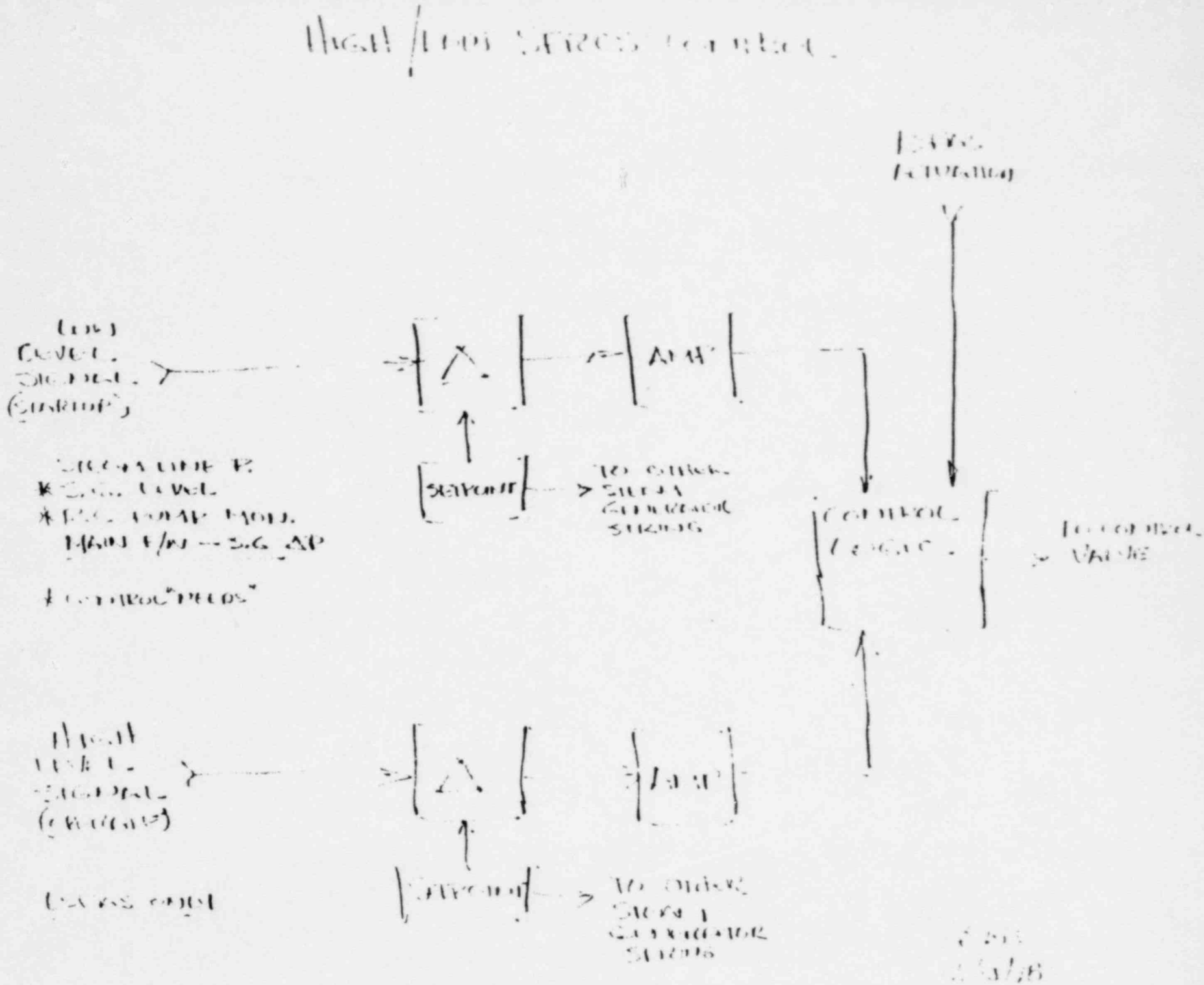

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ST = SIM injection calculation

initial condition pri. Vol = 11290
pressurizer
h ant feed = 8 Btu/lbm. Vol = 864
pri - press = 1042.6

conditions at $\bar{T}$ = 580 x 2200

h = 579. ν = .2243

M pri = 503344 lbm.

Assume auxfeed cover on and boils until Temp. primary equals sat @ 980

P = 980 T = 542.14 ν = .02152 h = 539.5

Vol = $\nu \cdot M_{pri}$ = 10832 ~~lbs~~ ft^3

Vol in pressurizer = 406 ft^3
Energy Pri = 542 x M = 272.81 x 10^6 Btu.
Energy Lost = (579-542) M = 18.6 x 10^6 Btu

@ 333 ft^3/min or 20667 lbm/min.
and Δh = 1194-8 = 1186 for bad water
time = 46 seconds.
Mass injected = 15683 lbm

System equalibrium after 10 ft in pressurizer

injected volume = 711 ft^3 per gen.
V_{inj} = 1422 ft^3 M = 88164 lbm. using ρ=62
M h = 705312 Btu

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$M_{tot} = 59\,1508$

$h_{new} = 462.4$

Sat $\rho_{sat} = 556.8$ $x = .01997$ $h = 462.4$

$V_{new} = 503344 * .01997 = 10052$

$V_{in\ primary} = 10426 - 10052 = 374\ ft^3$

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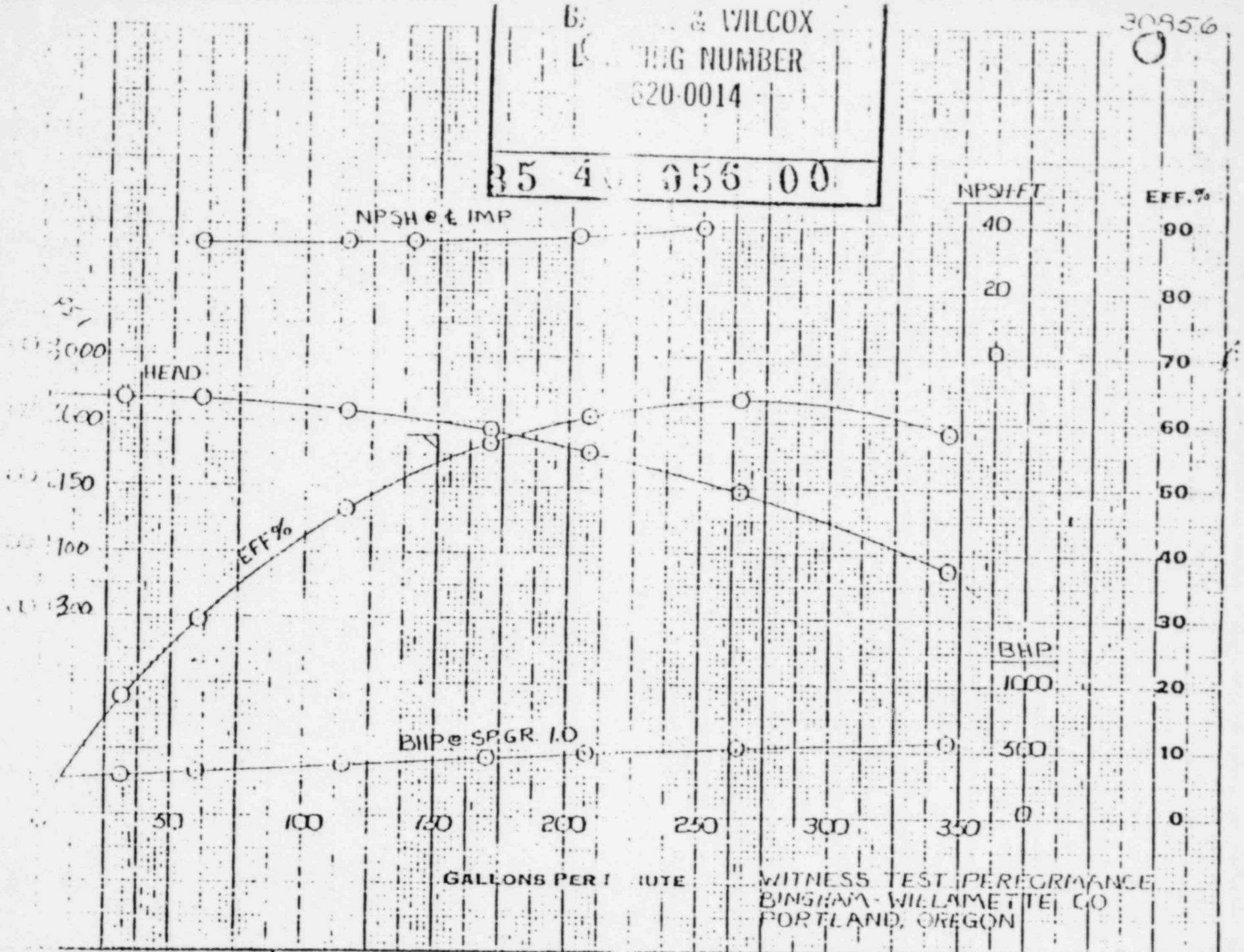
pressure 1000 psi Line Loss assumed @ 500 psi

Make up flow = 350 gpm
Let down flow = 50 gpm
net = 300 gpm

at 46 sec to 900 start of accumulator
256 sec to fill generator
total 300 sec of make up 5 min.

$\frac{5 \times 300}{7.2} = 208$ ft³

Net bubble remaining in RC system is 166 ft³.



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SEAL INJECTION

CHARACTERISTIC CURVE SHEET
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BINGHAM WILLAMETTE COMPANY
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IMPELLER PART 1) 313MSD-26 2) 313MSD-24/25

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NPSH REQUIRED

REFERENCE

CURVE NO.