UNION ELECTRIC

1901 Gratiot Street, St. Louis

Donald F. Schnell
Vice President

October 5, 1987

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

ULNRC- 1640

DOCKET NUMBER 50-483
CALLAWAY PLANT
RESPONSE TO NRC QUESTIONS ON MSLB SUPERHEAT ANALYSIS

References:
1. NRC Request for Additional Information, T. W. Alexion to D. F. Schnell, dated 9-10-87
2. WM 87-0253 dated 10-2-87
3. ULNRC-1473 dated 3-24-87
4. SLNRC 86-06 dated 4-4-86

The attachment addresses the questions transmitted via Reference 1. These responses were developed jointly with Wolf Creek Nuclear Operating Corporation and reflect the standard plant design (see Reference 2). If you have any questions on the attached responses, please contact us.

Very truly yours,

Robert J. Schukai
for Donald F. Schnell

GGY/lad

Attachment

A001
1/1

cc: Gerald Charnoff, Esq.
Shaw, Pittman, Potts & Trowbridge
2300 N. Street, N.W.
Washington, D.C. 20037

Dr. J. O. Cermak
CFA, Inc.
4 Professional Drive (Suite 110)
Gaithersburg, MD 20879

W. L. Forney
Chief, Reactor Project Branch 1
U.S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Bruce Little
Callaway Resident Office
U.S. Nuclear Regulatory Commission
RR#1
Steedman, Missouri 65077

Tom Alexion (2)
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Stop 316
7920 Norfolk Avenue
Bethesda, MD 20014

Manager, Electric Department
Missouri Public Service Commission
P.O. Box 360
Jefferson City, MO 65102

bcc: D. Shafer/A160.761
/QA Record (CA-758)
Nuclear Date
DFS/Chrono
D. F. Schnell
J. E. Birk
J. F. McLaughlin
A. P. Neuhalfen
R. J. Schukai
M. A. Stiller
G. L. Randolph
R. J. Irwin
H. Wuertenbaecher
W. R. Campbell
A. C. Passwater
R. P. Wendling
D. E. Shafer
D. J. Walker
O. Maynard (WCNOC)
R. C. Slovic (Bechtel)
G56.37 (CA-460)
Compliance (J. E. Davis)
NSRB (Sandra Auston)
G. G. Yates
E180.02
E210.01

RESPONSE TO NRC QUESTIONS

MAIN STEAM LINE BREAK SUPERHEAT ANALYSIS

QUESTION 1: For all instances where the qualification temperatures of various pieces of equipment (e.g., Main Steam Pressure Transmitter, Main Steam Isolation Valve, etc.) may be exceeded as a result of a design basis accident and you have determined that alternate equipment is available to accomplish the function of the failed equipment, discuss the environmental qualification status of the alternate equipment.

RESPONSE: In the Reference 1 evaluation of main steam line break (MSLB) superheat effects, the need to rely on alternate equipment is discussed with respect to two post-accident indication functions, i.e., steam generator pressure monitoring and verification of steam generator isolation.

The alternate equipment used to provide post-accident steam generator pressure indication consists of four pressure transmitters (one for each steam generator), AB-PT-01, 02, 03 and 04. Because of their location outside of the main steam tunnel, these transmitters are not subjected to the harsh environmental conditions following a postulated MSLB in the tunnel. These transmitters are Class 1E and are fully qualified for the environmental conditions postulated for their locations in rooms 1304 and 1305 of the Auxiliary Building.

Verification of steam generator isolation using alternate equipment may be required if valve position indication (limit switches and connected circuits) were to fail in the superheated MSLB environment. Steam generator isolation involves not only the Main Steam Isolation Valves (MSIVs) but the Main Feedwater Isolation valves (MFIVs) and several J-601A, air-operated valves, such as the MSIV Bypass Valves and Steam Line Drain Valves. The alternate equipment, mentioned on page 7 of Reference 1, consists of steam generator level indication, steam generator pressure indication, auxiliary feedwater flow indication, reactor coolant temperature indication, and main steam flow indication. The equipment associated with these alternate indicating circuits is located outside of the main steam tunnel and, therefore, would not be exposed to the MSLB superheat conditions. With the exception of the main steam flow indicating circuits, all of the alternate equipment is Class 1E and fully qualified for environmental conditions postulated at their respective locations. The main steam flow transmitters are high quality, commercial grade equipment and are powered from buses supplied by standby power sources so that their availability is assured even in the event of a loss of offsite power.

QUESTION 1a: Is the criteria for using the alternate equipment contained in the plant emergency operating procedures?

RESPONSE: Specific steps for use of alternate indication, following a postulated MSLB with superheat in the main steam tunnel, are not currently included in plant operating procedures. The primary reason for this is that the review of this issue is ongoing, and incorporating the results of the review into procedures is considered premature. However, the lack of specific procedural guidance is not considered of concern because the plant operators are trained to use alternate indication in the course of accident mitigation and the alternate indication available for steam generator pressure and steam generator isolation verification are well known to the operators.

In response to a recent NRC inspection finding, Union Electric Company has incorporated a change into the emergency operating procedures at Callaway Plant addressing the use of AB-PT-01, 02, 03, and 04 for alternate steam generator pressure monitoring.

QUESTION 2: In your evaluation, it is stated that the Main Steam Isolation Valves and the Main Feedwater Isolation Valves are both qualified to a temperature of 450°F; however, the appurtenances have various qualification temperatures. Our review has found that some of these qualification temperatures are as low as 300°F. Note that the staff considers the qualification status of any piece of equipment to be based on its weak link. Please explain why you consider this item to be qualified to 450°F when some of its appurtenances are qualified to temperatures less than 450°F (e.g., Terminal Blocks 300°F, Limit Switch 342°F, Wiring 346°F, Terminal Lugs 352° and Conax Seals 420°F).

RESPONSE: The statement regarding the 450°F qualification temperature was not intended to be applied to all the actuator appurtenances. The actuator was qualified by the vendor (Anchor-Darling) using 450°F steam. However, as identified in the Reference 1 evaluation, various appurtenances (limit switches, wiring, wiring lugs, etc.) were qualified under separate programs to different temperatures. It is noted in more recent submittals (References 2 and 3), that the 450°F has itself been reduced to a lower temperature (328°F) because of the manner in which Anchor-Darling exposed the actuator to steam during testing. The evaluation of equipment performance during exposure to superheated steam took into account the various temperatures to which the actuator and appurtenances had been qualified. For example, Reference 1 identified the Main Steam Isolation Valve (MSIV) actuator terminal blocks as a "weak link" component and required a special thermal lag analysis of the MSIV terminal blocks to be performed.

QUESTION 3: Explain why the (XLPE) Control Cable, identified in your submittal as qualified to 385°F, is expected to perform its function when its qualification temperature is exceeded.

RESPONSE: This question is not applicable to Callaway Plant. For Wolf Creek Generating Station, credit is not taken for cable that is not qualified for its environmental conditions. The discussion in Reference 1 is intended to note that, because of the insulating material used, the cable would most likely perform acceptably during the short time that the qualification temperatures were exceeded. The discussion goes on to explain and ultimately relies on the fact that, even if the cable failed such that the affected MSIV would not close, the effect on plant response would be no different than the FSAR Chapter 15 analysis of the MSLB event. This is based on the plant design which includes main steam lines in the tunnel designed and maintained as "superpipe" (i.e., a no break zone as defined in Reference 4) and on the NRC position, stated in Reference 5, that an additional single active failure need not be postulated if a break is assumed in a no break zone. Therefore, the failure of one MSIV to close because of environmental effects results in identical conditions (the uncontrolled blowdown of one steam generator) postulated in the FSAR accident analysis.

QUESTION 4: In the submittal provided by letter dated April 1, 1987,* you have compared various equipment items to establish similarity. Although all items may be similar as you have stated, you did not always provide sufficient information for a reviewer to reach that conclusion (e.g., on page 6 of 27 it is stated, in part, that a thermal lag curve was not specifically developed for a limit switch). It was assumed that a limit switch housing thermal response would be similar to the response of the solenoid valve solenoid housing (Equipment 1). It is further stated that this assumption is appropriate because the thickness of the limit switch body is equal to the molded solenoid valve solenoid housing. You also referred the reader to a sketch.

For Equipment 1 (solenoid housing), you have provided some detail information that is appropriate for comparison purposes such as the fabrication material of the housing, density, thermal conductivity, specific heat, thickness and a sketch. However, similar information was not provided for the limit switch.

Consequently, for all instances where you have made comparisons similar to the above examples, you must provide all information necessary to reach an independent conclusion (i.e., information such as that provided for Equipment 1 in the above example).

[*This date applies to the Wolf Creek Nuclear Operating Corporation submittal; the corresponding Union Electric Company submittal is dated March 24, 1987.]

RESPONSE: The sole instance of extrapolating calculated thermal lag parameters from one equipment type to another is the use of a solenoid housing calculation to approximate a limit switch as identified in the response to question 1F in References 2 and 3. The requested data for comparing the solenoid housing to a limit switch are provided below:

	Solenoid Housing	Limit Switch Housing* EA170	Limit Switch Housing* EA180	Limit Switch Cover Top	Limit Switch Cover Bottom
Material	stainless steel	zinc alloy	bronze alloy	stainless steel	nickel-plated steel
Thickness, inches	1/8	3/16**	3/16**	1/8	1/8
Density lbm/ft^3	488	446	540	488	490
Specific Heat, $Btu/lbm\text{-}^{o}F$	0.11	0.091	0.082	0.11	0.11
Thermal Conductivity, $Btu/hr\text{-}ft\text{-}^{o}F$	9	64	15	9	26

* Density, specific heat and thermal conductivity values are taken from Principles of Heat Transfer, F. Kreith, 1958, Appendix III for zinc and bronze.

** Approximate average thickness - refer to Figure 1.

Based on the above parameters, the lumped-capacity surface temperature response of the limit switches would be similar to the response of a solenoid valve solenoid housing.

QUESTION 5: In accordance with IEEE Standard 323-1974, a margin of $15^{o}F$ is required when qualifying for temperature in a harsh environment. According to information provided for MSIV/MFIV control cable and MSIV/MFIV wiring and lugs, margins of only $2^{o}F$ and $6^{o}F$ respectively, are indicated. Discuss the rationale for your determination that this is acceptable.

RESPONSE: The $15^{o}F$ margin from IEEE-323-1974 are appropriate for qualifying equipment when environmental temperature conditions are known. However, as in the case of the MSLB superheat issue, when a newly defined environmental condition, that exceeds the licensing basis for the plant, is identified, the need to comply with standard margin requirements should not be a rigorous requirement. The evaluation of the MSLB superheat condition involves a dynamic situation with time-dependent parameters. The goal of the analysis is to demonstrate that the required equipment will actuate to perform its safety function prior to exceeding its qualification temperatures or, barring that, that environmentally-induced faults occurring either prior to or subsequent to actuation, will neither prevent the safety function from being performed nor mislead plant operators. Under these conditions, more credit should be given to the conservatism inherent in the analysis, such as:

a. The Reference 6 Westinghouse mass/energy release calculations do not contain factors that would reduce superheat, e.g., froth, entrainment and compressibility.

b. The Westinghouse calculations are based on a more conservative steam generator design (Model D4) than used in the SNUPPS plants (Model F).

c. The Westinghouse calculations use several conservative assumptions listed on page 3 of Reference 1, e.g., core decay heat, single failure of one safety injection train, steam generator level, etc.

d. The temperature analysis assumed worst case, non-spatially varying conditions throughout the main steam tunnel. No credit was taken for buoyancy effects in the tunnel atmosphere cooling the equipment via natural circulation.

e. The thermal lag calculations assumed heat transfer based on fluid velocities well in excess of those expected to occur in the vicinity of the equipment modelled.

f. Margin requirements for equipment postulated to perform its function early in the event were discussed in Section 4.0 of Reference 1.

In the case of the margins identified in Question 5 for the MSIV/MFIV wiring and lugs, these components are located inside the terminal boxes on the MSIV/MFIV. Their thermal lag temperature is based on a one-dimensional analysis of the box itself (see discussion of item 1F in References 2 and 3). A more detailed two-dimensional analysis of these components would provide additional margin similar to the case of the MSIV/MFIV terminal blocks.

Based on the discussions in Reference 1 and in the response to Question 1 above, the failure of MSIV/MFIV limit switches would not result in a safety concern since alternate indications are available to assure that valves are in their safe positions; therefore, the 2°F margin for the limit switches is not a safety issue. In addition, it is noted that Westinghouse Electric Corporation has qualified the NAMCO model EA180 limit switches used on the MSIVs and MFIVs to a temperature in excess of 400°F.

Regarding the margins for MSIV/MFIV control cable discussed in Question 5, all MSIV/MFIV control cable meets the margin recommended in IEEE-323-1974 with the exception of the cable for one MSIV at Wolf Creek Generating Station. The implications of this were evaluated in Reference 1 and further discussed in the response to Question 3 above.

QUESTION 6: The analysis conducted for main steam line break with superheat indicated that the qualification temperatures of four items of equipment will be exceeded, and an additional two items (identified in Question 5 above) does not need the margin requirement of IEEE-323-1974. These six items are identified in Table 3.4 of your submittal as:

1. Main Steam Pressure Transmitter Instrument Cable
2. MSIV/MFIV Wiring and Lugs
3. MSIV/MFIV Control Cable
4. MSIV/MFIV Limit Switch
5. MSIV/MFIV Limit Switch Instrument Cable
6. J-601A Control Cable

Discuss the consequences of the simultaneous failure of all six items.

RESPONSE: The main steam pressure transmitter instrument cable carries the low steamline pressure signal from the 12 pressure transmitters (3 per steam line) to initiate a Steam Line Isolation Signal (SLIS). The consequences of failure of these cables in the superheated MSLB environment has been discussed, in Section 3.3.A of Reference 1, for the SLIS function as well as the post-accident steam generator pressure monitoring function. As noted in Reference 1, the SLIS function would not be adversely affected by the cable failure modes. The longer term steam generator pressure monitoring function was also addressed in Reference 1 and in the response to Question 1 above.

The MSIV actuators must receive an electrical signal to close the MSIVs, whereas the MFIV actuators fail closed on a loss of electrical signal. Therefore, the following discussion will focus on the MSIV actuators. The signal required to close the MSIVs is transmitted via MSIV control cable and MSIV wiring and lugs to the MSIV solenoid valves. There are two, redundant electro-pneumatic-hydraulic actuators on each MSIV; one receives a signal from safety train A (separation group 1) and the other, from safety train B (separation group 4). Actuation of solenoid valves on either of the redundant actuators (designated "active" and "standby") will result in closure of the MSIV. The active solenoids and terminal boxes (containing the MSIV wiring and lugs) are located on diametrically opposite sides of the actuator (see Figure 2). Therefore, the assumption regarding fluid velocity used in thermal lag heat transfer calculations, discussed in the response to Question 5 above, contains additional conservatism; because it is unlikely that the same high fluid velocity would be present on opposite sides of the actuator. Additional discussion of temperature margin for MSIV closure circuit components was provided in the response to Question 5. Based on that information, the MSIV closure circuits are expected to perform acceptably to close the valves (with the exception of the singular MSIV addressed in Question 3 above at Wolf Creek whose failure to close does not result in an unanalyzed condition). After the MSIVs and MFIVs are closed, environmentally induced failures of the actuators and/or appurtenances and control cable will not result in the valves reopening.

The loss of valve position indication resulting from limit switch or limit switch cable failures for each MSIV/MFIV or J-601A valve would not result in valve repositioning nor cause the plant operating staff to take any actions adverse to safety because the operators would not be expected to take actions based on those failures other than to verify valve position. If valve position needed to be verified, the alternate methods previously discussed in Question 1 would be available to the operators.

The postulated failure of J-601A control cable is addressed via failure modes and effects analysis in Reference 1, Sections 3.3.C, E, and F. The analysis concluded that control circuit failures would either cause the valve to actuate to its safe position or not prevent a safety signal from actuating the valve to its safe position. In addition, once actuated the valve would not reposition if an environmentally-induced control circuit failure occurred.

Based on the above discussion, the simultaneous failure of the equipment identified in NRC Question 6, with the exception of the MSIV closure circuit components, would not pose any significant difficulty for the operators in controlling the plant and mitigating the MSLB. In addition, the temperature margin applicable to the MSIV closure circuit components could be increased through additional analysis with less conservative assumptions. However, the additional information regarding margins in the above discussion and in the response to Question 5 provides adequate assurance that the equipment required to close the MSIVs will perform its safety function.

1b17-27

REFERENCES:

1. "Evaluation of Environmental Qualification of Equipment Considering Superheat Effects of High Energy Line Breaks for Callaway Plant and Wolf Creek Generating Station", forwarded by SNUPPS letter SLNRC 86-06, dated 4/4/86.

2. Union Electric Company letter (D. Schnell) to NRC, ULNRC-1473, dated 3/24/87.

3. Wolf Creek Nuclear Operating Corp. letter (B. Withers) to NRC WM 87-107, dated 4/1/87.

4. NUREG-0800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, 7/81 (Branch Technical Position MEB 3-1).

5. NRC Memorandum H. Denton, ONRR to V. Stello, DEDROGR, dated 4/29/85: Position on a MSLB in Superpipe Concurrent with a Single Active Failure.

6. WCAP-10961-P, Steamline Break Mass/Energy Releases for Equipment Environmental Qualification Outside Containment, October, 1985.

QTR 105

9.3 EA180-11302 LIMIT SWITCH ASSEMBLY

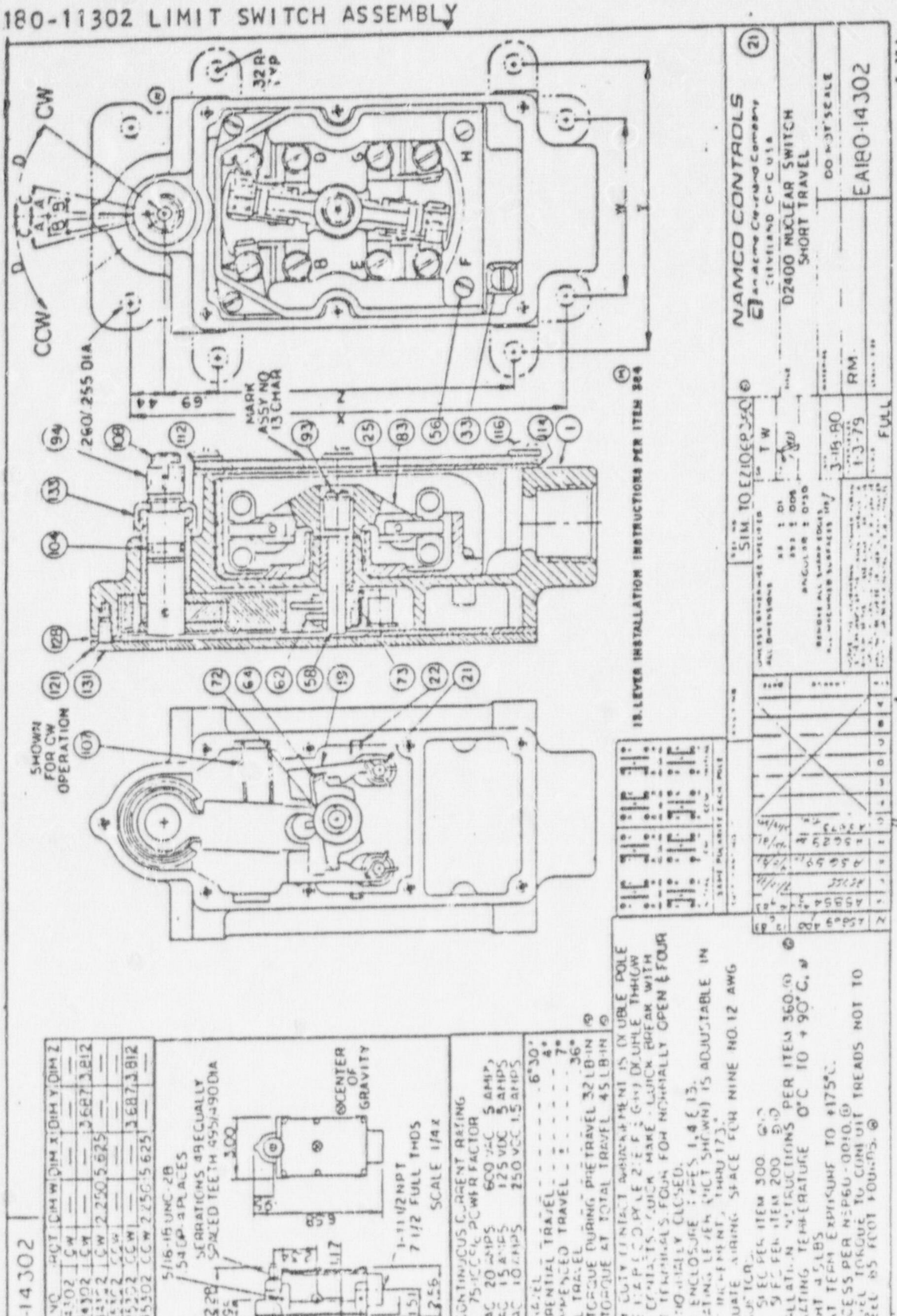

FIGURE 1

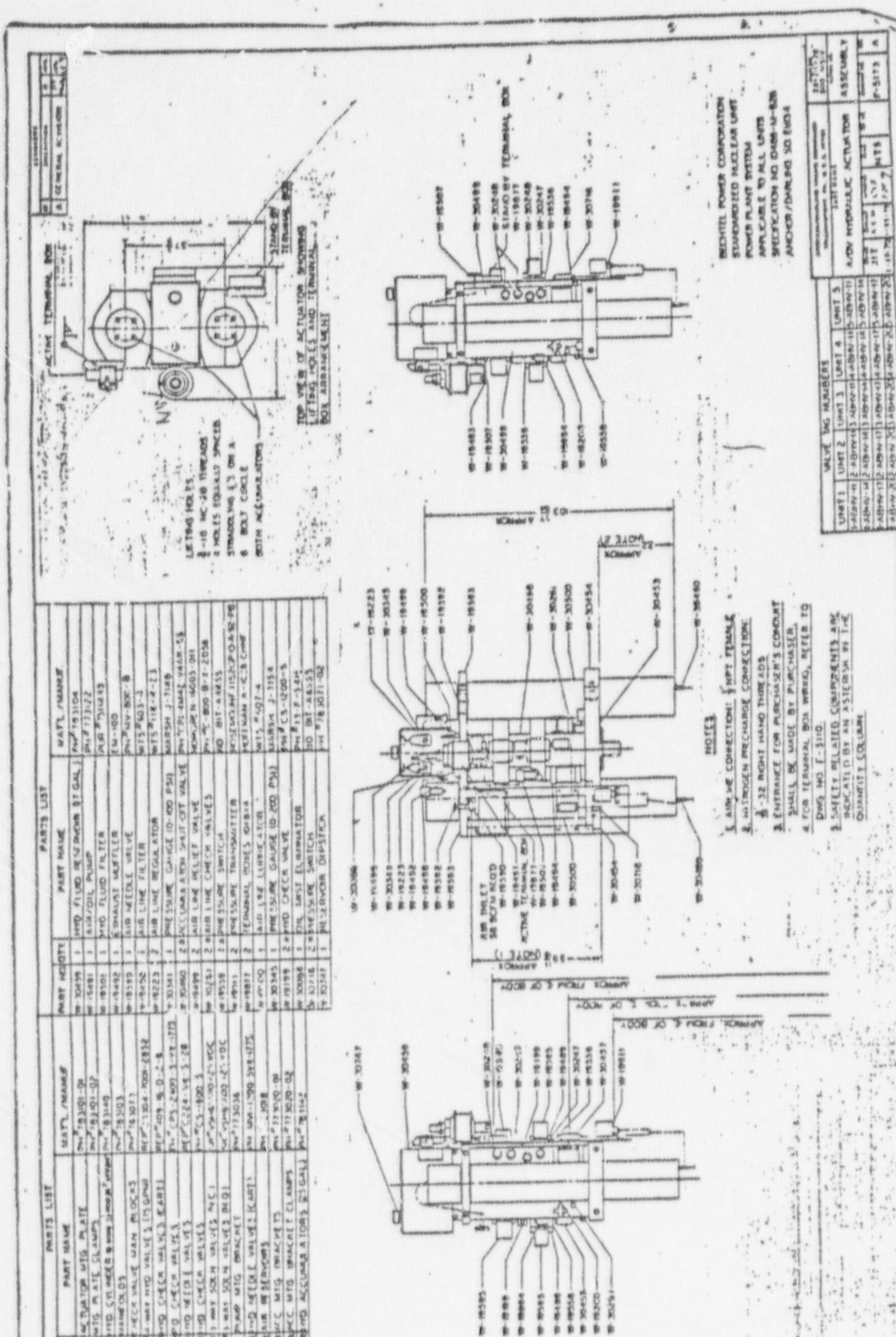

Figure 2