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AUTH.NAME AUTHOR AFFILIATION
VAN BRUNT,E.E. Arizona Public Service Co.
RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation, Director

MA/4

SUBJECT: Forwards Bechtel Power Corp responses to outstanding open items of Class IE dc power sys review.Responses are intended to resolve outstanding concerns of DC Power Sys Review Board.Final resolution of open items will be provided.

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	EMERG PREP 22	1	0	EQUIP QUAL BR13	1	1
	GEOSCIENCES 14	1	1	HUM FACT ENG BR	1	1
	HYD/GEO BR 15	2	2	I&C SYS BR 16	1	1
	I&E 06	3	3	LIC GUID BR	1	1
	LIC QUAL BR	1	1	MATL ENG BR 17	1	1
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	OP LIC BR	1	1	POWER SYS BR 19	1	1
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ARIZONA PUBLIC SERVICE COMPANY
P. O. BOX 21666 • PHOENIX, ARIZONA 85036

September 18, 1980
ANPP-16388 - JMA/JPS

Dr. H. R. Denton, Director
Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Palo Verde Nuclear Generating Station
PVNGS Units 1, 2 and 3
Docket Nos. STN-50-528/529/530

Reference: Letter dated September 4, 1980 from
E. E. Van Brunt, Jr. to Mr. H. R. Denton

Dear Dr. Denton:

The responses of Bechtel Power Corporation to the outstanding open items of the PVNGS Class IE DC Power System Review are attached for your information, and as a continuation of the DC System Review record. These responses are intended to resolve the outstanding concerns (as transmitted by the reference letter) of the DC Power System Review Board.

These revised responses have been redistributed to members of the PVNGS Power Systems Review Board who requested additional clarification of a particular open item. These members are to assure that responses sufficiently address their concerns noted in the original presentation. You will be informed of the final resolution of the open items when completed.

Respectfully submitted,

ARIZONA PUBLIC SERVICE COMPANY

By: Edwin E. Van Brunt
Edwin E. Van Brunt, Jr.
APS Vice President,
Nuclear Projects
ANPP Project Director

EEVBJr/JPS/av
Attachment
cc: J. Kerrigan (w/attach.)
F. Rosa (w/attach.)

STATE OF ARIZONA)
) ss.
County of Maricopa)

On its own behalf and as agent for all other joint applicants.

John M. Allen

Subscribed and sworn to before me this 18 day of September, 1980.

My Commission expires My Commission Expires Jan. 23, 1983

8009240422

ADDITIONAL CLARIFICATION
REGARDING DC POWER SYSTEM REVIEW

ACTION ITEM 4

Bechtel has misinterpreted the original question. Please respond to the question as expanded upon below.

(A) The necessity of thermal or magnetic trips on the battery to bus disconnect device should be determined. Since the battery must be most reliable and the chance of a fault occurring on the main D.C. bus is considered very remote, the necessity of tripping devices on this breaker is questioned when reliability and security of control is of extreme importance.

(B) Consideration should be given to the use of a permanently connected, mechanically interlocked disconnect device at each D.C. main switchgear. As the switchgear terminals, for termination of the power cables to the testing load bank, are not readily accessible, it is suggested that a permanent connection between this section of cables and the switchgear be considered. In this arrangement the other end of these power cables would be brought out to another location, suitably located for performing the testing operations, and be terminated in a junction box. This junction box would serve as the connection point for the load bank and thus provide a means for battery testing without disturbing the permanent battery connections.

RESPONSE

(A) A reliability analysis of the DC system was conducted in order to disclose any differences in reliability that may exist between the present design having an air circuit breaker on the battery versus a hard wired battery to bus version. The analysis was conducted assuming station AC blackout. The reliability analysis was performed on an overall system basis with system failure definied as loss of 2 out of 4 channels.

Loss of only one channel was not considered since it will not prevent system operation. Therefore, it has no safety significance.

One difference noted is the time required to clear a fault, since the system is unavailable to respond to a loss of all AC during the fault correction time. An 8 hour fault correction time was assumed for the battery breaker case and 24 hours was assumed for the hard wired case (due to battery damage). Battery damage in the event that the battery breaker failed to open was also considered. One hour was assumed as the time required to reset a breaker.

The difference in the two design alternatives due to common cause spurious trips on the battery breaker was also examined. The spurious trip rate for the DC breakers (obtained from IEEE P500) was converted to a common cause spurious trip rate by assuming improper breaker trip point settings (human error). The failure rate for common cause spurious trips is listed in Table 1.

The reliability data, provided in Table 1, was taken from IEEE P500-1977, "IEEE Guide to the Collection and Presentation of Electrical, Electronic and Sensing Component Reliability Data for Nuclear-Power Generating Stations," which was chosen as the data base because it includes spurious trip rates for breakers.

To further emphasize any potential differences, all component failures not related to fault correction were calculated on a demand basis. This means that failure rates from IEEE P500 in units of failures/hour must be multiplied by one hour to estimate the demand probability.

The results of the analysis are shown in Table 2. The fault trees used in the analysis are also attached as Figures 1 and 2.

The results indicate that, given the assumptions discussed above, case 2, the air breaker on the battery, is slightly more reliable. Therefore it is recommended that no changes be made to the present system design.

(B) It is our recommendation that the performance test (IEEE 450) be coordinated with regularly scheduled battery inspections (i.e. when battery connections are checked for cleanliness, tightness and corrosion). This procedure would be accomplished by disconnecting the cables supplying the DC Load Center and connecting the load bank cables to the battery. This is a simple procedure and, therefore, we see no significant advantage to be gained by adding the interlocked disconnect device.

TABLE 1

Component	Failure Rate (Maximum Values)	IEEE P500 Page No.
Bus (open)	$.0274 \times 10^{-6}$	pg. 188
(short)	transfer to Breaker as fault or demand on Breaker ($.457 \times 10^{-6}$ failures/hr.)	pg. 188
Cable (open)	11.02×10^{-6}	pg. 521
(short)	transfer to Breaker as fault or demand on Breaker (13.149×10^{-6} failures/hr.)	pg. 521
(AC) Breaker (spurious opening)	$.603 \times 10^{-6}$	pg. 148
(DC) Breaker (spurious opening)	$.38 \times 10^{-6}$; common cause = $(.38 \times 10^{-6})(.14)$	pg. 150
(fails to open on demand)	3146×10^{-6} failures/demand	pg. 150
Switch, Manual	$.737 \times 10^{-6}$	pg. 178
(Operator error - switch left off)	10^{-4} failures per action	WASH 1400
Charger (SCR)	3.89×10^{-6}	pg. 93
Battery	6.72×10^{-6}	pg. 104

Calculation of the unavailability of a battery breaker not opening due to a fault (BR3A1):

BR3A1 = (failures per demand on breaker) X (Number of shorts per unit time) X (battery damage fault corection time)

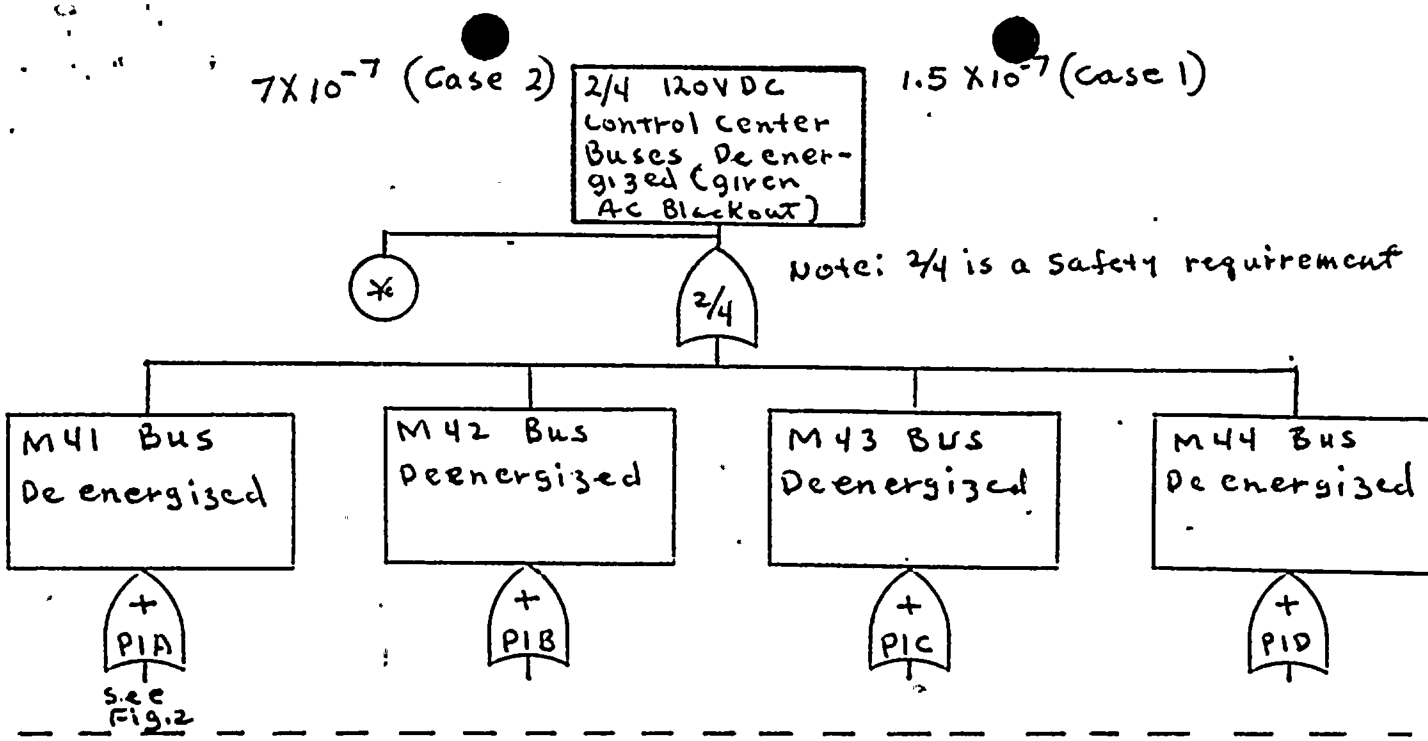
$$= \frac{3146}{10^6} \frac{\text{failures}}{\text{"short"}} \; \frac{.457 + 13.149}{10^6} \frac{\text{"Shorts"}}{\text{hr}} \; (24 \text{ hrs})$$

$$= 1.02 \times 10^{-6}$$

TABLE 2

The probability of
2 of 4 125 VDC Control Center buses
being unavailable given station AC Blackout

CASE 1	
(Breaker on Battery)	1.5×10^{-7}
CASE 2	
(Hard Wired Battery to Bus)	7×10^{-7}



In Case 2, events (Cleared fault correction (U)), (Spurious breaker Trip SBR3A1) & (Breaker does not open on fault BR3A1)

$(.457\times10^{-6} + 13.149\times10^{-6})$ 8 hrs $= 1.09\times10^{-4}$

$.38\times10^{-6}$

(4.28×10^{-8}) 24 hrs $= 1.02\times10^{-6}$

are replaced by (un cleared fault correction (U)); $(.457\times10^{-6} + 13.149\times10^{-6})$ (24 hrs) $= 3.264\times10^{-4}$

Note: (*) = (Common cause Spurious Breaker Trip) (applies to case 1 only)

$(.38\times10^{-6})(.14) = 5.3\times10^{-8}$

(U) = Unavailability ≃ [failure rate or fault rate or No. of short circuits per unit time] x (repair time)

Figure 1

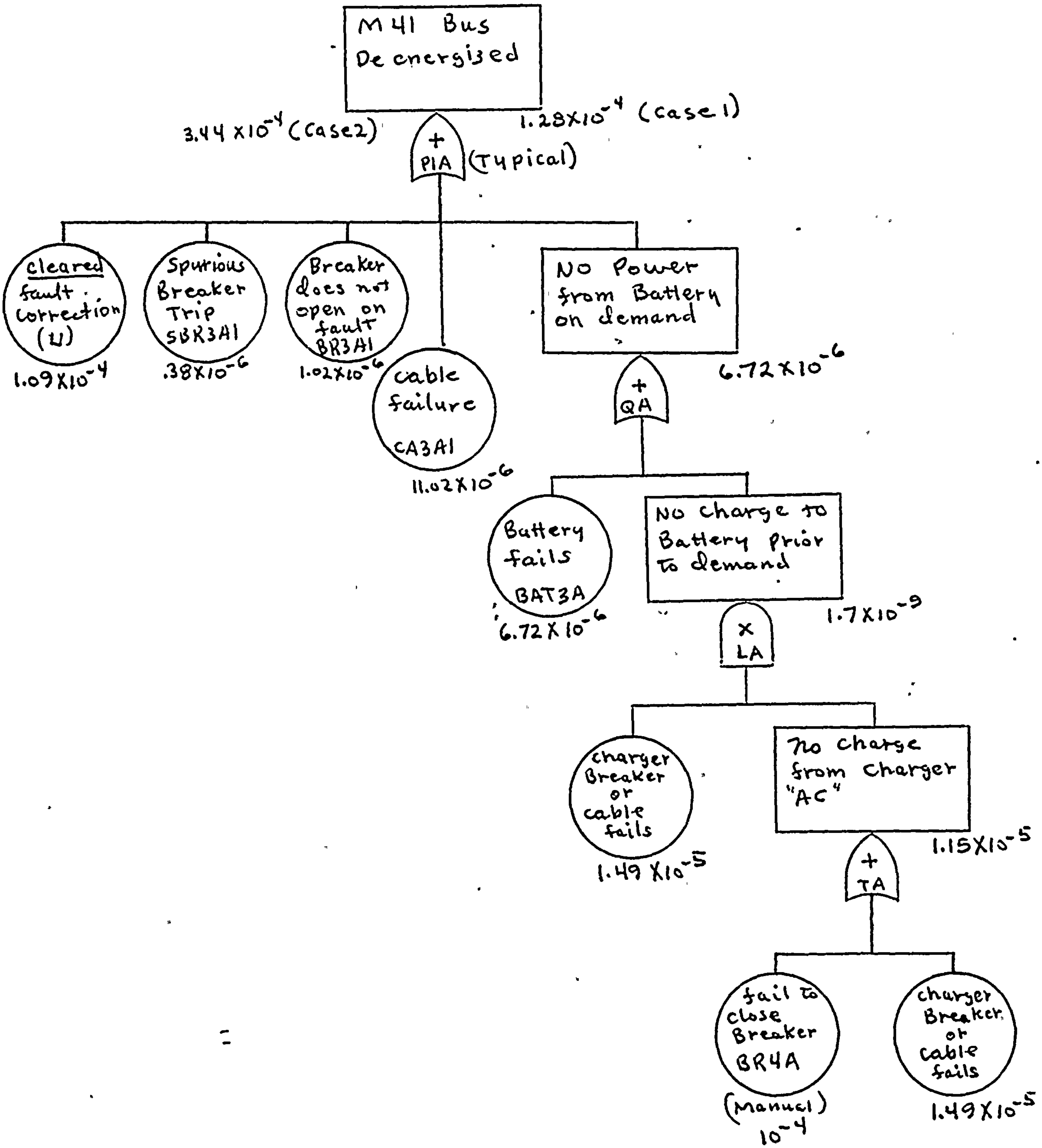

M41 Bus
De energized
3.44 X10^-4 (Case2)
1.28X10^-4 (case 1)
+
PIA
(Typical)
cleared fault correction (U)
1.09X10^-4
Spurious Breaker Trip SBK3A1
.38X10^-6
Breaker does not open on fault BR3A1
1.02X10^-6
cable failure CA3A1
11.02X10^-6
No Power from Battery on demand
6.72X10^-6
+
QA
Battery fails BAT3A
6.72X10^-6
No charge to Battery prior to demand
1.7X10^-9
X
LA
charger Breaker or cable fails
1.49 X10^-5
No charge from Charger "AC"
1.15X10^-5
+
TA
fail to close Breaker BR4A
(Manual)
10^-4
charger Breaker or cable fails
1.49X10^-5

Figure 2

ACTION ITEM 5

Bechtel stated that Power Conversion Products (PCP) has had no experience with failed battery chargers of the current design. What mechanism does PCP have to obtain feedback from previous customers?

RESPONSE

PCP has no formal system for obtaining customer feedback. However, it is expected that PCP would be notified of any problems by their customers. These problems would be analyzed and any design changes required would be implemented.

ACTION ITEM 6

Bechtel has examined the DC Power System's capability to withstand multiple failures.

Please expand the response to this item to incorporate the results of a recent Class IE DC System Reliability Analysis.

RESPONSE

Refer to response to Action Item 4.

ACTION ITEM 7

Bechtel has examined the potential for adverse interaction between acid spills in the battery room and the floor coatings. The response states the floors and embeds are coated with an epoxy paint which resists acid attack.

Please quantify this response to indicate to what degree it is resistant, i.e., what does the specification state? Also, the battery support frames and attachments to the embeds should also be analyzed.

RESPONSE

Embedded floor plates and weldments to the frame are coated with Mobil Chemical Company's Series 89 Epoxy, at 8 to 10 mil DFT. Chemical resistance tests for this material indicate resistance to intermittent splashes and exposure to 10% to 50% concentration of sulfuric acid without flaking, peeling, delamination or blistering or other physical damage to the film.

The battery frames are purchased as an integral component of the battery. There are two coats of paint on the frame. The paint has been 1000 hour tested in a solution of 50% sulfuric acid (1.4 specific gravity) and did not blister, crack, or discolor. Adhesion testing for the paint was conducted in accordance with ASTM D 3359-76. Therefore, the frame meets requirements for corrosion protection.

ACTION ITEM 8

Bechtel has investigated how the battery rooms are protected from flooding by fire protection water sprays in the lower cable spreading room and discussed how water is prevented from entering the battery rooms because of external drains.

Please discuss the possibility of flooding from any indirect routes (i.e., pipe chases) and also discuss how battery room flooding is prevented should the external drains become plugged.

RESPONSE

There are no pipe chases above elevation 100 ft. in the Control Building. There are a few sealed piping penetrations through the ceiling of the 100 ft level of the control building. Only one of these runs through any of the battery room ceilings. It is a floor drain from the 120' cable spreading room that penetrates the "D" battery room ceiling. There is water piping in each battery room for emergency shower and eyewashes. A pipe rupture may possibly affect one room, but no other battery room (unless the battery room drain line which is common to two rooms is plugged) due to separation.

In the unlikely event the exterior corridor drains become plugged, water will enter the battery rooms. The battery rooms have drains separated from the corridor drains which provide an independent path for the water

to drain to the control building sumps. Each of the two sumps has 50 gpm pumping capacity.

ACTION ITEM 13

It is indicated that the under-voltage relays to the DC bus will be set to alarm when the voltage level drops 5 volts below the float voltage level. It is considered that the voltage can vary up to 10 volts from the float voltage level. The system should be reviewed to ensure that the relay setting 5 volts below the float voltage will not cause nuisance alarms.

RESPONSE

Undervoltage alarms are delayed by a timer adjustable from 1.5 to 15 seconds to preclude the possibility of spurious alarms.