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August 18, 1980

Mr. Darrell G. Eisenhut, Director  
Division of Licensing  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555

Subject: Dresden Station Units 2 and 3  
Quad Cities Station Units 1 and 2  
Zion Station Units 1 and 2  
Additional Response concerning  
Adequacy of Station Electric  
Distribution System Voltages  
NRC Docket No.s 50-237/249,  
50-254/265 and 50-295/304

References (a): W. F. Naughton letter to H. R. Denton  
dated June 23, 1980

(b): R. F. Janecek letter to T. A. Ippolito  
dated June 30, 1980

Dear Mr. Eisenhut:

In accordance with commitments made in References (a) and (b), enclosed for your review are additional analyses performed concerning the adequacy of station electric distribution system voltages at Dresden 2/3, Quad Cities 1/2, and Zion 1/2.

It should be noted that these analyses are very conservative since they are based on the coincident occurrence of numerous improbable events. The simultaneous occurrence of the following events and conditions was assumed:

1. The grid system supplying the unit reserve auxiliary transformer (SAT/RAT) would have to be at the minimum expected voltage.
2. The SAT/RAT for one of the units at each site is out of service. By Tech Spec requirements, this is a "Limiting Condition of Operation," and can only exist for a short period of time if the diesel generators are operable.
3. The diesel generators are inoperable on the same unit which has its SAT/RAT out of service. This condition is precluded by condition 2 above which requires the diesels to be operable.

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Mr. D. G. Eisenhut, Director  
August 18, 1980  
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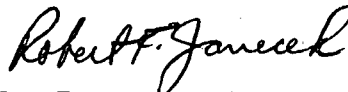
4. There is a LOCA on the same unit which has its SAT/RAT and diesel generators out of service or inoperable.
5. The other unit at the site is tripped and all load is transferred to its SAT/RAT. Thus for a few minutes its SAT/RAT is subject to shutdown load with the "largest load demand." This load is much greater than the "safe shutdown" load.

The results of the analyses for Dresden and Quad Cities are provided in Enclosure 1 and for Zion are provided in Enclosure 2. Although in some cases the running voltage is indicated to be slightly less than 90% of rated, we do not believe that this presents any significant safety concern due to the conservatisms and coincident improbable events identified above.

Please address any questions concerning this matter to this office.

One (1) signed original and seventy-nine (79) copies of this transmittal and attachments are provided for your use.

Very truly yours,



R. F. Janeczek  
Nuclear Licensing Administrator  
Boiling Water Reactors

Attachments

6078A

Enclosure 1

Dresden Station Units 2 & 3  
Quad Cities Station Units 1 & 2

7. Question

Each SAT is capable of supplying its own unit's auxiliary load and the emergency load of the other unit (see the summary e,f,g). NRC guideline 2 requires the voltage study for the largest load demand including when one unit is in LOCA and the other unit is in safe shutdown. The intertie between buses 24-1 and 34-1 (Dresden)<sup>e</sup>, 14-1 and 24-1 (Quad Cities)<sup>f</sup>, and a similar arrangement for Zion (bus numbers are unreadable in the report)<sup>g</sup> demand this voltage analysis.

Response

Dresden Unit 2

Attachment 1 shows the voltages at the buses and at the loads when Tr.#22 (RAT/SAT) is carrying the shutdown load (e.g. unit trip) of Unit 2 as well as the Engineered Safeguard System (ESS) loads (connected to 4160V bus 34-1) of Unit 3 through the intertie between 4160V buses 24-1 and 34-1.

The results indicate that:

1. The running voltage at the 460V motors is less than 90% of motor rated voltage.
2. The motor starting voltage of the 9000HP Rx feed pump is less than 75% of the motor rated load.

Dresden Unit 3

Attachment 2 shows the voltages at the buses and at the loads when Tr.#32 (RAT/SAT) is carrying all the shutdown load (e.g. unit trip) of Unit 3 as well as the ESS loads (connected to 4160V bus 24-1) of Unit 2 through the intertie between buses 34-1 and 24-1.

The results indicate that the running voltages of all the motors and the starting voltage of the Rx feed pump motor are satisfactory.

Quad Cities 1 & 2

Attachment 3 shows the voltages at the buses and at the loads when Tr.#12 (RAT/SAT) is carrying the shutdown load (e.g. unit trip) of Unit 1 as well as the ESS loads (connected to 4160V bus 24-1) of Unit 2 through the intertie between 4160V buses 14-1 and 24-1.

The results indicate that the running voltages of all the motors and the starting voltage of the Rx feed pump motor are satisfactory.

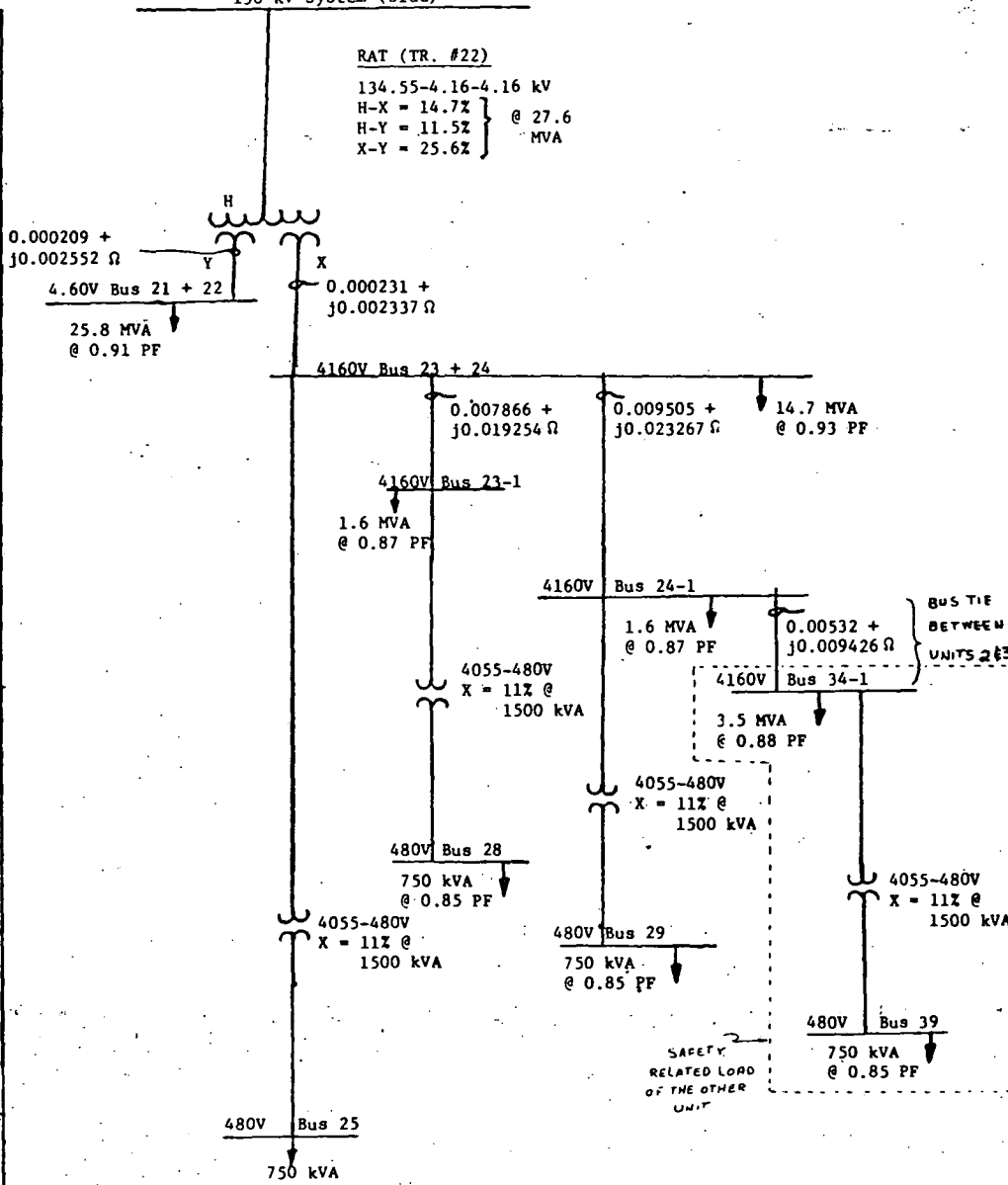
The calculations for Tr.#22 (RAT/SAT) feeding Unit 2 and the ESS load of Unit 1 will be similar to Attachment 3.

Starting  
Largest  
Motor @  
4160V Bus  
21+22

| 9000 HP<br>Rx Feed<br>Pump   | Full<br>Load<br>Volt         | No<br>Load<br>Volt |
|------------------------------|------------------------------|--------------------|
| ~ 132<br>95.6                | 132<br>95.6                  | 142<br>103         |
| 2974<br>71.5<br>2914<br>72.8 | 3748<br>90.1<br>3728<br>93.2 |                    |
| 3623<br>87.1<br>3603<br>90.1 | 3738<br>89.9<br>3718<br>92.9 |                    |
| 3617<br>86.9<br>3597<br>89.9 | 3732<br>89.7<br>3712<br>92.8 |                    |
| 3595<br>86.4<br>3575<br>89.4 | 3711<br>89.2<br>3691<br>92.3 |                    |
| 3587<br>86.2<br>3567<br>89.2 | 3703<br>89.0<br>3683<br>92.1 |                    |
| 408<br>84.9<br>393<br>85.4   | 422<br>88.0<br>407<br>88.5   |                    |
| 406<br>84.5<br>391<br>84.9   | 420<br>87.5<br>405<br>88.1   |                    |
| 405<br>84.8<br>390<br>84.7   | 419<br>87.3<br>404<br>87.9   |                    |
| 409<br>85.2<br>394<br>85.6   | 423<br>88.1<br>408<br>88.7   |                    |

SCC = 1945 MVA (Minimum)  
Volt range = 132 to 142 kV  
138 kV System (Blue)

DRESDEN UNIT 2  
RAT (TR.#22) CARRYING UNIT 2 SHUTDOWN LOAD  
AND UNIT 3 ESF LOAD THRU INTER.UNIT TIE



ATTACHMENT 1

Starting  
Largest  
Motor @  
4160V

Starting  
Largest  
Motor @  
4160V

Starting  
Largest  
Motor @  
4160V Bus

Starting  
Largest  
Motor @  
4160V Bus

Starting  
Largest  
Motor @  
480V ESF  
Bus 39

|   | Bus 23<br>+ 24<br>1750 HP<br>CWP | Bus 23-1<br>600 HP<br>RxClUp<br>Rec.Pump | Bus 24-1<br>600 HP<br>RxClUp<br>Rec.Pump | Bus 34-1<br>800 HP<br>Core<br>SprayPump | 100 HP<br>RxBldg.<br>Vent Fan<br>3B |
|---|----------------------------------|--|--|---|-------------------------------------|
| Syst. Volt<br>% of 138 kV                           | 132<br>95.6                      | 132<br>95.6                              | 132<br>95.6                              | 132<br>95.6                             | 132<br>95.6                         |
| Bus Volt<br>% of 4160V<br>Equip. Volt<br>% of 4000V | 3512<br>84.4<br>3492<br>87.3     |  |  |   | 3735<br>89.8<br>3715<br>92.9        |
| Bus Volt<br>% of 4160V<br>Equip. Volt<br>% of 4000V | 3506<br>84.3<br>3486<br>87.1     | 3621<br>87.0<br>3601<br>90.0             |  |   | 3729<br>89.6<br>3709<br>92.7        |
| Bus Volt<br>% of 4160V<br>Equip. Volt<br>% of 4000V | 3483<br>83.7<br>3463<br>86.6     |  | 3616<br>86.9<br>3596<br>89.9             |   | 3705<br>89.1<br>3685<br>92.1        |
| Bus Volt<br>% of 4160V<br>Equip. Volt<br>% of 4000V | 3474<br>83.5<br>3454<br>86.3     |  |  | 3554<br>85.4<br>3534<br>88.3            | 3695<br>88.8<br>3675<br>91.9        |
| Bus Volt<br>% of 480V<br>Equip. Volt<br>% of 460V   | 394<br>82.1<br>379<br>82.4       |  |  |   | 422<br>88.0<br>407<br>88.5          |
| Bus Volt<br>% of 480V<br>Equip. Volt<br>% of 460V   | 392<br>81.6<br>377<br>81.9       |  |  |   | 419<br>87.3<br>404<br>87.8          |
| Bus Volt<br>% of 480V<br>Equip. Volt<br>% of 460V   | 391<br>81.4<br>376<br>81.7       |  |  |   | 401<br>83.5<br>380<br>82.6          |
| Bus Volt<br>% of 480V<br>Equip. Volt<br>% of 460V   | 395<br>82.3<br>380<br>82.6       |  |  |   | 423<br>88.1<br>408<br>88.7          |

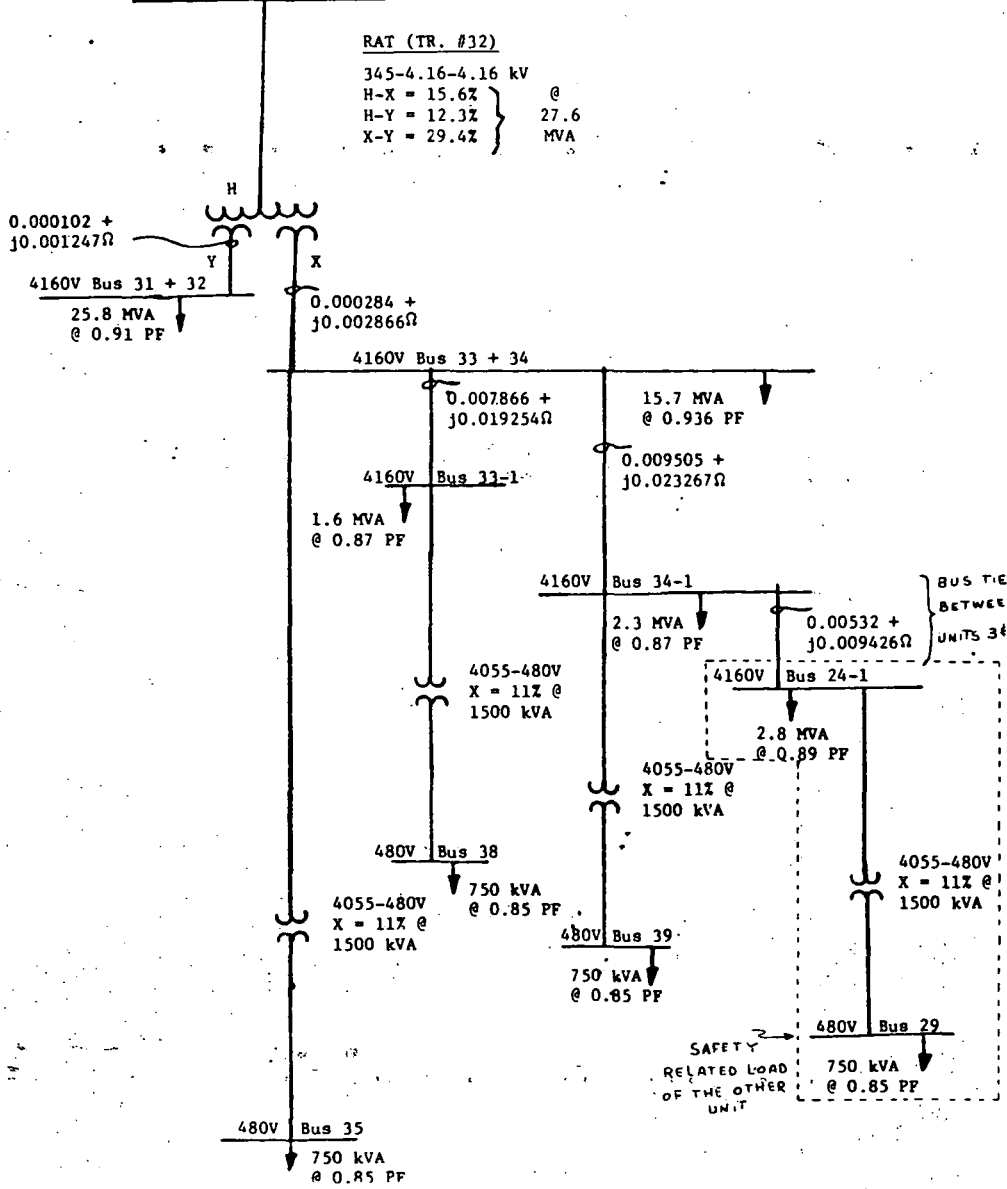
DRESDEN UNIT 3  
 RAT (TR.#32) CARRYING UNIT 3 SHUTDOWN  
 LOAD PLUS UNIT 2 ESF LOAD THROUGH INTER-  
 UNIT TIE

ATTACHMENT 2

SCC = 6275 MVA (MINIMUM)  
 Voltage Range = 344 to 362 kV  
 345 kV System (Red)

Starting  
 Largest  
 Motor @  
 4160V Bus  
 31 + 32

| 9000 HP<br>Rx Feed<br>Pump | Full<br>Load | No-Load<br>Volt |
|----------------------------|--------------|-----------------|
| 344                        | 344          | 362             |
| 99.7                       | 99.7         | 105             |
| 3106                       | 3883         |                 |
| 74.7                       | 93.4         |                 |
| 3046                       | 3863         |                 |
| 76.1                       | 96.6         |                 |
| 3876                       | 3853         |                 |
| 93.2                       | 92.6         |                 |
| 3856                       | 3833         |                 |
| 96.4                       | 95.8         |                 |
| 3870                       | 3847         |                 |
| 93.0                       | 92.5         |                 |
| 3850                       | 3827         |                 |
| 96.2                       | 95.7         |                 |
| 3850                       | 3827         |                 |
| 96.2                       | 92.0         |                 |
| 3830                       | 3807         |                 |
| 95.7                       | 95.2         |                 |
| 3843                       | 3820         |                 |
| 92.4                       | 91.8         |                 |
| 3823                       | 3800         |                 |
| 95.6                       | 95.0         |                 |
| 439                        | 436          |                 |
| 91.4                       | 90.9         |                 |
| 424                        | 421          |                 |
| 92.1                       | 91.6         |                 |
| 437                        | 434          |                 |
| 91.0                       | 90.4         |                 |
| 422                        | 419          |                 |
| 91.7                       | 91.1         |                 |
| 436                        | 433          |                 |
| 90.8                       | 90.2         |                 |
| 421                        | 418          |                 |
| 91.5                       | 90.9         |                 |
| 440                        | 437          |                 |
| 91.6                       | 91.0         |                 |
| 425                        | 422          |                 |
| 92.3                       | 91.7         |                 |



Starting  
 Largest  
 Motor @  
 4160V  
 Bus 33+34  
 CWP

Starting  
 Largest  
 Motor @  
 4160V  
 Bus 33-1  
 RxClnUp  
 Rec. Pump

Starting  
 Largest  
 Motor @  
 4160V  
 Bus 34-1  
 RxClnUp  
 Rec. Pump

Starting  
 Largest  
 Motor @  
 4160V  
 Bus 24-1  
 Core  
 SprayRamp

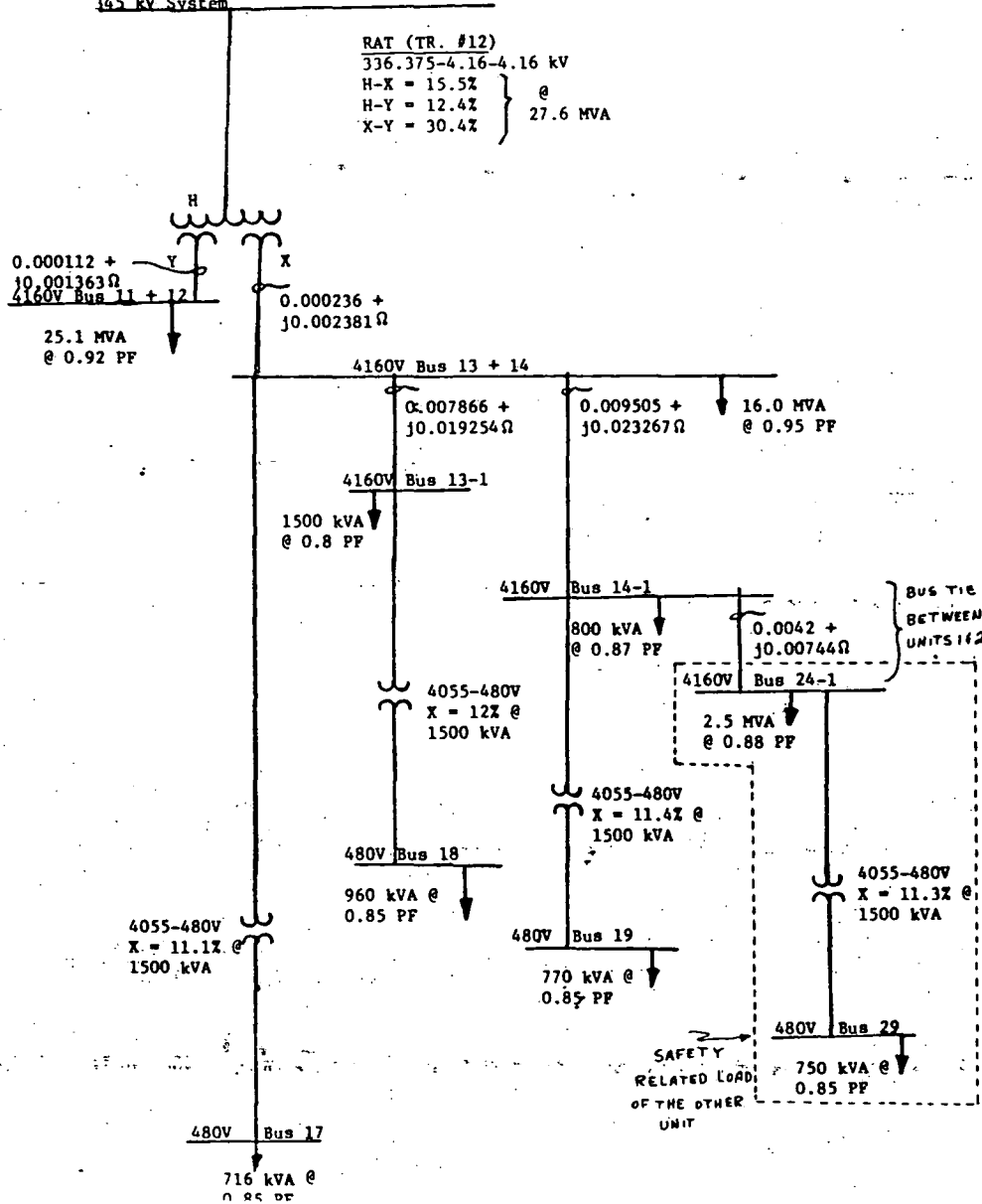
Starting  
 Largest  
 Motor @  
 480V ESF  
 Bus 29  
 Rx Bldg.  
 Vent. Fan  
 2B

|             | Bus 33+34<br>1750 HP<br>CWP | Bus 33-1<br>600 HP<br>RxClnUp<br>Rec. Pump | Bus 34-1<br>600 HP<br>RxClnUp<br>Rec. Pump | Bus 24-1<br>800 HP<br>Core<br>SprayRamp | 100 HP<br>Rx Bldg.<br>Vent. Fan<br>2B |
|-------------|-----------------------------|--|--|---|---------------------------------------|
| Syst. Volt  | 344                         | 344  | 344  | 344                                     | 344                                   |
| % of 345 kV | 99.7                        | 99.7                                       | 99.7                                       | 99.7                                    | 99.7                                  |
| Bus Volt    |                             |  |  |   |                                       |
| % of 4160V  |                             |  |  |   |                                       |
| Equip. Volt |                             |  |  |   |                                       |
| % of 4000V  |                             |  |  |   |                                       |
| Bus Volt    | 3622                        |  |  |   | 3853                                  |
| % of 4160V  | 87.1                        |  |  |   | 92.6                                  |
| Equip. Volt | 3602                        |  |  |   | 3833                                  |
| % of 4000V  | 90.0                        |  |  |   | 95.8                                  |
| Bus Volt    | 3616                        | 3738                                       |  |   | 3847                                  |
| % of 4160V  | 86.9                        | 89.8                                       |  |   | 92.5                                  |
| Equip. Volt | 3596                        | 3718                                       |  |   | 3827                                  |
| % of 4000V  | 89.9                        | 92.5                                       |  |   | 95.7                                  |
| Bus Volt    | 3594                        |  | 3730                                       |   | 3819                                  |
| % of 4160V  | 86.4                        |  | 89.7                                       |   | 91.8                                  |
| Equip. Volt | 3574                        |  | 3710                                       |   | 3799                                  |
| % of 4000V  | 89.3                        |  | 92.7                                       |   | 95.0                                  |
| Bus Volt    | 3587                        |  |  | 3667                                    | 3809                                  |
| % of 4160V  | 86.2                        |  |  | 88.1                                    | 91.6                                  |
| Equip. Volt | 3567                        |  |  | 3647                                    | 3789                                  |
| % of 4000V  | 89.2                        |  |  | 91.2                                    | 94.7                                  |
| Bus Volt    | 407                         |  |  |   | 436                                   |
| % of 480V   | 84.9                        |  |  |   | 90.9                                  |
| Equip. Volt | 392                         |  |  |   | 421                                   |
| % of 460V   | 85.3                        |  |  |   | 91.6                                  |
| Bus Volt    | 405                         |  |  |   | 433                                   |
| % of 480V   | 84.4                        |  |  |   | 90.2                                  |
| Equip. Volt | 390                         |  |  |   | 418                                   |
| % of 460V   | 84.8                        |  |  |   | 90.9                                  |
| Bus Volt    | 404                         |  |  |   | 416                                   |
| % of 480V   | 84.2                        |  |  |   | 86.6                                  |
| Equip. Volt | 389                         |  |  |   | 379                                   |
| % of 460V   | 84.6                        |  |  |   | 82.4                                  |
| Bus Volt    | 408                         |  |  |   | 437                                   |
| % of 480V   | 85.1                        |  |  |   | 91.0                                  |
| Equip. Volt | 393                         |  |  |   | 422                                   |
| % of 460V   | 85.5                        |  |  |   | 91.7                                  |

| Starting<br>Largest<br>Motor @<br>4160V Bus<br>11 + 12 | Full Load<br>Volt | No-Load<br>Volt |
|--|-------------------|-----------------|
| 333  | 333               | 354             |
| 96.5   | 96.7              | 102.6           |
| 3088   | 3871              |                 |
| 74.2   | 93.0              |                 |
| 3028   | 3851              |                 |
| 75.7   | 96.3              |                 |
| 3927   | 3877              |                 |
| 94.4   | 93.2              |                 |
| 3907   | 3857              |                 |
| 97.7   | 96.4              |                 |
| 3921   | 3871              |                 |
| 94.2   | 93.0              |                 |
| 3901   | 3851              |                 |
| 97.5   | 96.3              |                 |
| 3910   | 3860              |                 |
| 94.0   | 92.8              |                 |
| 3890   | 3840              |                 |
| 97.2   | 96.0              |                 |
| 3906   | 3856              |                 |
| 93.9   | 92.7              |                 |
| 3886   | 3836              |                 |
| 97.1   | 95.9              |                 |
| 437  | 431               |                 |
| 91.1   | 89.8              |                 |
| 422  | 416               |                 |
| 91.8   | 90.5              |                 |
| 443  | 437               |                 |
| 92.3   | 91.0              |                 |
| 428  | 422               |                 |
| 93.0   | 91.7              |                 |
| 443  | 437               |                 |
| 92.3   | 91.0              |                 |
| 428  | 422               |                 |
| 93.0   | 91.7              |                 |
| 447  | 441               |                 |
| 93.1   | 91.9              |                 |
| 432  | 426               |                 |
| 93.9   | 92.7              |                 |

SCC = 5195 MVA (Minimum)  
Volt range=333 to 354 kV  
345 kV System

QUAD-CITIES UNIT 1  
RAT (TR.#12) CARRYING UNPF SHUTDOWN LOAD  
PLUS UNIT 2 ESF LOAD THRU INTER.UNIT TIE



ATTACHMENT 3

|   | Starting<br>Largest<br>Motor @<br>4160V Bus<br>13 + 14 | Starting<br>Largest<br>Motor @<br>4160V Bus<br>24-1 | Starting<br>Largest<br>Motor @<br>480V ESP<br>24-1 | Starting<br>Largest<br>Motor @<br>480V ESP<br>Bus 29 |
|---|--|---|--|--|
| Syst. Volt<br>% of 345 kV                           | 333<br>96.5  | 333<br>96.5   | 333<br>96.5  | 333<br>96.5  |
| Bus Volt<br>% of 4160V<br>Equip. Volt<br>% of 4000V | NO<br>MOTOR<br>RUNNING                                 | NO<br>MOTOR<br>RUNNING                              |  |  |
| Bus Volt<br>% of 4160V<br>Equip. Volt<br>% of 4000V | 3647<br>87.7<br>3627<br>90.7                           | AT<br>THIS<br>BUS                                   | AT<br>THIS<br>BUS                                  | 3877<br>93.2<br>3857<br>96.4                         |
| Bus Volt<br>% of 4160V<br>Equip. Volt<br>% of 4000V | 3641<br>87.5<br>3621<br>90.5                           |   |  | 3871<br>93.0<br>3851<br>96.3                         |
| Bus Volt<br>% of 4160V<br>Equip. Volt<br>% of 4000V | 3629<br>87.2<br>3609<br>90.2                           |   |  | 3855<br>92.7<br>3835<br>95.9                         |
| Bus Volt<br>% of 4160V<br>Equip. Volt<br>% of 4000V | 3625<br>87.1<br>3605<br>90.1                           |   | 3705<br>89.1<br>3685<br>92.1                       | 3849<br>92.5<br>3829<br>95.7                         |
| Bus Volt<br>% of 480V<br>Equip. Volt<br>% of 460V   | 402<br>83.8<br>387<br>84.1                             |   |  | 431<br>89.8<br>416<br>90.5                           |
| Bus Volt<br>% of 480V<br>Equip. Volt<br>% of 460V   | 408<br>85.1<br>393<br>85.5                             |   |  | 436<br>90.9<br>421<br>91.6                           |
| Bus Volt<br>% of 480V<br>Equip. Volt<br>% of 460V   | 408<br>85.1<br>393<br>85.5                             |   |  | 410<br>85.5<br>385<br>83.6                           |
| Bus Volt<br>% of 480V<br>Equip. Volt<br>% of 460V   | 413<br>86.0<br>398<br>86.4                             |   |  | 441<br>91.9<br>426<br>92.7                           |

Enclosure 2

Zion Station Units 1 & 2

7. Question

Each SAT is capable of supplying its own unit's auxiliary load and the emergency load of the other unit (see the summary e,f,g). NRC guideline 2 requires the voltage study for the largest load demand including when one unit is in LOCA and the other unit is in safe shutdown. The intertie between buses 24-1 and 34-1 (Dresden)<sup>e</sup>, 14-1 and 24-1 (Quad Cities)<sup>f</sup>, and a similar arrangement for Zion (bus numbers are unreadable in the report)<sup>g</sup> demand this voltage analysis.

Response

Analyses were performed to determine the voltages on an Engineered Safeguard System (ESS) bus of one unit while being supplied from the SAT of the other unit. The case where a SAT carries its normal operating load and an ESS bus of the other unit was analyzed in the November 1, 1979 and June 23, 1980 reports.

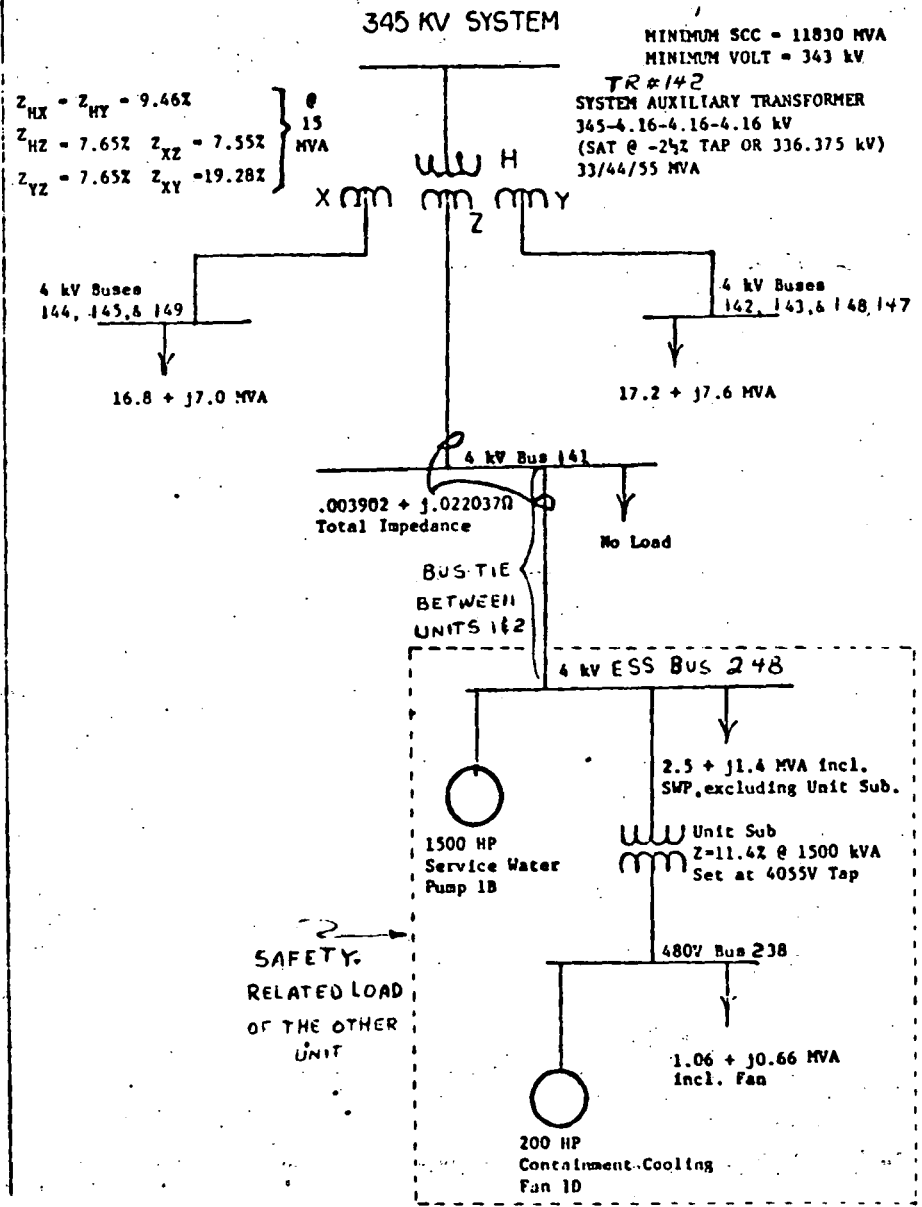
Attachment 1 shows the voltages at the buses and at the loads, with the largest load demand on the SAT, and minimum expected voltage on the 345Kv grid system. The SAT (TR#142) is carrying all the shutdown load (e.g. unit trip) of Unit 1 and one Division ESS loads (4KV bus 248) of Unit 2 through the intertie between 4KV buses 141 and 248. The calculations show that voltages on the 4KV buses are satisfactory. The lowest voltage on the 480 volt bus occurs while starting the containment cooling fan. Including the impedance of the cable feeding the motor, the starting voltage at the motor terminals is calculated to be 76.3% of motor rated voltage. The running voltage at the motor terminals is 93% of motor rated voltage.

The calculations of the SAT for Unit 2 (Tr#242) feeding the ESS bus of Unit 1 will result in the same voltages shown on the attachment.



STARTING VOLTAGES

|  | RUNNING VOLTAGE      |
|--|----------------------|
| kV<br>Z of 345 kV                      | 343<br>99.4          |
| Bus Volt<br>Z of 4160V<br>Z of 4000V   | 3921<br>94.3<br>98.0 |
| Bus Volt<br>Z of 4160V<br>Z of 4000V   | 3904<br>93.9<br>97.6 |
| Motor Volt<br>Z of 4160V<br>Z of 4000V | 3897<br>93.7<br>97.4 |
| Bus Volt<br>Z of 480V<br>Z of 460V     | 433<br>90.2<br>94.1  |
| Motor Volt<br>Z of 480V<br>Z of 460V   | 428<br>89.1<br>93.0  |



|  | Largest Motor On Bus 248 | Largest Motor On Bus 238 |  |
|--|--------------------------|--------------------------|--|
| Bus Volt<br>Z of 4160V<br>Z of 4000V   | 3683<br>88.5<br>92.1     | 3870<br>93.0<br>96.7     | Bus Volt<br>Z of 4160V<br>Z of 4000V   |
| Motor Volt<br>Z of 4160V<br>Z of 4000V | 3630<br>87.3<br>90.7     | 3862<br>92.8<br>96.5     | Motor Volt<br>Z of 4160V<br>Z of 4000V |
| Bus Volt<br>Z of 480V<br>Z of 460V     | 403<br>83.9<br>87.6      | 388<br>80.9<br>84.4      | Bus Volt<br>Z of 480V<br>Z of 460V     |
| Motor Volt<br>Z of 480V<br>Z of 460V   | 398<br>82.9<br>86.5      | 351<br>73.1<br>76.3      | Motor Volt<br>Z of 480V<br>Z of 460V   |

ZION AUXILIARY SYSTEM PERFORMANCE  
UNIT TRIP WITH LOCA ON OTHER UNIT  
PROPOSED CORRECTIVE MEASURES USED  
(SHED 2 COND. BOOST PUMPS & 1 CIRC. WATER PUMP)